Energy Resources Limited

Romanesque 3D and Black Cormorant 2D Seismic Survey Section 38 Referral *Environmental Protection Act 1986* (WA)

19 November 2020

EOC-EN-REP-0024 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* (WA)
ASS	Acid Sulfate Soil
ASX	Australian Securities Exchange
BAM Act	*Biosecurity and Agriculture Management Act 2007* (WA)
BC Act	*Biodiversity and Conservation Act 2016* (WA)
BOM	Bureau of Meteorology
CAMBA	China Australia Migratory Bird Agreement
CCW	Conservation Category Wetland
CBC	Carnaby's Black Cockatoo
DAA	Department of Aboriginal Affairs (WA)
DAWE	Department of Agriculture, Water and Environment (Cth)
DBCA	Department of Biodiversity, Conservation and Attractions (WA)
DMIRS	Department of Mines, Industry Safety and Regulation (WA)
DEE	former Department of Energy and Environment (now DAWE)
DoE	former Department of Environment (now DAWE)
DoW	former Department of Water (now DWER)
DPIRD	Department of Primary Industries and Regional Development (WA)
DPLH	Department of Planning, Lands and Heritage (WA)
DSEWPaC	former Department of Sustainability, Environment, Water, Population and Communities (now DAWE)
DWER	Department of Water and Environmental Regulation (WA)
EIA	Environmental Impact Assessment
EP	Environment Plan
EP Act	*Environmental Protection Act WA 1986* (WA)
EPA	Environmental Protection Authority
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ERL	Energy Resources Limited
FRTBC	Forest Red-Tailed Black Cockatoo
GoWA	Government of Western Australia
ha	hectares
IBRA	Interim Biogeographic Regionalisation for Australia
IUCN	International Union for Conservation of Nature

Term	Definition
JAMBA	Japan Australia Migratory Bird Agreement
Lkm	Line Kilometers
m	metres
mbgl	Metres below ground level
mm	millimetres
MNES	Matters of National Environmental Significance
MRL	Mineral Resources Limited
MRWA	Main Roads Western Australia
MUW	Multiple Use Wetland
NAHA	Noongar Alternative Heritage Agreement
NR	Nature Reserve
OSCP	Oil Spill Contingency Plan
PEC	Priority Ecological Community
PGER Act	*Petroleum and Geothermal Energy Resources Act 1967* (WA)
PGER€R.	Petroleum and Geothermal Energy Resources (Environment) Regulations 2012 (WA)
PMST	Protected Matters Search Tool
REW	Resource Enhancement Wetland
RGPF	Red Gully Production Facility
RIWI Act	*Rights in Water and Irrigation Act 1914* (WA)
ROKAMBA	Republic of Korea Australia Migratory Bird Agreement
SWALSC	South West Aboriginal Land and Sea Council
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Committee
VT	Vegetation Type
2D	Two dimensional
3D	Three dimensional

1. Introduction

1.1 Purpose of this Document

This document has been prepared to provide supporting information and evidence for referral of the Romanesque 3D and Black Cormorant 2D seismic surveys proposed by Energy Resources Limited (ERL) (Proposal).

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

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, two production licences, and a petroleum pipeline 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.

Table 1.1: Permit Operator Details

Permit	ERL stake	Area (km^2)
EP 389 (R4)	100% Operator	733
EP 440 (R1)	100% Operator	74
L 18	100% Operator	74
L 19	100% Operator	74

Proponent contact details are provided in Table 1.2.

Table 1.2: 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

Energy Resources Limited (ERL), a wholly owned subsidiary of Mineral Resources Limited (MRL), is proposing to undertake a 2D (Black Cormorant) and 3D (Romanesque) seismic acquisition surveys in the Shire of Gingin in the mid-west region of Western Australia within petroleum exploration permits EP 389 (R4), EP 440 (R1), petroleum production licences L 18 and L 19 (Proposal) (Figure 2.1).

The Proposal covers an area of approximately 205 km^2 (25 km long by 12 km wide (maximum)) within the Perth Basin (the Proposal Area). The Proposal will largely be undertaken in rural areas previously cleared for farming activities. The planned surveys require signed land access and compensation agreements with the underlying landholders. If agreements cannot be reached, alternate contingent lines are planned in some areas. The surveys comprise:

- Romanesque 3D seismic lines: 594 Lkm (line kilometres), plus 72 Lkm contingent lines; and
- Black Cormorant 2D seismic lines: 153 Lkm, plus 103 Lkm contingent lines.

As a result of the extent of current agricultural land use the Proposal will only require temporary disturbance of up to 3.73 ha of native vegetation to create access lanes for the vibroseis trucks and light vehicles. The seismic lines have been aligned to use previously cleared areas where possible to undertake the Proposal with the minimum amount of clearing and disturbance of native vegetation.

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

2.2 Justification

The proposed Romanesque 3D and Black Cormorant 2D Seismic Surveys are being acquired to further the sub-surface understanding of the potential reservoir and sealing horizons in and around the Red Gully Processing Facility (RGPF) gas plant. The Proposal has been designed to fit together with the previously acquired Gingin and Wannamal 3D seismic surveys undertaken in 2008 and 2013. The knowledge gained from the Proposal will allow the maturation of conventional drilling targets close to the infrastructure currently in care and maintenance at the RGPF in L 18.

The Proposal involves only the completion of a 3D and 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 'Proposal Area' is the physical area which includes the area of the Proposal (i.e. the 3D and 2D seismic lines) and areas for support and laydown facilities. The Proposal Area is located within the Shire of Gingin in the Wheatbelt region of Western Australia (Figure 2.1). The majority of the population resides in the towns of Gingin which is located approximately 20 km to the south and Lancelin, which is located on the coast approximately 50 km west of the Proposal Area.

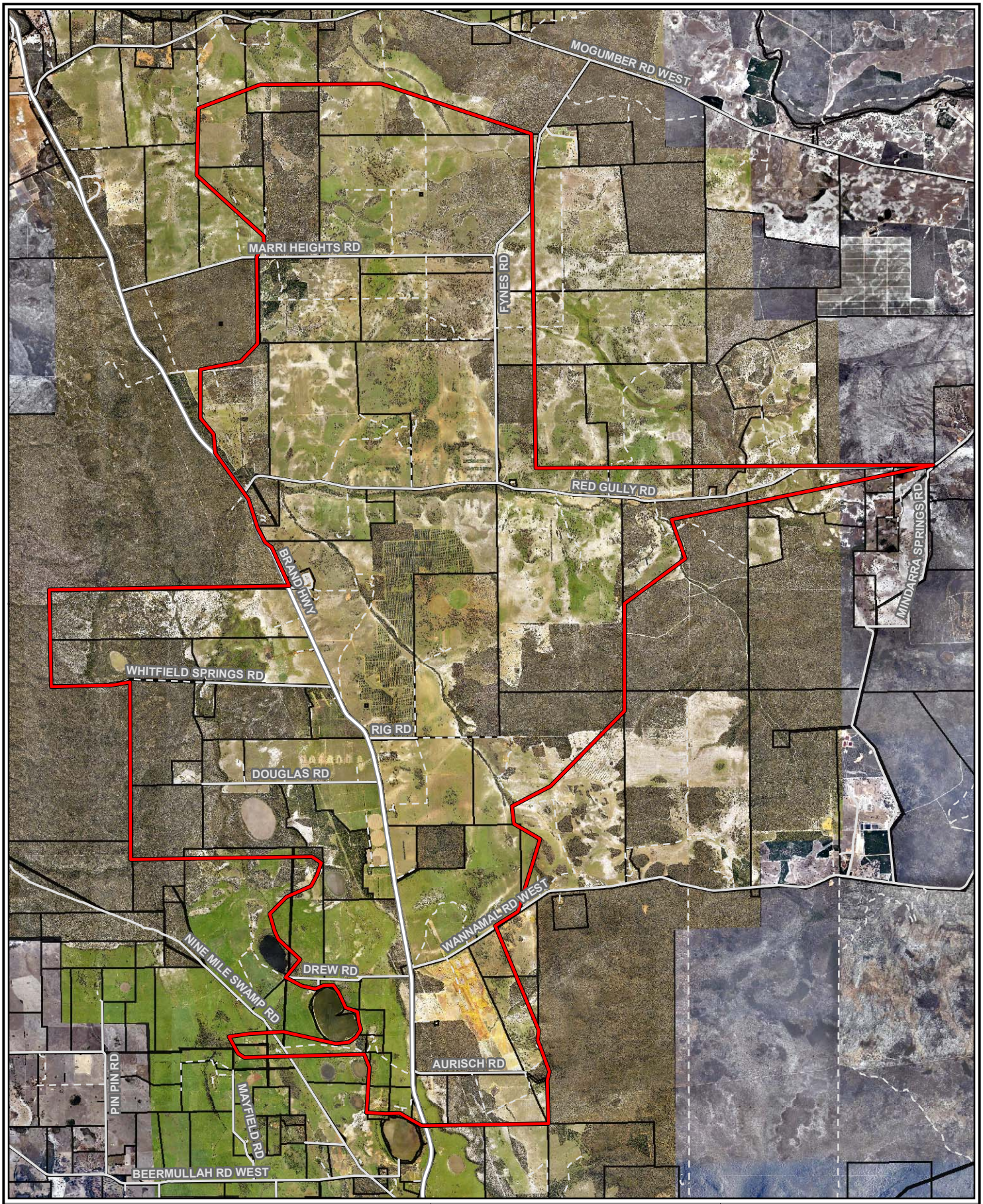
2.4 Proposal Description

The Proposal comprises a total of 594 Lkm (plus 72 Lkm contingent lines[1]) of 3D seismic lines (Romanesque) and 153 Lkm (plus 103 Lkm contingent lines) of 2D seismic lines (Black Cormorant) across a 205 km^2 area within Petroleum Exploration Permits EP 440 (R1) and EP 389 (R4) and Production Licences L 18 and L 19. The cadastral boundary for these permits and licences is shown in Figure 2.2.

[1] Contingent lines are less preferred replacement lines that will be used in the event preferred seismic lines cannot be accessed for any reason. Contingent lines are therefore not in addition to the proposed seismic lines. The total clearing area of 3.73 ha will not be exceeded.

The Proposal comprises the following key elements:

- Preparation of vehicle access lands by cutting up to 3.73 ha of vegetation above ground level and mulching green stock with immediate replacement of mulch in-situ;
- Laying receiver nodes along access lanes 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
- Cadastral boundary
- Major road
- Minor road
- Tracks

Note: High resolution imagery within project area supplied by Energy Resources Limited; surrounding imagery supplied by SLIP Public Services

Scale 1:120,000 at A4

0 1 2 Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57789

Client: Energy Resources Limited

Version: A | Date: 14-Jul-2020

Drawn By: hsullivan | Checked By: RD

PROPOSAL LOCATION

FIGURE 2.1

strategen JBS&G

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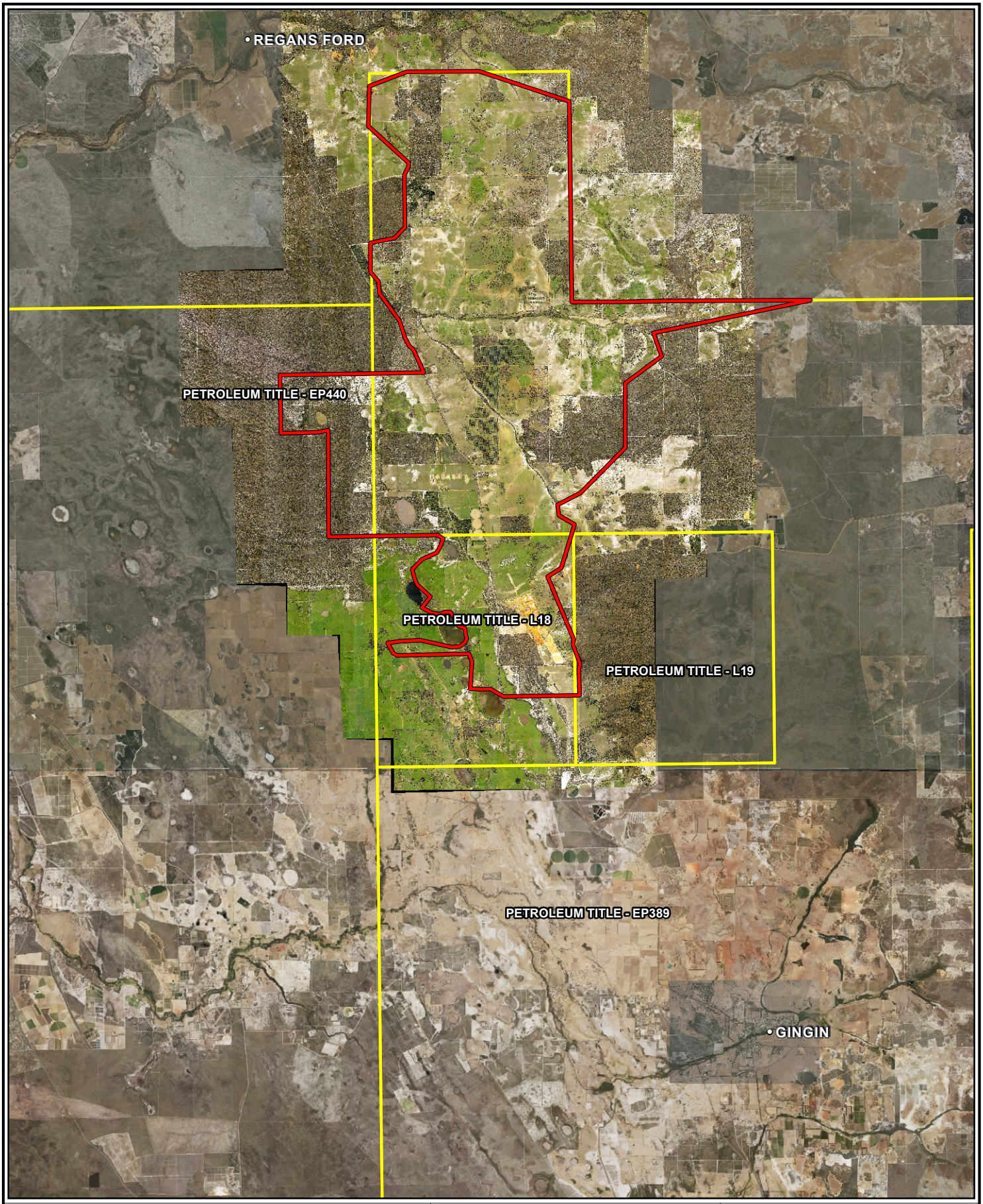
Image Reference: Energy Resources Limited.



Legend:

- Project Area
- Permit area

Scale 1:200,000 at A4

0 2.5 5
Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57624

Client: Energy Resources Limited

Version: A | Date: 14-Jul-2020

Drawn By: hsullivan | Checked By: CT

PERMIT AND LICENCE BOUNDARIES

FIGURE 2.2

strategen JBS&G

File Name: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_PermitAreas.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

2.4.1 Proposal Description

Seismic Acquisition

The Proposal involves laying out receiver nodes and conducting a seismic survey using vibroseis technology.

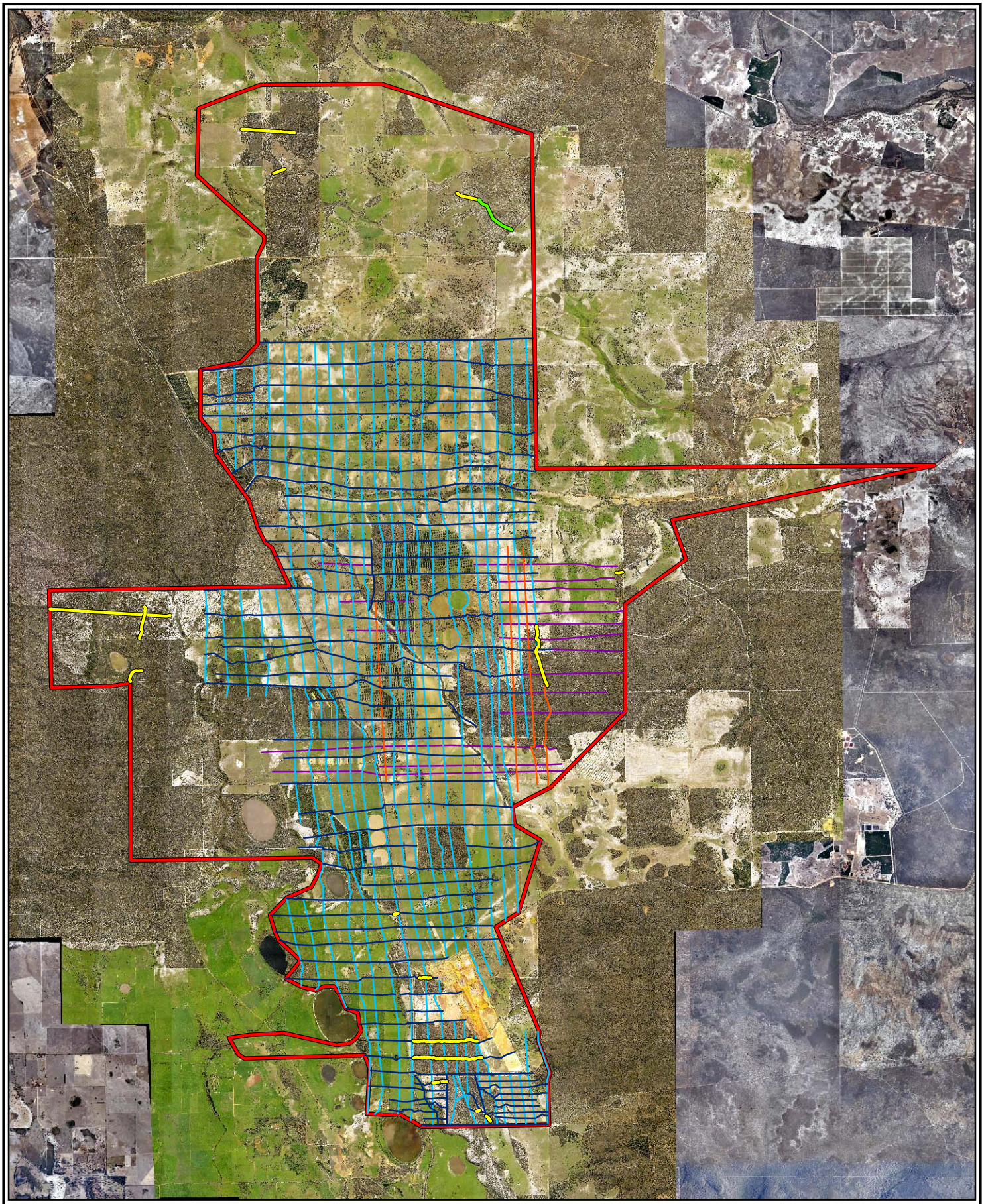
Nodal receivers (Figure 2.3) are placed at regular intervals along seismic lines, laid using light vehicles or by hand-carrying equipment through environmentally sensitive areas. The nodes are planted into the ground to approximately 100 mm depth (between 75 mm and 200 mm) so that about 50 mm sits above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

The nodes will be "leapfrogged" from behind the acquisition trucks to be placed ahead of the acquisition. This placement occurs in a systematic way dependant on stakeholder land access requirements. This means that not all receiver lines will be laid at once.

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 Proposal Area on pre-planned survey lines as shown in Figure 2.4 and Figure 2.5.

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.



Legend:

- Project Area
- Proposed clearing areas
- Proposed clearing areas – survey required

Romanesque 3D Seismic Lines (planned)

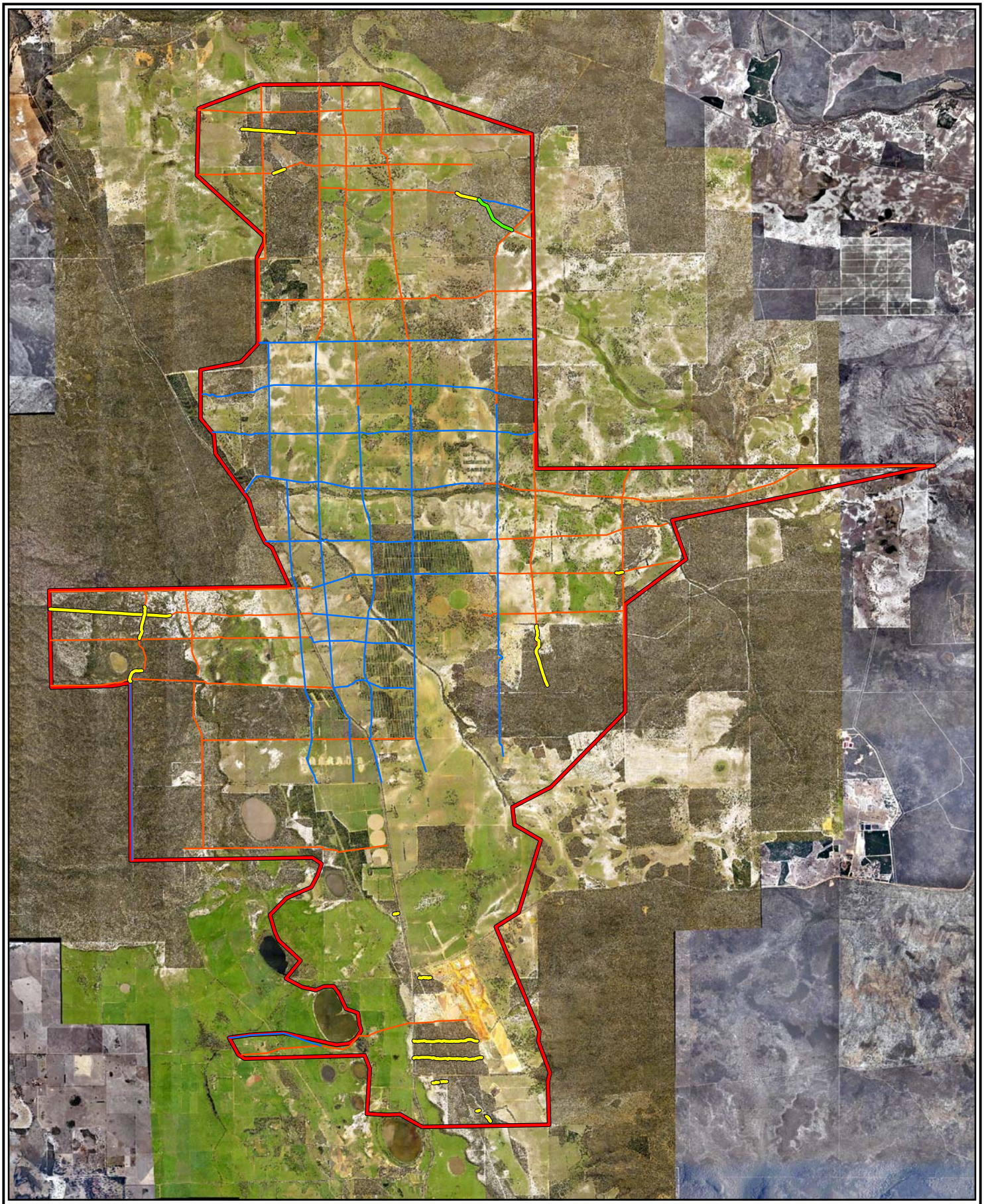
- Source Lines
- Receiver Lines

Romanesque 3D Seismic Lines (contingent)

- Source Lines
- Receiver Lines

Scale 1:120,000 at A4 (0 1 2 Kilometres)		**Romanesque / Black Cormorant Seismic Survey**
Coord. Sys. GDA 1994 MGA Zone 50		**ROMANESQUE 3D SEISMIC LINES**
Job No: 57624		
Client: Energy Resources Limited		**FIGURE 2.4**
Version: A	Date: 20-Aug-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\57789_R01_RevA\57789_08_Romanesque3D_SL.mxd
Image Reference: Energy Resources Limited



Legend:

- Project Area
- Proposed clearing areas
- Proposed clearing areas – survey required
- Black Cormorant 2D Source/Receiver Seismic Lines (contingent)
- Black Cormorant 2D Source/Receiver Seismic Lines (planned)

Scale 1:120,000 at A4 (0 1 2 Kilometres)		**Romanesque / Black Cormorant Seismic Survey**
Coord. Sys. GDA 1994 MGA Zone 50		**BLACK CORMORANT 2D SEISMIC LINES**
Job No: 57624		
Client: Energy Resources Limited		**FIGURE 2.5**
Version: A	Date: 20-Aug-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\57789_R01_RevA\57789_08_BlackCormorant_2D_SL.mxd
Image Reference: Energy Resources Limited

Seismic Survey Line Planning

The proposed seismic lines have been developed through a detailed process of review to ensure that impacts to the environment are minimised. These lines represent the most likely locations at this time, but may require some revision as a result of unforeseen circumstances that arise prior to commencement. Seismic survey lines can also be deviated from the nominal mapped alignments by up to approximately 50 m without losing definition in survey results. This potential deviation allows survey lines to avoid soaks, creek lines and other environmental values such as populations of conservation significant flora, vegetation or fauna habitat. Mulcher capacity (needed for clearing) is also limited by the girth of tree trunks and limbs, as the mulcher cannot process trunks or limbs larger than 100 mm. This mulcher limitation results in more mature trees (often also significant trees for listed species such as Black Cockatoo) remaining undisturbed. The maximum clearing area, avoidance and management measures outlined in this supporting document will be maintained in the event of any future potential modification of the seismic lines.

Initial proposed lines were developed by geophysicists with the aim of ensuing a desired level of data quality and acquisition across the Project Area. The proposed lines were then reviewed and refined through the following processes:

- high level review of existing aerial imagery to ensure, where possible:
  - avoidance of buildings and infrastructure;
  - avoidance of areas of native vegetation; and
  - 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. All acquisition lines that would have needed clearing, and traversed conservation areas and surface water bodies or drainage lines were removed through this review stage.
- consultation with private landholders to identify culturally or economically sensitive areas to avoid.
- bespoke further refinement of avoidance areas and moving lines through:
  - collection of high-resolution imagery;
  - identification of existing cleared tracks and areas within no understorey vegetation that would not require additional clearing; and
  - movement of lines into nearby areas which would not require clearing.
- on ground site survey to identify, delineate and deviate around flora populations or individual listed species and communities, significant trees and any trees with a trunk diameter greater than 100 mm and riparian zones for surface water bodies. All of these features have been avoided through line deviation or truncation.

In order to retain the necessary levels of data acquisition, in some locations survey continuity will be maintained by hand-carrying equipment through environmentally sensitive areas (with no clearing needed). 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 Project.

During implementation of the Project, the surveyors may move positions within 50 m either side of the planned location if they encounter any culturally significant sites (refer to Section 3.5) or believe there will be safety concerns with the position. The on-ground site survey involved a corridor of 50 m

either side of planned lines to ensure sensitive environmental features within those corridors are avoided.

As a result of this process, significant environmental features have been avoided and/or minimised. Overall, the mitigation process resulted in a total reduction in the area of clearing for line preparation by approximately 10 ha.

Seismic Survey Line Preparation

The majority of the Project Area comprises land which has been previously cleared for agricultural purposes. In areas of native vegetation, access lanes of maximum 3.5 m width are needed. These access lines are created through cutting and mulching of native vegetation. As a result, the Proposal will temporarily disturb up to 3.73 ha of native vegetation (3.33 ha with a contingency of 0.4 ha), which represents 0.01% of the Proposal Area (22 500 ha) and 0.04% of the native vegetation area (8 447 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. Up to two tractor-mounted 'fixed hammer' mulchers will be used for line preparation. Swing Hammer mulchers (rather than fixed) provide minimal ground disturbance and safe vehicle access. The swinging tooth enables the mulcher to follow the natural ground contours through flexible deflection from the ground 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. If necessary 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.

During recent flora and vegetation surveys undertaken by Strategen-JBS&G, historic seismic lines created using bulldozing or rolling techniques were still evident, primarily as a result of the absence of overstorey species. This method of clearing also produces lines of damaged and partly shredded vegetation, which may affect the post survey recovery. Rolling can also result in many uprooted plants especially in loose sandy soils typical of the Perth Basin.

ERL has ruled out rolling vegetation as an alternative to mulching due to significant safety concerns. HSE reported incidents involving rolled vegetation penetrating inside of personnel vehicles via a rubber moulding with near miss of serious personal injury.

In comparison, the cutting and mulching method results in a safe, cleaner and more stable site and 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; and

- mulching results in retention of significant overstorey species (i.e. diameter greater than 100 mm).

Rehabilitation and Monitoring

All equipment will be removed at the completion of the Proposal.

As the proposed mulching method does not require extensive rehabilitation at the cessation of the seismic survey, disturbed areas will be rehabilitated immediately following completion or returned to a condition as outlined in landowner access agreements. 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 Proposal to ensure native vegetation along seismic lines returns to a composition and structure that is comparable to its pre-disturbance state or returned to a condition as outlined in landowner access agreements.

Monitoring will commence one month after completion of the Proposal with a focus on unauthorised third party access issues. The program will then continue annually between September and November (i.e. Spring) 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 DMIRS in the form of an annual report.

Supporting Infrastructure and Services

The existing Red Gully Production Facility (RGPF) will be used to provide support services and laydown facilities relating to the Proposal. 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.

2.5 Timing and Proposal Staging

Pending receipt of all relevant approvals, ERL plans to commence the Proposal in February to April 2021.

2.6 Local and Regional Context

2.6.1 Regional Context

The Proposal Area is located within the Swan Coastal Plain 2 (SWA02 –Swan Coastal Plain subregion) the Interim Biogeographic Regionalisation for Australian bioregion (Mitchell et al. 2002). The Proposal Area is located along Brand Highway, in the immediate vicinity of Moore River National Park[2] (located to the west of the Proposal Area), Boonanarring Nature Reserve (NR)[3] (located to the east of the Proposal Area). Immediately west of the NR is the Boonanarring Mineral Sands Mine. The Proposal Area overlaps Bartlett's Nature Reserve, located approximately 600 metres east of Brand Highway.

The RGPF is located within the Proposal Area.

