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1 Proposed Activities

OzAurum Mines Pty Ltd, Line Hydrogen (Australia) Pty Ltd and BIM Metals Pty Ltd, together in a joint venture project, are proposing to commence development of the Mulgabbie North Project (the Project). The Project will involve formation of multiple open pits, waste rock dumps and a heap leach processing facility. Activities to support operations will also include a run-of-mine pad, access roads and borefields. To allow Project development, the constituents are seeking approval to clear up to 460 hectares (ha) within a disturbance envelope of 634 ha, shown in **Figure 1**.

1.1 Location

Mulgabbie North is situated approximately 110 kilometres (km) north-east of Kalgoorlie-Boulder in the Goldfields region of WA, straddling the border between Kalgoorlie-Boulder and Menzies local government areas. It is located approximately 2 km east of Northern Star's well established Carosue Dam operation, who's facilities will support the Mulgabbie North Project.

The disturbance envelope encompasses tenements listed in **Table 1**. Tenements overly Pinjin pastoral lease and crown land reserve and has been previously disturbed by grazing and mining exploration activities.

The nearest environmentally sensitive areas are Goongarrie National Park (R35637), located 60 km west and Queen Victoria Spring Nature Reserve (R30491), located 70 km east. There are no public drinking water source areas within 100 km of the Project. Lake Rebecca, a large inland salt lake, is situated approximately 6 km east.

Table 1: Tenement details

Tenement ID	Holder 1	Area (ha)	Expiry	Purpose(s)
M28/240	OzAurum Mines Pty Ltd	261.9	06/01/2029	N/A
M28/364	OzAurum Mines Pty Ltd	54.62	24/03/2030	N/A
L28/71	OzAurum Mines Pty Ltd	93.27	30/03/2043	Bore field, pipeline, power line, road, water management facility, bridge, taking water, search for groundwater, drainage channel, pump station, bore, water management facility
L28/75	OzAurum Mines Pty Ltd	57.54	22/03/2044	Bore, bore field, drainage channel, pipeline, power generation and transmission facility, power line, pump station, road, search for groundwater, water management facility, taking water
L28/76	OzAurum Mines Pty Ltd	98.69	22/03/2044	Bore, bore field, drainage channel, pipeline, power generation and transmission facility, power line, pump station, road, search for groundwater, water management facility, taking water
L28/48	OzAurum Mines Pty Ltd	70	07/02/2040	Pipeline, power line, road
L28/49	OzAurum Mines Pty Ltd	18.29	07/02/2040	Pipeline, power line, road

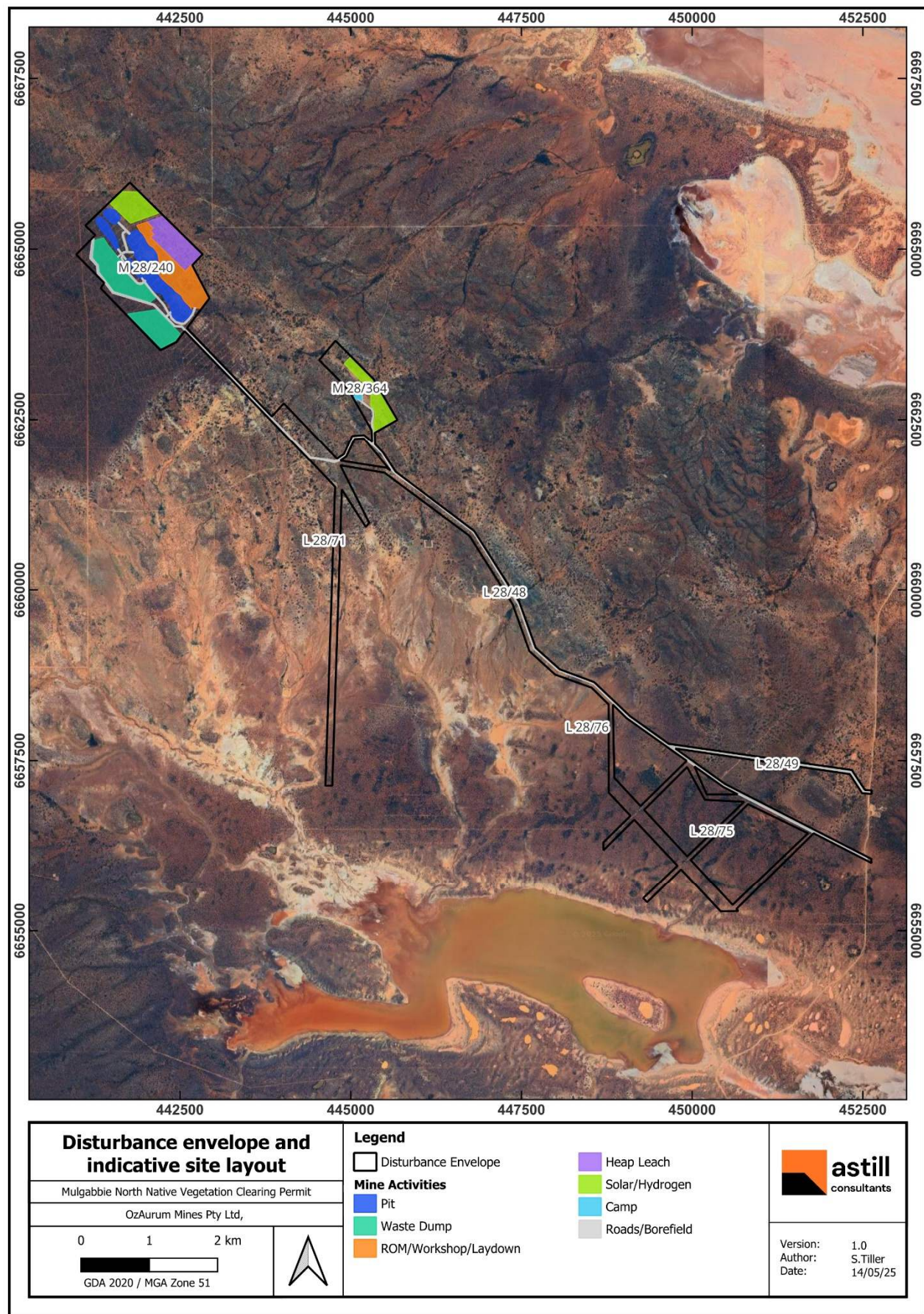


Figure 1: Disturbance envelope and indicative site layout

2 Environmental Setting

2.1 Climate

The Project is situated within the Goldfields region of WA, experiencing an arid to semi-arid climate with hot, dry summers and cool, wet winters (Cowan, 2001). The nearest Bureau of Meteorology (BOM) weather station is located 110 km south-west at Kalgoorlie-Boulder Airport (Station ID 012038) (BOM, 2025).

The area experiences average maximum temperature of 33.7°C, and average minimum temperature of 5.1°C. Annual average rainfall is 265.2 mm, with a mean of 39.2 days of rain per year (≥ 1 mm). Rainfall is highest in February at 31.8 mm and lowest in September at 13.4 mm. Mean monthly rainfall and temperature are shown in **Figure 2**. Based on the intensity-frequency-duration (IFD) chart for the Project, a 1:100-year annual exceedance probability, 72-hour storm event can be expected to generate approximately 193 mm of rainfall (BOM, 2025).



Figure 2: Mean rainfall and maximum temperature for years 1939–2025

2.2 Land Systems

As part of the Rangeland resource surveys, the Department of Agriculture mapped the Land Systems of Western Australia (DPIRD, 2017). The Deadman System (29%), described as calcareous plains supporting acacia, black oak and mallee shrublands / woodlands adjacent to salt lake systems, is the dominant land system within the disturbance envelope, followed by the Moriarty System (24%), described as low greenstone rises and stony plains supporting chenopod shrublands with patchy eucalypt overstoreys. All Land Systems occurring within the disturbance envelope are listed in **Table 2** below.

