

16 MILE WELL PROJECT WORKS APPROVAL

**Prescribed Premises Category:
70 (Crushing and Screening)**

Prepared by



Comprehensive Mine Site Services

MLG Oz Limited

Version 1.0

14 April 2025

Final

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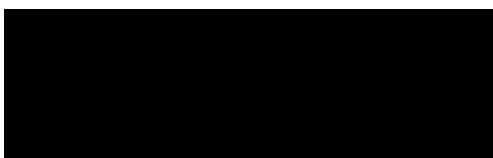
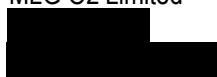
1. INTRODUCTION

1.1 Ownership

The 16 Mile Well Project (“**16 Mile**”, “**the Project**”) is owned and operated by MLG Oz Limited (“**MLG**”). MLG is listed on the Australian Stock Exchange as ASX: MLG.

All compliance and regulatory requirements regarding this assessment document should be forwarded by email or post to the following address:

Proponent: MLG Oz Limited



1.2 Location, Tenure and Site Layout

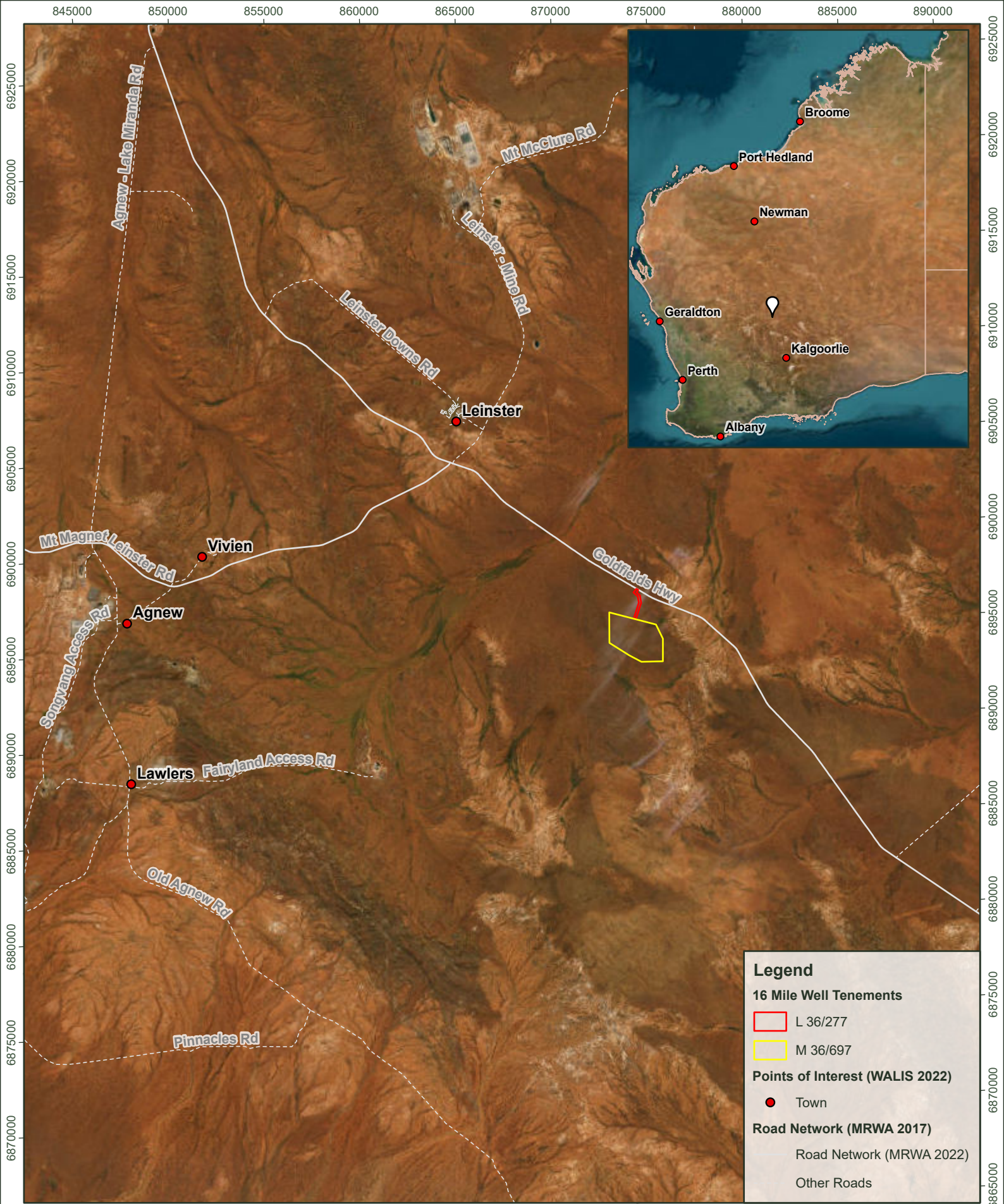
The Project is located 13 km southeast of Leinster in Western Australia. It is accessed from the Goldfields Highway and minor site access roads on L36/277. The project is situated on M36/697, which covers approximately 506.1 ha. The location of the Project is shown in **Figure 1**.

1.3 Proposed Prescribed Premise Area

The proposed Prescribed Premises category applicable to this Works Approval is:

- **Category 70:** *Screening, etc. of material: premises on which material extracted from the ground is screened, washed, crushed, ground, milled, sized or separated (More than 5 000 but less than 50 000 tonnes per year).*

The Prescribed Premise area where the mobile screening unit will be located is shown in **Figure 2**.



Scale: 0 4 8 km

Projection: GDA2020 MGA Zone 51



PROJECT

NAME

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DRAWING

Project Location

FIGURE No.

1

PROJECT No.

ADV-AU-00384

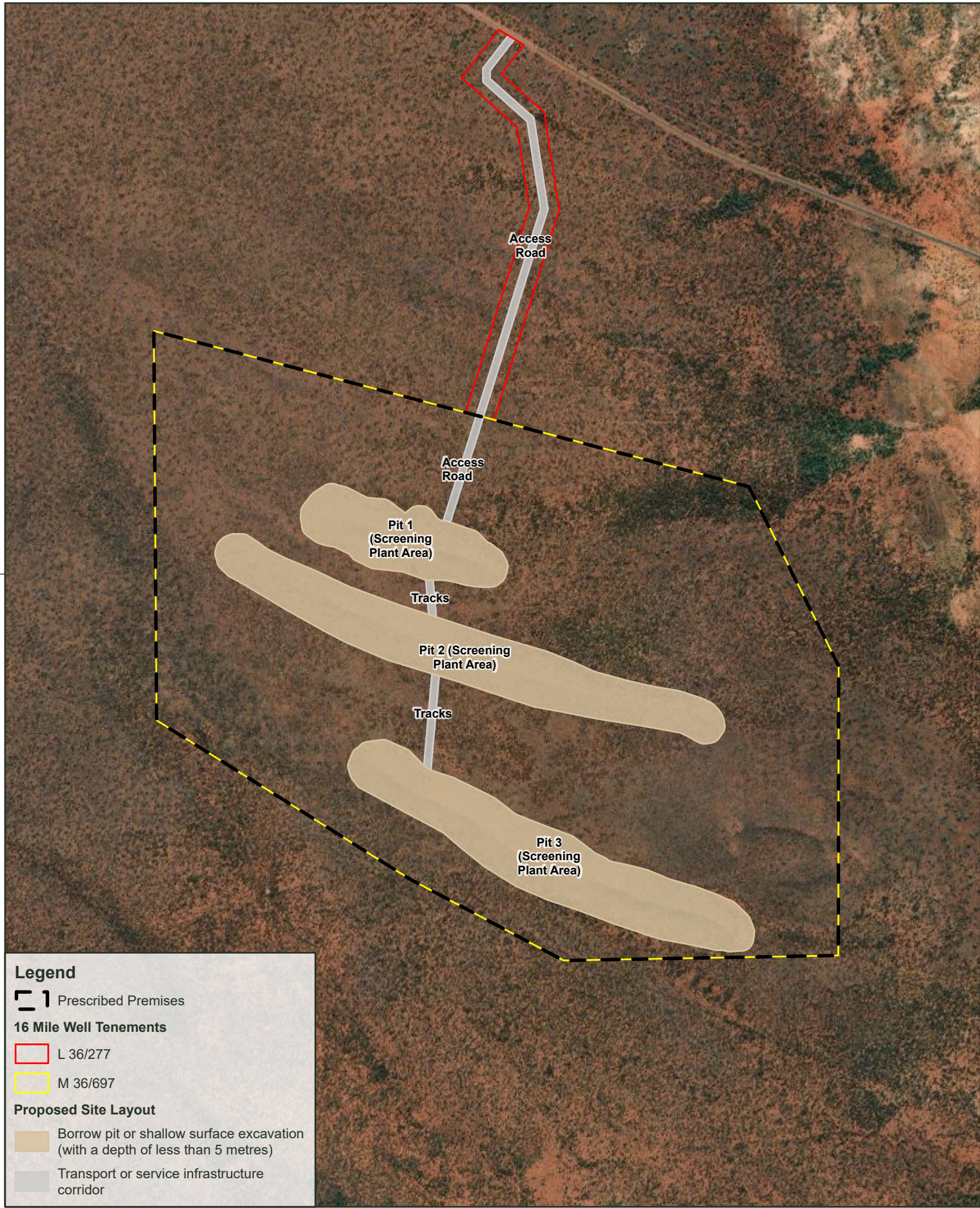
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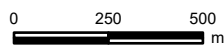
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Comprehensive Mine Site Services




Scale: 1:20,000



Projection: GDA2020 MGA Zone 51



PROJECT				CLIENT	
NAME				 Comprehensive Mine Site Services	
16 Mile Well - ESG - Works Approval					
DRAWING					
Prescribed Premises Boundary					
FIGURE No.	2	PROJECT No.	ADV-AU-00384	DATE	April 2025

2. EXISTING ENVIRONMENT

Baseline environmental data is presented below for 16 Mile Well. Where appropriate, specific project operational areas have been described in detail. The baseline data used for this Mining Proposal is based on available historical survey information and the most recent surveys undertaken.

2.1 Regional Setting

The Project is located within the East Murchison subregion of the Murchison Region as described by the Interim Biogeographic Regionalisation from Australia (IBRA) Version 7 (DCCEEW, 2020). The East Murchison sub-region is situated in the Yilgarn Craton covering an area of 7,847,996 ha (Cowan et al., 2001). East Murchison area is characterised by its internal drainage and elevated red desert sandplains with minimal dune development. The vegetation is dominated by Mulga woodlands with ephemerals, hummock grasslands, saltbush shrublands and *Halosarcia* shrublands (Cowan et al., 2001).

2.2 Climate

The nearest meteorological station to the Project is Leinster Aero (site number 012314), located approximately 10 km northwest of the Project site. Site 012314 readings commenced in 1994 with the latest available data from 18 August 2022.

The annual average rainfall reported at the site is 251.6 mm (BOM, 2022). The highest rainfall typically occurs in February (40.9 mm) and the lowest rainfall occurs in September (3.6 mm). The annual average number of days of rain is 30.8. Temperatures range from a mean maximum of 37.3°C in January to 19°C in July. Minimum mean temperatures at the Project site range from 23.2°C in January to 6.2°C in July. On average, there are 83.2 days per annum where the temperature is above 35°C. The highest mean number of days per month is January, with 22.3 days above 35°C.

2.3 Geology

The project is located within the Eastern Goldfields Province of the Yilgarn Craton. This province is typically defined by sequences of metamorphosed sedimentary, volcanic and intrusive rocks form linear greenstone belts separated by large areas of granitoid rock. The tenement area is situated west of a greenstone belt and is underlain by north-northwest trending felsic gneiss and granite. Overlying the granitic basement rocks are alluvial, colluvial or lacustrine formations of the Cainozoic age (Griffin, 1990), including lateritic/pisolithic materials and sand sheets. The tenement area has undulating northwest to southeast trending sand dunes. The dunes have aeolian characteristics and are of likely Pleistocene age. They are presently fixed by low shrubby vegetation and hummock grasses.

2.4 Soil and Landforms

The Murchison Province consists of an extensive plateau of low relief. Laterite or silcrete mesas are usually found at the top of the landscape in areas of granitic basement (Tille, 2006). These mesas have lateritic breakaways, kaolinised footslopes (often saline) and are surrounded by gently sloping plains (Tille, 2006). There are also some low hills, domes and tor fields of granite, gneiss and quartz found in upper parts of the landscape (Tille, 2006).

The Project occupies the Salinaland Plains Zone which, according to Tille (2006), is comprised of:

“Sandplains (with hardpan wash plains and some mesas, stony plains and salt lakes) on granitic rocks (and some greenstone) of the Yilgarn Craton. Red sandy earths, red deep sands, red shallow loams and red loamy earths with some red-brown hardpan shallow loams, salt lake soils and red shallow sandy duplexes. Mulga shrublands with spinifex grasslands (and some halophytic shrublands and eucalypt woodlands). Located in the northern Goldfields from Lakes Barlee and Ballard to Wiluna and Laverton”.

A desktop assessment of the DWER contaminated sites database (DWER, 2021) for known contaminated sites within and around the Project area was undertaken. The closest known contaminated site is 27 km southeast of the M36/697 on tenement M 36/582 (Parcel ID 71567, Date Classified 23 October 2019).

RPM Advisory Services Pty Ltd (RPM) were commissioned by MLG to conduct a Soil Assessment of three proposed deposits sites, including Comet Vale (E297/42), Mt Keith (E53/1480), and Jonah Bore (M36/657) owned by MLG in the surrounding areas. 16 Mile Well is situated within close proximity to all three other deposits, signifying soil conditions at 16 Mile Well will be similar to those of the other three proposed deposits.

The full soil assessment report is provided in **Appendix 1**. The key findings from this soil assessment comprise of (RPM, 2022):

- The materials are loose, pale red-brown aeolian sands with very low plant available water capacity.
- Although the sands have a low risk of generating significant amounts of dust, they contain substantial amounts of fine to medium sand-sized particles that are easily mobilised by moderate to strong wind gusts. The growth of emerging seedlings may be impacted by the associated sand blasting if the area is not thoroughly ripped.
- The sands are moderately acidic, with pH values ranging from 5.3 to 5.6. As the soils are comprised mainly of silica particles with very low concentrations of exchangeable aluminium, the acidity levels are unlikely to be a problem for common sand dune species (notably *Spinifex Triodia* spp) in the arid regions of WA.
- The sands are non-saline and non-sodic.
- Nutrient content and soil organic matter contents are extremely low. Low Phosphorus Buffering Index and cation exchange capacity values indicate they have very little capacity to retain soluble nutrients applied as soluble fertilisers or mineralised organic materials. The very low nutrient status is unlikely to support high densities of plant species, and application of slow-release, balanced fertilisers may be beneficial for revegetation.
- Heavy metal and metalloid concentrations are exceptionally low and, with the exception of slightly elevated nickel (when compared to DWER contamination threshold values) in the Comet Vale sample, comply with “clean fill” criteria in WA .

Overall, the soils property is described as stable, geochemically benign aeolian sands with limited nutritional value for plant growth. Given that local, native plant species are adapted to these conditions, revegetation of disturbed surfaces is expected to occur over time. This is reinforced by the positive performance of areas that have already been rehabilitated by MLG, as demonstrated by rehabilitation performance monitoring reports (Blueprint, 2021b, 2021a) and general site observations.

2.5 Hydrology

Regionally, drainage occurs largely by sheetwash into poorly defined ephemeral drainage lines, which either disappear into extensive flats, or flow after significant storm events into the adjoining, internally draining, Lake Carey paleodrainage system.

Locally, the Project area is situated relatively high in the landscape and only 10 km north of the catchment divide between the Lake Carey and Raeside-Pontoon catchments. The area includes the majority of a small local catchment that drains in a north-westerly direction towards a minor, unnamed ephemeral drainage line located approximately 5 km northwest of the Project. M36/697 covers 506.1 ha out of 184,885 ha (2%) of this catchment. The Project topography is relatively subdued, with slope angles generally not exceeding 5°. Elevations across the site vary from approximately 490 RL (AHD) in the northwest of to approximately 520m RL (AHD) in the southeast.

Given the elevated position in the landscape and absence of any significant upstream catchment area, the Project is unlikely to be subjected to flooding under most storm events.

2.6 Hydrogeology

The regional hydrogeology is dominated by Cenozoic paleochannels and the associated underlying major regional fracture sets, which control their orientation. Locally, the MLA is situated over fractured and deeply weathered rock, which typically forms localised, minor aquifers and groundwater resources, although locally large supplies from fracture zones and permeable horizons may be present. To the north of the Project, and in association with the Lake Carey paleosystem, lies an alluvial/colluvial deposit. These surficial deposits usually represent minor to major groundwater resources.

An assessment of DWER's online Water Information Reporting database suggests that local groundwater levels are in excess of 30 mbgl and have varying salinities ranging from brackish to saline.

The Project is not anticipated to intercept groundwater and no impacts to groundwater are expected to occur from the proposed activities.

2.7 Flora and Vegetation

Goldfields Landcare Services (GLS, 2021) was commissioned to conduct reconnaissance, detailed and targeted flora and vegetation surveys at the 16 Mile Well Project. This survey included a desktop assessment and two field surveys. The full report is provided in **Appendix 2**.

The desktop assessment identified:

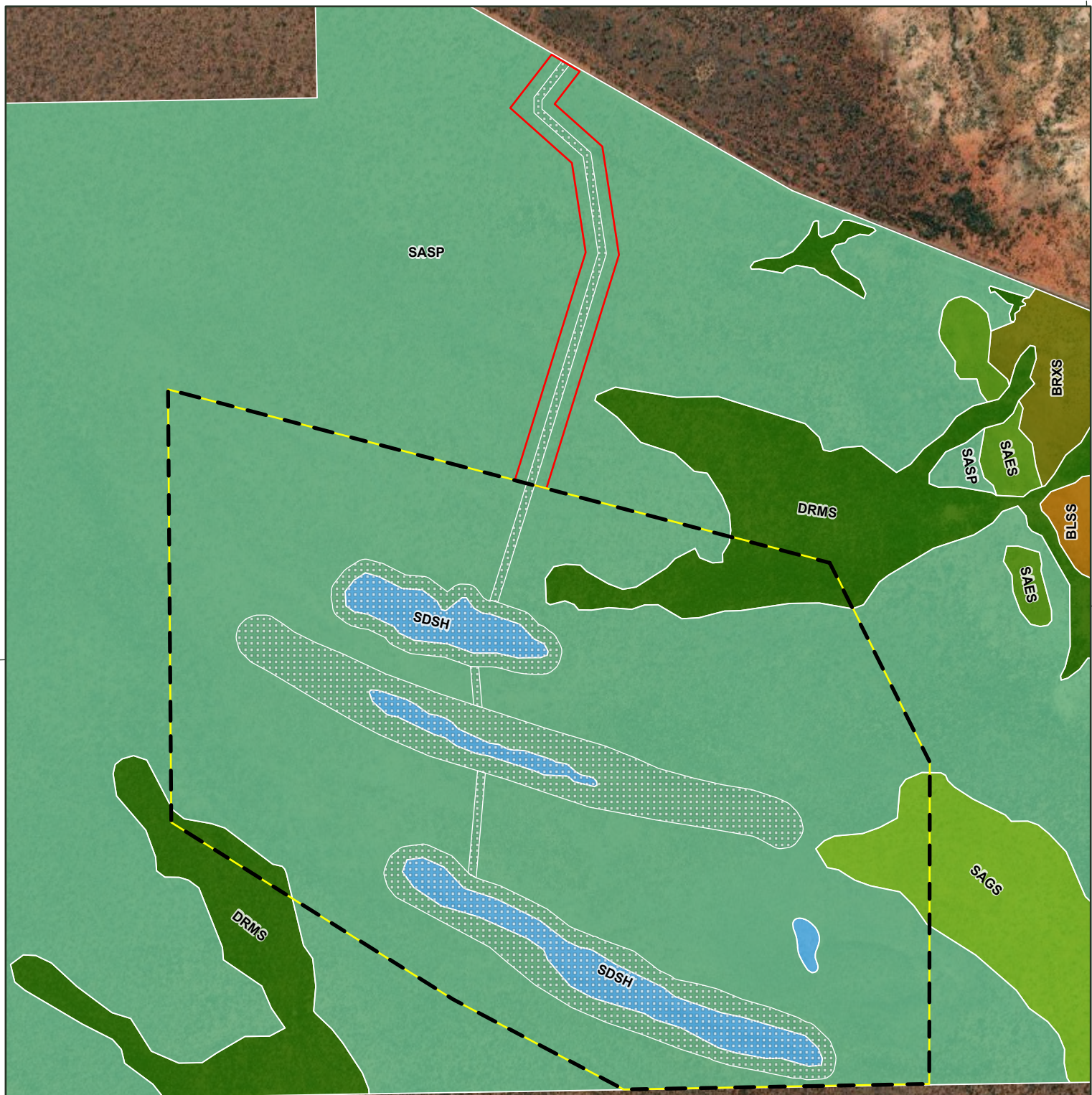
- A total of 42 species of conservation significance from five database searches have the potential to occur in the area, including two Threatened species, ten Priority 1 (P1) species, three Priority 2 (P2) species, 23 Priority 3 (P3) species, and four Priority 4 (P4) species.
- No Threatened Ecological Communities (TECs) are located within the Project area, with the nearest TEC approximately 73 km west of 16 Mile Well. The TEC is the 'Depot Springs stygofauna complex'.
- No Priority Ecological Communities (PECs) are located within the Project area, with the nearest PEC approximately 28 km north-northeast of 16 Mile Well. The PEC is the 'Yandal calcrete groundwater assemblage type on Carey Paleodrainage on Yandal Station'.

The first field survey was a reconnaissance survey completed by between 9 July 2021 and 13 July 2021 and covered an area of 1,721.5 ha identifying:

- 119 different species including sub-species and varieties from 26 families and 49 genera. The most abundant genera were *Eremophila* with 15 species and *Acacia* with 14 species.
- No non-native introduced species were recorded within the survey area.
- No conservation significant flora classified under Part 2 of the BC Act or Threatened flora classified under the EPBC Act were recorded within the survey area.
- No Priority flora species as listed by DBCA were recorded within the survey area. However, seven specimens were unable to be identified as they require floral parts to provide a positive determination. It was anticipated that the specimens will be able to be identified in the Spring survey.
- No TECs or PECs listed under state or federal legislation were identified within the survey area.
- A total of nine broad scale vegetation communities were identified.

The second field survey was completed as a detailed flora and vegetation survey with targeted searches of Priority species completed between 6 and 9 September 2021 over a more refined area of 648 ha. The field survey identified:

- Nine vegetation types identified from two land systems (**Figure 3**):
 - The Bullimore Land system comprised of five sub-types of Sandplain Spinifex Hummock Grassland (SASP). Due to the complex mosaic of similar vegetation types that had indistinguishable boundaries, three of the SASP sub-types were amalgamated. SASP was considered the most extensive vegetation type within the study area and made up ~86% of the total vegetation composition.
 - The Sherwood land system comprised of four vegetation types which make up ~13% of the total vegetation composition in the study area:
 - Bladder Saltbush Low Shrublands.
 - Breakaway Mixed Shrublands.
 - Stony Plain Acacia-Eremophila Shrublands.
 - Drainage Tract Mulga Shrublands.
- Vegetation condition was described as “Good” with evidence of historical mineral exploration activities and sheep grazing infrastructure in the form of fences, wells, bores and windmills.
- A total number of 147 plant taxa from 29 families and 71 genera.
- None of the plant taxa recorded from the study area were protected under the BC Act or EPBC Act.
- One sterile specimen of *Seringia* species, potentially *Seringia exastia* was collected. This species is currently listed as Critically Endangered under the BC Act and EPBC Act (**Figure 4**).
- Two species recorded from the study area were listed as Priority flora taxa by the DBCA (**Figure 4**):
 - *Bossiaea eremaea* (Priority 3).
 - *Thryptomene* sp. Leinster (B.J. Lepschi L. Craven 4362) (Priority 3).
- No plant species listed as a Weed of National Significance under the EPBC Act were encountered in the survey area.
- No non-native introduced species were recorded within the survey area.
- The Proposed Site Layout was designed to limit disturbance to the extensive Sandplain Spinifex Hummock Grassland within the Bullimore Land System (**Figure 3**) and to avoid all identified Conservation Significant Flora Species (**Figure 4**).



Legend

	Prescribed Premises	Vegetation Units (GLS, 2021)		SASP, Sandplain Spinifex Hummock Grasslands
	Proposed Site Layout			SDSH, Sand Dune Shrublands
16 Mile Well Tenements				
	L 36/277			
	M 36/697			



Scale: 1:20,000
0 250 500 m

Projection: GDA2020 MGA Zone 51

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Vegetation Communities

FIGURE No.

3

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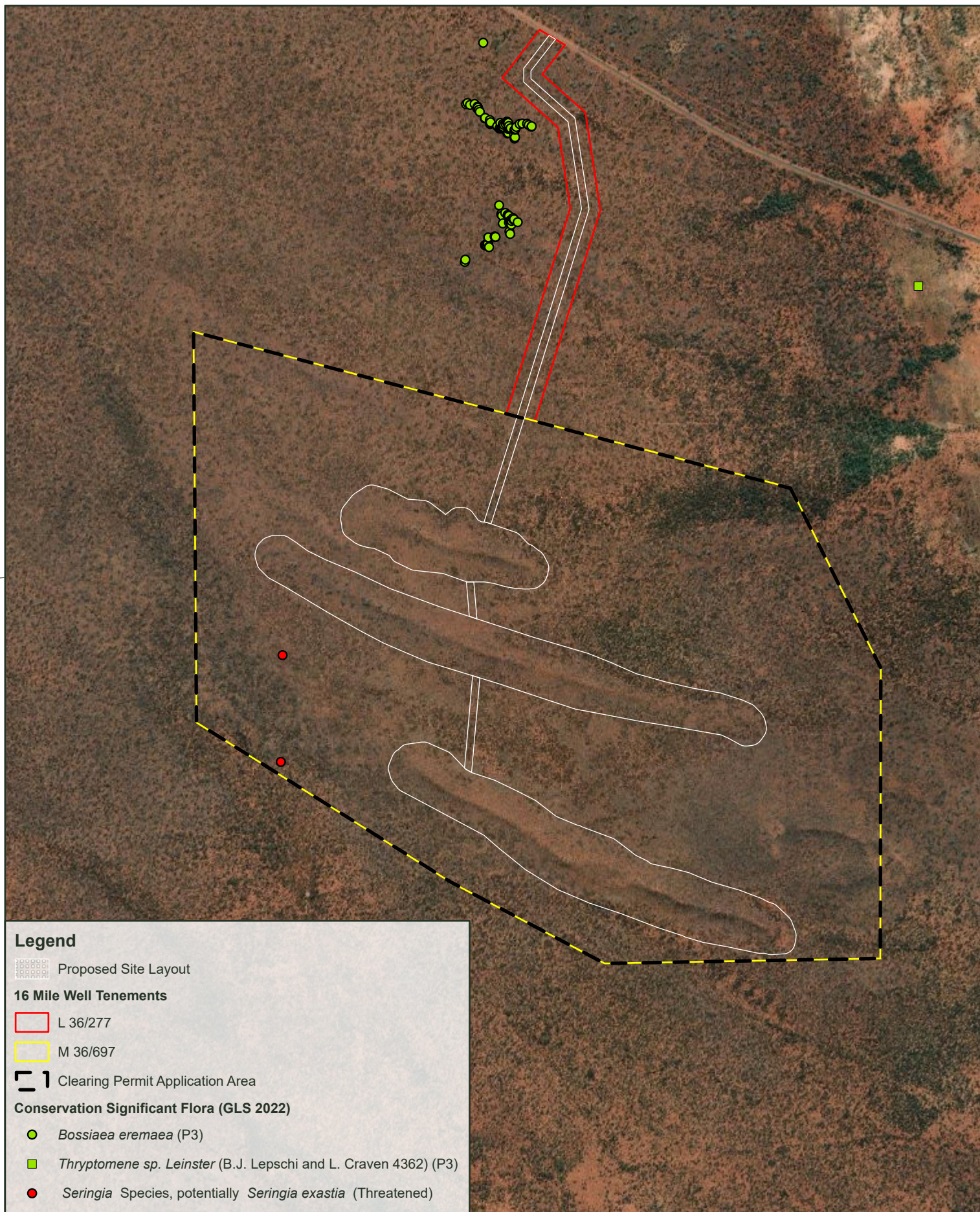
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Conservation Significant Flora

FIGURE No.

4

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2.8 Fauna and Habitat

Vertebrate Fauna and Habitat

Western Wildlife undertook a Basic Vertebrate Fauna Survey in August 2021 (Western Wildlife, 2022), (**Appendix 3**), covering a survey area of 685.5 ha.

The key findings of the study are:

- Four habitat types were delineated and mapped (**Figure 5**):
 - Eucalypt – spinifex sandplain habitat type covers an area of 64.1 ha and consists of consolidated sands providing habitat for burrowing mammals and reptiles. Eucalypts are also scattered across the habitat providing crevices and small hollows for the native fauna species of the area.
 - Mulga – spinifex sandplain habitat type covers an area of 492.5 ha and consists of dense vegetation providing nesting sites for birds.
 - Sand dune habitat type covers an area of 56.2 ha and consists of loose sands providing habitat for fossorial reptiles. Eucalypts are also scattered across the habitat providing crevices and small hollows for the native fauna species of the area.
 - Mulga drainage habitat type covers an area of 72.7 ha and consists of dense vegetation providing nesting sites for birds.
- Western Wildlife concluded that vegetation habitats of the study area are common and widespread in the semi-arid regions of Western Australia and are unlikely to provide ecological linkages or refugia.
- The predicted faunal assemblage of the Project area is considered moderately rich with up to nine frogs, 77 reptiles, 115 birds, 39 native mammals and nine introduced mammals. The assemblages include Eremaean fauna, with the study area most likely to be dominated by widespread arid-adapted species.
- The assessment identified 14 vertebrate species of conservation significance that may occur in the survey area, three of which are represented in **Figure 6**.
- Of the 14 conservation significant fauna, three species were recorded as known to occur or likely to occur, with suitable habitats present in the survey area.
 - Malleefowl (*Leipoa ocellata*) - Vulnerable (WA), Vulnerable (EPBC)
 - One inactive mound recorded outside of the Development Envelope.
 - Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4 (DBCAs)
 - Five sightings recorded during the survey .
 - Striated Grasswren (*Amytornis striatus striatus*) – Priority 4 (DBCAs)
 - One sighting during the field survey.
- The eucalypt and mulga -spinifex sandplain is known to provide habitat for both Priority 4 species, the Brush-tailed Mulgara and the Striated Grasswren.
- The mulga drainage habitat and denser patches within the mulga – spinifex sandplain habitat was identified as likely breeding habitat for the Threatened *Leipoa ocellata* (Malleefowl):
 - No Malleefowl mounds are present within the MLA (**Figure 6**)
 - Western Wildlife concluded that vegetation habitats of the study area are common and widespread in the semi-arid regions of Western Australia and are unlikely to provide ecological linkages or refugia (Western Wildlife, 2022). The project is unlikely to affect the two Priority habitats as the main focus of the operation is on sand and gravel from the sand dune habitat. The proposed site layout is designed to limit disturbance to that which is essential for the development of the project. This results in minimal disturbance to the eucalypt and mulga spinifex sandplains for access roads and tracks.

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Legend

- | | | | |
|--|------------------------|---|-------------------------------|
| | Proposed Site Layout | Fauna Habitats (Western Wildlife 2022) | |
| | Prescribed Premises | | Mulga - Spinifex sandplain |
| | 16 Mile Well Tenements | | Eucalypt - Spinifex sandplain |
| | L 36/277 | | Mulga Drainage |
| | M 36/697 | | Sand dune |



Scale: 1:20,000
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Fauna Habitat

FIGURE No.

5

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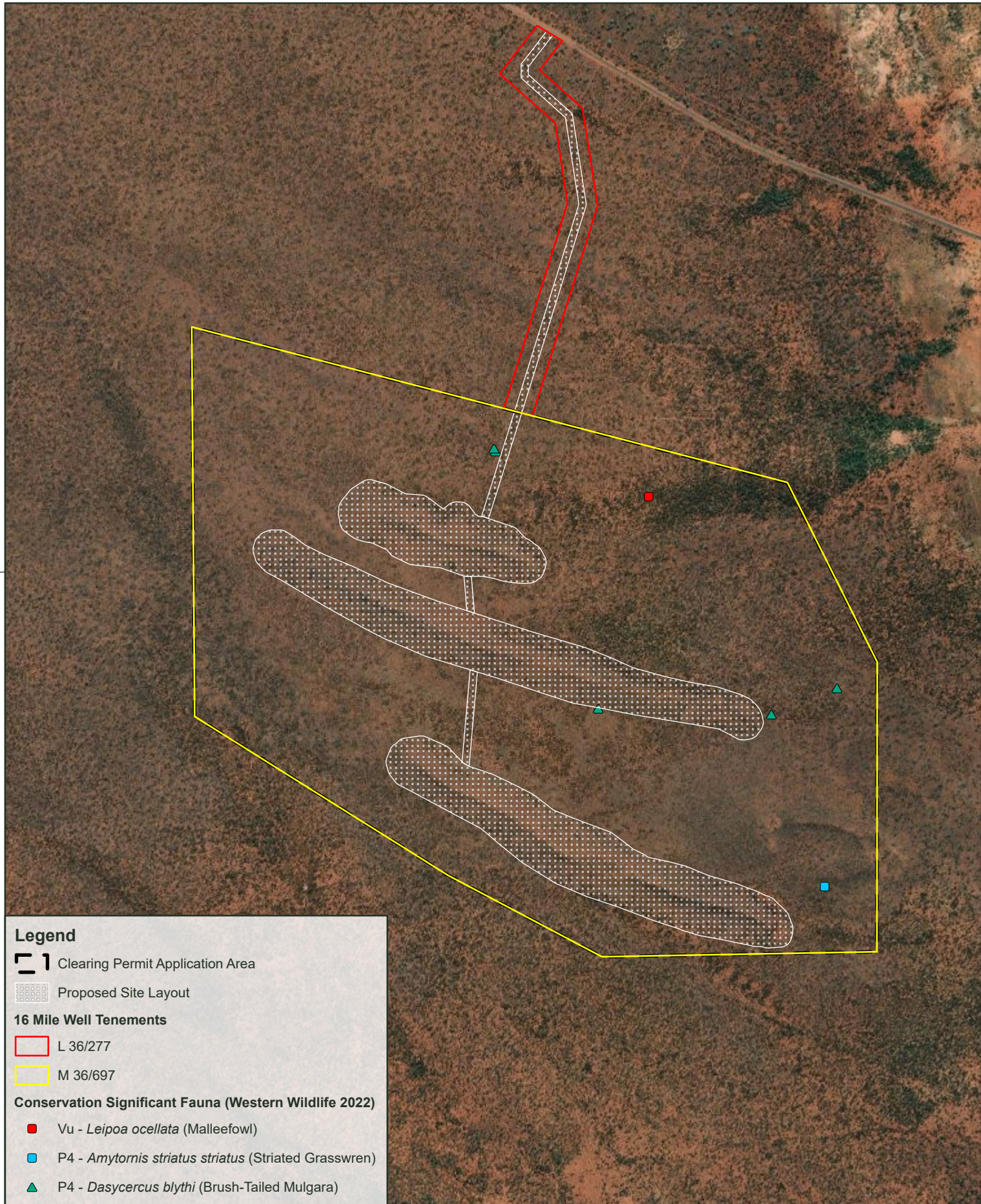
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Legend

Clearing Permit Application Area

Proposed Site Layout

16 Mile Well Tenements

L 36/277

M 36/697

Conservation Significant Fauna (Western Wildlife 2022)

Vu - *Leipoa ocellata* (Malleefowl)

P4 - *Amytornis striatus striatus* (Striated Grasswren)

P4 - *Dasycercus blythi* (Brush-Tailed Mulgara)



Scale: 1:20,000
0 250 500
m

Projection: GDA2020 MGA Zone 51



PROJECT

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Conservation Significant Fauna Records

FIGURE No.

6

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2.9 Short Range Endemic

Invertebrate Solutions Pty Ltd (Invertebrate Solution, 2022) was contracted to complete a Short-Range Endemic (SRE) desktop assessment of 16 Mile Well (**Appendix 4**). This survey was undertaken in regard to the 'Technical Guidance – Sampling of short-range endemic invertebrate fauna' (EPA, 2016).

The Project area has potential SRE habitats, associated with the drainage lines and the denser vegetated areas in the eastern and southwestern sections of the Project area. The desktop assessment identified:

- One potentially occurring conservation significant invertebrate having a moderate likelihood of occurrence being a mygalomorph spider – *Idiosoma clypeatum* (Priority 3).
- Five likely occurring SRE species having a low likelihood of occurrence:
 - idiopid trapdoor spiders (Kwonkan goongarriensis and Kwonkan moriartii).
 - armadillid isopod (*Acanthodillo* sp.'7').
 - millipedes (*Antichiropus* 'DIP002' and *Antichiropus* 'DIP003').

Any potential SRE taxa would not be restricted to the small amount of habitat present within the Project area as these habitats extend beyond the Project area and are continuous in the regional landscape. All identified species within the project area are considered possible SREs due to data deficiencies and absence of taxonomic frameworks that prohibit a conclusive assignment of SRE status. The remaining species identified from desktop resources were found to be widespread.

2.10 Subterranean Fauna

Subterranean fauna does not require investigation due to the mining operations not intersecting groundwater and the low impact activities undertaken on the tenement.

2.11 Social Setting

2.11.1 Land Use and Community

The Project located 13 km southeast of Leinster in the Shire of Leonora. The Shire of Leonora is sparsely populated, with a total population of 1,411 (ABS, 2022). Of this, 202 (14.3%) are Indigenous Peoples (ABS, 2022). The nearest population centre to the Project is the town of Leinster, with a population of approximately 405 (ABS, 2022). The Project is wholly on the Leinster Downs Station pastoral lease which operates currently as a sheep station. The principal economic activities in the area are gold and nickel mining, prospecting, pastoralism and tourism.

2.11.2 Aboriginal Heritage

A J Consulting (2022) were commissioned to undertake an Aboriginal cultural heritage survey of the mining lease application area. This included a field survey and desktop assessment. The full report is provided in **Appendix 5** and results are described below and represented in **Figure 7**.

Desktop assessment findings:

- One registered site (Parra Hill, Site ID 2728) and one lodged (Weebo Site 19, Site ID 29103) are located inside tenement E36/1003. Both are located on the northern side of the Goldfields Highway and are not within the mining lease application area (**Figure 7**).

There are several sites of cultural significance near the survey area. These sites are ethnographic in nature and are associated with breakaways and rocky outcrops.

Field Survey Findings:

The entire mining lease area and access road alignment were surveyed for the presence of Aboriginal sites.

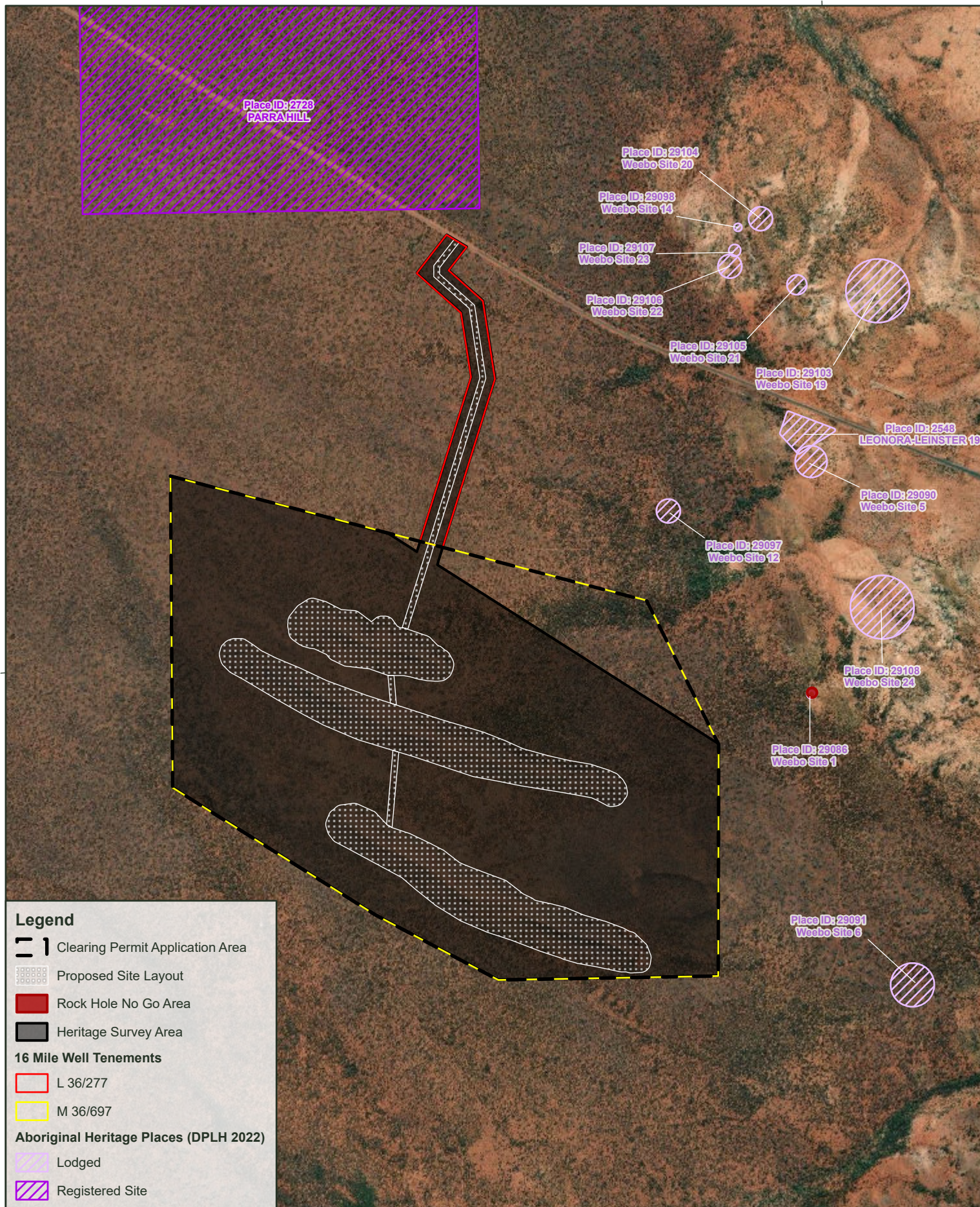
- The sandy substrate would have offered a hospitable environment for Aboriginal people to move through, use and occupy. The limited natural water, lithic raw material and food supply resources in the area would have influenced the nature and duration of occupation of Aboriginal people.
- Landforms associated with use by Aboriginal people in the past, and good preservation conditions, such as breakaways, rock shelters and rock overhangs, are not present in the survey area.
- No artefacts were observed, nor is there any outcropping of suitable material for tool manufacture, and there is no evident natural water source. The survey party agreed that there is no evidence of past use associated with this area.

No Aboriginal sites were identified during the three days field survey. An important and well-known rock-hole site that holds domestic and religious significance in Western Desert tradition is located just outside of the mining lease area (**Figure 7**).

The survey party emphasised that the site cannot be disturbed or impacted in any way. The survey party were satisfied that the area proposed for mining is clear of any Aboriginal sites and there is no cultural heritage impediment to the mining proceeding.

2.11.3 Non-Aboriginal Heritage

A search of the Heritage Council State Heritage Office inHerit database was undertaken on 26 July 2022 (Heritage Council State Heritage Office, 2022). No places of Non-Aboriginal heritage value were recorded within M36/697. The closest state-registered place is located in Sandstone, approximately 155 km west of the Project.



Scale: 1:25,000
0 250 500 m

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PROJECT

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Aboriginal Heritage

FIGURE No.

7

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3. PROJECT DESCRIPTION

The Project is a small-scale sand and gravel mining operation that will consist of shallow excavation of sand and gravel for use in the construction industry. The proposed site layout is provided in **Figure 2**. The mining operation will be carried out in a basic strip-mining style, comprising:

- Pre-stripping of vegetation and soil, which is stockpiled in low windrows perpendicular to the active mining area for later use in rehabilitation.
- Excavation of sand and gravel to a typical depth of 1.5 m (maximum of 5 m) is subsequently screened into different product sizes and loaded into road trains for transport offsite.
- Progressive rehabilitation of mined areas with no more than 10 ha of borrow pit open at one time.

Up to 150, 000 tonnes per annum of sand and gravel materials will be excavated, and of that up to 50,000 tonnes per annum to be screened:

- One Komatsu 155 bulldozer (pre-strip and rehabilitation activities).
- One Caterpillar 966H front end loader (road train loading of the material).
- Two Kenworth road trains (transport of the mined sand and gravel to the end customer).
- One Kenworth water truck (dust suppression).
- One Caterpillar 140H grader for road maintenance.
- One Mobile screening unit.

Explosives will not be used as part of strip-mining activities, and disturbed land will be progressively rehabilitated. No waste rock will be produced by this operation.

Sand and gravel will be picked up by a front-end loader and loaded into the mobile screening plant. The plant will be situated within already disturbed areas and will move across the active working area as required. No further processing will be required. The screened product will be stockpiled and loaded into road trains when required by a front-end loader.

4. COMPLIANCE AND CONSULTATION

4.1 Legislative Framework

A summary of the relevant environmental legislation applicable to this Works Approval is provided in **Table 1**.

Table 1: Environmental Legislative Framework

Relevant Legislation	Environmental Factor	Relevant Approval/Requirement and Status
<i>Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i>		
Projects with the potential to have significant impacts upon Matters of National Significance require referral.	Assessment against Matters of National Significance.	The Project is not considered to trigger referral under the EPBC Act. It is considered unlikely that the Project will have an impact on Matters of National Significance.
<i>Mining Act 1978 (Mining Act)</i>		
Projects involving mining, processing and associated activities that require approval and regulation under the Mining Act.	<p>Compliance with tenement conditions.</p> <p>Assessment of Mining Proposals (MP) and Mine Closure Plans (MCP). MCPs are reviewed every three years.</p>	<ul style="list-style-type: none"> MLG is committed to complying with tenement conditions. An MP and MCP will be submitted to the Department of Mines, Industry Regulation and Safety (DMIRS). The MP and MCP will be prepared to conform with the DMIRS Guidelines. (DMIRS, 2020b, DMIRS, 2020a).
<i>Environmental Protection Act 1986 (EP Act)</i>		
Part IV: Projects with the potential to have significant impacts on the environment require referral. An explanation of 'significance' is provided in the document 'Statement of Environmental Principles, Factors and Objectives' prepared by the Environmental Protection Authority (EPA) in June 2018.	<p>Key environmental factors assessed via EPA assessment under Part IV:</p> <ul style="list-style-type: none"> Benthic Communities and Habitats. Coastal Processes. Marine Environmental Quality. Marine Fauna. Flora and Vegetation. Landforms. Subterranean Fauna. Terrestrial Environmental Quality. Terrestrial Fauna. Inland Waters. Air Quality. Social Surroundings. Human Health. 	Based on the review of environmental data for the Project, it is considered unlikely that the Project poses a significant impact to any Key Environmental Factors. The Project does not trigger a referral to the EPA and can be adequately managed under the provisions of the Mining Act and Part V of the EP Act and associated regulations.
Part V (Section 51): Clearing of Native Vegetation: Part V of the EP Act specifies that clearing of native vegetation in Western Australia requires a permit. The clearing provisions of this Act are described in the <i>Environmental Protection Amendment Act 2003</i> (Western Australia) and the <i>Environmental Protection (Clearing of Native Vegetation) Regulations 2004</i> .	Assessment against the ten clearing principles (biological diversity, significant fauna habitat, rare flora, threatened ecological community, remnant vegetation, association with watercourse or wetland, cause appreciable land degradation, impact on a conservation area, impact surface or underground water quality, cause or exacerbate flooding).	A Native Vegetation Clearing Permit (NVCP) application will be submitted to DMIRS for the clearing activities proposed in this Mining Proposal.

Relevant Legislation	Environmental Factor	Relevant Approval/Requirement and Status
Part V (Section 52): Establishes a range of statutory instruments to permit the assessment and management of environmental outcomes arising from emissions from industry by DWER. Prescribed Premises categories are defined in Schedule 1 of the <i>Environmental Protection Regulations 1987</i> .	A Works Approval authorises work to be undertaken on Prescribed Premises that is likely to cause, increase, alter or result in discharge of waste, emission of noise, odour or electromagnetic radiation to the environment.	This Works Approval is being submitted for the mobile screening and crushing plant at the Project. Category 70: <i>Screening, etc. of material: premises on which material extracted from the ground is screened, washed, crushed, ground, milled, sized or separated (More than 5 000 but less than 50 000 tonnes per year).</i>
Biodiversity Conservation Act 2016 (BC Act)		
The BC Act is West Australian legislation for protection of Threatened flora, fauna and communities and in Western Australia and is administered by DBCA.	Threatened and Priority Flora, Fauna and Ecological Communities	It is unlikely that the proposal will impact the conservation status of any flora and fauna species based on the assessment of flora, vegetation, terrestrial fauna and communities completed by specialist consultants.
Aboriginal Heritage Act 1972 (AH Act)		
The AH Act allows for the protection of Aboriginal cultural heritage in Western Australia.	Protection of Aboriginal heritage sites and matters.	The project is outside of the boundary of Aboriginal registered site 2728 and any lodged Aboriginal heritage sites (Figure 7).
Aboriginal Cultural Heritage Act 2021 (ACH Act)		
The ACH Act provides recognition, protection, conservation and preservation of Aboriginal cultural heritage in Western Australia.	Protection of Aboriginal cultural heritage.	The project is outside of the boundary of Aboriginal registered site 2728 and any lodged Aboriginal heritage sites (Figure 7). MLG is committed to reporting any discovery of potential unregistered sites to the Registrar in accordance with Section 15 of the AH Act.
Native Title Act 1993 (Commonwealth)		
Records of Native Title applications and determinations to the Federal Court under the <i>Native Title Act 1993</i> are maintained by the National Native Title Tribunal.	Native Title registrations.	There are no Native Title applications or determinations within M36/697.
Rights in Water and Irrigation Act 1914 (RIWI Act)		
Provides for the regulation, management, use and protection of water resources.	Groundwater licences are required to abstract groundwater for dewatering and water supply purposes within proclaimed groundwater areas.	No groundwater licence is required for this Project as the excavation does not intersect groundwater.
National Greenhouse and Energy Reporting Act 2007 (Cth) (NGER Act)		
The NGER Act provides a national framework for reporting of greenhouse gas emissions and energy production and consumption.	Greenhouse gas emissions	MLG is not required to report greenhouse gas emissions due to the operations being below specified reporting thresholds.
Contaminated Sites Act 2003 (CS Act)		
The CS Act requires that known or suspected contamination is reported to DWER where the substance is present at above background concentrations in the land or waters of a site that presents or potentially presents a risk of harm to human health, the environment or any environmental value.	Contaminated sites.	A search of the DWER Contaminated Sites Database indicated that no confirmed contaminated sites have been listed under the CS Act within the Project area. There are no suspected contaminated sites associated with this Project.

4.2 DWER Guidelines

In 2016 to 2019, DWER released a series of guidelines that apply to Works Approvals, Licences and associated impact assessments. Guidelines that are of specific relevance to this Works Approval are listed in **Table 2**.

Table 2: Consideration of DWER Guidelines

Document Title	Description	Discussion
Guidance: Industry Regulation Guide to Licensing (DWER, 2019).	Describes the assessment process for works approvals and licence applications.	<ul style="list-style-type: none"> Reviewed as part of the application preparation process.
Guidance Statement: Environmental Risk Assessment Framework (DWER, 2017).	Establishes a risk assessment framework for assessment of Part V applications.	<ul style="list-style-type: none"> The risk assessment framework, including definitions of likelihood and consequence provided in the Guidance Statement, has been utilised as an impact assessment tool for this application.
Guidance Statement: Environmental Siting (DWER, 2016).	Provides guidance to environmental siting to inform the risk assessment of activities carried out on the Prescribed Premises. Environmental siting is the consideration of a Prescribed Premises in relation to sensitive and high value ecosystems.	<ul style="list-style-type: none"> No Threatened species will be impacted by the Project. There are no public drinking water supply areas within the Project footprint. There are no Ramsar wetlands within the Project footprint. There are no waterways within the Project footprint.

4.3 Consultation

The stakeholder engagement register for the Project is included in **Appendix 6**.

5. CONTROL OF EMISSIONS

5.1 Risk Assessment Overview

A risk assessment was completed in accordance with the DWER Guidance Statement: 'Risk Assessments, Part V, Division 3, Environmental Protection Act 1986' (February 2017). The risk assessment process identified the following:

- The sources of pollution and where available, quantification of emissions.
- The pathway which pollution follows from the source to the receptor.
- The environmental and health receptors.
- The potential impacts on the receptors from this source solution.
- The project specific controls and mitigation measures which will be applied to the Project.
- The likelihood, consequence and overall risk rating associated with this factor.
- The requirement for monitoring.

Likelihood and consequence categories (**Table 3** and **Table 4**) were derived from the Guidance Statement (DWER, 2017), and the associated risk matrix is presented in **Table 5**.

Table 3: Likelihood Criteria

Likelihood	Probability
Almost Certain	The risk event is expected to occur in most circumstances.
Likely	The risk event will probably occur in most circumstances.
Possible	The risk event could occur at some time.
Unlikely	The risk event will probably not occur in most circumstances.
Rare	The risk event may only occur in exceptional circumstances.

Table 4: Consequence Criteria

Consequence	Environment	Public Health and Amenity
Severe	<ul style="list-style-type: none"> • Onsite^A impacts: catastrophic. • Offsite impacts local scale: high level or above. • Offsite impacts wider scale: mid-level or above. • Mid to long-term or permanent impact to an area of high conservation value or special significance. • Specific Consequence Criteria (for environment) are significantly exceeded. 	<ul style="list-style-type: none"> • Loss of life. • Adverse health effects: high level or ongoing medical treatment. • Specific Consequence Criteria (for public health) are significantly exceeded. • Local scale impacts: permanent loss of amenity.
Major	<ul style="list-style-type: none"> • Onsite impacts: high level. • Offsite impacts local scale: mid-level. • Offsite impacts wider scale: low level. • Short-term impact to an area of high conservation value or special significance. • Specific Consequence Criteria (for environment) are exceeded. 	<ul style="list-style-type: none"> • Adverse health effects: mid-level or frequent medical treatment. • Specific Consequence Criteria (for public health) are exceeded. • Local scale impacts: high level impact to amenity.

Consequence	Environment	Public Health and Amenity
Moderate	<ul style="list-style-type: none"> Onsite impacts: mid-level. Offsite impacts local scale: low level. Offsite impacts wider scale: minimal. Specific Consequence Criteria (for environment) are at risk of not being met. 	<ul style="list-style-type: none"> Adverse health effects: low level or occasional medical treatment. Specific Consequence Criteria (for public health) are at risk of not being met. Local scale impacts: mid-level impact to amenity.
Minor	<ul style="list-style-type: none"> Onsite impacts: low level. Offsite impacts local scale: minimal. Offsite impacts wider scale: not detectable. Specific Consequence Criteria (for environment) likely to be met. 	<ul style="list-style-type: none"> Specific Consequence Criteria (for public health) are likely to be met. Local scale impacts: low level impact to amenity.
Slight	<ul style="list-style-type: none"> Onsite impact: minimal. Specific Consequence Criteria (for environment) met. 	<ul style="list-style-type: none"> Local scale: minimal impacts to amenity. Specific Consequence Criteria (for public health) criteria met.

^ 'Onsite' means within the prescribed premises boundary

Table 5: Risk Matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost Certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

Key sensitive receptors within the vicinity of the Project include:

- Flora, fauna and vegetation – immediate flora, fauna and vegetation surrounding the 16 Mile Project disturbance areas.
- Town of Leinster – located 13 km northwest of the Project.
- Leinster Downs Pastoral Station Lease holder and employees – the Project is situated within the Leinster Downs Pastoral Lease.

5.2 Risks and Impact Assessment

Potential impacts, control measures and risk evaluation associated with the proposal are summarised in **Table 6**. The risk criteria applied are based on DWER (2017), which includes environmental and public health criteria.