The nearest towns are Lancelin which is located on the coast approximately 50 km to the west of the Proposal area and Gingin which is located approximately 20 km to the south.

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[2] 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).

[3] Nature reserves are established for wildlife and landscape conservation, scientific study and preservation of features of archaeological, historic or scientific interest. Recreation that does not harm natural ecosystems is allowed, but other activities are usually not permitted (DBCA).

2.6.2 Climate

The Wheatbelt 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 Gingin Aero station (station 009178), approximately 28km from the Proposal area.

The average rainfall from 1996-2019 was 625.6mm with the highest monthly rainfall occurring from May to September (Figure 2.6). The wettest year on record was 1999, with an annual rainfall of 881.6mm, 627.8mm of which fell during the May to September period (BOM, 2019).

The average maximum temperatures range from 18.3°C in August to 31.1°C in January/February. The average minimum temperatures range from 6.4°C in July to 17°C in February.

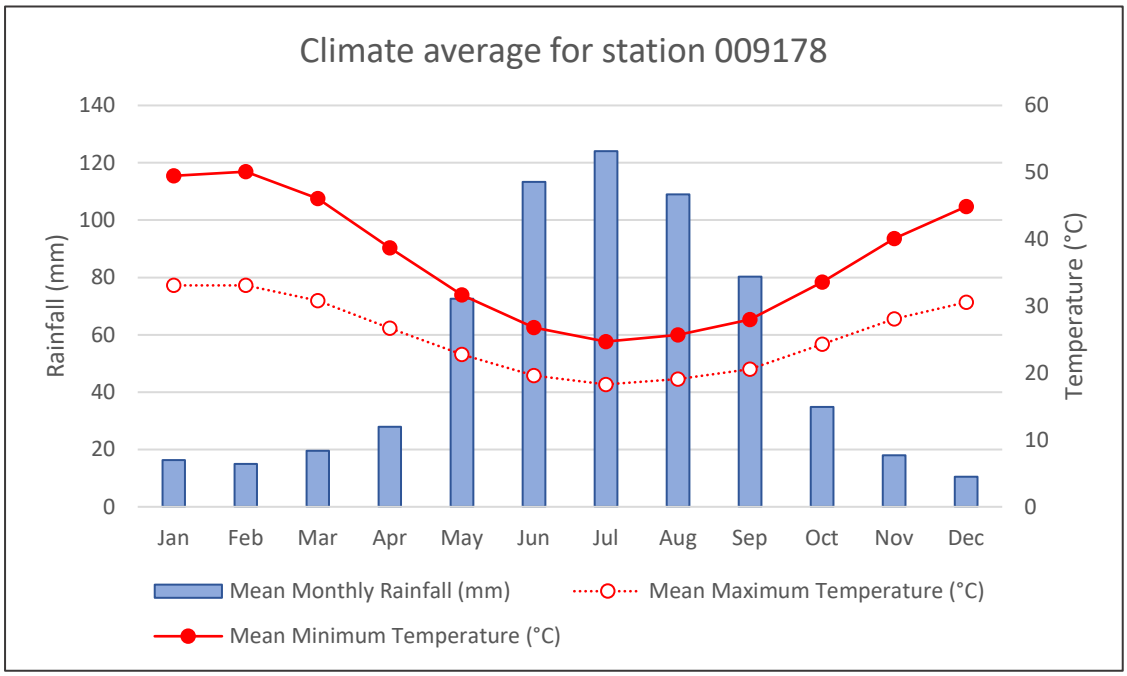

Figure 2.6: Monthly Average Rainfall and Temperature at Gingin Aero WA (Station 009178)

2.6.3 Landform

Landforms across the Project Area can be described as generally flat with gently undulating sand plains to the east. Elevations across the site range from 50 m – 75 m above sea level to the south east, rising to 230 m above sea level through the centre, northern and eastern portions, with the exception of depressions associated with surface features at elevations around 80 m above sea level (Figure 2.7).

2.6.4 Geology and Soils

The Proposal is located within the Perth Basin, which extends from the Murchison River in the north 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 lasky (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).

The Proposal Area is located within the Swan Coastal Plain 1 (SWA01 – Dandaragan Plateau subregion) of Western Australia (Mitchell et 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.

The Proposal Area is located within the Bassendean Dune, Pinjarra Plain, and Dandaragan Plateau landform units. The Dandaragan Plateau is comprised of lateritic deposits overlaying sedimentary bedrock, with alluvial transport of clayey sediment forming Pinjarra Plain located at the foothills of the Plateau. On the western side the Bassendean Dune formation is characterised by aeolian bedrock overlayed with siliceous sands (Smolinski & Scholz, 1997; McPherson & Jones, 2005).

2.6.5 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 there are no mapped risks ('extremely low probability') of ASS within the Proposal Area.

2.6.6 Regional Hydrology

2.6.6.1 Surface Water

The coastal region between Gingin and Geraldton is dominated by the Swan Coastal Plain, a low-lying, gently undulating plain with numerous wetlands and coastal sand dunes (DoW 2017). The Proposal Area is located on the border of the following two hydrographic catchments:

- Gingin Brook sub-catchment of the Moore River hydrographic catchment; and
- Brockman River sub catchment of the Swan-Avon hydrographic catchment.

The Gingin Brook sub-catchment is fed by run-off from the Dandaragan Plateau from which numerous groundwater supplied brooks originate, such as Gingin Brook, Boonanarring Brook and Red Gully Creek. The base of the Gingin Scarp is characterised by a low lying and poorly drained plain and includes a series of lakes and inundated areas such Beermullah and White Lakes, located south-west of the Proposal Area.

The Brockman River is fed by the Wannamal Lake systems and multiple seasonal creeks. The Brockman River runs south along the western edge of the Darling Scarp, through the Chittering Valley and flows into the lower Avon River.

The surface water drainage patterns near the Proposal Area are generally towards the west, reflecting the general slope of the landscape. Proposal activities will not impact on surface waters.

Mapping of the geomorphic wetlands of the Swan Coastal Plain indicates a number of wetlands are present within the Proposal Area:

- 137 Conservation Category Wetlands (CCW);
- 40 Resource Enhancement Wetlands (REW); and
- 40 Multiple Use Wetlands (MUW).

These wetlands are mapped in Figure 2.8.

There are no Ramsar listed wetlands or Nationally Important (Directory) listed wetlands within the Proposal Area (Department of Agriculture, Water and Environment)(DAWE).

Legend:

- Project Area

Elevation contours (mAHD)

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

strategen JBS&G

0 2 Kilometres

TOPOGRAPHY

Job No: 57624		Scale 1:80,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: hsullivan	Checked By: CT	Version: A	Date: 26-Jun-2020

FIGURE: 2.7

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Image Reference: Energy Resources Limited; www.nearmap.com© - Imagery Date: 13 April 2014.

Legend:

- Project Area
- Watercourse line

Geomorphic Wetlands (DBCA)

- Artificial Lake
- Dampland
- Floodplain
- Lake
- Paluslope
- Palusplain
- Sumpland

strategen JBS&G

0 2 Kilometres

SURFACE WATER FEATURES

Job No: 57789		Scale 1:80,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: hsullivan	Checked By: CT	Version: A	Date: 26-Jun-2020

FIGURE: 2.8

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

2.6.7 Groundwater

The largest fresh groundwater resources within the northern Perth Basin are in the Superficial, Leederville, Leederville–Parmelia and Yarragadee aquifers. There are also three secondary aquifers: the Mirrabooka, Cattamarra and Eneabba–Lesueur aquifers. In addition to these groundwater resources, there are minor shallow and fractured-rock aquifers that are locally significant sources of water. Hydraulic connection between aquifers is often impeded across faults and low permeability units, both within and between aquifers (DoW 2017).

Groundwater is contained within superficial aquifers including the Leederville aquifer west of the Proposal Area, the Leederville – Parmelia aquifer east of the Proposal Area and the Yarragadee aquifer on the coastal plain and the Dandaragan Land System (DoW 2017). Groundwater is understood to be fairly shallow with a depth of <20 mbgl and the groundwater quality in the general area is understood to be marginal (as per Perth Groundwater map), with a salinity of 500 – 1000 mg/L (Perth groundwater map, DWER).

The Leederville aquifer comprises sandstone and shale with a thickness of up to 550 metres. The aquifer is semi-confined to confined with a generally fresh groundwater quality. The Leederville – Parmelia aquifer consists of the interconnected Leederville formation and the Parmelia Group, comprising sandstone and shale. The aquifer is semi-confined to the north becoming confined to the south with generally fresh groundwater quality.

The Yarragadee Formation comprises sandstone, shales and siltstone, varies in thickness between 500 and 2000 m and extends to depths of up to 2000 metres below existing ground level. The aquifer is unconfined to confined with generally fresh groundwater quality, but high groundwater salinity exists along the Darling Fault, located approximately 20 kilometres east of the Proposal Area.

The Proposal Area is situated within the Gingin proclaimed groundwater area (DoW - Gingin groundwater allocation plan 2013). Water users therefore require a water licence to lawfully abstract groundwater under section 5C of the *Rights in Water and Irrigation Act 1914* (RIWI Act).

2.6.8 Vegetation

2.6.8.1 Desktop Assessment

The Proposal Area comprises approximately 8 447 ha of native vegetation; the remaining area (14 053 ha) comprises previously cleared land.

Database searches were undertaken to generate a list of vascular flora and Threatened and Priority Ecological Communities previously recorded within, and nearby the Proposal Area (Table 2.1). Database searches were conducted within a 10 km buffer of the Proposal Area. These are provided in Appendix A.

Table 2.1 Database Searches (Strategen-JBSG 2019)

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	Threatened and Priority Flora (TPFL) (*https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/*	Flora	5km
DBCA	Communities (*https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/*	Ecological Communities	5km
DAWE	Protected Matters Search Tool (PMST *(environment.gov.au/epbc/protected-matters-search-tool)*	Flora, Fauna and Communities	5km

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

Regional Vegetation

Beard (1990) Botanical Subdistrict

The Proposal 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).

Australia's Interim Biogeographic Regionalisation for Australia subregion

Australia's Interim Biogeographic Regionalisation for Australia (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 Area occurs within the Swan Coastal Plain 2 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 Vegetation Complex mapping over the System 6 area undertaken by Heddle et al. (1980).

At a vegetation association level, the Proposal Area comprises ten Beard (1981) associations. All of these vegetation associations are well represented on the Swan Coastal Plain 2 IBRA subregion (GoWA 2019a).

Table 2.2: Beard (1981) Vegetation Associations within the Proposal Area (Strategen-JBSG 2019)

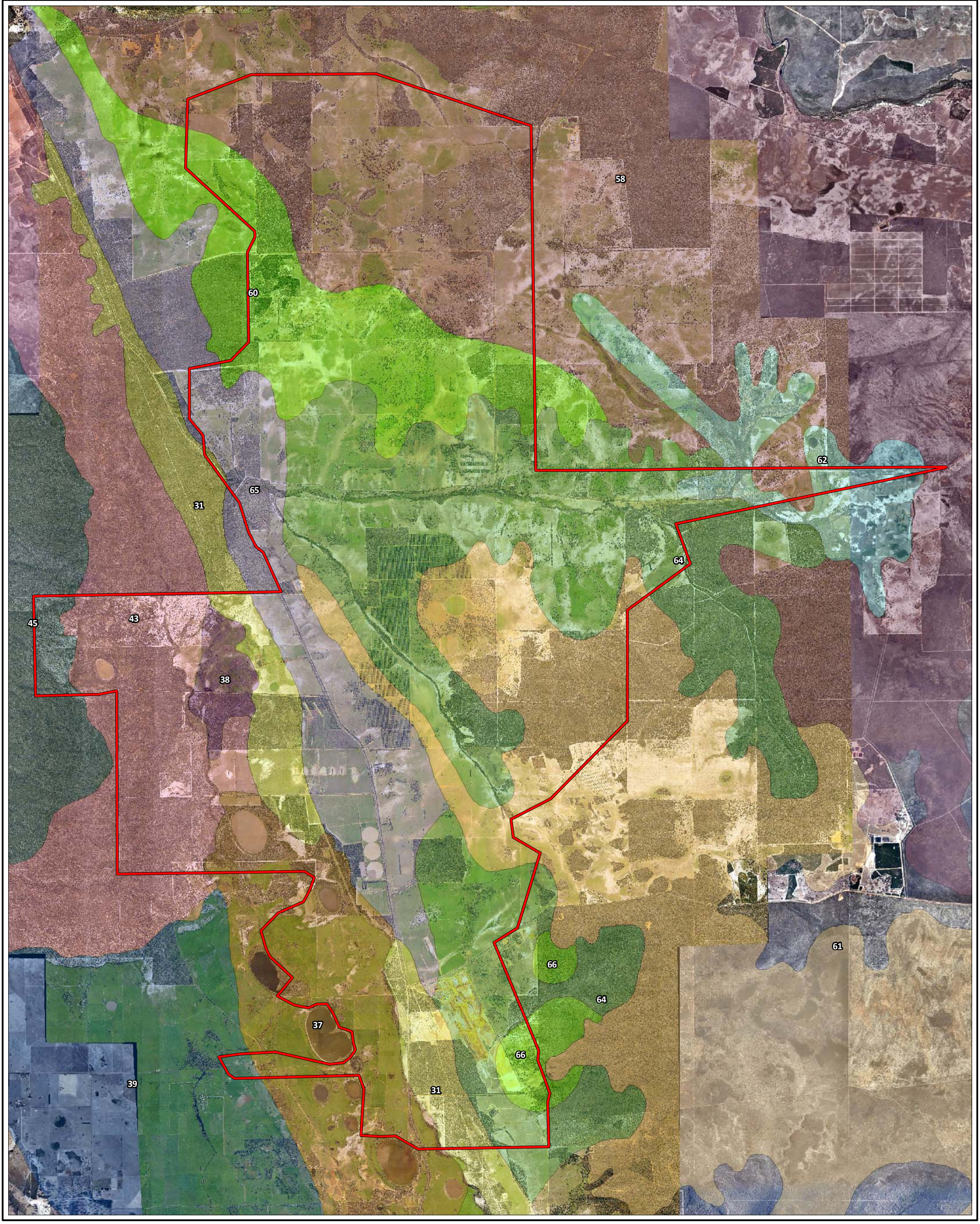
Vegetation Association	Description
37	Shrublands; teatree thicket
125	Bare areas; salt lakes
949	Low woodland; banksia
1008	Medium open woodland; marri
1014	Mosaic: Low woodland; banksia / Shrublands; teatree thicket
1015	Mosaic: Mixed scrub-heath / Shrublands; dryandra thicket
1016	Mosaic: Low woodland; banksia / Shrublands; dryandra heath
1017	Medium open woodland; jarrah & marri, with low woodland; banksia
1027	Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia / Medium sparse woodland; jarrah & marri
1030	Low woodland; *Banksia attenuata* & *Banksia menziesii*

At a vegetation complex level, based on regional vegetation mapping undertaken by Heddle et al. (1980), the Proposal Area comprises 13 vegetation complexes (Figure 2.9).

The vegetation complexes present within the Proposal Area and their percent remaining on the Swan Coastal Plain 2 IBRA subregion is outlined in Table 2.3,) (GoWA 2019b). With the exception of the Bootine Complex, the vegetation complexes to be impacted exist at > 30% of their original extent. The current extent of the Bootine Complex remaining is 16.01 % and the impact of vegetation clearing as a result of the Proposal represents a loss of <0.005% of this Complex. The clearing is estimated to impact on <0.05% on each of the vegetation complexes within the overall Proposal Area, with this impact limited to small areas of localised clearing within eight separate patches.

Table 2.3: Heddle et al. (1980) Vegetation Complexes within the Proposal Area (Strategen-JBSG 2019)

Vegetation Complex (Vegetation code as per Figure 2.9)	Description	Percent Remaining in IBRA Region	Area Impacted by Proposal Clearing (ha)	% Impact on Remaining Vegetation within IBRA Region
Bassendean Complex-North (43)	Vegetation ranges from a low open forest and low open woodland of Banksia species *Eucalyptus todtiana* (Pricklybark) to low woodland of Melaleuca species and sedgelands which occupy the moister sites.	71.67	0.26	0.0005
Bassendean Complex-North Transition (45)	A transition complex of low open forest and low woodland of Banksia species - *Eucalyptus todtiana* (Pricklybark) on a series of high sand dunes. The understorey species reflect similarities with both the Bassendean-North and Karrakatta-North vegetation complexes.	88.95	0	0
Bootine Complex (37)	Predominantly low open forest of *Banksia attenuata* (Slender Banksia) - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia) - *Eucalyptus todtiana* (Pricklybark). On lake margins transition from woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) to sedgelands.	16.01	0.04	0.0064
Coonambidgee Complex (31)	Vegetation ranges from a low open forest and low woodland of *Eucalyptus todtiana* (Pricklybark) - Banksia attenuata (Slender Banksia) - *Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia) with localised admixtures of *Banksia prionotes* (Acorn Banksia) to an open woodland of *Corymbia calophylla* (Marri) - Banksia species.	45.46	1.2	0.0421
Cullula Complex (62)	Mixture of low open forest of Banksia species - *Eucalyptus todtiana* (Pricklybark) and open woodland of *Corymbia calophylla* (Marri) with second storey of *Eucalyptus todtiana* (Pricklybark) – *B .attenuata - Banksia menziesii* (Firewood Banksia) - *Banksia ilicifolia* (Holly-leaved Banksia).	51.24	0	0
Gingin Complex (66)	Open woodland of *Corymbia calophylla* (Marri) with second storey of *Banksia grandis* (Bull Banksia) and *Nuytsia floribunda*. Fringing woodland of *Eucalyptus rudis* (Flooded Gum) - *Melaleuca rhaphiophylla* (Swamp Paperbark) along streams.	11.57	0	0
Karamal Complex-North (60)	Open woodland of Eucalyptus wandoo (Wandoo). Under storey of *Banksia squarrosa* (Pingle) and *Banksia polycephala* (Many-headed Dryandra).	22.37	0	0
Karamal Complex-South (61)	Open forest of Eucalyptus marginata (Jarrah) - *Corymbia calophylla* (Marri) with second storey of *Banksia grandis* (Bull Banksia).	64.06	0.39	0.0025
Mogumber Complex-North (58)	Open to closed heath of Banksia species - *Allocasuarina humilis* (Dwarf Sheoak).	47.70	0.61	0.0058
Moondah Complex (64)	Low closed to low open forest of *Banksia attenuata* (Slender Banksia) - *Banksia menziesii* (Firewood Banksia) - *Eucalyptus todtiana* (Pricklybark) - *Banksia prionotes* (Acorn Banksia) on slopes, open woodland of *Corymbia calophylla* (Marri) - Banksia species in valley.	40.83	0.82	0.0113
Mungala Complex (39)	Vegetation ranges from open woodland of *Corymbia calophylla* (Marri) - *Eucalyptus decipiens* to closed scrub of Melaleuca species - Casuarina species.	10.41	0	0
Reagan Complex (65)	Vegetation ranges from low open woodland of Banksia species *Eucalyptus todtiana* (Pricklybark) to closed heath depending on the depth of soil.	33.84	0.01	0.0003
Yanga Complex (38)	Predominantly a closed scrub of Melaleuca species and low open forest of *Casuarina obesa* (Swamp Sheoak) on the flats subject to inundation. On drier sites the vegetation reflects the adjacent vegetation complexes of Bassendean and Coonambidgee.	16.31	0	0



Legend:

- Project Area Vegetation complexes (DBCA)
- 31 - Low open forest and low woodland to open woodland
- 37 - Low open forest
- 38 - Closed scrub and low open forest
- 39 - Open woodland to closed scrub
- 43 - Low open forest and low woodland and sedgelands
- 45 - Low open forest and low woodland
- 58 - Open to closed heath
- 61 - Open forest
- 62 - Low open forest and open woodland
- 64 - Low closed forest and low open forest
- 65 - Low open woodland to closed heath
- 66 - Open woodland

strategen JBS&G

0 2 Kilometres

Job No: 57624		Scale 1:80,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: hsullivan	Checked By: TS	Version: A	Date: 14-Jul-2020

REGIONAL VEGETATION MAPPING - VEGETATION COMPLEXES (Heddle et. al)

FIGURE: 2.9

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_VegComplexes.mxd

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

Threatened and Priority Flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Proposal Area was undertaken using NatureMap (Parks and Wildlife 2007), the Western Australian Herbarium (Western Australian Herbarium 1998), and a DEE Protected Matters Search Tool (DEE 2019a).

The desktop assessment identified seven (7) Threatened flora and 49 Priority flora species that have been recorded in the local area. Of these, based on general habitat requirements, three (3) Threatened and 40 Priority flora species were considered to have potential to occur within the Proposal Area (Strategen-JBS&G 2019).

A field survey assessed whether these potential species actually occur in the areas that are required to be cleared to facilitate the Proposal (refer to Section 2.6.8.2).

Threatened and Priority Ecological Communities

Based on the desktop assessment, two TECs listed under the EPBC Act *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), one TEC listed under the *Biodiversity Conservation Act 2016* (WA) (BC Act), and two communities listed as a PEC by DBCA, were considered to be potentially present within the Proposal Area (Table 2.4).

Table 2.4: TECs and PECs within and near the Proposal Area (Strategen-JBSG 2019)

Community	Conservation Status	
	EPBC Act	BC Act
Banksia woodlands of the Swan Coastal Plain	Endangered	Priority 3
Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain (SCP26a)	Endangered	Endangered
Swan Coastal Plain *Banksia attenuata - Banksia menziesii* woodlands	Endangered	Priority 3

2.6.8.2 Field Survey

In addition to a detailed desktop assessment of the Proposal Area, a field assessment was undertaken in September and October 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 was undertaken 50m either side of the centre of each seismic line (i.e. 100m total survey corridor per line). The total area surveyed was 153.2 ha. For the purpose of the following sections, the area subject to the on-ground ecological field survey is called the 'Survey Area'.

The Ecological Survey also involved a Black Cockatoo habitat assessment in accordance with *EPBC Act Referral guidelines for three threatened Black Cockatoo species* (DSEWPaC 2012).

Native Flora

A total of 151 native vascular plant taxa from 37 plant families and 93 genera were recorded within the Survey Area (Strategen JBS&G 2019).

Threatened and Priority Flora

No Threatened 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 Survey Area (Strategen-JBSG 2019).

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 Proposal Area. As such, the Ecological Survey was undertaken during the optimal time to detect the majority of species present. Given this, the 43 conservation significant flora species with potential to occur within the Proposal Area, are considered unlikely to occur within the areas required to be cleared (Strategen-JBSG 2019).

Weeds

A total of nine introduced (exotic) taxa were recorded within the Survey Area (Appendix A). 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) (Strategen JBS&G 2019).

Vegetation Types

As a result of the Ecological Survey, a total of eight (8) vegetation types (VT) were mapped within the Survey Area (Table 2.5, Figure 2.10). Of the 8 447 ha area of native vegetation occurring with the Proposal Area, the total area mapped i.e. the Survey Area, was 153.2 ha (Strategen-JBS&G 2019). The Ecological Survey comprised 100 m corridors along the proposed seismic lines that occurred within areas of native vegetation. Where seismic lines are altered and are outside the ecological survey corridor, a pre-clearance survey will be undertaken to ensure that the extent and nature of the potential impacts described in this supporting document are not changed (i.e. the mitigation and avoidance measures will be applied to any changed lines). The Proposal requires the clearing of 3.33 ha of native vegetation (this measure does not include the contingent 0.4 ha).

Table 2.5: Vegetation Types within the Ecological Survey Area

Vegetation Type	Description	Area (ha)	Percentage of the Ecological Survey Area	Area to be Cleared (ha)
VT1	*Banksia attenuata* and *Banksia menziesii* low open woodland over *Eremaea pauciflora* over *Mesomelaena pseudostygia* low shrubland.	4.0	2.6	0.16
VT2	*Banksia prionotes* and *Eucalyptus todtiana* low open woodland over *Hakea lissocarpha* and *Xanthorrhoea preissi* mid open shrubland over *Hibbertia hypericoides*, *Isopogon drummondii* and *Synaphea spinulosa* low shrubland.	5.5	3.6	0.22
VT3	*Adenanthos cygnorum* tall shrubland over *Daviesia preissii, Xanthorrhoea preissii* mid open shrubland over *Eremaea pauciflora, Stirlingia latifolia* and *Scholtzia involucrata* low shrubland.	4.7	3.1	0.11
VT4	*Banksia attenuata, Nuytsia floribunda* and *Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum, Allocasuarina humilis* and *Xanthorrhoea preissii* mid open shrubland over *Stirlingia latifolia*, *Eremaea pauciflora* and *Hibbertia hypericoides* low shrubland.	25.3	16.5	0.71
VT5	*Isopogon drummondii, Daviesia preissii* and *Synapheae spinulosa* shrubland.	4.4	2.9	0.26
VT6	*Banksia attenuata, Banksia menziesii* low woodland *Eremaea pauciflora*, *Melaleuca systena* and *Xanthorrhoea preissii* mid open shrubland over *Mesomelaena pseudostygia* and *Melaleuca systena* low open shrubland.	47.7	31.1	1.61
VT7	*Banksia hookeriana* and *Adenanthos cygnorum* open low woodland over *Jacksonia floribunda, Eremaea pauciflora* and *Conospermum incurvum* low shrubland.	22.9	15.0	0.24
VT8	*Melaleuca preissiana*, *Banksia littoralis* and *Nuytsia floribunda* open low woodland over *Melaleuca seriata, Xanthorrhoea preissii* and *Verticordia nitens* mid shrubland.	13.6	8.9	0.02
CL	Cleared; non-native vegetation.	25.1	16.4	N/A
Total		**153.2**	**100**	**3.33**

Native Vegetation Condition

The Proposal Area shows signs of having been degraded for a long period of time. Most of the area consists of already cleared paddocks. Within the remaining native vegetation, historical disturbance from recreational vehicle use and partial clearing, and weed invasion are the two most prominent disturbances. As such, vegetation condition within the Proposal Area ranges from Very Good to Completely Degraded (Figure 2.18). The majority of the vegetated areas within the Ecological Survey Area were found to be in Excellent to Very Good condition (60.6%).