Table 2: Land systems within the disturbance envelope

Land System	Description	% of Envelope
Campsite System	Alluvial plains supporting eucalypt woodlands with halophytic understoreys and acacia shrublands.	1%
Carnegie System	Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.	15%
Deadman System	Calcareous plains supporting acacia, black oak and mallee shrublands / woodlands adjacent to salt lake systems.	29%
Gundockerta System	Extensive, gently undulating calcareous stony plains supporting bluebush shrublands.	19%
Leonora System	Low greenstone hills and stony plains supporting mixed chenopod shrublands.	12%
Moriarty System	Low greenstone rises and stony plains supporting chenopod shrublands with patchy eucalypt overstoreys.	24%

2.3 Surveys

The Project has been subject to flora, vegetation and fauna surveys as described in **Table 3** below.

Table 3: Biodiversity surveys

Survey Date	Survey Type	Title	IBSA Number
13 Dec 2024	Reconnaissance flora & vegetation	Reconnaissance Flora and Vegetation Survey of the Mulgabbie Project Borefield and Access Roads (NVS, 2025)	IBSA-2025-0182
13 Dec 2024	Basic fauna	Basic Vertebrate Fauna Survey and Assessment, Mulgabbie North Project Area (Terrestrial Ecosystems, 2025)	IBSA-2025-0183
7 – 23 Jan 2020	Reconnaissance flora, vegetation & basic fauna	Environmental Assessment: Relief Hill Survey Area (Alexander Hold and Associates, 2020)	IBSA-2025-0185
7 Jan – 13 Feb 2019	Reconnaissance flora, vegetation & basic fauna	Environmental Assessment: Proposed Seismic Survey Area (Alexander Holm & Associates, 2019)	IBSA-2025-0184

2.4 Flora and Vegetation

The Project lies within the Eremaean botanical province, mainly in the Austin botanical district (Beard, 1976). Lake Ballard/Lake Rebecca form a major vegetation divide with characteristic *Acacia aneura* (mulga) low woodlands associated with red loams over siliceous hardpan to the north and low woodlands of mixed mulga and *Casuarina obesa* (black oak) and *Eucalyptus* species on alkaline and calcareous soils to the south. Spinifex hummock grassland with eucalypt overstorey on sand plain is common. Halophytic vegetation occurs throughout the region on palaeo-drainage systems, breakaways and on some stony and alluvial plains. Highly saline soils support *Atriplex* (saltbush), *Maireana* (bluebush) and *Tecticornia* (samphire) shrublands, while less saline soils support eucalypt or mulga with saltbush or bluebush understoreys.

There are four vegetation associations (Beard, 1976) within the disturbance envelope. All vegetation associations have more than 99% of it's pre-European extent remaining:

- 20 – Low woodland; mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.

- 24 – Low woodland or open low woodland; other acacia, banksia, peppermint, cypress pine, casuarina, York gum, *Acacia* spp., *Banksia* spp., *Agonis flexuosa*, *Callitris* spp., *Allocasuarina* spp., *Eucalyptus loxophleba*.
- 480 – Saltbush and/or bluebush with scattered low trees; mulga, other wattle, casuarina, *Atriplex* spp. *Maireana* spp. with *Acacia aneura*, *A. papyrocarpa*, *Allocasuarina cristata*.
- 529 – Succulent steppe with open low woodland; mulga and sheoak over salt bush.

Three flora and vegetation surveys have been carried out over the Project area by A. Holm & Associates (2019; 2020) and Native Vegetation Solutions (NVS) (2025), involving a desktop assessment and reconnaissance vegetation and flora survey over the disturbance envelope and surrounds. A total of 19 vegetation types were identified, seven by A. Holm & Associates (2019; 2020) and twelve by NVS (2025), within the disturbance envelope as described in **Table 4**.













The area has been disturbed by recent and historic mining activity and is within a pastoral lease subject to low-intensity grazing. Vehicle tracks, cut lines and pastoral fences cross the area. Vegetation types supporting chenopod vegetation, preferentially grazed by livestock, are mostly degraded and few areas are in good condition (A. Holm & Associates 2019; 2020). Overall, the condition of vegetation (using the scale of Keighery 1994) was determined to range from “Completely Degraded” to “Very Good” with most of the area falling into the “Good” category. Areas which were affected by historic exploration and clearing were deemed in “Completely Degraded” condition (NVS, 2025).

No unique or restricted vegetation communities were identified, and all vegetation types/communities are common, widespread and well represented in the Eastern Murchison subregion. Assessment of ecological community information (DCCEEW, 2025) revealed that no Threatened or Priority Ecological Communities (TEC/PEC) occur within 20 km of the disturbance envelope and no vegetation groups recorded in this survey area are synonymous with PECs listed by DBCA (2023) (A. Holm & Associates 2019; 2020; NVS 2025).

No Threatened or Priority Flora were recorded in the disturbance envelope (A. Holm & Associates 2019; 2020; NVS 2025).

Six weed species were recorded within the disturbance envelope, *Carrichtera annua* (Wards Weed), *Centaurea melitensis* (Maltese Cockspur), *Salvia verbenaca* (Wild Sage), *Sisymbrium irio* (London Rocket), *Sonchus oleraceus* (Common Sow Thistle) and *Carthamus lanatus* (Saffron Thistle). None of these species are considered a Declared Pest under the *Biosecurity Agriculture Management Act 2007* (DPIRD, 2025) (A. Holm & Associates 2019; 2020; NVS 2025).

Table 4: Vegetation types within the disturbance envelope

Vegetation Types		
		
1. Breakaway footslope eucalypt woodland with chenopod understory (1c)	2. Calcareous casuarina acacia shrubland (2a)	3. Greenstone hill mixed shrubland (2b)
		
4. Hardpan mulga shrubland (4b)	5. Plain mixed halophyte shrubland (5a)	6. Plain eucalypt chenopod shrubland (5b)
		
7. Drainage tract acacia shrubland (6)	8. <i>Eucalyptus oleosa</i> woodland (A)	9. Acacia shrubland (B)
		
10. Mulga shrubland (C)	11. <i>Eucalyptus salmonoploia</i> woodland (D)	12. Chenopod shrubland (E)



13. Mulga over chenopod shrubland (F)



14. *Acacia burkittii* shrubland in creekline (G)



15. *Eucalyptus lesouefii* woodland (H)



16. *Eucalyptus loxophleba* woodland (I)



17. Chenopod shrubland over *Tecticornia* (J)



18. *Acacia kalgoorliensis* shrubland (K)



19. *Acacia* shrubland on rocky slope (L)

1–7 sourced from A. Holm & Associates 2019; 2020

8–19 sourced from NVS, 2025

2.5 Fauna

Three fauna surveys have been conducted over the study area by Bamford Consulting Ecologists (2019; 2020), and Terrestrial Ecosystems (2025) involving a desktop assessment and field survey over the disturbance envelope and surrounds. During field surveys, ecologists/zoologists traversed the area both in vehicle and on foot. This enabled environmental descriptions to be prepared and some opportunistic observations on fauna to be made. Surveys also involved assessment of possible presence of and recording evidence of species of conservation significance known to occur in the region. Results are shown in **Table 5** below.