Table 6: Assessment of Risks

Emissions Source/Event	Pathway	Receptor	Event Impact	Controls	Consequence on Receptor	Likelihood of the Event Impact Occurring (after controls implemented)	Level of Risk
Air Emissions							
Emissions to Air – Increase in particulate matter. <ul style="list-style-type: none"> Screening and transporting of sand and gravel materials. Truck movements along unsealed roads. 	Direct emissions to air – wind dispersion.	<ul style="list-style-type: none"> Flora, fauna, and vegetation. Leinster Downs Pastoral Station. Town of Leinster. 	<ul style="list-style-type: none"> Reduced air quality/health impacts through inhalation. Reduced amenity. Decline in vegetation health through dust smothering vegetation. 	<ul style="list-style-type: none"> Screening activities will not be undertaken during periods of strong wind. A water truck will be available at all times on the premises during the construction phase to suppress dust generated via earthworks, installation of the screening plant and vehicle movements. Dust suppression measures will be implemented as necessary during the construction and operation phases. Vehicles will travel at low speeds within the tenement areas to protect fauna and reduce dust and noise. 	Slight	Possible	Low
Emissions to air – increase in SO _x and NO _x from combustion of diesel by equipment and vehicles.	Direct emissions to air – wind dispersion.	<ul style="list-style-type: none"> Flora, fauna, and vegetation. Leinster Downs Pastoral Station. Town of Leinster. 	<ul style="list-style-type: none"> Reduced air quality/health impacts through inhalation. 	<ul style="list-style-type: none"> All vehicles and machinery will be regularly maintained to ensure they operate optimally and do not produce excess noise or emissions. 	Slight	Possible	Low
Noise Emissions							
Noise during operations associated with screening activities from:	Direct emissions to air – wind dispersion.	<ul style="list-style-type: none"> Leinster Downs Pastoral Stations. Town of Leinster. 	<ul style="list-style-type: none"> Reduced noise quality/health impacts through hearing 	<ul style="list-style-type: none"> All vehicles and machinery will be regularly maintained to ensure they are operating optimally and not producing excess noise or emissions. Screening activities will not be undertaken during periods of strong wind. 	Slight	Possible	Low

Emissions Source/Event	Pathway	Receptor	Event Impact	Controls	Consequence on Receptor	Likelihood of the Event Impact Occurring (after controls implemented)	Level of Risk
<ul style="list-style-type: none"> The engine associated with the screening plant. Surface mobile equipment and vehicle (e.g. reversing beepers, engines). 			loss and nuisance.	<ul style="list-style-type: none"> Vehicles will travel at low speeds within the tenement areas to protect fauna, reduce dust and noise. 			
Emissions to Land and Water							
Spillage, leakage, and seepage of hydrocarbon contaminants associated with fuel transfer, accidents, breakdowns or malfunctions from surface mobile equipment and vehicles.	<ul style="list-style-type: none"> Spillage to soil, surrounding vegetation. Seepage to groundwater. 	<ul style="list-style-type: none"> Flora, fauna, and vegetation. Leinster Downs Pastoral Station. Town of Leinster. 	<ul style="list-style-type: none"> Contamination of soil. Contamination of surface water and groundwater. Death or degradation of vegetation. Degradation of fauna habitat. 	<ul style="list-style-type: none"> No hydrocarbons are stored onsite, and fuel for the mobile plant is provided by a fuel cart. Regular inspection (start and end of shift) of operating equipment will be undertaken to identify if any leaks are occurring. Transfer of diesel to occur at designated transfer points with spill protection and containment available. Use of drip trays in the event that a leak is detected. If a drip tray cannot adequately contain a minor leak, the operation of the machinery will cease until it can be repaired. All vehicles and other equipment will be regularly maintained and will be stocked with appropriate spill kit equipment. Any contaminated material (e.g., hydrocarbon contamination soil) will be removed and disposed of at licenced facilities. 	Minor	Possible	Medium

Emissions Source/Event	Pathway	Receptor	Event Impact	Controls	Consequence on Receptor	Likelihood of the Event Impact Occurring (after controls implemented)	Level of Risk
				<ul style="list-style-type: none"> As required, any soils defined under Section 72 of the EP Act and <i>Environmental Protection (Unauthorised Discharges) Regulations 2004</i> will be reported to regulatory authorities as required. 			

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APPENDICES

APPENDIX 1: SOILS ASSESSMENT (RPM,2022)

Reference: P-116573

RPM Ref: ADV-AU-00235

3 March 2022

[REDACTED]
Managing Director
MLG Oz Limited
[REDACTED]
[REDACTED],

Re: Soil Assessment – Comet Vale, Jonah Bore and Mt Keith Deposits

Blueprint Environmental Strategies Pty Ltd (“Blueprint”) (prior to its acquisition by RPMGlobal Holdings Limited, acting under its wholly-owned subsidiary, RPM Advisory Services Pty Ltd, together “RPM”) was commissioned by MLG Oz Limited (“MLG” or the “Client”) to complete a soil assessment for the Comet Vale, Jonah Bore and Mt Keith Deposits.

The following Memorandum is a deliverable as defined as part of the scope of work agreed on in P-116573.

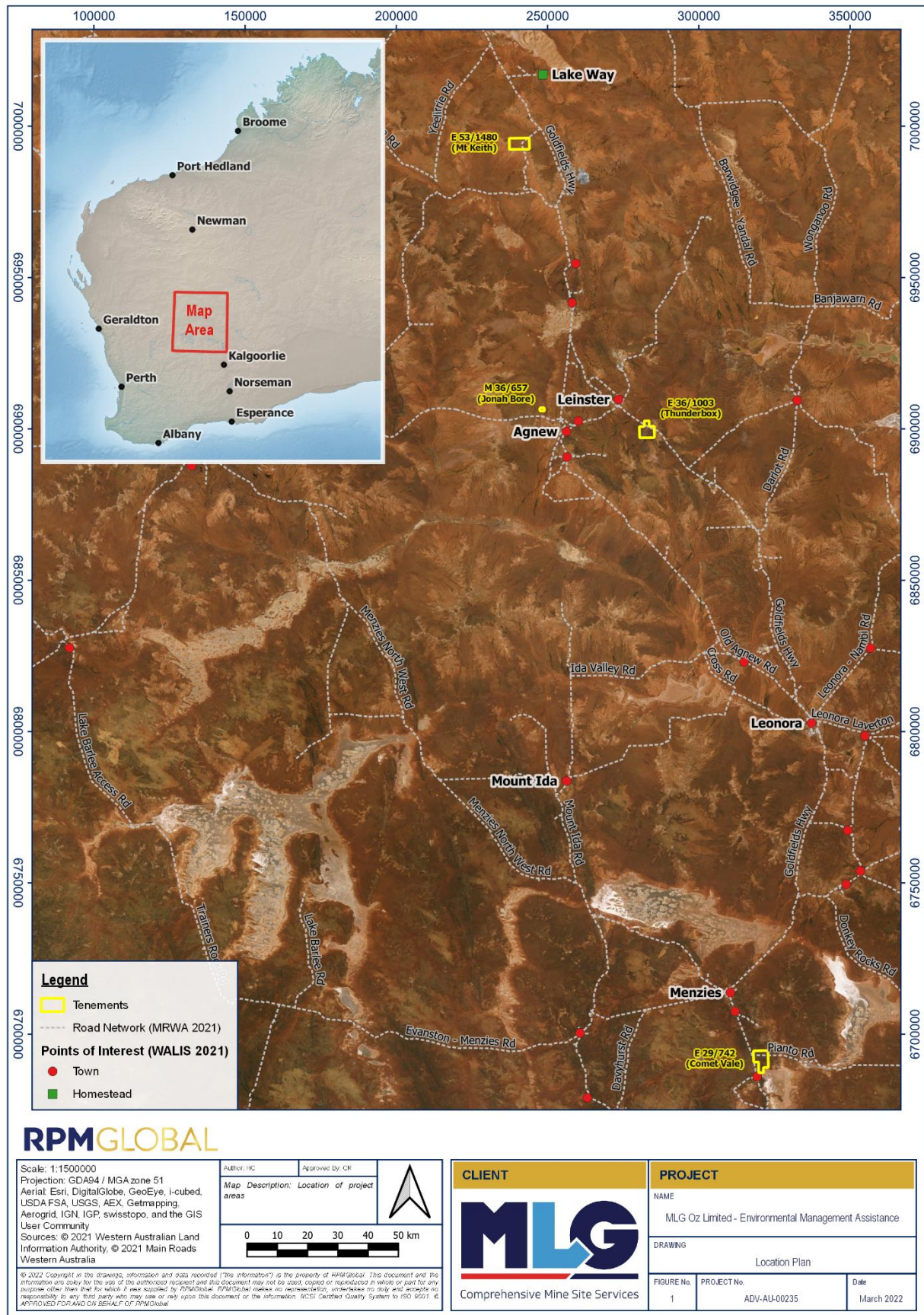
Yours Sincerely,

1. Introduction

MLG Oz Limited (“MLG”) was established in 2002 and currently operates 29 sites throughout Western Australia. MLG offers a range of value added services from bulk haulage, crushing and screening, aggregate and sand supplies. Its client base includes some of Australia’s largest resource companies in the gold, iron ore and nickel sectors.

MLG is seeking approval for developing sand supply operations at its Comet Value, Jonah Bore and Mt Keith deposits in the northeast Goldfields region of WA (**Figure 1**). This Memorandum provides an assessment of key physical and chemical properties of soil samples collected from each deposit, with a focus on the suitability of these materials for rehabilitation of the sites following mine closure.

Figure 1: Location Plan



This Memorandum has been prepared for MLG Oz Limited only for the purpose set out in and subject to the terms and conditions of its engagement with Blueprint Environmental Strategies Pty Ltd. This Memorandum must be read in its entirety and is subject to all limitations, assumptions and conditions as set out in its engagement and the body of the Memorandum. RPM does not authorise reliance on this Memorandum by any third party except for relevant government agencies, RPM and will not be liable for any loss or damage suffered by a third party relying on this Memorandum.

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2. Methodology

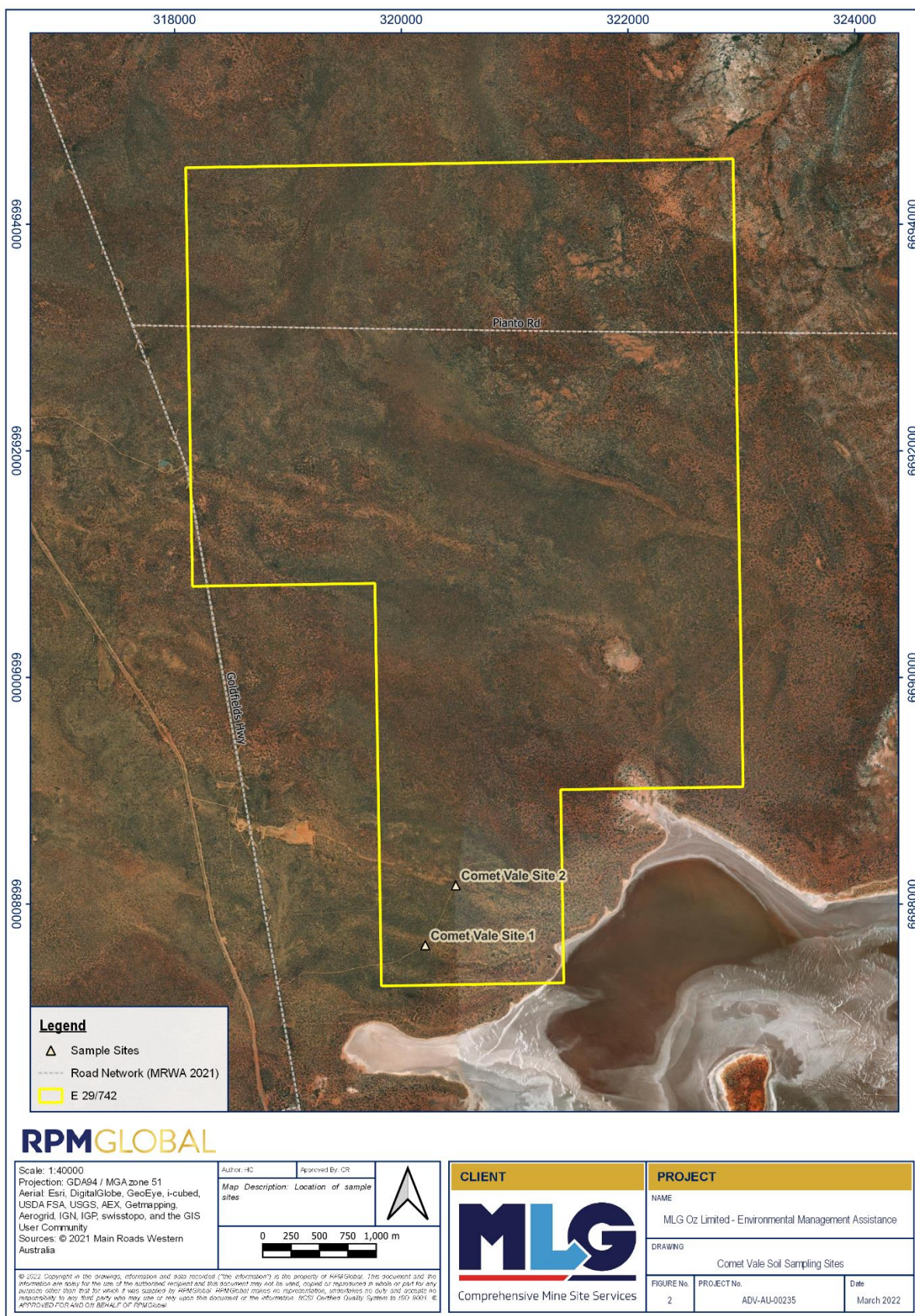
Representative samples of surface soil (0-20 cm) and subsoil (20-40 cm) were collected by MLG staff from the following locations:

- Two locations (Site 1 and Site 2) from Comet Vale (**Figure 2**);
- Two locations (Site 1 and Site 2) from Jonah Bore (**Figure 3**); and
- Two locations (Site 1 and Site 2) from Mt Keith (**Figure 4**).

The samples were submitted to Envirolab Services (WA) Pty Ltd (MPL Envirolabs), located in Myaree, WA, for analysis of the following parameters:

- pH of a 1:5 soil:water extract.
- Electrical conductivity (EC) of a 1:5 soil:water extract.
- Extractable sulfur by extraction with 0.25 M KCl solution at 40°C (KCL 40 test).
- Exchangeable cations (Ca, Mg, Na and K) by extraction with 1 M ammonium chloride, pH 7 solution.
- Extractable aluminium by extraction with 1 M KCl solution.
- Total nitrogen.
- Total phosphorus.
- Ammonium and nitrate nitrogen (by extraction with 1 M KCl).
- Extractable phosphorus (water extract).
- Phosphorus Buffer Index (PBI).
- Particle size distribution (PSD) by dry sieving through a stacked series of 150, 100, 75, 37.5, 19, 9.5, 4.75, 2.36, 1.18, 0.60, 0.425, 0.30, 0.15 and 0.075 mm sieves.
- Emerson Class Number using AS 1289.3.8.1 – 2017 (contracted to Western Geotechnical & Laboratory Services, Welshpool).
- Acid digestible metals and metalloids (As, B, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Se, Sn, Zn).

Figure 2: Comet Vale Soil Sampling Sites



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Figure 3: Jonah Bore Soil Sampling Sites

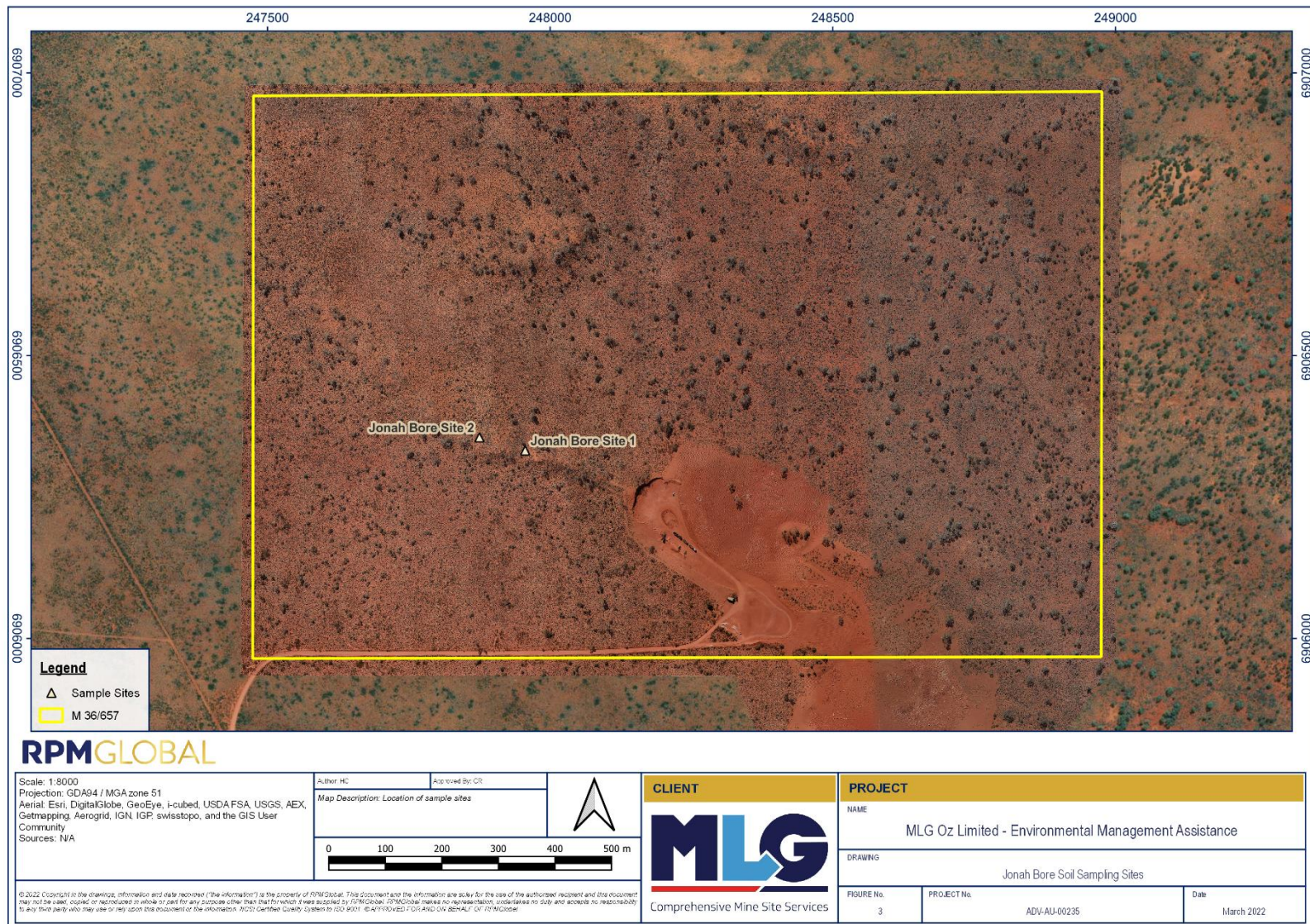
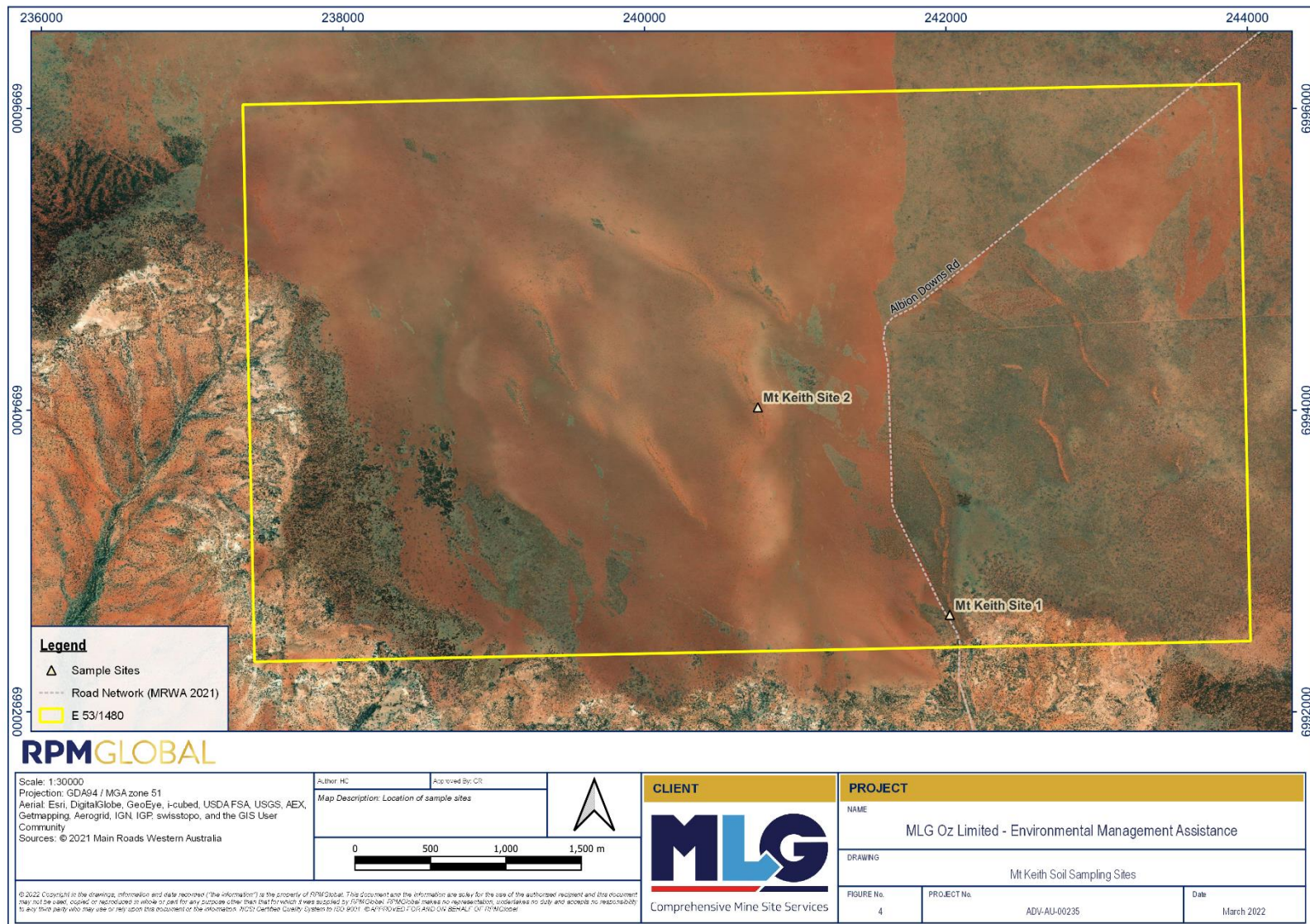


Figure 4: Mt Keith Soil Sampling Sites



3. Results and Discussion

3.1 Comet Vale Samples

Site information and results from laboratory analyses used to inform this assessment are presented in the following locations:

- **Plate 1** shows characteristics of the soil profile such as colour, texture and consistency.
- **Figure 5** presents particle size distribution data for four samples from Comet Vale.
- **Table 1** presents results for pH, EC and Emerson Class Number.
- **Table 2** presents results for plant nutrients and PBI.
- **Table 3** presents results for exchangeable cations (Ca, Mg, Na, K and Al) and calculated values for Cation Exchange Capacity (CEC) and Exchangeable Sodium Percentage (ESP).
- **Table 4** presents results for acid-digestible metals and metalloids. Results have been compared with concentration threshold values for clean fill under the DWER Landfill Waste and Classification Definitions 1996 (as amended 2019), where available. These threshold values are:
 - Arsenic 14 mg/kg
 - Barium 5%
 - Boron 5%
 - Beryllium 2 mg/kg
 - Cadmium 0.4 mg/kg
 - Cobalt 5%
 - Copper 5%
 - Manganese 5%
 - Mercury 0.2 mg/kg
 - Molybdenum 10 mg/kg
 - Lead 2 mg/kg
 - Nickel 4 mg/kg
 - Selenium 2 mg/kg

On the basis of this information, key findings relating to the characteristics of sand from Comet Vale are as follows:

- **Plate 1** shows that this soil is typical of pale reddish-brown sands from aeolian dune systems in the arid regions of Western Australia. The soil is uniform in colour and texture throughout the excavated profile, and apart from minor plant roots, is devoid of leaf litter and humus in the surface horizon.
- The particle size distributions of four samples tested (**Figure 5**) indicate very well sorted sand with a median particle diameter of approximately 0.3 mm. The fine fraction contents, which includes very fine sand (0.02 to 0.075 mm), silt (0.002 to 0.02 mm) and clay (<0.002 mm), are very low ($\leq 2\%$). The lack of fine material means that there is a low risk of dust generation, but also means the soil profile will be very well drained and have a low plant-available water holding capacity (PAWC).
- The samples are moderately acidic, as indicated by pH values between 5.4 and 5.6 (**Table 1**). These values are typical of leached siliceous sands, which are naturally acidic and have very little pH buffering capacity.
- The soil is non-saline, as indicated by low EC values ranging from 6.1 to 6.3 $\mu\text{S}\cdot\text{cm}$ (**Table 1**).
- Emerson Class Numbers of 5 indicate that the fine fraction materials have a low potential for dispersion. Spontaneous dispersion and hard-setting behaviours are not expected for this soil type.

- Nutrient contents of these samples are very low, as indicated by low concentrations of total N, total P, $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$, extractable S and extractable P presented in **Table 2**. PBI values, ranging from 27 to 29, are rated as very low, indicating the soil has very little capacity to retain nutrients supplied as soluble fertilisers or by mineralisation of organic matter.
- Exchangeable cation concentrations (**Table 3**) are very low, with all values except for calcium being below the laboratory reporting limits. These values indicate very low concentrations of calcium, magnesium and potassium (all essential plant nutrients) and confirm the limited capacity of the soil to retain other essential plant nutrients.
- The soils are classified as non-sodic, noting that soil sodicity is largely irrelevant to sandy sands.
- Concentrations of metals and metalloids (**Table 4**), with only nickel levels (4.3 to 4.9 mg/kg) exceeding the WA concentration threshold for clean fill (4 mg/kg). These values do not represent a risk to human health or the environment and remain well below the average global concentration of nickel in the Earth's crust (80 mg/kg, Smith and Huyck 1999).



Plate 1: Soil Profile at Comet Vale

Figure 5: Particle Size Distribution – Comet Vale Samples

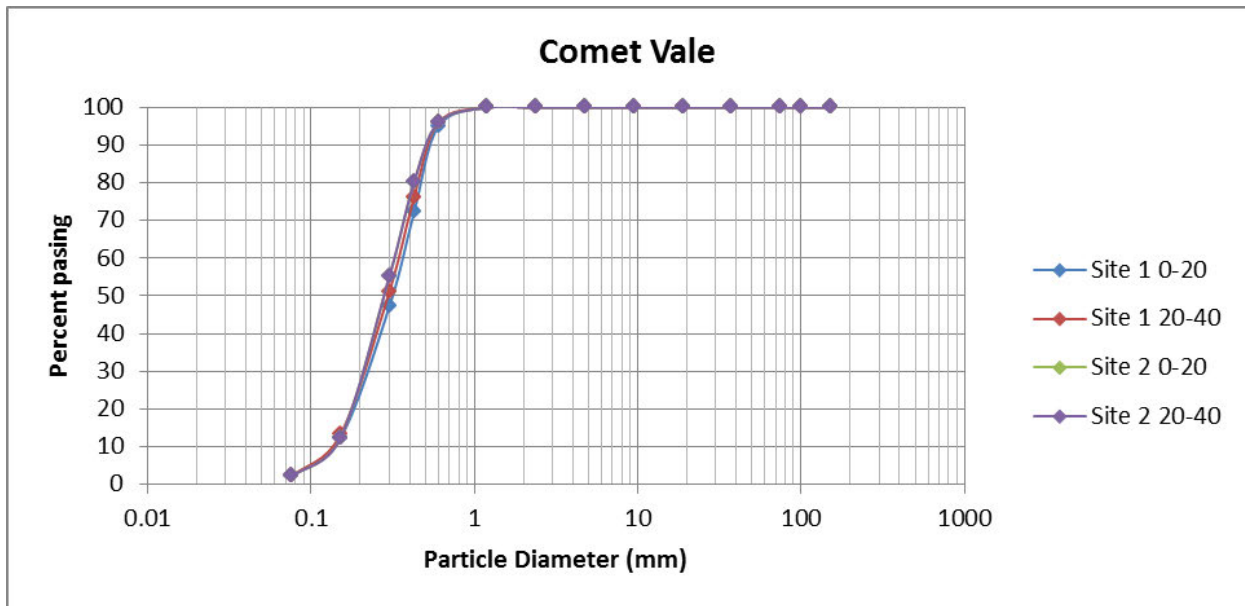


Table 1: pH, EC and Emerson Class – Comet Vale Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
pH	pH units	5.5	5.4	5.6	5.6
EC	µS/cm	6.1	6.3	6.3	6.1
Emerson Class	-	5	5	5	5

Table 2: Nutrients – Comet Vale Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
Total N	mg/kg	79	87	45	57
Total P	mg/kg	14	14	15	14
Ammonium-N	mg/kg	5.0	6.2	4.4	5.1
Nitrate-N	mg/kg	0.36	0.34	0.26	0.32
Extractable S	mg/kg	3	3	3	3
Extractable P	mg/kg	<0.5	<0.5	<0.5	<0.5
PBI	-	28	29	28	27

Table 3: Exchangeable Cations – Comet Vale Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
Calcium	cmol(+)/kg	0.3	0.3	0.3	0.4
Magnesium	cmol(+)/kg	<0.41	<0.41	<0.41	<0.41
Sodium	cmol(+)/kg	<0.22	<0.22	<0.22	<0.22
Potassium	cmol(+)/kg	<0.13	<0.13	<0.13	<0.13
Aluminium	cmol(+)/kg	<0.07	<0.07	<0.07	<0.07
CEC	cmol(+)/kg	<1	<1	<1	<1
ESP	%	<1	<1	<1	<1

Table 4: Metals and Metalloids – Comet Vale Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
Arsenic	mg/kg	1.3	1.5	1.7	1.7
Boron	mg/kg	<1	<1	<1	<1
Barium	mg/kg	2.8	3.1	2.6	2.7
Beryllium	mg/kg	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1
Cobalt	mg/kg	1.0	1.2	1.3	1.2
Chromium	mg/kg	75	82	97	100
Copper	mg/kg	1.7	2.0	2.3	2.2
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01
Manganese	mg/kg	12	11	20	16
Molybdenum	mg/kg	<0.5	<0.5	<0.5	<0.5
Nickel	mg/kg	4.3	4.7	4.9	4.8
Lead	mg/kg	1.3	1.4	1.6	1.7
Antimony	mg/kg	<0.5	<0.5	<0.5	<0.5
Selenium	mg/kg	0.1	0.1	0.2	0.2
Tin	mg/kg	<0.5	<0.5	<0.5	<0.5
Zinc	mg/kg	1.5	1.3	1.2	1.2

3.2 Jonah Bore Samples

Site information and results from laboratory analyses used to inform this assessment are presented in the following locations:

- **Plate 2** show characteristics of the soil profile such as colour, texture and consistency.
- **Figure 6** presents particle size distribution data for four samples from Comet Vale.
- **Table 5** presents results for pH, EC and Emerson Class Number.
- **Table 6** presents results for plant nutrients and PBI.
- **Table 7** presents results for exchangeable cations (Ca, Mg, Na, K and Al) and calculated values for Cation Exchange Capacity (CEC) and Exchangeable Sodium Percentage (ESP).
- **Table 8** presents results for acid-digestible metals and metalloids. Results have been compared with concentration threshold values for clean fill under the DWER Landfill Waste and Classification Definitions 1996 (as amended 2019), where available. These threshold values are:
 - Arsenic 14 mg/kg
 - Barium 5%
 - Boron 5%
 - Beryllium 2 mg/kg
 - Cadmium 0.4 mg/kg
 - Cobalt 5%
 - Copper 5%
 - Manganese 5%
 - Mercury 0.2 mg/kg
 - Molybdenum 10 mg/kg
 - Lead 2 mg/kg
 - Nickel 4 mg/kg
 - Selenium 2 mg/kg

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On the basis of this information, key findings relating to the characteristics of sand from Jonah Bore are as follows:

- **Plate 2** shows that this soil is typical of pale reddish-brown sands from aeolian dune systems in the arid regions of Western Australia. The soil is uniform in colour and texture throughout the excavated profile, and apart from minor plant roots, is devoid of leave litter and humus in the surface horizon.
- The particle size distributions of four samples tested (**Figure 6**) indicates very well sorted sand with a median particle diameter of approximately 0.25 mm. The fine fraction contents, which includes very fine sand (0.02 to 0.075 mm), silt (0.002 to 0.02 mm) and clay (<0.002 mm), are very low ($\leq 2\%$). The lack of fine material means that there is a low risk of dust generation, but also means the soil profile will be very well drained and have a low plant-available water holding capacity (PAWC).
- The samples are moderately acidic, as indicated by pH values of 5.3 (**Table 5**). These values are typical of leached siliceous sands, which are naturally acidic and have very little pH buffering capacity.
- The soil is non-saline, as indicated by low EC values ranging from 7.0 to 8.0 $\mu\text{S}\cdot\text{cm}$ (**Table 5**).
- Emerson Class Numbers of 5 indicate that the fine fraction materials have a low potential for dispersion. Spontaneous dispersion and hard-setting behaviours are not expected for this soil type.
- Nutrients contents of these samples are very low, as indicated by low concentrations of total N, total P, $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$, extractable S and extractable P presented in Table 6. PBI values, ranging from 17 to 29, are rated as very low, indicating the soil has very little capacity to retain nutrients supplied as soluble fertilisers or by mineralisation of organic matter.
- Exchangeable cation concentrations (**Table 7**) are very low, with all values except for calcium being below the laboratory reporting limits. These values indicate very low concentrations of calcium, magnesium and potassium (all essential plant nutrients) and confirm the limited capacity of the soil to retain other essential plant nutrients.
- The soils are classified as non-sodic, noting that soil sodicity is largely irrelevant to sandy sands.
- Concentrations of metals and metalloids (**Table 8**) were all below the WA concentration thresholds for clean fill. Chromium values were slightly elevated (16 – 190 mg/kg), but are considered to be of no environmental consequence as chromium is expected to be present in very stable minerals (such as chromite, FeCr_2O_4) in which it occurs as the almost insoluble trivalent form (Cr^{3+}).



Plate 2: Soil Profile at Jonah Bore

Figure 6: Particle Size Distribution – Jonah Bore Samples

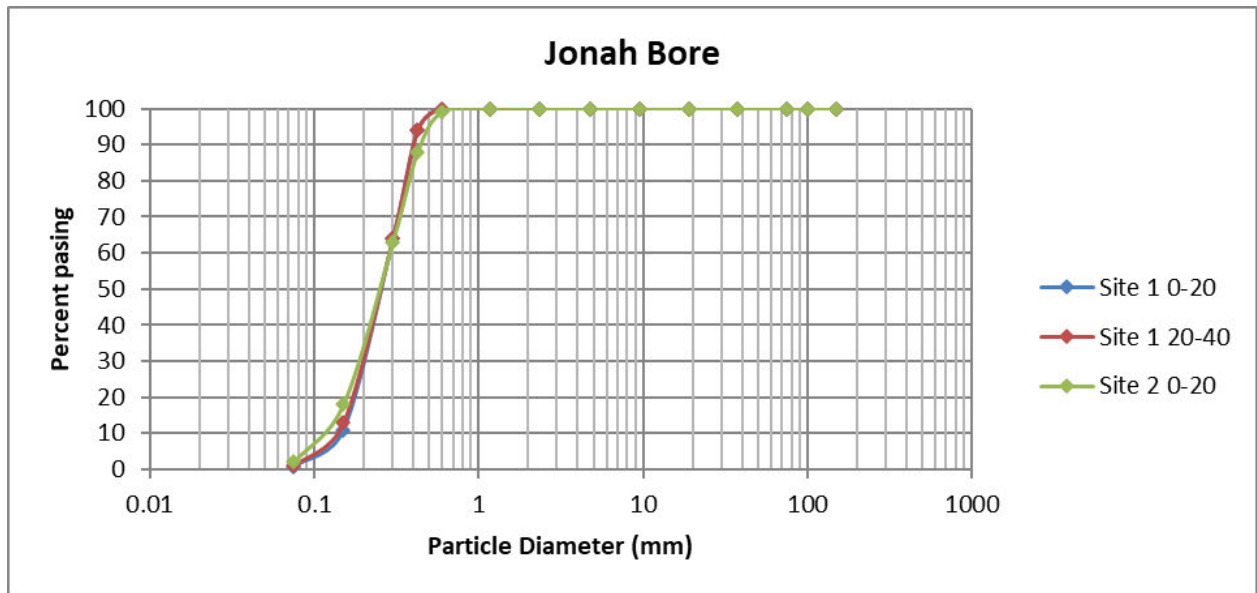


Table 5: pH, EC and Emerson Class – Jonah Bore Samples

Sample	Units	Sample 1	Sample 2	Sample 3
Location	-	Site 1	Site 1	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20
pH	pH units	5.3	5.3	5.3
EC	$\mu\text{S}/\text{cm}$	7.0	8.0	7.1
Emerson Class	-	5	5	5

Table 6: Nutrients – Jonah Bore Samples

Sample	Units	Sample 1	Sample 2	Sample 3
Location	-	Site 1	Site 1	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20
Total N	mg/kg	54	46	65
Total P	mg/kg	31	28	34
Ammonium-N	mg/kg	6.5	6.1	4.7
Nitrate-N	mg/kg	0.19	0.21	0.32
Extractable S	mg/kg	3	4	3
Extractable P	mg/kg	<0.5	<0.5	<0.5
PBI	-	26	29	17

Table 7: Exchangeable Cations – Jonah Bore Samples

Sample	Units	Sample 1	Sample 2	Sample 3
Location	-	Site 1	Site 1	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20
Calcium	$\text{cmol}(+)/\text{kg}$	<0.25	<0.25	0.4
Magnesium	$\text{cmol}(+)/\text{kg}$	<0.41	<0.41	<0.41
Sodium	$\text{cmol}(+)/\text{kg}$	<0.22	<0.22	<0.22
Potassium	$\text{cmol}(+)/\text{kg}$	<0.13	<0.13	<0.13
Aluminium	$\text{cmol}(+)/\text{kg}$	<0.07	<0.07	<0.07
CEC	$\text{cmol}(+)/\text{kg}$	<1	<1	<1
ESP	%	<1	<1	<1

Table 8: Metals and Metalloids – Jonah Bore Samples

Sample	Units	Sample 1	Sample 2	Sample 3
Location	-	Site 1	Site 1	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20
Arsenic	mg/kg	1.8	1.9	
Boron	mg/kg	<1	<1	<1
Barium	mg/kg	1.8	1.9	2.0
Beryllium	mg/kg	<0.5	<0.5	<0.5
Cadmium	mg/kg	<0.1	<0.1	<0.1
Cobalt	mg/kg	0.9	0.7	0.9
Chromium	mg/kg	190	160	160
Copper	mg/kg	2.7	2.4	3.1
Mercury	mg/kg	<0.01	<0.01	<0.01
Manganese	mg/kg	17	15	20
Molybdenum	mg/kg	<0.5	<0.5	<0.5
Nickel	mg/kg	3.9	3.2	3.8
Lead	mg/kg	2.8	2.5	2.8
Antimony	mg/kg	<0.5	<0.5	<0.5
Selenium	mg/kg	0.3	0.3	0.3
Tin	mg/kg	<0.5	<0.5	<0.5
Zinc	mg/kg	2.4	2.0	4.4

3.3 Mt Keith Samples

Site information and results from laboratory analyses used to inform this assessment are presented in the following locations:

- **Plate 3** show characteristics of the soil profile such as colour, texture and consistency.
- **Figure 7** presents particle size distribution data for four samples from Comet Vale.
- **Table 9** presents results for pH, EC and Emerson Class Number.
- **Table 10** presents results for plant nutrients and PBI.
- **Table 11** presents results for exchangeable cations (Ca, Mg, Na, K and Al) and calculated values for Cation Exchange Capacity (CEC) and Exchangeable Sodium Percentage (ESP).
- **Table 12** presents results for acid-digestible metals and metalloids. Results have been compared with concentration threshold values for clean fill under the DWER Landfill Waste and Classification Definitions 1996 (as amended 2019), where available. These threshold values are:
 - Arsenic 14 mg/kg
 - Barium 5%
 - Boron 5%
 - Beryllium 2 mg/kg
 - Cadmium 0.4 mg/kg
 - Cobalt 5%
 - Copper 5%
 - Manganese 5%
 - Mercury 0.2 mg/kg
 - Molybdenum 10 mg/kg
 - Lead 2 mg/kg
 - Nickel 4 mg/kg
 - Selenium 2 mg/kg

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On the basis of this information, key findings relating to the characteristics of sand from Jonah Bore are as follows:

- **Plate 3** shows that this soil is typical of pale reddish-brown sands from aeolian dune systems in the arid regions of Western Australia. The soil is uniform in colour and texture throughout the excavated profile, and apart from minor plant roots, is devoid of leave litter and humus in the surface horizon.
- The particle size distributions of four samples tested (**Figure 7**) indicates very well sorted sand with a median particle diameter of approximately 0.3 mm. The fine fraction contents, which includes very fine sand (0.02 to 0.075 mm), silt (0.002 to 0.02 mm) and clay (<0.002 mm), are very low ($\leq 2\%$). The lack of fine material means that there is a low risk of dust generation, but also means the soil profile will be very well drained and have a low plant –available water holding capacity (PAWC).
- The samples are moderately acidic, as indicated by pH values of 5.3 to 5.6 (**Table 9**). These values are typical of leached siliceous sands, which are naturally acidic and have very little pH buffering capacity.
- The soil is non-saline, as indicated by low EC values ranging from 4.6 to 7.0 $\mu\text{S}\cdot\text{cm}$ (**Table 9**).
- Emerson Class Numbers of 5 indicate that the fine fraction materials have a low potential for dispersion. Spontaneous dispersion and hard-setting behaviours are not expected for this soil type.
- Nutrients contents of these samples are very low, as indicated by low concentrations of total N, total P, $\text{NH}_4\text{-N}$, $\text{NO}_3\text{-N}$, extractable S and extractable P presented in Table 10. PBI values, ranging from 13 to 23, are rated as very low, indicating the soil has very little capacity to retain nutrients supplied as soluble fertilisers or by mineralisation of organic matter.
- Exchangeable cation concentrations (**Table 11**) are very low, with all values being below the laboratory reporting limits. These values indicate very low concentrations of calcium, magnesium and potassium (all essential plant nutrients) and confirm the limited capacity of the soil to retain other essential plant nutrients.
- The soils are classified as non-sodic, noting that soil sodicity is largely irrelevant to sandy sands.
- Concentrations of metals and metalloids (**Table 8**) were all below the WA concentration thresholds for clean fill.



Plate 3: Soil Profile at Mt Keith

Figure 7: Particle Size Distribution – Mt Keith Samples

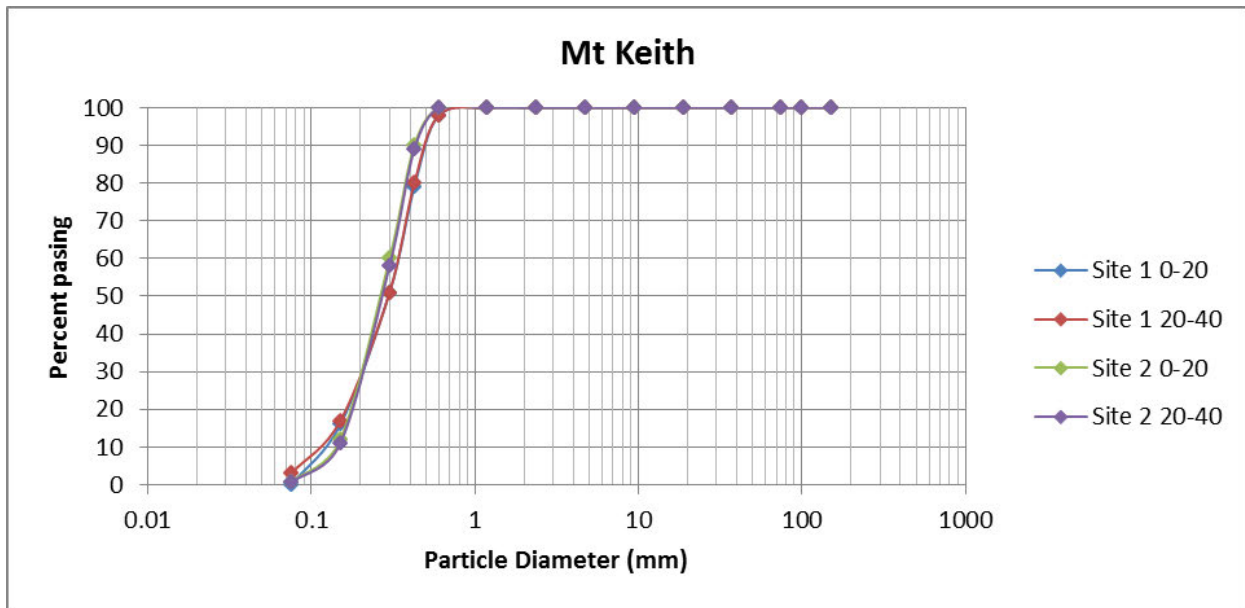


Table 9: pH, EC and Emerson Class – Mt Keith Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
pH	pH units	5.5	5.6	5.3	5.3
EC	µS/cm	4.6	4.9	7.0	6.7
Emerson Class	-	5	5	5	5

Table 10: Nutrients – Mt Keith Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
Total N	mg/kg	70	59	19	19
Total P	mg/kg	30	34	21	19
Ammonium-N	mg/kg	3.9	5.1	6.1	6.1
Nitrate-N	mg/kg	0.23	0.31	0.11	0.12
Extractable S	mg/kg	<2	<2	5	4
Extractable P	mg/kg	<0.5	<0.5	<0.5	<0.5
PBI	-	23	22	13	22

Table 11: Exchangeable Cations – Mt Keith Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
Calcium	cmol(+)/kg	<0.25	<0.25	<0.25	<0.25
Magnesium	cmol(+)/kg	<0.41	<0.41	<0.41	<0.41
Sodium	cmol(+)/kg	<0.22	<0.22	<0.22	<0.22
Potassium	cmol(+)/kg	<0.13	<0.13	<0.13	<0.13
Aluminium	cmol(+)/kg	<0.07	<0.07	<0.07	<0.07
CEC	cmol(+)/kg	<1	<1	<1	<1
ESP	%	<1	<1	<1	<1

Table 12: Metals and Metalloids – Mt Keith Samples

Sample	Units	Sample 1	Sample 2	Sample 3	Sample 4
Location	-	Site 1	Site 1	Site 2	Site 2
Depth	cm	0 - 20	20 - 40	0 - 20	20 - 40
Arsenic	mg/kg	1.8	1.9	1.3	1.3
Boron	mg/kg	<1	<1	<1	<1
Barium	mg/kg	2.5	2.7	3.0	3.0
Beryllium	mg/kg	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg	<0.1	<0.1	<0.1	<0.1
Cobalt	mg/kg	0.7	0.7	<0.5	<0.5
Chromium	mg/kg	75	77	64	59
Copper	mg/kg	2.4	2.6	1.5	1.6
Mercury	mg/kg	<0.01	<0.01	<0.01	<0.01
Manganese	mg/kg	18	22	13	12
Molybdenum	mg/kg	<0.5	<0.5	<0.5	<0.5
Nickel	mg/kg	2.1	2.6	1.3	1.4
Lead	mg/kg	2.2	2.2	1.4	1.3
Antimony	mg/kg	<0.5	<0.5	<0.5	<0.5
Selenium	mg/kg	0.2	0.2	0.2	0.2
Tin	mg/kg	<0.5	<0.5	<0.5	<0.5
Zinc	mg/kg	2.1	2.2	1.5	1.2

4. Conclusions

The physical and chemical properties of sands from Comet Vale (Section 3.1), Jonah Bore (Section 3.2) and Mt Keith (Section 3.3) are sufficiently similar for the same rehabilitation strategies to be applied at each deposit. Characteristics that need to be considered when implementing site rehabilitation include:

- The materials are loose, pale red-brown aeolian sands with very low plant available water capacity.
- Although the sands have a low risk of generating significant amounts of dust, they contain substantial amounts of fine to medium sand-sized particles that are easily mobilised by moderate to strong wind gusts. The growth of emerging seedlings may be impacted by the associated sand blasting if the area is not thoroughly ripped.
- The sands are moderately acidic, with pH values ranging from 5.3 to 5.6. As the soils are comprised mainly of silica particles with very low concentrations of exchangeable aluminium, the acidity levels are unlikely to be a problem for common sand dune species (notably *Spinifex triodia*) in the arid regions of WA.
- The sands are non-saline and non-sodic.
- Nutrients contents and soil organic matter contents are extremely low. Low PBI and CEC values indicate they have very little capacity to retain soluble nutrients applied as soluble fertilisers or mineralised organic materials. The very low nutrient status is unlikely to support high densities of plant species, and application of slow-release, balanced fertilisers may be beneficial for revegetation of each site.
- Heavy metal and metalloid concentrations are exceptionally low and, with the exception of slightly elevated nickel (when compared to DWER contamination threshold values) in the Comet Vale sample, comply with “clean fill” criteria in WA (DWER 2019).

In summary, the soils from all sites have comparable properties, comprising stable, geochemically benign aeolian sands with limited nutritional value for plant growth. Given that local, native plant species are adapted to these conditions, revegetation of disturbed surfaces is expected to occur over time. This is reinforced by the positive performance of areas that have already been rehabilitated by MLG, as demonstrated by rehabilitation performance monitoring reports (Blueprint 2021a, Blueprint 2021b) and general site observations.

5. References

Blueprint Environmental Strategies Pty Ltd (Blueprint) (2021a). *Eight Mile Rock Hole Project, Rehabilitation Performance Assessment*. An unpublished report prepared for MLG Oz Limited.

Blueprint Environmental Strategies Pty Ltd (Blueprint) (2021b). *Jonah Bore Project, Rehabilitation Performance Assessment*. An unpublished report prepared for MLG Oz Limited.

DWER (2019). Landfill Waste and Classification Definitions 1996 (as amended 2019). Department of Water and Environmental Regulation (DWER). December 2019.

Smith, KS and Huyck, HO (1999). An Overview of the Abundance, Relative Mobility, Bioavailability, and Human Toxicity of Metals. *Reviews in Economic Geology*. Volume 6, Chapter 2.

APPENDIX 2: FLORA AND VEGETATION SURVEY (GLS, 2021)

FLORA AND VEGETATION SURVEY

Prepared for

MLG Oz Limited

16 Mile Well Project



Prepared by

Goldfields Landcare Services

December 2021

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1. SUMMARY

Goldfields Landcare Services was contracted by MLG Oz Limited in July 2021 to conduct a Reconnaissance Flora and Vegetation Survey at their 16 Mile Well Project (aka Thunderbox Project) located approximately 15 kilometres south-east of Leinster to comply with requirements in seeking approvals for near surface sand-mining operations.

The first survey was undertaken in July 2021 with the second survey undertaken in the following Spring months to locate ephemeral species, resample any flowering species requiring positive identification, and conduct Targeted surveys for any Priority taxa that may have been previously identified.

The fieldwork for the July Reconnaissance survey over an area of 1721.5 Ha was conducted by two people over four days between 09.07.21 and 13.07.21. It consisted of 18 quadrat surveys, traverses, and opportunistic sampling conducted within and around the survey area.

The Detailed spring survey was confined to a smaller area of 648 Ha. It was contained within the perimeter of the Reconnaissance survey area and incorporated a proposed haulage road alignment; it was carried out from 06.09.21 to 09.09.21. An additional five quadrat surveys were completed, additional specimens collected, and Priority species population boundaries mapped.

A total of 23 quadrat surveys were conducted to characterise the vegetation of the survey area and that of the surrounding region.

Nine vegetation types were recorded and described within the survey areas.

One hundred and forty-seven vascular plant species have been recorded from within the survey areas. The most prevalent families recorded were *Fabaceae*, *Chenopodiaceae*, *Poaceae*, *Scrophulariaceae* and *Myrtaceae*.

No plant species gazetted as “Threatened” pursuant to Part 2 of the *Biodiversity Conservation Act 2016* (BC Act, WA) and no plant species listed as “Critically Endangered” under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Commonwealth) were recorded within the surveyed areas.

Two plant species of conservation significance, *Bossiaea eremaea* (P3), and *Thryptomene* sp. Leinster (B.J. Lepschi and L. Craven 4362) (P3), listed under State or Commonwealth acts were found within the survey areas.

No Threatened Ecological Communities (TECs) listed under the BC Act or EPBC Act or Priority Ecological Communities (PECs) listed by the Department of Biodiversity Conservation and Attractions (DBCA) were encountered during the surveys.

No weed species listed as Declared under *the Biosecurity and Agriculture Management Act (2007)* were recorded within the survey areas.

No plant listed as a Weed of National Significance (WoNS) under the EPBC Act was encountered in the survey areas.

No non-native introduced species were recorded within the survey areas.

The condition of the vegetation was classified as “Good” based on the Vegetation Condition Scale adapted from Keighery 1994 and Trudgen 1988). (Environmental Protection Authority 2016, p.10)

2. INTRODUCTION

2.1 Location

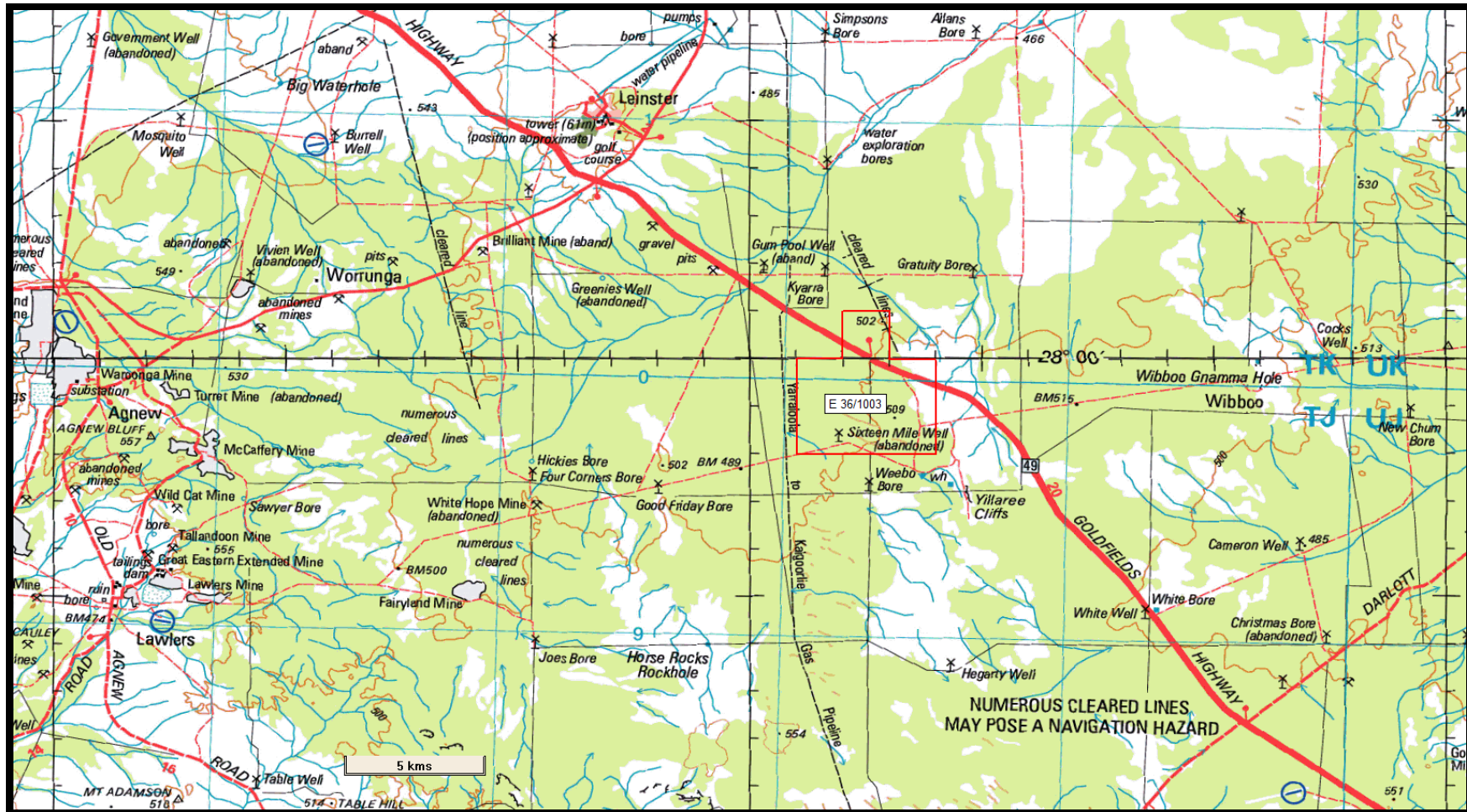
Situated on the land of the traditional owners, the Tjiwarl people, the mining town of Leinster is in the North-Eastern Goldfields of Western Australia approximately 326 kilometres north-north-west of Kalgoorlie and 650 kilometres north-east of Perth.