Table 2.6: Vegetation Condition within the Ecological Survey Area

Vegetation Condition	Area (ha)	Percentage of the Survey Area
Excellent	57.3	37.4
Very Good	35.6	23.2
Good	10.6	6.9
Degraded	24.0	15.7
Completely Degraded	0.7	0.4
No native vegetation present	25.1	16.4

Legend:

- Project Area

Vegetation type

- VT1
- VT2
- VT3
- Cleared
- Tracks

strategen JBS&G

0 200 Metres

Job No: 57789		Scale 1:8,200 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA PAGE 1 OF 8

FIGURE: 2.10

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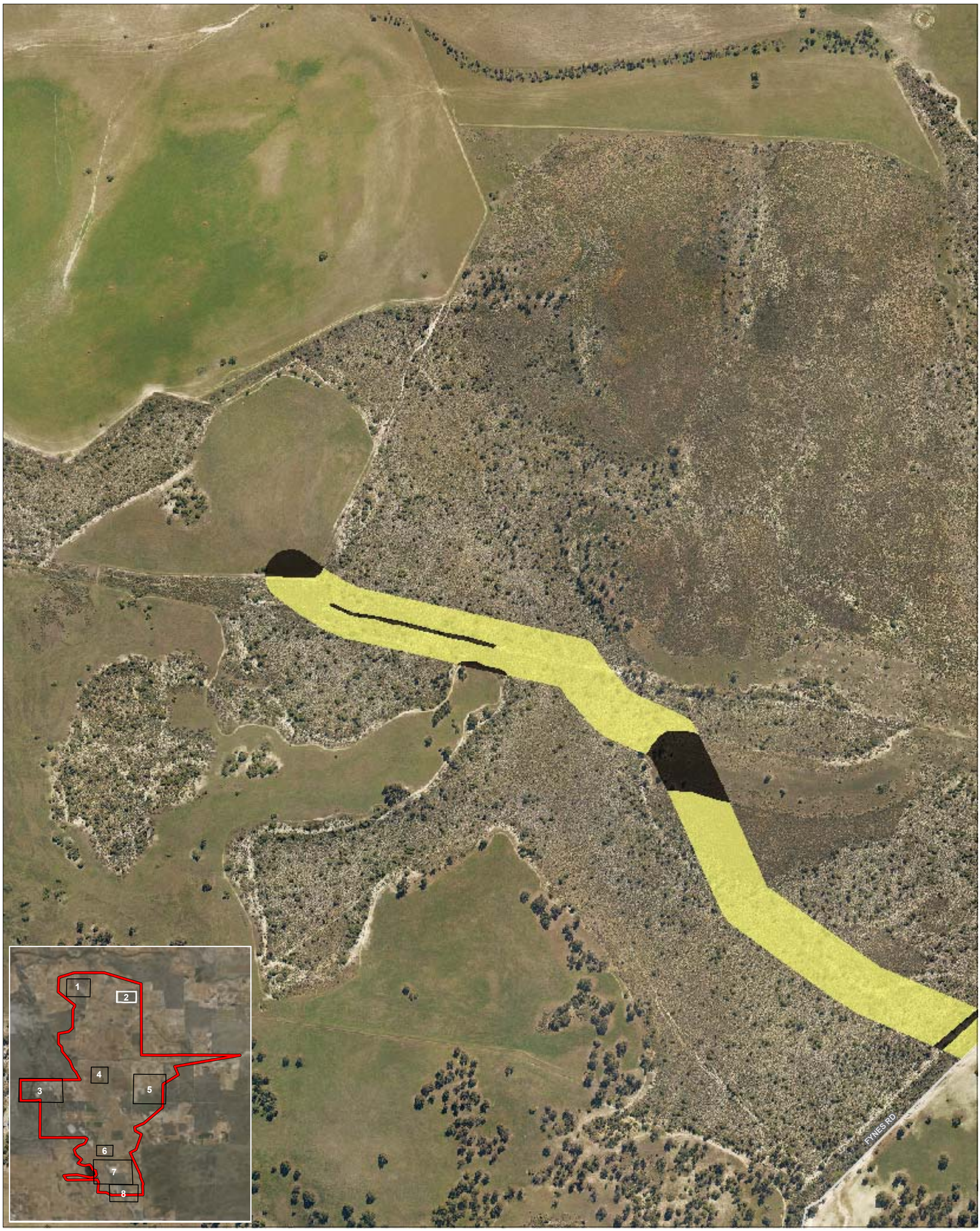
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project Area

Vegetation type

- VT4
- Cleared
- Minor road

strategen JBS&G

0 200
Metres

Job No: 57789		Scale 1:6,700 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 2 OF 8

FIGURE: 2.11

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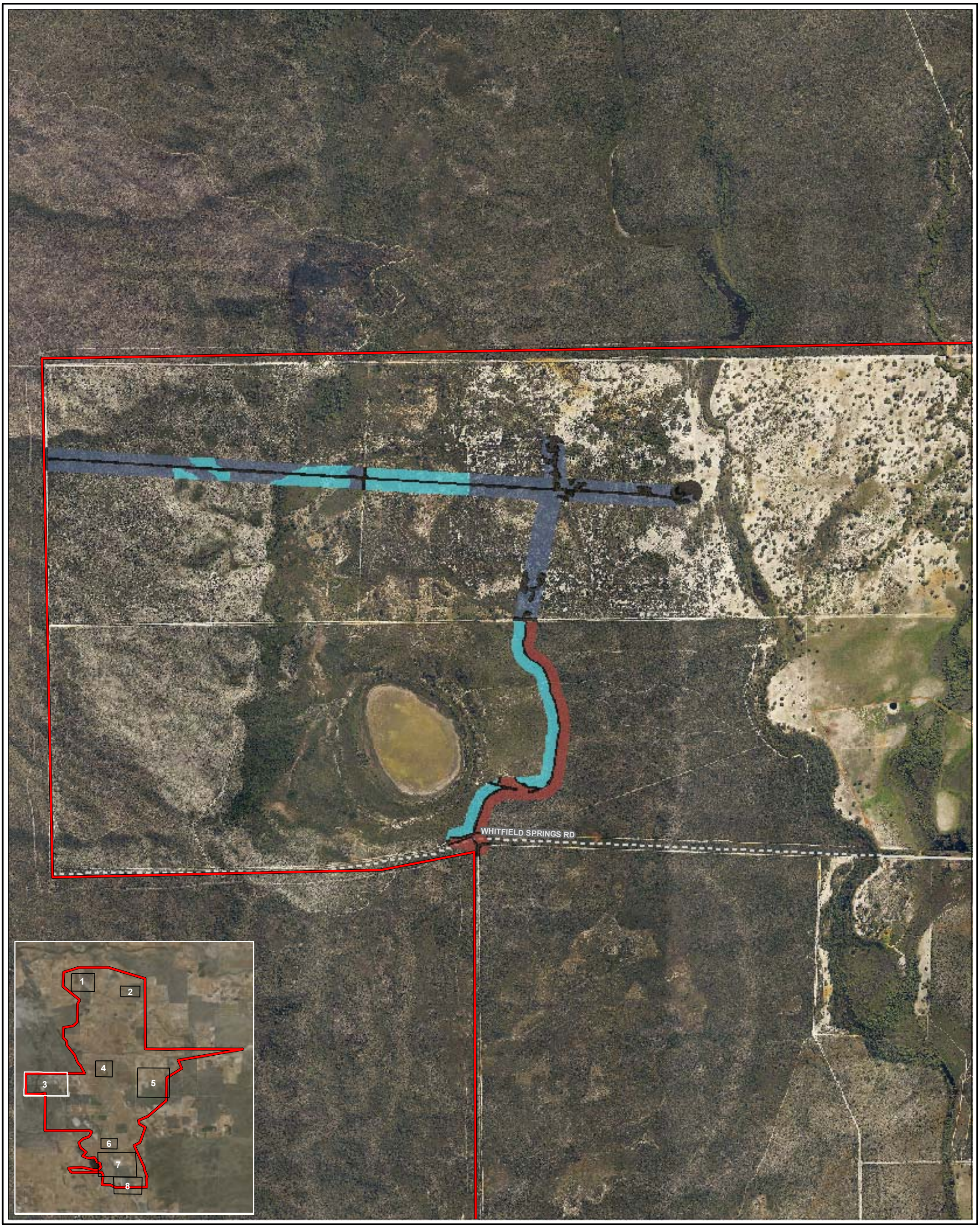

Legend:

- Project Area

Vegetation type

- VT6
- VT7
- VT8
- Cleared
- Minor road
- Tracks

strategen JBS&G

0 200 Metres

Job No: 57789		Scale 1:15,400 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 3 OF 8

FIGURE: 2.12

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

Legend:

- Project Area

Vegetation type

- VT4
- VT5
- Cleared
- Tracks

strategen JBS&G

0 200

Metres

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 4 OF 8

Job No: 57789		Scale 1:5,900 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 2.13

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

Legend:

- Project Area

Vegetation type

- VT4
- VT5
- Cleared
- Tracks

strategen JBS&G

0 200 Metres

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 5 OF 8

Job No: 57789		Scale 1:11,300 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 2.14**

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

Legend:

- Project Area

Vegetation type

- VT4
- Cleared

- Major road
- Tracks

strategen JBS&G

0 200
Metres

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 6 OF 8

Job No: 57789		Scale 1:5,650 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 2.15

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

Legend:

- Project Area

Vegetation type

- VT6
- Cleared

- Major road
- Minor road
- Tracks

strategen JBS&G

0 200 Metres

Job No: 57789		Scale 1:13,750 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 7 OF 8

FIGURE: 2.16

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

Legend:

- Project Area

Vegetation type

- VT6
- Cleared

- Major road
- Minor road
- Tracks

strategen JBS&G

0 200 Metres

Job No: 57789		Scale 1:10,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION TYPES (VT) MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 8 OF 8

FIGURE: 2.17

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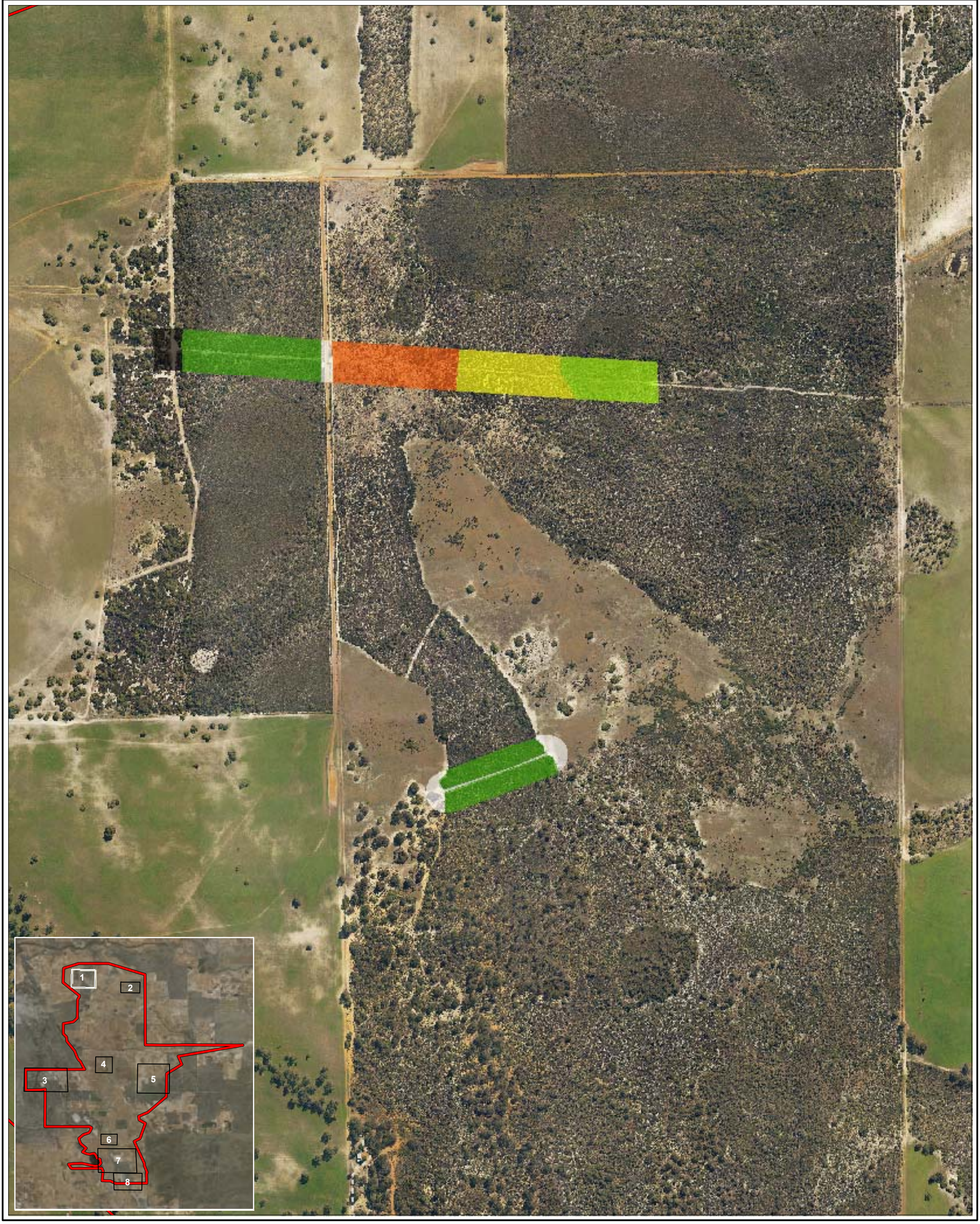


Legend:

- Project Area
- Tracks

Vegetation condition

- Excellent
- Very good
- Good
- Degraded
- Completely degraded
- n/a

strategen JBS&G

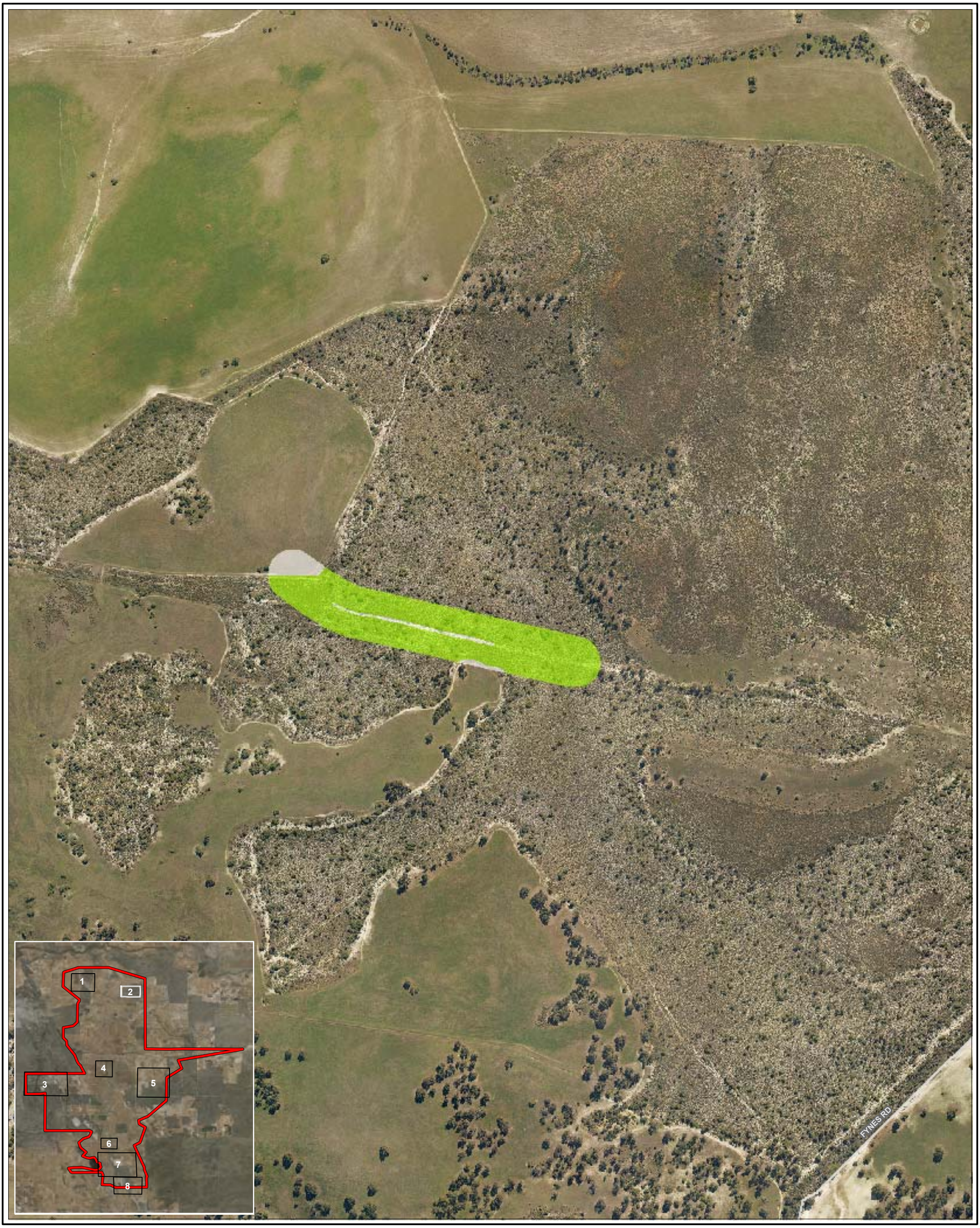
0 200 Metres

Job No: 57789		Scale 1:8,200 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION CONDITION MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 1 OF 8

FIGURE: 2.18

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project Area
- Minor road

Vegetation condition
- Very good
- n/a

strategen JBS&G

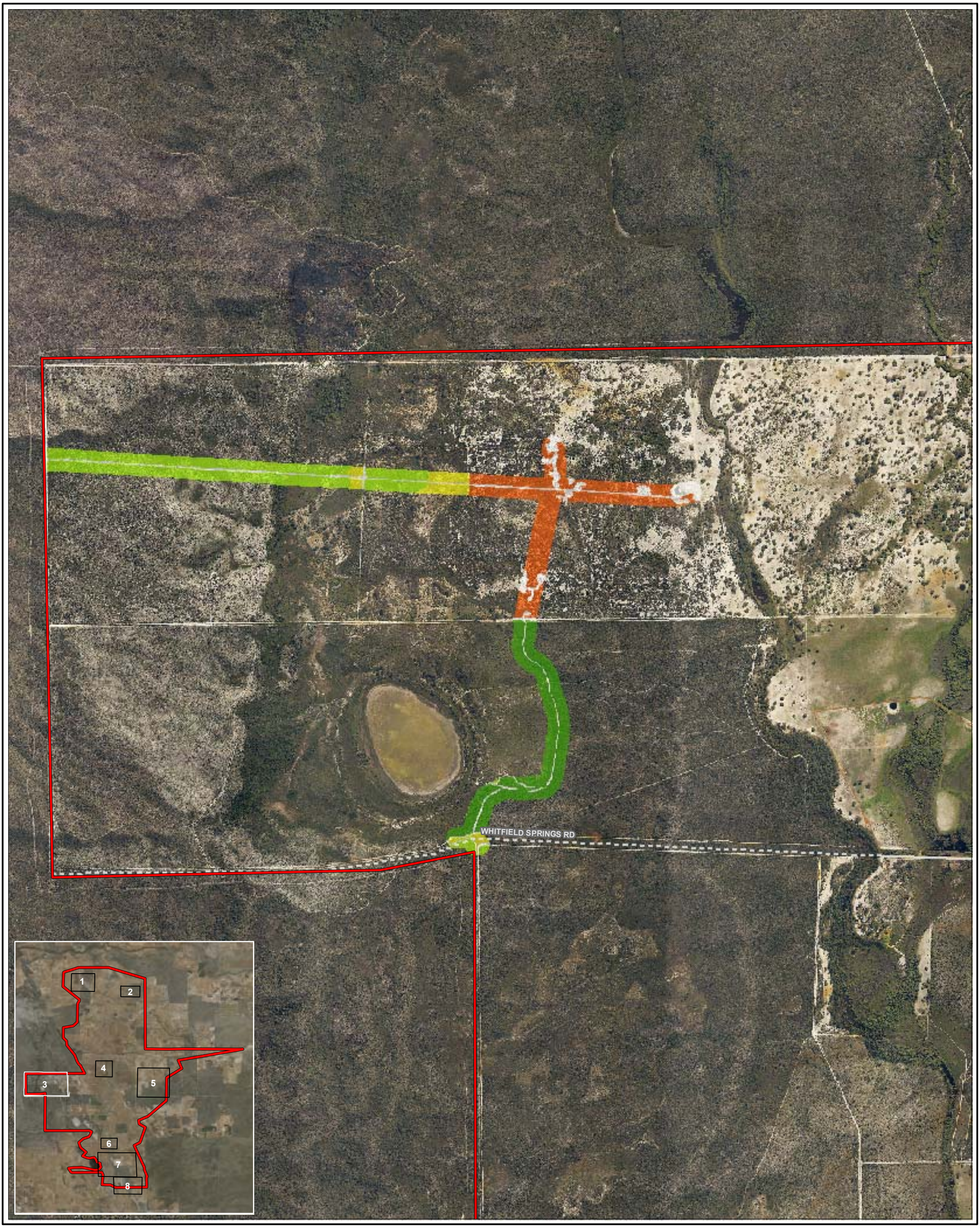
0 200
Metres

VEGETATION CONDITION MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 2 OF 8

Job No: 57789		Scale 1:6,700 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 2.19

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project Area
- Minor road
- Tracks

Vegetation condition
- Excellent
- Very good
- Good
- Degraded
- n/a

strategen JBS&G

0 200
Metres

Job No: 57789		Scale 1:15,400 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VVEGETATION CONDITION MAPPED WITHIN THE ECOLOGICAL SURVEY AREA
PAGE 3 OF 8

FIGURE: 2.20

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Threatened and Priority Ecological Communities

The EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community, was mapped in the Survey Area (refer Figure 2.26). 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 eight distinct patches. A total area of 67.3 ha was mapped during the Ecological Survey. This community extends beyond the Survey Area in large areas of contiguous vegetation (DBCA 2019) within the Proposal Area and surrounds. Average vegetation condition ranged from Good to Very Good-Excellent.

Of the total 67.3 ha mapped during the Ecological Survey, approximately 2.38 ha is expected to be cleared and is limited to trees with a diameter of <100 mm. This represents a much smaller percentage of that present within the Proposal Area and surrounds. Of that total native vegetation clearing, 2.27 ha is categorized as being in Good to Excellent condition. The clearing is not permanent and will be rehabilitated at the end of the Proposal as described in 2.4.

Legend:

- Project Aea
- Banksia Woodland

strategen JBS&G

0 2
Kilometres

BANKSIA WOODLAND MAPPED WITHIN THE ECOLOGICAL SURVEY AREA

Job No: 57624		Scale 1:80,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: hsullivan	Checked By: CT	Version: A	Date: 26-Jun-2020	**FIGURE: 2.26**

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_BanksiaWoodland.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

2.6.9 Fauna

A desktop assessment was initially conducted to determine conservation significant fauna with potential to occur within the Project area. From this, a likelihood assessment was undertaken based on habitat preferences, age and distance of know records, and known regional distribution.

2.6.9.1 Desktop Assessment

Database searches were undertaken to generate a list of conservation significant vertebrate fauna, previously recorded within, and nearby the Proposal Area are shown in Table 2.1 and 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 Proposal Area were also reviewed prior to the field assessment.

The likelihood of these species being present within the Proposal Area 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 Proposal Area due to the absence of suitable habitat, including a number of coastal and marine migratory birds.

Two conservation significant species retrieved from the database searches were considered as either likely to occur or have the potential to occur in the Proposal Area (Strategen-JBSG 2019):

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* (FRTBC); and
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (CBC).

This informed the decision to conduct a targeted Black Cockatoo habitat assessment within areas where clearing of native vegetation was proposed. The nature of the disturbance and the outcomes of the desktop assessment, indicated that it was unlikely that other species of conservation significant fauna would be subjected to significant impacts and therefore, further on-ground surveys were not required.

2.6.9.2 Field Survey

A targeted Black Cockatoo habitat assessment was undertaken by suitably qualified personnel in September and October 2019 in accordance with *EPBC Act Referral guidelines for three threatened black cockatoo species* (Strategen-JBSG 2019).

Black Cockatoo Habitat Assessment

The Survey Area includes approximately 127 ha of mapped Black Cockatoo foraging habitat, of which 3.33 ha will be disturbed. The Proposal Area ranges between poor quality and good quality with regard to Black Cockatoo foraging habitat quality (refer Figure 2.27, Table 2.7).

Vegetation will be removed via cutting and mulching, leaving root and seed stock intact. No breeding trees, i.e. significant trees, will be removed as a result of clearing. Clearing is limited to vegetation with a diameter of <100 mm. This temporary clearing is expected to begin to regenerate after the completion of the Proposal.

Table 2.7: Black Cockatoo Habitat Impacted by Clearing

Black Cockatoo Habitat	Area (ha)
Good	0.97
Moderate	2.34
Poor	0.02
Total	**3.33**

Legend:

- Project Area
- Black Cockatoo foraging

strategen JBS&G

0 2
Kilometres

Job No: 57624		Scale 1:80,000 at A4		**BLACK COCKATOO HABITAT MAPPED WITHIN THE ECOLOGICAL SURVEY AREA**
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: hsullivan	Checked By: CT	Version: A	Date: 26-Jun-2020	**FIGURE: 2.27**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_BCHabitat.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

2.7 National Parks and Reserves

Three DBCA managed lands occur within the Proposal Area (Figure 2.2; Table 2.8).

Table 2.8: DBCA Managed Lands within the Proposal Area

Type	Name	Identifier	Overview of Proposal Interaction
National Park	Moore River National Park	R 28462	Access via existing cleared track. No clearing required.
Nature Reserve	Moore River Nature Reserve	R 41830	Potential contingent line within reserve. No clearing required; existing cleared firebreak to be utilised.
Nature Reserve	Bartlett's Well 'A' Class Nature Reserve	R 1224	Access only. No clearing required.

No clearing or disturbance will be undertaken within National Parks or Nature Reserves.

Access will be sought into Bartlett's Well Nature Reserve for the purpose of planting receiver nodes only. Nodes will be 'walked in' and planted in areas of bare ground to ensure that there is no disturbance to native vegetation. Bartlett's Well Nature Reserve will be demarcated and uploaded into the GPS navigation system to ensure no access occurs other than on foot.

Acquisition is planned on Line MR19-BC15 for 1.66 km along the southern edge of the Moore River National Park. The line has been placed on an existing gravel road that is already cleared to ensure no clearing or disturbance occurs within the National Park.

Within the Moore River Nature Reserve, one contingent line (Line MR19-BC1012 for 4.25 km) is proposed on an existing cleared firebreak at the edge of the Reserve. This line will only be necessary if an adjacent overseas-based land-holder cannot be contacted for an access agreement. EP 440 (R1) overlies both of these Moore River managed lands. These areas will be clearly demarcated and uploaded into the GPS navigation system to ensure activity occurs only on the tracks identified and that no clearing or disturbance occurs.

ERL will ensure the required access permissions are obtained for entry into National Parks or Nature Reserves.

3. Land Use and Tenure

3.1 Location

Coordinates of the Proposal Area are provided in Table 3.1 projected in GDA94/MGA50.

Table 3.1: Proposal Area coordinates

Pt	Easting	Northing
1	384834	6545289
2	384902	6546375
3	384782	6546685
4	381898	6546613
5	381753	6546710
6	381534	6547110
7	382029	6547182
8	382838	6547226
9	384102	6546940
10	384416	6546975
11	384583	6547100
12	384645	6547193
13	384700	6547283
14	384653	6547433
15	384620	6547701
16	384331	6547805
17	384170	6548160
18	384041	6548345
19	383807	6548337
20	383604	6548252
21	383284	6548321
22	382889	6548530
23	383241	6548957
24	382719	6549438
25	382624	6549646
26	382509	6550048
27	382913	6550455
28	383498	6550716
29	383641	6550980
30	383746	6551274
31	383524	6551421
32	379176	6551357
33	379160	6555610
34	378741	6555529
35	377275	6555497
36	377228	6557816
37	382978	6557913
38	382559	6558832
39	382398	6558960
40	382220	6559299
41	382004	6559986
42	381202	6561099
43	381168	6561549
44	380846	6561935
45	380846	6563095
46	381812	6563288
47	382220	6563718
48	382199	6565801
49	382371	6566162
50	382368	6566290
51	380760	6567756
52	380805	6569356

Pt	Easting	Northing
53	380824	6569367
54	382285	6569925
55	385184	6569947
56	388782	6568744
57	388889	6560732
58	391140	6560742
59	392624	6560772
60	398417	6560812
61	398387	6560798
62	392143	6559497
63	392476	6558563
64	391016	6557489
65	391016	6554912
66	389233	6553108
67	388315	6552630
68	388369	6552211
69	388991	6551846
70	388476	6550149
71	388464	6550104
72	387918	6549765
73	388959	6547260
74	388938	6547035
75	389217	6546272
76	389163	6546057
77	389195	6545023
78	386156	6544973
79	385630	6545273
80	385286	6545263

The area defined as the 'Proposal Area' is the physical area used to conduct the Proposal, including the RGPF and camp facilities which will be used for accommodation and laydown. The acquisition area i.e. the area within which the seismic source will be generated to obtain data, occurs within the Proposal Area. The seismic source will not be activated outside of the Proposal Area or the interior seismic acquisition lines.

3.2 Land Use

Land use across the Proposal Area comprises:

- Unallocated Crown land – vacant open bush;
- Agriculture: cereal (wheat, oats, barley, lupins and canola); and
- Conservation estate including the Moore River National park and three Nature Reserves (Table 2.8).

The nearest townsites (with population greater than 500) include Lancelin to the west and Gingin to the south.

3.3 Land Tenure

The Proposal Area is located within freehold and crown allocated land as identified in Table 3.2.

Table 3.2: Land tenure within the Proposal Area

Property Identifier				
Lot	**Plan**		**Volume**	**Folio**
5431	DP	206482	1665	220
402	DP	65965	2768	534
22	DP	68417	2848	389
23	DP	68417	2848	390
501	P	13536	1644	769

Property Identifier				
5440	DP	206477	1333	52
1	P	9335	296	19A
5430	DP	206476	1773	326
2591	DP	138589	2062	907
829	DP	245872	1734	498
830	DP	245872	1734	705
200	DP	302098	1733	669
SWAN Location 192			MB29/259	
3125	DP	149549	2780	160
5918	DP	165282	2090	771
1	D	40630	423	51A
250	DP	56791	2676	966
5394	DP	206477	234	141A
5653	DP	206748	1259	706
104	DP	60851	2719	680
503	DP	59680	2708	973
32	DP	400196	2836	602
5439	DP	206477	26	19A
102	P	12595	1519	590
101	P	12595	1519	589
600	D	92150	2092	347
5382	DP	206477	2092	348
11	D	87243	2027	1000
2134	DP	119631	2128	809
2134	DP	119631	2128	809
12	D	92147	2090	770
31	DP	400196	2836	601
403	DP	71187	2773	765
2959	DP	143785	1363	596
2	P	9335	1761	387
10	D	87243	2027	999
501	DP	25041	2505	343
502	DP	25041	2505	344
5447	DP	206481	1942	508
5550	DP	206748	1325	631
404	DP	71187	2773	766
1758	DP	114095	1548	456
3119	DP	149547	1217	898
6894	DP	167390	405	165A
5381	DP	206476	69	97A
5495	DP	206476	40A	164A
63	DP	44984	2590	759
64	DP	44984	2590	760
2	D	31379	1885	230
201	DP	302098	1843	70
1	D	31379	1885	229
2726	DP	89951	1269	621
106	D	64468	1973	827
5448	DP	206481	1868	480
5432	DP	206482	1675	46
5432	DP	206482	2084	960
105	DP	60851	2719	681
502	DP	59680	LR3155	298
404	DP	68671	2754	532
5	P	13763	1592	547
104	P	12595	1931	422

ERL will ensure that land access and compensation agreements are in place with all owners and occupiers of private property within the Proposal Area prior to implementation of the Proposal.

Appropriate access permits will be sought from the Department of Biodiversity, Conservation and Attractions (DBCA) for entry into land within its control.

3.4 Native Title

The Proposal Area 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. ERL signed a Noongar Alternative Heritage Agreement (NAHA) over EP 389 (R4) in May 2020 with SWALSC on behalf of the Yued Agreement Group. A Heritage Agreement is in place for EP 440 (R1), L 18, and L 19.

3.5 Aboriginal Heritage

In Western Australia, the *Aboriginal Heritage Act 1972* (WA) (AH Act) protects Aboriginal sites defined under section 5 of the AH 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 AH Act.

A place search for Aboriginal heritage was conducted in October 2019 on the Department of Planning, Lands and Heritage (DPLH) database. Aboriginal heritage sites are shown on Figure 3.1.

There are three (3) registered Aboriginal heritage sites located within the Proposal Area, which have been assessed as meeting section 5 of the AH Act:

- Gingin Brook Waggyl Site (Site ID 20008, historical, mythological, camp, hunting place, plant resource, water source);
- Moore River Waugal (Site ID 20749, mythological); and
- Chandala Brook (Site ID 21620, mythological).

Two (2) places that overlap the Proposal Area have been assessed by the Aboriginal Cultural Heritage Material Committee as not meeting section 5 of the AH Act and are not Registered Sites under the AH Act:

- Red Gully Creek (Site ID 19183, mythological, plant resource); and
- Wetlands and Watercourses Moore River to Bullsbrook (Site ID 19138, mythological).