Table 5: Assessment of potential presence of significant fauna

Species	DBCA Schedule / Priority	Status under Cth EPBC Act	Comment on potential presence of a species
Night Parrot <i>Pezoporus occidentalis</i>	Critically Endangered	Endangered	There is no ring-forming spinifex in the project area. so, it is probably not present in the project area.
Sandhill Dunnart <i>Sminthopsis psammophila</i>	Endangered	Endangered	Not known in this area and not recorded by Western Wildlife (2022) in a nearby survey.
Great Desert Skink <i>Liopholis kintorei</i>	Vulnerable	Vulnerable	It is highly unlikely to be in the project area due to a lack of suitable habitat and because it is outside its known geographic range.
Malleefowl <i>Leipoa ocellata</i>	Vulnerable	Vulnerable	Possibly in the project area.
Grey Falcon <i>Falco hypoleucos</i>	Vulnerable	Vulnerable	Highly unlikely to be in the project area, as it has rarely been recorded in the eastern Goldfields.
Chuditch <i>Dasyurus geoffroii</i>	Vulnerable	Vulnerable	Highly unlikely to occur in the project area.
Princess Parrot <i>Polytelis alexandrae</i>	P4	Vulnerable	It may infrequently be seen in the region, however, clearing vegetation is unlikely to impact this species.
Southern Whiteface <i>Aphelocephala leucopsis</i>	P4	Vulnerable	Possibly in the project area.
Long-tailed Dunnart <i>Antechinomys longicaudatus</i>	P4	Migratory	It is highly unlikely to be in the project area due to a lack of suitable habitat (i.e. rocky breakaways and ridgelines).
Woma <i>Aspidites ramsayi</i>	P1		It is unlikely to be in the project area due to predation by feral cats and wild dogs.
Brush-tailed Mulgara <i>Dasyurus blythi</i>	P4	Migratory	It is outside its known geographic range, so it is unlikely to be in the project area.
Fork-tailed Swift <i>Apus pacificus</i>	Migratory	Migratory	It may very infrequently be seen in the region, however, clearing vegetation is unlikely to impact this aerial species.
Oriental Plover <i>Charadrius veredus</i>	Migratory	Migratory	It has not been recently recorded in the general area, so it is improbable that it is in the project area.
Grey Wagtail <i>Motacilla cinerea</i>	Migratory	Migratory	Highly unlikely to be present in the project area.
Peregrine Falcon <i>Falco peregrinus</i>	OS		It may very infrequently be seen in the region; however, clearing vegetation is unlikely to impact this species.

OS – Other specially protected fauna

Malleefowl (*Leipoa ocellata*)

Several Malleefowl (*Leipoa ocellata*) nesting mounds were observed during field surveys within the disturbance envelope and throughout the broader area, both active and inactive. The species is clearly resident in the area but ecologists believe the density of mounds is low when compared to other areas. There are five known malleefowl mounds within the disturbance envelope (Bamford Consulting Ecologists, 2019; 2020).

Southern Whiteface (*Aphelocephala leucopsis*)

The Southern Whiteface (*Aphelocephala leucopsis*) is a small bird found in the arid and semi-arid interior from the WA coast near Hamelin Bay through the Great Victoria Desert into the arid areas of South Australia, Victoria, NSW, and Queensland (Johnstone and Storr, 2004; DCCEEW, 2023).

It is found in open woodlands and shrublands with an understorey of grasses and low shrubs. It forages on the ground, feeding on insects, spiders, and seeds, mostly found in the leaf litter (Johnstone and Storr, 2004; DCCEEW, 2023).

This bird will readily move to adjacent areas if it is disturbed. There is an abundance of similar fauna habitats present in adjacent areas, so the proposed clearing of vegetation is unlikely to have a significant impact on this bird (Terrestrial Ecosystems, 2025).

2.6 Hydrology

The East Murchison subregion topography is undulating with occasional ranges of low hills and extensive areas of elevated red desert sand plains. This region is characterised by its internal drainage and salt lake system associated with the occluded palaeodrainage systems (Cowan, 2001). The region is typified by north-westerly trending saline lake drainage systems which flow parallel to and cross the stratigraphy.

The Mulgabbie North Project is situated within the Lake Rebecca surface water catchment, with predominantly southerly drainage towards Lake Rebecca, a large inland salt lake. There are no permanent rivers or major drainage lines in the area. Flood water runoff occurs as sheet flow concentrated in very shallow and broad lines of drainage over deposits of gravel, sand and silt. Minor sheet drainage lines exist within the disturbance envelope, but flow occurs only after major rainfall events.

It is unlikely that proposed activities will impact local or regional hydrology.

2.7 Aboriginal Heritage

A search of the Department of Planning, Lands and Heritage (DPLH) Aboriginal Cultural Heritage Inquiry System (ACHIS) has identified no Aboriginal heritage sites within the disturbance envelope (DPLH, 2025).

Several Aboriginal heritage surveys have been carried out over the Project area by Native Title Party 'Nyalpa Pirniku' and Aboriginal knowledge holders. OZLHBM engaged specialist Ethnographer Daniel de Gand to undertake a review of previous Aboriginal heritage surveys as well as carry out a field survey of the area. The survey indicated that there are no Aboriginal heritage sites within the disturbance envelope (Daniel de Gand, 2025).

3 Ten Clearing Principles

An assessment against each of the ten clearing principles as defined under Schedule 5 of the *EP Act* demonstrates that the proposed clearing is unlikely to be at variance with any of principles as outlined in **Table 6** below.

Table 6: Ten clearing principles

Clearing principle	Assessment	Outcome
1. It comprises a high level of biological diversity.	The project area is not considered to comprise a high level of biological diversity as vegetation is typical of surrounding region. The vegetation within the Project area has been impacted by historical and recent disturbances, reducing vegetation quality. Conservation significant species potentially in the project area (i.e. Malleefowl, Southern Whiteface) are unlikely to be significantly impacted.	Unlikely to be at variance to this principle.
2. It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing vegetation will not result in the loss of significant habitat for indigenous fauna. Habitat potentially cleared will include that which Malleefowl and Southern Whiteface utilises, but any potential impacts are not considered significant.	Unlikely to be at variance to this principle.
3. It includes or is necessary for the continued existence of rare flora.	No Threatened (Declared Rare) or Priority flora species were recorded in the project area during the vegetation and flora surveys.	Not at variance to this principle.
4. It comprises the whole or a part of or is necessary for the maintenance of a threatened ecological community.	There are no known threatened ecological communities located within the project area.	Not at variance to this principle.
5. It is significant as a remnant of native vegetation in an area that has been extensively cleared.	All vegetation associations within the project area have more than 99% of its pre-European extent remaining.	Not at variance to this principle.
6. It is growing in, or in association with, an environment associated with a watercourse or wetland.	There are no permanent watercourses or wetlands in the project area. Minor ephemeral surface water flow paths exist however, vegetation associated with these flow paths are not specific to these areas and are not considered riparian vegetation.	Unlikely to be at variance to this principle.
7. The clearing of the vegetation is likely to cause appreciable land degradation.	The project area has been subject to previous exploration disturbance, and following completion of project activities, the site will be rehabilitated in accordance with an approved Mine Closure Plan.	Unlikely to be at variance to this principle.
8. The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	There are no conservation areas within the project area. The nearest conservation area is located more than 50 km away.	Not at variance to this principle.

9. The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	There are no permanent rivers, lakes or creeks in the project area and watercourses are ephemeral and minor. Ephemeral drainage lines in the project area only flow as shallow overland flows. Groundwater in the region is hypersaline and has limited uses outside of the mining industry. Groundwater recharge is slow and will not be impacted by clearing activities.	Unlikely to be at variance to this principle.
10.If clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The climate is arid with an average annual rainfall under 300 mm. There are no permanent rivers, lakes or creeks in the project area and watercourses are ephemeral and minor. Ephemeral drainage lines in the project area only flow as shallow overland flows. Average annual evaporation exceeds average annual rainfall by a factor of almost 10 to 1.	Unlikely to be at variance to this principle

4 Clearing Method

Clearing areas will be kept to the minimum required for mine activities and undertaken progressively as required. Existing disturbances will be utilised where possible. Paths of least resistance through vegetation will be used when siting roads and other linear infrastructure as well as retention of canopy trees (where practicable).