The area over which these surveys were conducted sits on Leinster Downs Pastoral Station and at its nearest point is situated 10.7 kilometres south-west of the Leinster turn off on the Goldfields Highway. Access to the survey area can be gained from the highway. (Map 1 below). The first and larger survey area, conducted in July, covered approximately 81% of MLG Oz’s Exploration Lease E 36/1003, that being the portion lying south of the Goldfields Highway.

The region has a long history of mining dating back to 1897 and continuing today with new mines currently opening in the region. Pastoral development began on Leinster Downs in 1909 and continues in a scaled-down fashion today.

The pre-European vegetation mapped by Beard *et. al.* (2013) shows the vegetation type, within which most of this survey area lies, to have been Shrub Steppe hummock grassland. It is the second most extensive vegetation type in the State covering a total area of 25.3 million hectares with 3.2 million of that in the Murchison Bioregion. (Beard *et. al.* 2013, p. 14)

Map 1: Location Map



2.2 Objective

Goldfields Landcare Services was contracted by MLG Oz Limited to conduct a Reconnaissance Flora and Vegetation Survey over approximately 1721.5 hectares on their Exploration Lease E 36/1003, fifteen kilometres south-east of Leinster, to comply with requirements in seeking approvals for a proposed sand mining operation and associated haulage road.

-The objective of this initial survey was to assess potential impacts to flora and vegetation in accordance with the Environmental Protection Authority (EPA) *Technical Guidance, Flora and Vegetation Surveys for Environmental Impact Assessment, December 2016*.

A follow-up survey was designed to take place in Spring to capture any ephemeral plant species not previously recorded, to collect flowering samples of any previously collected but unidentified specimens, to conduct additional quadrat surveys where necessary to confirm vegetation type classifications, to refine vegetation type mapping boundaries where that may be deemed necessary and to map the populations of any Priority plant species located in either survey.

2.3 Survey Categories

Reconnaissance Survey

“A reconnaissance survey is undertaken to verify the information obtained from the desktop study, characterise the flora and delineate the vegetation units present. In some instances, a reconnaissance survey is necessary to determine the type of survey required. A reconnaissance survey generally involves a site visit by an experienced botanist to undertake low intensity sampling of the flora and vegetation, to describe the general vegetation characteristics and condition at an appropriate scale. The reconnaissance survey should clarify whether the area may support any significant flora or vegetation. If significant flora or vegetation is located or considered likely to be present during a reconnaissance survey, a targeted or detailed survey may be required.” (EPA 2016, p 5)

Targeted Survey

“A targeted survey is used to gather information on significant flora and/or vegetation. A targeted survey aims to determine the size and extent of all significant flora populations or vegetation in the survey area and to place any impacts into context” (EPA 2016, p. 5)

Detailed Survey

“A detailed survey is necessary for significant proposals to adequately address the EPA’s objective for Flora and Vegetation, as a preliminary or key environmental factor of assessment.” (EPA 2016, p.5)

2.4 Background Research

The purpose is to gather background information on the target area (usually at the locality scale). This involves a search of available sources of literature, data, and map-based information.

In the WA Department of Agriculture's Technical Bulletin, No 87 An inventory and condition survey of the north-eastern Goldfields, Western Australia, authors H. Pringle *et.al.* 1994 describe land systems according to their topography, soils and vegetation, reference to which, has provided the basis for the identification of the vegetation types described in this survey.

Other relevant survey reports reviewed were:

- The Western Australian Museum's (1992) Biological Survey of The Eastern Goldfields of Western Australia & Supplements covering the Sandstone-Sir Samuel and Laverton-Leonora study areas.
- Stantec. (2018) "*Flora and Fauna Survey: Agnew Gold Mine Camp, Power Plant, Airport, Wind Farm and Pipeline.*" Prepared for Goldfields Australia Pty Ltd, 21 June 2018.

2.4.1 Rare and Priority Flora Searches

In WA, under the BC Act, all plants are protected. Some, which are under threat of extinction, are classified as Threatened Species. Others which are either under consideration to be declared as Threatened Species or still require monitoring are classified as Priority Flora species. The definitions of the five different classifications of Priority Species and that of Threatened Species and Presumed Extinct Species are shown in Appendix D.

A database search for Rare and Priority Flora potentially occurring within 100 kilometres of the centre of the survey areas was carried out by the WA Department of Biodiversity Conservation and Attractions (DBCA) on 05.07.21, (Ref. No. 08-0721 FL).

The search results were cross-checked against the results of a search of the EPBC Act list of Threatened Flora.

One species listed as Critically Endangered, and one species listed as Endangered on the EPBC list also occurred on the DBCA list.

A Protected Matters Report was generated from the Department of Environment and Energy's online search facility on 22.07.2021. The report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act. The search area was located approximately at the centre of the survey areas with a 50-kilometre buffer. No plant species was listed as Threatened within the search area.

Forty-two plant species classified as Threatened or Priority species were recorded from the DBCA searches.

The W.A. Department of Parks and Wildlife Threatened and Priority Flora Database (TPFL) contained 14 species, the West Australia Herbarium Database (WAHerb) contained 38, however, some species occurred in both of the searches.

A DPaW NatureMap Species Report was created 22.06.21 covering an area with a 20-km radius from the survey areas which revealed six priority plant species occurring within it. A second NatureMap search was performed on 07.07.21 for a larger area with a radius of 40 K from the survey areas which revealed 12 priority species occurring within it.

The results indicate a total of 42 species of conservation significance from five searches, potentially occurring in the area.

Two species were listed as Threatened (Rare)

Ten plant species were listed as Priority 1

Three plant species were listed as Priority 2

Twenty-three plant species were listed as Priority 3

Four plant species were listed as Priority 4 (See Appendix A)

2.4.2 Threatened and Priority Ecological Communities Searches

Listed threatened species and ecological communities are recognized as a matter of national environmental significance. Consequently, any action that is likely to have a significant impact on listed threatened species and ecological communities under the EPBC Act must be referred to the Minister. The different categories of threatened species and threatened ecological communities and their respective definitions are shown in Appendices D2 and D3.

The Australian Government Department of Environment and Energy's List of Threatened Ecological Communities (TEC) viewed online, shows that the TEC nearest the survey area is at Toolibin Lake, east of Narrogin and is over 600 kilometres south-west of the survey area.

A database search was conducted by the DBCA of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs) endorsed by the minister for the environment on 29.06.21 (Ref: 40-0621E C)

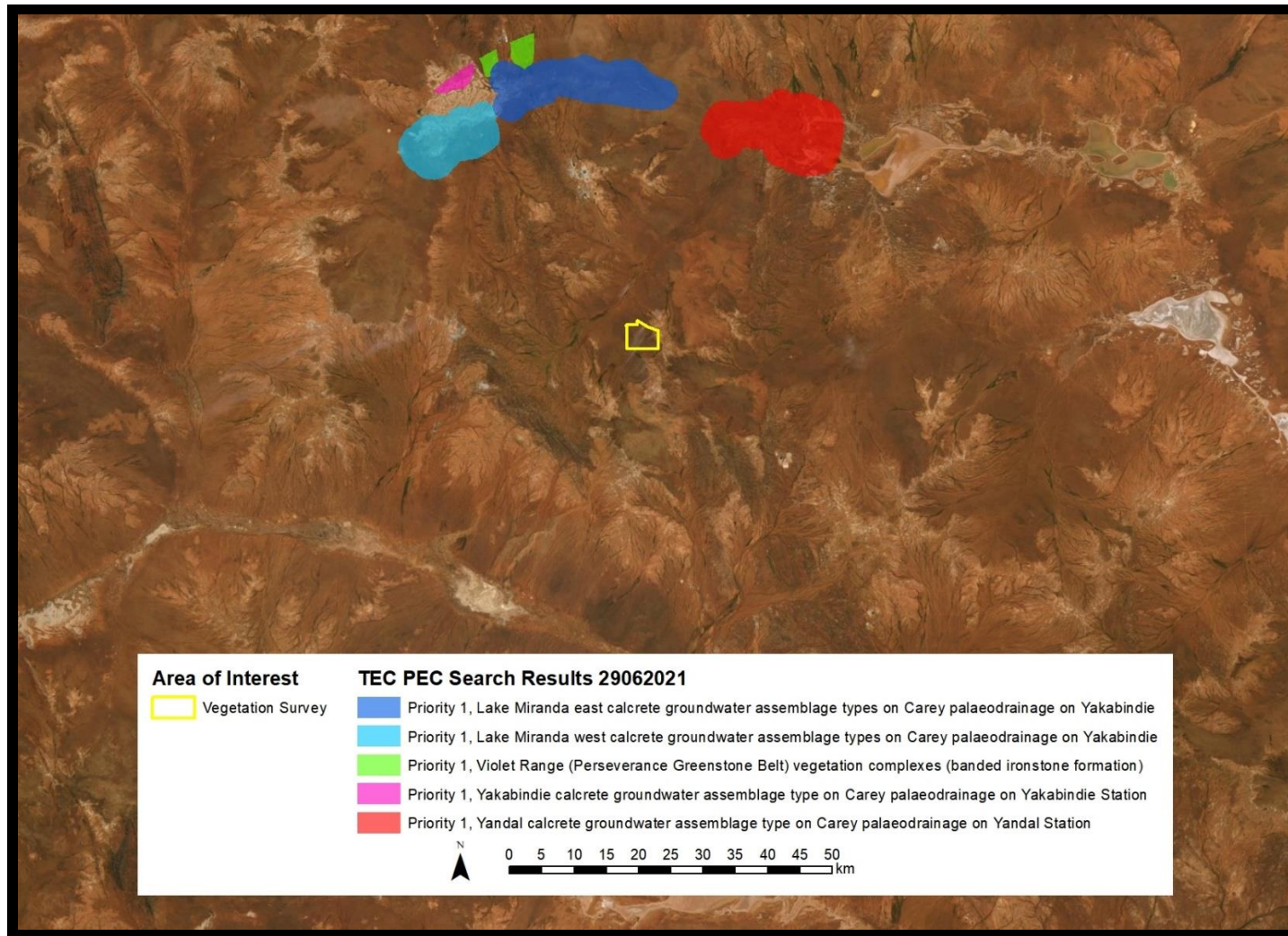
This search revealed that the nearest TEC to this survey area is the Depot Springs stygofauna complex which is located approximately 73 kilometres bearing 277 degrees from the survey areas.

The nearest PEC to this survey area is the Yandal calcrete groundwater assemblage type on Carey paleodrainage on Yandal Station located approximately 28 kilometres north - northeast of the survey areas

Table 1. TEC and PECs nearest the survey area

Ecological Community	Status
Depot Springs stygofauna community (TEC)	Vulnerable (B)
Yandal calcrete groundwater assemblage on Carey paleodrainage. (PEC)	P1

Map 2: TEC PEC Search Results



2.4.3 Climate

Beard described the climate of the Murchison Region (Austin Botanical District) in Plant Life of Western Australia, within which the survey area lies, as: “Arid with summer and winter rain; annual precipitation 200 mm”. (Beard 1990, p. 186)

The nearest Bureau of Meteorology (BOM) weather station for which temperature data is available is located at Leinster Aero (No. 12314), approximately 21 kilometres north-west of the survey area.

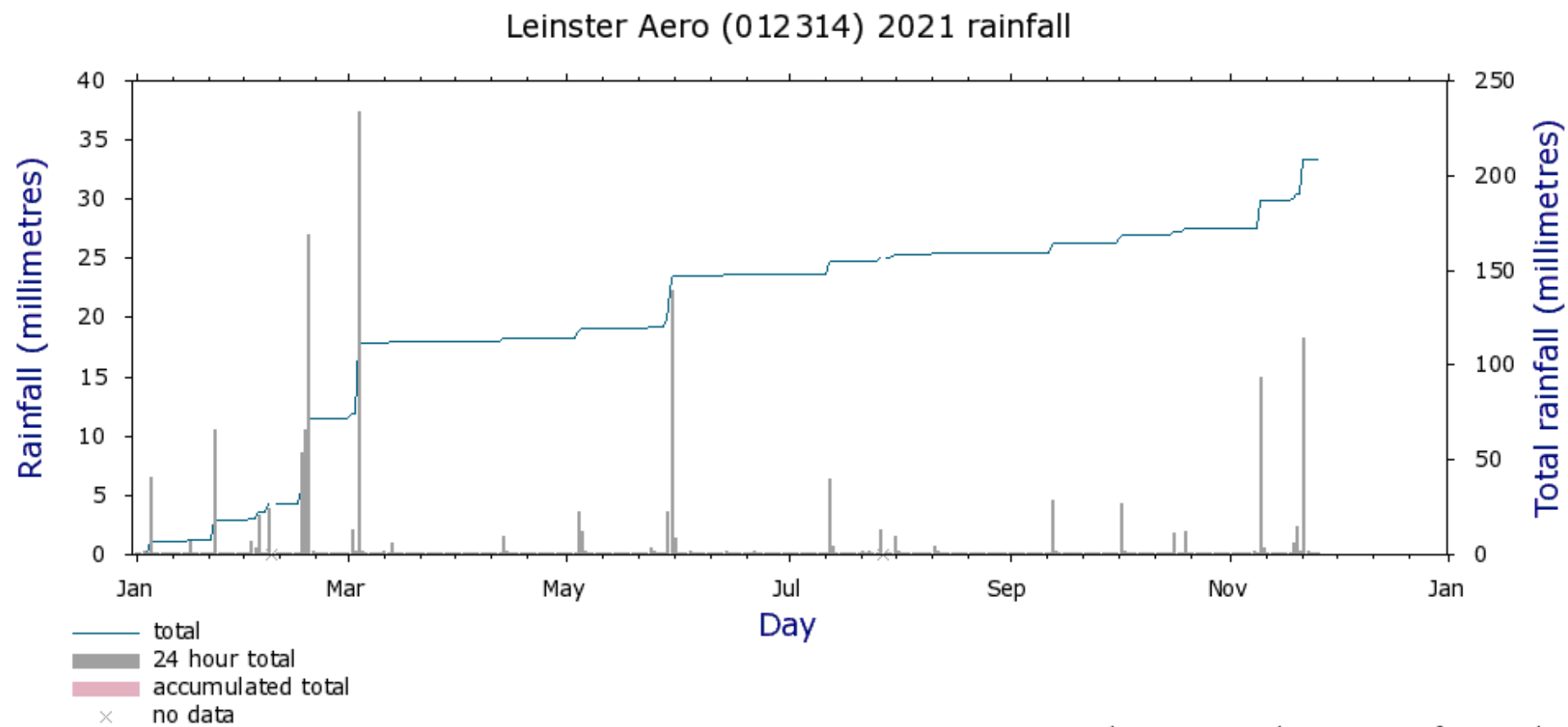
Records from that station for the 27 years from 1994 to 2021 show that the mean annual maximum temperature was 28.3° C, and the mean annual minimum temperature was 14.8° C.

Rainfall readings from 1926 to 2015 (89 years) from The BOM site at Pinnacles, (No 12067), located 38 kilometres southwest of the survey area, show that the mean annual rainfall is 235.5 mm with approximately 68% of that normally falling from January to June

The rainfall readings from Leinster Aero for the past 25 years, however, show that the mean annual figure is 253 mm and that 64 % of that falls between December and April as show on the graph below. (Bureau of Meteorology 2021).

Rainfall recorded for the six months prior to the July survey totalled 147.6 mm which represents 58.3% of the annual mean of 353 mm. The following two months, before the September survey, yielded an additional 11.8 mm resulting in a total for the preceding eight months of 159.4 mm or 63% of the annual mean rainfall.

Figure 1: Leinster Aero 2021 Rainfall Graph



Note: Data may not have completed quality control.

Climate Data Online, Bureau of Meteorology
Copyright Commonwealth of Australia, 2021

2.4.4 Land Systems

The surveyed areas lie within the Eastern Murchison (MUR 01) sub-region of the Murchison (MUR) region as classified under the Interim Biogeographic Regionalisation of Australia (IBRA) Version 7 which states:

“Under the Convention of Biological Diversity, Australia has worked towards a target of 17 per cent of our continent to be protected as part of the National Reserve System. In building the National Reserve System, priority is given to under-represented bioregions that have less than 10 per cent of their remaining area protected in reserves.” (Department of Environment and Energy (DEE) 2021).

The Murchison Bioregion is classed as Underrepresented with less than 10% protection.

In Plant Life of Western Australia, Dr. John Beard described and mapped the vegetation in the Austin Botanical District, now recognised as The Murchison Region which covers 316,239 square kilometres. He characterised the vegetation as “Predominantly mulga low woodland (*Acacia aneura*) on plains, reduced to scrub on hills. Tree steppe of *Eucalyptus* spp. and *Triodia basedowii* on sand plains.” Referring to the Eastern half of the region he wrote that it has “catenas comprising sandplains on the higher ground, loam soils on the slopes and plains, and salt lakes in the valley bottoms. In some case there are “low level sandplains” in the valleys formed of sand transported from the upper parts of the landscape.” (Beard 1990, p. 187)

The Western Australian Museum’s (WAM) Biological Survey of The Eastern Goldfields of Western Australia Supplements covering the Sandstone-Sir Samuel and Laverton-Leonora study areas describe the various Landforms in the region. This survey lies within the Laverton-Leonora study area. Three of these Landforms can be identified from satellite imagery interpretation within the larger July survey area: Breakaways, Dunefields and Drainage Lines. The smaller, September survey area contained just Dunefields and Drainage Lines. The Landforms are described below.

“**Breakaways** are scattered throughout (the) Study Areas. Breakaways that occur on a metabasalt substrate within Undulating Plains, contrast from those associated with Broad Valleys and Sandplains. Four distinct elements comprise the breakaway landform: summit flats, scree slopes, colluvial base and drainage channels. Species composition recorded on breakaways varied with geographical spread across the Study Areas. Although the tree or tall shrub layer invariably comprised *Acacia aneura* (Mulga), the shrub layer was

considerably more diverse, variable and characteristic. Each breakaway complex had an annual flora influenced by both the substrate and position within the breakaway landform. Drainage channels flowing off the breakaway supported the richest communities.” (WAM, p. 24)

“**Drainage Lines.** Scattered throughout the Study Areas are abrupt, well-defined creeklines with relatively deep channels supporting *Eucalyptus camaldulensis* Woodlands and Low Woodlands. Drainage lines are one of the few landforms in the Study Areas where introduced weeds were consistently recorded. Poorly developed drainage channels, however, are relatively narrow and shallow with similar vegetation structure to the surrounding landform. Many of these minor creeklines are included within the surrounding landform units. Drainage channels are frequently associated with Breakaways and Undulating Plains throughout both Study Areas. Drainages bordering salt lakes are poorly defined for most of the year. Smaller drainages in the Study Areas were dominated by *Acacia aneura*, *A. burkittii* and *Eucalyptus loxophleba* Low Woodlands.” (WAM, p. 27)

“**Dunefields** are associated with two landforms within both Study Areas: Sandplains and Salt Lake Features. Dunefields associated with Sandplains shared few structural or vegetational links to salt lake dunes. Vegetation on sandplain dune fields varied with the height and structure of the dune system. Broad, low dunes had a cover of tall *Eucalyptus gongylocarpa* over *Triodia basedowii* while narrow, abrupt dunes had a lower vegetation, sometimes with discernible zonation from crest to swale. Low Woodlands of *Eucalyptus gongylocarpa* dominated the-surrounding sandplains, the dune slopes supported mallees of *Eucalyptus kingsmillii* and *E. youngiana* while the dune crests and upper slopes were characterised by tall shrublands of *Grevillea* spp. The hummock grass *Triodia basedowii*, prominent on the slopes and swales, was replaced by *Plectrachne schinzii* [*Triodia schinzii*] on the dune crests and upper slopes. The ephemeral flora was essentially the same on dunes and surrounding sandplain areas.” (WAM, pp. 27-28)

In the WA Department of Agriculture’s Technical Bulletin, No 87 An inventory and condition survey of the north-eastern Goldfields, Western Australia, authors H. Pringle *et.al.* (Technical Bulletin No. 87) describe land systems according to their topography, soils and vegetation. The 1: 250 000 scale map of the land systems accompanying the report shows that the area surveyed for the larger project lies almost entirely within the Bullimore Land System with less than 11% lying within the Sherwood Land System. The second, smaller survey, was conducted entirely within the Bullimore Land System.

These land systems are described as follows:

Bullimore Land System: Extensive sandplains supporting spinifex hummock grasslands. (Pringle *et. al.* p. 180)

Sherwood Land System: Granite breakaways and extensive granitic plains, with mulga shrublands and minor halophytic shrublands. (Pringle *et. al.* p. 262)

Dr. Beard described the contact between these two land systems: “Frequently the sandplains are bounded by laterite scarps or breakaways, which generally carry shrubby *Acacia aneura*, *A. grasbyi* and *A. quadrimarginea*, but sometimes also trees of *Callitris glaucophylla* and *Eucalyptus carnei*. It is common to find an open area at the foot of the breakaways formed of white, gritty clay leached from the pallid zone on which there are small *Frankenia* or *Halosarcia* and other halophytes.” (Beard 1990, p. 193)

2.4.5 Vegetation

Technical Bulletin No. 87 identifies five different landform units which may exist within the Bullimore Land System and eight within the Sherwood Land System with each landform unit hosting a number of different vegetation types.

3. [METHODS](#)

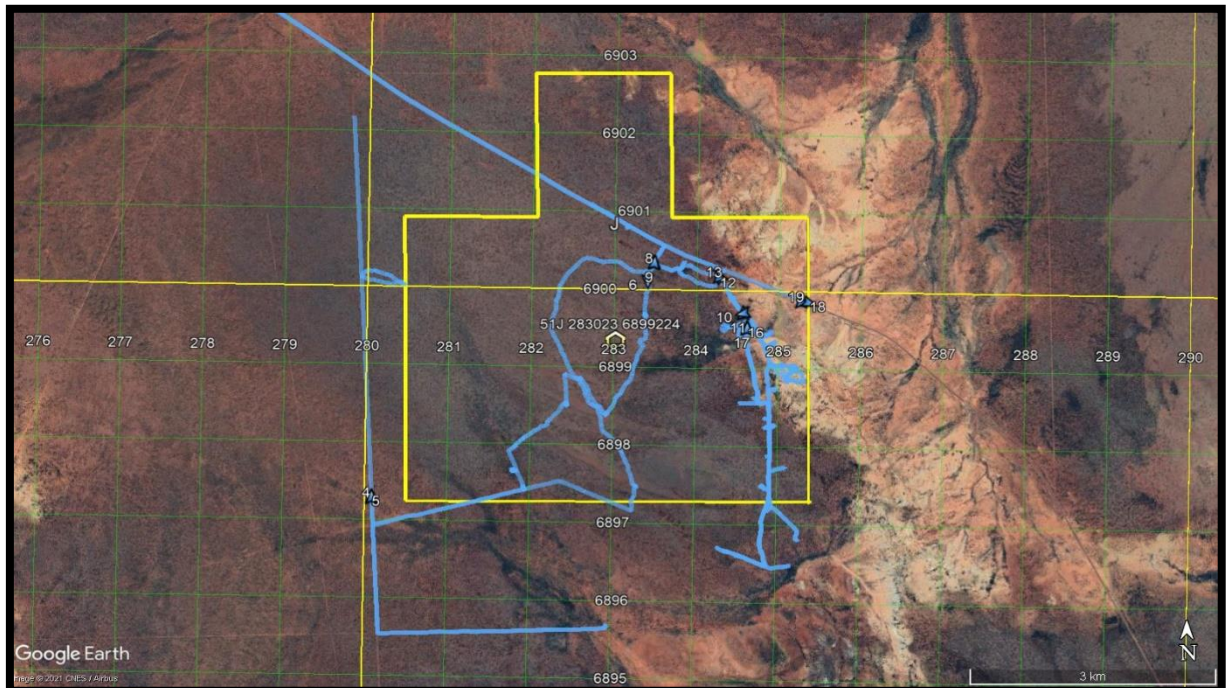
The field surveys were designed to provide data to facilitate the characterisation of the vegetation types present and produce a map depicting those units. Also, to search for Threatened and Priority plants species known or likely to occur in the area.

The first fieldwork for the Reconnaissance survey was undertaken between 09.07.21 and 13.07.21 to confirm the validity of the imagery interpretations made from satellite data of the area, to record and collect plant samples from traverses, and quadrat surveys, to determine the presence or otherwise of potential PEC's and flora of conservation significance and to record the condition of the vegetation.

The Detailed survey was planned to enable any ephemeral taxa absent or unidentifiable when the July survey was conducted to be recorded. Flowering specimens collected to enable positive identification of sterile samples, and mapping of any Priority species identified. This survey was carried out from 06.09.2021 to 09.09.2021.

Land Systems and associated Landform units were identified from the WA Department of Agriculture's Technical Bulletin, No 87 An inventory and condition survey of the north-eastern Goldfields, Western Australia. Vegetation Types were interpreted from quadrat surveys and vegetation type boundaries defined using satellite imagery. Group cluster analysis was also conducted on the July survey data as a check on the vegetation type correlations.

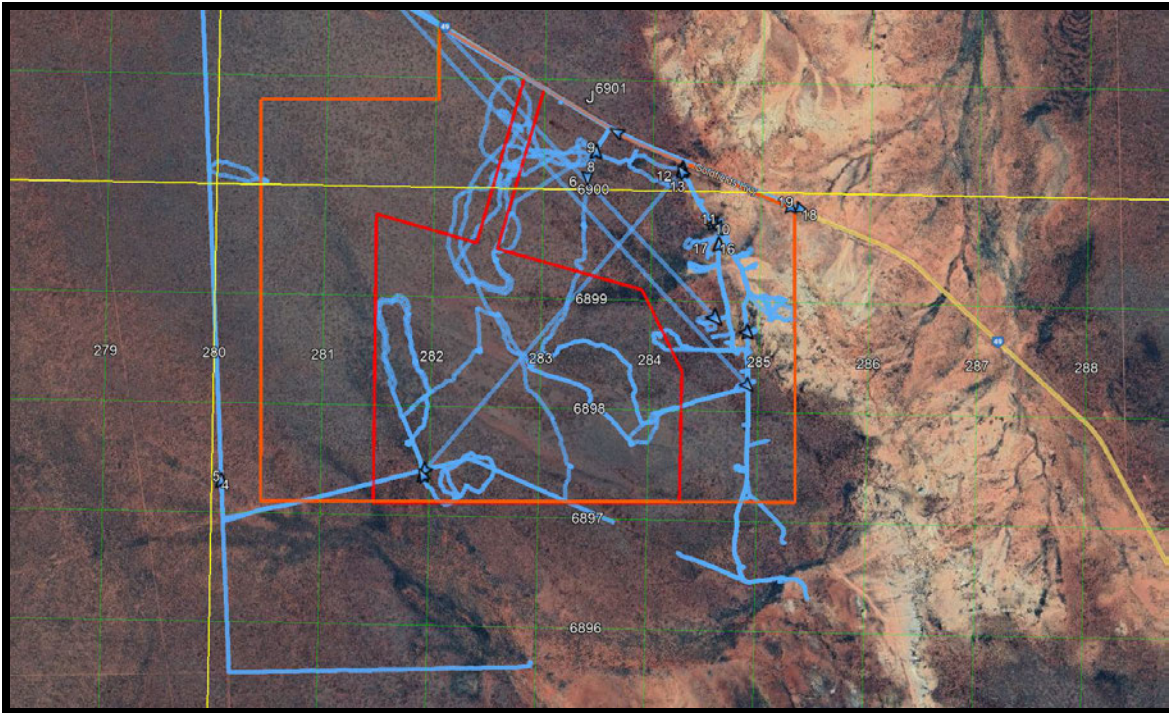
Vehicle access to the eastern side of the survey area was via numerous old, bulldozed grid lines and some station tracks. The western side of the area runs parallel and adjacent to gas pipeline access track which provides access to that side. Traverses were conducted by foot to selected points as shown in the images below.



Map 3: 16 Mile Well GPS tracks – July survey.

Legend:

- █ Lease boundary
- █ GPS tracks



Map 4: 16 Mile Well GPS tracks -- July and Sept. surveys.

Legend:

- GPS tracks July and Sept
- July Survey boundary
- September Survey boundary

Eighteen quadrat surveys were conducted during the July survey with another five added in the September survey.

Each 20m x 20m quadrat survey recorded descriptions of landscape, surface, rock type, soils, overall vegetation type, fire age, condition/disturbances, vegetation stratum height, total percentage cover and dominant species from which a vegetation description was deduced using the Vegetation Classification System shown at Appendix E. A list of species together with their height and percentage foliar cover was also recorded.

Plant species were recorded or sampled, and locations were recorded using Garmin GPSmap76csx and GPSmap 66i devices. Photographs were taken from the north-west corner of the quadrat and a soil sample was collected from each of the 18 quadrats surveyed in July. Opportunistic samples, notes, photographs and GPS coordinates were also taken to aid the mapping and reporting.

Specimens collected in the field were subsequently identified using appropriate text references, plant keys and web sites, with six specimens of sterile Myrtaceous shrubs collected during the July survey forwarded to the W. A. herbarium for positive identification

3.1 Definitions of Survey Limitations

According to the EPA Guidance Statement December 2016 for *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, flora and vegetation surveys may be limited by the following:

- sources of information and availability of contextual information (i.e. pre-existing background versus new material);
- the scope (i.e. what life forms, etc., were sampled);
- Proportion of flora collected and identified (based on sampling, timing and intensity);
- completeness and further work which might be needed (e.g. was the relevant area fully surveyed);
- mapping reliability;
- timing, weather, season, cycle;
- disturbances (fire, flood, accidental human intervention etc.);
- intensity (in retrospect, was the intensity adequate);
- resources;
- access problems; and
- experience levels (e.g. degree of expertise in plant identification to taxon level).

An assessment of these aspects is detailed in the table below:

3.2 Survey Limitations

TABLE 2: Survey Limitations

ASPECT	CONSTRAINT	COMMENT
Sources and availability of contextual information	No	The WA Department of Agriculture's <u>Technical Bulletin, No. 87 An inventory and condition survey of the north-eastern Goldfields, Western Australia</u> , and accompanying 1: 250 000 Leonora sheet provides extensive reference material for the region and the survey area.
Scope	No	The survey covered all aspects of flora and vegetation assessment required for both surveys and preparation of IBSA compliant data.
Proportion of flora collected and identified	No	Traverses covered the nine vegetation types encountered within the two land systems and 23 quadrat surveys were conducted 120 taxa were collected in July representing between 80% and 94% of all species within the larger survey area as calculated from the analysis shown in Sect.4.4 below. Additional analysis incorporating new specimens collected in September has not been conducted. Identification to species level is 98%.
Completeness	No	Survey effort considered adequate to characterise flora and vegetation in and around the survey area, assess vegetation condition and potential threats posed to it.
Mapping reliability	No	Detail considered adequate for a Detailed Survey in this region. Seven of the nine vegetation types identified have been mapped with the remaining two being sub-types of a broader classification and whose boundaries are ill-defined at this scale.
Timing	No	The recommended time for primary surveys in this region is 6-8 weeks post the wet season which is regarded as March–June. The reconnaissance survey was carried out from 9-13th July and the detailed survey from 6-9th September.
Disturbances	No	No impediments encountered.

Intensity	No	Data from the July survey enabled a concentration of effort in a much smaller area in September, facilitating adequate intensity in areas of potential disturbance.
Resources	No	Resources were adequate with two botanists devoted to survey work for four days on each survey.
Access Problems	No	Survey areas accessible by foot and four-wheel drive vehicle.
Experience Levels	No	Personnel have combined over 32 years field surveying experience in the Eastern and North-Eastern Goldfields and Murchison Region.

4. RESULTS

4.1 Flora

Twenty-three quadrats, each 20m x 20m were surveyed.

A total of 136 separate plant specimens (including duplicates) were collected from within the 1721.5 ha survey area during the July survey with an additional 44 collected during the 648 ha September survey.

Six sterile specimens of Myrtaceous shrubs were sent to the W. A. Herbarium for identification, one of which was confirmed to be the Priority 3 species, *Thryptomene* sp. Leinster (B. J. Lepschi and L. Craven 4362)

One hundred and forty-seven different species, including sub-species and varieties have been identified from 29 families and 71 genera.

The most abundant genera were *Acacia* with 16 species and *Eremophila* with 15 species.

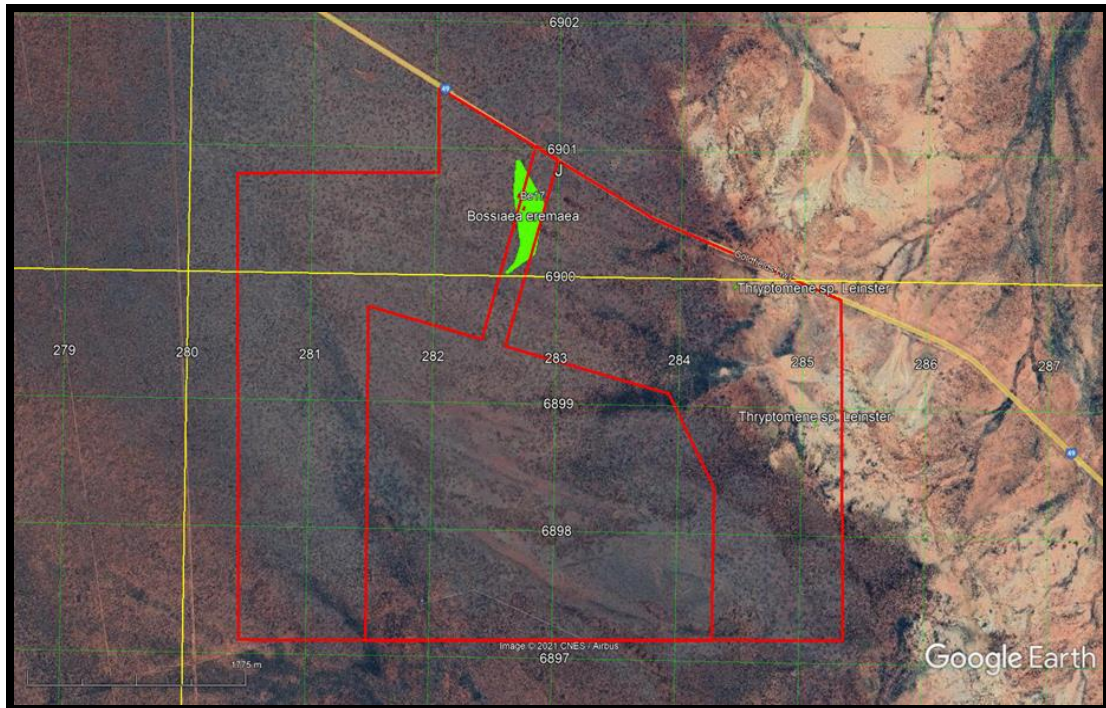
A complete list of species recorded is shown in the attached Appendix C.

No non-native introduced species were recorded within the survey area.

No plant species gazetted as Declared Rare Flora pursuant to Part 2 of the BC Act and no species listed as Threatened pursuant to the List of Threatened Flora of the EPBC Act

(Department of Sustainability, Water, Population and Communities) has been recorded from within the survey area.

Two priority species listed in the DPaW's Threatened and Priority Flora data search results, or the Nature Map Species Report have been identified. Ninety-two stems of *Bossiaea eremaea* (P3) were recorded within an area of approximately 5000 square metres and single stems of *Thryptomene* sp. Leinster (B.J. Lepschi L. Craven 4362) (P3) were recorded at two locations. (See Map 5 below)



Map 5: Priority species locations.

Legend:

Bossiaea eremaea (P3) and Thryptomene sp. Leinster (B.J. Lepschi L. Craven 4362) (P3)

Survey Boundaries

One sterile specimen of a *Seringia* species was collected which could not be positively identified, leaving open the possibility of it being *Seringia exastia*. The Threatened and Priority Flora search results provided by the DBCA gave notification that although this species is currently listed as Threatened, it has recently undergone a taxonomic review and found to be the same species as the common and widespread *S. elliptica*. As a result, it is expected to soon be delisted.

A search conducted by the DBCA of the Threatened and Priority Ecological Communities database revealed that there are no known occurrences of TEC's recorded within 50 kilometres of the survey area with the closest being Depot Springs, located 73 kilometres to the west.

No TEC's were identified during the survey.

The nearest PEC to this survey area is the Yandal calcrete groundwater assemblage type on Carey paleodrainage on Yandal Station located approximately 28 kilometres north - northeast of the survey area.

No PECs were identified within the survey area.


4.2 Vegetation Classification

The July survey area lies almost entirely within the Bullimore Land System which is described as “Extensive sandplains supporting spinifex hummock grasslands”. A small portion comprising less than 11% of the survey area falls within the Sherwood Land System which is described as “Granite breakaways and extensive stony granite plains, with mulga shrublands and minor halophytic shrublands” (Pringle, *et. al.* pp. 180, 262)





The smaller September survey excluded the Sherwood land system and was confined to the Bullimore system.

Nine vegetation types described in Technical Bulletin 87 were identified within the survey area, however, five of these were sub-types of the most extensive vegetation type, that being Sandplain Spinifex Hummock Grassland (SASP). The vegetative characteristics of the sub-types have been largely determined by their relative elevations and the amount of rainfall run-on that they receive. They form a complex mosaic of similar vegetation types with boundaries not readily distinguishable and have been rationalised in the mapping to show just two of the five sub-types identified within SASP.




The five vegetation sub-types identified within the broader vegetation type of SASP, are:

SAGS, Sandplain Gum Stratum. Typified by the distinctive Marble Gum, <i>Eucalyptus gongylocarpa</i> over Spinifex sandplain with an understory including species of Acacias, Sennas and Eremophilas	
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<p>SAHS, Sandplain Heath Stratum was encountered in interdunal swales and was dominated by Myrtaceous shrubs, less than one metre tall, over Spinifex, with few other taxa present.</p>	
<p>SDSH, Sand Dune Shrublands in this area had low Eucalypts scattered over open Spinifex with open shrubs of Acacia and Grevillea species over low shrubs of Myrtaceae and Eremophila species.</p>	
<p>SAMU, Sandplain Mulga. This vegetation type is characteristic of the floristic composition of the bulk of the survey area. Mallees and Mulgas on Spinifex sandplain with a sparse mid-story of xerophilous shrubs.</p>	
<p>SAMA, Sandplain Mallee. Distinguished within SASP by the presence of <i>Eucalyptus oldfieldii</i> and the paucity of Spinifex. SAMA retains the ubiquitous Acacia and Eremophila species.</p>	

Examples of the remaining four vegetation types within the survey area are shown below:

<p>BLSS, Bladder Saltbush Shrublands. Occurred on wash plains below breakaway footslopes. It consisted of low growing halophytes predominantly chenopods.</p>	
<p>BRXS, Breakaway Mixed Shrublands was encountered on the top edge of low breakaways with skeletal soils and fissures. Plant density was low but diversity relatively high. <i>Acacia quadrimarginea</i> and <i>A. incurvaneura</i> were the tallest shrubs with <i>Eremophila</i>, <i>Ptilotus</i>, <i>Sidas</i> and grasses with no genera dominant.</p>	
<p>SAES, Stony Plain Acacia Eremophila Shrubland. Although sparse the taxa in this vegetation type are diverse given that the slightly raised platforms receive little run-on, soils are shallow, and cattle are present.</p>	

DRMS, Drainage Tract
Mulga Shrublands benefit
from the concentrated run-
on from the breakaways up
slope and contains taller
trees and shrubs with the
greatest diversity than all
other veg types.



Vegetation types identified within the respective land systems are shown in Table 3 below.

Land Systems	Vegetation Types								
	SAMU	SAGS	SDSH	SAMA	SAHS	BLSS	BRXS	SAES	DRMS
Bullimore	X	X	X	X	X				
Sherwood						X	X	X	X

Table 3: Vegetation Types by Land Systems.

Vegetation type descriptions for the 23 quadrats surveyed are shown in Appendix B.

The area of the respective vegetation types mapped in the July survey is show below.

Vegetation Types	Hectares
BLSS, Bladder Saltbush Low Shrublands	18.4
BRXS, Breakaway Mixed Shrublands	59.2
DRMS, Drainage Tract Mulga Shrublands	140.4
SAES, Stony Plain Acacia-Eremophila Shrublands	13.7
SAGS, Eucalyptus gongylocarpa Open Woodlands	73.7
SASP, Sandplain Spinifex Hummock Grasslands	1,411.9
SDSH, Sand Dune Shrublands	4.2
Total	1,721.5

Table 4: Area by Vegetation Type

4.3 Statistical Analysis

The statistical analysis results shown below were based on the data obtained from the July survey only.

Examination of the data from the September survey revealed that of the 31 new taxa recorded, 16 of them were located within the vegetation type classified as Drainage Tract Mulga Shrublands (DRMS), from two locations, both of which are now outside the area of interest.

Of the remainder of the new taxa recorded, five were in Sand Dune Shrubland (SDSH) and 11 within Sandplain Spinifex Hummock Grassland (SASP) and one species, *Acacia ramulosa* var. *linophylla*, occurred in DRMS and SASP.

Of the five additional quadrats surveyed in September, one occurred in SDSH and four within SASP. These vegetation types had been previously mapped and described, negating the benefit of conducting further statistical analysis.

A group cluster analysis was carried out on the data collected in the July survey and a dendrogram, produced using the flexible β method (Lance and Williams, 1967) one of three methods recommended by McCune and Grace (2002), confirmed the classifications of the quadrats into the various vegetation types described above.

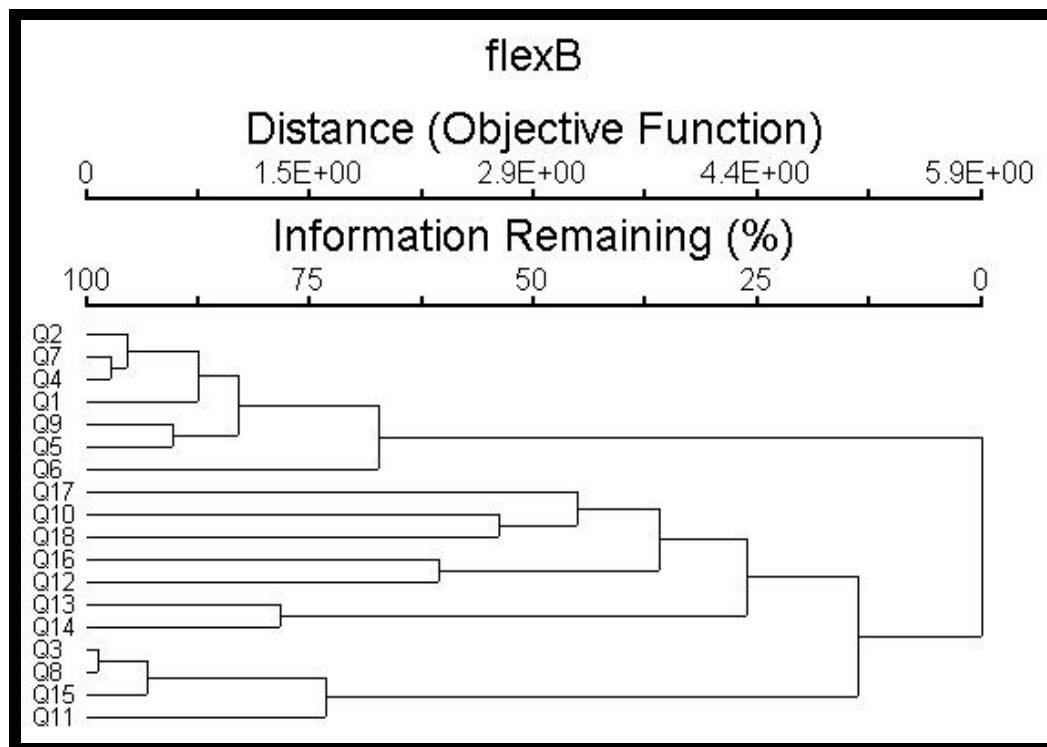


Figure 2: Dendrogram

Quadrats 11, 15, 8, and 3 are in vegetation type DRMS. Drainage Tract Mulga Shrublands.

Quadrats 14 and 13 are in BRXS. Breakaway Mixed Shrublands

Quadrats 12 and 16 are in BLSS. Bladder Saltbush Low Shrublands

Quadrats 18 and 10 are in SAES. Stony Plain Acacia -Eremophila Shrublands

Quadrats 6, 5, 9, 1, 4, 7 and 2 are all in SASP. Sandplain Spinifex Hummock Grasslands

Quadrat 17, although shown in the dendrogram to be most closely aligned to Quadrats 10 and 18, bears no floristic resemblance to either. The most obvious feature common to these three quadrats is the absence of species which occur over most of the survey area. Based on the six taxa present within quadrat 17 and its location on a low, broad sand dune, it is considered to lie within the Sandplain Spinifex Hummock Grassland vegetation type.

A species-area curve was produced using the Sorensen/Bray-Curtis distance measure with β set to -0.25, as recommended by McCune and Grace (2002)

Twenty-five species were collected opportunistically in addition to the 95 species collected within the quadrats giving a total of 120.

First and second order jack-knife estimates, calculated from the quadrat records, of the total number of species occurring within the survey area, were 134.7 and 149.4 respectively.

Chao2 classic form and Chao2 bias corrected form estimates were 127.7 and 124 respectively.

These figures indicate that the 120 taxa recorded represent between 80 and 94% of the total taxa on the site.

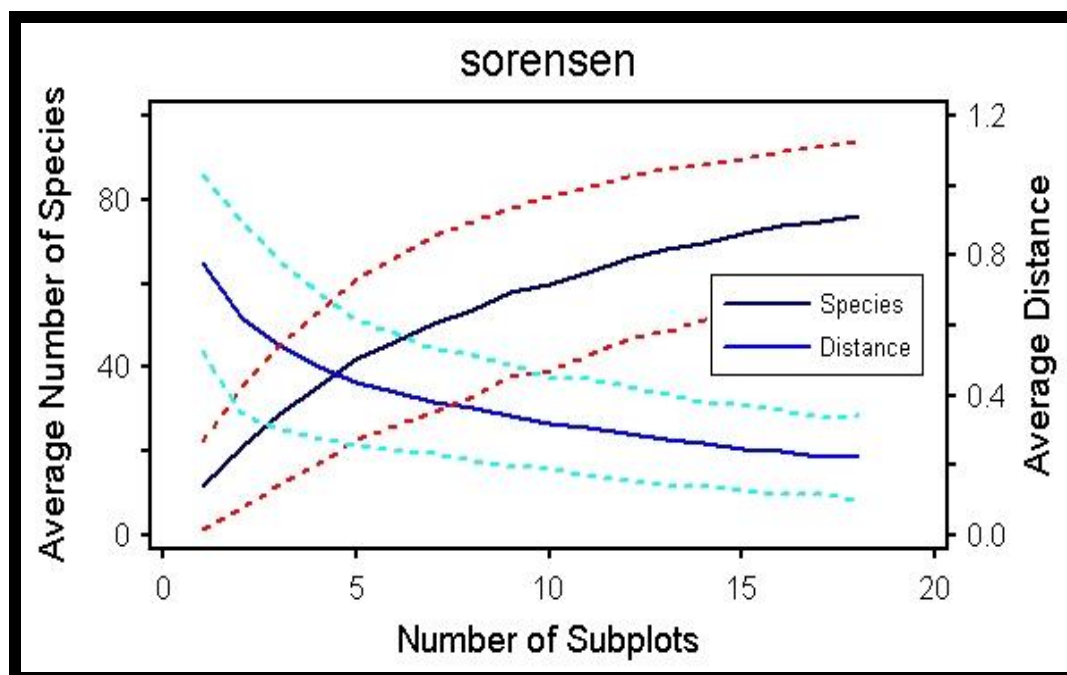
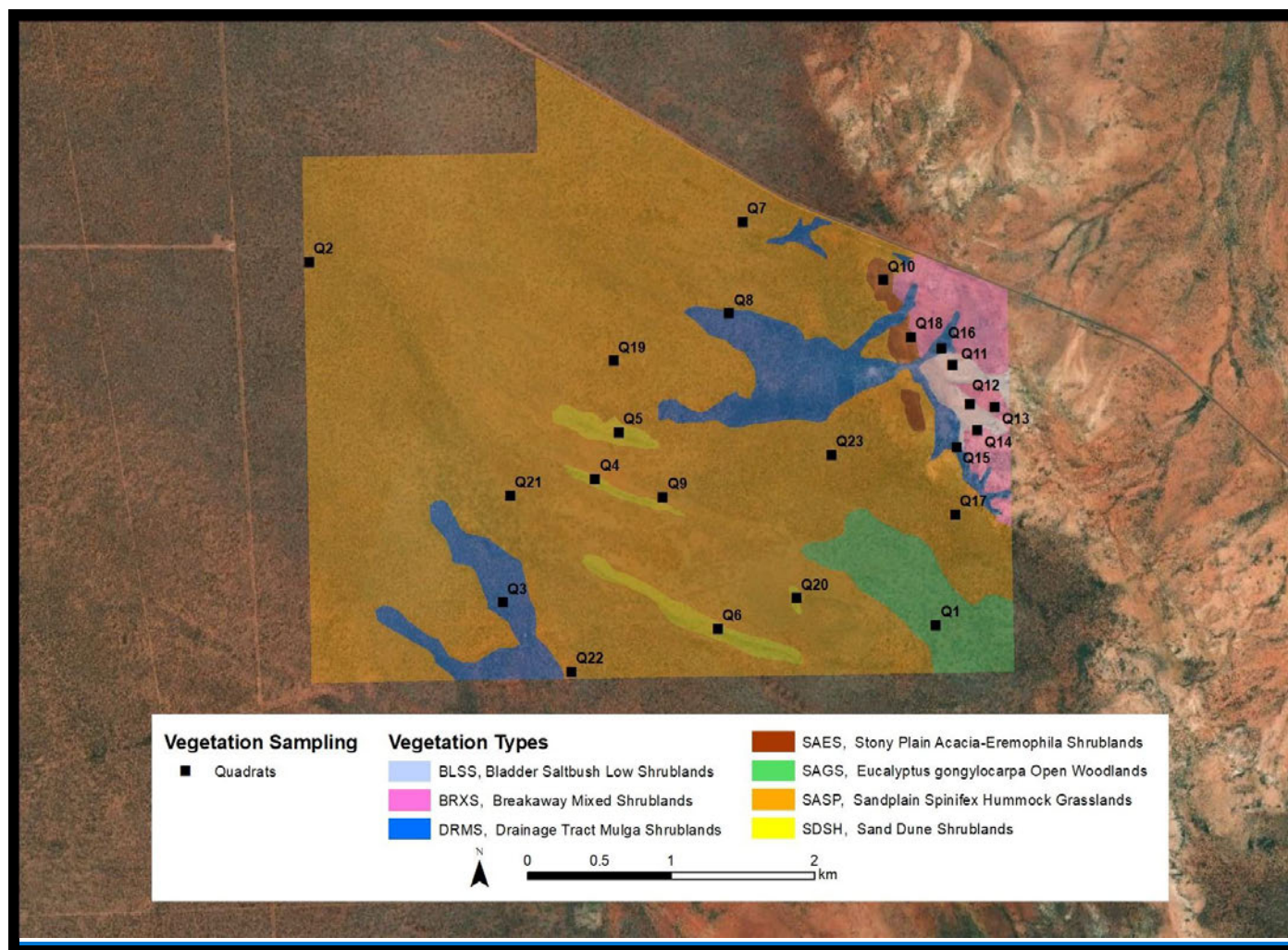


Figure 3: Species-Area Curve

MAP 6: 16 Mile Well Vegetation and Quadrat locations.



4.4 Condition of the Plant Communities

The region has been subjected to long-term pastoral and mining activities.

Mining began in 1897 with the discovery of gold in the region. Leinster Downs Station, on which the survey area is located, was established in 1909 and has been used to run horses, cattle and sheep and is currently lightly stocked with cattle.

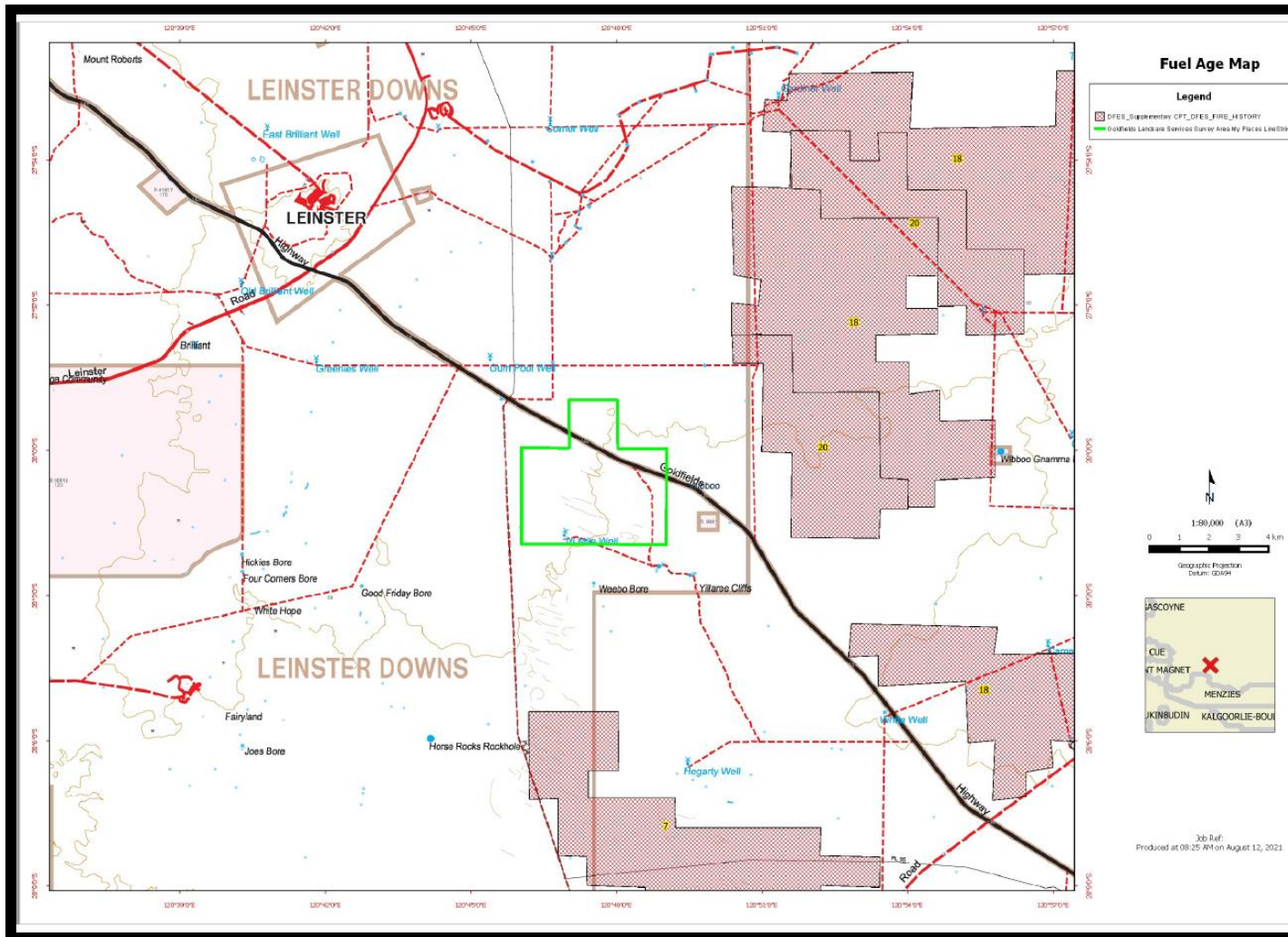
Evidence of the historical sheep grazing infrastructure in the form of fences, wells, bores and windmills are still apparent within the drainage tracts in the south of the survey area. Although no permanent water points remain, the few cattle seen were also within the drainage tracts which cover 5.4% of the survey area.

The most recent mineral exploration activity, evidenced by partially rehabilitated grid lines and drill pads, is estimated to be more than thirty years old and is most apparent within the drainage tracts in the north-eastern part of the survey area.

A few old station tracks and mineral exploration tracks in the vicinity of the wash plains below the breakaways in the north-eastern part of the survey area have been badly eroded and impassable in some places.

No introduced weed species were encountered in the survey.