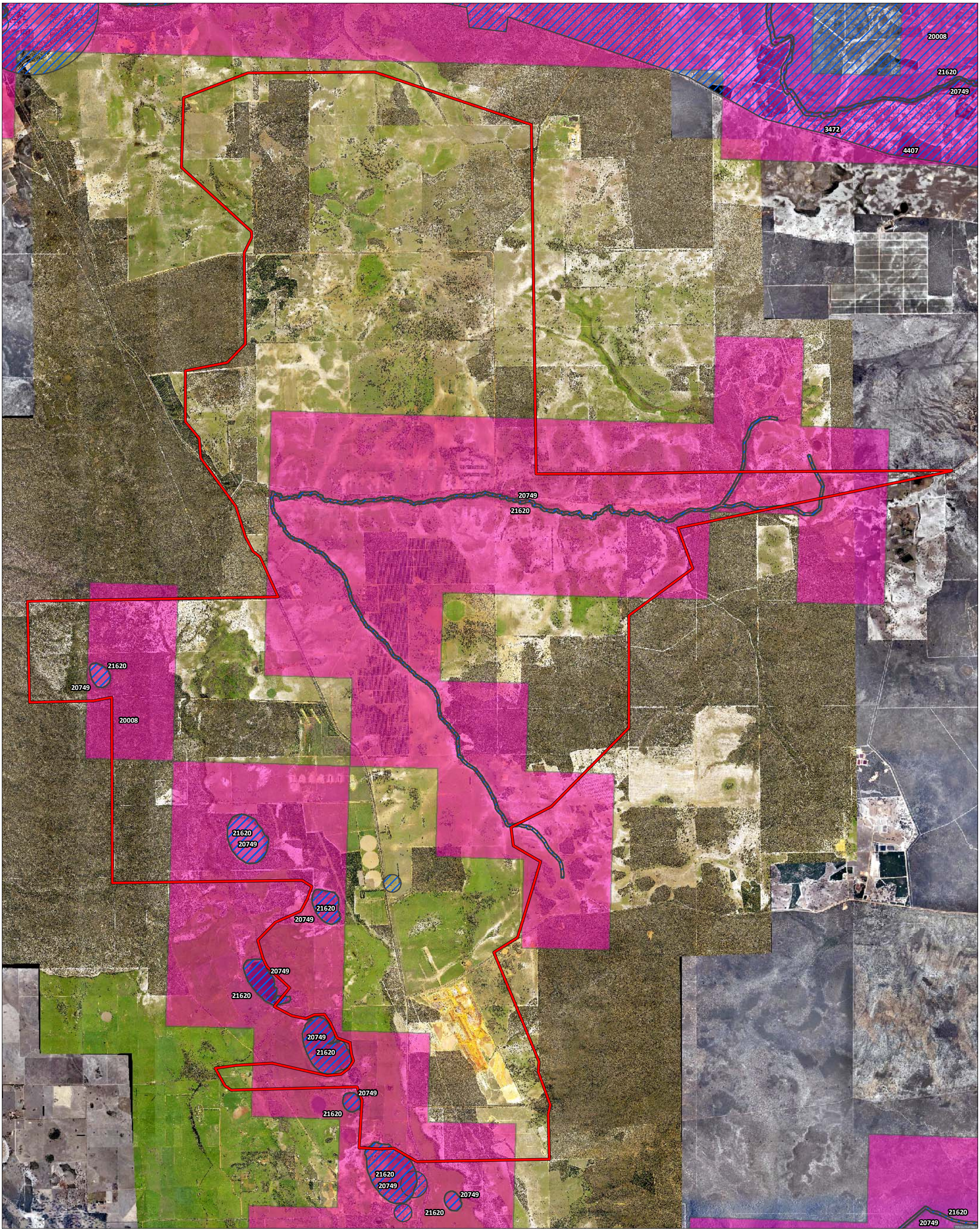
Furthermore, six (6) other places that overlap the Proposal Area have been lodged with the Department of Aboriginal Affairs (DAA) and are waiting assessment by the Aboriginal Cultural Heritage Material Committee under Section 5 of the AH Act:

- Mogumber/Moore River Native Settlement (Site ID 3409, camp, Other: Reserve);
- Lennard Brook (Site ID 20650, mythological, natural feature, water source, Other: Creek);
- Boonanarring Brook (Site ID 21616, Mythological);
- Wallering Brook (Site ID 21617, mythological);
- Nilila Brook (Site ID 21618, mythological); and
- Breera Brook (Site ID 21619, mythological).

Proposal activities will occur within the registered Aboriginal heritage sites located within the Proposal Area. ERL will have regard to the AH Act, the terms of its heritage agreements and the Aboriginal Heritage Due Diligence Guidelines issued by DPLH in conducting the Proposal:

- where using or maintaining existing tracks within the existing footprint, using established roads, walking on the ground and conducting scientific research using hand held tools, these activities associated with the Proposal will come within the scope of Minimal Impact Activities (as defined in the NAHA) such that an Activity Notice under the NAHA will not need to be issued;
- where clearing is needed, ERL will consider whether or not to issue an Activity Notice, taking into the matters referred to in cl 8.1(b) of the NAHA and the Due Diligence Guidelines. While it is not anticipated that Activity Notices will be required, if doubts arise, an Activity Notice will be issued;
- in the event ERL is conducting clearing activities and has made an assessment to not issue an Activity Notice after taking into the matters referred to in cl 8.1(b) of the NAHA and the Due Diligence Guidelines (e.g. because of the current use of the private land), ERL proposes to engage a heritage consultant (e.g. an archaeologist) to assist it on the ground in identifying and avoiding disturbance of any Aboriginal sites to ensure compliance with the AH Act; and
- ERL has been advised by SWALSC that a meeting with the Yued Working Group is not required prior to the conduct of the Proposal.

The registered anthropologist will survey the ground in front of the mulchers to ensure that the following Stop Work procedure is used in the event of the discovery of any artefacts.



Legend:

Project Area

Aboriginal Heritage Places (DAA-001)

Registered Site

Other Heritage Place

strategen JBS&G

0 2

Kilometres

ABORIGINAL HERITAGE SITES

Job No: 57624		Scale 1:80,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: hsullivan	Checked By: TS	Version: A	Date: 14-Jul-2020	**FIGURE: 3.1**

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

4. Other Approvals

The key environmental legislation applying to the Proposal are identified in Table 4.1.

Table 4.1: Other Approvals

Legislation	Requirement	Relevance to Proposal
Petroleum and Geothermal Energy Resources Act 1967 (WA) (PGER Act)	All onshore petroleum activities are regulated through the PGER Act.	The Project Area is within the following exploration permits held by ERL: 1. EP 440 (R1); and 2. EP 389 (R4). The Project Area is within the following Production Licenses held by ERL: 1. L 18; and 2. L 19. Petroleum and geothermal exploration and production activities undertaken throughout Western Australia are regulated by the Department of Mines, Industry Regulation and Safety (DMIRS) under the PGER Act which applies to all onshore areas. The Exploration Permits within which the surveys are proposed are administered by DMIRS under the PGER Act and regulated under PGER(E)R. Under these regulations, exploration proposals in state jurisdiction require the submission and approval of an Environment Plan (EP) and Oil Spill Contingency Plan (OSCP) from DMIRS. An EP is required to ensure that petroleum and geothermal activities are carried out in a manner consistent with the principles of ecologically sustainable development, and to provide a management tool to identify and manage potential risks and impacts associated with the activity. All activities are to be undertaken in accordance with an EP that has appropriate risk based environmental performance objectives and standards, and that provides criteria for determining whether the objectives and standards are met. OSCP(s) are Project specific plans outlining the response structure, strategy and associated information necessary to aid effective response in the event of a spill. OSCPs are an essential component of an EP which is to be incorporated into all relevant operating procedures and may be incorporated into the implementation strategy of an EP or submitted as a standalone document. An EP will be submitted to DMIRS for approval prior to undertaking the Proposal.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (WA)	Prescribe the conditions for clearing of native vegetation.	Unless the Proposal is formally assessed under Part IV of the EP Act, clearing of native vegetation needed for the Project will require a Native Vegetation Clearing Permit. Given the Project Area is located in the Swan Coastal Plain, no exemptions apply. DWER has delegated powers, under the Clearing Regulations, to DMIRS for clearing activities within mining and related tenements and under exploration permits. The clearing of native vegetation will be assessed against the 10 clearing principles: Native vegetation should not be cleared if – (a) it comprises a high level of biological diversity; or (b) it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia; or (c) it includes, or is necessary for the continued existence of, rare flora; or (d) it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community; or (e) it is significant as a remnant of native vegetation in an area that has been extensively cleared; or

Legislation	Requirement	Relevance to Proposal
		(f) it is growing in, or in association with, an environment associated with a watercourse or wetland; or (g) the clearing of the vegetation is likely to cause appreciable land degradation; or (h) the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area; or (i) the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or (j) the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding. ERL is of the view that the clearing of native vegetation can be adequately regulated through the NVCP process.
Biodiversity Conservation Act 2016 (WA) and *Biodiversity Conservation Regulations 2018*	An Act to provide for: • The conservation and protection of biodiversity and biodiversity • components in Western Australia; and • The ecologically sustainable use of biodiversity components in Western Australia; and • The repeal of the Wildlife Conservation Act 1950 and the Sandalwood Act 1929; and • Consequential amendments to other Acts, and for related purposes.	Assessment of potential impacts to listed conservation significant flora or fauna species has been considered in this referral supporting document. Refer to Table 7.1 and Table 7.4.
Conservation and Land Management Act 1984 (WA)	To make better provision for the use, protection and management of certain public lands, waters and flora and fauna and to establish authorities to be responsible for them.	Moore River National Park and Nature Reserve and Bartlett's Well Nature Reserves are located in the Project Area. No clearing is proposed within these areas. Refer to Section 2.7.
Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act)	The Act is the primary Commonwealth legislation directed to protecting the environment in relation to Commonwealth land and controlling significant impacts on matters of national environmental significance. The Act requires assessment and approval of actions that are likely to have a significant impact on a matter of national	Impacts on MNES have been identified and considered in this document. Refer to Section 9.

Legislation	Requirement	Relevance to Proposal
	environmental significance or are undertaken by a Commonwealth agency or involve Commonwealth land and will have a significant impact on the environment. The EPBC Act also protects a range of shorebirds listed under the JAMBA and CAMBA Migratory Bird Agreements.	

5. Stakeholder Engagement

5.1 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.

5.2 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 Proposal Area;
- 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.

5.3 Key Stakeholders

The following key stakeholder groups have been identified:

- Department of Mines, Industry Regulation and Safety (DMIRS);
- 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 Gingin and community stakeholders;
- Land owners;

- Image Resources;
- APA Group (Parmelia Pipeline);
- Dampier to Bunbury Natural Gas Pipeline;
- Western Power; and
- SWALSC - the native title representative body for the Yued and Whadjuk People registered Native Title Claim area.

6. 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 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 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 EP Act principles of environmental protection in relation to the Proposal is shown in Table 6.1.

Table 6.1: Environmental Protection Principles

Principle	Consideration
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: • careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and • 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 (refer to Section 2.4.1). 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.

Principle	Consideration
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: • seismic lines have been aligned using existing roads, tracks and disturbed areas to minimise clearing; • where required clearing has been minimised by reducing the access track width to the extent possible (3.5m) whist achieving data level and quality requirements; • seismic lines have been realigned to avoid sensitive environmental features; and • clearing of trees with a diameter of 100 mm or more has been avoided.
4. Principles Relating to Improved Valuation, Pricing and Incentive Mechanisms Environmental factors should be included in the valuation of assets and services. The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. 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.

7. Assessment of Preliminary Key Environmental Factors

7.1 Flora and Vegetation

7.1.1 EPA Objective

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

Table 7.1: 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 2016a)
	
	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 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 2016b)
	
	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 5.

	Potential Environmental Impacts
Receiving environment – Describe the current condition of the receiving environment in relation to this factor.	The receiving environment in the Proposal Area 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, 2019). **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 Plain 2 (SWA2) IBRA region. Vegetation systems as mapped by Beard that may be present within the proposed areas to be cleared as a result of the Proposal are listed in Table 7.2:

Table 7.2: Beard (1981) vegetation associations within the Ecological Survey Area

Vegetation Association	Description	Percent remaining in IBRA Region
37	Shrublands; teatree thicket	34.61
125	Bare areas; salt lakes	20.76
949	Low woodland; banksia	57.28
1008	Medium open woodland; marri	24.81
1014	Mosaic: Low woodland; banksia / Shrublands; teatree thicket	55.49
1015	Mosaic: Mixed scrub-heath / Shrublands; dryandra thicket	33.95
1016	Mosaic: Low woodland; banksia / Shrublands; dryandra heath	26.99
1017	Medium open woodland; jarrah & marri, with low woodland; banksia	44.39
1027	Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia / Medium sparse woodland; jarrah & marri	59.11
1030	Low woodland; Banksia attenuata & B. menziesii	63.81

With the exception of Vegetation Association 125, 1008 and 1016, the vegetation associations to be impacted exist at > 30% of their original extent.

Based on regional vegetation mapping undertaken by Heddle et al. 1980, the Proposal Area comprises 13 vegetation complexes (Table 2.7).

With the exception of the Bootine Complex, the vegetation complexes to be impacted exist at > 30% of their original extent. The current extent of the Bootine Complex remaining is 16.01 % and the impact of vegetation clearing as a result of the Proposal represents a loss of <0.005% of this Complex. The

	Potential Environmental Impacts
	clearing is estimated to impact on <0.05% on each of the vegetation complexes within the overall Proposal Area, with this impact limited to small areas of localised clearing within eight separate remnant patches. The 2019 Ecological Survey identified that the Project Area shows signs of having been degraded for a long period of time. Most of the area consists of already cleared paddocks. Within the remaining native vegetation, historical disturbance from recreational vehicle use and partial clearing, and weed invasion are the two most prominent disturbances. As such, vegetation condition within the Project Area ranges from Very Good to Completely Degraded. The majority of the vegetated areas within the Ecological Survey Area were found to be in Excellent to Very Good condition (60.6%). **Threatened and Priority Ecological Communities** Only the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community and Priority 3 BC Act listed PEC was mapped in the Survey Area. This TEC is listed as Endangered under the EPBC Act and as a P3 PEC at the state level. This listing is not subject to condition criteria. *Banksia Woodlands of the Swan Coastal Plain TEC* An analysis of the ecological survey (Strategen-JBS&G 2019) quadrat data was undertaken to determine the extent of the Banksia Woodlands of the Swan Coastal Plain TEC (Table 2.4). 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). Thirteen quadrats were included in the assessment, as they are likely to meet the criteria. The remaining quadrats were not assessed as they did not contain Banksia species, and as such, are not part of the ecological community. All 13 quadrats met the key diagnostic criteria for the Banksia Woodlands of the Swan Coastal Plain ecological community. These quadrats aligned with vegetation type VT1, VT4, VT5, and VT6 within the Ecological Survey Area across eight separate patches (Figure 2.26), representing a total area within the Ecological Survey Area of 67.3 ha. Of these patches, none are fully confined to the Ecological Survey Area, with vegetation adjacent being considered part of each patch. Average vegetation condition ranged from Good to Very Good-Excellent. Some areas within these patches recorded vegetation condition of Degraded or Completely Degraded in that they retained the upper canopy of Banksia species, characteristic of the community, but retained little understorey. *Banksia Woodlands of the Swan Coastal Plain PEC* 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. Given this, there is a total area of 67.3 ha within the Ecological Survey Area. **Conservation significant flora** A total of 151 native vascular plant taxa from 37 plant families and 93 genera were recorded within the Proposal Area. The desktop assessment identified seven (7) Threatened flora and 49 Priority flora species that have been recorded in the local area. Of these, based on general habitat requirements, three (3) Threatened and 40 Priority flora species were considered to have potential to occur within the Ecological Survey Area.

	Potential Environmental Impacts
	As a result of the targeted searches undertaken within the Ecological Survey Area, all identified conservation species are considered unlikely to occur within the areas of native vegetation that are proposed to be cleared as a result of the Proposal (3.33 ha required to be cleared plus contingency of 0.4 ha). The field survey was conducted during the main flowering season for flora of the southwest botanical region (i.e. Spring), including the Threatened and Priority species with potential to occur in the Proposal Area. This is the optimal time to detect the majority of species present and on this basis, the conservation significant flora species with potential to occur within the Proposal Area, are considered unlikely to occur within the Ecological Survey Area, and therefore areas impacted by clearing. No records of Threatened or Priority flora as listed under section 178 of the EPBC Act or section 19(1) of the BC Act were recorded within the Ecological Survey Area. This was confirmed by targeted flora surveys conducted within all vegetation with the potential to be impacted. **Weeds** Nine introduced (exotic) taxa were recorded within the Ecological Survey Area, as follows: • *Aira caryophyllea;* • *Arctotheca calendula;* • *Briza maxima;* • *Ehrharta calycina;* • *Ehrharta longiflora;* • *Gladiolus caryophyllaceus;* • *Hypochaeris glabra;* • *Ursinia anthemoides;* and • *Wahlenbergia capensis*. 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 (DPIRD 2017).
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: • Loss of vegetation from cutting and mulching along selected seismic survey lines; • Degradation of native vegetation from contamination which may result from spills or accidental releases; • Traversing of seismic lines by survey vehicles (light vehicles, vibroseis trucks); • Unauthorised access to areas previously inaccessible and associated damage to flora and vegetation and fauna; • Unauthorised clearing in areas outside the planned seismic survey lines; • Unauthorised access and clearing in conservation areas during the implementation of the Proposal; and • 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 at the RGPF within the Proposal Area.

	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 resulting from the Proposal are: • Disturbance to up to 3.73 ha of native vegetation (3.33 ha plus a 0.4 ha contingency area); • Unauthorised clearing of threatened or Priority flora; • Clearing of 2.38 ha of Banksia Woodland Commonwealth Listed TEC and State-listed PEC (as present within VT1, VT4, VT5 and VT6); and • Loss of habitat that supports Black Cockatoo. **Indirect Impacts** Potential indirect impacts that may occur from implementation of the Proposal on flora and vegetation include: • Contamination from waste and possible spills/leakage from fuels, chemicals and hydrocarbons required for the Proposal; • Weeds and other pathogens introduced on vehicles and by site staff activities; and • Dust – smothering of vegetation. **Cumulative Impacts** • Further 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) 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 3.73 ha of native vegetation (including a contingency of 0.4 ha) to provide access for light vehicles to lay nodes and the subsequent seismic survey which will be completed by vibroseis trucks;
Based on a 3.5 m wide clearing footprint, the clearing estimates for each vegetation type identified across the site in 2019 are presented in the following table:

Table 7.3: Vegetation clearing per vegetation types
<table>
<tr><th>Vegetation Type</th><th>Area of Impact (ha)</th></tr>
<tr><td>1</td><td>0.16</td></tr>
<tr><td>2</td><td>0.22</td></tr>
<tr><td>3</td><td>0.11</td></tr>
<tr><td>4</td><td>0.71</td></tr>
<tr><td>5</td><td>0.26</td></tr>
<tr><td>6</td><td>1.61</td></tr>
<tr><td>7</td><td>0.24</td></tr>
<tr><td>8</td><td>0.02</td></tr>
<tr><td>Cleared Areas</td><td>N/A</td></tr>
<tr><td>Rehabilitation</td><td>N/A</td></tr>
<tr><td>Total</td><td>3.33</td></tr>
</table>

Impact to 2.38 ha of Banksia Woodland PEC (EPBC TEC) as represented by VT1, VT4, VT5 and VT6 of 67.3 ha of mapped TEC within the Ecological Survey Area. The Ecological Survey Area covered 0.03% of the total of 8,447 ha of native vegetation in the Proposal Area.

It is considered that residual impacts which may be experienced as a result of the Proposal will be localised and temporary. No long lasting residual impacts are anticipated 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>
<tr><td>Mitigation – Describe the measures proposed to manage and mitigate the potential environmental impacts.</td><td>
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 have been minimised. Seismic surveys are inherently flexible, and the survey lines may be adjusted from the nominally mapped alignments by up to 50 m without impacting the definition in results.

The steps outlined below were implemented to ensure the final seismic plan results in the lowest environmental impact:

High level review of existing aerial imagery to ensure, where possible:

avoidance of areas of native vegetation; and
use of existing cleared tracks;

</td></tr>
</table>

	Potential Environmental Impacts
	• 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. All acquisition lines that would have needed clearing and traversed conservation areas and surface water bodies or drainage lines were removed through this review stage; • Consultation with private landholders to identify culturally or economically sensitive areas to avoid; • 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; and • On ground site survey in Spring 2019 to identify, delineate and deviate around flora populations or individual listed species and communities, significant trees and any trees with a trunk diameter greater than 100 mm and riparian zones for surface water bodies. All of these features have been avoided through line deviation or truncation and are reflected in the final line alignment. **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 swing hammer mulchers; • Where seismic lines are altered, impact on native vegetation and are outside the ecological survey corridor, a pre-clearance survey will be undertaken to ensure that the extent and nature of the potential impacts described in this supporting document are not changed (i.e. the mitigation and avoidance measures will be applied to any changed lines); • Mulching 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 o 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 will reduce the potential spread of weeds and plant pathogens, including: o All vehicles to be cleaned (brushed down) prior to mobilisation to site and all cleaning activities to recorded in register/log; o Vehicles, machinery and footwear to be clean on entry prior to entering area of native vegetation; and o Avoidance of work during wet soil conditions; • Avoidance areas (including Nature Reserves) 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 within areas of native vegetation have been restricted to 3.5 m; • Trees of diameter >100mm will be retained;

	Potential Environmental Impacts
	• Seismic survey will 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 concealed at road and tracks crossings, weaved smoothly around sensitive areas; • Restriction of all vehicle movements to created access tracks, existing tracks and gazetted roads; • Speed of vehicles when off road to be reduced to 40 km/hr or less to minimise the risk of dust generation; • All Proposal tracks and access lanes will be closed and rehabilitated as soon as possible after completion of the survey works, or returned to a condition as outlined in landowner access agreements; and • The risk of spills and impacts from any spills that may occur will be reduced and managed through implementation of the Oil Spill Contingency Plan (OSCP) approved by DMIRS.
Predicted Outcome – Describe the predicted outcome against the environmental objective.	The following outcomes are predicted: • The Proposal will impact on up to 3.78 ha of native vegetation; • No impacts to Threatened or Priority listed species; and • Minimal clearing (2.38 ha) of State listed PEC Banksia Woodland that is widely represented within the Proposal Area (8,447 ha) and outside the Proposal area. 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 communities and threatened species have been avoided or reduced to the extent possible. Vegetation clearing requirements to facilitate the Proposal have been minimised to the lowest possible extent and impacted vegetation is expected to recover naturally, or returned to a condition as outlined in landowner access agreements. 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.

7.3 Terrestrial Fauna

7.3.1 EPA Objective

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

Table 7.4: 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 5.</td></tr>
<tr><td>Receiving environment – Describe the current condition of the receiving environment in relation to this factor.</td><td>
Results of the databases searches identified a total of 25 listed vertebrate species were identified during the desktop review of the database searches. These were comprised of one (1) reptile, 17 birds, and seven (7) mammals.

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

Based on this, four conservation significant species were considered as either likely to occur or have the potential to occur in the Proposal Area (Table 7.5).

Table 7.5: Conservation significant fauna potentially occurring in the Proposal Area
<table>
<tr><th>Species</th><th>Common Name</th><th>Conservation Status</th><th>Likelihood</th></tr>
<tr><td colspan="4">Birds</td></tr>
<tr><td>Calyptorhynchus banksii naso</td><td>Forest Red-tailed Black-Cockatoo</td><td>VU</td><td>Likely</td></tr>
<tr><td>Calyptorhynchus latirostris</td><td>Carnaby’s Black Cockatoo</td><td>EN</td><td>Observed</td></tr>
</table>
EN = Listed as Endangered under the EBPC Act and BC Act, VU = Listed as Vulnerable under the EBPC Act and BC Act.

Carnaby’s Black Cockatoo (CBC) was recorded (actively foraging) during the 2019 Ecological Survey. Forest Red-tailed Black-Cockatoo (FRTBC) is considered likely to occur given the presence of suitable habitat that was identified during the Ecological Survey.

Approximately 127 ha of Black Cockatoo foraging habitat was recorded within the Ecological Survey Area during the 2019 survey (Strategen-JBS&G). Foraging species primarily comprised Jarrah, Tuart, Banksia attenuata, Banksii menziesii and Xanthorrhoea preissii. The vegetation in the Ecological Survey Area ranges between poor quality (VT5) and good quality (VT4) with regard to CBC and FRTBC foraging habitat quality. The highest quality habitat was present in areas of Banksia woodland (VT1, VT4, VT5, and VT6) where multiple species used for foraging were present in two or more strata.

These VTs and habitat are not confined to the Ecological Survey Area or larger Proposal Area. Suitable foraging habitat for both species of Black Cockatoo is known to occur throughout the region.

Habitat foraging quality of each vegetation type is shown in Table 7.7 and was determined using the scale described in Table 7.6. The area of each vegetation type to be impacted by clearing is shown in Table 7.8, with the total area of clearing impact being 3.33 ha, of which 0.97 ha is in good or
</td></tr>
</table>

better quality condition. This impact area represents a small portion of the area mapped within the Survey Area and an even smaller proportion of that present within the Proposal Area (8 447 ha of native vegetation within the Proposal Area) and surrounds.

Table 7.6: Black Cockatoo Foraging Habitat Quality Definitions

Foraging Quality	Justification
Excellent	High density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species >60%) and presence of food sources at several strata (i.e. canopy, midstorey and understorey).
Good	High density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (i.e. canopy and midstorey).
Poor	Low density of species suitable for foraging by Black Cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (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.

Table 7.7: Vegetation Types and Black Cockatoo Foraging Species within the Ecological Survey Area

Vegetation Type	Black Cockatoo Foraging Species	Foraging Quality	Area (ha)
VT1	CBC – *Banksia attenuata, Banksia menziesii, Eucalyptus todtiana, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	3.3
VT2	CBC – *Banksia prionotes, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	5.5
VT3	CBC – *Banksia prionotes, Eucalyptus todtiana, Hakea lissocarpha, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	4.7
VT4	CBC – *Banksia attenuata, Banksia dallanneyi, Banksia menziesii, Eucalyptus todtiana, Xanthorrhoea preissii* FRTBC, Nil	• Good (CBC) • Nil (FRTBC)	25.3
VT5	CBC – *Banksia dallanneyi, Corymbia calophylla, Hakea incrassata, Hakea ruscifolia, Hakea trifurcata, Xanthorrhoea preissii* FRTBC, *Corymbia calophylla*	• Good (CBC) • Poor (FRTBC)	4.4
VT6	CBC – *Banksia attenuata, Banksia ilicifolia, Banksia menziesii, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	47.7
VT7	CBC – *Banksia hookeriana, Banksia ilicifolia, Eucalyptus todtiana, Hakea psilorrhyncha, Xanthorrhoea preissii*	• Moderate (CBC) • Nil (FRTBC)	22.9

	Potential Environmental Impacts

	FRTBC, Nil		
VT8	CBC – *Banksia littoralis, Xanthorrhoea preissii* FRTBC, Ni	• Poor (CBC) • Nil (FRTBC)	13.6
Cleared	CBC – Nil FRTBC, Nil	• Nil	1.1

Note: Vegetation rated as Completely Degraded is not included in area calculation.

Table 7.8: Black Cockatoo Habitat Impacted

Black Cockatoo Habitat	Area (ha)
Good	0.97
Moderate	2.34
Poor	0.02
Total	**3.33**

Proposal activities – Describe the proposal activities that have the potential to impact the environment.

Proposal activities which have the potential to impact on terrestrial fauna include:

- Degradation or loss of fauna habitat from clearing and mulching of vegetation to create access lanes;
- Degradation of fauna habitat from contamination which may result from spills or accidental releases;
- Fauna strike from vehicle movements including equipment mobilisation, seismic line survey, seismic survey works (vibroseis truck use) and demobilisation on completion of the work; and
- Noise and vibrations from vehicles.

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 as a result of the Proposal include:

- Injury or mortality due to vehicle strike during implementation of the Proposal;
- Disturbance or displacement as a result of noise and vibration from all machinery and vehicles; and
- Loss or degradation of habitat, including habitat for conservation significant fauna;

Indirect Impacts

Potential indirect impacts as a result of the Proposal include:

- Degradation of habitat due to spread of weeds or dieback, contamination from spills or accidental releases or as a result of erosion along access tracks leading to degradation of adjacent areas; and
- Waste materials which may attract native fauna to operational areas.

	Potential Environmental Impacts
	Cumulative Impacts • Reduction (localised) in habitat for conservation significant fauna/listed threatened species that adds to the cumulative impact across the region.
Impacts – Assess the impacts of the proposal and review the residual impacts against the EPA objective.	Approximately 127 ha of foraging habitat for the CBC and FRBC has been recorded with Proposal Area of which up to 3.33 ha will be disturbed as a result of the Proposal, 0.97 ha of which is in good or better condition. Significant trees (i.e. trees with a trunk diameter of > 100 mm) will be retained ensuring overstorey habitat remains and reducing the extent of habitat loss within the 3.33 ha area of purposed clearing. 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 fauna species.
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 seismic survey. **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 have been minimised. Seismic surveys are inherently flexible, and the survey lines may be adjusted from the nominally mapped alignments by up to 50 m without impacting the definition in results. A detailed process of planning and review was undertaken to ensure the final seismic plan results in the lowest environmental impact (refer to Table 7.1). **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 swing hammer mulchers; • Where seismic lines are altered, impact on native vegetation and are outside the ecological survey corridor, a pre-clearance survey will be undertaken to ensure that the extent and nature of the potential impacts described in this supporting document are not changed (i.e. the mitigation and avoidance measures will be applied to any changed lines); • Method of clearing is designed to minimise impacts to native vegetation and risks of erosion as well as facilitate recovery of native vegetation (and fauna habitat) following completion of the survey (refer to Table 7.1); • Restriction of the number of vehicle passes per survey line to minimise traffic movements within the Proposal Area; • Implementation of strict hygiene to reduce the potential spread of weeds and plant pathogens (refer to Table 7.1); • Access line clearing width within areas of native vegetation have been restricted to 3.5 m; • Trees of diameter >100mm will be retained; • Restriction of all vehicle movements to created access tracks, existing tracks and gazetted roads; • Speed of vehicles when off road to be reduced to 40 km/hr or less to minimise risk of fauna strike; • All created access lanes will be closed and rehabilitated as soon as possible after completion of the Proposal, or returned to a condition as outlined in landowner access agreements; and • The risk of spills and impacts from any spills that may occur will be reduced and managed through implementation of the Oil Spill Contingency Plan (OSCP) approved by DMIRS;

	Potential Environmental Impacts
Predicted Outcome – Describe the predicted outcome against the environmental objective.	The Proposal will have a temporary impact on 3.33 ha of habitat that may support two listed threatened species which are likely to occur within the Proposal Area. 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 listed species has been avoided, reduced or minimised. The residual impacts of the Proposal on fauna is not considered to be significant and 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.