4.1 Equipment

Equipment required to undertake and support clearing activities may include a combination of:

- Dozer;
- Loader;
- Excavator;
- Water Cart; and
- Service Vehicles.

4.2 Methodology

Prior to any clearing, a internal surface disturbance permit will be authorised by OZLHBM to ensure clearing is able to be undertaken under a clearing permit or valid clearing exemption (i.e., Regulation 20 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*).

Proposed clearing will be demarcated by a surveyor using high visibility tape / survey pegs to ensure clear visual boundaries for operators prior to clearing commencement or alternatively a spotter with handheld GPS will guide clearing. A toolbox meeting will be held between the supervisor and clearing operator to ensure awareness of clearing areas and any areas to be avoided.

Where practicable raised blade clearing will be used. Where this is not practicable, topsoil will be stripped to 200 mm depth and stockpiled for use in rehabilitation, along with removed vegetation. Once clearing has been completed, surveyors will complete a pickup of cleared areas and maintain appropriate data records.

4.3 Rehabilitation

Rehabilitation of cleared areas will occur in accordance with the Mine Closure Plan (MCP) which will be prepared for the Mulgabbie North Project and will be submitted in conjunction with a Mining Proposal to DEMIRS.

5 Environmental Management

5.1 Weeds

Activities which disturb land and soils including clearing have the potential to create favourable conditions for weed infestation. Weeds can be difficult to eradicate once introduced and prevention of weed infestation has long term benefits for rehabilitation outcomes. The following management measures will be implemented to manage weed impacts:

- All vehicles and equipment arriving on site will be free of soil, seeds, and vegetative matter;
- Movement of vehicles and equipment will be restricted to areas to be cleared; and
- Weed spray programs may be implemented on a seasonal basis to eradicate identified weed infestations.

5.2 Dust

Dust may be generated by clearing activities. The following management measures will be implemented to mitigate dust impacts:

- Weather conditions are monitored, and dust impacts are assessed during clearing;
- Topsoil stripping and spreading activities will be restricted if dust cannot be adequately controlled during periods of high winds; and
- Water carts are available and utilised for wetting down of soils as required.

6 References

- Alexander Holm & Associates. (2019). Environmental Assessment: Proposed Seismic Survey Area. Prepared for Saracen Gold Mines. Dated February 2019.
- Alexander Holm & Associates. (2020). Environmental Assessment: Relief Hill Survey Area. Prepared for Saracen Gold Mines. Dated February 2020.
- Bamford Consulting Ecologists. (2019). Saracen Carosue Project. Fauna Assessment of Proposed Exploration Drilling Program. Dated February 2019.
- Bamford Consulting Ecologists. (2020). Saracen Relief Hill Project. Fauna Assessment. Dated February 2020.
- Beard J. S. (1976). Vegetation Survey of Western Australia – Sheet 6. Murchison. Nedlands, Western Australia, University of Western Australia Press.
- BOM (Bureau of Meteorology). (2025). Climate Summary Statistics for Kalgoorlie-Boulder. Australian Government. March 2025.
- Cowan, M. (2001). A Biodiversity Audit of Western Australia's 53 Biogeographical Region in 2001; Murchison 1 (MUR1 – East Murchison subregion), Department of Conservation and Land Management, August 2001.
- Daniel de Gand. (2025). Report on the Aboriginal Heritage Assessment of the Mulgabbie North Project Area near Lake Rebecca in the Eastern Goldfields in Western Australia. Prepared for OzAurum Mines Pty Ltd and Line Hydrogen Pty Ltd. Dated January 2025.
- DBCA, (2023), Priority Ecological Communities for Western Australia- Version 35, Department of Biodiversity, Conservation and Attractions
- DCCEEW (2023). Conservation Advice for *Aphelocephala leucopsis* (southern whiteface). Department of Climate Change, Energy, the Environment and Water, Australian Government, Canberra.
- DCCEEW (2025), Protected Matters Search Tool, Department of Climate Change, Energy, the Environment and Water, Australian Government
<http://www.environment.gov.au/epbc/protected-matters-search-tool>
Accessed: 23/01/2025
- DPIRD, (2025), Declared Plants Database, Department of Primary Industries and Regional Development, Western Australia
<https://www.agric.wa.gov.au/pests-weeds-diseases/weeds/declared-plants>
Accessed: 23/01/2025
- Johnstone, R. E., and G. M. Storr, (2004), Handbook of Western Australian Birds. Volume II – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth.
- Keighery, B.J., (1994), Bushland Plant Survey; A guide to plant community survey for the Community, Wildflower Society of Western Australia (Inc.) Nedlands

NVS (2025), Reconnaissance Flora and Vegetation Survey of the Mulgabbie Project Borefield and Access Roads – December 2024, Native Vegetation Solutions. Prepared for OzAurum Resources Ltd. Final V2.1. Dated February 2025.

Attachment A: Proof of Land Ownership

**ASIC**

Australian Securities & Investments Commission

Forms Manager

Company Officeholders

Company: OZAUURUM MINES PTY LTD ACN 645 117 111**Company details**

Date company registered 14-10-2020
 Company next review date 14-10-2025
 Company type Australian Proprietary Company
 Company status Registered
 Home unit company No
 Superannuation trustee company No
 Non profit company No

Registered office

UNIT 1 , 15 WILLIAMS STREET , WEST KALGOORLIE WA 6430

Principal place of business

UNIT 1 , 15 WILLIAMS STREET , WEST KALGOORLIE WA 6430

Ultimate holding company

OZAUURUM RESOURCES LIMITED

ACN 643 244 544

Incorporated in AUSTRALIA

Officeholders

PUMPHREY, ANDREW IAN

Born 09-04-1969 at NARROGIN WA

14 HARRIS PLACE , SOMERVILLE WA 6430

Office(s) held: Director, appointed 14-10-2020

HEWITT-DUTTON, STEPHEN JOHN

Born 01-05-1970 at LITHGOW NSW

99 COODE STREET , SOUTH PERTH WA 6151

 Office(s) held:
 Secretary, appointed 14-10-2020

WILLIAMS, JEFFREY WAYNE

Born 24-12-1953 at BROKEN HILL NSW

5 THOMAS STREET , DONCASTER EAST VIC 3109

Office(s) held: Director, appointed 14-10-2020

Company share structure

Share class	Share description	Number issued	Total amount paid	Total amount unpaid
ORD	ORDINARY	2	2.00	0.00

Members

OZAUURUM RESOURCES LIMITED ACN 643 244 544 UNIT 1 , 15 WILLIAMS STREET , WEST KALGOORLIE WA 6430

Share class	Total number held	Fully paid	Beneficially held
ORD	2	Yes	Yes

Document history

These are the documents most recently received by ASIC from this organisation.

Received	Number	Form	Description	Status
15-10-2021	7EBM32534	484	CHANGE TO COMPANY DETAILS	Processed and imaged
13-09-2021	7EBL30258	484	CHANGE TO COMPANY DETAILS	Processed and imaged
01-07-2021	7EBJ03761	484	CHANGE TO COMPANY DETAILS	Processed and imaged

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ASIC

Australian Securities & Investments Commission

Current Company Extract

Name: LINE HYDROGEN (AUSTRALIA) PTY LTD

ACN: 635 646 721

Date/Time: 29 April 2025 AEST 12:46:00 PM

This extract contains information derived from the Australian Securities and Investments Commission's (ASIC) database under section 1274A of the Corporations Act 2001.

Please advise ASIC of any error or omission which you may identify.