Evidence of wildfire within the survey area was only recorded in the vegetation type described as Sandplain Spinifex Hummock Grassland. The most recent fire age estimates, of greater than ten years, were made at quadrats 4,5,6 and 9, which are all located either on a dune or in an interdunal swale in the south-central part of the survey area. Elsewhere, the fire age was estimated to be greater than twenty years. These fire age estimates compared favourably with the Spinifex Class ratings compiled by the DBCA. (Burrows *et al.* 2014, pp. 3-6) The fuel age map below shows that the most recent wildfire recorded in the region occurred over seven years ago and was located approximately six kilometres to the south of the survey area, however, not all wildfires are recorded by authorities.



Map 7: Regional Fire History

The Agriculture WA publication entitled “*Pastoral resources and their management in the north-eastern goldfields, Western Australia*” (Pringle, 1994) provides an interpretation of the findings from the rangeland survey of that area.

The report covered an area of about 100,600 square kilometres and includes individual station reports on all or part of 51 stations within it including that prepared for Leinster Downs Station.

In assessing the pastoral resource condition for the stations, the survey employed a vegetation condition rating scale developed to describe the grazing potential of the various land systems encountered on the individual properties.

Although this scale uses different criteria to that used in the field assessments for this report, it is included here for the purpose of comparison.

- The vegetation condition rating of **Good** was described as: Perennials present include all or most of the species expected; some less palatable or unpalatable species may have increased, but total perennial cover is not very different from the optimal.
- The vegetation condition rating of **Poor** was described as: Conspicuous losses of palatable perennials; foliar cover is either decreased through a general loss of perennials or is increased by invasion of unpalatable species.

The report prepared for Leinster Downs shows that all of the Bullimore land system which occupies 27986 ha or 19.6% of the property, was assessed as being in Good condition. This concurs with the assessment made in this survey, although based upon different assessment criteria.

The Sherwood land system covers 3803 Ha or 2.7% of Leinster Downs and was all assessed as being in Poor condition.

The condition of the Sherwood land system within the July survey area, (based on the Keighery, Trudgen scale below), was deemed to be Good with one of the quadrats surveyed within it being the most species diverse in the survey with 23 species recorded compared to the average species count of the eighteen quadrats surveyed of 11.6 species.

As mentioned previously (Climate Sect 2.4.3) the rainfall recorded for the six months prior to the July survey totalled 147.6 mm which represents 58.3% of the annual mean of 353 mm. The following two months, before the September survey, yielded an additional 11.8 mm resulting in a total for the preceding eight months of 159.4 mm or 63% of the annual mean rainfall.

The effect of the relatively dry period between the two surveys on the vegetation was manifested in numerous ways:

- It was anticipated that sterile specimens of six Myrtaceous shrubs collected during the July survey would be able to be positively identified by collecting flowering specimens in September with sufficient diagnostic features to enable identification. In fact, not one of those species had flowered and the specimens were sent to the WA Herbarium for identification.
- Very few annual plant species were seen in Spring with the majority of those confined to minor drainage lines.
- It was noted that *Eremophila foliosissima* which had not set buds in early July, had flowered, and set fruit by Sept 6.

Overall, the condition of the vegetation overall was considered to be “Good” based on the Vegetation Condition Scale adapted from Keighery (1994) and Trudgen (1988) shown below.

Table 5: Vegetation Condition Scale for Eremaean and Northern Botanical Provinces (Keighery 1994, Trudgen 1988) taken from EPA (2016)

Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation, i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

5. DISCUSSION

The WA Department of Agriculture's Technical Bulletin, No. 87 covers a survey area of 100,570 square kilometres. Within that area the Bullimore Land System occupies 24,013 square kilometres or 24% and the Sherwood Land System 3875 square kilometres or 3.9%. Within the larger, July survey area those Land Systems are represented in the proportions of 1537.8 ha or 89.3% and 183.7 ha or 10.67% respectively. The September survey area was confined entirely within the Bullimore Land System

Given the nature of the proposed activity, i.e., shallow strip mining of sand and gravel, it is likely that any physical disturbance created would be confined to the extensive Sandplain Spinifex Hummock Grassland within the Bullimore Land System.

No potential Priority Ecological Communities were identified, with the nearest known one located 28 kilometres north north-east of the survey area.

The nearest Threatened Ecological Community is located 73 kilometres east of the survey area.

An Index of Biodiversity Surveys for Assessment (I. B. S. A.) data package has been prepared in accordance with the requirements of the *Environmental Protection Act of 1986*.

6. CONCLUSION AND RECOMMENDATIONS

A total of 147 species (including sub-species and varieties) from 29 families and 71 genera have been recorded in the survey areas. The most prevalent families recorded were *Fabaceae*, *Chenopodiaceae*, *Scrophulariaceae*, *Myrtaceae* and *Poaceae* (Appendix C).

- No plant species gazetted as Threatened or Declared Rare Flora pursuant to subsection (2) of section 23F of the BC Act were recorded.
- No plant species listed as Threatened pursuant to Schedule 1 of the EPBC Act (Department of Sustainability, Water, Population and Community) were recorded.
- No species listed as Declared by the Department of Agriculture and Food Western Australia under the BAM Act were recorded.
- No plant species listed as a Weed of National Significance (WoNS) under the EPBC Act were encountered in the survey area. Weeds of National Significance are considered by the States and Territories to pose a significant threat to biodiversity.
- Two plant species, *Bossiaea eremaea* and *Thryptomene* sp. Leinster (B. J. Lepschi and L. Craven 6432) listed as Priority three species by DBCA (2019) have

been recorded. The former on the alignment of a proposed haulage road and the latter east of and outside the September survey.

- No Threatened Ecological Communities listed by the DBCA (2019) were recorded.
- No Threatened Ecological Communities listed by the Australian Government Department of Environment and Energy were identified.
- No Priority Ecological Communities listed by the DBCA (2019) were recorded.

The following recommendations are made to protect and enhance the conservation and botanical values in the Thunderbox project area:

- Ground disturbance and clearing of vegetation should be limited to that which is essential for the development of the project.
- Realignment of the proposed haulage road will be required to avoid disturbance to a population of 92 stems of the Priority three species, *Bossiaea eremaea*.
- Apply weed prevention measures.
- Maintain rehabilitation techniques developed on similar previous projects.

7. PARTICIPANTS

Mr Phil Stanley Dip Cart; Dip Hort and Ms Paula Pavlovic BA, MA of Goldfields Landcare Services carried out the survey work, plant identification, mapping and report preparation for this project. Flora Taking (Biological Assessment) Licence numbers: FB2000231 and FB62000232.

Statistical analysis was conducted by Dr Chris Hancock, BSc, PhD. and GIS mapping by Mr Andrew Waters, BSc, GradCertGIS, AdvCertHort. of Woodgis.

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Appendix A: Species of Conservation Significance Database Search Results

Appendix A: Species of Conservation Significance recorded from DBCA data searches and DAWE Protected Matters Search. (See Key at bottom)

Taxon	Cons_Code	WAHERB	TPFL	NatureMap	EPBCA
<i>Acacia</i> sp. Marshall Pool (G. Cockerton 3024)	3	x		x	
<i>Anacampseros</i> sp. Eremaean (F. Hort, J. Hort & J. Shanks 3248)	1	x	x		
<i>Atriplex yeelirrie</i>	T	x	x		E
<i>Austroparmelina macrospora</i>	3	x	x		
<i>Baeckea</i> sp. Sandstone (C.A. Gardner s.n. 26 Oct. 1963)	3	x	x	x	
<i>Bossiaea eremaea</i>	3	x			
<i>Calandrinia quartzitica</i>	1	x			
<i>Calytrix praecipua</i>	3	x			
<i>Calytrix warburtonensis</i>	2		x		
<i>Cratystylis centralis</i>	3	x			
<i>Eremophila arachnoides</i> subsp. <i>arachnoides</i>	3	x			
<i>Eremophila congesta</i>	1	x			
<i>Eremophila gracillima</i>	3		x		
<i>Eremophila pungens</i>	4	x		x	
<i>Eremophila shonae</i> subsp. <i>diffusa</i>	3	x			
<i>Eremophila simulans</i> subsp. <i>megacalyx</i>	3	x			
<i>Eremophila</i> sp. long pedicels (G. Cockerton 1975)	2	x			
<i>Frankenia georgei</i>	1	x			
<i>Goodenia modesta</i>	3	x	x		
<i>Grevillea inconspicua</i>	4	x	x	x	
<i>Hemigenia exilis</i>	4	x	x	x	
<i>Hibbertia</i> sp. Sherwood Breakaways (R.J. Cranfield 6771)	2	x			
<i>Homalocalyx echinulatus</i>	3	x			
<i>Hybanthus floribundus</i> subsp. <i>chloroxanthus</i>	3	x			

Appendix A: Species of Conservation Significance recorded from DBCA data searches and DAWE Protected Matters Search. (See Key at bottom)

Taxon	Cons_Code	WAHERB	TPFL	NatureMap	EPBCA
<i>Korthalsella leucothrix</i>	1	x	x	x	
<i>Micromyrtus chrysodema</i>	1	x	x	x	
<i>Mirbelia ferricola</i>	3	x			
<i>Olearia arida</i>	4	x			
<i>Olearia mucronata</i>	3	x			
<i>Philotheca tubiflora</i>	1	x			
<i>Phyllanthus baeckeoides</i>	3	x	x	x	
<i>Seringia exastia</i>	T	x			CE
<i>Sida picklesiana</i>	3	x			
<i>Stenanthemum patens</i>	1	x	x	x	
<i>Swainsona katjarra</i>	1	x			
<i>Tecticornia cymbiformis</i>	3	x			
<i>Tecticornia enodis</i>	1	x			
<i>Thryptomene nealensis</i>	3	x		x	
<i>Thryptomene</i> sp. Leinster (B.J. Lepschi & L.A. Craven 4362)	3	x	x	x	
<i>Tribulus adelacanthus</i>	3	x			
<i>Triodia plurinervata</i>	3	x			
<i>Verticordia jamiesonii</i>	3	x		x	

Appendix A: Species of Conservation Significance recorded from DBCA data searches and DAWE Protected Matters Search.

KEY:

T: Threatened (DBCA)

P1, P2, P3, & P4: Priority rating (DBCA)

EPBC: Environment Protection and Biodiversity Conservation Act 1999

E: Endangered (EPBC)

CE: Critically Endangered

WAHerb: WA Herbarium Database (DBCA)

NatureMap: NatureMap (DBCA)

TPFL: Threatened and Priority Flora Database (DBCA)

Appendix B: Quadrat Sampling Site Descriptions



Plate 1: Quadrat 19 Sandplain Spinifex Hummock Grassland (SASP)

At quadrat number nineteen (51J 282564 m E; 6899353 m S), the vegetation was described as Low Woodland A of *Eucalyptus gongylocarpa* (2-10% PFC, 5-15 m) over Scattered Tall Shrubs of *Acacia caesaneura*, *A. ayersiana* and *Grevillea juncifolia* with emergent *E. gongylocarpa* (<2% PFC, >2m) over Open Low Scrub of *Eremophila forrestii* subsp. *forrestii*, *A. ramulosa* var. *linophylla*, *A. caesaneura*, *A. effusifolia*, *Senna glutinosa* subsp. *x-luersenii* and *Olearia subspicata* (2-10% PFC, 1-2 m) over Scattered Low Shrubs of *Ptilotus obovatus*, *Solanum lasiophyllum* and *Enchylaena tomentosa* (<2% PFC, <1m) over Open Hummock Grass of *Triodia basedowii* (14% PFC, 0.4m) on orange sandy silt, mid slope of a low dune.



Plate 2: Quadrat 21 Sandplain Spinifex Hummock Grassland (SASP)

At quadrat number twenty- one (51J 281843 m E; 6898412 m S), the vegetation was described as Scattered Low Trees A of *Eucalyptus kingsmillii* (<2% PFC, 5-15 m) over Low Scrub of *Acacia effusifolia*, *Enekbatus eremaeus* and *Micromyrtus flaviflora* (10-30%, 1-2 m) over Open Hummock Grass of *Triodia basedowii* (10-30%, 0.4 m) and Scattered Low Shrubs of *Seringia* sp. (<2% PFC. 0.3 m) on orange silty sand on a sand plain.



Plate 3: quadrat 23 Sandplain Spinifex Hummock Grassland (SASP)

At quadrat number twenty-three 51 J 284082 m E; 6898696 m S) the vegetation was described as Scattered Low Trees A of *Eucalyptus gongylocarpa* (<2%, 5-15 m) over Open Scrub of *Acacia incurvaneura* and *A. effusifolia* (2-10% PFC, >2 m) over Open Low Scrub of *Eremophila forrestii* subsp. *forrestii* and *Psydrax latifolia* (2-10% PFC, 1-2 m) over Scattered Low Shrubs of *Ptilotus obovatus* and *Solanum lasiophyllum* (<2% PFC, <1 m) over Open Hummock Grass of *Triodia basedowii* (20% PFC, 0.4 m) on orange silty sand on a low sand dune.



Plate 4: Quadrat 2. Sandplain Mulga (SASP sub-type SAMU)

At quadrat number two (51J 280440 m E; 6900040 m S), the vegetation was described as *Eucalyptus lucasii*, *Acacia caesaneura* Low Woodland A (10-30% Projected foliar cover (PFC), 5-15 m) over *A.caesaneura*, *A. aptaneura* Open Scrub (2-10% PFC, >2 m) over *A. aptaneura*, *A. caesaneura*. *A. incurvaneura* and *Eremophila forrestii* subsp. *forrestii* Scattered Shrubs (<2% PFC, 1-2 m) over *Teucrium teucriiflorum* and *Ptilotus obovatus* Scattered Low Shrubs (<2% PFC, <1 m) over Open Hummock Grass of *Triodia basedowii* with Scattered Grass of *Eragrostis eriopoda* (10-30% PFC, 0.4 m) on orange sandy silt with approximately 20% leaf litter.



Plate 5: Quadrat 22 Sandplain Mulga (SASP sub-type SAMU)

At quadrat number twenty-two (51 J 282268 m E; 6897181 m S) the vegetation was described as *Acacia fuscaneura*, *A. effusifolia* Scrub (10-30% PFC, >5 m) with Scattered Low Trees A of *Eucalyptus kingsmillii* (<2% PFC 5-15 m) over Open Low Scrub of *Eremophila forrestii* subsp. *forrestii*, *Acacia ramulosa* var. *linophylla* and *Psydrax suaveolens* (<2% PFC, 1-1.5 m) over Scattered Low Shrubs of *Eremophila forrestii* subsp. *forrestii*, *Maireana thesioides*, and *Teucrium teucriiflorum* (<2%, <1 m) over Very Open Hummock Grass of *Triodia basedowii* (2-10% PFC, 0.4 m) on orange silty sand on an alluvial plain.



Plate 6: Quadrat 1 Sandplain Gum Stratum (SASP sub-type SAGS)

At quadrat number one (51J 284809 m E; 6897506 m S), the vegetation was described as *Eucalyptus gongylocarpa* and *E. youngiana* Low Woodland A (10-30% PFC, 5-15 m) over *Acacia caesaneura*, *A. balsamea* and *Psydrax suaveolens* Open Scrub (2-10% PFC, >5 m) over *Scaevola spinescens*, *Senna artemisioides*, *S. artemisioides* subsp. *filifolia* and *Acacia caesaneura* Low Scrub (10-30% PFC, 1-2 m) over *Eremophila forrestii* subsp. *forrestii*, *Ptilotus obovatus*, *Teucrium teucriflorum*, *E. fraseri* subsp. *fraseri*, *Psydrax suaveolens* and *Seringia* sp. (sterile) Scattered Low Shrubs (<2% PFC, <1m) over *Triodia basedowii* Open Hummock Grass (10-30% PFC, 0.4 m) on orange sandy silt with approximately 20% leaf litter.



Plate 7: Quadrat 7 Sandplain Gum Stratum (SASP sub-type SAGS)

At quadrat number seven (51J 283461 m E; 6900322 m S), the vegetation was described as Open Low Woodland B of *Eucalyptus gongylocarpa* and *E. lucasii* (2-10% PFC, <5 m) over Low Scrub of *Eremophila forrestii* subsp. *forrestii*, *Acacia mulganeura* and *A. balsamea* (2-10% PFC, 1-2 m) over Scattered Low Shrubs of *E. forrestii* subsp. *forrestii*, *Ptilotus obovatus* and *Solanum lasiophyllum* (<2% PFC, <1 m) over Open Hummock Grass of *Triodia basedowii* (20% PFC, 0.4 m) with Scattered Grass of *Eragrostis eriopoda* (<2% PFC, 0.5 m) on sandy silt with <2% leaf litter.



Plate 8: Quadrat 4 Sand Dune Shrubland (SASP sub-type SDSH)

At quadrat number four (51J 282432 m E; 6898527 m S), the vegetation was described as *Eucalyptus gongylocarpa* and *E. youngiana* Open Low Woodland B (2-10% PFC, <5 m) over *Grevillea stenobotrya* and *Acacia jamesiana* Open Scrub (2-10% PFC, >2 m) over *Enekbatus eremaeus*, *Euryomyrtus maidenii* and *Senna artemisioides* Open Dwarf Scrub (2-10% PFC, <1 m) on orange sandy silt with <5% leaf litter.



Plate 9: Quadrat 5 Sand Dune Shrubland (SASP sub-type SDSH)

At quadrat number five (51 J 282597 m E, 6898853 m S), the vegetation was described as Scattered Low Trees A of *Eucalyptus youngiana* (<2% PFC, 5-15 m) over Open Scrub of *Acacia jamesiana* (2-10% PFC, >2 m) over Low Scrub of *Enekbatus eremaeus* and *Eremophila forrestii* subsp. *forrestii* (10-30% PFC, 1-2 m) over Open Hummock Grass of *Triodia basedowii* (15% PFC, 0.5 m) with Scattered Grass of *Eriachne helmsii* on orange sandy silt with approximately 5% leaf litter.



Plate 10: Quadrat 6 Sand Dune Shrubland (SASP sub-type SDSH)

At quadrat number six (51 J 283287 m E, 6897481 m S) the vegetation was described as Scattered Low Trees B of *Eucalyptus kingsmillii* (<2% PFC, <5 m) over Open Scrub of *Acacia jamesiana* and *Grevillea stenobotrya* (2-10% PFC, >2 m) over Low Scrub of *Calytrix erosipetala* (10-30% PFC, 1-2 m) over Scattered Low Shrubs of *Eremophila platythamnos* subsp. *platythamnos* and *Euryomyrtus maidenii* (<2% PFC, <1 m) over Very Open Hummock Grass of *Triodia basedowii* (8% PFC, 0.4 m) on orange sandy silt with 5-10% leaf litter.



Plate 11: Quadrat 20 Sand Dune Shrubland (SDSH)

At quadrat number twenty (51J 283837 m E; 6897698 m S) the vegetation was described as Scattered Low Trees A of *Eucalyptus gongylocarpa* (<2% PFC, 5-15 m) over Open Low Scrub of *Acacia balsamea*, *Eremophila platythamnus* subsp. *platythamnus* and *Dodonaea adenophora* (2-10% PFC, 1-2 m) over Scattered Low Shrubs and Herbs of *Chrysocephalum puteale*, *Scaevola parvifolia*, *Halgania cyanea*, *Leptosema chambersii* and *Lomandra leucocephala* (<2% PFC, <1 m) over Open Hummock Grass of *Triodia basedowii* with Scattered Grasses of *Eragrostis eriopoda*, *Aristida contorta* and *Poa* #131 (10-30% PFC, 0.4 m) on orange sand on a dune.



Plate 12: Quadrat 17 Sandplain Mallee (SASP sub-type SAMA)

At quadrat number seventeen (51J 284943 m E; 6898278 m S), the vegetation was described as Very Open Shrub Mallee of *Eucalyptus oldfieldii* (2-10% PFC, 5 m) over Open Scrub of *Acacia caesaneura* (2-10% PFC, >2 m) over Low Scrub of *Eucalyptus forrestii* subsp. *forrestii* and *A. balsamea* (10-30% PFC, 1-2 m) over Scattered Hummock Grass of *Triodia basedowii* and *Eragrostis eriopoda* (<2% PFC, 0.4 m) on orange silt with approximately 12% leaf litter.

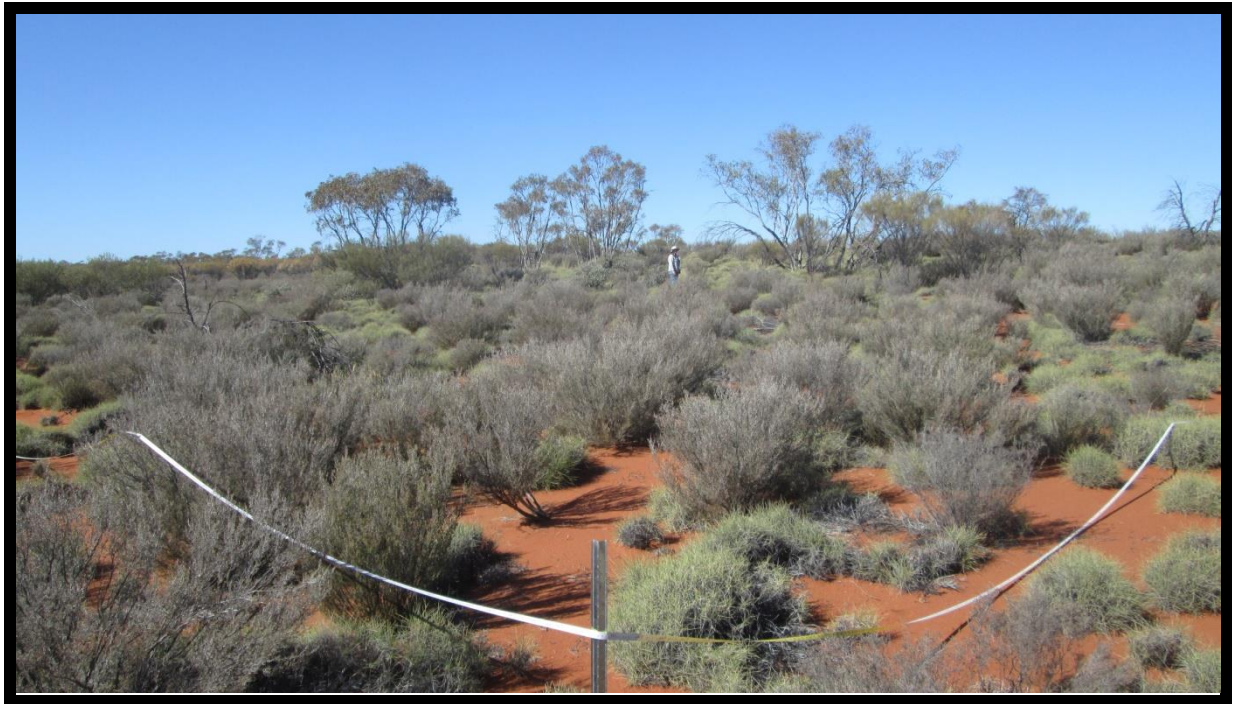


Plate 13: Quadrat 9 Sandplain Heath Stratum (SASP sub-type SAHS)

At quadrat number nine (51J 282905 m E; 6898401 m S), the vegetation was described as Dwarf Scrub of *Calytrix erosipetala* (PFC 10-30%, <1 m) with Scattered *Acacia jamesiana* (<2% PFC, 1-2 m) over Very Open Hummock Grass of *Triodia basedowii* (14% PFC, 0.4 m) on orange sandy silt with <1% leaf litter.



Plate 14: Quadrat 12 Bladder Saltbush Low Shrubland (BLSS)

At quadrat number twelve (51J 285049 m E; 6899050 m S), the vegetation was described as Scattered Shrubs of *Hakea preissii* (<2% PFC, 1-2 m) over Mixed Dwarf Halophytic Shrubs of *Maireana georgei*, *M. glomerifolia*, *M. pyramidata*, *M. tomentosa*, *Atriplex acutibractea*, *A. codonocarpa*, *Frankenia laxiflora* and *Sclerolaena articulata* (10-30% PFC, <1 m) over Grass of *Amphipogon caricinus* (<1% PFC, 0.1 m) on light brown sandy silt with <1% leaf litter.



Plate 15: Quadrat 16 Bladder Saltbush Low Shrubland (BLSS)

At quadrat number sixteen (51J 284927 m E; 6899323 m S), the vegetation was described as Scattered Shrubs of *Hakea preissii* (<2% PFC, 1-2 m) over Open Halophytic Scrub of *Maireana glomerifolia*, *M. pyramidata*, *M. georgei*, *M. tomentosa*, *Atriplex acutibractea*, *A. codonocarpa* and *Dysphania radinostachya* subsp. *inflata* and Grasses of *Amphipogon caricinus* and *Eragrostis dielsii* (2-10% PFC, <1 m) on orange silt with <1% litter.



Plate 16: Quadrat 13 Breakaway Mixed Shrublands (BRXS)

At quadrat number thirteen (51J 285220 m E: 6899027 m S), the vegetation was described as Open Scrub of *Acacia quadrimarginea* (<2% PFC, >2 m) over Scattered Shrubs of *Eremophila latrobei* subsp. *latrobei*, *A. quadrimarginea*, *Sida phaeotricha* and *Prostanthera campbellii* (<2% PFC, 1-2 m) over Open Dwarf Shrubs of *A. quadrimarginea*, and *A. tetragonophylla* (<2% PFC, <1 m) over Very Open Mixed Forbs, and Ferns of *Ptilotus obovatus*, *P. sessifolius*, *P. polystachyus*, *P. aervoides*, *Solanum lasiophyllum*, *Cheilanthes sieberi*, *C. brownii*, *Sida* sp. *Excedentifolia* (J.L. Egan 1925), *Abutilon otocarpum*, *Goodenia havilandii*, *Euphorbia drummondii*, *Calandrinia pleiopetala* and Grasses of *Cymbopogon ambiguous*, *Eriachne mucronata*, *Enneapogon caeruleus* and *Amphipogon caricinus* (2-10% PFC, <1 m) on shallow orange sand over outcropping Granite with approximately 2% leaf litter.



Plate 17: Quadrat 14 Breakaway Mixed Shrublands (BRXS)

At quadrat number fourteen (51J 285100 m E; 6898867 m S), the vegetation was described as Open Scrub of *Acacia incurvaneura*, *A. quadrimarginea* and *Psydrax latifolia* (2-10% PFC, >2 m) over Open Low Scrub of *Eremophila shonae* subsp. *shonae*, *Calytrix erosipetala*, *Thryptomene* sp. Leinster (B.J. Lepschi and L. Craven 4362) **P3**, *P. latifolia* and *Dodonaea adenophora* (2-10% PFC, 1-2 m) over Scattered Low Shrubs and Forbs of *Ptilotus obovatus*, *P. sessifolius*, *Acacia quadrimarginea*, *A. incurvaneura*, *Sida spodochroma*, *Abutilon otocarpum*, *Dysphania radinostachya* subsp. *inflata* and Grasses of *Eriachne mucronata* and *Amphipogon caricinus* (<2% PFC, <1 m) on weathered Granite breakaway with approximately 2% leaf litter.



Plate 18: Quadrat 10 Stony Plain Acacia – Eremophila Shrublands (SAES)

At quadrat number ten (51J 284440 m E; 6899918 m S), the vegetation was described as Scattered Tall Shrubs of *Acacia pteraneura*, *A. sibirica* and *A. caesaneura* (<2% PFC, >2 m) over Scattered Shrubs *A. caesaneura*, *A. tetragonophylla* and *Scaevola spinescens* (<2% PFC, 1-2 m) over Scattered Mixed Low Shrubs of *Eremophila latrobei* subsp. *latrobei*, *E. oldfieldii*, *Thryptomene* sp. Leinster (B.J. Lepschi and L.Craven 4362)**P3**, *Dodonaea adenophora*, *Maireana thesioides*, *M. aff. triptera*, *A. incurvaneura*, *A. tetragonophylla* and *Solanum lasiophyllum* (<2% PFC, <1 m) on light brown silty loam with <1% leaf litter.



Plate 19: Quadrat 18 Stony Plain Acacia – Eremophila Shrublands (SAES)

At quadrat number eighteen (51J 284636 m E; 6899518 m S), the vegetation was described as Scattered Tall Shrubs of *Acacia fuscaneura* (<2% PFC, >2 m) over Open Low Scrub of *Eremophila platycalyx*, *E. fraseri* subsp. *fraseri*, *Dodonaea adenophora*, *A. craspedocarpa*, *A. aptaneura*, *Scaevola spinescens*, *Sida* sp., *Solanum lasiophyllum*, and *Ptilotus schwartzii* (2-10% PFC, <1 m) on light brown silty loam with Fe/Mn (?) and Quartz cobbles and <1% leaf litter.



Plate 20: Quadrat 3 Drainage Tract Mulga Shrubland (DRMS)

At quadrat number three (51J 281791 m E; 6897648 m S), the vegetation was described as *Acacia fuscaneura*, *E. lucasii* Mixed Low Woodland A (10-30% PFC, 5-15 m) over *A. balsamea* Open Scrub (2-10% PFC, >2 m) over Scattered Shrubs of *Psyrax latifolia* (<25 PFC, 1-2 m) over Mixed Open Dwarf Scrub of *Eremophila foliosissima*, *E. forrestii* subsp. *forrestii*, *E. latrobei* subsp. *latrobei*, *Psyrax suaveolens*, *Ptilotus obovatus* and *Abutilon* aff. *cryptopetalum* (2-10% PFC, <1 m) over Very Open Grass and Hummock Grass of *Eragrostis eriopoda*, *E. helmsii* and *Triodia basedowii* (2-10% PFC, <1 m) on orange sandy silt with approximately 20% leaf litter.



Plate 21: Quadrat 8. Drainage Tract Mulga Shrubland (DRMS)

At quadrat number eight (51J 283368 m E; 6899684 m S), the vegetation was described as *Eucalyptus lucasii*, *Acacia fuscaneura* Mixed Low Woodland A (10-30% PFC, >5 m) over *A. balsamea* Scrub (10-30% PFC, >2 m) over Scattered Mixed Shrubs of *Eremophila forrestii* subsp. *forrestii*, *E. foliosissima* and *Psydrax rigidula* (<2% PFC, 1-2 m) over Scattered Low Shrubs of *E. forrestii* subsp. *forrestii*, *E. foliosissima*, *Maireana thesioides*, *Ptilotus obovatus*, *Sida* sp., *A. balsamea* and *Psydrax latifolia* (<2% PFC, <1 m) over Very Open Grass of *Eragrostis eriopoda* (2-10%, <1 m) on orange sandy silt with approximately 18% leaf litter.



Plate 22: Quadrat 11. Drainage Tract Mulga Shrubland (DRMS)

At quadrat number eleven (51J 284848 m E;6899441 m S), the vegetation was described as Low Woodland A of *Acacia fuscaneura* (10-30% PFC, >5 m) over Open Scrub of *A. tetragonophylla*, *A. aptaneura*, *A. minyura*, *Eremophila platycalyx*, *Santalum spicatum* and *Psydrax latifolia* (2-10%, >2 m) over Scattered Shrubs of *A. minyura*, *E. platycalyx*, *Sida spodochroma*, *P. latifolia* and *P. rigidula* (<2% PFC, 1-2 m) over Open Grasses of (primarily) *Austrostipa eremophila* with Scattered *A. scabra* (12% PFC, 0.4 m) and Scattered Low Shrubs, Forbs and Ferns of *Eremophila latrobei* subsp. *latrobei*, *Teucrium teucriiflorum*, *A. tetragonophylla*, *Abutilon otocarpum*, *Nicotiana rosulata*, *Goodenia havilandii*, *Ptilotus aervoides*, *Calandrinia reticulata*, *C. pleiopetala* and *Cheilanthes sieberi* (<2% PFC, <1 m) on orange silt with minor quartz cobbles and approximately 20% leaf litter.



Plate 23: Quadrat 15 Drainage Tract Mulga Shrubland (DRMS)

At quadrat number fifteen (51J 284954 m E, 6898749 m S), the vegetation was described as Low Woodland A of *Eucalyptus lucasii*, *Acacia fuscaneura* and *A. aptaneura* (10-30% PFC, >5 m) over Scattered *A. tetragonophylla* (<2% PFC, >2m) over Open Low Scrub of *Sida* sp. Golden calyces glabrous (H.N. Foote 32), *Eremophila foliosissima*, *E. granitica*, *E. shonae* subsp. *shonae*, *Senna artemisioides*, *S. artemisioides* subsp. *filifolia*, *Rhagodia preissii* and *R. eremaea* (2-10% PFC, 1-2 m) over Scattered Low Shrubs of *Teucrium teucriiflorum*, *Sida* sp., *Ptilotus obovatus*, *Psydrax latifolia*, *Enchylaena tomentosa* and *Maireana tomentosa* (<2% PFC, <1 m) over Scattered Grasses of *Austrostipa nitida*, *Rytidosperma caespitosum* and *Chloris truncata* on orange sand with approximately 8% leaf litter.

Appendix C: Species List by Vegetation Type

Appendix C: Plant Species List by Vegetation Type. (See key at end of list.)

Family	Genus	Species	SASP	SAGS	SAHS	SAMA	SAMU	SDSH	BLSS	BRXS	SAES	DRMS
Amaranthaceae	<i>Ptilotus</i>	<i>aeroides</i>	X							X		X
Amaranthaceae	<i>Ptilotus</i>	<i>gaudichaudii</i>										X
Amaranthaceae	<i>Ptilotus</i>	<i>obovatus</i>		X			X			X	X	X
Amaranthaceae	<i>Ptilotus</i>	<i>polystachyus</i>								X		
Amaranthaceae	<i>Ptilotus</i>	<i>schwartzii</i>	X								X	
Amaranthaceae	<i>Ptilotus</i>	<i>sessilifolius</i>								X		
Apocynaceae	<i>Leichhardtia</i>	<i>australis</i>								X		
Asparagaceae	<i>Lomandra</i>	<i>leucocephala</i>						X				
Asteraceae	<i>Brachyscome</i>	<i>ciliaris</i>										X
Asteraceae	<i>Calotis</i>	<i>hispidula</i>	X									
Asteraceae	<i>Centipeda</i>	<i>thespidioides</i>	X									
Asteraceae	<i>Chrysocephalum</i>	<i>puteale</i>						X				
Asteraceae	<i>Erymophyllum</i>	<i>ramosum</i>										X
Asteraceae	<i>Gnephosis</i>	<i>tenuissima</i>	X									
Asteraceae	<i>Olearia</i>	<i>stuartii</i>										X
Asteraceae	<i>Olearia</i>	<i>subspicata</i>	X	X				X				
Asteraceae	<i>Rhodanthe</i>	<i>charsleyae</i>	X									X
Asteraceae	<i>Streptoglossa</i>	<i>liatroides</i>	X									
Asteraceae	<i>Vittadinia</i>	<i>sulcata</i>										X
Boraginaceae	<i>Halgania</i>	<i>cyanea</i>	X					X				
Brassicaceae	<i>Lepidium</i>	<i>oxytrichum</i>	X									
Chenopodiaceae	<i>Atriplex</i>	<i>acutibractea</i>							X			
Chenopodiaceae	<i>Atriplex</i>	<i>bunburyana</i>									X	
Chenopodiaceae	<i>Atriplex</i>	<i>codonocarpa</i>							X			
Chenopodiaceae	<i>Dysphania</i>	<i>rhadinostachya</i> subsp. <i>inflata</i>							X	X		
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i> subsp. <i>tomentosa</i>	X									X
Chenopodiaceae	<i>Maireana</i>	<i>carnosa</i>	X									

Appendix C: Plant Species List by Vegetation Type. Continued

Family	Genus	Species	SASP	SAGS	SAHS	SAMA	SAMU	SDSH	BLSS	BRXS	SAES	DRMS
Chenopodiaceae	<i>Maireana</i>	<i>georgei</i>							X			
Chenopodiaceae	<i>Maireana</i>	<i>glomerifolia</i>							X			
Chenopodiaceae	<i>Maireana</i>	<i>pyramidata</i>							X			
Chenopodiaceae	<i>Maireana</i>	<i>thesioides</i>	X								X	X
Chenopodiaceae	<i>Maireana</i>	<i>tomentosa</i>							X			X
Chenopodiaceae	<i>Maireana</i>	<i>triptera</i>									X	
Chenopodiaceae	<i>Rhagodia</i>	<i>drummondii</i>										X
Chenopodiaceae	<i>Rhagodia</i>	<i>eremaea</i>	X									X
Chenopodiaceae	<i>Rhagodia</i>	<i>preissii</i>										X
Chenopodiaceae	<i>Sclerolaena</i>	<i>articulata</i>							X			
Convolvulaceae	<i>Duperreya</i>	<i>commixta</i>								X		
Euphorbiaceae	<i>Euphorbia</i>	<i>drummondii</i>								X		
Fabaceae	<i>Acacia</i>	<i>aptaneura</i>					X				X	X
Fabaceae	<i>Acacia</i>	<i>ayersiana</i>	X									
Fabaceae	<i>Acacia</i>	<i>balsamea</i>	X	X		X		X				X
Fabaceae	<i>Acacia</i>	<i>caesaneura</i>	X	X		X	X				X	
Fabaceae	<i>Acacia</i>	<i>craspedocarpa</i>	X								X	
Fabaceae	<i>Acacia</i>	<i>effusifolia</i>	X									
Fabaceae	<i>Acacia</i>	<i>fuscaneura</i>	X								X	X
Fabaceae	<i>Acacia</i>	<i>incurvaneura</i>	X		X		X			X	X	
Fabaceae	<i>Acacia</i>	<i>jamesiana</i>			X			X				
Fabaceae	<i>Acacia</i>	<i>minyura</i>		X								X
Fabaceae	<i>Acacia</i>	<i>mulganeura</i>		X								
Fabaceae	<i>Acacia</i>	<i>pteraneura</i>									X	
Fabaceae	<i>Acacia</i>	<i>quadrimarginea</i>								X		
Fabaceae	<i>Acacia</i>	<i>ramulosa</i> var. <i>linophylla</i>	X									X
Fabaceae	<i>Acacia</i>	<i>sibirica</i>									X	

Appendix C: Plant Species List by Vegetation Type. *Continued*

Family	Genus	Species	SASP	SAGS	SAHS	SAMA	SAMU	SDSH	BLSS	BRXS	SAES	DRMS
Fabaceae	<i>Acacia</i>	<i>tetragonaphylla</i>								X	X	X
Fabaceae	<i>Bossiaea</i>	<i>eremaea</i> (P3)	X									
Fabaceae	<i>Leptosema</i>	<i>chambersii</i>						X				
Fabaceae	<i>Senna</i>	<i>artemisioides</i>		X				X				X
Fabaceae	<i>Senna</i>	<i>artemisioides</i> subsp. <i>filifolia</i>	X	X								X
Fabaceae	<i>Senna</i>	<i>cardiosperma</i>		X								
Fabaceae	<i>Senna</i>	<i>glutinosa</i> subsp. <i>xluerssenii</i>	X									
Fabaceae	<i>Senna</i>	<i>pleurocarpa</i> subsp. <i>pleurocarpa</i>						X				
Fabaceae	<i>Swainsona</i>	<i>paradoxa</i>	X									
Frankeniaceae	<i>Frankenia</i>	<i>laxiflora</i>							X			
Frankeniaceae	<i>Frankenia</i>	<i>setosa</i>							X			X
Geraniaceae	<i>Erodium</i>	<i>cygnorum</i>					X					X
Goodeniaceae	<i>Goodenia</i>	<i>haviandii</i>	X							X		X
Goodeniaceae	<i>Goodenia</i>	<i>mimuloides</i>										X
Goodeniaceae	<i>Scaevola</i>	<i>parvifolia</i>						X				
Goodeniaceae	<i>Scaevola</i>	<i>spinescens</i>		X						X	X	
Lamiaceae	<i>Prostanthera</i>	aff. <i>prostantheroides</i>	X									
Lamiaceae	<i>Prostanthera</i>	<i>campbellii</i>								X		
Lamiaceae	<i>Teucrium</i>	<i>teucriflora</i>	X	X			X					X
Malvaceae	<i>Abutilon</i>	<i>cryptopetalum</i>										X
Malvaceae	<i>Abutilon</i>	<i>otocarpum</i>								X		X
Malvaceae	<i>Androcalva</i>	<i>loxophylla</i>	X									
Malvaceae	<i>Brachychiton</i>	<i>gregorii</i>										X
Malvaceae	<i>Seringia</i>	sp.	X	X								X
Malvaceae	<i>Sida</i>	<i>phaeotricha</i>								X		
Malvaceae	<i>Sida</i>	sp.									X	X
Malvaceae	<i>Sida</i>	sp. <i>Excedentifolia</i> J. L. Egan (1925)								X		
Malvaceae	<i>Sida</i>	sp. <i>Golden calyces glabrous</i> (H.N.Foote 32)	X									X

Appendix C: Plant Species List by Vegetation Type. Continued

Family	Genus	Species	SASP	SAGS	SAHS	SAMA	SAMU	SDSH	BLSS	BRXS	SAES	DRMS
Malvaceae	<i>Sida</i>	<i>spodochroma</i>								X		X
Montiaceae	<i>Calandrinia</i>	<i>pleiopetala</i>								X		X
Montiaceae	<i>Calandrinia</i>	<i>reticulata</i>										X
Myrtaceae	<i>Calytrix</i>	<i>eriosipetala</i>	X		X			X		X		
Myrtaceae	<i>Enekbatus</i>	<i>eremaeus</i>	X		X			X				X
Myrtaceae	<i>Eucalyptus</i>	<i>gongylocarpa</i>	X	X				X				
Myrtaceae	<i>Eucalyptus</i>	<i>kingsmillii</i>	X					X				X
Myrtaceae	<i>Eucalyptus</i>	<i>lucasia</i>	X	X			X			X		X
Myrtaceae	<i>Eucalyptus</i>	<i>oldfieldii</i>	X			X						
Myrtaceae	<i>Eucalyptus</i>	<i>oleosa</i>	X									
Myrtaceae	<i>Eucalyptus</i>	<i>trivalva</i>	X									
Myrtaceae	<i>Eucalyptus</i>	<i>youngiana</i>	X	X				X				
Myrtaceae	<i>Euryomyrtus</i>	<i>maidenii</i>	X		X			X				
Myrtaceae	<i>Homalocalyx</i>	<i>thryptomenoides</i>	X									
Myrtaceae	<i>Malleostemon</i>	<i>roseus</i>	X									
Myrtaceae	<i>Micromyrtus</i>	<i>flaviflora</i>	X									
Myrtaceae	<i>Thryptomene</i>	sp. Leinster (B.J. Lepschi and L.Craven 362)(P3)								X	X	
Pittosporaceae	<i>Marianthus</i>	<i>bicolor</i>		X								
Poaceae	<i>Amphipogon</i>	<i>caricinus</i>						X	X	X		
Poaceae	<i>Aristida</i>	<i>contorta</i>						X				
Poaceae	<i>Austrostipa</i>	<i>eremophila</i>										X
Poaceae	<i>Austrostipa</i>	<i>nitida</i>										X
Poaceae	<i>Austrostipa</i>	<i>scabra</i>										X
Poaceae	<i>Chloris</i>	<i>truncata</i>										X
Poaceae	<i>Cymbapogon</i>	<i>ambiguus</i>								X		
Poaceae	<i>Enneapogon</i>	<i>cerulescens</i>								X		
Poaceae	<i>Eragrostis</i>	<i>dielsii</i>							X			
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>	X	X		X	X	X				X
Poaceae	<i>Eriachne</i>	<i>helmsii</i>						X				X

Appendix C: Plant Species List by Vegetation Type. Continued

Family	Genus	Species	SASP	SAGS	SAHS	SAMA	SAMU	SDSH	BLSS	BRXS	SAES	DRMS
Poaceae	<i>Eriachne</i>	<i>mucronata</i>	X							X		
Poaceae	<i>Rytidosperma</i>	<i>caespitosa</i>										X
Poaceae	<i>Triodia</i>	<i>basedowii</i>	X	X	X	X	X	X				X
Proteaceae	<i>Grevillea</i>	<i>aff. sarissa</i> subsp. <i>bicolor</i>	X									
Proteaceae	<i>Grevillea</i>	<i>juncifolia</i>	X									
Proteaceae	<i>Grevillea</i>	<i>stenobotrya</i>						X				
Proteaceae	<i>Hakea</i>	<i>lorea</i>	X									
Proteaceae	<i>Hakea</i>	<i>minyma</i>	X									X
Proteaceae	<i>Hakea</i>	<i>preissii</i>							X			
Pteridaceae	<i>Cheilanthes</i>	<i>brownii</i>								X		
Pteridaceae	<i>Cheilanthes</i>	<i>sieberi</i>								X		X
Rhamnaceae	<i>Cryptandra</i>	<i>connata</i>								X		
Rubiaceae	<i>Psyrax</i>	<i>latifolia</i>	X							X		X
Rubiaceae	<i>Psyrax</i>	<i>rigidula</i>		X								X
Rubiaceae	<i>Psyrax</i>	<i>suaveolens</i>	X	X								X
Rutaceae	<i>Philotheca</i>	<i>brucei</i> subsp. <i>brucei</i>								X		
Santalaceae	<i>Santalum</i>	<i>spicatum</i>										X
Sapindaceae	<i>Dodonaea</i>	<i>adenophora</i>						X		X	X	
Scrophulariaceae	<i>Eremophila</i>	<i>battii</i>	X	X								
Scrophulariaceae	<i>Eremophila</i>	<i>exilifolia</i>										X
Scrophulariaceae	<i>Eremophila</i>	<i>foliosissima</i>										X
Scrophulariaceae	<i>Eremophila</i>	<i>forrestii</i> subsp. <i>forrestii</i>	X	X		X	X	X			X	X
Scrophulariaceae	<i>Eremophila</i>	<i>fraseri</i> subsp. <i>fraseri</i>		X							X	
Scrophulariaceae	<i>Eremophila</i>	<i>gilesii</i> subsp. <i>gilesii</i>	X									X
Scrophulariaceae	<i>Eremophila</i>	<i>glabra</i> subsp. <i>glabra</i>		X								
Scrophulariaceae	<i>Eremophila</i>	<i>granitica</i>	X									X
Scrophulariaceae	<i>Eremophila</i>	<i>homoplastica</i>	X									
Scrophulariaceae	<i>Eremophila</i>	<i>latrobei</i> subsp. <i>latrobei</i>								X	X	X
Scrophulariaceae	<i>Eremophila</i>	<i>oldfieldii</i>									X	

Appendix C: Plant Species List by Vegetation Type. Continued

Family	Genus	Species	SASP	SAGS	SAHS	SAMA	SAMU	SDSH	BLSS	BRXS	SAES	DRMS
Scrophulariaceae	<i>Eremophila</i>	<i>pantonii</i>									X	
Scrophulariaceae	<i>Eremophila</i>	<i>platycalyx</i>	X								X	X
Scrophulariaceae	<i>Eremophila</i>	<i>platythamnos</i> subsp. <i>platythamnos</i>		X				X				
Scrophulariaceae	<i>Eremophila</i>	<i>shonae</i> subsp. <i>shonae</i>	X							X		X
Solanaceae	<i>Nicotiana</i>	<i>rosulata</i>										X
Solanaceae	<i>Solanum</i>	<i>lasiophyllum</i>	X	X						X	X	
Thymelaeaceae	<i>Pimelea</i>	<i>microcephala</i>		X								

Key:

SASP: (Undifferentiated) Sandplain Spinifex Hummock Grasslands.

SAGS: *Eucalyptus gongylocarpa* Open Woodlands.

SAHS: Sandplain Heath Stratum

SAMA: Sandplain Mallee

SAMU: Sandplain Mulga

SDSH: Sand Dune Shrublands.

BLSS: Bladder Saltbush Low Shrublands.

BRXS: Breakaway Mixed Shrublands.

SAES: Stony Plain Acacia-Eremophila Shrublands.

DRMS: Drainage Tract Mulga Shrublands

Appendix D: Conservation Code Definitions

Appendix D1: Conservation Codes for Western Australian Flora and Fauna (Department of Biodiversity, Conservation and Attractions, 2016) Retrieved Feb. 2019

Specially protected fauna and flora Code	Description
T	<p><u>Threatened species</u></p> <p>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.</p>
CR	<p><u>Critically endangered species</u></p> <p>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.</p>
EN	<p><u>Endangered species</u></p> <p>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.</p>
VU	<p><u>Vulnerable species</u></p> <p>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.</p>
EX	<p><u>Extinct species</u></p> <p>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.</p>
EW	<p><u>Extinct in the wild species</u></p> <p>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.</p>

Appendix D2: Conservation Codes for Western Australian Flora and Fauna (Department of Biodiversity, Conservation and Attractions, 2016) Retrieved Feb. 2019 *continued*

Specially protected species	Description
MI	<p>Migratory species</p> <p>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.</p>
CD	<p>Species of special conservation interest (conservation dependent fauna)</p> <p>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..</p>
OS	<p>Other specially protected species</p> <p>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>

Appendix D3: Conservation Codes for Western Australian Flora and Fauna (Department of Biodiversity, Conservation and Attractions, 2016) Retrieved Feb. 2019 *continued*

Priority Species Codes	Description
P1	<p>Priority 1: Poorly-known species</p> <p>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.</p>
P2	<p>Priority 2: Poorly-known species</p> <p>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.</p>
P3	<p>Priority 3: Poorly-known species</p> <p>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.</p>
P4	<p>Priority 4: Rare, Near Threatened and other species in need of monitoring</p> <p>(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.</p> <p>(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.</p> <p>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.</p>

Appendix D4: Definition of Threatened Flora Species (Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth))

Category Code	Category
Ex	<p>Extinct</p> <p>Species which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.</p>
ExW	<p>Extinct in the Wild</p> <p>Species which is known only to survive in cultivation, in captivity or as a naturalized population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.</p>
CE	<p>Critically Endangered</p> <p>Species which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.</p>
E	<p>Endangered</p> <p>Species which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.</p>
V	<p>Vulnerable</p> <p>Species which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.</p>
CD	<p>Conservation Dependent</p> <p>Species which at a particular time if, at that time: a) the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximized; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.</p>

Appendix D5: Definitions and Criteria of Threatened Ecological Communities (Department of Environment and Conservation 2013)

Category Code	Category
PD	<p>Presumed Totally Destroyed</p> <p>An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies:</p> <p>(i) Records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or;</p> <p>(ii) All occurrences recorded within the last 50 years have since been destroyed.</p>
CE	<p>Critically Endangered</p> <p>A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.</p> <p>B) Current distribution is limited, and one or more of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.</p> <p>C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).</p>
EN	<p>Endangered</p> <p>An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):</p> <p>A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):</p> <p>i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);</p> <p>ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.</p> <p>B) Current distribution is limited, and one or more of the following apply (i, ii or iii):</p> <p>i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);</p> <p>ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;</p> <p>iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.</p> <p>C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).</p>
VU	<p>Vulnerable</p> <p>An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):</p> <p>A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.</p> <p>B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.</p> <p>C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.</p>

Appendix D6: Definitions and Criteria for Priority Ecological Communities (Department of Environment and Conservation 2013)

Category Code	Category
P1	<p>Poorly-known ecological communities:</p> <p>Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.</p>
P2	<p>Poorly-known ecological communities:</p> <p>Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.</p>
P3	<p>Poorly known ecological communities:</p> <p>(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:</p> <p>(ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;</p> <p>(iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.</p> <p>Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.</p>
P4	<p>Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.</p> <p>6. Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.</p> <p>(ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.</p> <p>(iii) Ecological communities that have been removed from the list of threatened communities during the past five years.</p>
P5	<p>Conservation Dependent ecological communities</p> <p>Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.</p>

Appendix E: Vegetation Classification System

Appendix E: Vegetation Classification System (Modified Muir 1977)

Form/Height	Canopy Cover				
	Dense 70-100%	Mid-Dense 30-70%	Sparse 10-30%	Very Sparse 2-10%	Scattered <2%
Trees >30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland	Scattered Tall Trees
Trees 15-30m	Dense Forest	Forest	Woodland	Open woodland	Scattered Trees
Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A	Scattered Low Trees A
Trees <5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B	Scattered Low Trees B
Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee	Scattered Tree Mallees
Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee	Scattered Shrub Mallees
Shrubs >2m	Dense Thicket	Thicket	Scrub	Open Scrub	Scattered Tall Shrubs
Shrubs 1-2m	Dense Heath	Heath	Low Scrub	Open Low Scrub	Scattered Shrubs
Shrubs <1m	Dense Low Heath	Low Heath	Dwarf Scrub	Open Dwarf Scrub	Scattered Low Shrubs
Mat plants, Bunch	Dense Mat Plants/	Mat Plants/Grass/	Open Mat Plants/	Very Open Mat Plants/	Scattered Mat Plants/
Grass, Hummock	Grass/Hummock	Hummock Grass/	Grass/Hummock	Grass/Hummock Grass/	Grasses/Hummock
Grass, Sedges, Herbs	Grass/Sedges/Herbs	Sedges/Herbs	Grass/Sedges/Herbs	Sedges/Herbs	Grasses/Sedges/Herbs

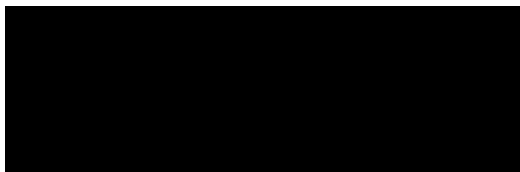
APPENDIX 3: BASIC VERTEBRATE FAUNA SURVEY (WESTERN WILDLIFE, 2021)

16 Mile Well Project:

Basic Vertebrate Fauna Survey 2021



Prepared for: MLG Oz Limited



August 2022

Executive Summary

Introduction

MLG Oz Limited (MLG) propose to develop a sand quarry at their 16 Mile Well Project, 13km southeast of Leinster in the Goldfields region of Western Australia. Western Wildlife was commissioned to carry out a basic vertebrate fauna survey of the study area.

The aims of the fauna survey were to:

- Identify the fauna habitats present in the study area.
- List the vertebrate fauna that were recorded in the study area and/or have the potential to occur in the study area.
- Identify species of conservation significance, or habitats of particular importance for fauna, that potentially occur in the study area.

Methods

The fauna survey was undertaken in accordance with *Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment* (EPA 2020) and relevant State and Federal Guidelines on surveying conservation significant fauna.

The field study was undertaken by two zoologists on the 24th August 2021 and included:

- Identification of fauna habitats
- Opportunistic record keeping of all vertebrate fauna observed

Species of conservation significance were classified as: **Threatened** if listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act); **Migratory** if listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened; **Specially Protected** if listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act; **Priority** if listed as Priority by DBCA and **Locally Significant** if considered by the author to potentially be of local significance.

Fauna Habitats

Four fauna habitats were identified across the study area:

- Eucalypt – spinifex sandplain
- Mulga – spinifex sandplain
- Sand dune
- Mulga drainage

Habitats that are less common in the Bioregion, such as granite outcrops, salt lakes or freshwater wetlands, were absent from the study area.

Faunal Assemblage

The faunal assemblage of the study area is likely to be largely intact, as the study area is situated within a larger tract of native vegetation. Many of the species that occur are widely distributed through semi-arid Australia. The predicted faunal assemblage includes up to nine frogs, 77 reptiles, 115 birds, 30 native mammals and nine introduced mammals.

Conservation Significant Fauna

Seventeen conservation significant species may occur in the study area, 14 vertebrates and three invertebrates.

The eight Threatened species that may occur are:

- **Arid Bronze Azure Butterfly** (*Ogyris subterrestris petrina*) - EPBC Act (Critically Endangered), BC Act (Critically Endangered)
- **Night Parrot** (*Pezoporus occidentalis*) - EPBC Act (Endangered), BC Act (Critically Endangered)
- **Black-footed Rock-wallaby** (*Petrogale lateralis lateralis*) - EPBC Act (Endangered), BC Act (Endangered)
- **Malleefowl** (*Leipoa ocellata*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- **Grey Falcon** (*Falco hypoleucos*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- **Great Desert Skink** (*Liopholis kintorei*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- **Chuditch** (*Dasyurus geoffroii*) - EPBC Act (Vulnerable), BC Act (Vulnerable)
- **Princess Parrot** (*Polytelis alexandrae*) - EPBC Act (Vulnerable), Priority 4

No host ants for the Arid Bronze Azure Butterfly were recorded, and although this was not a comprehensive survey the widely spaced eucalypts on sandy soils are unlikely to provide sufficient habitat for this species. The Night Parrot possibly occurs, although the spinifex present is unlikely to be large enough for roosting or breeding according to current knowledge. The study area lacks the rocky habitats required to support the Black-footed Rock Wallaby. The Malleefowl potentially occurs as a foraging visitor and may breed in the mulga drainage and dense patches within the mulga – spinifex sandplain. The Princess Parrot possibly occurs, and the study area included potential breeding and foraging habitat, however, the core range of this irruptive species is further east. The Great Desert Skink possibly occurs, but it is uncertain whether the current range of the species extends as far southwest as the study area, and it generally favours treeless sandplains. The Grey Falcon is unlikely to occur as the study area is outside the core range for the species, and breeding habitat is absent. The Chuditch is likely to be locally extinct.