7.4 Inland Waters

7.4.1 EPA Objective

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

Table 7.9: 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 5.

	Potential Environmental Impacts
Receiving environment – Describe the current condition of the receiving environment in relation to this factor.	**Surface Water** The Proposal is located within the Swan Coastal Plain geomorphologic division of the Western Australia and specifically on the border of two hydrographic catchments; the Gingin Brook sub-catchment of the Moore River hydrographic catchment and the Brockman River sub catchment of the Swan-Avon hydrographic catchment. The Gingin Brook sub-catchment is fed by run-off from the Dandaragan Plateau from which numerous groundwater supplied brooks originate, such as Gingin Brook, Boonanarring Brook and Red Gully Creek. The base of the Gingin Scarp is characterised by a low lying and poorly drained plain and includes a series of lakes and inundated areas such Beermullah and White Lakes, located south-west of the Proposal Area. The Brockman River is fed by the Wannamal Lake systems and multiple seasonal creeks. The Brockman River runs south along the western edge of the Darling Scarp, through the Chittering Valley and flows into the lower Avon River. The surface water drainage patterns near the Proposal Area are generally towards the west, reflecting the general slope of the landscape. Proposal activities will not impact on surface waters. Mapping of the geomorphic wetlands of the Swan Coastal Plain indicates a number of wetlands are present within the Proposal Area; 137 Conservation Category Wetlands (CCW), 40 Resource Enhancement Wetlands (REW) and 40 Multiple Use Wetlands (MUW). **Groundwater** The Proposal Area is underlain by a series of main groundwater resources: superficial, Leederville, Parmelia-Leederville and Yarragadee aquifers. In addition, there are three secondary aquifers: Mirrabooka, Cattamarra and Eneabba-Lesueur. Hydraulic connection between aquifers is often impeded across faults and low permeability units, both within and between aquifers (DoW 2017). Groundwater is contained within superficial aquifers including the Leederville aquifer west of the Proposal Area, the Leederville – Parmelia aquifer east of the Proposal Area and the Yarragadee aquifer on the coastal plain and the Dandaragan Land System (DoW 2017). Groundwater is understood to be fairly shallow with a depth of <20 m bgl and the groundwater quality in the general area is understood to be marginal (as per Perth Groundwater map), with a salinity of 500 – 1000 mg/L (Perth groundwater map, DWER). The Leederville aquifer comprises sandstones and shales with a thickness of up to 550 metres. The aquifer is semi-confined to confined with a generally fresh groundwater quality. The Leederville – Parmelia aquifer consists of the interconnected Leederville formation and the Parmelia Group, comprising sandstone and shale. The aquifer is semi-confined to the north becoming confined to the south with generally fresh groundwater quality. The Yarragadee Formation comprises sand, shale and siltstone and is up to 2000 metres deep. The aquifer is unconfined to confined with generally fresh groundwater quality, but high groundwater salinity exists along the Darling Fault, located approximately 20 kilometres east of the Proposal Area. The Proposal Area is situated within the Gingin proclaimed groundwater area (DoW - Gingin groundwater allocation plan 2013).
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: • Contamination from spills or leaks from the operation and servicing of vehicles; and • Clearing of native vegetation to allow vehicle access.

	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** There are no planned direct impacts to surface water or groundwater as a result of the Proposal. **Indirect Impacts** Potential indirect impacts that may be experienced are • Contamination of surface water and groundwater through leakage from vehicles, stored fuels, chemicals and hydrocarbons; • Contamination of surface water and groundwater from storage and handling of waste materials – general waste; and • Disturbance of surface water flows by track construction/clearing. **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 Proposal Area is approximately 205 km^2. The Proposal will require the temporary disturbance of up to 3.73 ha of 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. There is a risk that the use and storage of fuels to undertake the survey could result in contamination of surface or groundwater. However, groundwater levels in the Proposal Area are >10 m below ground and based on trajectory modelling and the spill response actions, migration of any contamination plume into groundwater is highly unlikely with appropriate response measures. Furthermore, given buffer distance of 100 m and vehicle movements buffer distance of 20 m applied to surface waters, there is no credible scenario where a direct discharge could occur to any surface waters located within the Project Area.

	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. A detailed process of planning and review was undertaken to ensure the final seismic plan results in the lowest environmental impact (refer to Table 7.1). **On ground Mitigation Measures** • Line planning has ensured that water courses and surface water bodies are avoided; • Where seismic lines are altered, impact on native vegetation and are outside the ecological survey corridor, a pre-clearance survey will be undertaken to ensure that the extent and nature of the potential impacts described in this supporting document are not changed (i.e. the mitigation and avoidance measures will be applied to any changed lines) No vehicle movements within 20 m of surface water features; • Access lanes are created in a manner that minimises the formation of road edges/windrows which may impact surface water flows during and after rainfall; • All Proposal tracks and access lanes to be closed and rehabilitated as soon as possible after completion of the survey works, or returned to a condition as outlined in landowner access agreements. 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; • Restriction of all vehicle movements to created access tracks, existing tracks and gazetted roads; • No more than 2000 L bulk fuel storage; • 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; • Refuelling will not be conducted within 100 m of surface water bodies; • Servicing and refuelling of vehicles to undertaken off site in laydown area where spill control equipment is available; • Spill kits available at RGPF and in all vehicles and drip trays, spill mats or equivalent are to be used while refuelling; and • The risk of spills and impacts from any spills that may occur will be reduced and managed through implementation of the Oil Spill Contingency Plan (OSCP).
Predicted Outcome – Describe the predicted outcome against the environmental objective.	It is considered that residual impacts which may be experienced as a result of the Proposal are limited. Surface water features have been avoided through the planning and design process, and no clearing or riparian vegetation will occur. There are no planned activities that could result in contamination of surface or groundwater and measures will be in place to minimise and appropriately respond to any incidences of spills or releases. 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.

7.5 Terrestrial Environmental Quality

7.5.1 EPA Objective

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

Table 7.10: 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 5.
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 Proposal Area 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.

	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 terrestrial environmental quality include: • 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** There are no planned direct impacts to soils as a result of the Proposal. **Indirect Impacts** Potential direct impacts that may occur as a result of the Proposal are: • Compaction of soils by survey vehicles and acquisition equipment – vibration plates or tyres; and • Contamination of soils by vehicle use, spills and leaks from hydrocarbon storage. **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 Proposal Area is approximately 225205 km^2. 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 are limited to very localised impacts associated with access track preparation works and the actual seismic survey. No long lasting residual impacts are anticipated.
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. A detailed process of planning and review was undertaken to ensure the final seismic plan results in the lowest environmental impact (refer to Table 7.1). **On ground Mitigation Measures** • Restriction of all vehicle movements to created access tracks, existing tracks and gazetted roads; • Where seismic lines are altered, impact on native vegetation and are outside the ecological survey corridor, a pre-clearance survey will be undertaken to ensure that the extent and nature of the potential impacts described in this supporting document are not changed (i.e. the mitigation and avoidance measures will be applied to any changed lines); • No more than 2000 L bulk fuel storage;

	Potential Environmental Impacts
	• 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; • Spill kits available at RGPF and in all vehicles and drip trays, spill mats or equivalent are to be used while refuelling; and • The risk of spills and impacts from any spills that may occur will be reduced and managed through implementation of the Oil Spill Contingency Plan (OSCP).
Predicted Outcome – Describe the predicted outcome against the environmental objective.	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 not consideration significant. 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.

8. 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 8.1.

Table 8.1: 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 of groundwater dewatering required (i.e. drilling). The Proposal will have an impact on subterranean fauna.
Social Surroundings	The nearest population to the Proposal Area is 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 Proposal Area is 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	There 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.

9. Matters of National Environmental Significance

9.1 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 DAWE. 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 "Proposal Area" in this section of the referral.

9.2 Proposal Area and Assessment

The Proposal Area will involve the temporary clearing of up to 3.73 ha of native vegetation of which:

- 2.38 ha is Banksia Woodland TEC; and
- 3.33 ha is Black Cockatoo foraging habitat.

Further information regarding the Proposal Area is presented in Section 2.

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

- Section 2.6.8: Vegetation;
- Section 2.6.9: Fauna; and
- Section 2.6.6: 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.

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.

9.3 Controlled Action Provisions

The Proposal Area is not considered to be significant with respect to the possible impact on MNES (DoE 2013). As a consequence, the Proposal Area is not being referred to DAWE for assessment.

The environmental values of the Proposal Area 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 Proposal Area 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 Proposal Area 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);
  - Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Endangered); and
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso)* (Vulnerable).

9.4 Listed Threatened Species and Communities

9.4.1 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 67.3 ha has been mapped during the Ecological Survey. The area mapped as part of the Ecological Survey was 153.2 ha of the total area of native vegetation present within the Proposal Area of 8 447 ha (the remaining 14 053 ha area comprises previously cleared land). The maximum area of impact to this TEC is 2.38 ha within the Proposal Area.

The results of an assessment completed with reference to the EPBC significance criteria are presented in Table 9.1.

Table 9.1: 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 VT1, VT4, VT5 and VT6 met the key diagnostic criteria for the Banksia Woodlands of the Swan Coastal Plain ecological community. Eight separate patches of the ecological community (Figure 2.26), have been identified representing a total area within the Proposal area of 67.3 ha. Of these patches, none are fully confined to the Ecological Survey Area, with vegetation adjacent being considered part of each patch. This community also extends outside of the broader Proposal Area. Average vegetation condition ranged from Good to Very Good-Excellent. Some areas within these patches recorded vegetation condition of Degraded or Completely Degraded where they retained the upper canopy of Banksia species, characteristic of the community, but retained little understorey. At a local context the Proposal occurs within the range of the TEC with extensive areas of potential TEC in the Proposal Area and surrounds. The Proposal will result in removal of up to 2.38 ha of the TEC.

Significance criteria	Response
	The Proposal will not significantly reduce the extent of the Banksia woodlands TEC, as 64.94 ha (96.5%) of the mapped Banksia Woodland TEC patch within the Ecological Survey Area will remain.
Will the action fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines?	The Proposal Area is unlikely to increase fragmentation of the TEC. The proposed clearing will result in removal of up to 2.38 ha of TEC, leaving 64.94 ha) of contiguous area of TEC to be retained in the Patch. The Proposal is unlikely to fragment patches of existing Banksia Woodland TEC due to the low impact nature of clearing associated with the proposed action, retention of trees with a trunk diameter greater than 100 mm and 3.5 m-wide tracks where native vegetation is cleared. Rehabilitation of the access lanes following completion of the proposed action will be undertaken with appropriate monitoring to ensure native vegetation along access lanes return to a composition and structure that is comparable to their pre-disturbance state.
Will the action adversely affect habitat critical to the survival of an ecological community?	The Proposal Area is not expected to adversely affect habitat critical to the survival of the TEC. The Proposal Area will directly impact no more than 2.38 ha of Banksia Woodland TEC. The Banksia Woodland TEC extends beyond the Ecological Survey Area and the broader Proposal Area. 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 Proposal is not expected to modify abiotic factors necessary for the survival of the TEC. The Proposal Area 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 Proposal 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, and the low impact nature of clearing (3.5 m wide access tracks) within the areas of native vegetation including the eight TEC patches identified by the Ecological Survey, 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 Proposal Area is not expected to result in a substantial reduction in the quality or integrity of Banksia Woodland TEC. The Proposal Area will incorporate mitigation measures that will minimise spread of weeds and dieback including weed treatment and hygiene. ERL will monitor rehabilitation of the Proposal Area following completion of the Proposal Area to ensure native vegetation along access lanes return to a composition and structure that is comparable to their pre-disturbance state.

Significance criteria	Response
Will the action interfere with the recovery of an ecological community?	It is not anticipated that the Proposal Area will impact or interfere in the recovery of the ecological community.

9.4.2 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 Proposal Area on Black Cockatoos have been broadly assessed against the Commonwealth Significant Impact Guidelines 1.1 (DoE 2013) (refer Table 9.2)

Table 9.2: Significant Impact Criteria for Black Cockatoos

Significance criteria	Response
Lead to a long-term decrease in the size of a population	The Proposal Area is not expected to lead to a long-term decrease in the size of CBC and FRTBC populations. CBC and FRTBC 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. The species of 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 CBC (good) and FRTBC (poor) foraging habitat was present in areas of Banksia woodland (VT5 for both species) where multiple species

Significance criteria	Response
	suitable for foraging were present in two or more strata. This vegetation is widespread locally. Based on a 3.5 m wide clearing footprint, clearing of Black Cockatoo foraging habitat is limited to 3.33 ha, of which 0.97 ha is considered good or better quality. The occurrence of suitable habitat extends to within the 8447 ha of native vegetation within the Proposal Area and also extends outside the Proposal Area. 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 Proposal Area is not expected to reduce the area of occupancy of Black Cockatoos. The Proposal Area is located within the mapped distribution of CBC (DSEWPaC, 2012; DoEE, 2017). The Proposal Area is located immediately to the north of the modelled distribution of the FRTBC (DSEWPaC 2012). There is approximately 127 ha of mapped potential foraging habitat within the Proposal Area which ranges between poor quality (VT5) and good quality (VT5) (Strategen-JBSG 2019). This vegetation is widespread locally and the removal of 3.33 ha of potential foraging habitat, of which only 0.97 ha is considered in good or better condition, is unlikely reduce the area of occupancy of the species.
Fragment an existing population into two or more populations	The Proposal Area is not expected to fragment populations of CBC and FRTBC. Both species are highly mobile, and as suitable foraging habitat is widespread locally outside of the Ecological Survey Area and the broader Proposal Area, the species is not likely to be dependent on a particular patch of foraging habitat within the Proposal Area. Carnaby's Black Cockatoo are expected to forage outside the Proposal Area amongst large patches of suitable foraging habitat within the local area. Based on a 3.5 m wide clearing footprint, 3.33 ha of low impact clearing for tracks created by the Proposal Area is unlikely to fragment an existing population into two or more populations. Rehabilitation will be undertaken following completion of the Proposal Area 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 Proposal Area is not expected to directly or indirectly impact habitat critical to the survival of the two Black Cockatoo species. CBC 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). FRTBC breed at a similar time of year generally in hollows in live or dead trees of marri, karri, wandoo, bullich (*E. megacarpa*), blackbutt (*E. patens*), tuart and jarrah located in woodland or forest and in areas of former woodland or forest now present as isolated trees. The Ecological Survey Area comprises 127 ha suitable foraging habitat. There was no evidence of nesting and/or breeding sites recorded during the Ecological Survey. The proposed seismic surveys will not clear any trees with a diameter greater than 100 mm. Suitable foraging and breeding habitat occur outside of the area to be impacted within the Proposal Area and 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 Proposal Area and to the north of the Proposal Area.

Significance criteria	Response
Disrupt the breeding cycle of a population	The Proposal Area is not expected to disrupt the breeding cycle of a population of CBC or FRTBC as no evidence of nesting and/or breeding was recorded during the ecological survey (Strategen-JBS&G 2019). The proposed seismic surveys will not clear any trees with a diameter greater than 100mm.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The Proposal Area is not expected to impact the availability or quality of habitat to the extent that CBC and/or FTRBC are likely to decline. The clearing of approximately 3.33 ha of potential habitat represents a 2.50 % reduction in potential foraging habitat for Carnaby's Black Cockatoos within the local area. The reduction in foraging habitat for the two species of Black Cockatoo may result in a minor residual impact associated with the Proposal Area, however it is 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 Proposal Area 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 Proposal Area is unlikely to introduce harmful or invasive species that reduce the extent or quality of suitable foraging habitat to the CBC and /or FTRBC within the Proposal Area and surrounds. Freehold farmland and existing roads (for example Marri Tree Road and Red Gully Road), together with introduction of vehicles, machinery material from external areas are the primary existing sources of weed propagules. The Proposal Area 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 Proposal Area 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 Proposal Area that may be spread by activities associated with the Proposal Area. The Proposal Area EP will include measures to manage dieback within the Proposal 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 (DPaW, 2013 and DEC, 2008) provide measures for the species recovery. These measures include identifying, protecting and managing important habitat. The Proposal Area is not inconsistent with the recovery plans for the CBC or FRTBC.

10. 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 Romanesque 3D Seismic Survey Ecological Assessment

Energy Resources

Black Cormorant and Romanesque Seismic Surveys
Flora, Vegetation and Black Cockatoo Survey

17 June 2020

57624/126824 (Rev 0)

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

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Appendix D Plant taxa recorded within the Survey Area

1. Introduction

Energy Resources Limited (ERL), a subsidiary of Minerals Resources Limited (MRL), is proposing to undertake a 2D (Black Cormorant) and 3D (Romanesque) onshore seismic acquisition survey in the Shire of Gingin in the mid-west region of Western Australia within exploration permit areas EP 440 R1 and EP 389 R3; and Production licence areas L 18 and L 19.

This report presents the findings of a Reconnaissance flora and vegetation survey, Desktop fauna survey, and targeted Black cockatoo habitat survey conducted during September and October 2019.

1.1 Background

Energy Resources has requested flora, vegetation, and fauna surveys to be conducted within the Black Cormorant and Romanesque seismic survey areas to support approvals to conduct seismic surveys exploration (the Project Area, Figure 1.1).

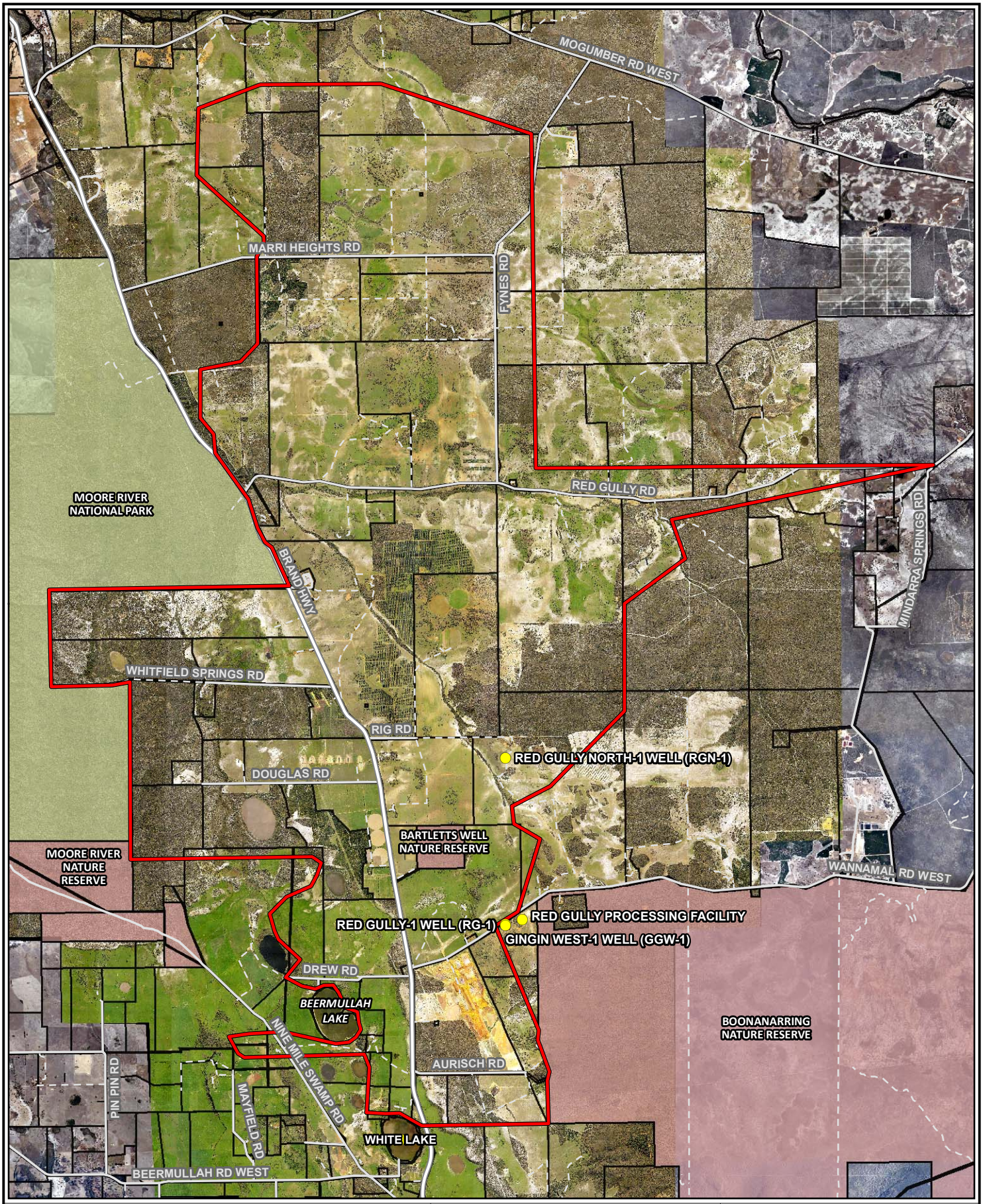
The proposed works may impact native vegetation and as such, a flora and vegetation survey, Desktop fauna survey, and targeted Black cockatoo habitat survey were deemed necessary to determine the environmental values within these areas of native vegetation (Survey Areas, Figure 1.2).

1.2 Scope

The scope of these surveys was to undertake a desktop assessment and field assessment within the Survey Areas.

The objectives were to:

- Undertake a flora and vegetation survey of areas of native vegetation within, and adjacent to, areas that may be impacted by clearing.
- Undertake a desktop fauna and targeted black cockatoo habitat survey of vegetation within, and adjacent to, areas that may be impacted by clearing.
- Prepare a biological survey report incorporating the results of the flora and vegetation, and fauna surveys.



Legend:

- Project Area
- Cadastral boundary

Legislated lands (DBCA)

- National Park
- Nature Reserve
- Major road
- Minor road
- Tracks
- Red Gully sites

Note: High resolution imagery within project area supplied by Energy Resources Limited; surrounding imagery supplied by SLIP Public Services

Scale 1:120,000 at A4

0 1 2 Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 57624

Client: Energy Resources Limited

Version: A | Date: 20-Aug-2020

Drawn By: cthatcher | Checked By: AL

Romanesque / Black Cormorant Seismic Survey

THE PROJECT AREA

FIGURE 1.1

strategen JBS&G

File Name: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\5789_03_ProjectArea.mxd
Image Reference: Energy Resources Limited

Legend:

- Project Area
- Ecological Survey Area

strategen JBS&G

0 2
Kilometers

ECOLOGICAL SURVEY AREAS

Job No: 57624		Scale 1:80,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: hsullivan	Checked By: TS	Version: A	Date: 14-Jul-2020	**FIGURE: 1.2**

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_SurveyAreas.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

2. Context

2.1 Legislative Context

Flora and fauna in WA are protected formally and informally by various legislative and non-legislative measures, which are as follows:

- *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:

- WA 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 given below. Other definitions, including species conservation categories, are provided in Appendix A.

2.1.1 Environmental 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 the Environment and Energy (DEE) lists protected species and Threatened Ecological Communities (TECs) by 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 so are not protected under the 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 as 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 Threatened Ecological Communities (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*. Exemptions for a clearing permit do not apply in an ESA.

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.

2.2 Environmental Setting

2.2.1 Soils and Topography

The Survey Area is located within the Swan Coastal Plain 1 (SWA01 – Dandaragan Plateau subregion) of Western Australia (Mitchell et 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 Survey Area is located within the Bassendean Dune, Pinjarra Plain, and Dandaragan Plateau landform units. The Dandaragan Plateau is comprised of lateritic deposits overlaying sedimentary bedrock, with alluvial transport of clayey sediment forming Pinjarra Plain located at the foothills of the Plateau. On the western side the Bassendean Dune formation is characterised by aeolian bedrock overlayed with siliceous sands (Smolinski & Scholz, 1997; McPherson & Jones, 2005).

2.2.2 Climate

The Wheatbelt 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 Gingin Aero station (station 009178), approximately 28km from the survey site. The average rainfall from 1996-2019 was 625.6mm with the highest monthly rainfall occurring from May to September (Figure 2.1). The wettest year on record was 1999, with an annual rainfall of 881.6mm, 627.8mm of which fell during the May to September period (BOM, 2019).

The average maximum temperatures range from 18.3°C in August to 31.1°C in January/February. The average minimum temperatures range from 6.4°C in July to 17°C in February.

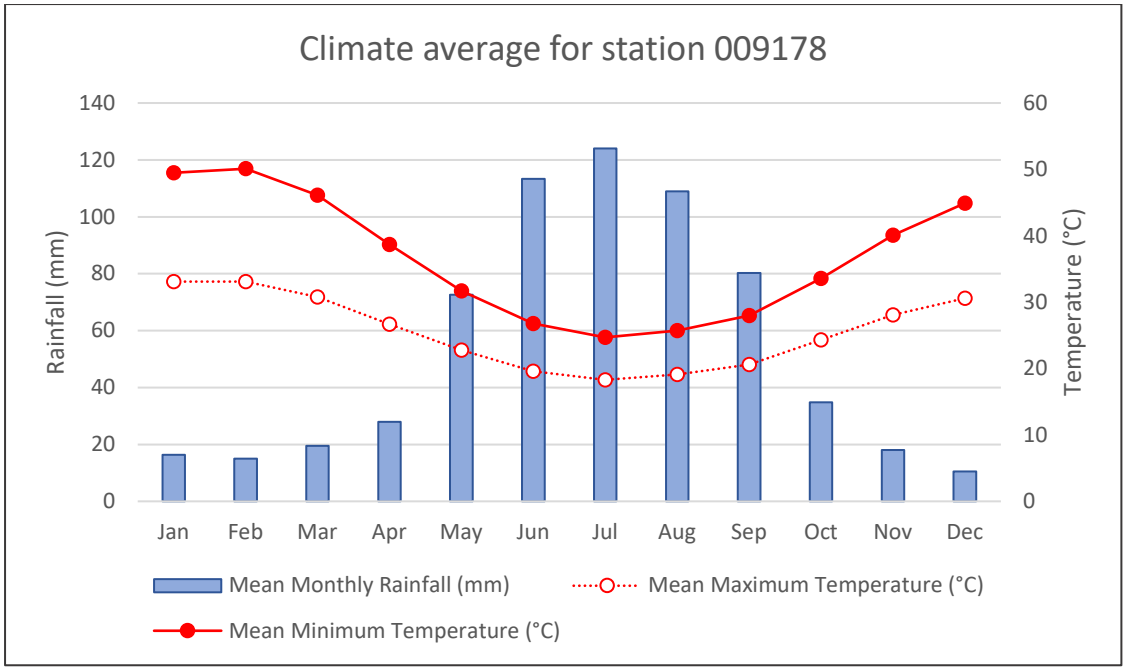


Figure 2.1: Monthly average rainfall and temperature at Gingin Aero WA (Station 009178)

2.2.3 Hydrology

Mapping of the geomorphic wetlands of the Swan Coastal Plain indicates a number of wetlands are present within the Project Area; 137 Conservation Category Wetlands (CCW), 40 Resource Enhancement Wetlands (REW) and 40 Multiple Use Wetlands (MUW), are mapped within the Project Area (Figure 2.2).

2.2.4 Conservation Areas

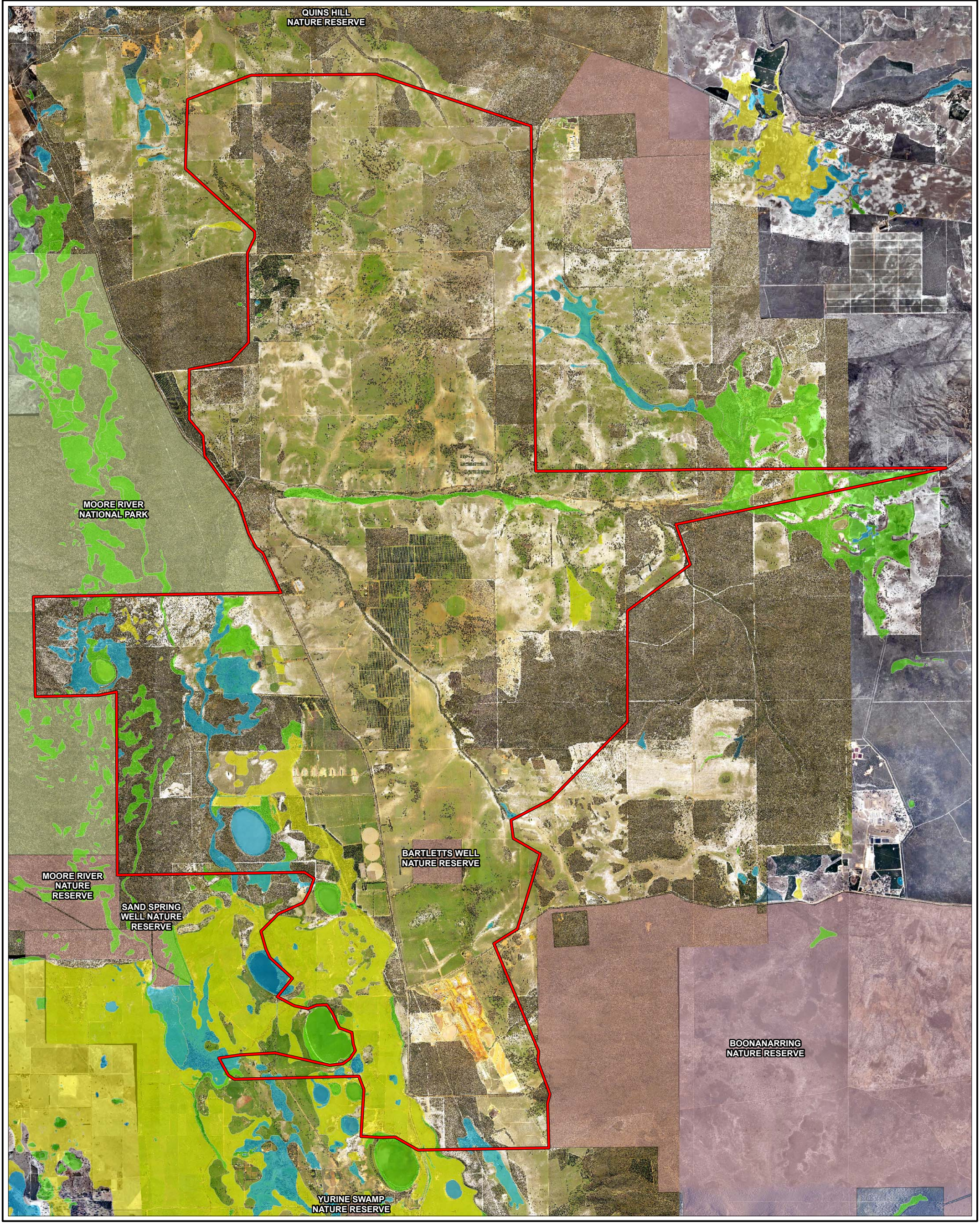
Four DBCA managed lands occur within the Project Area; Figure 2.2; Table 2.1).