EXTRACT

Organisation Details	Document Number
Current Organisation Details	
Name: LINE HYDROGEN (AUSTRALIA) PTY LTD	4EAA30335
ACN: 635 646 721	
ABN: 53635646721	
Registered in: Queensland	
Registration date: 20/08/2019	
Next review date: 20/08/2025	
Name start date: 20/08/2019	
Status: Registered	
Company type: Australian Proprietary Company	
Class: Limited By Shares	
Subclass: Proprietary Company	

Address Details	Document Number
Current	
Registered address: 10-14 Wormald Street, SYMONSTON ACT 2609	7EDI53538
Start date: 07/04/2025	
Principal Place Of Business address: 10-14 Wormald Street, SYMONSTON ACT 2609	7EDI53538
Start date: 03/03/2025	

Officeholders and Other Roles	Document Number
Director	
Name: BRENDAN LEE JAMES	7EBJ69088
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Born: 23/06/1974, SYDNEY, NSW	
Appointment date: 20/08/2019	
Name: BRENT ZHIWEI JIANG	7EBL32348
Address: 12 Kite Street, ROCHEDALE QLD 4123	
Born: 02/03/1959, SICHUAN, CHINA	
Appointment date: 26/08/2021	
Secretary	
Name: BRENT ZHIWEI JIANG	7ECO95404
Address: 12 Kite Street, ROCHEDALE QLD 4123	
Born: 02/03/1959, SICHUAN, CHINA	
Appointment date: 01/02/2024	
Appointed Auditor	
Name: PKF NORTH QUEENSLAND AUDIT	7ECK65084
Address: Level 6 10 Eagle Street BRISBANE QLD 4000	
Start date: 08/03/2023	

Share Information
Share Structure

Class	Description	Number issued	Total amount paid	Total amount unpaid	Document number
CSF	ORDINARY CSF SHARES	229558	1377348.00	0.00	5EGW20986
ORD	ORDINARY	1000000 0	100.00	0.00	7EBN65557

Members

Note: For each class of shares issued by a proprietary company, ASIC records the details of the top twenty members of the class (based on shareholdings). The details of any other members holding the same number of shares as the twentieth ranked member will also be recorded by ASIC on the database. Where available, historical records show that a member has ceased to be ranked amongst the top twenty members. This may, but does not necessarily mean, that they have ceased to be a member of the company.

Name: RUILI CHARLES VELLA
Address: 19 Kalmaine Court, DIAMOND CREEK VIC 3089

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: SHANE BARTEL CONSULTING PTY LTD
ACN: 145 490 017
Address: 175 Tinderbox Road, TINDERBOX TAS 7054

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: JANNA MDINARADZE
Address: Unit 4, 30-32 Frome Avenue, HAMPSTEAD GARDENS SA 5086

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: CHRISTOPHER HUNTER
Address: 12 Aronia Avenue, ST IVES NSW 2075

Class	Number held	Beneficially held	Paid	Document number
CSF	5000	yes	FULLY	3EGQ41096

Name: ACM RECRUITMENT PTY LTD
ACN: 167 236 571
Address: 60 Margaret Street, SYDNEY NSW 2000

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: DOUGLAS MICHAEL WILLIAM HANCOCK
Address: 21 Hammond Street, RINGWOOD VIC 3134

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: FIONA ELIZABETH SCHMIDT
Address: 12 Eureka Crescent, KIRWAN QLD 4817

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: DATO MDINARADZE
Address: 5 Stanfield Avenue, WINDSOR GARDENS SA 5087

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: JOHN GIBBONS CONTRACTING PTY. LTD.
ACN: 121 409 747
Address: 5 Thompson Street, BUNDEENA NSW 2230

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: A14M INVESTMENTS PTY LTD
ACN: 161 075 538
Address: Unit 36, 102 Miller Street, PYRMONT NSW 2009

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: CAN SENG OOI
Address: 63 Olinda Grove, MOUNT NELSON TAS 7007

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: CLINTON RORY SEARES
Address: 17 Bounty Hill Road, MACMASTERS BEACH NSW 2251

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: SOFIA HANCOCK
Address: 21 Hammond Street, RINGWOOD VIC 3134

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: DEBRA GRAHAM
Address: 22 Gristock Street, COORPAROO QLD 4151

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: TARM MICHIELSEN
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Class	Number held	Beneficially held	Paid	Document number
CSF	5000	no	FULLY	3EGQ41096

Name: PHILIP MICHAEL SMITH

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Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: M.A.D. SUPER PTY LTD
ACN: 139 491 517
Address: 3 Elliver Street, SMITHFIELD QLD 4878

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: BARDSLEY SUPER FUND PTY LTD
ACN: 167 676 333
Address: 22 Somers Street, MITCHAM VIC 3132

Class	Number held	Beneficially held	Paid	Document number
CSF	16666	no	FULLY	3EGQ41096

Name: CARLO RAPHAEL LARUCCIA
Address: Unit 402, 16 Musgrave Street, COOLANGATTA QLD 4225

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: JJB 83 PTY LTD
ACN: 164 695 292
Address: Unit 2, 211 Macquarie Street, DUBBO NSW 2830

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: CINDY RAE ESTERHUIZEN
Address: Unit 605, 35 Shelley Street, SYDNEY NSW 2000

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: JAMES THOMAS MOORE
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Class	Number held	Beneficially held	Paid	Document number
CSF	5000	yes	FULLY	3EGQ41096

Name: COLIN JOSEPH STUBBS
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Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: @FEARN PTY LTD
ACN: 633 782 260
Address: 27 Mater Street, COLLINGWOOD VIC 3066

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	no	FULLY	3EGQ41096

Name: ROSALIE ELAINE MARTIN
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Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: MATTHEW CHARLES VELLA
Address: 19 Kalmaine Court, DIAMOND CREEK VIC 3089

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: MOHD FAWWAZ ALI AL-BASHEER
Address: Unit 423, 8 Grattan Close, FOREST LODGE NSW 2037

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: APICAL SERVICES PTY LTD
ACN: 600 760 469
Address: 7 St James Drive, BELGIAN GARDENS QLD 4810

Class	Number held	Beneficially held	Paid	Document number
CSF	4207	yes	FULLY	3EGQ41096

Name: JOHN MICHAEL SCOTese
Address: 15 Leon Close, BRINSMEAD QLD 4870

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: DIANE LOUISE BRODIE
Address: 33 Wandie Crescent, ANULA NT 0812

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: COREY CUNNINGHAM
Address: 32 Hull Road, BEECROFT NSW 2119

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: SANDEEP SHIVANAND SALUNKE
Address: 10 Mayfair Drive, SAMFORD VALLEY QLD 4520

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: JACKSON KEIGHTLEY DEMLER
Address: 1 Palkana Drive, WARANA QLD 4575

Class	Number held	Beneficially held	Paid	Document number
CSF	1666	yes	FULLY	3EGQ41096

Name: GAETAN BRIGANTE
Address: 16 Rue Du Vieux-college Sion 1950, Switzerland

Class	Number held	Beneficially held	Paid	Document number
CSF	750	yes	FULLY	5EGW20986

Joint members

Name: BRENDAN LEE JAMES
Address: 48 Dominion Circuit, FORREST ACT 2603
Name: NICOLE ROBYN JAMES
Address: 48 Dominion Circuit, FORREST ACT 2603

Class	Number held	Beneficially held	Paid	Document number
ORD	5080000	no	FULLY	7EBN65557

Name: DEVETH INVESTMENTS PTY LTD
ACN: 129 990 478
Address: 9A Formation Street, WACOL QLD 4076

Class	Number held	Beneficially held	Paid	Document number
ORD	600000	no	FULLY	7EBN65557

Name: SPRING RIVER PTY LTD
ACN: 651 565 230
Address: 12 Kite Street, ROCHEDALE QLD 4123

Class	Number held	Beneficially held	Paid	Document number
ORD	2520000	no	FULLY	7EBN65557

Name: GREEN CAPITAL NO. 2 PTY LTD
 ACN: 153 095 053
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Class	Number held	Beneficially held	Paid	Document number
ORD	500000	no	FULLY	7EBN65557