The two Migratory species that may occur are:

- **Fork-tailed Swift** (*Apus pacificus*) – EPBC Act (Migratory), BC Act (Migratory)
- **Oriental Plover** (*Charadrius veredus*) – EPBC Act (Migratory), BC Act (Migratory)

The Fork-tailed Swift is thought to be almost entirely aerial when visiting Australia. Although this species is likely to overfly the study area on occasion, the study area is not likely to provide important habitat. The Oriental Plover may occur on occasion, but the study area is not likely to regularly support significant numbers. Several Migratory shorebirds occur in the region but there is no significant shorebird habitat in or within 35km of the study area.

The one Specially Protected species that may occur is:

- **Peregrine Falcon** (*Falco peregrinus*) – BC Act (Other Specially Protected Fauna)

No breeding habitat is present, but the study area may represent a small part of the foraging range for a pair of Peregrine Falcons.

The six Priority species that may occur are the:

- **Brush-tailed Mulgara** (*Dasyercus blythi*) – Priority 4
- **Long-tailed Dunnart** (*Sminthopsis longicaudata*) – Priority 4
- **Central Long-eared Bat** (*Nyctophilus major tor*) - Priority 3
- **Striated Grasswren** (*Amytornis striatus striatus*) – Priority 4
- **Moriarty's Trapdoor Spider** (*Kwonkan moriartii*) – Priority 2
- **Northern Shield-backed Trapdoor Spider** (*Idiosoma clypeatum*) - Priority 3

Of these, the Striated Grasswren and Brush-tailed Mulgara were recorded during the fauna survey. These species are likely to occur in the eucalypt – spinifex sandplain and mulga – spinifex sandplain. The Central Long-eared Bat possibly occurs, roosting in tree hollows. The Long-tailed Dunnart is unlikely to occur due to lack of suitable rocky habitats. The two species of Priority spider possibly occur where heavier soils are present in the mulga drainage.

Important Habitats

The habitats in the study area are common and widespread in the subregion and are unlikely to function as ecological linkages or refugia, except at a local level. Of the habitats present in the study area, the eucalypt - spinifex sandplain and mulga – spinifex sandplain provide habitat for Priority 4 species the Brush-tailed Mulgara (*Dasyercus blythi*) and the Striated Grasswren (*Amytornis striatus striatus*) and the mulga drainage habitat and denser patches within the mulga – spinifex sandplain habitat may provide breeding habitat for the Malleefowl (*Leipoa ocellata*; Vulnerable).

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1. Introduction

MLG Oz Limited (MLG) propose to develop a sand quarry at their 16 Mile Well Project, 13km southeast of Leinster in the Goldfields region of Western Australia. Western Wildlife was commissioned to carry out a basic vertebrate fauna survey of the study area.

The aims of the fauna survey were to:

- Identify the fauna habitats present in the study area.
- List the vertebrate fauna that were recorded in the study area and/or have the potential to occur in the study area.
- Identify species of conservation significance, or habitats of particular importance for fauna, that potentially occur in the study area.

This report details the findings of the fauna survey conducted in August 2021.

1.1 The Study Area

The 16 Mile Well Project is located in the Shire of Leonora in the Goldfields region of Western Australia, about 13km southeast of Leinster and 306km north of Kalgoorlie (Figure 1). The study area is situated to the west of the Goldfields Highway and totals 685.5ha of native vegetation (Figure 2).

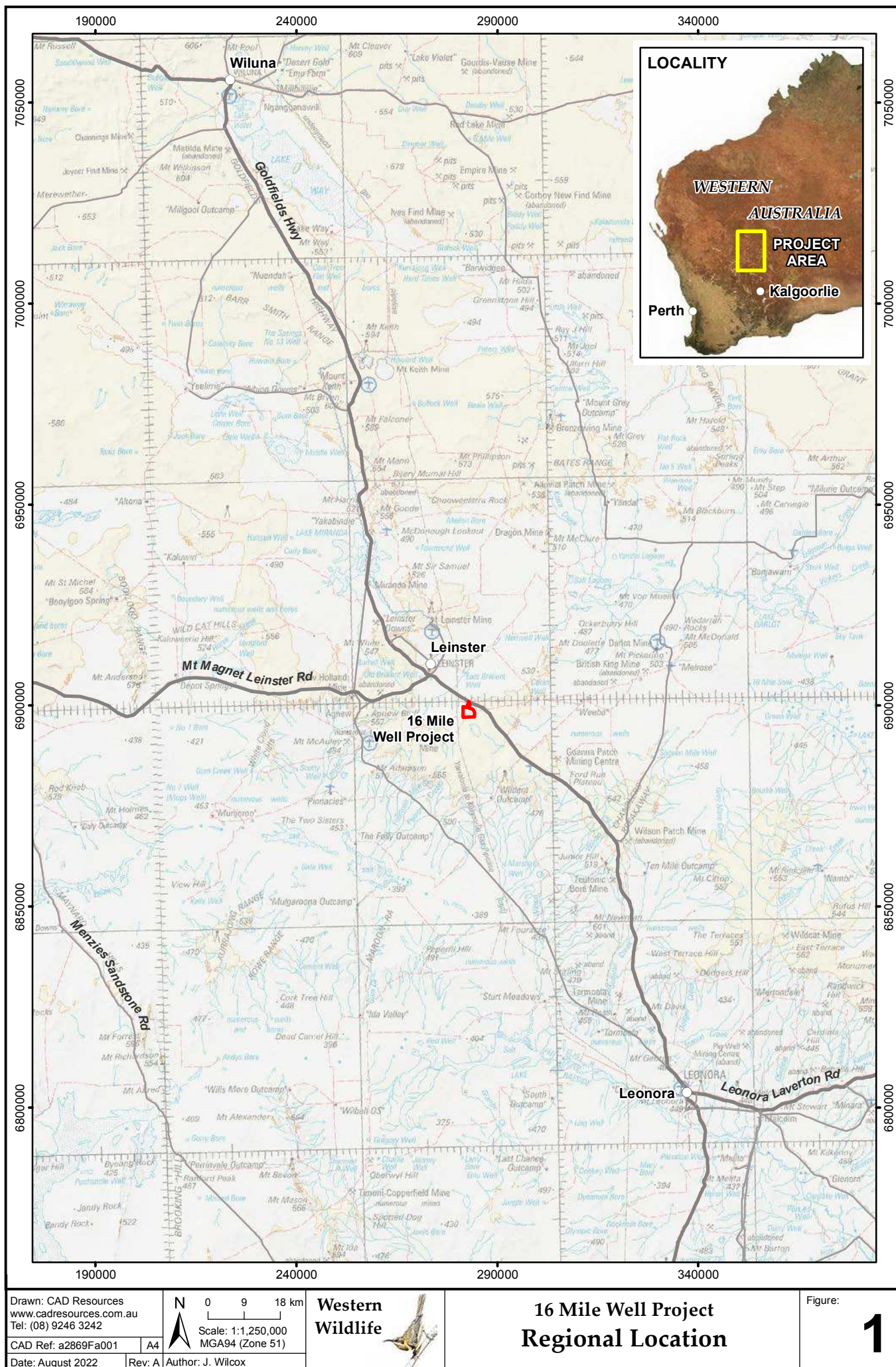
1.2 Regional Context

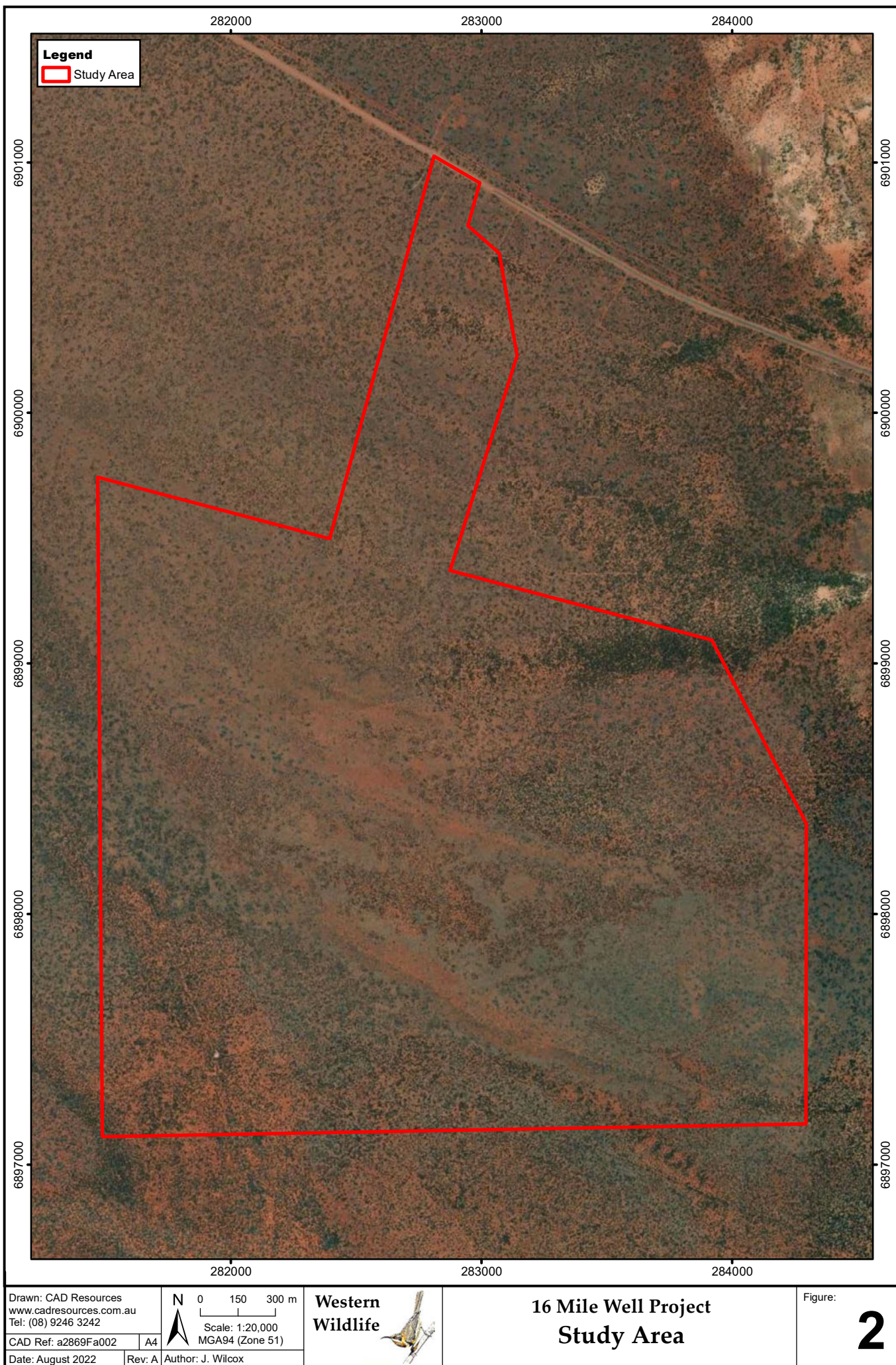
1.2.1 IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia into 89 Bioregions and 419 subregions, each defined by a set of environmental influences that impact the occurrence of flora and fauna and their interaction with the physical environment (DoEE 2018).

The study area lies in the East Murchison Subregion (MUR1) of the Murchison Bioregion. The subregion includes hummock grasslands on red desert sandplains with minimal dune development, broad plains supporting mulga woodlands and large salt lake systems with saltbush and samphire shrublands (Cowan 2001).

Important features of the subregion include calcrete aquifers, which support stygofauna (subterranean aquatic invertebrates). Although the vertebrate fauna is considered diverse, they are generally wide-ranging and occur in one or more neighbouring subregions (Cowan 2001). Lake Barlee, about 126km southwest of the study area, is considered regionally significant as it is an important breeding site for Banded Stilts (*Cladorhynchus leucocephalus*).





1.2.2 Botanical Province

The Botanical Provinces are determined by vegetation mapping (Beard 1980) and broadly correspond to climactic regions; the Southwest (Bassian) Province experiencing warm dry summers and cool wet winters, the Northern Province experiencing warm wet summers and cool dry winters and the Eremaean Province experiencing low, irregular rainfall. The study area is in Eremaean Province, therefore, the faunal assemblage of the area is likely to be dominated by widespread arid-adapted species.

1.2.3 Parks and Reserves

The study area does not overlap with any parks or reserves. The nearest is Wanjarri Nature Reserve (Figure 1).

1.2.4 Land Systems

Land systems are broad descriptions of landform, geology and soils. The study area intersects with a single land system, characterised as follows:

- **Bullimore System** – gently undulating sandplain with occasional linear dunes and stripped surfaces supporting spinifex grasslands with mallees and acacia shrubs.

1.3 Climate and Weather

The climate statistics for Leinster Aero (Site 012314) are presented in Figure 3. November to February are the hottest months and June to August the coolest. The variable rainfall recorded at Leinster is indicative of the Eremaean region. This weather station has a mean annual rainfall of 253mm. The annual rainfall recorded for 2020 was below average at 102.6mm. Weather during the fauna survey was warm (26°C) and dry.

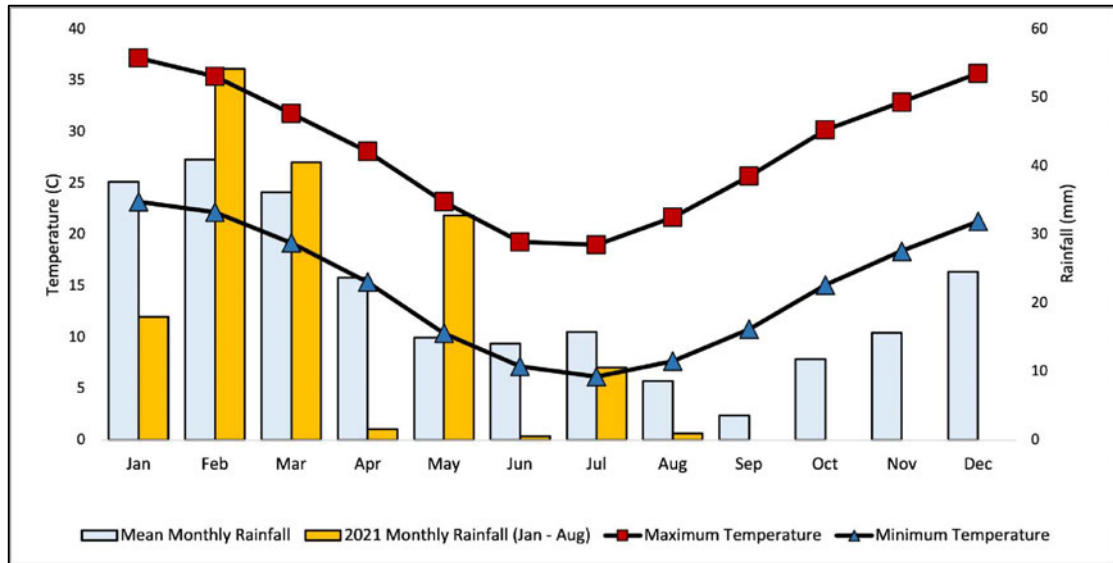


Figure 3. Mean monthly temperature and rainfall at Leinster (data from Bureau of Meteorology 2021).

2. Methods

2.1 Level of Survey

A basic vertebrate fauna survey was conducted. The fauna survey was conducted with reference to the following documents:

- Environmental factor guideline – terrestrial fauna (EPA 2016)
- Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)

The fauna survey included a search of available literature and databases (a desk-top study), and a short site visit. The data collected in the field serve to put the desk-top study into context, as well as allowing for the identification of fauna habitats and likely faunal assemblages of the site.

2.2 Personnel

Two zoologists from Western Wildlife carried out the fauna survey (Table 1).

Table 1. Personnel involved in the fauna survey.

Name	Role	Qualification	Experience
Jenny Wilcox	Supervising Zoologist (plan and lead fieldwork, prepare report)	BSc.Biol./Env.Sci., Hons.Biol.	21 years
Tim Gamblin	Conduct fieldwork	BSc.	10 years

2.3 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report follow the Western Australian Museum checklists.

2.4 Literature Review

Lists of fauna expected to occur in the study area were produced using information from a number of sources. These included publications that provide information on general patterns of distribution of frogs (Tyler *et al.* 2000), reptiles (Storr *et al.* 1983, 1990, 1999 and 2002, Wilson and Swan 2017), birds (Barrett *et al.* 2003; Johnstone and Storr 1998; Johnstone and Storr 2004) and mammals (Churchill 2007, Menkhorst and Knight 2011; Van Dyck and Strahan 2008).

The databases in Table 2 were searched for fauna records in and around the study area. Some species may occur on database results that are not likely to be present in the study area, usually due either to lack of suitable habitat or the study area being outside the known range of the species (i.e., erroneous records or records of vagrants). Where possible, these species are not included in lists of expected fauna.

In addition, the results of the following fauna surveys within 100km of the study area were used to compile the fauna lists:

- *Vertebrate Fauna Assessment, Yeelirrie Project: Baseline Report* (Bamford Consulting Ecologists 2011). The Yeelirrie Project is located about 90km north of the study area. This survey was undertaken in 2009 and 2010 and included a site reconnaissance survey, a two-phase detailed trapping survey and two targeted survey for conservation significant species. A total of four frog, 49 reptile, 82 bird, 21 native mammal and four introduced mammals were recorded. Conservation significant species recorded were the Brush-tailed Mulgara (*Dasycercus blythi*), Malleefowl (*Leipoa ocellata*), Peregrine Falcon (*Falco peregrinus*), Black-flanked Rock-wallaby (*Petrogale lateralis lateralis*) and Central Long-eared Bat (*Nyctophilus major tor*).

Table 2. Databases used in the preparation of this report.

Database	Type of records held on database	Area searched
Atlas of Living Australia (ALA) Database	Records of fauna compiled from a variety of sources, including Birddata, iNaturalist, the WA Museum and interstate museums.	The study area with a 40km buffer.
Birddata (Birdlife Australia 2022)	Records of bird observations in Australia, 2010-current.	The study area with a 40km buffer.
DBCA's Threatened and Priority Fauna Database	Records of Threatened and Priority species in Western Australia, also drawing from the databases above.	100km surrounding 282770 E, 6898280 N (Zone 51)
EPBC Act Protected Matters Search Tool	Records on matters protected under the EPBC Act, including threatened species.	The study area with a 5km buffer.
Index of Biodiversity Surveys for Assessments (IBSA) Database.	Biodiversity reports and spatial data that support assessments and compliance.	Murchison Biogeographic Region (within 100km of study area).

- *The Biological Survey of the Eastern Goldfields of Western Australia Part 10: Sandstone-Sir Samuel and Leonora-Laverton Study Area* (Hall *et al.* 1994). The Sandstone – Sir Samuel study area was located at Wanjarri, about 70km north of the study area and the Leonora-Laverton study area was located at Erlistoun, about 135km south-east of the study area. These sites were sampled 1979 – 1981.
- *Mt Keith Satellite Proposal: Vertebrate Fauna Review* (Biota Environmental Sciences 2017). This review includes data from previous surveys at the Mt Keith Project in 2004 by ATA (2005) and 2004, 2005 and 2006 by Biota Environmental Sciences (2006a, 2006b). The Mt Keith Project is located about 90km north of the study area. A total of three frog, 38 reptile, 77 bird, 16 native mammal and one introduced mammal were recorded across all surveys reviewed. No species currently listed as conservation significant were recorded but the Brush-tailed Mulgara (*Dasymercus blythi*) was recorded nearby.
- *Bellevue Gold Limited Level 2 Fauna Assessment: Bellevue Gold Project* (Bamford Consulting Ecologists 2019). The Bellevue Gold Project is located about 45km northwest of the study area. This survey was undertaken in 2018 and involved a single-phase detailed survey and targeted surveys for conservation significant fauna. A total of one frog, 29 reptile, 58 bird, eight native mammal and four introduced mammals were recorded. No species currently listed as conservation significant were recorded.

- *Flora and Fauna Survey: Agnew Gold Mine Camp, Power Plant, Airport, Wind Farm and Pipeline* (Stantec 2018). The Agnew Gold Project is located about 26km west of the study area. The basic fauna survey was conducted in 2018 and one reptile, five birds, two native mammals and four introduced mammals were recorded. No species currently listed as conservation significant were recorded. This report also summarises the results of a single-phase detailed survey of the Agnew Gold Mine by ENV Australia (2008) in which 62 species but no conservation significant fauna were recorded, and three basic fauna surveys undertaken by Astron (2012), Minesite Rehabilitation Services (2003) and Rapallo Environmental (2017).

2.5 Field Studies

2.5.1 Licensing

The fauna survey was completed under Fauna Taking (Biological Assessment) Licence 27000507 and Authorisation to Take or Disturb Threatened Species TFA 2021-0105.

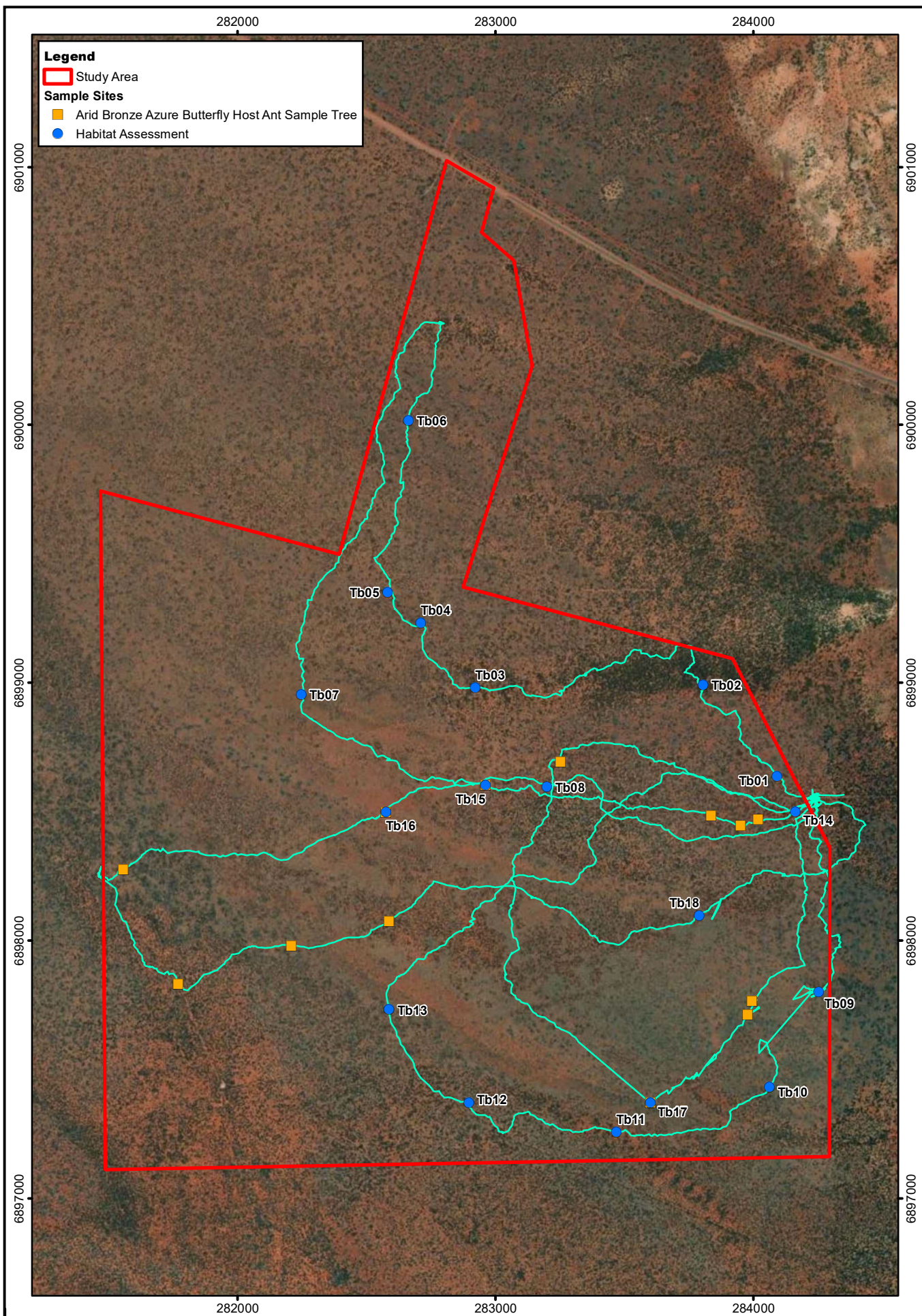
2.5.2 Opportunistic Records

The transects walked through the study area are shown in Figure 4. All vertebrate fauna observed in the study area were recorded. Fauna were observed directly, or inferred from secondary signs such as burrows, diggings, feathers, tracks, scats or skulls. Particular attention was paid to searching for signs of conservation significant species, including the Malleefowl (*Leipoa ocellata*) and Brush-tailed Mulgara (*Dasyurus blythi*). All Malleefowl mounds were recorded with a GPS location, photograph and indication of activity.

Although a comprehensive survey for the Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) was not undertaken as per the guidelines in DBCA (2020), 13 trees were sampled opportunistically for the host ant (Figure 4).

2.6 Habitat Mapping

Habitat mapping was undertaken using observations made by fauna personnel in the field (Figure 4, Appendix 5), interpretation of aerial photography and vegetation mapping in Goldfields Landcare Services (2021). CAD Resources produced the maps from shapefiles and information provided by Western Wildlife. Habitat assessments were undertaken at 18 locations (Figure 4). Elements of each habitat likely to be important for fauna were identified. Habitat elements may include, but are not limited to, rocky crevices, caves, tree hollows, tree crevices, leaf litter or sands suitable for burrowing.



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Author: J. Wilcox

**Western
 Wildlife**



**16 Mile Well Project
 Survey Effort**

Figure:

4

2.7 Likelihood of Occurrence

Fauna of conservation significance were assessed and ranked for their likelihood of occurrence in the study area, according to the criteria in Table 3.

Table 3. Criteria for assessing likelihood of occurrence.

Likelihood	Criteria
Unlikely	<ul style="list-style-type: none"> • The study area is outside the current known distribution of the species as presented in the literature. • No suitable habitat was identified as being present during the field survey. • For some species, individuals may occur occasionally as vagrants, especially if suitable habitat is located nearby, but the study area itself would not support the species. • May include species generally accepted as being locally extinct.
Possible	<ul style="list-style-type: none"> • The study area is within or just outside the current known distribution of the species, as presented in the literature. • Any habitat present is either limited in extent or of marginal quality at best. • No recent or nearby records of the species on databases. • The species is generally known to be less common in the vicinity of the study area (e.g., for inland sites, where the species usually occurs on the coast).
Potential	<ul style="list-style-type: none"> • The study area is within the current known distribution of the species, as presented in the literature. • Habitat of reasonable quality was identified as being present during the field survey. • There are some recent and/or nearby records of the species of databases.
Likely	<ul style="list-style-type: none"> • The study area is well within the current known distribution of the species, as presented in the literature. • Habitat of good quality was identified as being present during the field survey. • Many recent and nearby records of the species on databases.
Known to occur	<ul style="list-style-type: none"> • The species was positively identified in the study area during this field survey or recorded as occurring in the study area on previous recent field surveys. • Note that for a species 'known to occur', the habitat may still be marginal and therefore the population may be small, or the species may visit the site irregularly.

2.8 Assessing Conservation Significance of Fauna

2.8.1 Legislative Protection for Fauna

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'Matters of National Environmental Significance' (MNES); these include threatened species, threatened ecological communities and migratory species. Threatened fauna species are assessed against categories based on International Union for Conservation of Nature (IUCN) criteria.

The migratory species listed under the EPBC Act are those recognised under international agreements. These agreements are the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), or species listed under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) for which Australia is a range state.

Matters of National Environmental Significance (MNES) include the following categories:

- **Extinct in the wild (EW):** Taxa known to survive only in captivity.
- **Critically Endangered (Cr):** Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En):** Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu):** Taxa facing a very high risk of extinction in the wild in the medium-term future.
- **Migratory (Mi):** Taxa listed under international agreements to which Australia is a party.

Reports on the conservation status of most vertebrate fauna species have been produced by the federal Department of Agriculture, Water and the Environment (DAWE) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger *et al.* 1993), birds (Garnett *et al.* 2011) and mammals (Woinarski *et al.* 2014). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

The *Biodiversity Conservation Act 2016* (BC Act) is State legislation that aims to conserve and protect biodiversity and biodiversity components in Western Australia, including threatened fauna. It is administered by the Department of Biodiversity, Conservation and Attractions (DBCA). In addition to threatened fauna, the BC Act has scope to protect threatened ecological communities and important habitats.

Fauna species are listed under the BC Act as threatened species using IUCN categories, or as specially protected species, as described below.

Threatened Species:

- **Extinct in the wild (EW):** Taxa known to survive only in captivity.
- **Critically Endangered (Cr):** Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En):** Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu):** Taxa facing a very high risk of extinction in the wild in the medium-term future.

Specially Protected Species:

- **Migratory (Mi):** A subset of the migratory fauna that are known to visit Western Australia that are protected under the international agreements or treaties, excluding species that are listed as Threatened species.
- **Conservation dependent fauna (CD):** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened
- **Other specially protected species (OS):** fauna in need of special protection to ensure their conservation.

The BC Act supersedes the *Western Australian Wildlife Conservation Act 1950* (WC Act).

Priority species are not listed under State or Commonwealth Acts. In Western Australia, DBCA maintains a list of Priority Fauna made up of species that are possibly Threatened but do not meet adequacy of survey requirements or are otherwise data deficient. There are four levels of Priority as defined by DBCA, as listed below.

- **Priority 1:** Poorly known species (on threatened lands)
- **Priority 2:** Poorly known species in few locations (some on conservation lands)
- **Priority 3:** Poorly known species in several locations (some on conservation lands)
- **Priority 4:** Rare, near threatened and other species in need of monitoring

2.8.2 Levels of Conservation Significance in this report

Five levels of conservation significance are used within this report to indicate the level of significance of fauna species, according to the following criteria:

- **Threatened (T):** Taxa listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the EPBC Act and/or BC Act. These species are grouped as they are all species considered to be at risk of extinction, are often rare and are likely to be subject to on-going threatening processes.
- **Migratory (Mi):** Taxa listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened. These species are grouped as they are not necessarily rare but may be dependent on specific habitats for a portion of their life-cycle. For these species, loss of important foraging, breeding or stop-over sites may have a disproportionately large impact on populations.
- **Specially Protected (SP):** Taxa listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act. These species are not necessarily rare but may be dependent on on-going conservation to ensure their protection.
- **Priority (P):** Taxa listed as Priority by DBCA. These species are grouped as they are either conservation dependent or data deficient and in need of further survey.

- Locally Significant (LS):** Locally significant taxa are not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by DBCA, but are considered by the author to potentially be of local significance because they are at the limit of their distribution in the area, they have a very restricted range or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative recognition and is based on interpretation of information on the species patterns of distribution. For example, the Government of Western Australia (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity.

2.9 Survey Limitations

Various factors can limit the effectiveness of a fauna survey. Pursuant to EPA Technical Guidance (EPA 2020), these factors have been identified and their potential to impact on the effectiveness of the survey has been assessed in Table 4 below. All fauna surveys have limitations, and not all fauna species present on the site are likely to be sampled during a survey. Fauna may not be recorded because they are rare, they are difficult to trap or observe, or because they are only present on the site for part of the year.

Table 4. Fauna survey limitations.

Potential Limitation	Extent of limitation for the fauna survey	
Availability of data and information	Minor limitation	Although few studies have been undertaken in the region, making it difficult to place records in the study area into a regional context, studies at the nearby Mt Keith Mine provide some regional context. Some species are data deficient and are thus difficult to place in context.
Competency/experience of the survey team, including experience in the bioregion surveyed	Not limiting	Supervising zoologist has 21 years' experience with fauna surveys in Western Australia and is experienced with targeted Malleefowl surveys. Assisting zoologist has over 10 years' experience.
Scope of survey (e.g., faunal groups excluded from the survey)	Not limiting	No vertebrate groups were excluded.
Timing, weather and season	Not limiting	The weather was warm and dry, and conducive to recording fauna.
Disturbance that may have affected the results	Not limiting	No disturbances noted.
The proportion of fauna identified, recorded or collected	Not limiting	Although only a small proportion of the fauna were recorded, a complete inventory is not the purpose of a basic fauna survey.
The adequacy of the survey intensity and proportion of survey achieved (e.g., extent to which the area was surveyed)	Not limiting	A representative proportion of all habitats were able to be accessed and surveyed.

Table 4. (cont.)

Potential Limitation	Extent of limitation for the fauna survey	
Access problems	Not limiting	Entire study area accessible by vehicle or on foot.
Problems with data and analysis, including sampling biases	Not limited	No complex analyses were undertaken, and no problems were noted.

3. Fauna Habitats

Four broad fauna habitats were identified in study area (Table 5, Figure 5). The habitats are described in the sections below, with vegetation descriptions after Goldfields Landcare Services (2021).

Table 5. Fauna habitats in the study area.

Fauna Habitat	Key Habitat Elements	Total Area (ha)
Eucalypt - Spinifex Sandplain	<ul style="list-style-type: none"> Consolidated sands provide habitat for burrowing mammal and reptiles. Scattered eucalypts provide crevices and hollows. 	64.1
Mulga – Spinifex Sandplain	<ul style="list-style-type: none"> Dense vegetation provides nesting sites for birds. 	492.5
Sand Dune	<ul style="list-style-type: none"> Loose sands provide habitat for fossorial reptiles. Scattered eucalypts provide crevices and small hollows. 	56.2
Mulga Drainage	<ul style="list-style-type: none"> Dense vegetation provides nesting sites for birds. 	72.7
		685.5

The fauna habitats of the study area are relatively common in the subregion and typical of the Bullimore Land System. Restricted habitat types that occur in the IBRA subregion, such as granite exposures, salt lakes or freshwater wetlands, are absent from the study area. The nearest salt lakes are at least 30km distant.

The habitats are in good condition, with some impact from the presence of cattle in proximity to watering points.



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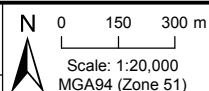
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16 Mile Well Project Fauna Habitats

Figure:

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3.1 Eucalypt - Spinifex Sandplain

Red sandplain and low sandy rises support a very open Marble Gum (*Eucalyptus gongylocarpa*) woodland over an open *Acacia*, *Eremophila* and *Senna* shrubland over spinifex hummock grassland (Plates 1 and 2). Conservation significant fauna that may use this habitat include the Brush-tailed Mulgara (*Dasycercus blythi* – Priority 4) and Striated Grasswren (*Amytornis striatus striatus* – Priority 4).



Plate 1. Eucalypt – spinifex sandplain.



Plate 2. Eucalypt - spinifex sandplain.

3.2 Mulga – Spinifex Sandplain

Red sandplains support a spinifex hummock grassland with a variable cover of mulga, sometimes with mallee eucalypts (Plates 3 and 4). Conservation significant fauna that may use this habitat include the Malleefowl (*Leipoa ocellata* – Vulnerable), Brush-tailed Mulgara (*Dasycercus blythi* – Priority 4) and Striated Grasswren (*Amytornis striatus striatus* – Priority 4).



Plate 3. Mulga - spinifex sandplain.



Plate 4. Mulga - spinifex sandplain.

3.3 Sand Dune

Low red sand dunes supported an open spinifex grassland with scattered Marble Gums (*Eucalyptus gongylocarpa*) and mallee eucalypts (*Eucalyptus youngiana* and *E. kingsmillii*) over patches of open mixed shrubs such as *Grevillea*, *Eremophila* and *Acacia* sp. (Plates 5 and 6). The loose sands of this habitat support fossorial reptiles, some of which are sand dune specialists. Conservation significant fauna that may use this habitat include the Striated Grasswren (*Amytornis striatus striatus* – Priority 4).



Plate 5. Sand dune.



Plate 6. Sand dune.

3.4 Mulga Drainage

Red sandy clays support a low, dense woodland of mulga (*Acacia fuscaneura*) with scattered mallee eucalypts (*Eucalyptus lucasii*) over *Acacia* and *Eremophila* shrubs with a sparse grass understorey (Plates 7 and 8). Conservation significant fauna that may use this habitat include the Malleefowl (*Leipoa ocellata* - Vulnerable) and Central Long-eared Bat (*Nyctophilus major* - Priority 3).



Plate 7. Mulga drainage.



Plate 8. Mulga drainage.

4. Vertebrate Fauna of the Study Area

The results of the desktop survey and the field survey were combined to form lists of the vertebrate fauna potentially occurring in the study area. The lists of frogs, reptiles, birds and mammals that potentially occur in the study area are presented in Appendices 1 – 4 and are summarised below in Table 6. There are seven conservation significant fauna that potentially occur, and these are summarised in Table 7.

Table 6. Summary of vertebrate fauna potentially occurring in the study area.

Taxon	Total species	Introduced species	Recorded on this survey	Conservation significant species				
				Threatened	Migratory	Specially Protected	Priority	Locally Significant
Amphibians	9	-	-	-	-	-	-	-
Reptiles	77	-	1	1	-	-	-	-
Birds	115	-	20	4	2	1	1	-
Mammals	39	9	6	2	-	-	3	-
Totals:	244	9	27	7	2	1	4	0

As it is situated in a larger tract of native vegetation, the study area is likely to support a relatively intact faunal assemblage, with only regionally extinct species likely to be missing from the area. The faunal assemblage is likely to be primarily Eremaean, dominated by species occurring in arid areas with irregular rainfall. As the study area is relatively small it is unlikely that all of the species listed in Appendices 1 – 4 occur, however, these are all species known to occur in the region.

The predicted faunal assemblages and fauna of conservation significance are discussed in the sections below. The results of the EPBC Act Protected Matters search are given in Appendix 6. The results of the DBCA Threatened and Priority Fauna Database search and conservation significant fauna recorded on the survey are shown in Figures 6 and 7.

4.1 Amphibians

There are nine frog species potentially occurring in the study area (Appendix 1). Most of the species expected to occur are burrowing frogs that use seasonal or ephemeral wetlands for breeding. These species also breed opportunistically in man-made depressions. The study area lacks large natural wetlands, but temporary pools may occur in the mulga drainage habitat. During the non-breeding season burrowing frogs may forage in the terrestrial habitats in the study area.

4.2 Reptiles

There are up to 77 species of reptile that potentially occur in the study area (Appendix 2). One species was observed opportunistically during the site visit, the Military Dragon (*Ctenophorus isolepis*). Given its setting in a large, continuous tract of native vegetation, the study area is likely to support an intact reptile assemblage in each habitat. The expected reptile assemblage is relatively species rich.

Species that rely on rocky habitats are likely to be absent from the study area due to lack of suitable habitat. The study area is likely to support a suite of sandplain and sand-dune dwelling species, and a suite of more generalist species, such as the Dwarf Skink (*Menetia greyii*) and Mulga Snake (*Pseudechis australis*) that have large distributions and occur in a range of vegetation and soil types. Semi-arboreal species may occur in association with the larger eucalypt and mulga trees, where they can shelter in hollows and crevices.

4.3 Birds

There are 115 species of bird that potentially occur in the study area, of which 20 were observed during the fauna survey (Appendix 3). As the study area is in the arid (Eremaean) region, the bird assemblage is likely to be dominated by species that are widespread, occurring across the inland arid areas of Australia. Although waterbirds occur in the region, they have been excluded from the list in Appendix 3 as there is no waterbird habitat present.

Most of the predicted bird species are likely to occur across all habitats. Some are more dependent on a single habitat or habitat characteristic.

Honeyeaters feed on nectar and move to take advantage of seasonal flowering resources. These species are likely to fluctuate in abundance, both seasonally and between years, and are likely to be abundant in the study area when the *Eremophila* shrubs (present in all habitats) are flowering. Eucalypt – spinifex sandplain provides tree hollows for hollow-nesting species such as the Australian Ringneck (*Barnardius zonarius*) and Striated Pardalote (*Pardalotus striatus*). Mulga and mallee eucalypt trees in the mulga drainage and mulga – spinifex sandplain may provide small hollows suitable for species such as the Chestnut-rumped Thornbill (*Acanthiza uropygialis*).

A dense cover of shrubs in the mulga drainage and mulga – spinifex sandplain habitats provide sheltered nesting sites for species such as the Splendid Fairy-wren (*Malurus splendens*) and Rufous Whistler (*Pachycephala rufiventris*). Many species nest on or near the ground, such as the Inland Thornbill (*Acanthiza apicalis*). These nests can be vulnerable to feral predators, (foxes and cats), when dense habitats are fragmented.

4.4 Mammals

There are 39 mammals with the potential to occur in the study area, of which 30 are native and nine are introduced (Appendix 4). Six mammals were observed opportunistically during the site visit: the Red Kangaroo (*Osphranter rufus*), Cow (*Bos taurus*), Dog (*Canis familiaris*), Echidna (*Tachyglossus aculeatus*), Spinifex Hopping Mouse (*Notomys alexis*) and the Brush-tailed Mulgara (*Dasycercus blythi*). The mammal fauna is likely to be typical of the sandplains in the region, and species that inhabit rocky habitats such as Woolley's False Antechinus (*Pseudantechinus woolleyae*) and the Long-tailed Dunnart (*Sminthopsis longicaudata*) are likely to be absent, although they would occur nearby where breakaways are present.

The mammal assemblage is likely to be relatively intact, missing only those species extinct in the bioregion. Many of the critical weight range mammals, including species such as the Common Brushtail Possum (*Trichosurus vulpecula*), were noted to be lost from the semi-arid and arid regions in the vicinity of the study area by 1906 (Short 2004).

5. Fauna of Conservation Significance

5.1 Vertebrate Fauna

There are 14 vertebrate fauna of conservation significance known to occur in the region: seven Threatened, two Migratory, one Specially Protected and four Priority species. Each species is summarised in Table 7 and discussed in the sections below. No locally significant vertebrate fauna were identified. The majority of species likely to occur are wide-ranging in arid regions.

The following species are represented by records on DBCA's Threatened and Priority Fauna Database or possible occurrence on the EPBC Act Protected Matters Search Tool (Figure 6, Appendix 6), however, these are species that are reliant on wetlands, a habitat that is absent from the study area:

- Common Sandpiper (*Actitis hypoleucos*) – Migratory
- Curlew Sandpiper (*Calidris ferruginea*) – Critically Endangered
- Gull-billed Tern (*Geochelidon nilotica*) – Migratory
- Common Greenshank (*Tringa nebularia*) – Migratory
- Sharp-tailed Sandpiper (*Calidris acuminata*) – Migratory
- Pectoral Sandpiper (*Calidris melanotos*) – Migratory
- Yellow Wagtail (*Motacilla flava*) – Migratory
- Grey Wagtail (*Motacilla cinerea*) – Migratory

These species have been omitted from the faunal assemblage lists in Appendices 1 – 4 and the potentially occurring conservation significant species listed in Table 7 and are not discussed further.

Table 7. Summary of conservation significant vertebrate fauna.

Key: Mi = Migratory, En = Endangered, Vu = Vulnerable, OS = Other Specially Protected Fauna, P = Priority, LS = locally significant.

Species	Status				Habitat preferences	Likelihood of occurrence	Notes
	EPBC Act	BC Act	DBCA Priority	Locally Significant			
Threatened							
<i>Pezoporus occidentalis</i> Night Parrot	En	Cr			Large spinifex clumps for roosting and breeding, chenopod shrublands and spinifex for foraging.	Possible	This species is known from very few records. Records in WA have been in association with salt lakes. The study area includes mature spinifex, although much of it is relatively short and the habitats are relatively wooded.
<i>Petrogale lateralis lateralis</i> Black-footed Rock Wallaby	En	En			Rocky cliffs, breakaways and boulders.	Unlikely	This species may occur in the region, but the study area lacks the rocky habitats it requires.
<i>Leipoa ocellata</i> Malleefowl	Vu	Vu			Acacia thickets, mallee woodlands and shrublands with leaf litter. Also forages in adjacent habitats.	Likely	A single old mound was found in the study area. This species may breed and forage in the study area.
<i>Falco hypoleucos</i> Grey Falcon	Vu	Vu			Forages over lightly timbered plains, rivers.	Unlikely	The study area is outside the core range of this species, there are no records within 100km and breeding habitat is absent.
<i>Dasyurus geoffroii</i> Chuditch	Vu	Vu			Forests, woodlands & shrublands, denning in hollow logs, babbler nests, burrows or rock crevices.	Unlikely	There are no recent records in the region and it is likely that this species is very uncommon or locally extinct.
<i>Liopholis kintorei</i> Great Desert Skink	Vu	Vu			Sandplains.	Possible	This species is represented by a single record from 1964, however, the habitat of the study area is potentially suitable.
<i>Polytelis alexandrae</i> Princess Parrot	Vu		P4		Sandplains, breeds in Marble Gums	Possible	Although outside the core range of this species, the habitats present are potentially suitable for foraging and breeding.
Migratory							
<i>Apus pacificus</i> Fork-tailed Swift	Mi	Mi			Overfly any habitat.	Potential	This species is largely aerial in Australia, and although it may overfly the area, the study area is not likely to be important for this species.

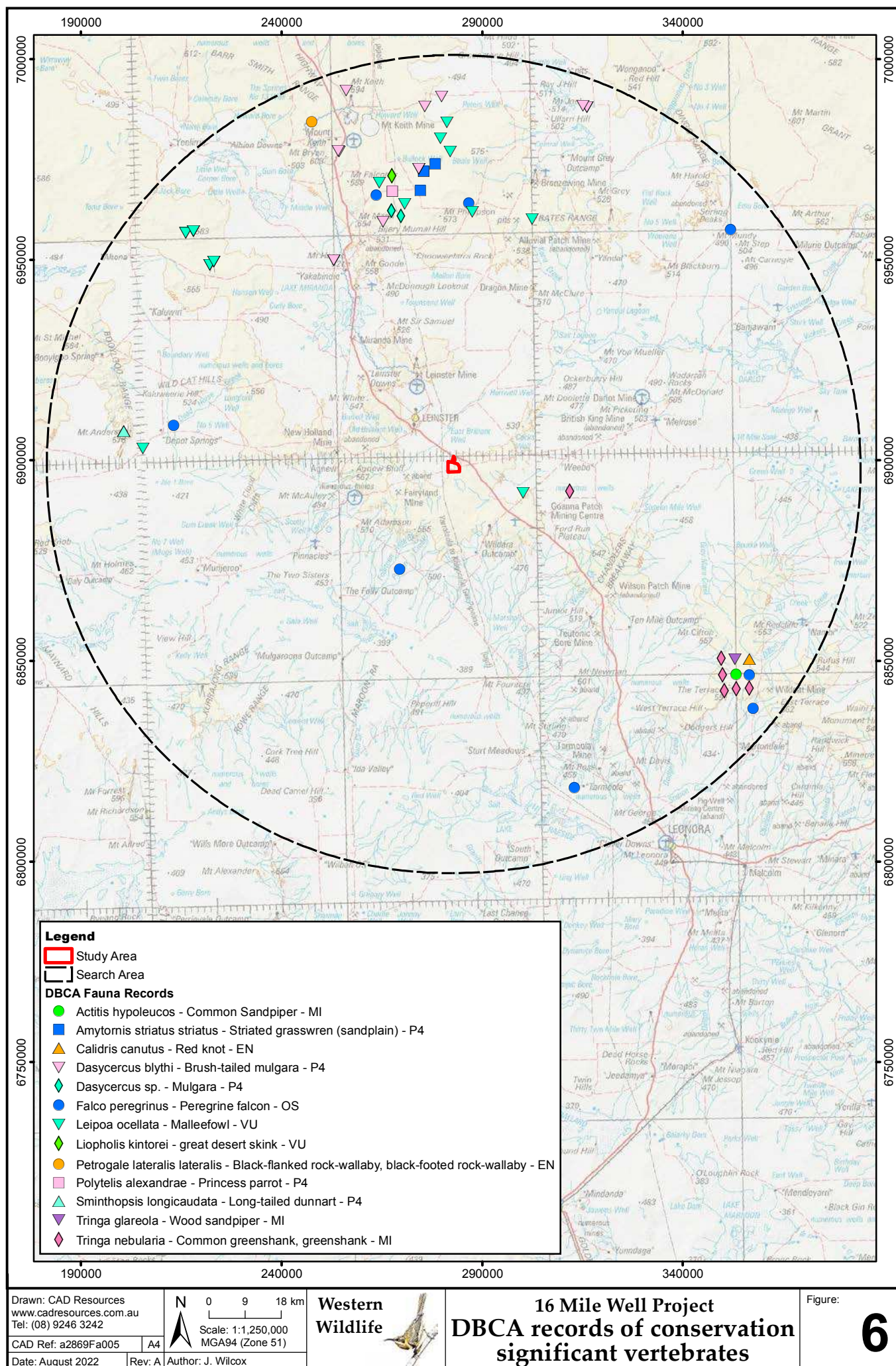
Table 7. (cont.)

Species	Status				Habitat preferences	Likelihood of occurrence	Notes
	EPBC Act	BC Act	DBCA Priority	Locally Significant			
<i>Charadrius veredus</i> Oriental Plover	Mi	Mi			Plains, open areas, recently burnt areas.	Possible	This species may occur occasionally but the habitat is generally too densely wooded.
Specially Protected							
<i>Falco peregrinus</i> Peregrine Falcon		OS			Variety of habitats, nests in tall trees, cliffs, open pits.	Potential	Although likely to occur in the region, the study area is unlikely to be of particular significance to this species.
Priority Fauna							
<i>Dasycercus blythi</i> Brush-tailed Mulgara			P4		Spinifex sandplains.	Known to occur	This species was recorded during the August 2021 field survey.
<i>Sminthopsis longicaudata</i> Long-tailed Dunnart			P4		Breakaways, rocky habitats, scree slopes.	Unlikely	Although known from nearby records, there is no suitable habitat in the study area.
<i>Nyctophilus major tor</i> Central Long-eared Bat			P4		Woodlands.	Possible	The study area is within the range of this species and the eucalypts and mulgas may provide roosting habitat.
<i>Amytornis striatus striatus</i> Striated Grasswren			P4		Spinifex grasslands.	Known to occur	This species was recorded during the August 2021 field survey.

5.1.1 Threatened Fauna

There are seven Threatened vertebrates that potentially occur in the study area (Table 7).

Threatened species are those that are considered in danger of extinction as their populations have declined and/or are still declining, and their total population size is small and/or fragmented or geographically restricted. Sites that support these species may be important for their long-term conservation, particularly if the site supports a resident or breeding population.



Night Parrot – *Pezoporus occidentalis*

The Night Parrot is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act. Historically, the Night Parrot was recorded across a large range in the arid and semi-arid interior of Australia (Garnett *et al.* 2011). In recent times however, there are very few verified records of the species. Reliable records in recent times are from two main areas, one in western Queensland and one in Western Australia (TSSC 2016b). Western Australia records are from Lake Gregory in the southern Kimberley, a site near Wiluna and near the Fortescue Marsh in the Pilbara (NPRT 2021, Davis and Metcalf 2008).

The key habitats for the Night Parrot are thought to be chenopod shrublands and Spinifex grasslands, with the chenopod shrublands a refuge during dry conditions (Garnett *et al.* 2011). Nesting sites are in mature Spinifex, often large ring-forming clumps (DPAW 2017). Foraging habitats are likely to vary across Australia, but include herbs, grasses, grass-like plants, *Sclerolaena spp.* and other chenopods (DPAW 2017). With the reasons for its decline unknown, potential threats to the species remain unconfirmed (TSSC 2016b). Possible threats include predation by feral cats or foxes, human-induced fire and degradation of soil around watering points (TSSC 2016b).

Knowledge about the current distribution and habitat requirements of the Night Parrot in Western Australia is based on very few records. Therefore, there is considerable uncertainty when assessing the likelihood of occurrence of this species. The spinifex observed was mature and sometimes ring-forming, however it was also relatively short and the habitats are more wooded than in known Night Parrot locations. Although this species possibly occurs, the study area is unlikely to be suitable for roosting or nesting according to current knowledge.

Black-footed Rock Wallaby – *Petrogale lateralis lateralis*

The Black-footed Rock-wallaby is listed as Endangered under the BC Act and EPBC Act.

Formerly widespread, the Black-footed Rock Wallaby has decreased both in range and abundance, now occurring in isolated subpopulations. For shelter, this species requires deep shade in rocky areas, such as caves, rock piles and cliffs (Woinarski *et al.* 2014). At dusk they emerge to feed, usually in areas close to shelter sites. There are two records of the Black-footed Rock-wallaby within 100km on DBCA's Threatened and Priority Fauna Database (Figure 6). The records are from Yeelirrie in 2009 and 2015. This species is unlikely to occur in the study area due to lack of suitable habitat.

Malleefowl – *Leipoa ocellata*

The Malleefowl is listed as Vulnerable under the BC Act and EPBC Act.

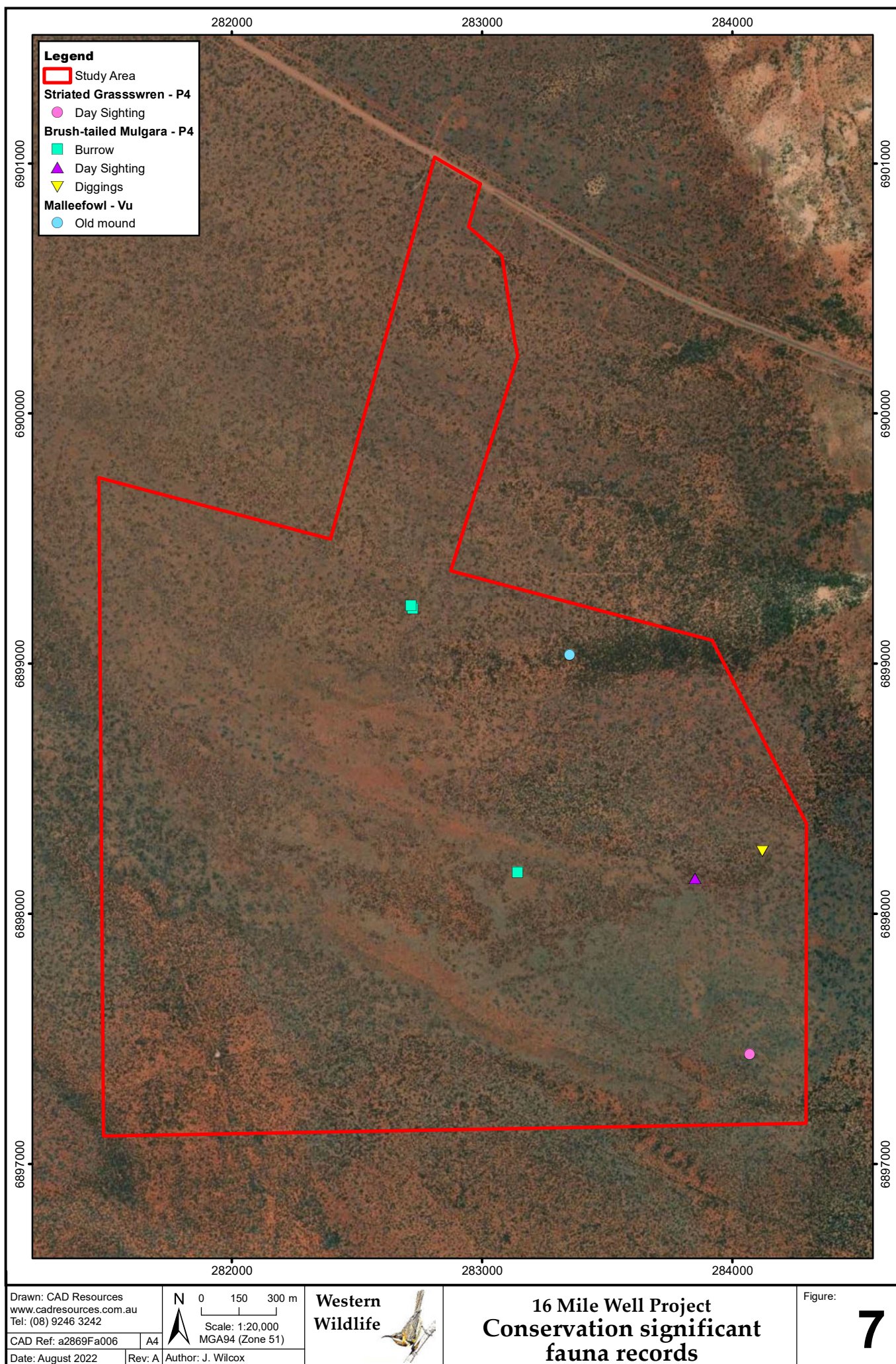
The Malleefowl is a bird of dense shrublands, mulga woodlands and mallee woodlands. It used to be common in the southern arid and semi-arid areas of Western Australia (Johnstone and Storr 1998). In order to construct their nest mounds, the Malleefowl needs leaf litter on sandy substrates (Garnett and Crowley 2010). The mounds are usually constructed intermittently by a pair of birds between autumn and spring. Between early spring and mid to late summer, 15 - 25 eggs are laid in the mound by the female, while the male continues to tend the mound. The chicks emerge between November and January (sometimes as late as March), and as they receive no parental care, chick mortality can be high (Benshemesh 2007).