Table 2.1: DBCA Manage lands within the Project Area

Type	Name	Identifier
National Park	Moore River National Park	R 28462
Nature Reserve	Moore River Nature Reserve	R 41830
Nature Reserve	Bartletts Well Nature Reserve	R 1224

2.2.5 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 the project area, historical land uses principally include agriculture, mining and conservation.



Legend:

- Project Area

Legislated Lands (DBCA)
- National Park
- Nature Reserve

Geomorphic Wetlands (DBCA)
- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed

strategen JBS&G

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: hsullivan	Checked By: TS	Version: A	Date: 14-Jul-2020	**FIGURE: 2.2**

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

2.2.6 Regional Vegetation

Beard (1990) Botanical Subdistrict

The Survey 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, 2019). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Survey Area occurs within the Swan Coastal Plain 2 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 Survey Area comprises ten Beard (1981) vegetation associations (Figure 2.3). Percentage remaining of each vegetation association is provided in Table 2.2 (GoWA 2019a).

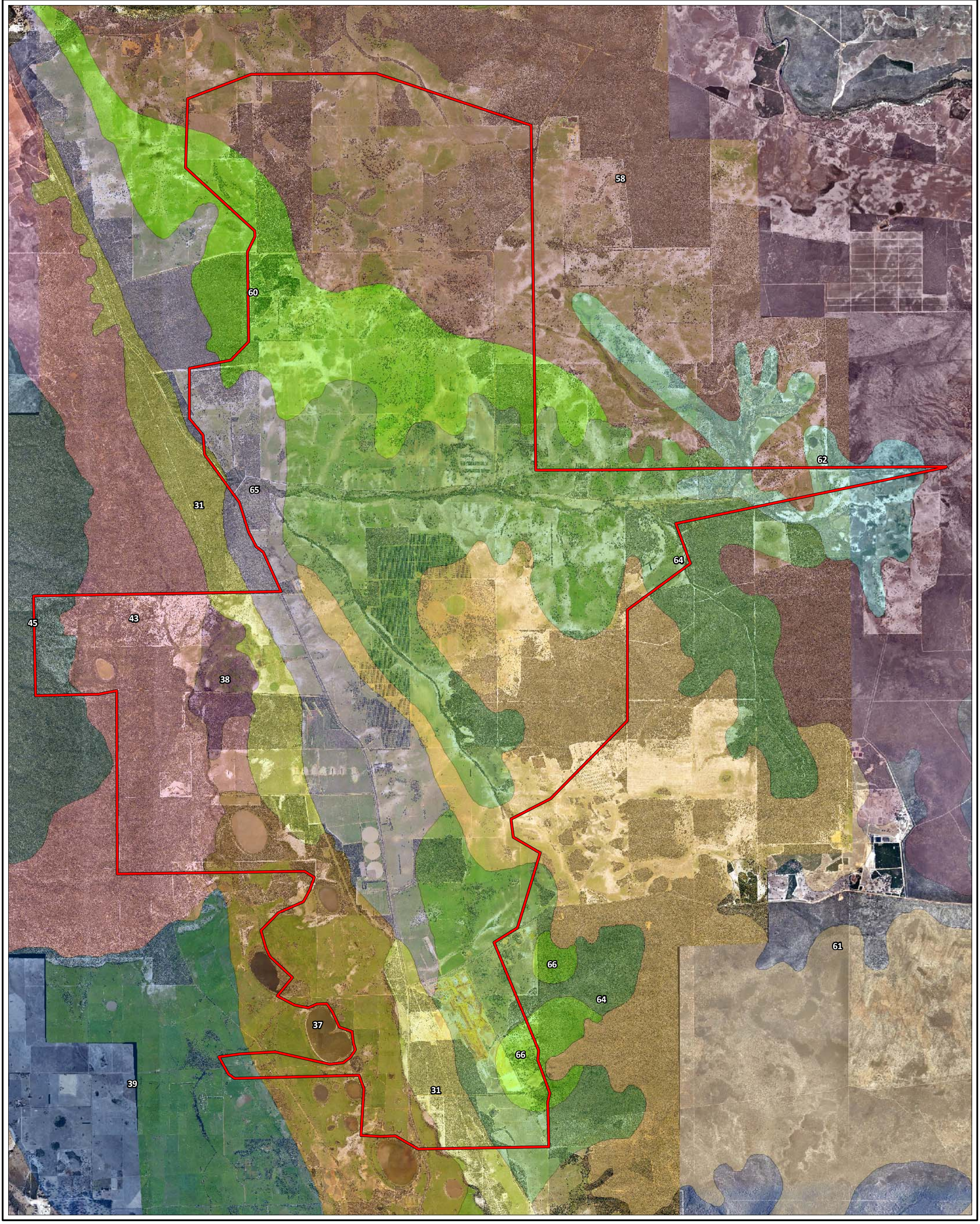
Table 2.2: Beard (1981) Vegetation Associations within the Survey Area

Vegetation Association	Description	Percent remaining in IBRA Region
37	Shrublands; teatree thicket	34.61
125	Bare areas; salt lakes	20.76
949	Low woodland; banksia	57.28
1008	Medium open woodland; marri	24.81
1014	Mosaic: Low woodland; banksia / Shrublands; teatree thicket	55.49
1015	Mosaic: Mixed scrub-heath / Shrublands; dryandra thicket	33.95
1016	Mosaic: Low woodland; banksia / Shrublands; dryandra heath	26.99
1017	Medium open woodland; jarrah & marri, with low woodland; banksia	44.39
1027	Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia / Medium sparse woodland; jarrah & marri	59.11
1030	Low woodland; Banksia attenuata & B. menziesii	63.81

Based on regional vegetation complex mapping (Heddle et al. 1980) the Survey Area comprises 13 vegetation complexes, (Table 2.3, Figure 2.3). Percentage of original extent remaining in the IBRA bioregion is provided in Table 2.3 (GoWA 2019b).

Table 2.3: Heddle et al. (1980) Vegetation Complexes within the Survey Area

Vegetation Complex	Description	Percent remaining in IBRA Region
Bassendean Complex-North	Vegetation ranges from a low open forest and low open woodland of Banksia species Eucalyptus todtiana (Pricklybark) to low woodland of Melaleuca species and sedgelands which occupy the moister sites.	71.67
Bassendean Complex-North Transition	A transition complex of low open forest and low woodland of Banksia species - Eucalyptus todtiana (Pricklybark) on a series of high sand dunes. The understorey species reflect similarities with both the Bassendean-North and Karrakatta-North vegetation complexes.	88.95
Bootine Complex	Predominantly low open forest of Banksia attenuata (Slender Banksia) - Banksia menziesii (Firewood Banksia) - Banksia ilicifolia (Holly-leaved Banksia) - Eucalyptus todtiana (Pricklybark). On lake margins transition from woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) to sedgelands.	16.01
Coonambidgee Complex	Vegetation ranges from a low open forest and low woodland of Eucalyptus todtiana (Pricklybark) - Banksia attenuata (Slender Banksia) - Banksia menziesii (Firewood Banksia) - Banksia ilicifolia (Holly-leaved Banksia) with localised admixtures of Banksia prionotes (Acorn Banksia) to an open woodland of Corymbia calophylla (Marri) - Banksia species.	45.46
Cullula Complex	Mixture of low open forest of Banksia species - Eucalyptus todtiana (Pricklybark) and open woodland of Corymbia calophylla (Marri) with second storey of Eucalyptus todtiana (Pricklybark) - B. attenuata - Banksia menziesii (Firewood Banksia) - Banksia ilicifolia (Holly-leaved Banksia).	51.24
Gingin Complex	Open woodland of Corymbia calophylla (Marri) with second storey of Banksia grandis (Bull Banksia) and Nuytsia floribunda. Fringing woodland of Eucalyptus rudis (Flooded Gum) - Melaleuca rhaphiophylla (Swamp Paperbark) along streams.	11.57
Karamal Complex-North	Open woodland of Eucalyptus wandoo (Wandoo). Under storey of Banksia squarrosa (Pingle) and Banksia polycephala (Many-headed Dryandra).	22.37
Karamal Complex-South	Open forest of Eucalyptus marginata (Jarrah) - Corymbia calophylla (Marri) with second storey of Banksia grandis (Bull Banksia).	64.06
Mogumber Complex-North	Open to closed heath of Banksia species - Allocasuarina humilis (Dwarf Sheoak)	47.70
Moondah Complex	Low closed to low open forest of Banksia attenuata (Slender Banksia) - Banksia menziesii (Firewood Banksia) - Eucalyptus todtiana (Pricklybark) - Banksia prionotes (Acorn Banksia) on slopes, open woodland of Corymbia calophylla (Marri) - Banksia species in valley.	40.83
Mungala Complex	Vegetation ranges from open woodland of Corymbia calophylla (Marri) - Eucalyptus decipiens to closed scrub of Melaleuca species - Casuarina species	10.41
Reagan Complex	Vegetation ranges from low open woodland of Banksia species Eucalyptus todtiana (Pricklybark) to closed heath depending on the depth of soil.	33.84
Yanga Complex	Predominantly a closed scrub of Melaleuca species and low open forest of Casuarina obesa (Swamp Sheoak) on the flats subject to inundation. On drier sites the vegetation reflects the adjacent vegetation complexes of Bassendean and Coonambidgee.	16.31



Legend:

- Project Area Vegetation complexes (DBCA)
- 31 - Low open forest and low woodland to open woodland
- 37 - Low open forest
- 38 - Closed scrub and low open forest
- 39 - Open woodland to closed scrub
- 43 - Low open forest and low woodland and sedgelands
- 45 - Low open forest and low woodland
- 58 - Open to closed heath
- 61 - Open forest
- 62 - Low open forest and open woodland
- 64 - Low closed forest and low open forest
- 65 - Low open woodland to closed heath
- 66 - Open woodland

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0 2 Kilometres

REGIONAL VEGETATION MAPPING

Job No: 57624		Scale 1:80,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: hsullivan	Checked By: TS	Version: A	Date: 14-Jul-2020

FIGURE: 2.3

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_VegComplexes.mxd

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

2.2.7 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 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). 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). 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 2019b). Mapping of Carnaby's Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the Survey Area as occurring within the range of the species.

Forest Red-tailed Black-Cockatoos, listed as Vulnerable under the EPBC Act, depend primarily on Marri and Jarrah trees for both foraging and nesting. The seeds of both eucalypts are the favoured food source of the birds and hollows within live or dead individual trees are utilised for nesting purposes (Johnstone 2010b). Breeding varies between years and occurs at times of Jarrah and Marri fruiting. These black cockatoos breed in woodland, forest or artificial nest boxes, but may also breed in former woodland or forest that has been reduced to isolated trees (DEE 2019b). Mapping of the Forest Red-tailed Black Cockatoo distribution (Johnstone and Kirkby undated) identifies the species as likely to occur in the Survey Area.

Baudin's Black-Cockatoos primarily occur in eucalypt forests and forage at all strata levels within the forests with a tendency to favour areas containing Marri (Johnstone and Kirkby 2008, DEE 2017b). Breeding generally occurs in the Jarrah, Marri and Karri forests of the southwest of Western Australia in areas averaging more than 750 mm of rainfall annually (DEE 2019b). As with the other two species of Threatened black cockatoos in Western Australia, breeding habitat also occurs in former woodland or forest that has been reduced to isolated trees (DEE 2019b). Mapping of the Baudin's Black-Cockatoos distribution (Johnstone and Kirkby undated) identifies the species as unlikely to occur in the Survey Area, and as such this species will not be discussed further.

3. Methods

3.1 Desktop Assessment

Database searches were undertaken to generate a list of vascular flora and vertebrate fauna, and Threatened and Priority Ecological Communities previously recorded within, and nearby the Survey Area – with an emphasis on species and communities of conservation significance and introduced species (Table 3.1). Database searches were conducted within a 10km buffer of the Survey Area.

Table 3.1: Database searches conducted for the desktop assessment

Custodian	Database	Taxonomic group	Buffer
DBCA	NatureMap	Flora and Fauna	10km
DBCA	WA Herb	Flora	5km
DBCA	TPFL	Flora	5km
DBCA	TFauna	Fauna	5km
DBCA	Communities	Ecological Communities	5km
DoE	PMST	Flora, Fauna and Communities	5km

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

3.2 Field Assessment

3.2.1 Flora and Vegetation

The field assessment of the Survey was conducted by two ecologists from Strategen on 25 – 26 September, 2 and 8 October 2019. The survey was conducted in accordance with guidelines provided in *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016).

Table 3.2: Personnel

Name	Role	Flora collection permit
Tristan Sleigh Senior Botanist	Planning, fieldwork, plant identification, data interpretation and report preparation	FB62000128
Robyn Chesney Senior Botanist	Planning, fieldwork, plant identification	FB62000123

Data Collection

Non-permanent quadrats (10m x 10m) were sampled to characterise vegetation types and condition and ensure appropriate representation of the flora and vegetation present. Indicative site locations were identified prior to commencement of the field survey using aerial photography, topographic maps and existing vegetation maps, to ensure that all broad vegetation types and landforms within the Survey Area would be sampled.

At each quadrat the following information was recorded:

- Name of recorder.
- Date.
- Quadrat dimensions.
- GPS co-ordinates (recorded in GDA94 UTM 50H).
- Photograph of the vegetation from north-west corner.
- Vegetation condition.

- Brief vegetation description.
- Vascular flora taxa present (with average height and total percentage foliage cover of each taxon).
- Topography.
- Soil type and colour.
- Geology (type, size and cover of any rocks, stones, gravel or outcropping).
- Average percentage cover of leaf litter and bare ground.
- Disturbance details including fire history (time since last fire), and physical disturbance including evidence of erosion, grazing and weed invasion.

Any flora taxa observed opportunistically around quadrats or while traversing on foot within the Survey Area were recorded. For any populations of taxa known to be conservation significant or introduced flora observed, a GPS location and a count of the individuals present, or percentage foliar cover for a given area for the species, were recorded.

Conservation Significant Flora

Prior to the survey, a list of conservation significant flora with the potential to occur within the Survey Area was compiled. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before conducting the survey and once on the ground systematically searched for them along all proposed clearing areas.

Flora Identification and Nomenclature

All plant specimens collected during the field surveys 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-).

Vegetation Condition

Vegetation condition was recorded at all quadrats, and opportunistically within the Survey Area during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (EPA 2016; Table 3.3). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation and were digitised as for vegetation type mapping polygon boundaries.

Table 3.3: Vegetation Condition Scale for South West and Interzone Botanical Provinces (EPA 2016)

Vegetation Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Vegetation Condition	Description
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

Vegetation Units

Vegetation types (VT) were delineated using a combination of results, site observations and cluster analysis. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the Survey Area. These polygon boundaries were then digitised using the Geographic Information System (GIS) software.

VT descriptions (through floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent VTs, so that comparable and consistent data is produced nation-wide. For the purposes of this report, a VT is considered equivalent to a NVIS sub-association as described in ESCAVI (2003).

In addition to the mapping of the survey area, an additional 100m buffer area was mapped by extrapolation of the on-ground data and using aerial imagery to provided context to the proposed clearing.

3.3 Black Cockatoo Habitat Assessment

The Survey Area was inspected on 25 – 26 September, 2 and 8 October 2019 by Strategen personnel with relevant experience as specified by the *EPBC Act Referral guidelines for three threatened black cockatoo species* (DSEWPaC 2012). A significant tree assessment was not conducted as no clearing of significant trees will be undertaken.

3.4 Survey Limitations and Constraints

There are possible limitations and constraints that can impinge on the adequacy of vegetation, flora and fauna surveys. The flora and vegetation assessment has been evaluated against a range of potential limitations (Table 3.4). 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 3.4: 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 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).
Scope (i.e. what life forms, etc., were sampled).	**Not a constraint.**	Number of species recorded, number of quadrats sampled and timing of the survey (i.e. spring) were adequate for this level of survey.
Proportion of flora/fauna collected and identified (based on sampling, timing and intensity).	**Not a constraint.**	The proportion of flora surveyed was adequate. The entire survey area was traversed, and flora species were recorded systematically. The targeted black cockatoo habitat assessment covered the entire survey area.
Completeness and further work which might be needed (i.e. was the relevant Survey Area fully surveyed).	**Not a constraint.**	The information collected during the survey was sufficient to assess the vegetation and black cockatoo habitat that was present during the time of the survey.

Potential Limitation	Impact on assessment	Comment
Mapping reliability.	**Not a constraint.**	Aerial photography of a suitable scale was used to map the survey area and identify potential fauna habitat. Sites were chosen from these aerials to reflect changes in community structure. Vegetation types were assigned to each site based on topography, soil type and presence/absence and percent foliage cover of vegetation.
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 September and October (i.e. spring) in fine weather conditions. Winter rainfall prior to the survey was less than the long-term average. This may have impacted the presence of annual species which presents a minor survey constraint.
Disturbances (fire flood, accidental human intervention, etc.).	**Not a constraint.**	The Survey Area and regional surrounds have been subject to disturbance over a significant period of time. Given the wide range of this disturbance, this is not considered to be a limitation within the survey area.
Intensity (in retrospect, was the intensity adequate).	**Not a constraint.**	The Survey Area was traversed on foot and all differences in vegetation structure were recorded appropriately.
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 survey.
Access problems (i.e. ability to access Survey Area).	**Not a constraint.**	Existing tracks enabled adequate access to survey the vegetation and fauna within the survey 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.**	All survey personnel have the appropriate training in sampling and identifying the flora of the region and identifying Black cockatoo habitat.

4. Results

4.1 Flora and Vegetation

4.1.1 Desktop Assessment

Threatened and Priority flora

A desktop survey for Threatened and Priority flora that may potentially occur within the Survey 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 2017c) (Appendix A).

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 WC Act, the taking of such flora without the written consent of the Minister is an offence. The WC 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 (2017a) 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. Parks and Wildlife categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P5 (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 (2017b) website.

The 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), three Threatened and 40 Priority flora species were considered to have potential to occur within the Survey Area. As a result of the targeted searches undertaken within all proposed areas of impact, all identified conservation species are considered unlikely to occur within the proposed areas of impact.

Threatened and Priority Ecological Communities

Based on site location, comparison of community descriptions and assessment against diagnostic criteria (DCBA 2018, TSSC 2016, TSSC 2019), two TECs listed under the EPBC Act, one TEC listed under the BC Act, and two communities listed as a PEC by DBCA, were considered to be potentially present within the Project Area (Table 4.1).

Table 4.1: TECs and PECs Identified within and near the Survey Area

Community	Conservation Status	
	EPBC Act	BC Act
Banksia woodlands of the Swan Coastal Plain	Endangered	Priority 3
Shrublands and woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Endangered
SCP23b - Swan Coastal Plain Banksia attenuata - Banksia menziesii woodlands	Not listed (part of the Banksia woodlands of the Swan Coastal Plain TEC	Priority 3

4.1.2 Field Survey

Native Flora

A total of 151 native vascular plant taxa from 37 plant families and 93 genera were recorded within the Survey Area (Appendix D).

Conservation Significant Flora

No Threatened flora species as listed under section 178 of the EPBC Act or section 19(1) of the BC Act were recorded within the Survey Area.

The survey was conducted during the main flowering season for flora of the southwest botanical region (i.e. spring), including the Threatened and Priority species with potential to occur in the Survey Area; as such, this is the optimal time to detect the majority of species present. Given this, the conservation significant flora species with potential to occur within the Project Area (3 Threatened and 40 Priority flora species) are considered unlikely to occur within the areas surveyed.

Introduced (exotic) Taxa

A total of nine introduced (exotic) taxa were recorded within the Survey Area, as follows:

- *Aira caryophyllea.*
- *Arctotheca calendula.*
- *Briza maxima.*
- *Ehrharta calycina.*
- *Ehrharta longiflora.*
- *Gladiolus caryophyllaceus.*
- *Hypochaeris glabra.*
- *Ursinia anthemoides.*
- *Wahlenbergia capensis.*

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 (DAFWA 2017).

Vegetation Types

Eight vegetation types (VT) (Table 4.2) was defined and mapped within the Survey Area (Figure 4.1). The total area mapped within the Survey Area was 153.2 ha.

Table 4.2: Vegetation Types

Vegetation Type	Description	Area (ha)	Percentage of the Survey Area
VT1	*Banksia attenuata* and *Banksia menziesii* low open woodland over *Eremaea pauciflora* over *Mesomelaena pseudostygia* low shrubland.	4.0	2.6
VT2	*Banksia prionotes* and *Eucalyptus todtiana* low open woodland over *Hakea lissocarpha* and *Xanthorrhoea preissi* mid open shrubland over *Hibbertia hypericoides*, *Isopogon drummondii* and *Synaphea spinulosa* low shrubland.	5.5	3.6
VT3	*Adenanthos cygnorum* tall shrubland over *Daviesia preissii*, *Xanthorrhoea preissii* mid open shrubland over *Eremaea pauciflora*, *Stirlingia latifolia* and *Scholtzia involucrata* low shrubland.	4.7	3.1
VT4	*Banksia attenuata*, *Nuytsia floribunda* and *Eucalyptus todtiana* low open woodland over *Adenanthos cygnorum*, *Allocasuarina humilis* and *Xanthorrhoea preissii* mid open shrubland over *Stirlingia latifolia*, *Eremaea pauciflora* and *Hibbertia hypericoides* low shrubland.	25.3	16.5
VT5	*Isopogon drummondii*, *Daviesia preissii* and *Synapheae spinulosa* shrubland.	4.4	2.9
VT6	*Banksia attenuata*, *Banksia menziesii* low woodland *Eremaea pauciflora*, *Melaleuca systena and Xanthorrhoea preissii* mid open shrubland over *Mesomelaena pseudostygia* and *Melaleuca systena* low open shrubland.	47.7	31.1
VT7	*Banksia hookeriana* and *Adenanthos cygnorum* open low woodland over *Jacksonia floribunda*, *Eremaea pauciflora* and *Conospermum incurvum* low shrubland.	22.9	15.0
VT8	*Melaleuca preissiana*, *Banksia littoralis* and *Nuytsia floribunda* open low woodland over *Melaleuca seriata*, *Xanthorrhoea preissii* and *Verticordia nitens* mid shrubland.	13.6	8.9
CL	Cleared; non-native vegetation	25.1	16.4
Total		153.2	100

Legend:

- Project Area

Vegetation type

- VT1
- VT2
- VT3
- Cleared
- Tracks

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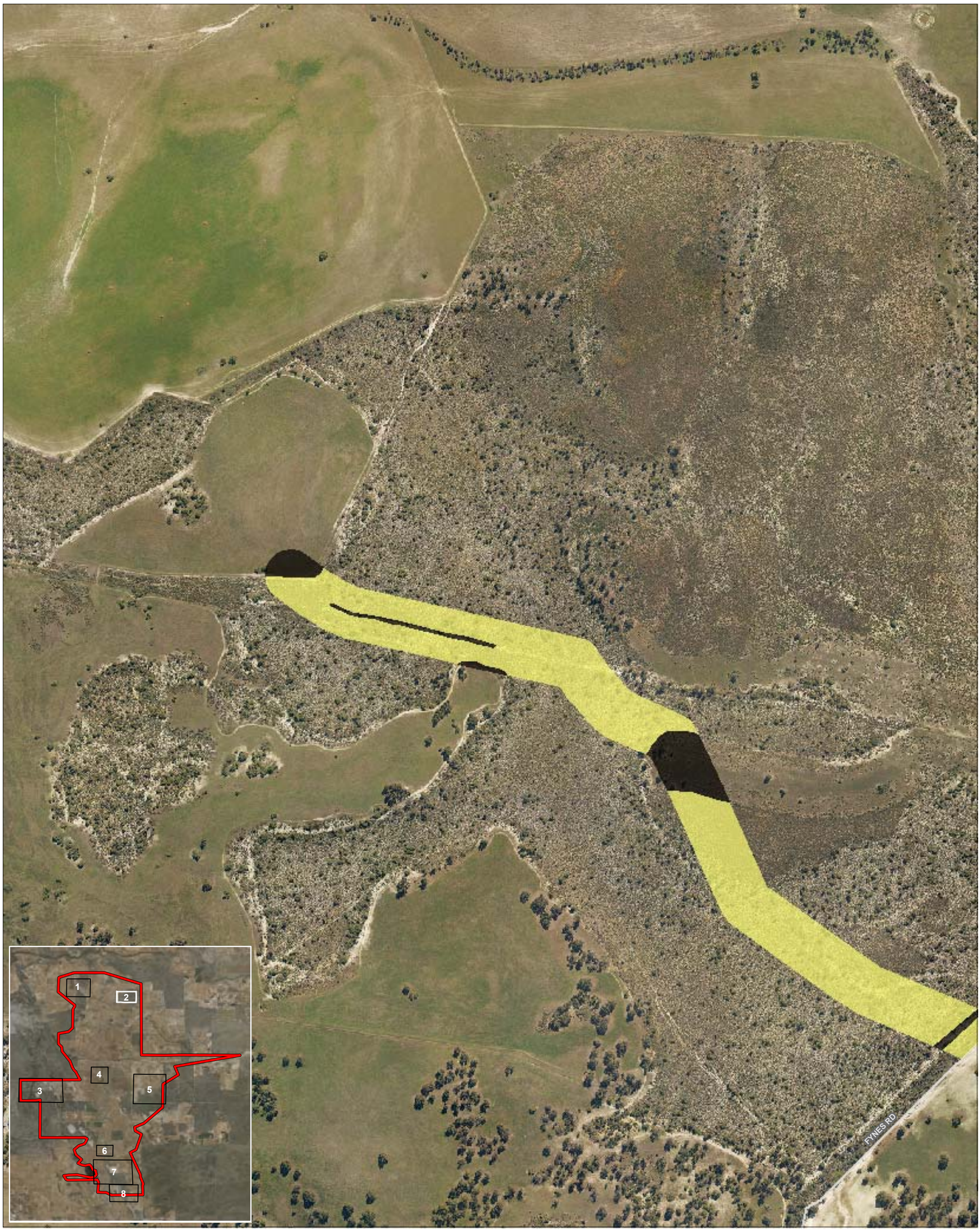
0 200 Metres

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY
PAGE 1 OF 8

Job No: 57789		Scale 1:8,200 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.1**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project Area

Vegetation type

- VT4
- Cleared
- Minor road

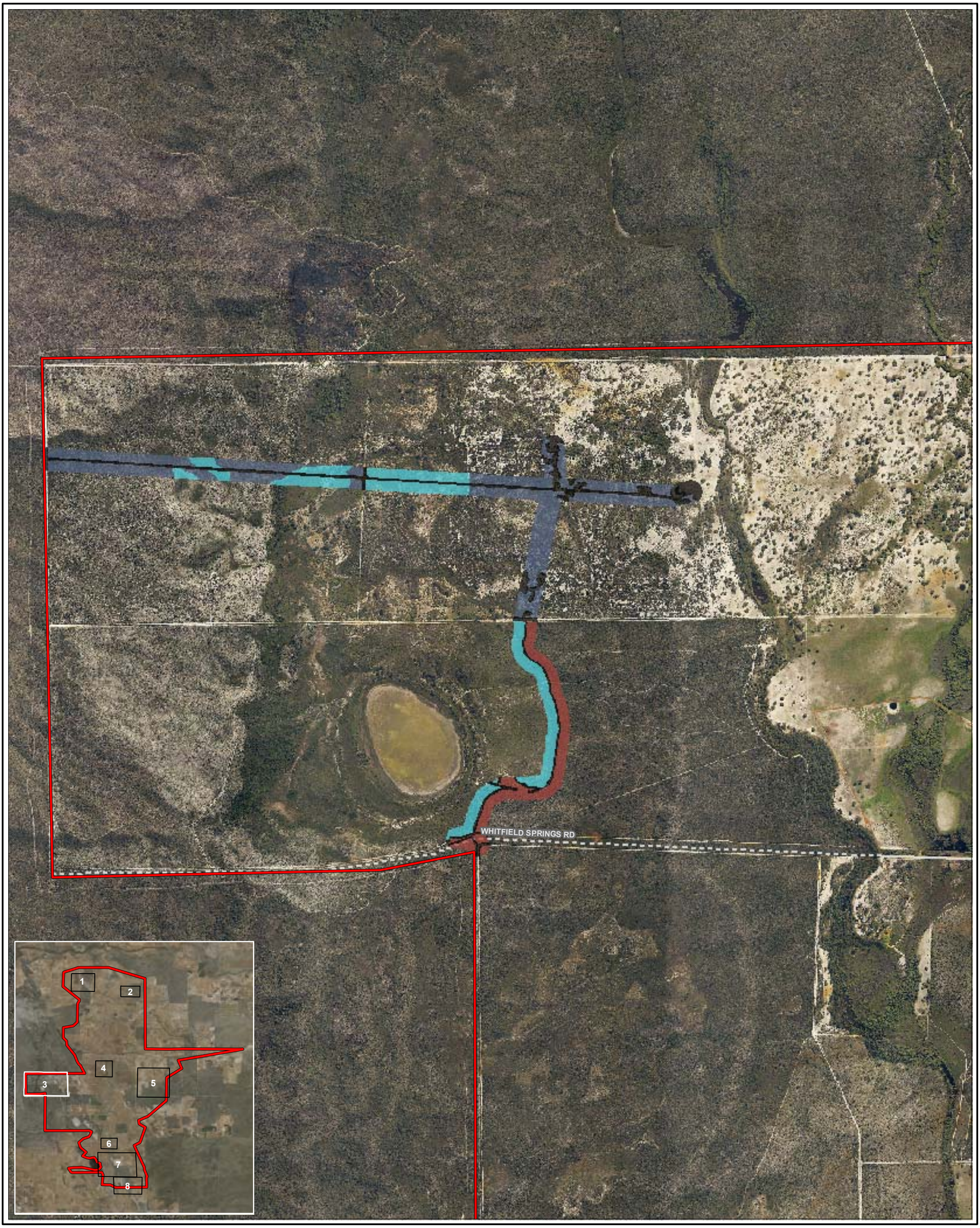
strategen JBS&G

0 200 Metres

Job No: 57789		Scale 1:6,700 at A4		**VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY PAGE 2 OF 8**
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.1**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd

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



Legend:

- Project Area

Vegetation type

- VT6
- VT7
- VT8
- Cleared
- Minor road
- Tracks

strategen JBS&G

0 200 Metres

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY
PAGE 3 OF 8

Job No: 57789		Scale 1:15,400 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.1**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Legend:

- Project Area

Vegetation type

- VT4
- VT5
- Cleared
- Tracks

strategen JBS&G

0 200
Metres

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY
PAGE 4 OF 8

Job No: 57789		Scale 1:5,900 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 4.1

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd
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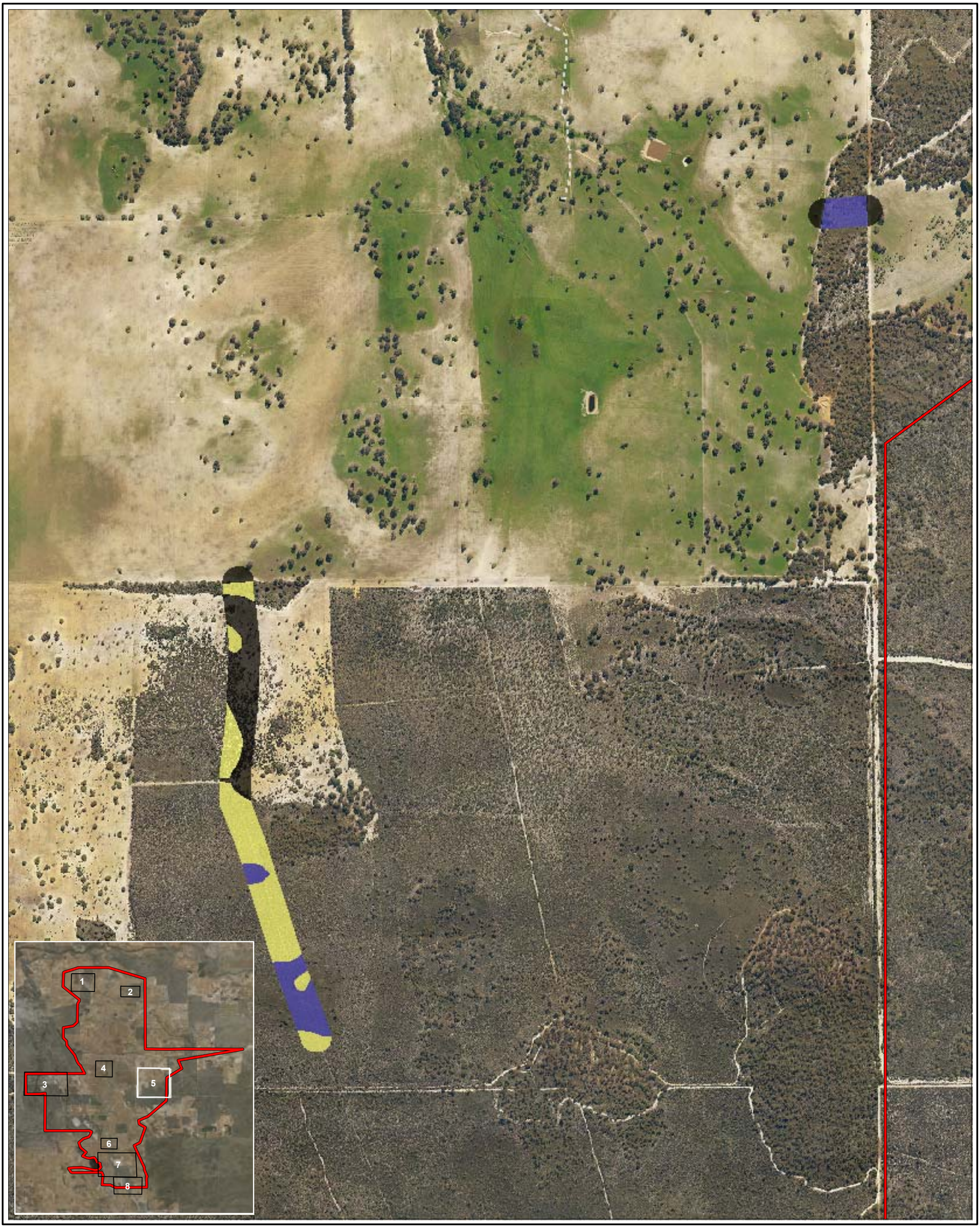

Legend:

- Project Area

Vegetation type

- VT4
- VT5
- Cleared
- Tracks

strategen JBS&G

0 200 Metres

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY PAGE 5 OF 8

Job No: 57789		Scale 1:11,300 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.1**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd

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

Legend:

- Project Area

Vegetation type

- VT4
- Cleared
- Major road
- Tracks

strategen JBS&G

0 200

Metres

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY
PAGE 6 OF 8

Job No: 57789		Scale 1:5,650 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.1**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd

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

Legend:

- Project Area

Vegetation type

- VT6
- Cleared

- Major road
- Minor road
- Tracks

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0 200 Metres

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY PAGE 7 OF 8

Job No: 57789		Scale 1:13,750 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.1**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd

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

Legend:

- Project Area

Vegetation type

- VT6
- Cleared

- Major road
- Minor road
- Tracks

strategen JBS&G

0 200 Metres

Job No: 57789		Scale 1:10,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

VEGETATION TYPES IDENTIFIED DURING ECOLOGICAL SURVEY
PAGE 8 OF 8

FIGURE: 4.1

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_8_VegTypes.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

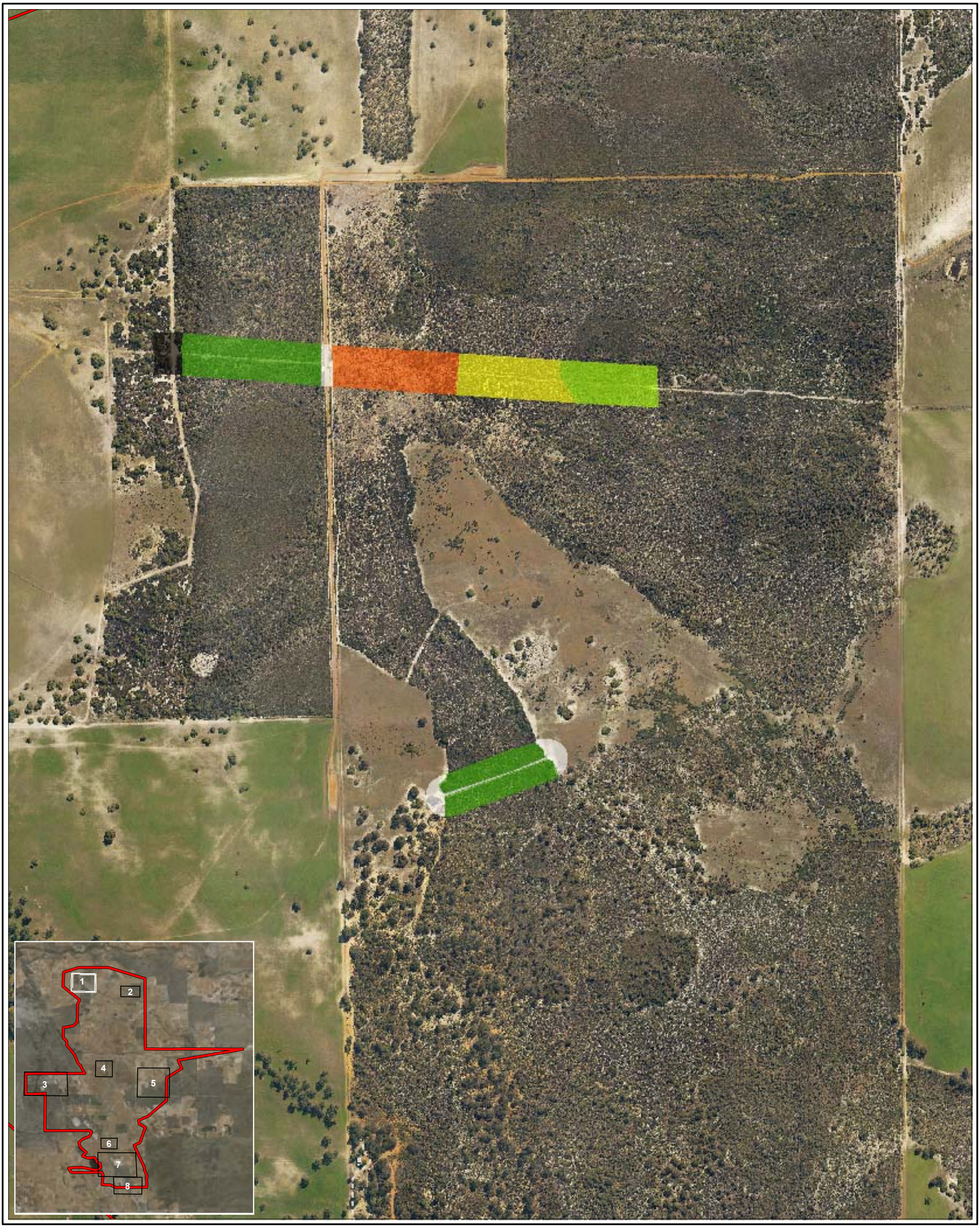
Vegetation Condition

The Survey Area shows signs of having been degraded for a long period of time. Historical disturbance from recreation vehicle use and partial clearing, and weed invasion are the two most prominent disturbances within the Survey Area. As such, vegetation condition within the Survey Area ranged from Very Good to Completely Degraded (EPA 2016; Figure 4.2).

Table 4.3 provides a numerical breakdown of the area occupied by each vegetation condition rating within the Survey Area. Areas mapped as cleared are grouped as 'no native vegetation present'.

Table 4.3: Vegetation Condition within the Survey Area

Vegetation Condition	Area (ha)	Percentage of the Survey Area
Excellent	57.3	37.4
Very Good	35.6	23.2
Good	10.6	6.9
Degraded	24.0	15.7
Completely Degraded	0.7	0.4
No native vegetation present	25.1	16.4



Legend:

- Project area
- Tracks

Vegetation condition

- Excellent
- Very good
- Good
- Degraded
- Completely degraded
- n/a

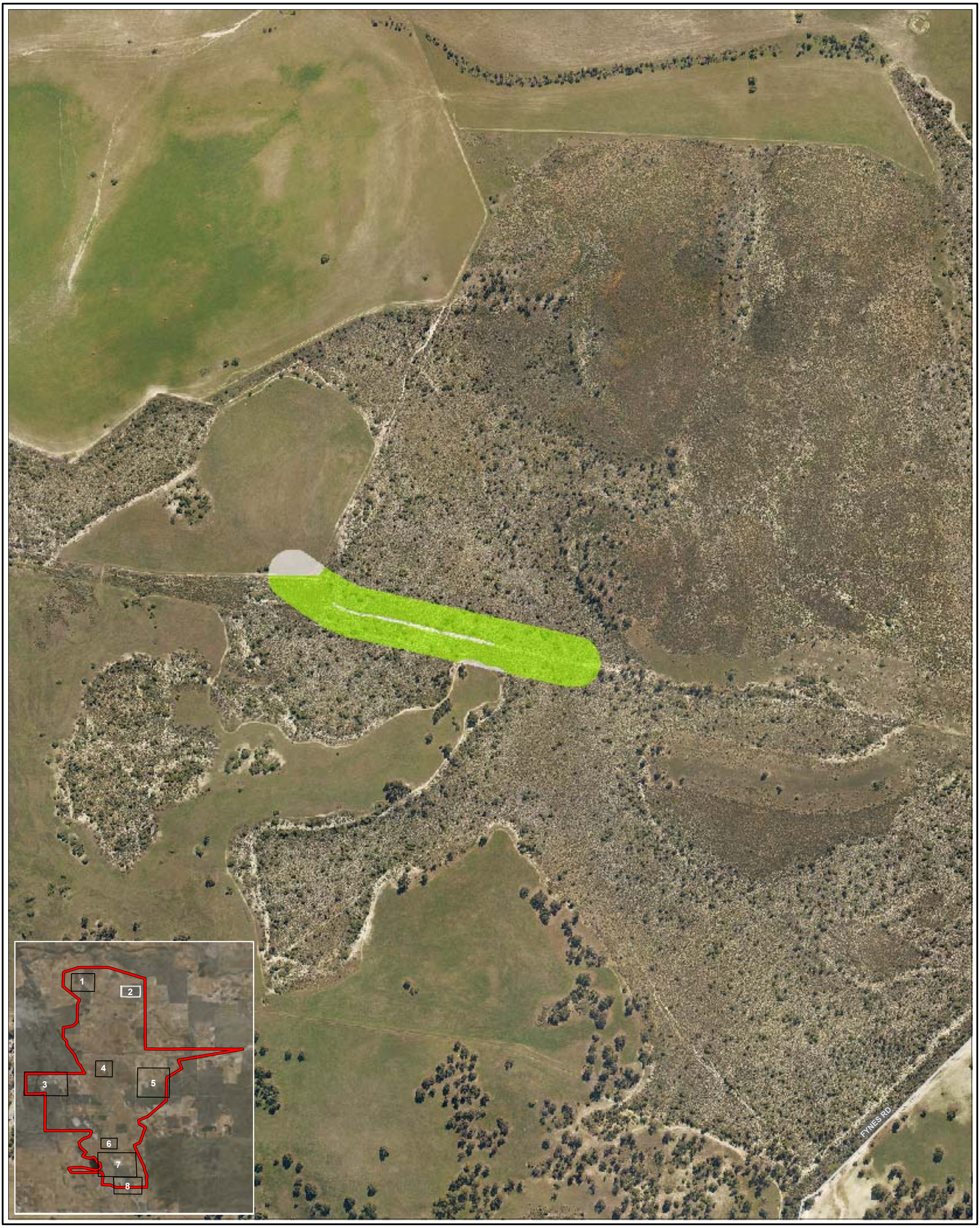
strategen JBS&G

0 200 Metres

VEGETATION CONDITION
PAGE 1 OF 8

Job No: 57789		Scale 1:8,200 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.2**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project area
- Minor road

Vegetation condition
- Very good
- n/a

strategen JBS&G

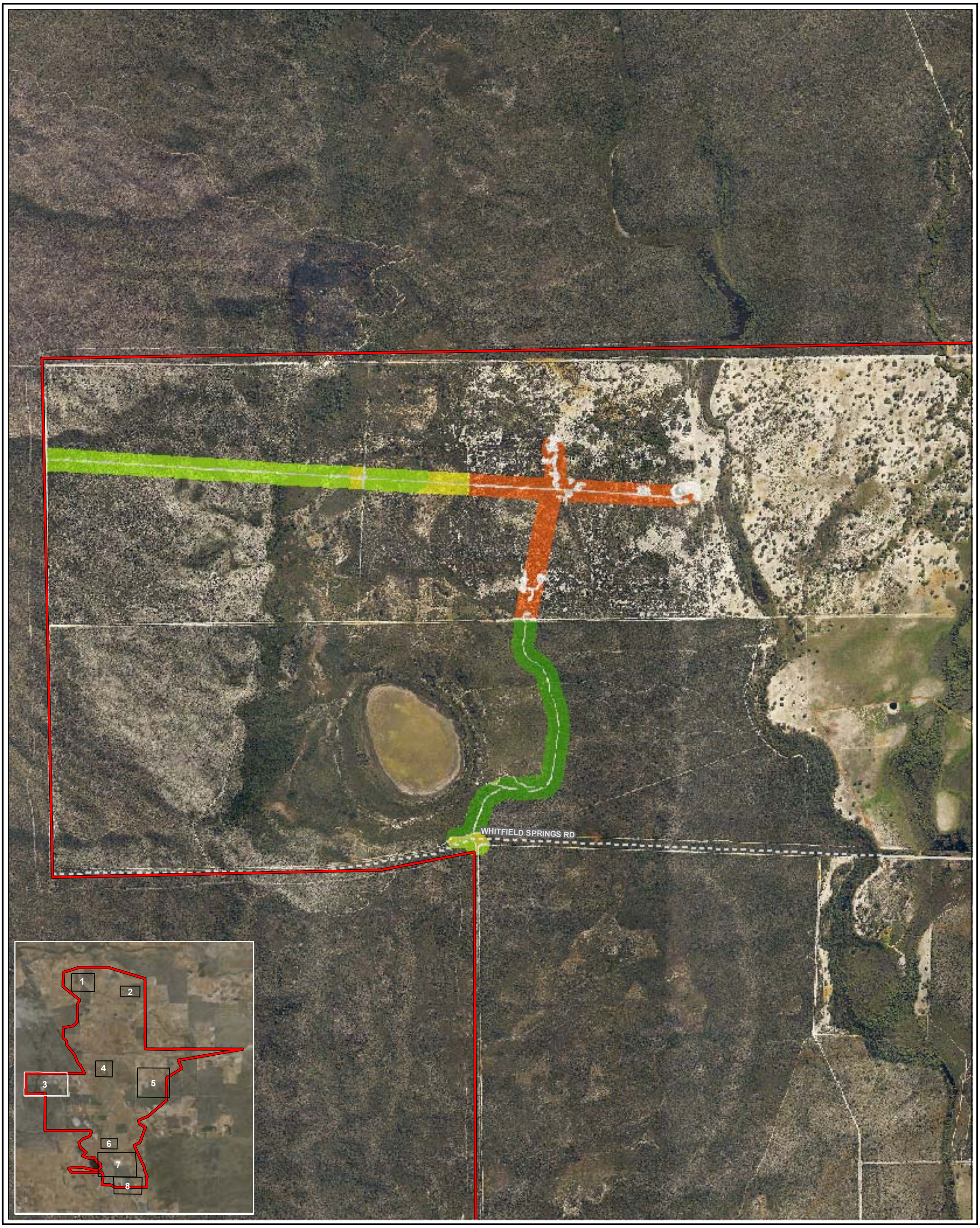
0 200
Metres

VEGETATION CONDITION
PAGE 2 OF 8

Job No: 57789		Scale 1:6,700 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 4.2

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project area
- Minor road
- Tracks

Vegetation condition
- Excellent
- Very good
- Good
- Degraded
- n/a

strategen JBS&G

0 200
Metres

VEGETATION CONDITION
PAGE 3 OF 8

Job No: 57789		Scale 1:15,400 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.2**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Legend:

- Project area
- Tracks

Vegetation condition
- Very good
- Good
- Degraded
- n/a

strategen JBS&G

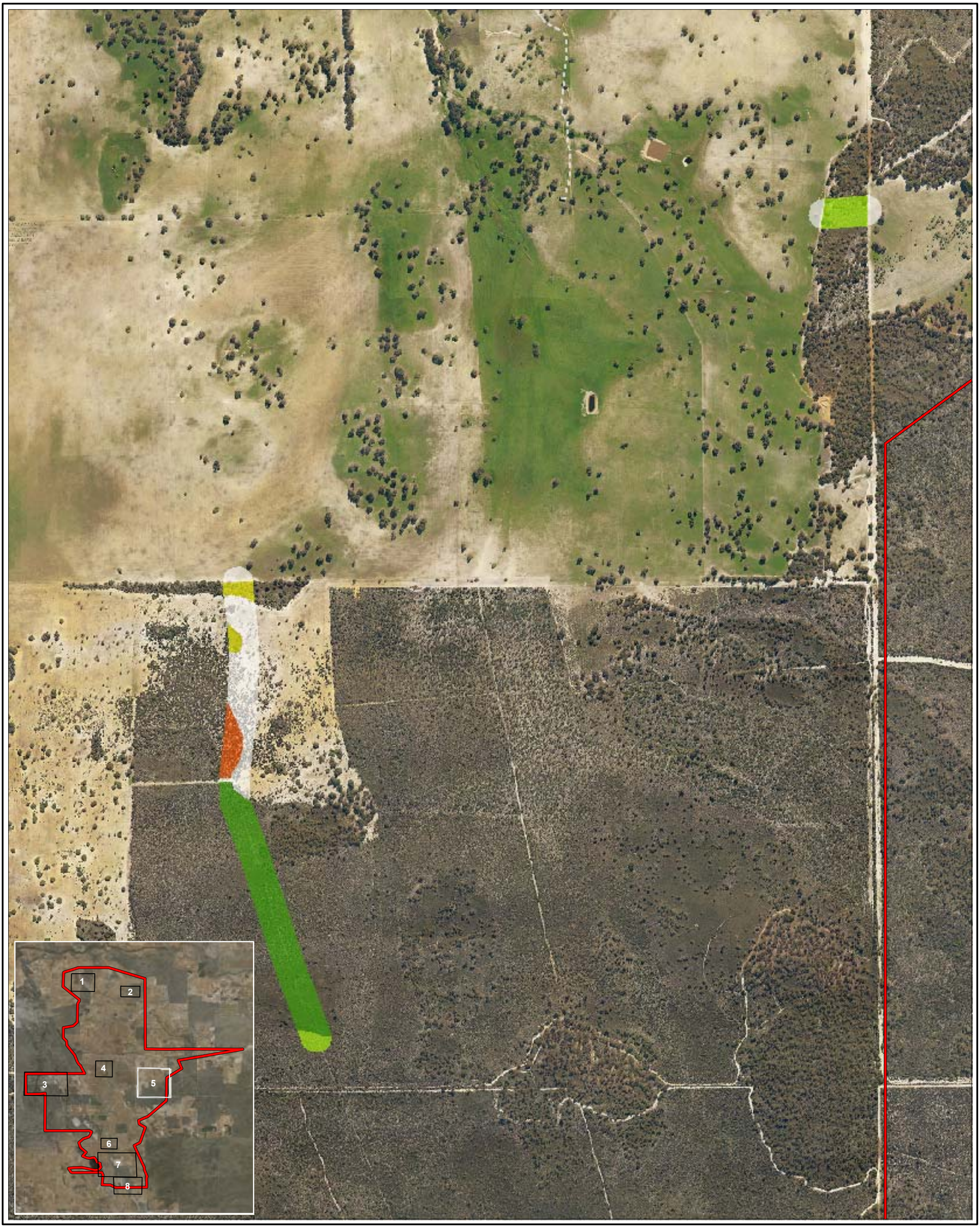
0 200
Metres

VEGETATION CONDITION
PAGE 4 OF 8

Job No: 57789		Scale 1:5,900 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 4.2

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.



Legend:

- Project area
- Tracks

Vegetation condition

- Excellent
- Very good
- Good
- Degraded
- n/a

strategen JBS&G

0 200 Metres

VEGETATION CONDITION
PAGE 5 OF 8

Job No: 57789		Scale 1:11,300 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.2**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Legend:

- Project area
- Major road
- Tracks

Vegetation condition

- Good
- n/a

strategen JBS&G

0 200 Metres

VEGETATION CONDITION
PAGE 6 OF 8

Job No: 57789		Scale 1:5,650 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020

FIGURE: 4.2

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Legend:

- Project area
- Major road
- Minor road
- Tracks

Vegetation condition

- Excellent
- Very good
- Good
- Degraded
- n/a

strategen JBS&G

0 200 Metres

VEGETATION CONDITION
PAGE 7 OF 8

Job No: 57789		Scale 1:13,750 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.2**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

Legend:

- Project area
- Major road
- Minor road
- Tracks

Vegetation condition
- Excellent
- Very good
- Degraded
- n/a

strategen JBS&G

0 200 Metres

VEGETATION CONDITION
PAGE 8 OF 8

Job No: 57789		Scale 1:10,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: cthatcher	Checked By: RD	Version: A	Date: 29-Jun-2020	**FIGURE: 4.2**

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57059 MRL Seismic surveys\GIS\Maps\57789_R01_RevA\57789_2_9_VegCond.mxd

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

Threatened and Priority Ecological Communities

The desktop survey identified two TECs and two PECs as having the potential to occur within the Survey Area. From the results of the field survey, one TEC (and one PEC) is considered to occur within the Survey Area:

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

Only the EPBC Act listed 'Banksia Woodlands of the Swan Coastal Plain' threatened ecological community and Priority 3 BC Act listed PEC was recorded and mapped in the Survey Area. This TEC is listed as Endangered under the EPBC Act and as a P3 PEC at the state level. This listing is not subject to condition criteria.

Banksia Woodlands of the Swan Coastal Plain TEC

An analysis of the quadrat data was undertaken to determine the extent of the Banksia Woodlands of the Swan Coastal Plain TEC (Table 4.4). 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). Thirteen quadrats were included in the assessment, as they are likely to meet the criteria. The remaining quadrats were not assessed as they did not contain Banksia species, and as such, are not part of the ecological community.

All 13 quadrats met the key diagnostic criteria for the Banksia Woodlands of the Swan Coastal Plain ecological community. These quadrats aligned with vegetation type VT1, VT4, VT5, and VT6 within the Survey Area, this included eight separate patches of the ecological community (Figure 4.3), representing a total area within the Survey Area of 67.3 ha. Of these patches, none are fully confined to the Survey Area, with vegetation adjacent being considered part of each patch. Average vegetation condition ranged from Good to Very Good-Excellent. Some areas within these patches recorded vegetation condition of Degraded or Completely Degraded. They retained the upper canopy of Banksia species, characteristic of the community, but retained little understorey. Should these occurrences be isolated from other Banksia woodland vegetation, they would not be considered part of a patch. However, as they are contiguous with, or separated by less than 30 metres, from an existing patch of Banksia woodland TEC, they are considered to be part of that patch.

Banksia Woodlands of the Swan Coastal Plain PEC

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. Given this, there is a total area of 67.3 ha within the survey area.

Table 4.4: Banksia Woodlands of the Swan Coastal Plain – Assessment Against Key Diagnostic Criteria (TSSC 2016)

Key diagnostic criteria (TSSC 2016)	Patch							
	1	2	3	4	5	6	7	8
Assessment sites	T02, R04	T03, T04,	T05	T08	R9	R6, R7, R8, R10	T18	T09
Area within survey area	3.3 ha	5.6 ha	4.5	7.2 ha	2.6 ha	36.7 ha	6.3 ha	1.1 ha
Total patch size	18.0 ha	59.4 ha	21.1 ha	105.2 ha	17.3 ha	262.0 ha	103.8 ha	13.7 ha
Location: Occurs in the Swan Coastal Plain or Jarrah Forest IBRA bioregions.	YES	YES	YES	YES	YES	YES	YES	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	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	YES - sandy colluviums and aeolian sands	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	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species	YES – occurs as a low woodland with an upper layer of Banksia spp. Emergent Eucalyptus species

Key diagnostic criteria (TSSC 2016)	Patch							
	1	2	3	4	5	6	7	8
sometimes be present above the banksia canopy • an often highly species-rich understorey.								
<u>Composition:</u> Contains at least one of the following species: • Banksia attenuata • Banksia menziesii • Banksia prionotes • Banksia ilicifolia.	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata* and *Banksia menziesii*	YES – contains *Banksia attenuata* and *Banksia menziesii*	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata*	YES – contains *Banksia attenuata*
<u>Condition (Keighery 1994):</u> 'Pristine': no minimum patch size 'Excellent': 0.5 ha 'Very Good': 1 ha 'Good': 2 ha.	Good to Excellent	Good to Excellent	Good to Excellent	Good to Excellent	Degraded to Excellent	Degraded to Excellent	Excellent	Good to Very Good

Legend:

- Project Area
- Banksia woodland

strategen JBS&G

0 2
Kilometres

BANKSIA WOODLANDS OF THE SWAN COASTAL PLAIN TEC

Job No: 57624		Scale 1:80,000 at A4		
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50		
Drawn By: hsullivan	Checked By: CT	Version: A	Date: 26-Jun-2020	**FIGURE: 4.3**

Document Path: W:\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_BanksiaWoodland.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

4.2 Fauna

A desktop assessment was initially conducted to determine conservation significant fauna with potential to occur within the Project Area. From this, a likelihood assessment was undertaken based on habitat preferences, age and distance of know records, and known regional distribution. The outcomes of this assessment that two threatened species, Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo, are known to occur within the local area, and foraging habitat highly likely to occur. This informed the decision to conduct a targeted Black Cockatoo habitat assessment within areas where clearing of native vegetation was proposed. The nature of the disturbance and the outcomes of the desktop assessment, indicated that it was unlikely that other species of conservation significant fauna would be subjected to significant impacts and therefore, further on-ground surveys were not required.

4.2.1 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.

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 Survey 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). Wetland habitat with shallow water and sand or mud flats or marine waters are not present in the Survey Area; therefore, these species have been omitted from any further discussion.

Marine /mammals

A number of marine mammals were also returned in the database searches, mainly from the EPBC PMST. The Survey Area is inland from the ocean and so does not contain marine habitat, as such, 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 extinct. These species have therefore been omitted from any further discussion.

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 Survey 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.