Name: GINA BOZINOVSKI
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Class	Number held	Beneficially held	Paid	Document number
ORD	700000	yes	FULLY	7EBN65557

Name: CXC ENTERPRISES PTY LIMITED
 ACN: 145 086 835
 Address: 27 Hopewood Road, BOWRAL NSW 2576

Class	Number held	Beneficially held	Paid	Document number
ORD	25000	no	FULLY	7EBT02954

Joint members

Name: MATTHEW CHARLES JOHNSON
 Address: 23 Roberts Street, UNLEY SA 5061
 Name: SUSAN JACQUELINE JOHNSON
 Address: 23 Roberts Street, UNLEY SA 5061

Class	Number held	Beneficially held	Paid	Document number
ORD	30000	no	FULLY	7EBY26432

Name: LORENA GOLD MINE PTY LTD
 ACN: 137 631 862
 Address: Unit 1, 27 O'Halloran Street, ADELAIDE SA 5000

Class	Number held	Beneficially held	Paid	Document number
ORD	65000	yes	FULLY	7ECG99840

Name: ORE PROCESSING SERVICES PTY LTD
ACN: 166 016 833
Address: 'L' U 1, 27 O'Halloran Street, ADELAIDE SA 5000

Class	Number held	Beneficially held	Paid	Document number
ORD	45000	yes	PARTIALLY	7ECG99840

Name: BLUE CAP MINING PTY LTD
ACN: 133 660 045
Address: 25 Samford Road, ALDERLEY QLD 4051

Class	Number held	Beneficially held	Paid	Document number
ORD	435000	yes	FULLY	7ECG99840

Financial Reports

Balance date	Report due date	AGM due date	Extended AGM due	AGM held date	Outstanding	Document number
30/06/2023	31/10/2023				no	7ECK65084
30/06/2024	31/10/2024				no	7EDA76057

Documents

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Date received	Form type	Date processed	Number of pages	Effective date	Document number
05/06/2022	484N Change To Company Details Changes To (Members) Share Holdings	05/06/2022	2	05/06/2022	7EBT02954
25/07/2022	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	25/07/2022	2	25/07/2022	7EBU74151
01/08/2022	492 Request For Correction	02/08/2022	2	01/08/2022	7EBU95775

08/08/2022	484 Change To Company Details 484O Changes To Share Structure 484G Notification Of Share Issue 484N Changes To (Members) Share Holdings	08/08/2022	16	08/08/2022	3EGQ41096
09/08/2022	A104 Supplementary Pages To Imaged Document	29/09/2022	5	09/08/2022	031720001
05/10/2022	484 Change To Company Details 484O Changes To Share Structure 484G Notification Of Share Issue 484N Changes To (Members) Share Holdings	05/10/2022	2	24/08/2022	5EGW20986
10/11/2022	484N Change To Company Details Changes To (Members) Share Holdings	10/11/2022	2	10/11/2022	7EBY26432
30/01/2023	205C Notification Of Resolution Converting To A Public Company	REQUISITION	0	30/01/2023	031717363
30/01/2023	206C Application For Change Of Company Status Conversion Of Company From Pty To Public	REQUISITION	0	30/01/2023	031717364
12/04/2023	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	12/04/2023	2	12/04/2023	7ECC86933
10/08/2023	484N Change To Company Details Changes To (Members) Share Holdings	10/08/2023	3	10/08/2023	7ECG99840
28/08/2023	484 Change To Company Details 484B Change Of Registered Address 484C Change Of Principal Place Of Business (Address)	28/08/2023	2	28/08/2023	7ECH71008
31/10/2023	388 (FR 2023) Financial Report 388N Pty. Coy. With Crowd-Sourced Funding Shareholders 388E Company - Appoint Change Name/address Of	31/10/2023	41	30/06/2023	7ECK65084

	Auditor				
27/11/2023	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	27/11/2023	2	27/11/2023	7ECL86438
23/02/2024	484E Change To Company Details Appointment Or Cessation Of A Company Officeholder	23/02/2024	2	23/02/2024	7ECO95404
28/10/2024	388N (FR 2024) Financial Report Pty. Coy. With Crowd-Sourced Funding Shareholders	28/10/2024	36	30/06/2024	7EDA76057
31/03/2025	484 Change To Company Details 484B Change Of Registered Address 484C Change Of Principal Place Of Business (Address)	31/03/2025	2	31/03/2025	7EDI53538

End of Extract of 12 Pages



ASIC

Australian Securities & Investments Commission

Current Company Extract

Name: BIM METALS PTY LTD

ACN: 602 461 870

Date/Time: 29 April 2025 AEST 12:34:43 PM

This extract contains information derived from the Australian Securities and Investments Commission's (ASIC) database under section 1274A of the Corporations Act 2001.

Please advise ASIC of any error or omission which you may identify.

EXTRACT

Organisation Details	Document Number
Current Organisation Details	
Name: BIM METALS PTY LTD	2E1124169
ACN: 602 461 870	
ABN: 69602461870	
Registered in: Queensland	
Registration date: 22/10/2014	
Next review date: 22/10/2025	
Name start date: 22/10/2014	
Status: Registered	
Company type: Australian Proprietary Company	
Class: Limited By Shares	
Subclass: Proprietary Company	

Address Details	Document Number
Current	
Registered address: 10-14 Wormald Street, SYMONSTON ACT 2609	7EDI53839
Start date: 07/04/2025	
Principal Place Of Business address: 10-14 Wormald Street, SYMONSTON ACT 2609	7EDI53839
Start date: 03/03/2025	

Officeholders and Other Roles	Document Number
Director	
Name: BRENDAN LEE JAMES	7EBH93187
Address: 48 Dominion Circuit, FORREST ACT 2603	
Born: 23/06/1974, SYDNEY, NSW	
Appointment date: 22/10/2014	

Share Information					
Share Structure					
Class	Description	Number issued	Total amount paid	Total amount unpaid	Document number
ORD	ORDINARY	100	100.00	0.00	2E1124169
Members					
Note: For each class of shares issued by a proprietary company, ASIC records the details of the top twenty members of the class (based on shareholdings). The details of any other members holding the same number of shares as the twentieth ranked member will also be recorded by ASIC on the database. Where available, historical records show that a member has ceased to be ranked amongst the top twenty members. This may, but does not necessarily mean, that they have ceased to be a member of the company.					
Joint members					
Name: BRENDAN LEE JAMES					

Address: 48 Dominion Circuit, FORREST ACT 2603

Name: NICOLE ROBYN JAMES

Address: 48 Dominion Circuit, FORREST ACT 2603

Class	Number held	Beneficially held	Paid	Document number
ORD	100	no	FULLY	7EBX64694

Documents

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Date received	Form type	Date processed	Number of pages	Effective date	Document number
24/10/2022	484A2 Change To Company Details Change Member Name Or Address	24/10/2022	2	24/10/2022	7EBX64694
24/07/2023	484 Change To Company Details 484B Change Of Registered Address 484C Change Of Principal Place Of Business (Address)	24/07/2023	2	24/07/2023	7ECG28020
31/03/2025	484 Change To Company Details 484B Change Of Registered Address 484C Change Of Principal Place Of Business (Address)	31/03/2025	2	31/03/2025	7EDI53839

*****End of Extract of 2 Pages*****

Attachment B: Biodiversity Surveys

1. Alexander Holm & Associates. (2019). Environmental Assessment: Proposed Seismic Survey Area. Prepared for Saracen Gold Mines. Dated February 2019.
2. Alexander Holm & Associates. (2020). Environmental Assessment: Relief Hill Survey Area. Prepared for Saracen Gold Mines. Dated February 2020.
3. Terrestrial Ecosystems. (2025). Basic vertebrate fauna survey and assessment of Mulgabbie North Project Area. Prepared or Mulgabbie North Project Area. Dated April 2025.
4. NVS (2025), Reconnaissance Flora and Vegetation Survey of the Mulgabbie Project Borefield and Access Roads – December 2024, Native Vegetation Solutions. Prepared for OzAurum Resources Ltd. Final V2.1. Dated February 2025.