As Malleefowl nest on the ground, the eggs and flightless chicks are vulnerable to predation by feral predators. However, the main threat to Malleefowl is habitat loss and the fragmentation and degradation of remaining habitat, as well as the death of adults on roads (Benshemesh 2007, Garnett *et al.* 2011). Fire can have a significant impact on populations, by killing adult birds, causing local extinctions in fragmented habitats and causing a cessation in breeding activity for many years after a fire (Benshemesh 2007).

There are many records of Malleefowl within the 100km of the study area on DBCA's Threatened and Priority Fauna Database, many of them recent (Figure 6). An old Malleefowl mound was recorded in the study area (Plate 9, Figure 7). Malleefowl will often breed in the same general area year after year, and new mounds may be constructed, or old mounds re-used. The adult birds have been found to range over one to many square kilometres, and these home ranges overlap (Benshemesh 2007). It is likely that all vegetation in the study area is foraging habitat for Malleefowl. Potential breeding habitat is present in the mulga drainage habitat, and more densely vegetated parts of the mulga- spinifex sandplains may also be suitable.



Plate 9. Old Malleefowl mound.



Chuditch – *Dasyurus geoffroii*

The Chuditch is listed as Vulnerable under the BC Act and EPBC Act.

The Chuditch used to occur across much of the continent but is now restricted to the southwest of Western Australia. Although they used to occupy a range of habitats, the majority of Chuditch now occur in the Jarrah forest with some wheatbelt/goldfields populations in drier woodlands, heath and mallee shrublands (Van Dyck and Strahan 2008; Orrell and Morris 1994). Up until recently, there were only occasional records of the Chuditch from the wheatbelt and goldfields, with this population estimated at 2,000 mature individuals (Woinarski *et al.* 2014, DoEE 2016). In recent years a substantial population has been recorded at Forrestiana (pers. obs., Raynor *et al.* 2011).

Chuditch are highly mobile, and typically have large home-ranges (Woinarski *et al.* 2014). In the study at Forrestiana, the average distance travelled between consecutive refuge sites was 500 m for females and 3.3km for males, with the maximum distance travelled 1.5 km for females and 4.5 - 12 km for males (Rayner *et al.* 2011). Males were found to occur across large core home ranges averaging 2,125 ha which overlapped with other males and females. Females inhabited a smaller core home range of 189 ha (Rayner *et al.* 2011). The core home range describes the area contained by den locations, and the actual area over which individuals can range is much higher (DEC 2012). As Chuditch use up to 180 different dens sites within their core home range (Woinarski *et al.* 2014), no particular den site is likely to be significant.

The current major threats to Chuditch are land clearing (including fragmentation of continuous habitat), predation by and competition with feral predators (foxes and cats) and deliberate and accidental mortality from poisoning, trapping, illegal shooting or road kills (DEC 2012). There are no records of Chuditch within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 6). It is considered unlikely that the Chuditch would occur in the study area, and it is likely to be locally extinct in this part of its range.

Grey Falcon – *Falco hypoleucos*

The Grey Falcon is listed as Vulnerable under the BC Act and EPBC Act.

The Grey Falcon may number fewer than 1000 individuals, though it occurs across a large portion of arid and semi-arid Australia with its distribution centred on inland drainages (Garnett *et al.* 2011). It forages over timbered plains, including *Acacia* shrublands, also ranging out onto treeless plains. The Grey Falcon nests in tall trees on watercourses (Garnett *et al.* 2011) and occasionally on man-made structures such as transmission line towers (pers. obs.). Threats to this species are unknown but may include habitat degradation due to overgrazing or clearing and provision of water in arid areas favouring the closely related Peregrine Falcon (Garnett *et al.* 2011).

The study area lacks suitable breeding habitat for this species. The Grey Falcon may forage during the non-breeding season, but the species is at the southern limit of its range in the vicinity of the study area and there are no records within 100km on DBCA's Threatened and Priority Fauna Database (Figure 6).

Great Desert Skink – *Liopholis kintorei*

The Great Desert Skink is listed as Vulnerable under the BC Act and EPBC Act.

The Great Desert Skink is a large burrowing lizard that occurs patchily across the western deserts region of central Australia (McAplin 2001). Formerly widespread, it has disappeared from much of its range in Western Australia (TSSC 2016a). This species usually occurs on spinifex sandplains and may also inhabit adjacent dune swales. In the Tanami and parts of the Great Sandy Desert it also occurs in the lateritic soils of paleodrainage lines (McAplin 2001). The Great Desert Skink lives in burrow systems that can be 1m deep and over 10m in diameter. The burrow systems can have multiple entrances and are characterised by the presence of a scat latrine. Up to three generations live in the burrow system. Burrows may remain active for several years, and males move between burrow systems, mating with females across several burrows. Great Desert Skinks hibernate in the cooler months, usually between May/June and September/October.

Threats to the Great Desert Skink include predation after loss of vegetation cover from fire and possibly habitat degradation from feral Camels and Rabbits (TSSC 2016a). With the cessation of traditional land management practices across much of the western deserts region, frequent patch-burning has been replaced by extensive hot fires (McAplin 2001). Fire management to protect the species should focus on prevention of frequent, widespread hot fires, though the needs of other fauna should also be considered (Cadenhead *et al.* 2016). Great Desert Skinks prefer a mosaic of fire ages, favouring areas that have been burnt in the past three to 15 years (McAplin 2001). Both Cats and Foxes are known to prey on the Great Desert Skink.

There is a single record of this species on DBCA's Threatened and Priority Fauna Database, from Wanjarri Nature Reserve in 1964 (Figure 6, DBCA 2021). Although this species possibly occurs on the eucalypt – spinifex sandplains and mulga – spinifex sandplains, it prefers treeless sandplains and it is uncertain whether this species is still extant in the region.

Princess Parrot – *Polytelis alexandrae*

The Princess Parrot is listed as Vulnerable under the EPBC Act and Priority 4 by DBCA.

The Princess Parrot occurs across inland arid Australia where it inhabits shrublands and open woodlands over Spinifex in the swales between dunes (Garnett *et al.* 2011). There is limited information on population trends, as this species generally occurs in unpopulated areas and can be irruptive (TSSC 2018). The Princess Parrot can congregate in large flocks to breed in response to rainfall events (TSSC 2018). It nests in hollows and has been recorded nesting in River Red Gum (*Eucalyptus camaldulensis*), Marble Gum (*Eucalyptus gongylocarpa*) and Desert Oak (*Allocasuarina decaisneana*) (Garnett *et al.* 2011). Though no threats are confirmed for the species, it may be adversely affected by altered fire regimes and competition with introduced grazing herbivores (Garnett *et al.* 2011). The conservation priority for the species is to undertake active fire management to protect breeding habitat (TSSC 2018).

This species possibly occurs as a foraging or breeding visitor to the study area, although its core range is generally further inland. The lack of records in the region make the difficult to determine its local status. There is a single record within 100km on DBCA's Threatened and Priority Fauna Database, from Wanjarri Nature Reserve in 1964 (Figure 6, DBCA 2021). Potential breeding habitat is present in the stands of Marble Gum in the spinifex - eucalypt sandplain habitat.

5.1.2 Migratory Fauna

There are two Migratory species that potentially occur in the study area (Table 7). Other Migratory species are known from the region but require wetland habitats.

Migratory species are not always present at a site, but a particular site may have significance as a seasonal or ephemeral foraging, breeding or shelter area. Impacts to these sites may then impact the population both within the site and further afield. For Migratory shorebirds, a site is deemed internationally important if it regularly supports more than 1% of the flyway population of a species, or a total abundance of at least 20,000 shorebirds, and nationally important if it regularly supports more than 0.1% of the flyway population of a species, at least 2,000 shorebirds or at least 15 shorebird species (Hansen *et al.* 2016, Commonwealth of Australia 2017).

Fork-tailed Swift – *Apus pacificus*

The Fork-tailed Swift is listed as Migratory under the BC Act and EPBC Act.

The Fork-tailed Swift is a non-breeding visitor to Australia between September and April (Boehm 1962). While it can be common further north, in southwest Australia this species is generally scarce (Johnstone and Storr 1998). The bird is primarily observed foraging for insects in proximity to cyclonic weather (Boehm 1962). Although a migratory species, the Fork-tailed Swift has a large range and a large population that appears to be stable (Birdlife International 2020).

There is a single record in the region on DBCA's Threatened and Priority Fauna Database, about 41km west of the study area (Figure 6). Although it is likely to occur periodically, in Western Australia the Fork-tailed Swift is largely an aerial species and the study area is not likely to be of particular importance to the species.

Oriental Plover – *Charadrius veredus*

The Oriental Plover is listed as Migratory under the BC Act and EPBC Act.

After breeding in Mongolia, Siberia and China, the Oriental Plover overwinters in northern Australia (casual elsewhere) between late August and early April (Johnstone and Storr 1998). This species favours dry grasslands and open plains, including recently burnt areas (Geering *et al.* 2007).

There are no records of the Oriental Plover within 100km on DBCA's Threatened and Priority Fauna Database (Figure 6). A site is deemed nationally important for this species if it regularly supports at least 230 birds. The Oriental Plover possibly occurs, but the habitats present are relatively wooded and this species prefers open habitats. Even if present, the study area is unlikely to regularly support nationally or internationally significant numbers of this species.

5.1.3 Specially Protected Fauna

There is one specially protected species that potentially occurs in the study area (Table 7).

The populations of Specially Protected species are large enough that they are not considered to be Threatened. However, they require on-going conservation intervention (i.e., Conservation Dependent) or be specially protected in order to prevent them from becoming Threatened.

Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon is listed as Other Specially Protected Fauna under the BC Act.

The Peregrine Falcon is a widespread bird of prey that globally has a very large range and a very large population that appears to be secure (BirdLife International 2020). In Western Australia the population is secure, though this species may experience reductions at a local level due to human disturbance at nesting sites (Debus 1998). The Peregrine Falcon nests mainly on ledges on cliffs or rocky outcrops, and it may also use tall trees (Johnstone and Storr 1998). This species often takes advantage of man-made structures such as abandoned open pits or quarries.

The Peregrine Falcon was recorded in the region on DBCA's Threatened and Priority Fauna Database (Figure 6), with the nearest record about 27km southwest. The study area lacks breeding habitat for this species. If a pair nests nearby, they may forage over the sandplain shrublands and other more open habitats, with the study area representing only a small part of a much larger foraging territory.

5.1.4 Priority Fauna

There are four Priority fauna species that potentially occur in the study area (Table 7).

Priority 1, 2 or 3 species need further survey effort, as insufficient data exist to adequately determine their status. Many Priority 1, 2 and 3 species are known from only a few records in a limited number of locations, thus determining their status in the study area may be problematic. Priority 4 species are considered to require regular monitoring, as although they are adequately known, they are either rare, near threatened or recently removed from the threatened list.

Brush-tailed Mulgara – *Dasyercus blythi*

The Brush-tailed Mulgara is listed as Priority 4 by DBCA.

This species is widely distributed across arid Australia, and though its population has declined in the past, it is currently thought to be stable or declining only slowly (Woinarski *et al.* 2014). It is thought that its ability to use a variety of food resources, tolerate severe declines in bodyweight, enter torpor and dig deep burrows has buffered the species from the impacts of feral predators and a variable climate and resource availability (Masters and Dickman 2012). It is therefore listed as of 'Least Concern' in the Action Plan for Australian Mammals 2012 (Woinarski *et al.* 2014). The Brush-tailed Mulgara occurs mostly on Spinifex grasslands, sheltering during the day in burrows.

There are records of this species within 100km on DBCA's Threatened and Priority Fauna Database, in the vicinity of Mt Keith and Wanjarri Nature Reserve (Figure 6, DBCA 2021). The Brush-tailed Mulgara was also recorded in the study area (Plates 10 and 11, Figure 7). This species is likely to be resident in the eucalypt - spinifex sandplains and mulga – spinifex sandplains, although the population of this species is likely to fluctuate from year to year depending on prevailing environmental conditions.



Plate 10. Brush-tailed Mulgara burrow with fresh tracks.



Plate 11. Brush-tailed Mulgara burrow with scat.

Long-tailed Dunnart – *Sminthopsis longicaudata*

The Long-tailed Dunnart is listed as Priority 4 by DBCA.

This species is associated with breakaways and scree slopes, but also occurs on gravel or stony plains (Van Dyck and Strahan 2008). There are records of this species within 100km on DBCA's Threatened and Priority Fauna Database (Figure 6). Although the study area is within the known range of the Long-tailed Dunnart, potentially suitable breakaway and stony habitats are absent and this species is considered unlikely to occur.

Central Long-eared Bat – *Nyctophilus major tor*

The Central Long-eared Bat is listed as Priority 3 by DBCA.

The Central Long-eared Bat occurs across southern central Australia, inhabiting woodlands, mallee and thickets (Woinarski *et al.* 2014). Although there are no estimates of population size, it is not thought to be declining and there is no evidence that its range has contracted (Woinarski *et al.* 2014). Although there are no records within 100km on DBCA's Threatened and Priority Fauna Database (Figure 6), this species has been recorded at Yeeleerie (Bamford Consulting Ecologists 2011). The Central Long-eared Bat potentially occurs in the mulga – spinifex sandplain, eucalypt – spinifex sandplain and mulga drainage, foraging in any habitat and roosting in tree hollows.

Striated Grasswren – *Amytornis striatus striatus*

The sandplain subspecies of the Striated Grasswren is listed as Priority 4 by DBCA.

The species occurs across much of arid Australia, inhabiting Spinifex sandplains, usually with an overstorey of shrubs or mallee eucalypts (Garnett *et al.* 2011, Johnstone and Storr 2004). It is listed as 'Near Threatened' in the Action Plan for Australian Birds due to its decline in the central and south-eastern parts of its range (Garnett *et al.* 2011). The key threat to the Striated Grasswren is extensive fires that burn mature Spinifex grasslands.

The Striated Grasswren was recorded in the study area (Figure 7). There is a 2016 record and some older records (1979, 1987) from the Wanjarri Nature Reserve on DBCA's Threatened and Priority Fauna Database (Figure 6), about 65km north of the study area. This species is likely to inhabit most habitats in the study area. It is likely that the Striated Grasswren is patchily distributed across sandplains in the region, and their abundance is likely to fluctuate in response to fire.

5.2 Invertebrate Fauna

This report is primarily concerned with vertebrate fauna and no comprehensive literature review was undertaken for this group. The invertebrate fauna of the study area are more species rich and abundant than the vertebrate fauna, but cataloguing their occurrence was outside the scope of this survey. However, three invertebrates of conservation significance were recorded within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 8, DBCA 2021) or are known to occur in the region (Table 8).

5.2.1 Threatened Invertebrates

Arid Bronze Azure Butterfly - *Ogyris subterrestris petrina*

This butterfly is listed as Critically Endangered under both the EPBC Act and BC Act.

The Arid Bronze Azure Butterfly is only known from two sub-populations, both near Barbalin in the eastern Wheatbelt. A third subpopulation at Lake Douglas, near Kalgoorlie, appears to be extinct. This species is reliant on an attendant ant, the sugar ant *Camponotus* sp. nr. *terebrans*, as the butterfly larvae live in the nest and the ants protect the larvae. The ant colonies occur at the base of smooth-barked eucalypts, and only large colonies of the host ant are able to support the butterfly.

There are no records of this species within 100km of the study area (Figure 8), however, the study area is within the predicted range of the attendant ant species (DBCA 2020). A few trees were opportunistically sampled for the ant in this survey (Figure 4). No ants were found, and although this did not constitute a comprehensive survey, it is unlikely that the widely spaced trees in the eucalypt – spinifex sandplain would support sufficient ant colonies to support this butterfly. The mulga drainage, sand dune and mulga-spinifex sandplain only supported a few scattered eucalypts and would not be habitat for this species.

Table 8. Summary of conservation significant invertebrate fauna.

Key: Mi = Migratory, En = Endangered, Vu = Vulnerable, OS = Other Specially Protected Fauna, P = Priority, LS = locally significant.

Species	Status				Habitat preferences	Likelihood of occurrence	Notes
	EPBC Act	BC Act	DBCA Priority	Locally Significant			
Threatened							
<i>Ogyris subterrestris petrina</i> Arid Bronze Azure Butterfly	Cr	Cr			Smooth-barked eucalypt woodland hosting large colonies of the larval attendant ant, <i>Camponotus sp. nr. terebrans</i> .	Unlikely	Although smooth-barked eucalypts were present, no colonies of the attendant ant were recorded.
Priority							
<i>Kwonkan moriartii</i> Moriarty's Trapdoor Spider			P2		Poorly known.	Possible	Sandplain and sand dune habitat is unlikely to be suitable for burrow construction.
<i>Idiosoma clypeatum</i> Northern Shield-backed Trapdoor Spider			P3		Acacia shrublands on clay-loam or loamy soils.	Possible	Sandplain and sand dune habitat is unlikely to be suitable for burrow construction.

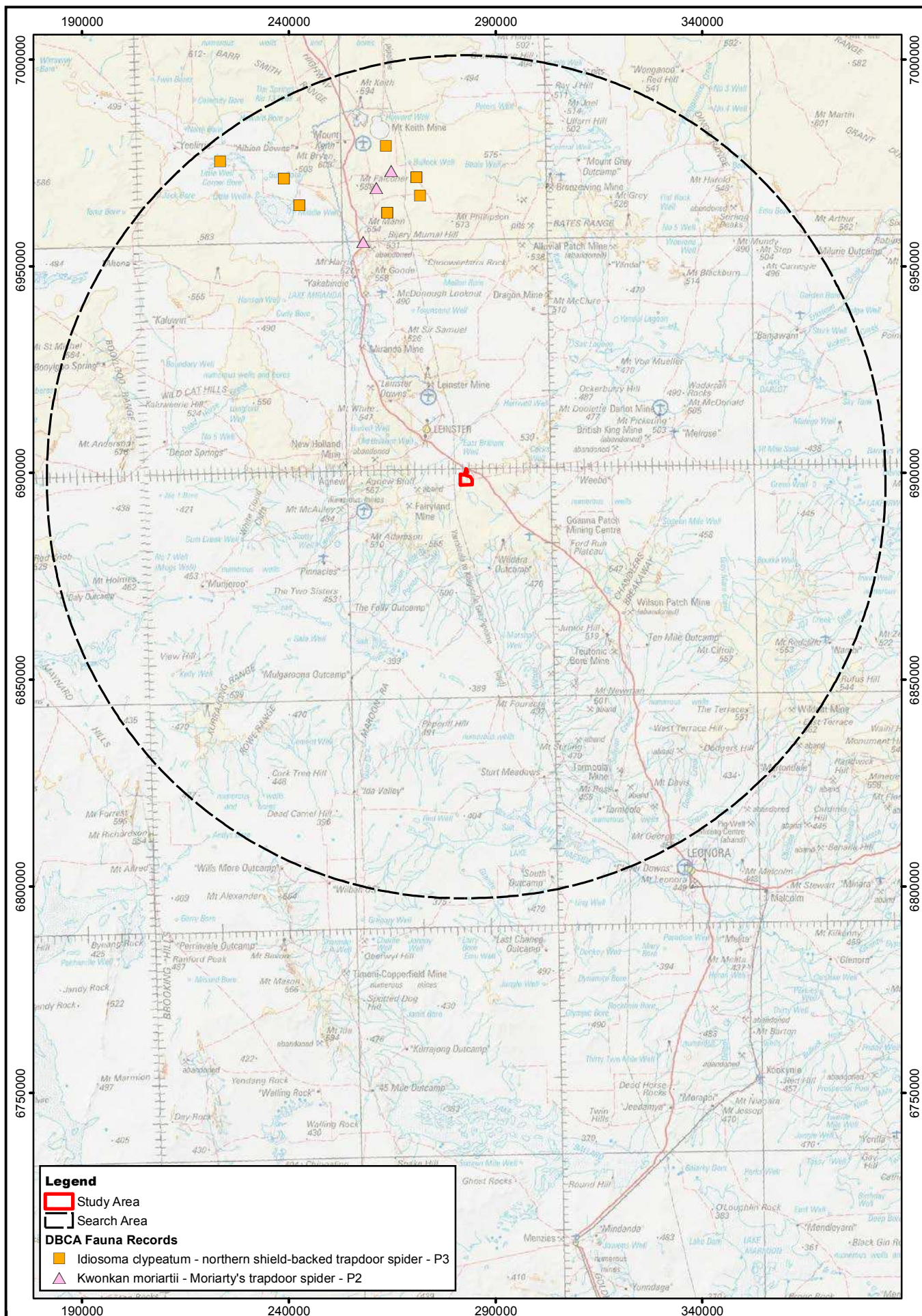
5.2.2 Priority Invertebrates

Moriarty's Trapdoor Spider - *Kwonkan moriartii*

This spider is listed as Priority 2 by DBCA.

A mygalomorph spider, this species is likely to be relatively long-lived. The females construct a silk-lined burrow in which they reside for their entire life. The males will disperse in search of females when they reach sexual maturity, dying after mating.

There are three records of this species within 100km of the study area on DBCA's Threatened and Priority Fauna Database, although it is probable that this is the same record in triplicate from different sources. The records are from 1962 and the nearest is about 62km north (Figure 8). This spider is poorly known and represented by very few records, hence it is difficult to determine its pattern of distribution in the region. This species may possibly occur in the study area, but only the mulga drainage habitat is likely to have soils heavy enough to support burrow construction. The sandy soils of sand dune and sandplain habitats are unlikely to be suitable for this species.



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MGA94 (Zone 51)

Western
Wildlife



16 Mile Well Project
DBCFA records of conservation
significant invertebrates

Figure:

8

Northern Shield-backed Trapdoor Spider - *Idiosoma clypeatum*

This spider is listed as Priority 3 by DBCA.

This species was formerly known as the Shield-backed Trapdoor Spider (*Idiosoma nigrum*) before a review determined that *Idiosoma nigrum* was comprised of several species (Rix *et al.* 2018). The Northern Shield-backed Trapdoor Spider has a wide distribution through the Murchison and Yalgoo Bioregions and is the most arid-adapted of the genus. Studies have generally found burrows of this species in association with *Acacia* shrublands on clay-loam or loam soils on lower slopes and flats (Biologic 2012, Ecologia 2013).

There are several records of this species within 100km on DBCA's Threatened and Priority Fauna Database (Figure 8), the closet being about 66km north. This species may possibly occur in the study area, but only the mulga drainage habitat is likely to have soils heavy enough to support burrow construction. The sandy soils of sand dune and sandplain habitats are unlikely to be suitable for this species.

6. Conclusions

6.1 Faunal Assemblage

The faunal assemblage of the study area is likely to be largely intact, as the study area is situated within a larger tract of native vegetation. The assemblage is likely to be mostly Eremaean, made up of species with a primarily inland distribution. Many of the species that occur are widely distributed through semi-arid Australia. The predicted faunal assemblage includes up to nine frogs, 77 reptiles, 115 birds, 30 native mammals and nine introduced mammals. The observed assemblage thus far includes no frogs or reptiles, 20 birds, four native mammals and two introduced mammals.

6.2 Conservation Significant Fauna

Fourteen conservation significant vertebrates and three conservation significant invertebrates potentially occur in the study area, as summarised in Tables 7 and 8.

Two conservation significant species are **known to occur**: the Striated Grasswren (*Amytornis striatus striatus*; Priority 4) and Brush-tailed Mulgara (*Dasycercus blythi*; Priority 4). Both species were recorded during the survey (Figure 7) and are likely to be resident, although their populations may fluctuate in response to fire and prevailing climactic conditions.

One conservation significant species is **likely to occur**: the Malleefowl (*Leipoa ocellata*; Vulnerable). This species is known from recent records in the region and an old mound was found in the mulga drainage habitat (Figure 7).

Two conservation significant species may **potentially occur**: the Fork-tailed Swift (*Apus pacificus*; Migratory) and Peregrine Falcon (*Falco peregrinus*; Specially Protected Fauna). The study area is unlikely to provide important habitat to the Fork-tailed Swift, as this species is almost entirely aerial when visiting Australia. The Peregrine Falcon may occur as a non-breeding visitor, but the study area would comprise a small part of a much larger home-range for a pair of birds.

Seven conservation significant species (five vertebrates and two invertebrates) **possibly occur**: the Night Parrot (*Pezoporus occidentalis*; Critically Endangered), Princess Parrot (*Polytelis alexandrae*; Vulnerable), Great Desert Skink (*Liopholis kintorei*; Vulnerable), Oriental Plover (*Charadrius veredus*; Migratory), Central Long-eared Bat (*Nyctophilus major tor*; Priority 3), Moriarty's Trapdoor Spider (*Kwonkan moriartii*; Priority 2) and the Northern Shield-backed Trapdoor Spider (*Idiosoma clypeatum*; Priority 3). There is mature spinifex in the study area that may possibly support the Night Parrot, however, the known locations for this species in Western Australia are less wooded and in proximity to salt lakes. The Princess Parrot is an irruptive species that may occur on occasion, but its core range is further east. The sandplain habitats may support the Great Desert Skink, but it is uncertain whether the distribution of the species extends as far southwest as the study area, and this species usually prefers treeless sandplains unlike the more wooded sandplains of the study area. The Oriental Plover may occur on occasion, but the study area is not likely to regularly support significant numbers. The Central Long-eared Bat is known from the region and may use the eucalypts on the sandplain. Moriarty's Trapdoor Spider or the Northern Shield-backed Trapdoor Spider may occur where there are more consolidated soils for burrow construction, such as the mulga drainage habitat.

The remaining five species (four vertebrates and one invertebrate) are considered **unlikely to occur**. These are the Black-footed Rock Wallaby (*Petrogale lateralis lateralis*; Endangered), Grey Falcon (*Falco hypoleucos*; Vulnerable), Chuditch (*Dasyurus geoffroii*; Vulnerable), Long-tailed Dunnart (*Sminthopsis longicaudata*; Priority 4) and Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*; Critically Endangered). The study area is outside the core range of the Grey Falcon, and lacks breeding habitat for this species. The Chuditch is not represented by any records in the region and may be locally extinct. The study area lacks the breakaways and stony habitats that support the Black-footed Rock Wallaby and Long-tailed Dunnart. No host ants for the Arid Bronze Azure Butterfly were recorded, and although this was not a comprehensive survey the widely spaced eucalypts on sandy soils are unlikely to provide sufficient habitat for this species.

6.3 Important Habitats

All habitats have some importance in that they support native fauna, however, habitats may be of particular importance if they:

- support very diverse or unique faunal assemblages
- are restricted or rare in the region (and thus the associated faunal assemblages are restricted or rare)
- are refugia (e.g. from drought or fire)
- provide ecological linkage
- support conservation significant fauna

The habitats in the study area are common and widespread in the subregion and are unlikely to function as ecological linkages or refugia, except at a local level. Of the habitats present in the study area, the eucalypt - spinifex sandplain and mulga – spinifex sandplain provide habitat for Priority 4 species the Brush-tailed Mulgara (*Dasycercus blythi*) and the Striated Grasswren (*Amytornis striatus striatus*) and the mulga drainage habitat and denser patches within the mulga – spinifex sandplain habitat may provide breeding habitat for the Malleefowl (*Leipoa ocellata*; Vulnerable).

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Appendices

Appendix 1. Frog Species Recorded or Potentially Occurring in the Study Area

Key to records:

This survey = species recorded in the survey area August 2021.

Yeelirrie Project = species recorded at the Yeelirrie Project, 79km north of the study area, by Bamford Consulting Ecologists (2011).

Bellevue Gold = species recorded at the Bellevue Gold Project, 50km north of the study area, by Bamford Consulting Ecologists (2019).

Mt Keith Project = species recorded at the Mt Keith Project, 79km north of the study area, by Biota (2017, 2006a, 2006b) and/or ATA (2005).

Agnew Gold = species recorded at the Agnew Gold Mine, 8km south of the study area, by Stantec (2018), ENV (2008), Astron (2012), Minesite Rehabilitation Services (2003) and/or Rapallo Environmental (2017).

WAM Goldfields = species recorded in the Sir Samuel-Sandstone and Leonora-Laverton study areas by the WA Museum (Hall *et al.* 1994).

ALA = species records from the Atlas of Living Australia Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation status	Records								
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	ALA	DBCA	EPBC
Pelodryadidae (tree frogs and water-holding frogs)										
Main's Frog <i>Cyclorana mainii</i>			+		+		+			
Western Water-holding Frog <i>Cyclorana occidentalis</i>			+		+		+			
Desert Tree Frog <i>Litoria rubella</i>			+	+		+		+		
Limnodynastidae (burrowing frogs)										
Northern Burrowing Frog <i>Neobatrachus aquilonius</i>								+		
Kunapalari Frog <i>Neobatrachus kunapalari</i>							+	+		
Shoemaker Frog <i>Neobatrachus sutor</i>								+		
Plonking Frog <i>Neobatrachus wilmorei</i>										
Centralian Burrowing Frog <i>Platyplectrum spenceri</i>					+			+		
Myobatrachidae (ground frogs)										
Western Toadlet <i>Pseudophryne occidentalis</i>			+							
Number of frog species predicted:		9								

Appendix 2. Reptile Species Recorded or Potentially Occurring in the Study Area

Key to records:

This survey = species recorded in the survey area August 2021.

Yeelirrie Project = species recorded at the Yeelirrie Project, 79km north of the study area, by Bamford Consulting Ecologists (2011).

Bellevue Gold = species recorded at the Bellevue Gold Project, 50km north of the study area, by Bamford Consulting Ecologists (2019).

Mt Keith Project = species recorded at the Mt Keith Project, 79km north of the study area, by Biota (2017, 2006a, 2006b) and/or ATA (2005).

Agnew Gold = species recorded at the Agnew Gold Mine, 8km south of the study area, by Stantec (2018), ENV (2008), Astron (2012), Minesite Rehabilitation Services (2003) and/or Rapallo Environmental (2017).

WAM Goldfields = species recorded in the Sir Samuel-Sandstone and Leonora-Laverton study areas by the WA Museum (Hall *et al.* 1994).

ALA = species records from the Atlas of Living Australia Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation status	Records								
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	ALA	DBCA	EPBC
Carphodactylidae (knob-tailed geckoes)										
<i>Nephurus laevis</i>										
Mid-line Knob-tail <i>Nephurus vertebralis</i>			+	+						
Southern Barking Gecko <i>Underwoodisaurus milii</i>				+		+				
Diplodactylidae (ground geckos)										
<i>Diplodactylus conspicillatus</i>			+	+	+		+	+		
Wheatbelt Ground Gecko <i>Diplodactylus granariensis</i>			+	+		+		+		
<i>Diplodactylus pulcher</i>			+	+	+	+	+			
Southern Sandplain Gecko <i>Lucasium bungabinna</i>										
Mottled Ground Gecko <i>Lucasium squarrosum</i>				+	+		+			
Western Beaked Gecko <i>Rhynchoedura ornata</i>			+	+	+	+	+			
Goldfield’s Spiny-tailed Gecko <i>Strophurus assimilis</i>										
Jewelled Gecko <i>Strophurus elderi</i>			+		+		+			
Western Ring-tailed gecko <i>Strophurus strophurus</i>			+	+	+			+		
<i>Strophurus wellingtonae</i>			+		+	+	+			
Gekkonidae (geckoes)										
Purplish Dtella <i>Gehyra purpurascens</i>							+			
Tree Dtella <i>Gehyra variegata</i>			+	+	+	+	+	+		
Bynoe’s Gecko <i>Heteronotia binoei</i>			+	+	+	+	+	+		
Pygopodidae (legless-lizards)										
Sandplain Worm-lizard <i>Aprasia repens</i>				+						
<i>Delma butleri</i>			+				+			
<i>Delma nasuta</i>			+				+			
Burton's Legless-Lizard <i>Lialis burtonis</i>			+	+	+		+			
Western Hooded Scaly-foot <i>Pygopus nigriceps</i>			+	+	+					

Appendix 2. (cont.)

Species		Conservation status	Records								
			This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	ALA	DBCA	EPBC
Agamidae (dragon lizards)											
Ring-tailed Dragon	<i>Ctenophorus caudicinctus</i>			+	+		+	+	+		
Mallee Sand Dragon	<i>Ctenophorus fordi</i>							+			
Military Dragon	<i>Ctenophorus isolepis</i>		+	+		+	+	+	+		
Central Netted Dragon	<i>Ctenophorus nuchalis</i>			+	+		+		+		
Western Netted Dragon	<i>Ctenophorus reticulatus</i>							+	+		
Salt Pan Dragon	<i>Ctenophorus salinarum</i>				+			+			
Lozenge-marked Dragon	<i>Ctenophorus scutulatus</i>			+				+	+		
Mulga Dragon	<i>Diporiphora amphiboluroides</i>						+	+			
Thorny Devil	<i>Moloch horridus</i>			+				+	+		
Bearded Dragon	<i>Pogona minor</i>			+				+			
Pebble-mimic Dragon	<i>Tympanocryptis pseudopsephos</i>					+	+		+		
Scincidae (skink lizards)											
Fence Skink	<i>Cryptoblepharus buehnanii</i>			+							
	<i>Cryptoblepharus plagioccephalus</i>			+				+			
	<i>Ctenotus ariadnae</i>			+		+		+			
	<i>Ctenotus calurus</i>					+		+			
	<i>Ctenotus grandis</i>			+				+			
	<i>Ctenotus hanloni</i>			+							
	<i>Ctenotus helenae</i>			+		+		+			
Common Desert Ctenotus	<i>Ctenotus leonhardii</i>			+	+	+		+	+		
Leopard Ctenotus	<i>Ctenotus pantherinus</i>			+		+		+			
	<i>Ctenotus quattuordecimlineatus</i>					+		+			
	<i>Ctenotus schomburgkii</i>			+					+		
	<i>Ctenotus uber</i>					+					
Southern Pygmy Spiny-tailed Skink	<i>Egernia depressa</i>			+		+		+	+		
	<i>Egernia formosa</i>					+		+	+		
Broad-banded Sand Swimmer	<i>Eremiascincus richardsonii</i>			+	+	+		+	+		
	<i>Lerista bipes</i>					+		+			
	<i>Lerista desertorum</i>			+	+	+	+	+	+		
	<i>Lerista timida</i>				+	+	?	?	+		
Desert Skink	<i>Liopholis inornata</i>			+		+					
Great Desert Skink	<i>Liopholis kintorei</i>	T								+	
Night Skink	<i>Liopholis striata</i>			+		+					
Dwarf Skink	<i>Menetia greyii</i>			+	+	+		+			
	<i>Morethia butleri</i>			+		+	+	+	+		
Western Blue-tongue	<i>Tiliqua occipitalis</i>			+				+	+		
Centralian Blue-tongue	<i>Tiliqua multifasciata</i>			+		+		+			

Appendix 2. (cont.)

Species	Conservation status	Records								
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	ALA	DBCA	EPBC
Varanidae (goannas)										
Short-tailed Pygmy Monitor <i>Varanus breviceauda</i>							+			
Stripe-tailed Monitor <i>Varanus caudolineatus</i>			+		+		+			
Desert Pygmy Monitor <i>Varanus eremius</i>			+							
Perentie <i>Varanus giganteus</i>			+		+					
Sand Goanna <i>Varanus gouldii</i>			+	+		+	+			
Yellow-spotted Monitor <i>Varanus panoptes</i>			+	+	+	+	+	+		
Black-tailed Tree Monitor <i>Varanus tristis</i>										
Pythonidae (Australian pythons)										
Stimson's Python <i>Antaresia stimsoni</i>				+						
Typhlopidae (blind-snakes)										
Dark-spined Blind Snake <i>Anilius bicolor</i>			+							
Prong-snouted Blind Snake <i>Anilius bituberculatus</i>								+		
<i>Anilius hamatus</i>			+	+			+			
Southern Beaked Blind Snake <i>Anilius waitii</i>				+						
Elapidae (front-fanged snakes)										
Narrow-banded Shovel-nosed Snake <i>Brachyuropsis fasciolatus</i>										
Southern Shovel-nosed Snake <i>Brachyuropsis semifasciatus</i>								+		
Yellow-faced Whipsnake <i>Demansia psammophis</i>										
Moon Snake <i>Furina ornata</i>							+			
Black-naped Snake <i>Neelaps bimaculatus</i>										
Monk Snake <i>Parasuta monarchus</i>					+			+		
Mulga Snake <i>Pseudechis australis</i>							+			
Ringed Brown Snake <i>Pseudonaja modesta</i>			+	+	+	+		+		
Gwardar / Western Brown Snake <i>Pseudonaja mengdeni</i>			+	+	+		+			
Jan's Banded Snake <i>Simoselaps bertholdi</i>			+				+	+		
Rosen's Snake <i>Suta fasciata</i>				+				+		
Number of reptile species predicted:							77			

Appendix 3. Bird Species Recorded or Potentially Occurring in the Study Area

Key to records:

This survey = species recorded in the survey area August 2021.

Yeelirrie Project = species recorded at the Yeelirrie Project, 79km north of the study area, by Bamford Consulting Ecologists (2011).

Bellevue Gold = species recorded at the Bellevue Gold Project, 50km north of the study area, by Bamford Consulting Ecologists (2019).

Mt Keith Project = species recorded at the Mt Keith Project, 79km north of the study area, by Biota (2017, 2006a, 2006b) and/or ATA (2005).

Agnew Gold = species recorded at the Agnew Gold Mine, 8km south of the study area, by Stantec (2018), ENV (2008), Astron (2012), Minesite Rehabilitation Services (2003) and/or Rapallo Environmental (2017).

WAM Goldfields = species recorded in the Sir Samuel-Sandstone and Leonora-Laverton study areas by the WA Museum (Hall *et al.* 1994).

Birdata = species records from the Birdata Database (see Table 2).

ALA = species records from the Atlas of Living Australia Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).

EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).

Species	Conservation status	Records									
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	Birdata	ALA	DBCA	EPBC
Dromaiidae (emus)											
Emu <i>Dromaius novaehollandiae</i>		+	+	+	+	+	+	+	+		
Megapodiidae (mound-builders)											
Malleefowl <i>Leipoa ocellata</i>	T	+	+							+	+
Phasianidae (pheasants and quails)											
Stubble Quail <i>Coturnix pectoralis</i>											
Accipitridae (kites, hawks and eagles)											
Black-shouldered Kite <i>Elanus caeruleus</i>									+		
Square-tailed Kite <i>Hamiostra isura</i>											
Black-breasted Buzzard <i>Hamiostra melanosternon</i>				+					+		
Whistling Kite <i>Haliastur sphenurus</i>			+	+	+	+		+	+		
Black Kite <i>Milvus migrans</i>											
Spotted Harrier <i>Circus assimilis</i>			+				+		+		
Brown Goshawk <i>Accipiter fasciatus</i>					+	+					
Collared Sparrowhawk <i>Accipiter cirrocephalus</i>			+		+		+		+		
Wedge-tailed Eagle <i>Aquila audax</i>			+	+	+	+	+	+	+		
Little Eagle <i>Hieraaetus morphnoides</i>			+		+		+				
Otidae (bustards)											
Australian Bustard <i>Ardeotis australis</i>		+	+				+		+		
Turnicidae (button-quails)											
Little Button-quail <i>Turnix velox</i>											
Burhinidae (stone-curlews)											
Bush Stone-curlew <i>Burhinus grallarius</i>		+	+	+			+				

Appendix 3. (cont.)

Species	Conservation status	Records									
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	Birddata	ALA	DBCA	EPBC
Charadriidae (lapwings and plovers)											
Banded Lapwing <i>Vanellus tricolor</i>			+			+	+		+		
Columbidae (pigeons and doves)											
Common Bronzewing <i>Phaps chalcoptera</i>			+		+	+	+		+		
Crested Pigeon <i>Ocyphaps lophotes</i>			+	+	+	+	+	+	+		
Diamond Dove <i>Geopelia cuneatus</i>				+		+	+		+		
Cuculidae (cuckoos)											
Pallid Cuckoo <i>Cacomantis pallidus</i>			+		+		+	+	+		
Black-eared Cuckoo <i>Chalcites osculans</i>									+		
Horsfield's Bronze-Cuckoo <i>Chalcites basalus</i>			+		+		+		+		
Tytonidae (barn owls)											
Eastern Barn Owl <i>Tyto javanica</i>									+		
Strigidae (hawk-owls)											
Southern Boobook Owl <i>Ninox boobook</i>			+						+		
Podargidae (frogmouths)											
Tawny Frogmouth <i>Podargus strigoides</i>			+		+		+	+	+		
Caprimulgidae (nightjars)											
Spotted Nightjar <i>Eurostopodus argus</i>			+						+		
Aegothelidae (owlet-nightjars)											
Australian Owlet-Nightjar <i>Aegotheles cristatus</i>			+		+		+		+		
Apodidae (swifts)											
Fork-tailed Swift <i>Apus pacificus</i>	Mi									+	
Alcedinidae (forest kingfishers)											
Red-backed Kingfisher <i>Todiramphus pyrrhopygius</i>			+	+	+	+	+		+		
Sacred Kingfisher <i>Todiramphus sanctus</i>		+				+					
Meropidae (bee-eaters)											
Rainbow Bee-eater <i>Merops ornatus</i>			+	+	+	+					
Falconidae (falcons)											
Grey Falcon <i>Falco hypoleucos</i>	T										+
Peregrine Falcon <i>Falco peregrinus</i>	OS		+							+	
Australian Hobby <i>Falco longipennis</i>			+	+		+	+		+		
Brown Falcon <i>Falco berigora</i>			+	+	+	+	+		+		
Australian Kestrel <i>Falco cenchroides</i>			+	+	+	+	+	+	+		
Cacatuidae (cockatoos)											
Galah <i>Eolophus roseicapilla</i>			+		+	+	+		+		
Cockatiel <i>Nymphicus hollandicus</i>			+		+	+	+	+	+		

Appendix 3. (cont.)

Species	Conservation status	Records										
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	Birddata	ALA	DBCA	EPBC	
Psittacidae (lorikeets & parrots)												
Night Parrot	T										+	
Budgerigah			+		+		+		+			
Bourke’s Parrot							+		+			
Elegant Parrot			+									
Scarlet-chested Parrot												
Princess Parrot	T									+	+	
Australian Ringneck			+	+	+	+	+		+			
Mulga Parrot			+	+	+	+	+		+			
Ptilonorhynchidae (bowerbirds)												
Western Bowerbird			+	+	+	+	+		+			
Climacteridae (treecreepers)												
White-browed Treecreeper					+		+		+			
Maluridae (fairy-wrens)												
Striated Grasswren	P	+					+			+		
Splendid Fairy-wren			+	+	+	+			+			
Variegated Fairy-wren			+	+	+	+	+		+			
White-winged Fairy-wren			+	+	+	+	+	+	+			
Meliphagidae (honeyeaters)												
Black Honeyeater					+		+					
Red Wattlebird								+	+			
Spiny-cheeked Honeyeater			+	+	+	+	+	+	+			
Yellow-throated Miner		+	+	+	+	+	+	+	+			
Singing Honeyeater			+	+	+		+	+	+			
White-plumed Honeyeater			+	+	+		+	+	+			
Grey-fronted Honeyeater		+			+				+			
Brown Honeyeater			+	+		+	+	+	+			
White-fronted Honeyeater			+		+	+	+		+			
Pied Honeyeater					+	+	+		+			
Grey Honeyeater					+							
Crimson Chat			+	+		+	+		+			
Orange Chat								+				
Pardalotidae (pardalotes)												
Red-browed Pardalote												
Striated Pardalote			+		+	+	+		+			

Appendix 3. (cont.)

Species	Conservation status	Records									
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	Birdata	ALA	DBCA	EPBC
Acanthizidae (thornbills, gerygones & allies)											
Rufous Fieldwren	<i>Calamanthus campestris</i>								+		
Redthroat	<i>Pyrholaemus brunneus</i>	+	+	+				+	+		
Weebill	<i>Smicrornis brevirostris</i>	+	+		+	+	+	+	+		
Western Gerygone	<i>Gerygone fusca</i>		+			+			+		
Inland Thornbill	<i>Acanthiza apicalis</i>		+	+	+	+	+	+	+		
Slender-billed Thornbill	<i>Acanthiza iredalei</i>					+					
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>		+	+	+	+	+		+		
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		+	+	+	+	+		+		
Slaty-backed Thornbill	<i>Acanthiza robustirostris</i>		+		+		+	+	+		
Southern Whiteface	<i>Aphelocephala leucopsis</i>		+	+	+	+	+		+		
Pomatostomidae (Australian babblers)											
White-browed Babbler	<i>Pomatostomus superciliosus</i>	+	+	+	+	+	+	+	+		
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>		+	+	+	+			+		
Psophodidae (whipbirds, wedgebills and quail-thrush)											
Western Quail-thrush	<i>Cinclosoma marginatum</i>		+	+			+	+	+		
Chestnut (Copper-back) Quail-Thrush	<i>Cinclosoma clarum</i>				+						
Western Wedgebill	<i>Psophodes occidentalis</i>				+				+		
Artamidae (woodswallows)											
Masked Woodswallow	<i>Artamus personatus</i>		+		+	+	+		+		
Black-faced Woodswallow	<i>Artamus cinereus</i>	+	+	+	+	+	+	+	+		
Little Woodswallow	<i>Artamus minor</i>			+	+	+	+		+		
Cracticidae (butcherbirds, currawongs & magpie)											
Grey Butcherbird	<i>Cracticus torquatus</i>	+	+	+	+	+	+	+	+		
Pied Butcherbird	<i>Cracticus nigrogularis</i>	+	+	+	+	+	+	+	+		
Australian Magpie	<i>Gymnorhina tibicen</i>		+	+	+	+	+	+	+		
Grey Currawong	<i>Strepera versicolor</i>		+		+	+	+		+		
Campephagidae (cuckoo-shrikes and trillers)											
Ground Cuckoo-shrike	<i>Coracina maxima</i>		+	+	+		+		+		
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		+	+	+	+	+	+	+		
White-winged Triller	<i>Lalage tricolor</i>		+		+		+		+		
Neosittidae (sittellas)											
Varied Sittella	<i>Daphoenositta chrysoptera</i>		+				+		+		
Oreoicidae (bellbird)											
Crested Bellbird	<i>Oreoica gutturalis</i>	+	+	+	+	+	+	+	+		
Pachycephalidae (whistlers)											
Rufous Whistler	<i>Pachycephala rufiventris</i>	+	+	+	+	+	+		+		
Grey Shrike-thrush	<i>Colluricincla harmonica</i>		+	+	+	+	+		+		

Appendix 3. (cont.)

Species	Conservation status	Records							
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	Birdata	ALA DBCA EPBC
Rhipiduridae (wagtails and fantails)									
Grey Fantail <i>Rhipidura albiscapa</i>			+					+	+
Willie Wagtail <i>Rhipidura leucophrys</i>		+	+	+	+	+	+	+	
Monarchidae (monarchs and flycatchers)									
Magpie-lark <i>Grallina cyanoleuca</i>			+	+	+	+	+	+	
Corvidae (ravens and crows)									
Australian Raven <i>Corvus coronoides</i>					+	+		+	
Little Crow <i>Corvus bennetti</i>		+	+	+	+	+	+	+	
Torresian Crow <i>Corvus orru</i>			+	+	+	+	+	+	
Petroicidae (Australian robins)									
Jacky Winter <i>Microeca fascians</i>			+				+		
Hooded Robin <i>Melanodryas cucullata</i>			+	+	+	+	+	+	
Red-capped Robin <i>Petroica goodenovii</i>			+	+	+	+	+	+	
Hirundinidae (swallows)									
White-backed Swallow <i>Cheramoeca leucosterna</i>			+	+		+	+	+	+
Fairy Martin <i>Hirundo ariel</i>			+	+	+			+	
Welcome Swallow <i>Hirundo neoxena</i>			+	+	+	+	+	+	
Tree Martin <i>Petrochelidon nigricans</i>			+		+	+	+	+	
Locustellidae (Old World warblers, songlarks & grassbirds)									
Brown Songlark <i>Cincloramphus cruralis</i>							+		+
Rufous Songlark <i>Cincloramphus mathewsi</i>					+		+	+	
Dicaeidae (flower-peckers)									
Mistletoebird <i>Dicaeum hirundinaceum</i>			+		+	+	+	+	
Estrildidae (finches)									
Zebra Finch <i>Taeniopygia gutatta</i>			+	+	+	+	+	+	
Motacillidae (pipits and true wagtails)									
Australian Pipit <i>Anthus australis</i>			+	+	+	+	+	+	
Number of bird species predicted:		115							

Appendix 4. Mammal Species Recorded or Potentially Occurring in the Study Area

Key to records:

This survey = species recorded in the survey area August 2021.

Yeelirrie Project = species recorded at the Yeelirrie Project, 79km north of the study area, by Bamford Consulting Ecologists (2011).

Bellevue Gold = species recorded at the Bellevue Gold Project, 50km north of the study area, by Bamford Consulting Ecologists (2019).

Mt Keith Project = species recorded at the Mt Keith Project, 79km north of the study area, by Biota (2017, 2006a, 2006b) and/or ATA (2005).

Agnew Gold = species recorded at the Agnew Gold Mine, 8km south of the study area, by Stantec (2018), ENV (2008), Astron (2012), Minesite Rehabilitation Services (2003) and/or Rapallo Environmental (2017).

WAM Goldfields = species recorded in the Sir Samuel-Sandstone and Leonora-Laverton study areas by the WA Museum (Hall *et al.* 1994).

ALA = species records from the Atlas of Living Australia Database (see Table 2).

DBCA = species records from the DBCA Threatened and Priority Species Database (see Table 2).




EPBC = species & species habitat from the EPBC Protected Matters Search Tool (see Table 2).




Species	Conservation status	Records								
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	ALA	DBCA	EPBC
Tachyglossidae (echidnas)										
Echidna <i>Tachyglossus aculeatus</i>		+	+	+	+	+	+			
Dasyuridae (carnivorous marsupials)										
Kultarr <i>Antechinomys laniger</i>							+	+		
Brush-tailed Mulgara <i>Dasyercus blythi</i>	P	+	+		+				+	
Chuditch <i>Dasyurus geoffroii</i>	T									+
Wongai Ningau <i>i</i>			+		+		+	+		
Woolley’s False Antechinus <i>Pseudantechinus woolleyae</i>			+				+	+		
Fat-tailed Dunnart <i>Sminthopsis crassicaudata</i>					+		+			
Little Long-tailed Dunnart <i>Sminthopsis dolichura</i>					+	+		+		
Hairy-footed Dunnart <i>Sminthopsis hirtipes</i>			+				+			
Long-tailed Dunnart <i>Sminthopsis longicaudata</i>	P								+	
Stripe-faced Dunnart <i>Sminthopsis macroura</i>			+		+	+	+	+		
Ooldea Dunnart <i>Sminthopsis ooldea</i>			+				+			
Macropodidae (kangaroos and wallabies)										
Euro <i>Osphranter robustus</i>			+	+	+	+	+	+		
Red Kangaroo <i>Osphranter rufus</i>		+	+	+		+	+			
Western Grey Kangaroo <i>Macropus fuliginosus</i>						+				
Muridae (rodents)										
House Mouse <i>Mus musculus</i>	Int.		+		+		+	+		
Spinifex Hopping Mouse <i>Notomys alexis</i>		+	+			+	+			
Bolam’s Mouse <i>Pseudomys bolami</i>					+					
Desert Mouse <i>Pseudomys desertor</i>					+					
Sandy Inland Mouse <i>Pseudomys hermannsburgensis</i>					+		+	+		
Emballonuriidae (sheathtail bats)										
Yellow-bellied Sheathtail Bat <i>Saccolaimus flaviventris</i>			+							
Hill’s Sheathtail Bat <i>Taphozous hilli</i>						+				




Appendix 4. (cont.)




Species	Conservation status	Records								
		This survey	Yeelirrie Project	Bellevue Gold	Mt Keith Project	Agnew Gold	WAM Goldfields	ALA	DBCA	EPBC
Molossidae (free-tailed bats)										
White-striped Free-tailed Bat <i>Austronomus australis</i>			+	+		+	+			
Inland Free-tailed Bat <i>Ozimops petersi</i>			+	+		+	+			
Vespertilionidae (evening bats)										
Gould's Wattled Bat <i>Chalinolobus gouldii</i>	P		+	+		+	+			
Chocolate Wattled Bat <i>Chalinolobus morio</i>						+				
Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>			+	+		+	+	+		
Central Long-eared Bat <i>Nyctophilus major tor</i>			+							
Inland Broad-nosed Bat <i>Scotorepens balstoni</i>			+		+	+	+			
Inland Forest Bat <i>Vespadelus baverstocki</i>			+							
Findlayson’s Cave Bat <i>Vespadelus findlaysoni</i>			+	+		+	+			
Canidae (dogs & foxes)										
Dingo/Dog <i>Canis familiaris dingo/familiaris</i>	Int.	+	+	+		+				
Fox <i>Vulpes vulpes</i>	Int.		+				+			
Felidae (cats)										
Feral Cat <i>Felis catus</i>	Int.		+	+		+	+			
Camelidae (camels)										
Dromedary Camel <i>Camelus dromedarius</i>	Int.		+				+			
Bovidae (goats & cows)										
Cow <i>Bos taurus</i>	Int.	+		+		+	+			
Sheep <i>Ovis aries</i>	Int.						+			
Goat <i>Capra hircus</i>	Int.					+				
Leporidae (rabbits)										
European Rabbit <i>Oryctolagus cuniculus</i>	Int.		+	+		+	+			
Number of mammal species predicted:		30 native, 9 introduced								




Appendix 5. Habitat Assessment Sites.




Appendix 5 – Habitat Assessment Sites.	
<p>Tb01</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: undulating plain</p> <p>Vegetation: Open mulga woodland with scattered tall eucalypts over open Eremophila shrubland and spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sandy loam</p> <p>Rock: none</p> <p>Important elements: tree hollows, leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb02</p> <p>Habitat: Mulga drainage</p> <p>Landform: broad drainage channel</p> <p>Vegetation: Tall, dense Mulga woodland over open Acacia and Eremophila shrubland over sparse tussock grasses.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: Cattle</p> <p>Soil: orange hardpan</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: seasonal or ephemeral drainage channel.</p>	
<p>Tb03</p> <p>Habitat: Mulga drainage</p> <p>Landform: undulating plain</p> <p>Vegetation: Open woodland of Mulga and Acacia over open Eremophila shrubland over tussock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: orange hardpan</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	

Appendix 5 – Habitat Assessment Sites.	
<p>Tb04</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: undulating plain</p> <p>Vegetation: Mulga woodland with occasional mallee eucalypt over spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb05</p> <p>Habitat: Sandplain</p> <p>Landform: low rise</p> <p>Vegetation: Open eucalypt woodland over open shrubland of Acacia and Eremophila over spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: tree hollows, leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb06</p> <p>Habitat: Sandy rise</p> <p>Landform: low rise</p> <p>Vegetation: Open eucalypt woodland over open shrubland of Acacia and Eremophila over spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	

Appendix 5 – Habitat Assessment Sites.	
<p>Tb07</p> <p>Habitat: Sandy rise</p> <p>Landform: low rise</p> <p>Vegetation: Open mallee eucalypt woodland over open shrubland of Acacia over a mix of Aluta shrubland and spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: tree hollows, leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb08</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: plain</p> <p>Vegetation: Mulga woodland with scattered mallee eucalypts over open Acacia and Eremophila shrubland over sparse tussock grasses.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: orange sandy loam</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb09</p> <p>Habitat: Sand dune</p> <p>Landform: dune</p> <p>Vegetation: Open shrubland of Acacia and Eremophila over a mix of Aluta shrubland and spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	

Appendix 5 – Habitat Assessment Sites.	
<p>Tb10</p> <p>Habitat: Sand dune</p> <p>Landform: slope</p> <p>Vegetation: Occasional mulga and mallee eucalypts over a mix of Aluta shrubland and spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb11</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: plain</p> <p>Vegetation: Mulga woodland over open Acacia and Eremophila shrubland over sparse tussock grass and spinifex.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: Orange hardpan</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb12</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: plain</p> <p>Vegetation: Mulga woodland with scattered mallee eucalypts over open Acacia and Eremophila shrubland over sparse tussock grass and spinifex.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: orange sandy loam</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	

Appendix 5 – Habitat Assessment Sites.	
<p>Tb13</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: plain</p> <p>Vegetation: Mulga shrubland with occasional mallee eucalypt over shrubland of Eremophila and Acacia over spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: orange sandy loam</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb14</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: plain</p> <p>Vegetation: Mulga woodland with scattered eucalypts over low shrubs on spinifex.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sandy loam</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb15</p> <p>Habitat: Mulga Sandplain</p> <p>Landform: plain</p> <p>Vegetation: Open low acacia shrubland with scattered mallee eucalypts over spinifex hummock grassland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	

Appendix 5 – Habitat Assessment Sites.	
<p>Tb16</p> <p>Habitat: Sand dune</p> <p>Landform: dune</p> <p>Vegetation: Open low acacia shrubland.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: leaf litter, woody debris.</p> <p>Wetlands: none</p>	
<p>Tb17</p> <p>Habitat: Sand dune</p> <p>Landform: dune</p> <p>Vegetation: Scattered mallee eucalypts over spinifex and sparse tussock grasses.</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: none noted.</p> <p>Wetlands: none</p>	
<p>Tb18</p> <p>Habitat: Mulga Drainage</p> <p>Landform: flat</p> <p>Vegetation: Dense mulga and acacia shrubland</p> <p>Fire age: no evidence of recent fire</p> <p>Disturbance: none noted</p> <p>Soil: red sand</p> <p>Rock: none</p> <p>Important elements: Dense vegetation.</p> <p>Wetlands: none</p>	

Appendix 6. EPBC Act Protected Matters Search Tool Results

Fauna species listed for the study area with a 5km buffer, excluding marine species.