4.2.2 Conservation Significant Fauna

With the afore mentioned wading birds and locally/regionally extinct and database errors species removed, a total of four conservation significant species retrieved from the database searches are considered as either likely, possibly or unlikely to occur in the Survey Area. Of these four conservation significant species, one species was recorded during the survey, one species is considered Likely to occur in the Survey Area, two species are considered Unlikely to occur (Table 4.5).

The Likelihood of each species is based on the following criteria:

- Recorded: Recorded during the field survey or site reconnaissance.
- Likely: Suitable habitat is present in the Survey Area and the Survey Area is in the species' known distribution.
- Possible: Limited or no suitable habitat is present in Survey Area but is nearby. The species has good dispersal abilities and is known from the general area.
- Unlikely: No suitable habitat is present in Survey Area but is nearby, the species has poor dispersal abilities, but is known from the general area.

Table 4.5: Conservation Significant Fauna Potentially Occurring in the Project Area

Species	Common Name	Conservation Status	Likelihood
Birds			
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	VU	Likely
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	Observed
Oxyura australis	blue-billed duck	P4	Unlikely
Mammals			
Dasyurus geoffroii	Chuditch, Western Quoll	VU	Unlikely

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, , and P = Listed as Priority by the DBCA.

4.2.3 Black Cockatoo Habitat Assessment

4.2.3.1 Foraging Habitat

There was approximately 127 ha of foraging habitat recorded within the Survey Area (Figure 4.4). Foraging species in the Survey Area primarily consist of, Jarrah, Marri, *Banksia attenuata, Banksia menziesi*i, and *Xanthorrhoea preissii*.

Active foraging by Carnaby's cockatoo was recorded with Banksia woodland (VT4) during the survey. In addition, evidence of foraging in the way of chewed Banksia cones was recorded in the Survey Area.

The Survey Area ranges between poor quality and good quality with regard to Black Cockatoo foraging habitat quality. Habitat foraging quality of each vegetation type is shown in

Table 4.7 and was determined using the scale described in Table 4.6.

Table 4.6: 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, midstorey and understorey).
Good	High density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species >60%) but food sources only present at one or two strata (i.e. canopy and midstorey).
Moderate	Moderate foraging value density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 20-40%) and food sources only present at one or two strata (i.e. canopy and midstorey).
Poor	Low density of species suitable for foraging by black cockatoos (i.e. foliage cover of suitable species 10-20%) and presence of food sources at only one stratum (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.

Table 4.7: Vegetation Types and Black Cockatoo Foraging Species within the Survey Area

Vegetation type	Black cockatoo foraging species	Foraging quality	Area (ha)
VT1	CBC – *Banksia attenuata, Banksia menziesii, Eucalyptus todtiana, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	3.3
VT2	CBC – *Banksia prionotes, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	5.5
VT3	CBC – *Banksia prionotes, Eucalyptus todtiana, Hakea lissocarpha, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	4.7
VT4	CBC – *Banksia attenuata, Banksia dallanneyi, Banksia menziesii, Eucalyptus todtiana, Xanthorrhoea preissii* FRTBC, Nil	• Good (CBC) • Nil (FRTBC)	25.3
VT5	CBC – *Banksia dallanneyi, Corymbia calophylla, Hakea incrassata, Hakea ruscifolia, Hakea trifurcata, Xanthorrhoea preissii* FRTBC, *Corymbia calophylla*	• Good (CBC) • Poor (FRTBC)	4.4
VT6	CBC – *Banksia attenuata, Banksia ilicifolia, Banksia menziesii, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	47.7
VT7	CBC – *Banksia hookeriana, Banksia ilicifolia, Eucalyptus todtiana, Hakea psilorrhyncha, Xanthorrhoea preissii* FRTBC, Nil	• Moderate (CBC) • Nil (FRTBC)	22.9
VT8	CBC – *Banksia littoralis, Xanthorrhoea preissii* FRTBC, Nil	• Poor (CBC) • Nil (FRTBC)	13.6
Cleared	CBC – Nil FRTBC – Nil	• Nil	1.1

Note: Vegetation rated as Completely Degraded, not included in area calculation.

Legend:

- Project Area
- Black Cockatoo foraging

strategen JBS&G

0 2
Kilometres

BLACK COCKATOO HABITAT IDENTIFIED DURING ECOLOGICAL SURVEY

Job No: 57624		Scale 1:80,000 at A4	
Client: Energy Resources Limited		Coord. Sys. GDA 1994 MGA Zone 50	
Drawn By: hsullivan	Checked By: CT	Version: A	Date: 26-Jun-2020

FIGURE: 4.4

Document Path: \\008pmpmr004v001.jbsg.aust\JBS Perth\Projects\1)Open\Mineral Resources\57624 - MRL Seismic - Baseline Ecology\GIS\Maps\R01_Rev_A\57624_0x_BCHabitat.mxd
Image Reference: Energy Resources Limited; SLIP Public Services Imagery 2020.

5. Discussion

5.1 Flora and Vegetation

No records of Threatened or Priority flora occur within the Survey Area. This was confirmed by targeted flora surveys conducted within all vegetation with the potential to be impacted. While habitat to support conservation significant species was present, the potential impact areas and therefore targeted survey areas, represent less than 4% of the mapped area.

Eight native vegetation communities were defined and mapped within the Survey Area. Areas not classified as native vegetation included cleared areas and covered 16.4% of the Survey Area.

The most dominant vegetation type within the Survey Area was VT6 (*Banksia attenuata*, *Banksia menziesii* low woodland *Eremaea pauciflora*, *Melaleuca systena* and *Xanthorrhoea preissii* mid open shrubland) with 31.1% of this native vegetation within the Survey Area.

The condition of vegetation within the survey area was highly variable. This is due to the fragmented nature of the area, with roads, agriculture, partial clearing, and weed invasion impacting smaller areas of remnant vegetation.

Five conservation significant communities were identified to occur within the Survey Area.

The TEC "Banksia woodlands of the Swan Coastal Plain" was identified in the desktop assessment as occurring within the Survey Area. This TEC is listed as Endangered under the EPBC Act and as a P3 PEC at the state level. An assessment of quadrat data, against published diagnostic criteria determined vegetation mapped as VT1, VT4, VT5, and VT6, represents the TEC. This vegetation is present in eight distinct patches meeting the diagnostic criteria over an area of 67.3 ha. Average vegetation condition ranged from Good to Very Good-Excellent. This TEC extends beyond the Survey Area in large areas of contiguous vegetation.

5.2 Fauna

Within the Survey Area, 127 ha of Black Cockatoo foraging habitat was mapped. The highest quality habitat was present in areas of Banksia woodland (VT1, VT4, VT5, and VT6) where multiple species used for foraging were present in two or more strata. This vegetation is widespread locally, as shown by the Banksia Woodland extent (Figure 4.3).

A desktop assessment was initially conducted to determine conservation significant fauna with potential to occur within the Project Area. From this, a likelihood assessment was undertaken based on habitat preferences, age and distance of know records, and known regional distribution.

The desktop fauna assessment identified four conservation significant flora as having potential to occur within the survey area. Of these, Carnaby's black cockatoo was recorded (actively foraging) and Forest red-tailed black cockatoo was considered likely to occur based on local records and likely habitat. The remaining two species, Chuditch and blue billed duck, were considered unlikely to occur within the survey area. Based on this assessment, no further survey effort for conservation fauna is considered necessary.

This informed the decision to conduct a targeted Black Cockatoo habitat assessment within areas where clearing of native vegetation was proposed. The nature of the disturbance and the outcomes of the desktop assessment, indicated that it was unlikely that other species of conservation significant fauna would be subjected to significant impacts and therefore, further on-ground surveys were not required.

6. Conclusion

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

- eight native vegetation types were mapped within the Survey Area.
- one TEC and one PEC was recorded and mapped within the Survey Area:
  - Banksia woodland of the Swan Coastal Plain (TEC and PEC).
- no Threatened or Priority flora species were recorded within the Survey Area.
- 127 ha of Black cockatoo foraging habitat was mapped within the Survey Area.

7. 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 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.

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 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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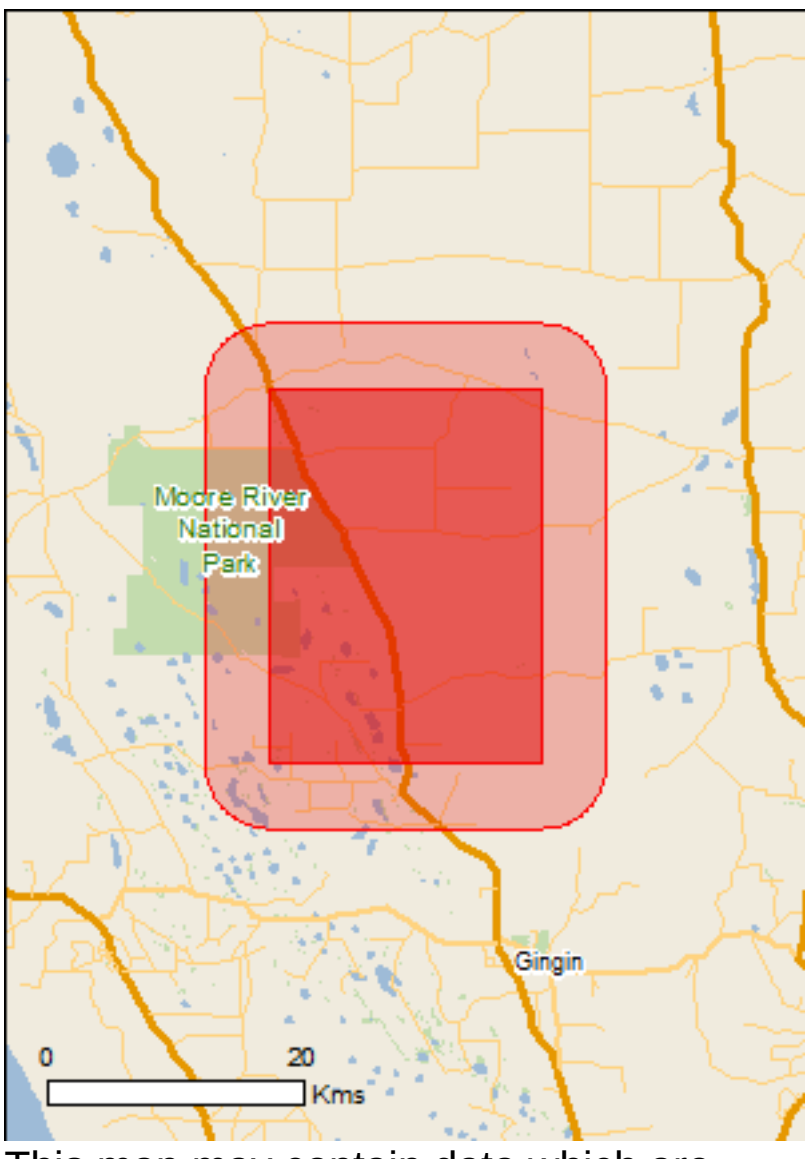

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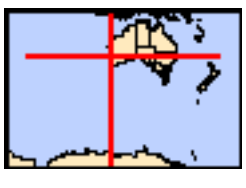

Summary

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:	4
Listed Threatened Species:	32
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	16
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:	15
Regional Forest Agreements:	None
Invasive Species:	23
Nationally Important Wetlands:	None
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
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Shrublands and Woodlands on Muchea Limestone of the Swan Coastal Plain	Endangered	Community known 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 ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat 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
Fish		
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Parantechinus apicalis Dibbler [313]	Endangered	Species or species

Name	Status	Type of Presence
		habitat may occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat likely to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat known to occur within area
Asterolasia nivea Bindoon Starbush [8225]	Vulnerable	Species or species habitat likely to occur within area
Banksia fuscobractea Dark-bract Banksia [83059]	Critically Endangered	Species or species habitat likely to occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat likely to occur within area
Banksia serratuloides subsp. serratuloides Southern Serrate Dryandra [82768]	Vulnerable	Species or species habitat may occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat likely to occur within area
Conospermum densiflorum subsp. unicephalatum One-headed Smokebush [64871]	Endangered	Species or species habitat likely to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus absita Badgingarra Box [24260]	Endangered	Species or species habitat may occur within area
Eucalyptus dolorosa Dandaragan Mallee, Mount Misery Mallee [56709]	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 recta Silver Mallet [56430]	Endangered	Species or species habitat likely to occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Goodenia arthrotricha [12448]	Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Paracaleana dixonii Sandplain Duck Orchid [86882]	Endangered	Species or species habitat known to 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 known to 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
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 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 likely to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Defence - PEARCE ILS/TACAN SITE

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
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat 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 likely 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 likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thinornis rubricollis		
Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bartletts Well	WA
Boonanarring	WA
Bootine	WA
Moochamulla	WA
Moore River	WA
Moore River	WA
NTWA Bushland covenant (0048)	WA
NTWA Bushland covenant (0057)	WA
Namming	WA
Quins Hill	WA
Sand Spring Well	WA
Unnamed WA25591	WA
Unnamed WA46899	WA
Unnamed WA47808	WA
Yurine Swamp	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		
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis		
Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur

Name	Status	Type of Presence 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
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		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 linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

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

-31.0 115.71,-31.0 115.9,-31.225 115.9,-31.225 115.71,-31.0 115.71

Acknowledgements

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

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

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

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

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Appendix C Conservation significant flora likelihood assessment

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Andersonia gracilis ERICACEAE	Vulnerable	Vulnerable	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.	Unlikely	Unlikely
Anigozanthos viridis subsp. *Terraspectans* HAEMODORACEAE	Vulnerable	Vulnerable	Rhizomatous, perennial, herb, 0.05-0.2 m high. Fl. green/yellow-green, Aug to Sep. Grey sand, clay loam. Winter-wet depressions.	Unlikely	Unlikely
Banksia mimica PROTEACEAE	Endangered	Vulnerable	Prostrate, lignotuberous shrub, 0.15-0.4 m high. Fl. yellow-brown, Dec or Jan to Feb. White or grey sand over laterite, sandy loam.	Possible	Unlikely
Eleocharis keigheryi CYPERACEAE	Vulnerable	Vulnerable	Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green, Aug to Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans.	Unlikely	Unlikely
Goodenia arthrotricha GOODENIACEAE	Endangered	Endangered	Erect perennial, herb, to 0.4 m high. Fl. blue, Oct to Nov. Gravel. Granite rocks, slopes.	Unlikely	Unlikely
Macarthuria keigheryi MACARTHURIACEAE	Endangered	Endangered	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.	Possible	Unlikely
Paracaleana dixonii ORCHIDACEAE	Vulnerable	Vulnerable	Tuberous, perennial, herb, 0.09-0.2 m high. Fl. yellow-brown, Oct to Dec or Jan. Grey sand over granite.	Possible	Unlikely
Grevillea evanescens PROTEACEAE	Not listed	P1	Erect, robust shrub, to 4 m high. Brown Spearwood sand. Shrubs, 2-4 m high; branchlets glabrous or hairy, not glaucous. Flowers in July, August or September.	Possible	Unlikely
Stylidium vinosum STYLIDIACEAE	Not listed	P1	No description available.	Possible	Unlikely
Calectasia elegans DASYPOGONACEAE	Not listed	P2	No description available.	Likely	Unlikely
Desmocladus microcarpus RESTIONACEAE	Not listed	P2	Rhizomes tufted, hairy. Basal sheath glabrous, glossy, striate. Culms terete, internal structure (at base of culm) solid, glabrous, not striate, not marbled, not fasciculate. Culm 50-105 mm long. Flowering Time August, September or October.	Likely	Unlikely
Goodenia xanthotricha GOODENIACEAE	Not listed	P2	Viscid shrub, to 0.5 m high. Fl. blue, Nov to Dec or Jan to Feb. Sandy soils. Gravelly hills. Stems unribbed. Leaves flat, 10-60 mm long, 2-10 mm wide, hairy. Flowers in January, February, November and December.	Likely	Unlikely
Haloragis aculeolate HALORAGACEAE	Not listed	P2	Slender, erect perennial, herb, to 0.4 m high. Fl. green, Sep or Dec. Black sand or clay over limestone. Winter-wet areas.	Unlikely	Unlikely

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Haloragis aculeolate HALORAGACEAE	Not listed	P2	Slender, erect perennial, herb, to 0.4 m high. Fl. green, Sep or Dec. Black sand or clay over limestone. Winter-wet areas.	Unlikely	Unlikely
Hibbertia glomerata subsp. *Ginginensis* DILLENIACEAE	Not listed	P2	Erect shrub, to 0.5 m high. Fl. yellow, Jul to Sep. Sand, brown clay, laterite. Near roadsides.	Likely	Unlikely
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.	Unlikely	Unlikely
Loxocarya gigas RESTIONACEAE	Not listed	P2	Rhizomatous, clumped perennial, herb (sedge-like), 0.8-2 m high. Sandy gravelly lateritic soils. Low hills & ridges, sandplains. Rhizomes spreading, hairy. Basal sheath hairy, dull, striate. Culms terete or semi-flattened, internal structure (at base of culm) hollow, glabrous, striate, not marbled, not fasciculate. Flowering Time February, April, May or December.	Likely	Unlikely
Schoenus loliaceus CYPERACEAE	Not listed	P2	Annual, grass-like or herb (sedge), 0.03-0.06 m high. Fl. Aug to Nov. Sandy soils. Winter-wet depressions.	Possible	Unlikely
Scholtzia laciniate MYRTACEAE	Not listed	P2	No description available, renamed in April 2019 from Scholtzia sp. Lancelin (M.E. Trudgen 1516).	Possible	Unlikely
Tetraria sp. Chandala (G.J. Keighery 17055) CYPERACEAE	Not listed	P2	No description available.	Possible	Unlikely
Tetratheca hirsuta subsp. *Boonanarring* ELAEOCARPACEAE	Not listed	P2	No description available.	Possible	Unlikely
Acacia cummingiana FABACEAE	Not listed	P3	Sprawling, straggly, rush-like shrub, 0.3-0.5 m high. Fl. yellow, May to Jun or Aug. Grey or yellow sand, lateritic gravel. Sandplains, lateritic breakaways.	Possible	Unlikely
Acacia drummondii subsp. *Affinis* FABACEAE	Not listed	P3	Erect shrub, 0.3-1 m high. Fl. yellow, Jul to Aug. Lateritic gravelly soils.	Possible	Unlikely
Acacia pulchella var. *reflexa acuminate bracteole variant* (R.J. Cumming 882) FABACEAE	Not listed	P3	Shrub, 0.3-1 m high. Fl. yellow, Jul to Sep. Sandy loam or sandy clay over laterite. Woodland.	Possible	Unlikely
Austrostipa sp. Cairn Hill (M.E. Trudgen 21176) POACEAE	Not listed	P3	No description available.	Possible	Unlikely
Banksia dallanneyi subsp. *pollosta* PROTEACEAE	Not listed	P3	Prostrate, lignotuberous shrub. Fl. yellow-brown, Aug to Sep. Grey/yellow sand. Flats, lateritic rises. Prostrate shrubs, 0.20-0.50 m high. Flowers in August.	Possible	Unlikely

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
Banksia kippistiana var. *paenepeccata* PROTEACEAE	Not listed	P3	Erect, prickly, lignotuberous shrub, 0.3-1.2 m high. Fl. yellow-cream, Oct to Nov. Lateritic gravelly soils.	Possible	Unlikely
Banksia pteridifolia subsp. *vernalis* PROTEACEAE	Not listed	P3	Prostrate, lignotuberous shrub, to 0.4 m high. Fl. cream-white/yellow, Sep to Oct. White/grey sand over laterite. Prostrate shrubs, 0.35-0.40 m high; Flowers in September.	Possible	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	Unlikely
Comesperma rhadinocarpum POLYGALACEAE	Not listed	P3	Perennial, herb. Fl. blue, Oct to Nov. Sandy soils.	Possible	Unlikely
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	Unlikely
Dillwynia dillwynioides FABACEAE	Not listed	P3	Decumbent or erect, slender shrub, 0.3-1.2 m high. Fl. red & yellow/orange, Aug to Dec. Sandy soils. Winter-wet depressions.	Possible	Unlikely
Eryngium sp. Subdecumbens (G.J. Keighery 5390) APIACEAE	Not listed	P3	No description available.	Possible	Unlikely
Haemodorum loratum HAEMODORACEAE	Not listed	P3	Bulbaceous, perennial, herb, 0.45-1.2(-2) m high. Fl. black/brown-black/green, Nov. Grey or yellow sand, gravel. Flowers in November.	Possible	Unlikely
Isopogon drummondii 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. Occurs in the South-west (SW) Botanical Province(s), in the Geraldton Sandplains (GS), Swan Coastal Plain (SWA) or Jarrah Forest (JF) IBRA subregion(s).	Possible	Unlikely
Lasiopetalum venustum MALVACEAE	Not listed	P3	No description available.	Possible	Unlikely
Leucopogon allittii ERICACEAE	Not listed	P3	Erect, single-stemmed shrub, 0.3-1 m high. Fl. white, Mar to Apr. Sand over gravel.	Possible	Unlikely
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.	Unlikely	Unlikely
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.	Possible	Unlikely

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
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.	Possible	Unlikely
Platysace ramosissima APIACEAE	Not listed	P3	Perennial, herb, to 0.3 m high. Fl. white-cream, Oct to Nov. Sandy soils.	Possible	Unlikely
Stylidium nonscandens STYLIDACEAE	Not listed	P3	Erect perennial, herb, 0.18-0.46 m high, Leaves in whorls, linear, 0.2-4.2 cm long, 0.4-1.2 mm wide, apex subacute to acute, margin entire, glabrous. Scape glabrous. Inflorescence racemose. Fl. pink, Sep to Nov. Sand over laterite. Hillslopes and crests. Banksia woodland, heath, mallee shrubland.	Possible	Unlikely
Styphelia filifolia ERICACEAE	Not listed	P3	No description available.	Possible	Unlikely
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.	Possible	Unlikely
Banksia chamaephyton PROTEACEAE	Not listed	P4	Low, lignotuberous shrub, to 0.4 m high, up to 2 m wide. Fl. cream & brown, Oct to Dec. Grey or white sand over laterite. Prostrate shrubs. Flowers in October, November or December.	Possible	Unlikely
Caladenia speciose ORCHIDACEAE	Not listed	P4	Tuberous, perennial, herb, 0.35-0.6 m high. Fl. white-pink, Sep to Oct. White, grey or black sand.	Possible	Unlikely
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	Unlikely
Grevillea saccate 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	Unlikely
Hypolaena robusta RESTIONACEAE	Not listed	P4	Dioecious rhizomatous, perennial, herb, ca 0.5 m high. Fl. Sep to Oct. White sand. Sandplains. Rhizomes spreading, glabrous. Basal sheath glabrous, dull, striate. Culms terete, internal structure (at base of culm) solid, glabrous, striate, not marbled, not fasciculate. Culm 230-570 mm long. Sheaths (including blade) spreading, dull, striate, glabrous. Flowering Time September or October.	Possible	Unlikely
Lepidobolus densus RESTIONACEAE	Not listed	P4	Rhizomatous, caespitose perennial, herb (sedge-like), to 0.4 m high. Yellow lateritic sand, lateritic gravel. Dry kwongan. Rhizomes tufted, hairy. Flowering Time August or September.	Possible	Unlikely

Species FAMILY Common name (if applicable)	Conservation status		Description	Potential to occur (pre-field survey)	Potential to occur (post-field survey)
	EPBC Act	BC Act			
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	Unlikely
Synaphea grandis PROTEACEAE	Not listed	P4	Tufted shrub, ca 0.3 m high. Fl. yellow, Oct to Nov. Laterite. Shrubs; branchlets hairy. Flowers in October or November.	Possible	Unlikely
Thysanotus glaucus ASPARAGACEAE	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	Unlikely
Tripterococcus sp. Brachylobus (A.S. George 14234) CELASTRACEAE	Not listed	P4	No description available.	Possible	Unlikely
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.	Possible	Unlikely
Verticordia paludosa MYRTACEAE	Not listed	P4	Erect shrub, 0.3-0.9 m high. Fl. pink-white, Jan to May. White/grey sand. Winter-wet flats.	Possible	Unlikely

Appendix D Plant taxa recorded within the Survey Area

FAMILY	Taxa
Amaranthaceae	*Ptilotus manglesii*
Anarthriaceae	*Lyginia barbata*
Apiaceae	*Xanthosia huegelii*
Araliaceae	*Trachymene pilosa*
Asparagaceae	*Laxmannia ramosa* subsp. *ramosa*
	Laxmannia squarrosa
	Lomandra caespitosa
	Lomandra hermaphrodita
	Thysanotus manglesianus
Asteraceae	* *Arctotheca calendula*
	Hyalosperma cotula
	* *Hypochaeris glabra*
	Podotheca angustifolia
	Podotheca gnaphalioides
	Siloxerus humifusus
	* *Ursinia anthemoides*
	Waitzia suaveolens
Campanulaceae	* *Wahlenbergia capensis*
Casuarinaceae	*Allocasuarina huegeliana*
	Allocasuarina humilis
	Allocasuarina microstachya
Celastraceae	*Stackhousia monogyna*
Colchicaceae	*Burchardia congesta*
Cupressaceae	*Callitris preissii*
Cyperaceae	*Caustis dioica*
	Gahnia decomposita
	Lepidosperma sp.
	Lepidosperma squamatum
	Lepidosperma tenue
	Mesomelaena pseudostygia
	Mesomelaena stygia subsp. *stygia*
	Schoenus curvifolius
	Tetraria octandra
	Cyperaceae sp.
Dasypogonaceae	*Calectasia narragara*
Dilleniaceae	*Hibbertia acerosa*
	Hibbertia desmophylla
	Hibbertia huegelii
	Hibbertia hypericoides
	Hibbertia stellaris
	Hibbertia subvaginata
	Hibbertia vaginata
Droseraceae	*Drosera erythrorhiza* subsp. *erythrorhiza*
	Drosera macrantha subsp. *macrantha*
	Drosera stolonifera
	Drosera sp.
Ericaceae	*Conostephium pendulum*
	Leucopogon sp.
	Styphelia tenuiflora
Fabaceae	*Acacia cyclops*
	Acacia pulchella
	Acacia pulchella var. *pulchella*
	Acacia trigonophylla
	Bossiaea eriocarpa
	Daviesia decurrens subsp. *decurrens*
	Daviesia divaricata
	Daviesia nudiflora
	Daviesia nudiflora subsp. *nudiflora*

FAMILY	Taxa
	Daviesia preissii
	Daviesia sp.
	Daviesia triflora
	Gompholobium knightianum
	Gompholobium tomentosum
	Jacksonia floribunda
	Jacksonia nutans
	Jacksonia sternbergiana
	Labichea lanceolata subsp. *lanceolata*
Goodeniaceae	*Dampiera lavandulacea*
	Goodenia berardiana
	Lechenaultia biloba
	Scaevola calliptera
Gyrostemonaceae	*Gyrostemon subnudus*
Haemodoraceae	*Anigozanthos humilis* subsp. *humilis*
	Conostylis aculeata subsp. *aculeata*
	Conostylis aurea
	Conostylis juncea
	Conostylis serrulata
	Conostylis setigera subsp. *setigera*
	Conostylis setosa
	Conostylis sp.
	Haemodorum sp.
Hemerocallidaceae	*Hensmania turbinata*
Iridaceae	* *Gladiolus caryophyllaceus*
	Patersonia occidentalis
Juncaceae	*Juncus pallidus*
Lamiaceae	*Hemiphora bartlingii*
Lauraceae	*Cassytha racemosa*
Loranthaceae	*Nuytsia floribunda*
Macarthuriaceae	*Macarthuria australis*
Myrtaceae	*Astartea scoparia*
	Beaufortia elegans
	Beaufortia sp.
	Calothamnus quadrifidus
	Corymbia calophylla
	Eremaea asterocarpa
	Eremaea pauciflora
	Eremaea pauciflora var. *pauciflora*
	Eucalyptus rudis subsp. *rudis*
	Eucalyptus todtiana
	Hypocalymma angustifolium
	Hypocalymma xanthopetalum
	Kunzea glabrescens
	Kunzea recurva
	Melaleuca clavifolia
	Melaleuca preissiana
	Melaleuca rhaphiophylla
	Melaleuca seriata
	Melaleuca systena
	Melaleuca urceolaris
	Pericalymma ellipticum
	Scholtzia involucrata
	Verticordia nitens
Orchidaceae	*Caladenia flava* subsp. *flava*
	Caladenia sp.
	Pyrorchis nigricans
	Thelymitra campanulata
Poaceae	* *Aira caryophyllea*

FAMILY	Taxa
	Amphipogon amphipogonoides
	Austrostipa elegantissima
	* *Briza maxima*
	* *Ehrharta calycina*
	* *Ehrharta longiflora*
	Neurachne alopecuroidea
	Poaceae sp.
Proteaceae	*Adenanthos cygnorum* subsp. *cygnorum*
	Adenanthos meisneri
	Banksia attenuata
	Banksia dallanneyi
	Banksia hookeriana
	Banksia ilicifolia
	Banksia littoralis
	Banksia menziesii
	Banksia prionotes
	Banksia sessilis var. *sessilis*
	Conospermum incurvum
	Conospermum stoechadis subsp. *stoechadis*
	Conospermum triplinervium
	Hakea incrassata
	Hakea lissocarpha
	Hakea psilorrhyncha
	Hakea ruscifolia
	Hakea trifurcata
	Isopogon drummondii
	Isopogon linearis
	Petrophile linearis
	Petrophile macrostachya
	Petrophile serruriae
	Stirlingia latifolia
	Synaphea spinulosa
Restionaceae	*Alexgeorgea nitens*
	Chordifex sinuosus
	Lepidobolus preissianus
	Loxocarya cinerea
	Restionaceae sp.
Rubiaceae	*Opercularia spermacocea*
Rutaceae	*Philotheca spicata*
Stylidiaceae	*Levenhookia pusilla*
	Stylidium piliferum
	Stylidium repens
	Stylidium sp.
Xanthorrhoeaceae	*Xanthorrhoea preissii*
Zamiaceae	*Macrozamia riedlei*

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