ENVIRONMENTAL ASSESSMENT:

PROPOSED SEISMIC SURVEY AREA

SARACEN GOLD MINES



Alexander Holm & Associates
Natural Resource Management Services

February 2019

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Attachments

Attachment 1: 'NatureMap' report
Attachment 2: 'Protected matters' search tool output
Attachment 3: List of flora taxa found at each inventory site
Attachment 4: Inventory site data on landform, soil type and erosion.
Attachment 5: Inventory site data on dominant flora vegetation cover and condition.
Attachment 6: Location of inventory sites
Attachment 7: Fauna memo report

SUMMARY

This report for Saracen Gold Mines Pty Ltd covers environmental assessments to support clearing applications within a 4300ha area associated with a seismic survey in the Carosue dam area approximately 115km north east of Kalgoorlie.

The environmental assessment had three components:

- A reconnaissance vegetation and flora survey from January 7 -12, 2019.
- A reconnaissance fauna survey from January 14-17, 2019.
- A targeted flora survey for *Eremophila arachnoides* subsp. *tenera* from February 4- 13, 2019.

Rainfall during winter in 2017 and 2018 was well below average (Figure 2). There were late winter rains in 2018 and as a result, some biannual herbs and grasses persisted from preceding seasons and were readily identified at the time of survey. There were few annual species.

Seventy-two inventory sites were assessed during the reconnaissance vegetation and flora survey which provided systematic coverage of the area and encompassed variations in photo-pattern. A systematic assessment of land-type, geology, relief, soil type and vegetation at each site enabled the area to be mapped into readily-identifiable land units.

Thirteen land units were identified, and eleven associated vegetation communities described. Approximately 40% of the survey area is occupied by plains supporting acacia shrublands with sparse overstoreys of eucalypts and casuarina. Chenopod shrublands occur on approximately 25% of the area either on calcareous plains or alluvial plains. Sand plains and sandy rises occupy 4% of the area and typically support spinifex tussock grasslands with sparse eucalypt overstoreys. Low hills and rises on laterite, basalt or felsic rocks occupy the remainder.

One hundred and twenty-nine flora taxa representing 26 families were found during the reconnaissance survey. Chenopodiaceae accounted for 24 taxa, Fabaceae 19 taxa and Scrophulariaceae 17 taxa. There were four sterile specimens which were identified to genera level. Flora species composition and vegetation communities are typical of the area and not considered to be unusually diverse.

No listed species of rare or critically endangered flora were found during this survey and no records of Declared Rare Flora (DRF) in or nearby the survey area. Three populations consisting of over 2500 plants of *Eremophila arachnoides* subsp. *tenera*, a Priority 1 listed taxa (P1), were located within the survey envelope during the follow-up targeted flora survey. Priority flora are under consideration for listing as threatened species and as such require protection until their status is decided.

The collection of the following species at this location indicates a significant extension of their known distribution range:

- *Eucalyptus oleosa* subsp. *cylindroidea*

- *Thryptomene kochii*
- *Sclerolaena glabra*

No taxa are considered to be locally endemic.

No alien to Western Australia (weed) species were located during survey although *Carthamus lanatus* (saffron thistle) was noted growing along road verges.

Approximately 17% of the survey area is occupied by alluvial plains where moderate soil erosion is evident and are rated as moderately vulnerable to erosion. These alluvial systems support “Plain mixed halophyte low shrublands” and “Plain eucalypt chenopod woodland” vegetation communities which are degraded through over grazing. While, disturbance to alluvial plains has the potential to increase sediment discharge to drainage tracts down-slope and ultimately, and through extreme events, to Lake Rebecca, the proposed strip clearing is unlikely to result in significant increases in sediment discharge.

The survey landscape mainly drains via overland flow to a main drainage which flows into Lake Rebecca 5 km to the north. Southern areas drain southerly through various drainage systems again to Lake Rebecca. Lake Rebecca is a major wetland with local and regional significance. Survey lines will intercept these watercourses.

Malleefowl are active in the survey area. There were three sightings of birds during this survey and active mounds have been found in previous studies. Malleefowl is probably more abundant to the west where there are extensive sandy soils associated with land unit 1d and 4d occupying about 4.5% of the survey area. They may also be more abundant in rocky hills and low rises collectively occupying 17% of the survey area. Malleefowl mounds are of importance for the birds, whether or not they are active or recently-used.

Large Eucalypt trees, common in land unit 5b, may support nesting by the Peregrine Falcon (and other birds).

There are no Threatened Ecological Communities (TECs) within the north east Goldfields subregion and no Priority Ecological Communities within or adjacent to the survey area. No conservation areas are nearby.

It is recommended that, in planning and implementing seismic operations within the survey area, the proponent:

1. **Avoids disturbance to *Eremophila arachnoides* subsp. *tenera*.**
2. **Undertakes a Malleefowl survey especially within land units 1a, 1b, 1c, 1d, 2a and 2b and avoids disturbance within 50m of active Malleefowl nests during nesting and incubation.**
3. **Installs signage on access roads to the exploration area if Malleefowl are seen or suspected.**
4. **Avoids destruction of mature Eucalyptus trees with nesting hollows.**
5. **Takes measures to minimise erosion through soil disturbance and concentration of overland water flows on vulnerable land units, especially alluvial plains (land unit 5a and 5b).**
6. **Avoids disturbance to the main drainage channel (land unit 6).**

SCOPE OF WORKS

Alexander Holm & Associates were contracted by Saracen Gold Mines Pty Ltd (Saracen) to conduct the following surveys in the Carosue Dam area. Bamford Consulting Ecologists (BCE), were sub-contracted by Alexander Holm & Associates to undertake and report on the fauna component of the assessment.

Saracen operates the Carosue Gold Mine and is proposing intensive exploration around its existing mine. A seismic survey is proposed over a 4300ha area requiring clearing of 3m wide access-lines at 90m spacing. Parts of this area have been covered by earlier environmental assessments. The current assessment envelope covers the balance of 3136ha.

Part A: An environmental assessment to include:

- A review of available information on likelihood of a) presence of threatened (rare) or priority plant species and b) threatened plant communities in the general search area.
- A reconnaissance level fauna, flora and vegetation survey.
- An assessment of landscape stability and condition.
- A description of land units and relate information on fauna, flora, vegetation communities and landscape stability to these units.
- A map of land units and associated vegetation communities.
- A report on findings within a local and regional context
- An assessment of the proposal in relation to impacts on fauna.
- An assessment of the proposal against clearing principles.

The scope of works is to comply with Western Australian Environmental Protection Authority (EPA) objectives for protection of the environment specifically to “ensure that flora and vegetation surveys provide sufficient information to address both biodiversity conservation and ecological function values within the context of the type of proposal being considered” and to “enable an assessment of impacts on the conservation values and status of the site in a regional and local context” (Environmental Protection Authority, 2004).

The work takes into account the following surveys that are either within or adjoin the proposed project envelope and will produce a unified landunit/ vegetation association map to cover these surveys:

- Matiske Consulting Pty Ltd (2010) Flora and vegetation survey of the proposed airstrip.
- Matiske Consulting Pty Ltd (2010) Flora and vegetation survey of the Karari pit extension.
- Alexander Holm & Associates (2010) Environmental assessment-proposed expansion of Whirling Dervish mine.
- Alexander Holm & Associates (2012b) Environmental assessment – proposed expansion of Tailings Storage Facility.