Species	EPBC Act Status	Type of Presence
Night Parrot <i>Pezoporus occidentalis</i>	Endangered	Species or species habitat MAY occur within area
Malleefowl <i>Leipoa ocellata</i>	Vulnerable	Species or species habitat LIKELY to occur within area
Grey Falcon <i>Falco hypoleucos</i>	Vulnerable	Species or species habitat MAY occur within area
Princess Parrot <i>Polytelis alexandrae</i>	Vulnerable	Species or species habitat MAY occur within area
Chuditch <i>Dasyurus geoffroii</i>	Vulnerable	Species or species habitat MAY occur within area
Grey Wagtail <i>Motacilla cinerea</i>	Migratory (terrestrial)	Species or species habitat MAY occur within area
Yellow Wagtail <i>Motacilla flava</i>	Migratory (terrestrial)	Species or species habitat MAY occur within area
Common Sandpiper <i>Actitis hypoleucos</i>	Migratory (wetland)	Species or species habitat MAY occur within area
Sharp-tailed Sandpiper <i>Calidris acuminata</i>	Migratory (wetland)	Species or species habitat MAY occur within area
Pectoral Sandpiper <i>Calidris melanotos</i>	Migratory (wetland)	Species or species habitat MAY occur within area
Oriental Plover <i>Charadrius veredus</i>	Migratory (wetland)	Species or species habitat MAY occur within area

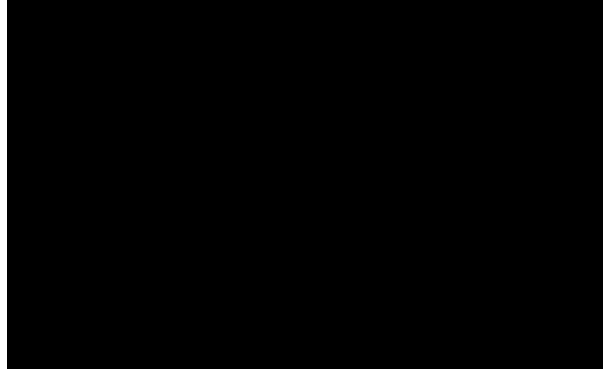
**APPENDIX 4: SHORT RANGE ENDEMIC FAUNA
DESKTOP ASSESSMENT (INVERTEBRATE SOLUTIONS,
2022)**

Desktop assessment for Short Range Endemic Fauna for Sand and Gravel Pits – Comet Vale, Mt Keith, Thunderbox and Jonah Bore, Northern Goldfields, Western Australia.



Report by *Invertebrate Solutions Pty Ltd*
for MLG OZ Ltd

May 2022



Invertebrate Solutions. (2022). Desktop assessment for Short Range Endemic Fauna for Sand and Gravel Pits – Comet Vale, Mt Keith, Thunderbox and Jonah Bore, Northern Goldfields, Western Australia. Unpublished report to MLG OZ Ltd, May 2022.

Report Number 2021ISJ13_F01_20220505

Prepared for: MLG OZ Ltd

Frontispiece: The widespread mygalomorph spider *Gaius austini* from the Goldfields area

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Executive Summary

MLG Oz Ltd (MLG) is proposing to develop a series of four separate sand and gravel pits (the Project) located in the northern Goldfields region of Western Australia. MLG proposes to extract sand and gravel from the four deposits for industrial use. The four projects to be assessed for SRE invertebrates are:

- Comet Vale E297/42 – 21km SW of Menzies
- Mt Keith E53/1480 – 62 km SE of Wiluna
- Thunderbox E36/1003 – 12 km SE of Leinster
- Jonah Bore M36/657 – 25 km W of Leinster

Invertebrate Solutions has been requested by MLG to undertake a desktop assessment for Short Range Endemic (SRE) invertebrates for the Sand and Gravel Pit Project. The assessment is required to support environmental approvals under Commonwealth and State legislation. Due to the disparate nature of the four Project areas throughout the Northern Goldfields region, two separate Desktop Study areas (Northern and Southern) were searched for potential SRE species to determine the potential likelihood of SRE species being present within each individual Project area.

The Project areas within the Northern Desktop Study Area contain no known Confirmed SRE species, six Likely SRE species and 55 Possible SRE species. The Likely species are summarised below:

- Two slaters (*Acanthodillo* sp.'7' and *Buddelundia* sp.'45') – Likely SRE species
- Two Idiopid trapdoor spiders (*Kwonkan goongarriensis* and *K. moriartii*) – Likely SRE species
- Two millipedes (*Antichiropus* 'DIP002' and *Antichiropus* 'DIP003') – Likely SRE species

The Southern Desktop Study Area contains no known Confirmed SRE species, one Likely SRE species and four Possible SRE species:

- One anamid trapdoor spider (*Kwonkan goongarriensis*) – Likely SRE species

The remaining species identified from desktop resources were found to be widespread. Species that are considered to be Possible SREs is related to incomplete taxonomy or distributional data where survey data is inadequate to provide meaningful further comment on the species.

An additional conservation significant invertebrate (widespread, non-SRE species), was identified in the desktop assessment as having a Moderate likelihood of occurrence in the Thunderbox and Comet Vale Project areas:

- A mygalomorph spider – *Idiosoma clypeatum* - DBCA Priority 3

Whilst some Likely and Possible SRE species occur near the four Project areas, it should, however, be noted that all SRE habitat identified within the Project areas is not restricted in nature and occurs in adjoining land. No SRE or conservation significant terrestrial invertebrates are anticipated to be restricted to any of the four Project areas, due to the homogenous habitat present in the region and the very small extent of the Project areas themselves.

No survey work is required in order to meet the requirements for EPA technical guidance Sampling of short range endemic invertebrate fauna (EPA) 2016.

1. Introduction

MLG Oz Ltd (MLG) is proposing to develop a series of four separate sand and gravel pits (the Project) located in the northern Goldfields region of Western Australia. MLG proposes to extract sand and gravel from the four deposits for industrial use. Invertebrate Solutions Pty Ltd (Invertebrate Solutions) has been requested by MLG to undertake a desktop assessment for Short Range Endemic (SRE) invertebrates for the four Sand and Gravel Pit locations. The assessment is required to support environmental approvals under Commonwealth and State legislation.

The four projects to be assessed for SRE invertebrates are:

- Comet Vale E297/42 – 21km SW of Menzies
- Mt Keith E53/1480 – 62 km SE of Wiluna
- Thunderbox E36/1003 – 12 km SE of Leinster
- Jonah Bore M36/657 – 25 km W of Leinster

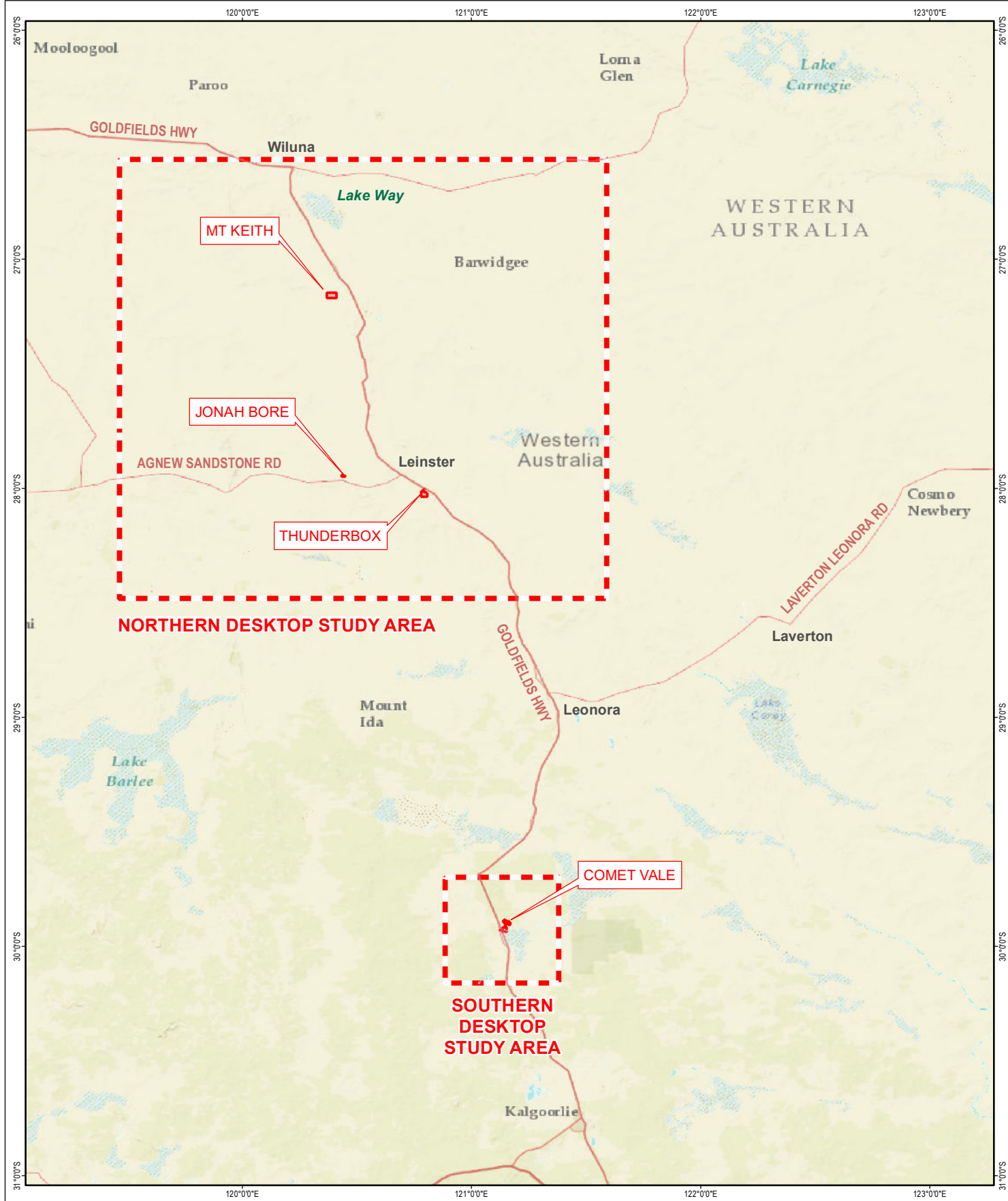
SRE invertebrates occur within terrestrial habitats and possess naturally restricted ranges and poor dispersal capabilities. The high degrees of local endemism and lack of habitat connectivity makes SRE fauna susceptible to high level impacts from localised projects, with species' extinction a real possibility if they are not adequately considered during project planning phases.

1.1 Purpose of this report



Invertebrate Solutions has been requested by Blueprint Environmental Strategies on behalf of MLG to undertake the following scope of works within the four MLG project areas, Western Australia:

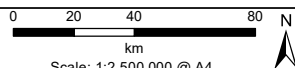
- Undertake a desktop assessment for short range endemic (SRE) invertebrates to determine known SRE fauna in the area, as well as habitats in which they likely occur.
- A summary of the invertebrate fauna (SRE and conservation significant) of the four desktop assessment areas and the likelihood of occurrence of such fauna and their conservation values in the context of the proposed sand and gravel mines for each of the four areas individually;
- Provide recommendations and any suggested requirements for further work to comply with relevant legislation.
- Provide a written report containing the above items.

The desktop assessment will be undertaken with regard to Technical Guidance Sampling of short range endemic invertebrate fauna (EPA 2016).



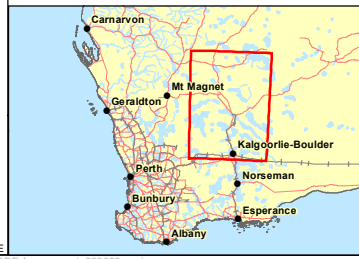
Legend

-  Desktop Study Area
-  Project Area



- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP





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PROJECT ID	DATE
SRE Assessment of Sand & Gravel Pits	29/03/2022
HORIZONTAL DATUM AND PROJECTION	
GCS GDA 1994	

CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

MLG Oz Ltd

Figure 1
Desktop Study Areas and
Project Areas for SRE Assessment

1.2 Project Area and Desktop Study Area

The four Project areas are located throughout the Northern Goldfields region of Western Australia and are shown in Figure 1. Due to the disparate nature of the four sites, two separate Desktop Study areas (Northern and Southern) were searched for potential SRE species to determine the potential likelihood of SRE species being present within each individual site. The Desktop Study areas are centred on the project areas and were used for the purposes of database searches and relevant literature (Figure 1).

The Northern Desktop Study area (~4.3 million Ha), is bounded by the north west corner (26.565274°S, 119.464898°E) and the south east corner (28.480838°S, 121.591088°E) and encompasses the Mt Keith, Thunderbox and Jonah Bore sites.

The Southern Desktop Study area (~250,000 Ha), is bounded by the north west corner (29.696918°S, 120.883626°E) and the south east corner (30.159383°S, 121.379448°E) and encompasses the Comet Vale site.

1.3 Introduction to SRE fauna

Short range endemic (SRE) invertebrates are species with restricted distributions. The isolation of invertebrates in specific habitats or bioregions leads to endemism at various spatial scales. The vast majority of invertebrates are capable of dispersing substantial distances at some phase of their life cycle. Some groups, however, are susceptible to short-range endemism which describes endemic species with restricted ranges, arbitrarily defined in Western Australia as less than 10,000 km² (100 km x 100 km) (Harvey, 2002). Taxa that have been more commonly found to contain SRE representatives include:

- Onychophorans (velvet worms);
- Crustaceans (Isopoda);
- Arachnids (mygalomorph spiders, pseudoscorpions, opiliones, scorpions, schizomids);
- Myriapods (millipedes and centipedes);
- Molluscs (land snails); and
- Insects (hemipterans, grasshoppers, butterflies).

SRE invertebrate fauna taxa are generally found in sheltered, relatively mesic environments such as isolated habitats (e.g. boulder piles, isolated hills, dense patches of vegetation, gullies) and can include microhabitats within these environments such as deep leaf litter accumulation, large logs, under bark, cave areas, springs and permanent water bodies.

Many processes contribute to taxa being susceptible to short range endemism. Generally, these factors are related to the isolation of a species which can include the ability and opportunity to disperse, life history, physiology, habitat requirements, and habitat availability. Taxa that exhibit short range endemism generally exhibit poor dispersal, low growth rates, low fecundity and reliance on habitat types that are discontinuous (Harvey, 2002). Taxa that reside within easily isolated habitats surrounded by physical barriers such as islands, mountains, aquifers, lakes and caves are also more susceptible to becoming SRE species often including additional taxa not otherwise generally forming SREs.

Taxa that exhibit short range endemism are particularly vulnerable to disturbance, either natural or anthropogenic, as they are reliant upon specialised and often restricted habitats (often moist) (Framenau, *et al.*, 2008). Short range endemic taxa are unable to disperse to *refugia* when their habitats are threatened or destroyed, thus making them a priority for conservation efforts.

The allocation of short range endemism status can be difficult due to the often incomplete taxonomic framework of many invertebrate groups and the often frequent need for substantial revision to enable accurate identification. Short Range Endemic status is assigned using the categories described in Table 1, based upon the available information from the Western Australian Museum (WAM) database and discussion with appropriate taxonomic authorities for various invertebrate groups. Insufficient information exists for many invertebrate species due to specimens being juvenile, the wrong sex to allow identification, damaged, or inadequate taxonomic frameworks, precluding the assignment of SRE status.

Table 1 Short Range Endemic Status of Species

SRE Status	Definition
Confirmed	A confirmed SRE species. A known distribution of < 10,000 km ² (after Harvey 2002). Taxonomy of the group is well known. The group is well represented in collections, or via comprehensive sampling.
Likely	Likely to be a SRE species based upon knowledge of the family/genus, where other closely related species show evidence of short range endemism. Where habitats containing the specimens show discontinuity within the landscape.
Possible	Based upon existing knowledge of the genus / family there is a possibility that the species may have a restricted range. Where habitats containing the specimens may show discontinuity within the landscape. Possible SRE species may be assigned one of the sub categories below: <ul style="list-style-type: none"> A. Data deficient i.e. new species, lack of distribution, taxonomic or collecting knowledge, juvenile specimens, wrong sex for identification B. Habitat indicators C. Morphology indicators D. Molecular evidence E. Research and expertise of WAM staff/taxonomic specialists
Widespread	Not a SRE, a wide ranging distribution of > 10,000 km ²

1.4 Conservation Legislation and Guidance Statements

Terrestrial SRE species are protected under state legislation via the newly enacted *Biodiversity Conservation Act 2016* (BC Act) which came into force on 1st January 2019, replacing the outdated *Wildlife Conservation Act 1950*. The new BC Act is aligned with the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment of SRE fauna for environmental impact assessment (EIA) is undertaken in Western Australia with regard to Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

At the State level, the BC Act provides a list of species that have special protection as species listed under Part 2 of BC Act. This notice is updated periodically by the Department of Biodiversity,

Conservation and Attractions (DBCA) (formerly the Department of Parks and Wildlife (DPaW)) and the current list (November 2019) includes numerous SRE species from the Wheatbelt, South Coast, Murchison and Pilbara regions. Included in the list are crustaceans, arachnids and myriapods that are considered to be “rare or likely to become extinct, as critically endangered fauna, or are declared to be fauna that is in need of special protection” (DPaW 2019). In addition to the specially protected fauna, DBCA also maintains a list of Priority fauna that are considered to be of conservation significance but do not meet the criteria for formal listing under the BC Act. The Priority fauna list is irregularly updated by DBCA and is now part of the BC Act.

The BC Act now provides the ability for the state government of Western Australia to formally list Threatened Ecological Communities (TECs), along with threatening processes.

The federal EPBC Act protects both species and ecological communities. The most relevant Western Australian listing for SRE fauna is the mygalomorph spider *Idiosoma nigrum* that only occurs in the northern Wheatbelt region and is listed as Vulnerable.

1.5 Report Limitations and Exclusions

This study was limited to the written scope provided to the client by Invertebrate Solutions (5th August 2021) and in Section 1.1. This study was limited to the extent of information made available to Invertebrate Solutions at the time of undertaking the work. Information not made available to this study, or which subsequently becomes available may alter the conclusions made herein. Assessment of potential impacts to SRE fauna was based on proposed development plans provided by the client.

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by Invertebrate Solutions described in this report (this section and throughout this report). Invertebrate Solutions disclaims liability arising from any of the assumptions being incorrect.

Invertebrate Solutions has prepared this report on the basis of information provided by MLG Oz Ltd and others (including Government authorities), which Invertebrate Solutions has not independently verified or checked beyond the agreed scope of work. Invertebrate Solutions does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

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

Short Range Endemic status was assigned using the available information from the WAM database and discussion with appropriate taxonomic authorities for various invertebrate groups. Insufficient information exists for many invertebrate species due to specimens being juvenile, the wrong sex to allow identification, damaged, or inadequate taxonomic frameworks, precluding the assignment of SRE status.

2. Methods

Invertebrate Solutions undertook the following tasks for the desktop SRE assessment survey of the Project area:

- SRE desktop assessment based upon Western Australian Museum Records and previous survey reports.

The desktop assessment was undertaken with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

2.1 SRE Desktop Methodology

The likelihood of SRE invertebrate species occurring in the Desktop Study Area was assessed using a combination of regional and local botanical and landform information and database searches including:

- Analysis of published and unpublished reports concerning SRE invertebrate from the region.
- Botanical and vegetation mapping and other information available for the Study Area.
- A field survey of the Project area informed the initial Desktop Likelihood of occurrence.
- Results of a Protected Matters Search from the Federal Government's Department of Agriculture, Water and the Environment (DAWE) website.
- Records of fauna held by the WAM.

When considering the likelihood of SRE invertebrates at the local scale the Project area was specifically investigated whilst assessments at the regional scale included the entire Northern Goldfields. Based on the analysis of all available information the Desktop Study Area was assigned a level of likelihood to support SRE invertebrates of either 'Very Low', 'Low', 'Moderate', 'High', or 'Definite' (Table 2).

The likelihood that a particular vegetation unit or habitat type potentially contains or supports SRE species is defined in Table 3.

2.2 Short Range Endemic Status

Taxonomic groups known to contain SRE representatives were examined in more detail to determine if the specimens collected in this study are potentially restricted forms. SRE status will be assigned after comparison with the morphology of other close relatives in the group and current knowledge on their distribution and ecology, where known.

Table 2 SRE species likelihood of occurrence definitions

SRE Species Likelihood of occurrence	Definition
Definite	The species is confirmed to occur within the Project area.
High	Habitat for the species is known to occur within the Project area and known records of the species are within 20 km.
Moderate	Habitat for the species is known to occur within the Project area and known records of the species are within 50 km.
Low	The species has been recorded from within 50 km, however, no habitat is present for the species within the Project area.
Very low	No habitat exists for the species within the Project area and no records of the species are within 50 km or the distribution of the species is known well enough to exclude its presence within the Project area.

Table 3 SRE habitat suitability definitions

SRE habitat Likelihood of occurrence	Definition
High	The habitat has a High likelihood of containing SRE species as it has at least three microhabitat factors that support the presence of SRE species such as: SE facing slopes, moisture, rocky areas, habitat isolates, deep leaf litter, mountainous areas, deep gullies or gorges, riparian vegetation, or habitats known to contain SRE species.
Moderate	The habitat has a Moderate likelihood of containing SRE species as it has at least two microhabitat factors that support the presence of SRE species such as: SE facing slopes, moisture, rocky areas, habitat isolates, deep leaf litter, mountainous areas, deep gullies or gorges, riparian vegetation or habitats known to contain SRE species.
Low	The habitat has a Low likelihood of containing SRE species as it has only a single microhabitat factor that support the presence of SRE species such as: SE facing slopes, moisture, rocky areas, habitat isolates, deep leaf litter, mountainous areas, deep gullies or gorges, riparian vegetation or habitats known to contain SRE species.
Nil	No potential habitat exists for SRE species within the vegetation type / condition area. This includes areas that are totally cleared, completely degraded or urbanised. This also includes areas that are dominated by weeds or exotic vegetation species.

3. Results

3.1 SRE Invertebrates of the Goldfields region

Whilst there are limited systematic surveys for SRE species close to the Project Areas there are several studies from the region for various resources projects. One of the closest projects to be completed recently is at the Mt Keith satellite mine expansion project (MWH 2016) south of Leinster. This comprised of multiple survey seasons and included the Mt Keith disturbance footprint as well the adjacent Wanjarri Nature Reserve. The surveys recorded over 1,500 specimens representing 49 taxa, however, only two species were considered by experts as Confirmed SRE species, four as Likely SRE species and 23 as Potential SRE species.

A SRE assessment was undertaken at Lake Wells in 2018 that lies to the east of the Northern Desktop Study area (Bennelongia 2018). This survey identified seven different habitats that were investigated for potential SRE species, however, most were considered to have a Low likelihood of containing SRE species. The field survey identified 38 taxa with potential to be SRE species from groups including mygalomorph spiders, pseudoscorpions, millipedes, scorpions, isopods and land snails. The most prospective habitat for SRE species were the gypsum dunes with some taxa only recorded in this habitat, however, the extent of this habitat is large and no taxa were anticipated to be restricted to the Project area (Bennelongia 2018).

A comprehensive SRE survey was undertaken for the Tropicana Gold Project (Ecologia 2009) located approximately 330 km to the north east of Kalgoorlie between 2006 and 2008 using pitfall traps and active searching. The surveys recorded 46 potential SRE species from within the Tropicana Project area, with three confirmed SRE mygalomorph spiders being recorded only from within proposed impact areas (Ecologia 2009). The habitat for these species was found to be more widespread than the proposed impacts although a monitoring program was initiated to ensure these species were not significantly impacted (EPA 2010).

A baseline survey for SRE invertebrates in the Northern goldfields was undertaken on Cashmere Downs station for Cashmere Iron in 2010. This survey used a wide variety of different trapping techniques to record several likely SRE species including *Antichiropus* millipedes and mygalomorph trapdoor spiders (GHD 2010). No species were found to be restricted to proposed impact areas.

More widely within the greater Goldfields and Yilgarn areas comprehensive SRE surveys have been undertaken at the Gruyere Gold Project located approximately 100 km to the north east of Laverton. The survey recorded 20 taxa with the potential to contain SRE species, of which eight were determined to be Potential SRE species and the other 12 were found to be widespread (Harewood 2016, Framenau 2015, Volschenk 2015). The Potential SRE species included two species of scorpion, four species of spider, one species of isopod and one species of centipede (Harewood 2016).

Habitats within the wider Goldfields and Yilgarn area that are considered prospective for SRE invertebrates include creek and drainage lines, Banded Iron Formation (BIF) ridges, mesas, stony hills and breakaways. The majority of reported SRE species in the Goldfields and Yilgarn comprise of Camaenid land snails, Mygalomorph spiders, *Urodacus* scorpions, and *Antichiropus* and *Atelomastix*

millipedes (Bamford 2006; Bamford and Bancroft 2006; Bennelongia 2012, Biota 2009; Biota 2011; Car et al. 2013; GHD 2012; Harewood 2016, Ninox 2009, Volschenck 2015).

3.2 SRE Habitat in Project Areas

All assessments for likelihood of occurrence of conservation significant and SRE invertebrate species were undertaken with regard to the Technical Guidance – Sampling of short range endemic invertebrate fauna (EPA 2016).

Mt Keith SRE Habitat

The potential SRE habitat at the Mt Keith Project area is associated with the sand dunes that are present throughout the area (Figure 2). These provide a Moderate likelihood of containing potential SRE species due to their isolated nature, however, the local abundance and homogeneous nature of this habitat would suggest that taxa would be present throughout the entire sand dune habitat and not restricted to the Project area.

Jonah Bore SRE Habitat

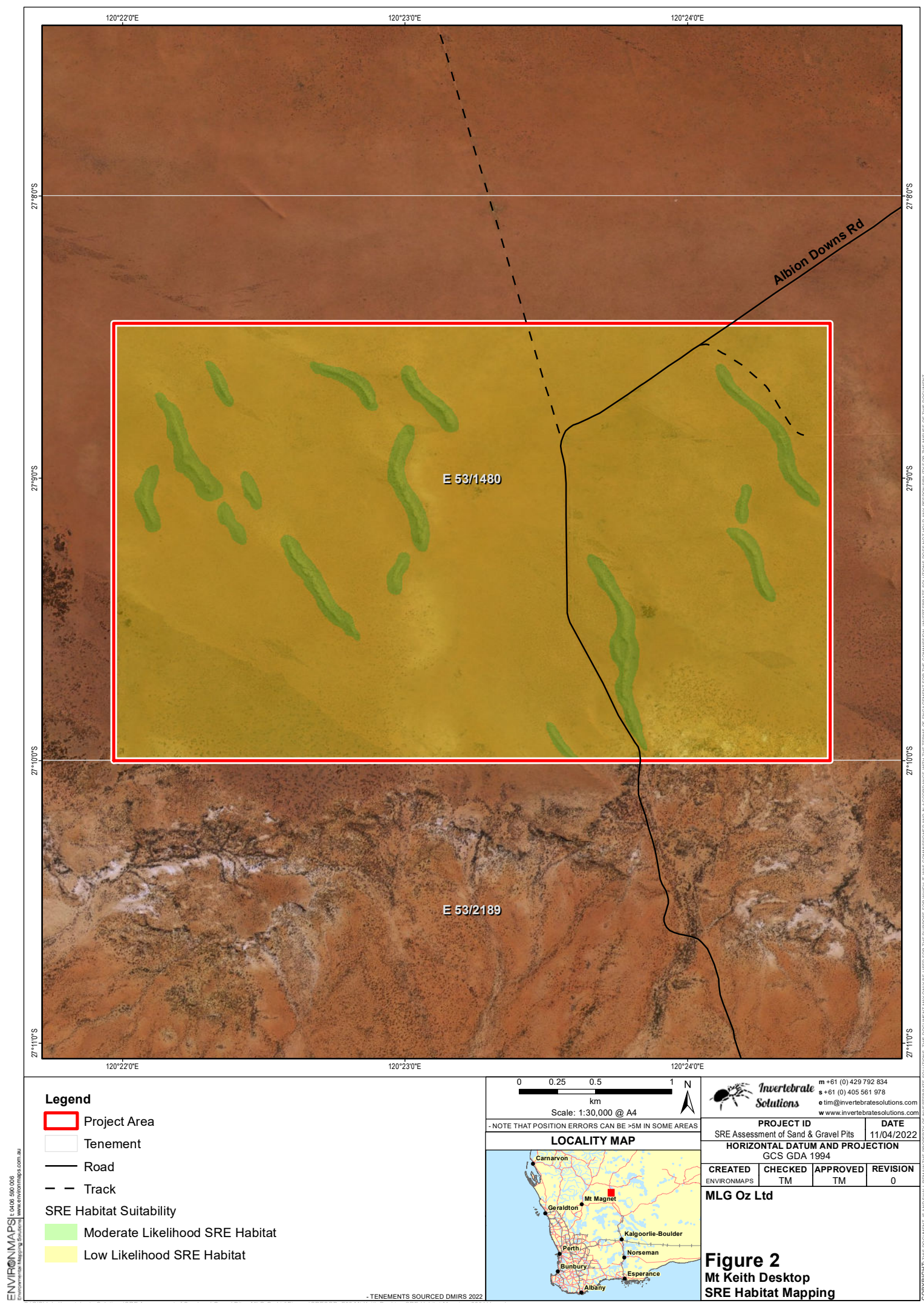
The potential SRE habitat at the Jonah Bore Project area is associated with the single sand dune that is present in the central portion of the Project area (Figure 3). These provide a Moderate likelihood of containing potential SRE species due to their isolated nature, however, the local abundance and homogeneous nature of this habitat would suggest that taxa would be present throughout the entire sand dune habitat and not restricted to the Project area.

Thunderbox SRE Habitat

The potential SRE habitat at the Thunderbox Project area is associated with the drainage lines and more dense vegetated areas that are present in the eastern and south western portions of the Project area (Figure 4). These provide a Moderate likelihood of containing potential SRE species due to their increased leaf litter accumulations and higher moisture content providing potential refugia for SRE taxa. These habitat do, however, extend beyond the Thunderbox Project area and are continuous in the regional landscape that would suggest that any potential SRE taxa would be not be restricted to the small amount of habitat present within the Project area.

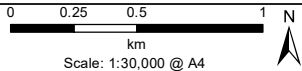
Comet Vale SRE Habitat

The potential SRE habitat at the Comet Vale Project area is associated with the drainage lines, sand dunes and more dense vegetated areas that are present in the north eastern and south western portions of the Project area (Figure 5). These provide a Moderate likelihood of containing potential SRE species due to their increased leaf litter accumulations and higher moisture content providing potential refugia for SRE taxa. These habitat do, however, extend beyond the Comet Vale Project area and are continuous in the regional landscape that would suggest that any potential SRE taxa would be not be restricted to the small amount of habitat present within the Project area.



Legend


- Project Area
- Tenement
- Road
- Track
- SRE Habitat Suitability
 - Moderate Likelihood SRE Habitat
 - Low Likelihood SRE Habitat



- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

LOCALITY MAP





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s +61 (0) 405 561 978
e tim@invertebratesolutions.com
w www.invertebratesolutions.com

PROJECT ID		DATE	
SRE Assessment of Sand & Gravel Pits		11/04/2022	
HORIZONTAL DATUM AND PROJECTION			
GCS GDA 1994			
CREATED	CHECKED	APPROVED	REVISION
ENVIRONMAPS	TM	TM	0

MLG Oz Ltd

Figure 2
Mt Keith Desktop
SRE Habitat Mapping

- TENEMENTS SOURCED DMIRS 2022

120°26'0"E

120°26'30"E

27°53'0"S

27°53'0"S

27°57'0"S


27°57'0"S


120°26'0"E

120°26'30"E

Legend
 Project Area

 Tenement

 Road

 Track
SRE Habitat Suitability
 Low Likelihood SRE Habitat

 Nil

0 75 150 300

m

Scale: 1:10,000 @ A4



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PROJECT ID

SRE Assessment of Sand & Gravel Pits

DATE

11/04/2022

HORIZONTAL DATUM AND PROJECTION

GCS GDA 1994

CREATED

ENVIRONMAPS

CHECKED

TM

APPROVED

TM

REVISION

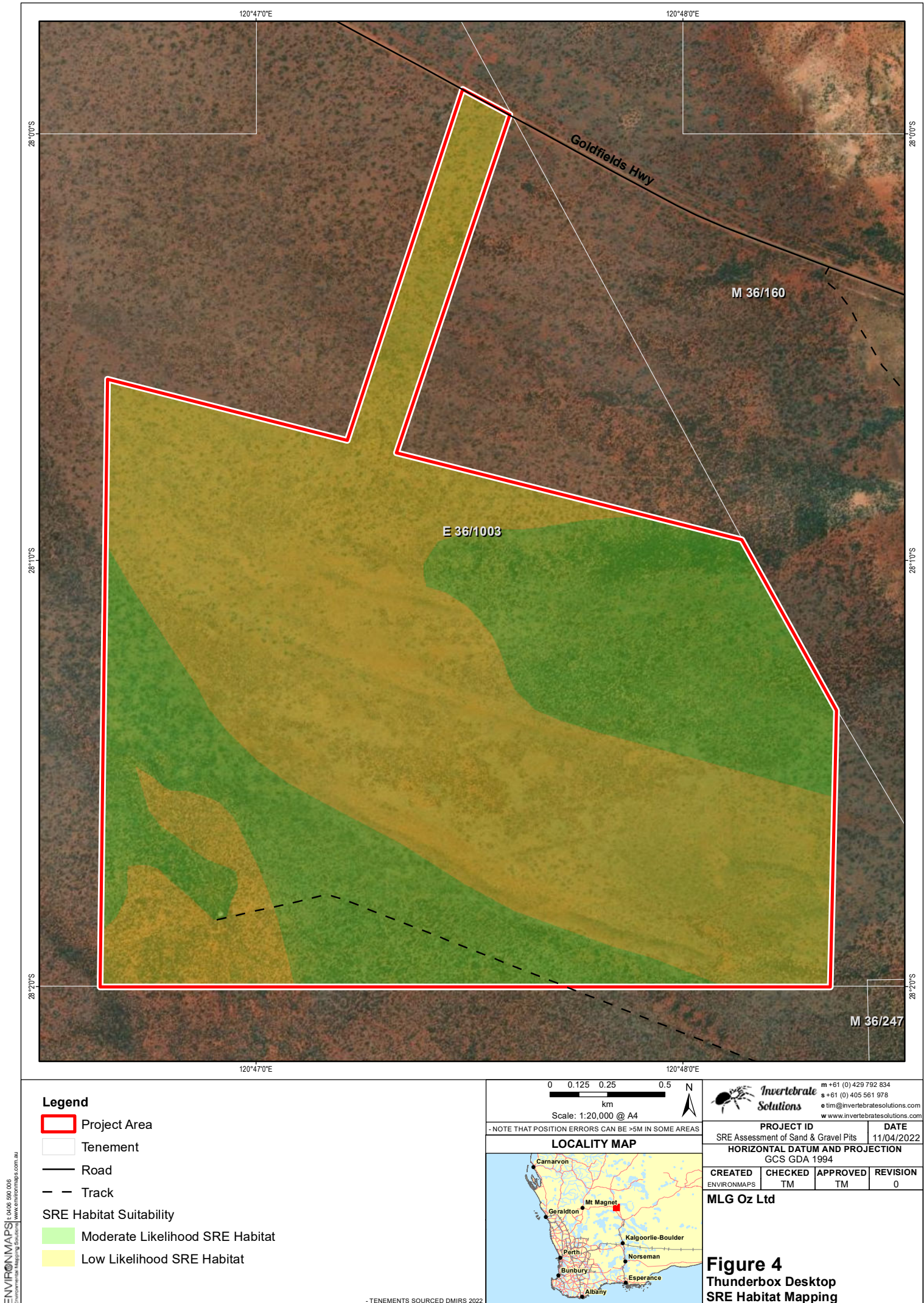
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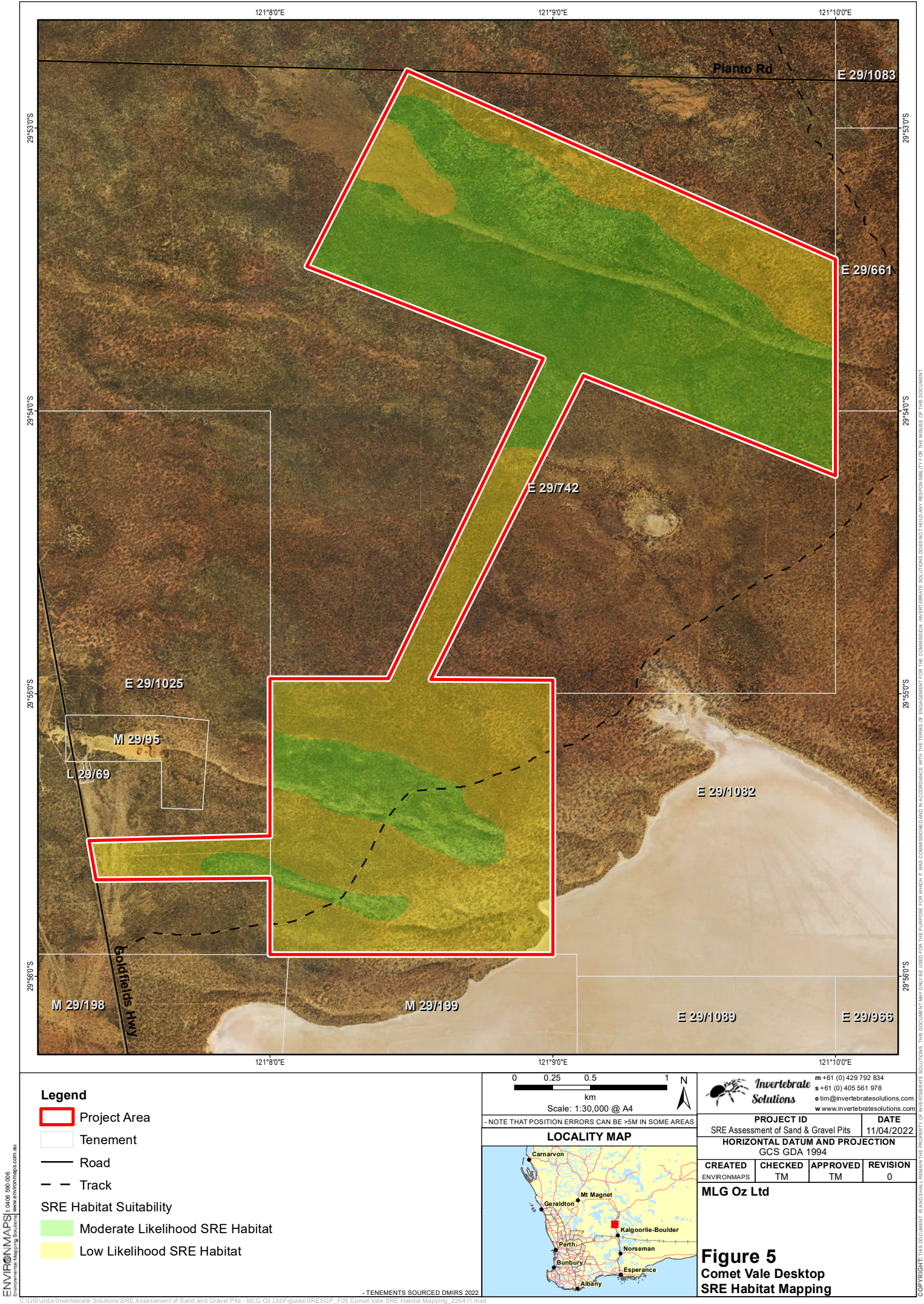
MLG Oz Ltd

LOCALITY MAP

Figure 3
Jonah Bore Desktop
SRE Habitat Mapping

- TENEMENTS SOURCED DMIRS 2022





3.3 Conservation Significant and SRE Fauna in the Desktop Study Areas

A list of conservation significant fauna for the Northern and Southern Desktop Study Areas was compiled from the DBCA Specially Protected Fauna Notice 2019 (DBCA 2019) and the DAWE's Protected Matters Search Tool (PMST). SRE species that are listed under the BC Act and/or the EPBC Act and are likely to occur or have known habitat within the Desktop Study Area are shown in Table 4 along with their conservation code. The PMST results listed no known SRE or conservation significant invertebrate fauna within 50 km of the four Project areas. A full description of the BC and DBCA conservation codes are shown in Appendix 1. The full list of species obtained from the PMST searches are shown in Appendix 2.

A search of the WAM databases for potential SRE taxa occurring in the Northern and Southern Desktop Study Areas centred on the Project areas was undertaken (WAM 2021a, b, c). The results of these were filtered for SRE species as shown in Table 4. Definitions for SRE status are found in Table 1.

The records held by the WAM are not exhaustive and represent only specimens within the WAM collections that have been databased. The Entomology, Mollusc and Crustacean collections remain largely un-databased. Specimens identified to genus level only have been excluded from the analysis as it is impossible to determine if they represent a SRE taxa.

The Northern Desktop Study Area contains no known Confirmed SRE species, six Likely SRE species and 55 Possible SRE species (Table 4). The Likely species are summarised below:

- Two slaters (*Acanthodillo* sp.'7' and *Buddelundia* sp.'45') – Likely SRE species
- Two Idiopid trapdoor spiders (*Kwonkan goongarriensis* and *Kwonkan moriartii*) – Likely SRE species
- Two millipedes (*Antichiropus* 'DIP002' and *Antichiropus* 'DIP003') – Likely SRE species

The Possible SRE species include 27 mygalomorph spiders, 11 scorpions, six armadillid slaters, three pseudoscorpions, and two centipedes that have habitat present within the three Project areas. All these species are considered Possible SREs due to data deficiencies and absence of taxonomic frameworks that prohibit a conclusive assignment of SRE status. The remaining species identified from desktop resources were found to be widespread.

The Southern Desktop Study Area contains no known Confirmed SRE species, one Likely SRE species and four Possible SRE species (Table 4). The species are summarised below:

- One anamid trapdoor spider (*Kwonkan goongarriensis*) – Likely SRE species
- One anamid trapdoor spider (*Aname* 'MYG347 -DNA') – Possible SRE species
- Three pseudoscorpions (*Sundochernes* 'PSE020', *Synsphyronus* 'PSE023', *Beierolpium* 'sp. 8/2') – Possible SRE species

All these species from the southern Desktop Study area are considered Possible SREs due to data deficiencies and absence of taxonomic frameworks that prohibit a conclusive assignment of SRE status. The remaining species identified from desktop resources were found to be widespread.

An additional four conservation significant invertebrates (widespread, non-SRE species) were identified in the desktop assessment:

- A fairy shrimp - *Branchinella simplex* – DBCA Priority 1
- A fairy shrimp - *Branchinella denticulata*– DBCA Priority 3
- A mygalomorph spider – *Idiosoma clypeatum* – DBCA Priority 3
- A butterfly – The Inland Hairstreak (*Jalmenus aridus*) – DBCA Priority 1
- A butterfly – The Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) – BC Act Critically Endangered / EPBC Act Critically Endangered

Only one of these conservation significant species is considered as having potential habitat within the Project areas, the Priority 3 mygalomorph spider *Idiosoma clypeatum* that is associated with Acacia woodlands on a variety of soil types including sandy, clay and gravel, outside of drainage channels. The Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) was not identified as occurring, or having potential habitat within 50 km of the Projects area using the PMST.

Table 4 SRE Invertebrates in WAM databases and Conservation Significant invertebrates recorded from or with potential habitat within each Project area.

Higher Classification	Genus and Species	SRE status	DBCA / BC Act Conservation Status	EPBC Conservation Status	Likely habitat present in each Project area				Desktop likelihood of species within each Project Area			
					Southern Area		Northern Area		Southern Area		Northern Area	
					Comet Vale	Mt Keith	Thunderbox	Jonah Bore	Comet Vale	Mt Keith	Thunderbox	Jonah Bore
Crustacea:												
Thamnocephalidae	Branchinella denticulata	Widespread	Priority 3	-	Not present	Not present	Not present	Not present	Very Low	Very Low	Very Low	Very Low
	Branchinella simplex	Widespread	Priority 1	-	Not Present	Not Present	Not Present	Not Present	Very Low	Very Low	Very Low	Very Low
Armadillidae	Acanthodillo sp.'7'	Likely	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Acanthodillo sp.'yakabindie a'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Buddelundia sp.'25'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
	Buddelundia sp.'45'	Likely	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
	Buddelundia sp.'96'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
	Cubaris sp.'wiluna'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
	Cubaris sp.'yeelirrie 1'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
	Cubaris sp. 'yeelirrie 2'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
Arachnida:												
Araneae: Mygalomorphae												
Barychelidae	Mandjelia sp.'wanjarri'	Possible (A)	-	-	Not Present	Present	Present	Not Present	Very Low	Moderate	Low	Very Low
	Synothele 'MYG312'	Possible (A)	-	-	Not Present	Not Present	Present	Present	Very Low	Very Low	Moderate	Moderate
Idiopidae	Idiosoma' MYG014'	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Moderate	Very Low	Low
	Idiosoma' MYG015'	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Moderate	Very Low	Low
	Idiosoma' MYG017'	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Moderate	Very Low	Low
	Idiosoma' MYG019'	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Moderate	Very Low	Low
	Idiosoma' MYG020'	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Moderate	Very Low	Low
	Idiosoma 'MYG061'	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Moderate	Very Low	Low
	Idiosoma clypeatum	Widespread	Priority 3	-	Present	Not Present	Present	Not Present	Moderate	Low	Moderate	Very Low
	Eucyrtops 'MYG029'	Possible (A)	-	-	Not Present	Present	Present	Not Present	Very Low	Moderate	Low	Very Low
	Eucyrtops 'MYG032'	Possible (A)	-	-	Not Present	Present	Present	Not Present	Very Low	Moderate	Low	Very Low
Anamidae	Aname 'MYG030'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG031'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG170'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG173'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG176'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG177'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG212'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG216'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG227'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG235'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Aname 'MYG347 -DNA'	Possible (A)	-	-	Present	Not Present	Not Present	Not Present	Moderate	Very Low	Very Low	Very Low
	Kwonkan 'MYG171'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Low	Very Low	Very Low
	Kwonkan 'MYG172'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Low	Very Low	Very Low
	Kwonkan 'MYG175'	Possible (A)	-	-	Not Present	Not Present	Not Present	Not Present	Very Low	Low	Low	Low
	Kwonkan 'MYG194'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Low	Very Low	Very Low
	Kwonkan 'MYG210'	Possible (A)	-	-	Not Present	Not Present	Not Present	Not Present	Very Low	Very Low	Very Low	Very Low
	Kwonkan 'MYG211'	Possible (A)	-	-	Not Present	Not Present	Not Present	Not Present	Very Low	Very Low	Very Low	Very Low
	Kwonkan 'MYG352 -DNA'	Possible (A)	-	-	Not Present	Not Present	Not Present	Not Present	Very Low	Very Low	Very Low	Very Low
	Kwonkan 'MYG447'	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Kwonkan goongarriensis	Likely	-	-	Present	Not Present	Present	Not Present	High	Very Low	Low	Very Low
	Kwonkan moriartii	Likely	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	Teyl 'MYG025'	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Low	Moderate	Very Low

Higher Classification	Genus and Species	SRE status	DBCA / BC Act Conservation Status	EPBC Conservation Status	Likely habitat present in each Project area				Desktop likelihood of species within each Project Area			
					Southern Area	Northern Area			Southern Area	Northern Area		
					Comet Vale	Mt Keith	Thunderbox	Jonah Bore	Comet Vale	Mt Keith	Thunderbox	Jonah Bore
	<i>Teyl 'MYG053'</i>	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Low	Moderate	Very Low
	<i>Teyl 'MYG124'</i>	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Low	Moderate	Very Low
Pseudoscorpiones												
Chernetidae	<i>Sundochernes 'PSE020'</i>	Possible (A)	-	-	Present	Present	Present	Not Present	Very Low	Low	Low	Very Low
Garypidae	<i>Synsphyronus 'PSE023'</i>	Possible (A)	-	-	Present	Present	Present	Not Present	Very Low	Low	Low	Very Low
Olpiidae	<i>Beierolpium 'sp. 8/2'</i>	Possible (A)	-	-	Present	Present	Present	Present	Low	Low	Low	Low
Scorpiones												
Urodacidae	<i>Urodacus sp.'cf gibson 5'</i>	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Low	Very Low	Low
	<i>Urodacus sp.'gibson 1'</i>	Possible (A)	-	-	Not Present	Present	Not Present	Present	Very Low	Low	Very Low	Low
	<i>Urodacus sp.'gibson 3'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	<i>Urodacus sp.'gibson 5'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	<i>Urodacus sp.'lakeway 1'</i>	Possible (A)	-	-	Not Present	Not Present	Not Present	Not Present	Very Low	Very Low	Very Low	Very Low
	<i>Urodacus sp.'lakeway2'</i>	Possible (A)	-	-	Not Present	Not Present	Not Present	Not Present	Very Low	Very Low	Very Low	Very Low
	<i>Urodacus sp.'laverton 2'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	<i>Urodacus sp.'laverton 5'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Very Low	Low	Very Low
	<i>Urodacus 'SCO009 Biota 2'</i>	Possible (A)	-	-	Not Present	Present	Present	Not Present	Very Low	Moderate	Low	Very Low
	<i>Urodacus 'SCO018'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
	<i>Urodacus 'species A Biota'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
	<i>Urodacus 'species B Biota'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
	<i>Urodacus 'yeelirrie'</i>	Possible (A)	-	-	Not Present	Present	Not Present	Not Present	Very Low	Moderate	Very Low	Very Low
Myriapoda												
Chilopoda												
Chilenophilidae	<i>'CHI001'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
Mecistocephalidae	<i>Mecistocephalus 'CHI002'</i>	Possible (A)	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
Diplopoda												
Paradoxosomatidae	<i>Antichiropus 'DIP002'</i>	Likely	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
	<i>Antichiropus 'DIP003'</i>	Likely	-	-	Not Present	Not Present	Present	Not Present	Very Low	Low	Low	Very Low
Insecta												
Lepidoptera	<i>Jalmenus aridus</i>	Widespread	Priority 1	-	Not present	Not present	Not present	Not present	Very Low	Very Low	Very Low	Very Low
	<i>Ogyris subterrestris petrina</i>	Widespread	Critically Endangered	Critically Endangered	Not present	Not present	Not present	Not present	Very Low	Very Low	Very Low	Very Low

4. Discussion

4.1 SRE Invertebrate Assessment

The Project areas within the Northern Desktop Study Area contain no known Confirmed SRE species, six Likely SRE species and 55 Possible SRE species. The Likely species are summarised below and in Table 5:

- Two slaters (*Acanthodillo* sp.'7' and *Buddelundia* sp.'45') – Likely SRE species
- Two Idiopid trapdoor spiders (*Kwonkan goongarriensis* and *Kwonkan moriartii*) – Likely SRE species
- Two millipedes (*Antichiropus* 'DIP002' and *Antichiropus* 'DIP003') – Likely SRE species

The Southern Desktop Study Area contains no known Confirmed SRE species, one Likely SRE species and four Possible SRE species (Table 4) with the Likely SRE species shown below:

- One anamid trapdoor spider (*Kwonkan goongarriensis*) – Likely SRE species

All the Possible SRE species are classified as such due to data deficiencies and absence of taxonomic frameworks that prohibit a conclusive assignment of SRE status. The remaining species identified from desktop resources were found to be widespread.

An additional conservation significant invertebrate (widespread, non-SRE species), was identified in the desktop assessment as potentially occurring in both the Northern and Southern Desktop Study areas and is shown below and in Table 5:

- A mygalomorph spider – *Idiosoma clypeatum* - DBCA Priority 3

All Likely SRE, and conservation significant species with habitat within the four Project areas, are considered in depth in Section 4.1.1 – 4.1.3 respectively. Species that are considered to be Possible SREs is related to incomplete taxonomy or distributional data where survey data is inadequate to provide meaningful further comment on the species.

Table 5 Likelihood of occurrence summary for Likely SRE and conservation significant invertebrates

Taxa	SRE Status / Conservation Status	Project Area where taxa may occur	Likelihood of occurrence in individual Project area	Explanation
Crustacea: Armadillidae				
<i>Buddelundia</i> sp.'45'	Likely	Mt Keith	Moderate	Records within 20 km but differing habitat
<i>Acanthodillo</i> sp.'7'	Likely	Thunderbox	Low	Records over 50 km but similar habitat
Arachnida: Mygalomorphae				
<i>Idiosoma clypeatum</i>	DBCA Priority 3	Thunderbox	Moderate	Records within 20 km and similar habitat
	DBCA Priority 3	Comet Vale	Moderate	Records within 20 km and similar habitat
<i>Kwonkan goongarriensis</i>	Likely	Thunderbox	Moderate	Records over 50 km but similar habitat
	Likely	Comet Vale	High	Records within 20 km and similar habitat
<i>Kwonkan moriartii</i>	Likely	Thunderbox	Low	Records over 50 km but similar habitat
Diplopoda: Paradoxosomatidae				
<i>Antichiropus</i> DIP002	Likely	Thunderbox	Low	Records over 50 km but similar habitat
<i>Antichiropus</i> DIP003	Likely	Thunderbox	Low	Records over 50 km but similar habitat

4.1.1 Crustacea: Armadillidae

The taxonomic framework of slaters in Australia is extremely poorly making assessment of SRE status for this fauna difficult. The armadillid isopods from the Australian genus *Buddelundia* are extremely diverse in arid Australia with over 150 putative species identified in collections, primarily from Western Australia, but requires taxonomic revision at a family level making the proper identification of species difficult (Dalens 1992; Judd and Perina 2013).

Buddelundia sp.'45' is only known from four locations north of Leinster and is considered to be a Likely SRE based on knowledge of the genus and the distribution of other *Buddelundia* taxa in the region (Dr Simon Judd, pers comm. April 2022). The species is considered to have a Moderate likelihood of occurrence within the Mt Keith Project area due to the proximity to the known records although the habitat is not similar due to the sand dune dominated Mt Keith Project area.

All species within the armadillid genus *Acanthodillo* are morphologically very similar and reliable morphological characters for determining species are not yet available thus it is currently impossible to identify the taxa beyond generic level (Invertebrate Solutions 2020, Judd 2019). The genus is cryptic and much less frequently collected than *Buddelundia* and all *Acanthodillo* are considered Likely SRE species (Invertebrate Solutions 2020, Judd 2019). The taxa *Acanthodillo* sp.'7' has been recorded from Woodland and calcrete plain habitats near Lake Maitland and although some habitat similarities exist with the Thunderbox Project area the distance results in a Low likelihood of occurrence for this species.

4.1.2 Arachnida: Mygalomorphae

Idiosoma clypeatum – Priority 3 (DBCA)

Idiosoma clypeatum was previously known by the WAM identification code 'MYG018' and prior to the taxonomic revision of Rix et al. 2018 was often incorporated into *Idiosoma nigrum* that is now known to only occur in the northern Wheatbelt region of Western Australia (Rix et al. 2018).

Idiosoma clypeatum has a widespread distribution in the Yalgoo and Murchison bioregions of Western Australia's inland arid zone, strongly correlated with annual rainfall of less than 250 mm (Plate 1). Like many *Idiosoma* species from the *I. nigrum* complex the burrows are adorned with a moustache like arrangement of twigs (Plate 2). Males have been collected wandering in search of females in late autumn, winter and spring, with a peak of activity in winter (Invertebrate Solutions 2017, Rix et al. 2018).

In 2017, *Idiosoma clypeatum* was formally assessed as Priority 3 fauna by DBCA; this assessment incorporated the latest taxonomic, geographic, and genetic data summarised by Rix et al. 2018. The species has a known extent of occurrence of over 120,000 km², and thus is not considered to be a short range endemic species by the definition of Harvey 2002, however, it does largely occur within areas prospective for mining and mineral resource development.

Idiosoma clypeatum (Plate 3) is known to occur in the northern Goldfields and is considered a Moderate Likelihood of occurring within the Thunderbox and Comet Vale Project areas due to their *Acacia* dominated vegetation that provides habitat for this species. Although widespread the species is patchy in distribution and can be highly localised in favourable habitat with maternal clusters occurring near the base of shrubs within accumulated leaf litter.

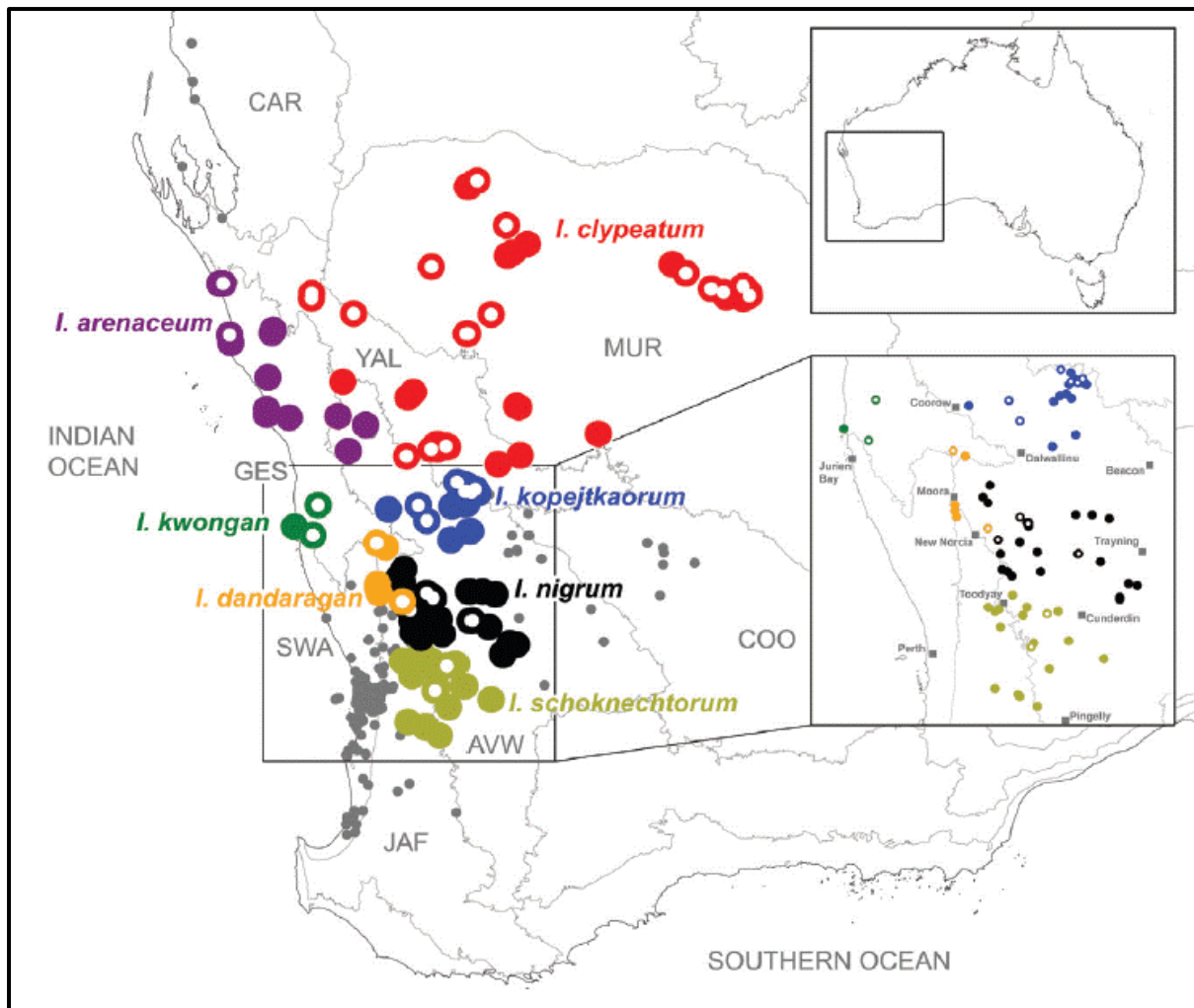


Plate 1 Distribution of *Idiosoma clypeatum* (red circles) in the Murchison and Yalgoo bioregions (after Rix et al. 2018, Figure 374).



Plate 2 Burrow of *Idiosoma clypeatum* from the Murchison bioregion marked with red arrow, showing characteristic moustache arrangement of leaves (Photo T Moulds).



Plate 3 Adult female of *Idiosoma clypeatum* from the Murchison bioregions (Photo T Moulds).

***Kwonkan goongarriensis* – Likely SRE**

The mygalomorph spider *Kwonkan goongarriensis* was described in 1983 (Main 1983) from material collected from leaf litter of heathland and Casuarina woodland in the Menzies and Leonora areas, with the type locality of Goongarrie Station. The spider makes a shallow silk lined tube that is only visible by scraping leaf litter to reveal the openings (Main 1983). It is considered to be a Likely SRE species based upon the known distribution and knowledge of the genus. The species is considered to have potential habitat in the Comet Vale and Thunderbox Project areas due to proximity to Menzies and the similar vegetation that occurs in these locations. The likelihood of occurrence is considered to be High for Comet Vale due to the close proximity to the type locality Goongarrie, whilst the Thunderbox Project area is considered to have a Low likelihood of occurrence due to the 200 km distance from Goongarrie.

***Kwonkan moriartii* – Likely SRE**

This species is known from a single male specimen collected at Kathleen Valley Station (Main 1983). Nothing is known of its habitat or ecology, however, it is considered to be a Likely SRE species. The species is considered to have potential habitat in the Thunderbox Project area due to proximity to Kathleen Valley, however the likelihood of occurrence is considered to be Low.

4.1.3 Diplopoda: Paradoxosomatidae

***Antichiropus* ‘DIP002 and DIP003’ – Likely SRE species**

Millipedes from the genus *Antichiropus* all have limited powers of dispersal and conservative ecological requirements (Car et al. 2013). In addition, the above-ground activity of most *Antichiropus* species are limited to a very small window of opportunity when there is sufficient moisture for them to forage and mate during wetter winter months (Car et al. 2013). *Antichiropus* species are, consequently, short-range endemics with very small distributions *sensu* Harvey 2002.

The two species of *Antichiropus* millipedes (DIP002 and DIP003) are both known from approximately 50 km north of Leinster where all specimens were collected in wet pitfall traps in a variety of habitats including drainage/creek lines, mulga woodland on sandy plains and rocky slopes. Although potential habitat is present at the Thunderbox Project area, the distance of over 50 km between the localities would make the likelihood of occurrence Low.

5. Conclusions and Recommendations

The Project areas within the Northern Desktop Study Area contain no known Confirmed SRE species, six Likely SRE species and 55 Possible SRE species. The Likely species are summarised below:

- Two slaters (*Acanthodillo* sp.'7' and *Buddelundia* sp.'45') – Likely SRE species
- Two Idiopid trapdoor spiders (*Kwonkan goongarriensis* and *Kwonkan moriartii*) – Likely SRE species
- Two millipedes (*Antichiropus* 'DIP002' and *Antichiropus* 'DIP003') – Likely SRE species

The Southern Desktop Study Area contains no known Confirmed SRE species, one Likely SRE species and four Possible SRE species (Table 4):

- One anamid trapdoor spider (*Kwonkan goongarriensis*) – Likely SRE species

The remaining species identified from desktop resources were found to be widespread. Species that are considered to be Possible SREs is related to incomplete taxonomy or distributional data where survey data is inadequate to provide meaningful further comment on the species.

An additional conservation significant invertebrate (widespread, non-SRE species), was identified in the desktop assessment as having a Moderate likelihood of occurrence in the Thunderbox and Comet Vale Project areas:

- A mygalomorph spider – *Idiosoma clypeatum* - DBCA Priority 3

Whilst some Likely and Possible SRE species occur near the four Project areas, it should, however, be noted that all SRE habitat identified within the Project areas is not restricted in nature and occurs in adjoining land. No SRE or conservation significant terrestrial invertebrates are anticipated to be restricted to any of the four Project areas, due to the homogenous habitat present in the region and the very small extent of the Project areas themselves.

No survey work is required in order to meet the requirements for EPA technical guidance Sampling of short range endemic invertebrate fauna (EPA) 2016.

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Appendix 1

Conservation Codes from Department of Biodiversity, Conservation and Attractions

CONSERVATION CODES

For Western Australian Flora and Fauna

Threatened, Extinct and Specially Protected fauna or flora¹ are species² 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).

Appendix 2

Protected Matters Search Tool Results



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. Please see the caveat for interpretation of information provided here.

Report created: 23-Mar-2022

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment 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 (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	8
Listed Migratory Species:	7

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

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 Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	11
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Nationally Important Wetlands:	2
EPBC Act Referrals:	2
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area	In feature area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area	In feature area
MAMMAL			
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area	In feature area
PLANT			
Eleocharis papillosa Dwarf Desert Spike-rush [2519]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ricinocarpos brevis [82879]	Endangered	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[[Resource Information](#)]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Migratory Terrestrial Species

Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
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Migratory Wetlands Species

Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands

[[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.

Commonwealth Land Name	State	Buffer Status
Unknown		

Commonwealth Land Name	State	Buffer Status
Commonwealth Land - [51750]	WA	In buffer area only

Listed Marine Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In buffer area only
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Thinornis cucullatus as Thinornis rubricollis Hooded Dotterel, Hooded Plover [87735]		Species or species habitat likely to occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Credo	NRS Addition - Gazettal in Progress	WA	In buffer area only
Goongarrie	National Park	WA	In buffer area only

Nationally Important Wetlands			[Resource Information]
Wetland Name		State	Buffer Status
Lake Ballard		WA	In buffer area only
Lake Marmion		WA	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Ularring Hematite Project, WA	2012/6426	Not Controlled Action	Completed	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

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

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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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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. Please see the caveat for interpretation of information provided here.

Report created: 23-Mar-2022

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)

Summary

Matters of National Environment 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 (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	7
Listed Migratory Species:	7

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

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 Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	2
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	6
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area	In feature area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area	In feature area

MAMMAL			
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area	In feature area
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat may occur within area	In buffer area only

PLANT			
Atriplex yeelirrie [88538]	Endangered	Species or species habitat known to occur within area	In buffer area only

Listed Migratory Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In buffer area only
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Thinornis cucullatus as Thinornis rubricollis Hooded Dotterel, Hooded Plover [87735]		Species or species habitat may occur within area overfly marine area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Kaluwiri	NRS Addition - Gazettal in Progress	WA	In buffer area only
Wanjarri	Nature Reserve	WA	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Extension to Wiluna Uranium Mine (Millipede & Lake Maitland), Wiluna, WA	2014/7138	Controlled Action	Post-Approval	In buffer area only
Wiluna Uranium Project	2009/5174	Controlled Action	Post-Approval	In buffer area only
Yeelirrie Uranium Mine	2009/4906	Controlled Action	Post-Approval	In buffer area only
Not controlled action				
Clearing for Mt Keith Satellite Project, WA	2017/8001	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
Referral decision				
Northern Goldfields Interconnect Pipeline	2021/8900	Referral Decision	Referral Publication	In buffer area only

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and 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

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

Where little information is available for a 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 detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

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.

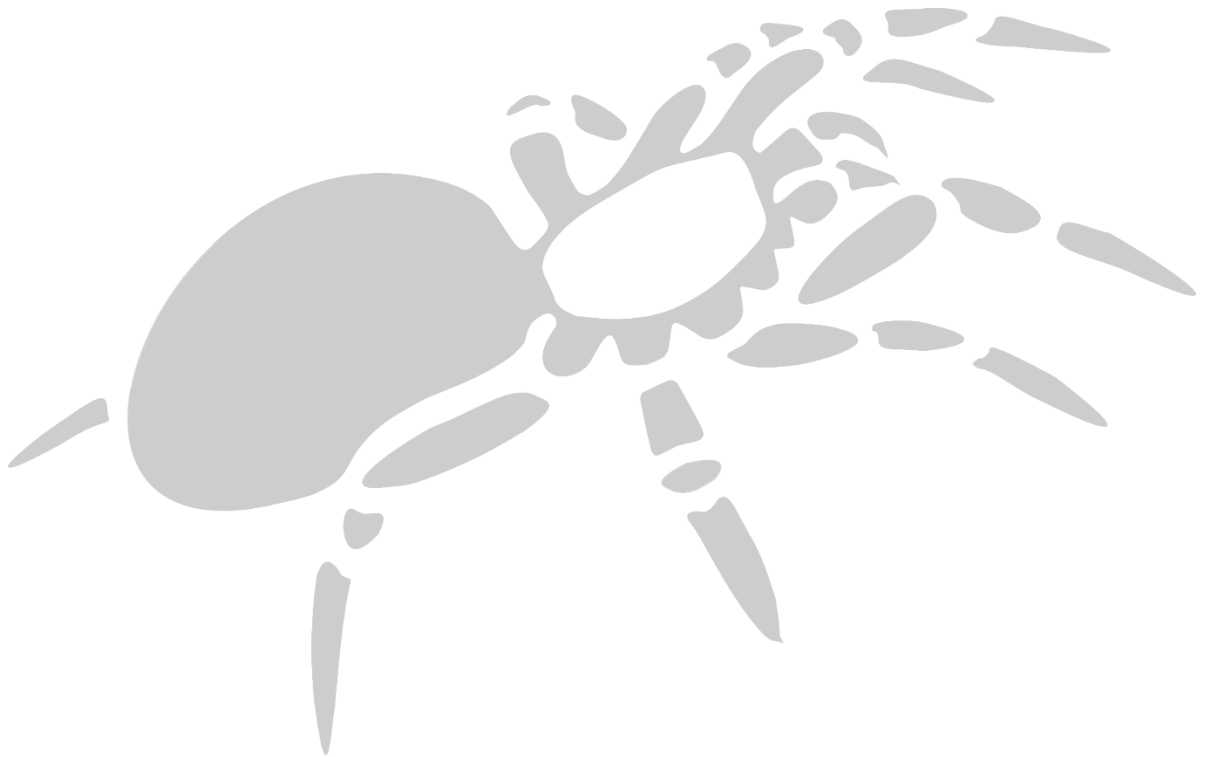
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APPENDIX 5: ABORIGINAL CULTURAL HERITAGE SURVEY (A J CONSULTING, 2022)

Report of an Aboriginal Cultural Heritage Survey of the 16 Mile Well Project.

Prepared for MLG Oz Ltd.



November 2022

Disclaimers

The analysis and recommendations contained within this report are based on information made available at the time of its preparation. The author takes no responsibility for omissions and/or inconsistencies that may result from information becoming available after the report's completion.

This report offers independent heritage advice and recommendations to assist MLG OZ Ltd. This advice is based on the author's own opinions, interpretations, knowledge and experience of the Aboriginal regulatory heritage system in Western Australia and does not constitute legal advice.

This advice is relevant to the prevailing Aboriginal heritage laws in Western Australia – the *Aboriginal Heritage Act 1972*.

Any future compensation liabilities that may arise under the *Native Title Act 1993* do not form part of this advice.

Author

Aaron Rayner led the survey fieldwork, analysis and prepared this report for MLG OZ Ltd. Aaron is the former Chief Heritage Officer and Deputy Director General at the Department of Aboriginal Affairs in Western Australia. In these roles, Aaron was responsible for managing the *Aboriginal Heritage Act 1972* and its regulations and for providing advice to executive government and industry proponents. For five years, Aaron was a member of the Aboriginal Cultural Material Committee, the statutory body that provides advice to the Minister for Aboriginal Affairs on all Aboriginal heritage matters. Aaron is a cultural heritage practitioner specialising in Aboriginal anthropology and Aboriginal heritage site identification. He has significant experience and an expert understanding of the Aboriginal Heritage regulatory framework in WA and is routinely called upon to provide expert evidence to regulatory decision makers.

Glossary of Terms

ACMC	Aboriginal Cultural Material Committee
ACH Act	<i>Aboriginal Cultural Heritage Act 2021</i>
AH Act	<i>Aboriginal Heritage Act 1972</i>
DPLH	Department of Planning, Lands and Heritage
Minister	Minister for Aboriginal Affairs
MLG	MLG OZ Ltd
NT Act	<i>Native Title Act 1993</i> (Cth.)
Register	Register of Aboriginal Sites
Registrar	Registrar of Aboriginal Sites
s18	Section 18 of the <i>Aboriginal Heritage Act 1972</i> (WA)

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Executive Summary

MLG OZ Ltd (**MLG**) is planning to commence the mining of aggregate at its 16 Mile Well project (the **Project**) and has applied for a mining lease over land within exploration tenement E36/1003. MLG commissioned an Aboriginal cultural heritage survey to determine what cultural values may exist in the proposed mining lease area. The Project is located adjacent to the Goldfields Highway, approximately 15km southeast of Leinster in Western Australia.

The Project area includes an access road linking directly to the Goldfields Highway and three mining pits with room to expand. There has been no native title claim over the Project area since the Wutha claim was dismissed in 2019. MLG does not have an Aboriginal heritage agreement with any Aboriginal entity or individual for the Project area that prescribe Aboriginal heritage processes for compliance with the *Aboriginal Heritage Act 1972 (AH Act)*. The purpose of the heritage survey was to identify if there are any Aboriginal sites pursuant to section 5 of the AH Act and or areas of cultural interest that may affect the mining development.

Because there are no native title claimants for the area, the survey participants were selected by MLG's Aboriginal heritage consultant following consultation with senior Aboriginal people in Leonora and with an Aboriginal senior loreman. Following consultation, a survey party of six people was selected which included three initiated Aboriginal men and two female Elders (**Survey Party**). All survey party members were selected because of their knowledge of the traditions and customs associated with the survey area land.

Prior to the field survey, a desktop assessment considered the existing Aboriginal heritage information held on the public record for the survey area and adjacent areas. A search of the Aboriginal Heritage Inquiry System (**AHIS**) found no recorded Aboriginal heritage sites or areas of cultural interest within the proposed mining lease area (**Survey Area**). There are several Aboriginal sites which have been recorded in areas adjacent to the survey area including artefact and camping sites. The AHIS lists any Aboriginal heritage survey reports for the survey area, which indicates that the land has not been surveyed for Aboriginal sites.

The heritage survey was conducted between 27 – 30 October 2022. The survey party travelled each day by vehicle from Leonora to the survey area. The survey area was accessed directly from the Goldfields Highway with several pastoral tracks available for use. The survey party conducted pedestrian transects across the entire survey area walking at 10-15 m spacings. The ground cover included patches of spinifex, which were quite dense in small areas, and patches of mulga scrub. The conditions for artefact identification were optimal.

The senior members of survey party confirmed that there were no ethnographic sites of importance and significance in the survey area. The Elders knew of a rock-hole to the south of the survey area which was inspected when the survey was completed. This rock-hole will not be impacted if MLG confines its mining operations to the area surveyed.

The survey party completed the inspection of the entire survey area in the allocated time. The survey party paid particular attention to the three areas proposed for mining pits as they were located on elevated, softer ground. The Elders noted that the conditions were good for camping. However, it was also noted that no permanent or semi-permanent natural water sources are located in the area. The single rock-hole outside of the survey area being the only nearby semi-permanent water source. The key finding of the survey is that the survey party confirmed that there are no Aboriginal sites in the survey area. The survey party agreed that

MLG can commence its mining operations in the survey area and there are no Aboriginal heritage management considerations that MLG need to address.

Recommendations

It is recommended that MLG OZ Ltd:

1. Note that the survey area, which is the extent of the proposed mining lease and access road has been completed – see Appendix 1.
2. Note that the survey party did not identify any Aboriginal heritage sites and the survey area is cleared.
3. Carry out further Aboriginal heritage surveys where it seeks to use land outside of the cleared heritage survey area (proposed mining lease area) prior to commencing ground disturbing activities.
4. Ensures its staff and contractors are aware of their obligations under the AH Act; and
5. Reports any newly discovered Aboriginal sites pursuant to section 15 of the *Aboriginal Heritage Act 1972*.

Introduction

MLG is preparing to commence mining aggregate within a portion of tenement E36/1003, which involves installing new access tracks and mining three pits. MLG has applied for a mining lease to facilitate project development. The tenement is located approximately 15km southeast of Leinster in the Northern Goldfields of Western Australia.

To mitigate the risk of disturbing an unrecorded Aboriginal site, MLG decided to complete an Aboriginal heritage survey of the proposed mine site area with Aboriginal people with cultural knowledge of the area. A cultural heritage survey was commissioned by MLG to understand if any cultural heritage sites are located in the survey area.

Methodology

The methodology used to conduct this Aboriginal cultural heritage field survey and assessment included the following:

- Identification of appropriate Aboriginal people to participate in the field survey
- A search and review of historical cultural heritage information, including site files and Aboriginal heritage survey reports held by the DPLH
- Consideration of the previous and ongoing land uses
- Interviews with the Aboriginal survey party members prior to conducting the field survey
- A field survey conducted to a site identification standard
- Preparation of this report

The primary objective of the field survey was to establish if any ethnographic or cultural material sites of importance and significance to Aboriginal people are located within the survey area or in immediate proximity to it.

Because there is no active native title claim, MLG's heritage consultant contacted several Aboriginal elders in Leonora. During these discussions, it was agreed that senior Aboriginal people with an understanding of the traditions and customs and the country where the Project is located should attend the survey.

Contact was made with Ms Geraldine Hogarth and Ms Colleen Berry who are both Elders and members of the Darlot and Tjiwarl native title groups, which are the nearest native title determination areas to the survey area. These Elders invited several initiated men, known as *watis*, and Mr Colin Peterson, a very senior loremen (senior *wati*), to participate in the survey.

Mr Peterson is a senior wati with significant knowledge of Western Desert Aboriginal laws and customs. He is responsible for teaching law and culture to Aboriginal men in accordance with tradition and custom. Mr Peterson is aged in his 70s and has lived and worked on Yandal, Leinster, and Weebo Pastoral Stations in the 1960s and 1970s.



Photo 1. Survey party including Mr Colin Peterson, Ms Geraldine Hogarth, Ms Colleen Berry

Prior to the field survey, the author undertook a review of the existing Aboriginal heritage information recorded in the survey area and adjacent land. This was done by searching and considering the following sources of Aboriginal heritage information from:

- The Department of Planning, Land and Heritage (**DPLH**) AHIS and Register of Aboriginal Sites
- The National Native Title Tribunal (**NNTT**) database of Future Act decisions
- The author's own private collection of reports, papers, and journals

The field survey was conducted to a 'site identification' standard and included ethnographic and cultural material surveys. The objective of the site identification heritage assessment is to identify the location, boundary of the heritage place(s), cultural values, and views of Aboriginal people in sufficient detail to enable the regulatory authorities to determine if the place is protected under section 5 of the AH Act.

The fieldwork methodology included vehicle navigation to the area using existing access tracks and then a pedestrian inspection of the land. Ground surface visibility in the survey area was good to very good, with only sparse to moderate vegetation coverage, and field conditions for Aboriginal object and site identification were optimal.

The ethnographic consultation undertaken for this survey was twofold. Firstly, interviews were conducted with the survey party in Leonora using maps and previous heritage survey reports

of the adjacent land. Secondly, open discussions were held during the survey with the Elders and watis.

Survey Party

The following Survey Party was selected in consultation with Elders from Leonora.

Geraldine Hogarth – Darlot & Tjiwarl elder	Andrew McCabe – Darlot & Tjiwarl native title holder and <i>wati</i>
Colin Peterson – senior wati	Colleen Berry – Darlot & Tjiwarl elder
Leeton Redmond – Darlot & Tjiwarl native title holder and <i>wati</i>	Wayne Abdullah – Darlot & Tjiwarl native title holder

The survey party were supported by Mr Aaron Rayner, Senior Ethnographer and Cultural Heritage Specialist and Mr Terry Russell, Cultural Heritage Specialist. Two young Aboriginal people from Leonora also attended the final day of the heritage survey to gain experience and learn from their Elders.

Ethnographic Background

The survey area is located in land that forms part of the Western Desert Cultural Bloc. The ethnographic understanding of the Western Desert Region is well-defined, with many Dreamtime narratives held on the public record.

The Dreaming is the creative period in which a set of known creative (or ancestral) beings formed the landscape, often transforming themselves or others into recognisable features, and established the correct ways for Aboriginal people to live their lives, the lore.

The creative beings roamed the earth and transformed it from a featureless plain into its present shape by creating or forming the various physical features which we know today. In some cases, these ancestors were also responsible for the creation of animal and plant species. On their journeys, they camped, ate, killed, gave birth and performed ritual and magical acts. In places they are metamorphosed in stone, water and other natural features, which are the foci from which the sacred presence radiates.

Two of the most important beings in Western Desert Dreaming are the “two men”, *Wati Kutjarra*. These two men are sometimes depicted as two snakes or two lizards. Their travels and accomplishments span the Western Desert. Aboriginal people living in the different parts of the Western Desert know local events and places associated with the *Wati Kutjarra* and other ancestral beings of the Dreamtime, such as *Papa*, *Walawaru* and *Karlaya*. Song lines recount the activities and creations of these creation beings that connect places and form a strong part of Aboriginal tradition and prescribe the customs and rituals performed at each place.

Environment

The survey area falls within a desert climatic zone characterised by highly variable summer and winter rainfall. No permanent water sources occur in the vicinity of the survey area, but shallow creek lines and small drainage lines are evident. These are minor, diffuse, and highly ephemeral.

The topography of the survey area is mainly flat, with three small sandy ridgelines in the centre of the survey area.

The survey area is situated on Leinster Downs Pastoral Station and is networked with access tracks and supporting infrastructure such as fencing. Prospecting and gold mining activities commenced in the late 19th century comprising underground reef mining and surface alluvial gold mining operations. There are numerous old working, shafts and historic workings dotted around the survey area.

Post contact history

Aboriginal history in the survey region, following European contact, can be summarised as follows:

- Large population of gold miners move into the region in the 1890s
- Indigenous population depleted by violence, starvation and introduced diseases
- Aboriginal migration from other regions, both voluntary and enforced, commences, and intermarriage and settlement on the newly formed pastoral stations begins to break down traditional patterns of social organisation and land ownership
- The collective Aboriginal identity begins to develop
- Throughout this period of resettlement, “station Aborigines” retain knowledge of and contact with cultural sites
- Traditional ownership custodianship increasingly tends to include the factor of birth on a specific station
- Since pre-contact traditional life tended to determine specific station residence, speech communities tended to settle on stations within their traditional lands, leading to the gradual redefinition of “traditional custodian” in terms of station boundaries
- Following adoption of the Pastoral Award for Aborigines in 1969, permanent residence and employment on stations becomes less secure and movement to central locations such as Kalgoorlie, Leonora, and Wiluna accelerates
- Therefore, through all of these historical development the sacred associations of land in the general survey region have been retained and can be traced

Native Title Claim - Dismissed

The Wutha native title claim was registered on 15 June 1999 for an area of land covering some 32,630 square kilometres in WA's Goldfields Region, including the area of tenement E36/1003. The claim was made by a group of people, including June Rose Ashwin, Geoffrey Ashwin, Raymond Ashwin and Ralph Ashwin, who were said to be descendants of six named apical ancestors at the head of four ancestral families, including:

- a) Darugadi (aka Thurraguddy)
- b) Julia Sandstone ("Old Julia")
- c) Billy
- d) Inyarndi

The Wutha claimed their traditions were part of the Western Desert Cultural Bloc of customs and traditions. The Federal Court accepted this claim.

Nearly twenty (20) years later, on 8 March 2019, Justice Bromberg in the Federal Court of Australia dismissed the Wutha native title claim because:

1. The Wutha Group did not establish that since effective sovereignty, the traditional laws and customs, and in particular the laws relating to the acquisition, transmission and exercise of rights to land and waters, have continued to be recognised and observed by the Wutha Group as a whole; and
2. The Wutha Group failed to establish that their applications for native title were properly authorised by all the applicants.

The Wutha claim was dismissed on the grounds of that the native title claimants could not demonstrate an ongoing connection to the claim area. The Darlot native title determination area (WC2018/005) and Tjiwarl determination (WC2015/002) are the nearest native title areas to the survey area. Many of the Darlot and Tjiwarl native title holders were registered on the Wutha claim, including Ms Hogarth and Ms Berry.

Regulatory Framework

State Aboriginal heritage legislation

In December 2021, the Aboriginal Cultural Heritage Act 2021 (**ACH Act**) was passed by the Western Australia Parliament. The ACH Act is currently in a transitional period which commenced on 22 December 2021 and will last for at least 12 months. During the transitional period, regulations, statutory guidelines and operational policies will be developed as parts of the ACH Act are progressively proclaimed. Part 1 of the ACH Act came into effect on 22 December 2021. Part 1 includes the commencement clause, an overview of the proposed Act, the objects and principles of the proposed Act, terms used and the interaction with other Acts. Further parts of the ACH Act establishing the Aboriginal Cultural Heritage Council, and associated *Aboriginal Cultural Heritage Regulations 2022*, came into effect on 18 and 17 June 2022 (respectively). When the ACH Act comes fully into operation, it will replace the AH Act.

Until this time the AH Act remains the primary legislation in Western Australia for protecting all Aboriginal heritage sites of significance, whether the sites are registered or not and whether they are known or unknown. Section 5 defines the places the Act protects. The legislative regime is expansive as it protects both cultural material places and sacred sites of importance and significance to Aboriginal people.

Section 5 of the AH Act applies to:

- (a) Any place of importance and significance where persons of Aboriginal descent have, or appeared to have, left any object, natural or artificial, used for, or made

- or adapted for use for, any purpose connected with traditional cultural life of the Aboriginal people, past or present;
- (b) Any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;
 - (c) Any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State; and
 - (d) Any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or remove.

Section 6 of the AH Act protects Aboriginal objects.

Section 17 of the AH Act provides that it is a criminal offence to excavate, destroy, damage, conceal or in any way alter any Aboriginal site. Penalties include fines up to \$100,000 and or two years imprisonment for a breach of section 17.

Section 18 of the AH Act provides the only means whereby a landowner can use land where an Aboriginal site might exist and where a site can be altered or damaged in any way without the activity being an offence.

Section 28 establishes the Aboriginal Cultural Material Committee as an advisory body to the Minister for Aboriginal Affairs.

Section 38 provides for a Register of Aboriginal Places and Objects.

Section 39 prescribes the functions of the ACMC to evaluate on behalf of the community the importance of places and objects alleged to be associated with Aboriginal persons and to recommend to the Minister places and objects which, in the opinion of the ACMC, are, or have been, of special significance to persons of Aboriginal descent and should preserved. Associated sacred beliefs, and ritual or ceremonial usage, in so far as such matters can be ascertained, are regarded as the primary factors to be considered in the evaluation of any place or objects for the purposes of this Act.

Section 62 provides that it is a defence if the charged person did not know and could not reasonably be expected to have known, that the place or object to which the charge relates was a place or object to which the Act applies.

Aboriginal Heritage Due Diligence Guidelines

The State's Cultural Heritage Due Diligence Guidelines contain a Risk Matrix designed to assist land users to determine risk of damage to an Aboriginal heritage site and the appropriate course of action to mitigate that risk (see **Figure 1.** below). The State encourages land users to determine risk of damage to Aboriginal heritage sites by using the Cultural Heritage Due Diligence Guidelines and taking appropriate action to obtain further information where appropriate.

SCHEDULE 2 – THE ABORIGINAL HERITAGE RISK MATRIX

Previous Land Use	LAND ACTIVITIES – CATEGORIES 1-5					
		1. Negligible disturbance	2. Minimal disturbance	3. Moderate disturbance	4. Significant disturbance	5. Major disturbance
	Built Environment - e.g. urban environment, towns, metropolitan region.	Low	Low	Low	Low	Medium
	Significantly Altered Environment - e.g. cultivated and cleared land.	Low	Low	Low	Medium	High
	Moderately Altered Environment - e.g. partially cleared lands, re-vegetated landscape.	Low	Low	Medium	Medium	High
	Minimally Altered Environment - e.g. urban bush land, regrowth areas	Low	Medium	Medium	High	High
	Unaltered Environment - e.g. protected areas or pristine environment.	Low	Medium	High	High	High
Risk Assessment		Actions				
Low Risk (Review)		Review the landscape and proposed activity (see sections 2.4 - 2.8 - assessing the landscape and the activity). Refer to the AHIS.				
Medium Risk (Review /Exercise Caution)		Review the landscape and proposed activity (as above). The precautionary principle (see page 2) applies. Refer to the AHIS and contact the DAA. A range of actions may be recommended, including: no action, consultation with the relevant Aboriginal people, an Aboriginal heritage survey or modification of the proposed activity to avoid or minimise site impact.				
High Risk (Consult / Survey / Approvals)		Refer to the AHIS. Consult with the DAA and the relevant Aboriginal people. Dependent on consultation outcomes you may need to include: an Aboriginal heritage survey, modification of the proposed activity to avoid or minimise (see sections 2.24 - 2.28) impact to the site and/or other heritage management strategies. The land user may also need to apply for approval or consent (see section 2.26) to the activity.				
For major development projects refer to sections 2.10 - 2.12 for further advice.						

Figure 1. Heritage Risk Matrix

With reference to the Aboriginal Heritage Risk Matrix, the proposed mining operations are considered a 'major disturbance'. The survey area is properly described as an 'unaltered environment'. The risk assessment confirms there is a high risk to Aboriginal heritage, and consultation, including a field survey with the appropriate Aboriginal knowledge holders, is recommended as the appropriate risk mitigation action.

Existing Aboriginal heritage site information and Aboriginal heritage surveys

Recorded Aboriginal Sites

The State categorises Aboriginal heritage sites into two categories; *Registered sites* and *Other Heritage Places*. Registered sites have been assessed by the ACMC as meeting the threshold tests for registration under section 5 of the AH Act. Other Heritage Places have either been assessed as not meeting the threshold test to be entered in the Register (*not a site*), or that the site is awaiting a formal assessment by the ACMC (*lodged*).

Recorded Aboriginal Sites in the Survey Area

The AHIS confirms that there are no recorded Aboriginal sites in the survey areas, but there are sites in or near the tenement. The search results are detailed below in **Figures 2 and 3**.

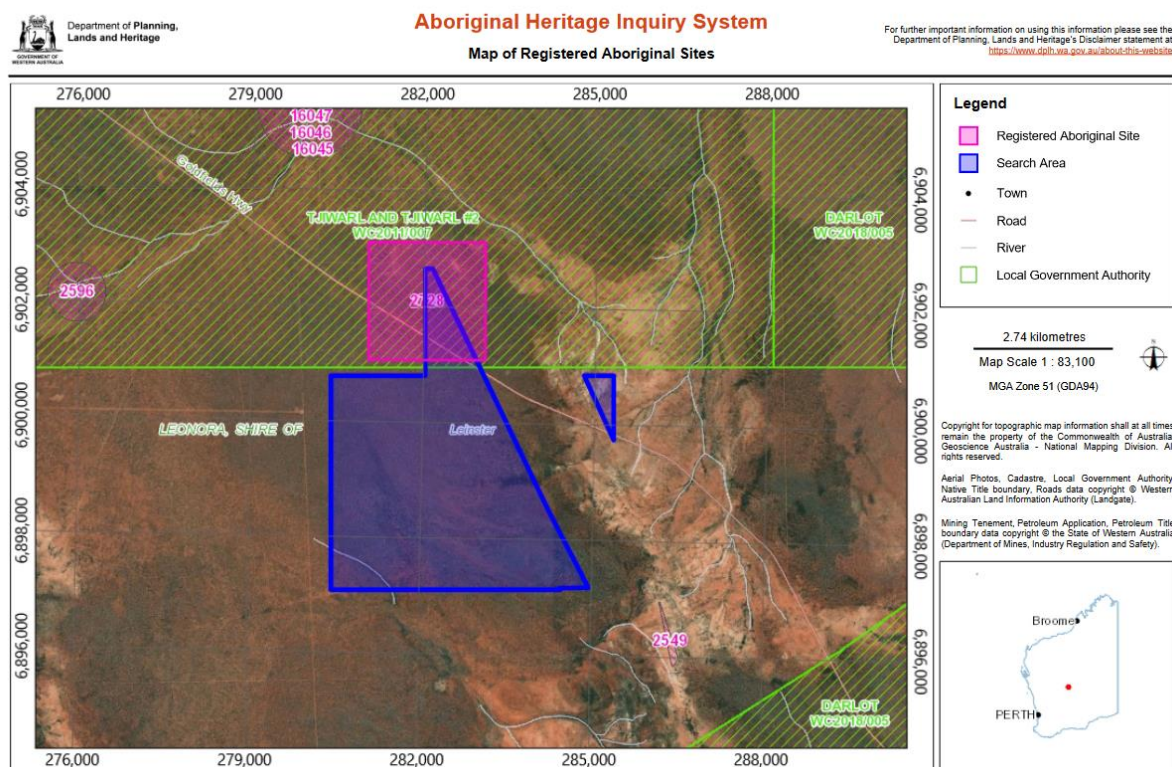


Figure 2. Registered Site Search E36/1003

There are two sites located inside tenement E36/1003. Both are located on the northern side of the Goldfields Highway and are not within the mining lease application area.

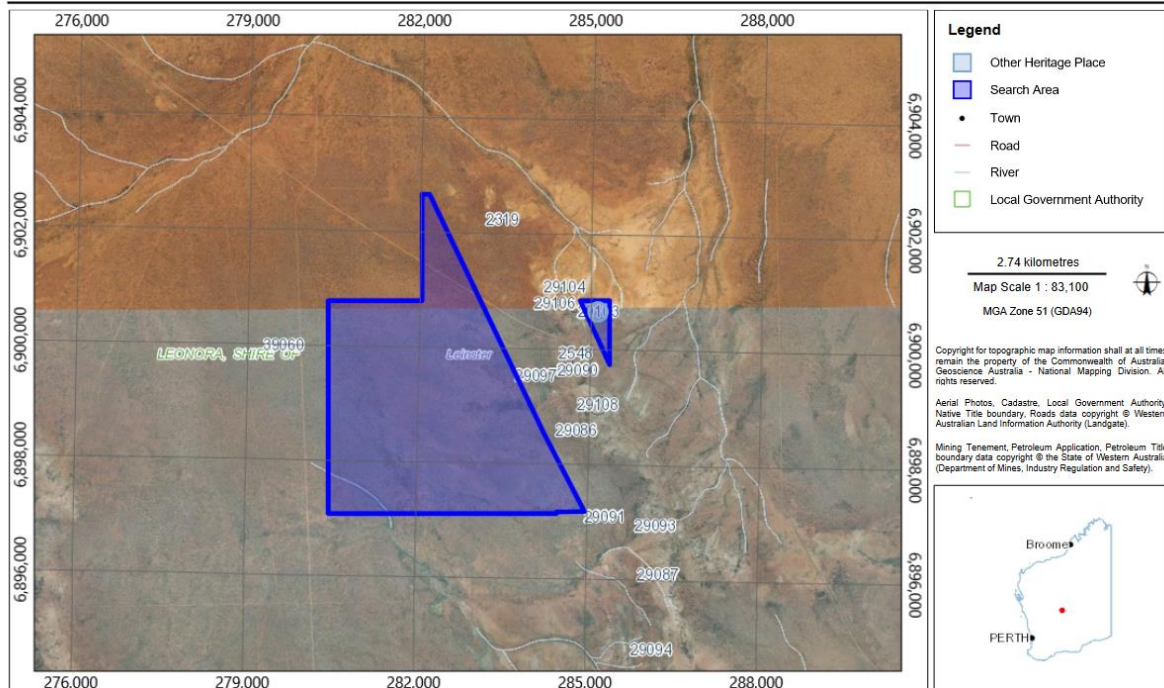


Figure 3. Other Heritage Place Search E36/1003

Site ID 2728 – Parra Hill

This site is the closest registered site to the proposed mining lease, being some 600 m directly to the north. The site was first recorded by Dr Ken Liberman in 1977 with senior Aboriginal men (watis). Information about the site is limited because of the cultural sensitivities about the site. The site is highly significant because of the associated use of the cultural material available at the site. However, Mr Peterson recalls going to the site with some of the 'old people'. He said it is a '*kunti*' site, which means that the cultural material is harvested and used in male traditions. Mr Peterson said that the '*parra*' is a type of large tree that grows in the area, not a traditional name.

The site was registered in 1982.

Site ID 29103 – Weebo Site 19

This site was recorded as an ethnographic site during an Aboriginal heritage survey undertaken for BHP Billiton Nickel West in 2008. The survey party were surveying for heritage sites in a proposed gas pipeline corridor. The site is described as camp site and rock-shelter. The site remains lodged on the AHIS pending assessment by the ACMC.

Previous Heritage Survey Reports

There are no Aboriginal heritage reports listed on the AHIS for the survey area. It is, therefore, impossible to determine whether Aboriginal heritage surveys have been undertaken. Surveys of land adjacent to the survey area are listed on the AHIS. Several of these reports were reviewed prior to the fieldwork commencing and made available to the Survey Party for their review. These surveys identified the various sites that have been recorded close to the Survey Area.

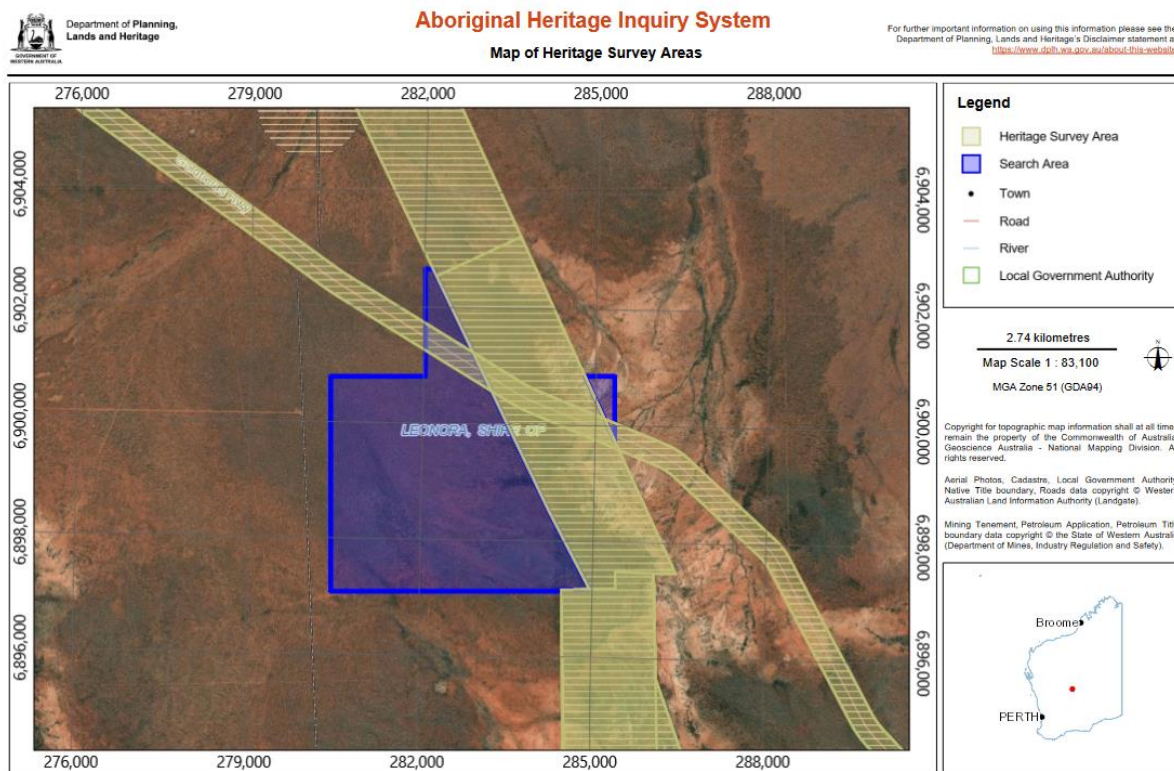


Figure 4. Survey coverage E36/1003

In this part of the Western Desert, it is common for topographical features to be connected to a Dreamtime myth. It is believed that during the Dreamtime, the human-animal creatures created the high hills and the breakaways. They burrowed below the ground, fought and hunted, and then passed on, leaving the caves and rock holes.

The historical survey reports indicate that most of the recorded sites include the presence of rocky outcrops suitable for the manufacture of stone tools. This indicates that there is a higher potential to find cultural material sites near outcrops of suitable lithic materials, such as fined grained stone materials like chert, chalcedony, silcrete, and (some) banded ironstones.

The survey reports reviewed prior to the survey being undertaken are listed in Table 1. below. Appendix 1 shows the heritage survey coverage of the survey area.

Table 1.

Report Title	Author & Year	Type
Addendum to the report on the survey of Aboriginal heritage significance at Telecom DRS repeaters in the Wiluna and Leonora Systems	R. O'Connor 1987	Archaeological and Ethnographic ID 17264
Report on an ethnographic survey of Western Mining Corporation Leinster Nickel Operations	Macintyre & Dobson 1990	Ethnographic ID 23224
Report on stage two of the archaeological survey of the proposed teutonic bore to Leinster Road alignment	M. Smith 1980	Archaeological ID 17232
A Report of an Ethnographic Survey of Weebo and Allstate Tenements with the Koara Native Title Claimant Group Prepared for BHP	T. Doulman 2008	Ethnographic ID 23781
Report on an Aboriginal Heritage Assessment of the Leinster Mining Leases ML255SA with the Tjupan/Wanmulla/Sir Samuel Group Prepared for BHP	D. de Gand 2008	Ethnographic ID 23820

The desktop review found that there are several sites of cultural significance near the survey area. These sites are ethnographic in nature and are associated with breakaways and rocky outcrops.

Findings of Field Inspection

Prior to leaving Leonora, all survey party members undertook a Rapid Antigen Test (RAT) to detect Covid-19. This was done at the request of the survey party. All members tested negative. Mr Rayner advised the survey team of the Covid-19 safety regime that would be adopted during the course of the survey. It was explained that each member of the survey team would be required to report immediately any symptoms such as sore throat, runny nose, fever or aches and pains. Disposable face masks and hand sanitiser were made available to each member of the survey team.

The survey party considered the survey objectives, survey land, topography and ground cover and agreed on the survey methodology, which began by discussing the ethnography of the region. Given no heritage surveys have been undertaken over the area, the survey party agreed to conduct pedestrian transects of the entire mining lease area. The vehicle was driven to the closest point, and the survey party walked in the inspection area.

The survey was undertaken in one trip between 27 – 30 October 2022.

Ethnographic Findings

Mr Peterson confirmed that the broader Dreamtime stories in the region relate to the two men (Wati Kutjarra), an emu (Karlaya), and a Dingo (Papa). These ancestral beings travelled the region and created sacred sites in the landscape. During the survey, Mr Peterson confirmed that none of the sites that relate to these Dreamtime adventures are located within the survey area.

The survey party confirmed that no places of cultural, ceremonial, or ritual significance were identified immediately within the survey area. Mr Peterson observed that 'no cultural business is done here'. The nearest ethnographic site is located approximately 600 m north of the survey area. Mr Peterson confirms his knowledge of the '*kunti*' place and that it would not be affected by the proposed mining operations proposed by MLG. He noted that knowledge and use of the site are restricted to initiated men only and that women are forbidden to enter the site. Mr Peterson advised that the site is no longer in use and traditional lore practices have not occurred in this area since the 1960s. Male initiation now occurs at Bondini in Wiluna. He confirmed that while not still in use, the site retains its 'power'.

The senior women also confirmed that there are no 'women only' sites located in the survey area. The nearest 'women only' site is approximately 9km east of the tenement.



Photo 2. Survey party inspecting the survey area

Cultural Material Findings

The survey party began the survey in the northwest section of the survey area, walking pedestrian transects through the area and inspecting the ground for cultural artefacts. The vegetation consisted of sparse low-level shrubs, including spinifex on a bed of red sand.

The northern most proposed mining pit was closely inspected as the most prominent of the three sand ridges. Initially, the survey party thought the area could have been used as a camping area, given its elevation and soft sand. However, no artefacts were observed, nor is there any outcropping of suitable material for tool manufacture, and there is no evident natural water source. The survey party agreed that there is no evidence of past use associated with this area.



Photo 3. Survey party in discussion

Relevant observations

There are several factors that contribute to the occurrence of Aboriginal sites and past use of the area by Aboriginal people, that are relevant to the findings of this field survey inspection. These are outlined below.

- The whole of the area is a sheet of sandy substrate. The sandy substrate would have offered a more hospitable environment for Aboriginal people to move through, use and occupy than the harsh, barren stone fields that dominate areas outside the proposed

mining lease area. Movement by Aboriginal people through the rocky terrain of these areas would have been more difficult, slow-going, and uncomfortable than the sandy terrain of the localised sand-sheets.

- However, no permanent natural water sources were identified in the survey area. The lack of water, either permanent or semi-permanent, would have been a critical factor limiting Aboriginal use and occupation of the area in the past.
- No lithic sources other than the outcropping and locally ubiquitous quartz outside of the survey area. The limited range of resources (water, lithic raw material, food supply) available in the area would have influenced the nature and duration of occupation by Aboriginal people, which appears to have been limited.
- For the most part, the proposed land use locations are situated on unremarkable flat plains with sparse mulga scrub as the primary vegetation.
- Landforms associated with use by Aboriginal people in the past, and good preservation conditions, such as breakaways, rock shelters and rock overhangs, are not present in the survey area.



Photo 4. Mr Peterson at the rock-hole

The entire mining lease area and access road alignment were surveyed for the presence of Aboriginal sites. No Aboriginal sites were identified during the three days field survey. The survey party are satisfied that the area proposed for mining is clear of any Aboriginal sites and there is no cultural heritage impediment to the mining proceeding.

The survey party took the author to an important and well known rock-hole site just outside of the mining lease area. They were concerned that the mining proposal does not extend into the area of the site. Mr Peterson said that site is very significant in Western Desert tradition. It is of both domestic and religious significance in Western Desert tradition and cannot be disturbed or impacted in any way. Several stone artefacts were present at the rock-hole indicating cultural usage at this place.



Photo 5. Artefact located at rock-hole

Conclusion

This report presents the findings of an Aboriginal cultural heritage survey undertaken with Aboriginal people with customary knowledge of the area of land MLG proposes to mine. The survey was undertaken to ensure that MLG's proposed mining operations do not cause damage to unrecorded Aboriginal sites and complies with the requirements of the AH Act.

The survey party were identified through consulting Aboriginal Elders living in Leonora. The survey party consisted of prominent elders recognised to have customary knowledge and cultural authority in Western Desert traditions.

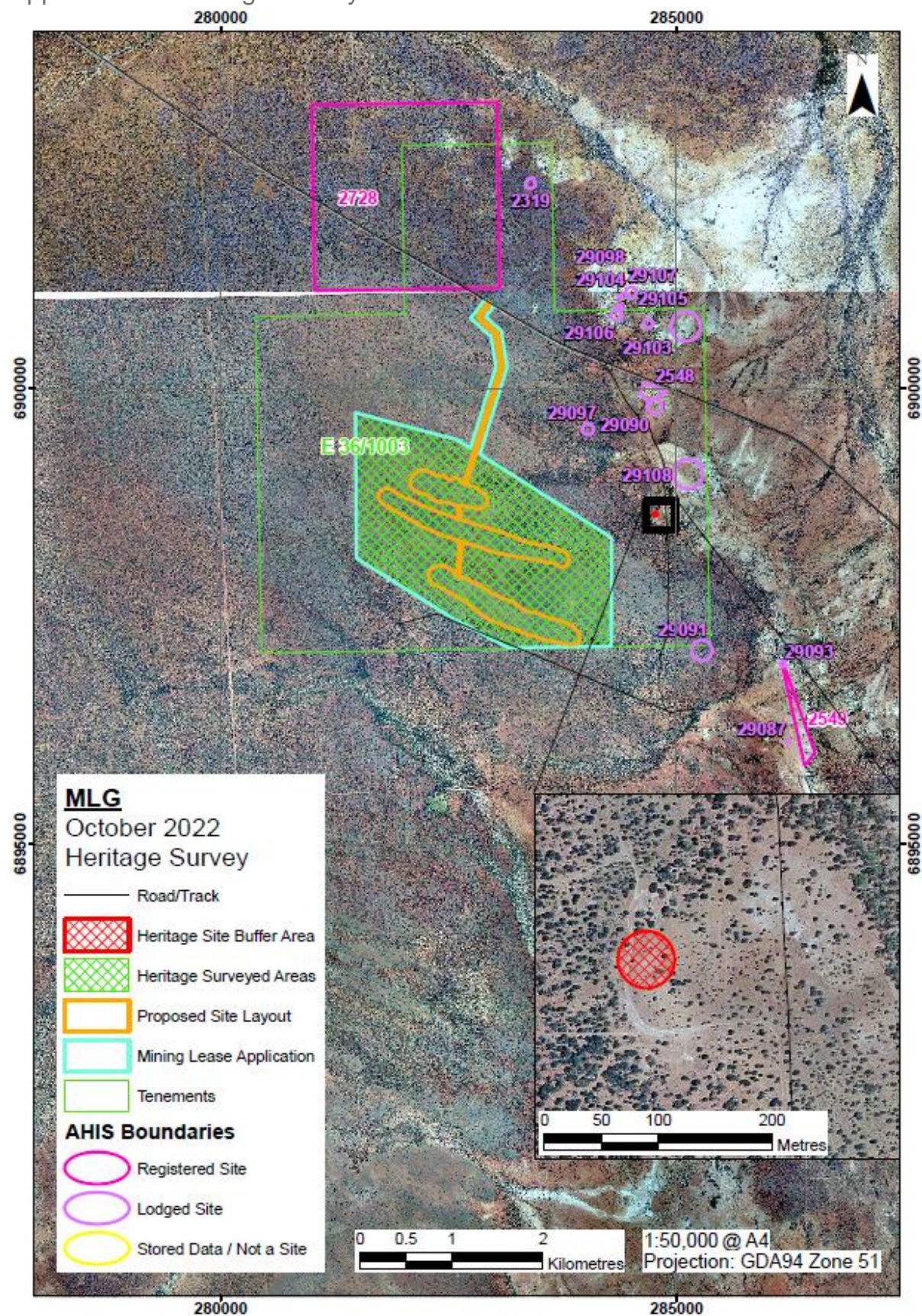
The desktop assessment using publicly available Aboriginal heritage information found no recorded sites in the survey area. This was also the primary finding confirmed during the fieldwork survey. The survey party confirmed that there are no Aboriginal sites within the survey area and the survey area is clear for MLG to proceed with its mining operations.

Recommendations

It is recommended that MLG OZ Ltd:

1. Note that the survey area, which is the extent of the proposed mining lease and the access road, has been completed – see Appendix 1.
2. Note that the survey party did not identify any Aboriginal heritage sites, and the Survey Area is cleared.
3. Carry out further Aboriginal heritage surveys where it seeks to use land outside of the cleared heritage survey area (proposed mining lease area) prior to commencing ground disturbing activities.
4. Ensures its staff and contractors are aware of their obligations under the AH Act; and
5. Reports any newly discovered Aboriginal sites pursuant to section 15 of the *Aboriginal Heritage Act 1972*.

Appendix 1 – Heritage Survey Area and Results



APPENDIX 6: STAKEHOLDER REGISTER

Date	Stakeholder Group	Representatives	Description of Consultation	Type of Consultation
14/1/2021	Tjiwarl Traditional owner Group, Leinster Downs Pastoral Leaseholder	Pastoralist and Chairman of the Tjiwarl Traditional Owners Group, Brett Lewis	16 Mile Well Project briefing at Tjiwarl head office in Kewdale.	Meeting
Quarterly 2021	Tjiwarl Traditional Owner Group, Leinster Downs Pastoral Leaseholder	Pastoralist and Chairman of the Tjiwarl Traditional Owners Group, Brett Lewis	Regular communication to discuss the project and provided updates and ensure collaboration.	Phone call and email
9/12/2021	Tjiwarl Traditional owner Group, Leinster Downs Pastoral Leaseholder	Jordan Lewis (Pastoral Representative) and Tjiwarl Heritage Committee	Walk through of project, briefing on the status of mining lease applications and heritage planning works. Presentation on the Mt Keith Project and proposed disturbance activities. Tjiwarl to arrange heritage survey over Project area	Meeting
Quarterly 2022	Tjiwarl Traditional owner Group, Leinster Downs Pastoral Leaseholder	Pastoralist and Chairman of the Tjiwarl Traditional Owners Group, Brett Lewis	Regular communication to discuss the project and provided updates.	Phone call and email