In addition, information on fauna was available from a number of previous studies in the area. These include:

- Alexander Holm and Assoc. (2017). Malleefowl survey of proposed airstrip. Saracen Gold Mines.
- Coffey environments (2010). Level 1 vertebrate fauna survey for the Carosue Dam Project, Saracen Gold.
- Biologic. (2010). Level 1 survey for a proposed pipeline from GGT to Carosue Dam and powerline from Black Swan to Carosue Dam. Tropicana JV and Saracen Gold Mine Pty Ltd.
- Henry-Hall *et al.* (1990). Report on survey of Goongarrie Nature Reserve.
- ABRS (2013). Bush Blitz; Biological survey of Credo Station Reserve WA.

Part B: A targeted survey to locate, record and map the extent of populations of *Eremophila arachanoides* subsp. *tenera*, a Priority 1 taxon, within and adjacent to habitats identified during the reconnaissance survey.

REGIONAL OVERVIEW

Regional setting

Carosue Dam TSF is approximately 115 km north east of Kalgoorlie Boulder, and south east of Lake Rebecca (Figure 1). It is within the north-eastern Goldfields region, Kalgoorlie-Boulder local government area, and partly within unallocated crown land (UCL), Gindalbie and Pinjin pastoral leases. It is located in the south-east of Eastern Murchison (MUR 1) bio-geographic subregion and adjacent to Shield and Eastern Goldfields bio-geographic sub-regions (Cowan 2001, Desmond, Cowan and Chant 2003).

The most extensive land use in the region is pastoralism and over 80% of this region is pastoral leasehold. Most of the remainder is unallocated crown land and less than 1% is set aside for nature conservation.

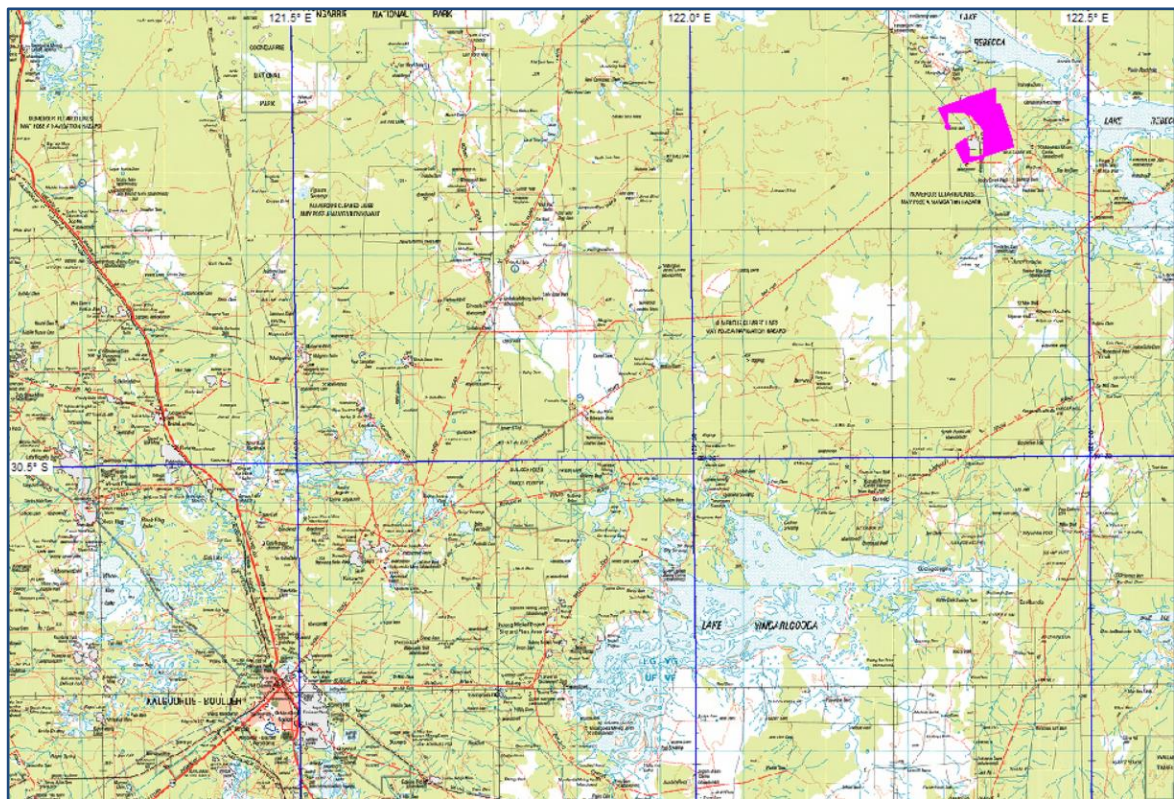


Figure 1: Survey area (in pink) in relation to Lake Rebecca and Kalgoorlie Boulder in the south west.

Climate

Rainfall in the region is unreliable and inconsistent. Winter rainfall consists of light showers from April to October. Significant summer rainfall events originating from the north-west as tropical cyclones are most likely between January and March. The highest recorded daily rainfall at Kalgoorlie is 177.8 mm (in February) and 92.6 mm (in January) at Laverton. For Kalgoorlie, one in one hundred years rainfall events of 1 hour and 72 hours are estimated to result in 43 and 173 mm of rain respectively. (Data from www.bom.gov.au).

The average potential pan evaporation rate at Carosue Dam is approximately 2800 mm per annum¹.

Winds are mostly light easterlies.

Topography and drainage

Landform patterns in the general area comprise extensive sand plain, sub-parallel greenstone belts and breakaways with often extensive lower pediments which give way to level to very gently inclined sheet flood plains. Relief is subdued. There are no major river systems. South-east trending, broad, saline, palaeo-drainage systems traverse the region and are defining features of the Yilgarn block of south-western Australia (Gentili, 1979). These drainage systems have very low gradients and contain playa lakes including Lake Rebecca, Carey and Raeside. Lakes form local depo-centres with poorly developed radial drainage systems. During occasional intense rainfall events lakes may fill, and in very rare events some may overflow, link-up and discharge to the Nullarbor Plain through Ponton Creek (Pringle, Van Vreeswyk & Gilligan, 1994).

Hydrogeology

Groundwater occurs throughout the region within sparse fractures in basement rocks, within the weathering profile, and in alluvial sediments. Regional water table elevations vary from around 350 m above sea level around Lake Raeside to 400 – 450 m above sea level around Lake Carey and are generally 30 to 100 m below surface. Groundwater recharge occurs from major, but infrequent, rainfall events, mainly on drainage divides, and locally at site specific intake areas such as drainage lines or sandplains and dune fields. Groundwater is in hydraulic continuity and flows from drainage divides towards palaeo-drainages and then south-easterly toward the Nullarbor Plain. Groundwater beneath catchment divides occurs as lenses of less than 5000 mg/l TDS which are superimposed on a regional field of saline groundwater with linear bodies of hypersaline groundwater along palaeo-drainages, and local brine pools associated with salt lakes.

Vegetation and soils

The region lies within the Eremaean botanical province, mainly in the Austin botanical district, with the eastern edge approaching the Helms botanical district (Beard, 1976). Lake Ballard/Lake Rebecca form a major vegetation divide with characteristic *Acacia aneura* (mulga) low woodlands associated with red loams over siliceous hardpan to the north and low woodlands of mixed mulga and *Casuarina obesa* (black oak) and

¹ http://www.bom.gov.au/cgi-bin/climate/cgi_bin_scripts/evaporation.cgi.

Eucalyptus species on alkaline and calcareous soils to the south. Spinifex hummock grassland with eucalypt overstory on sand plain is common. Halophytic vegetation occurs throughout the region on palaeo-drainage systems, breakaways and on some stony and alluvial plains. Highly saline soils support *Atriplex* (saltbush), *Maireana* (bluebush) and *Tecticornia* (samphire) shrublands, while less saline soils support eucalypt or mulga with saltbush or bluebush understoreys.

The most common vegetation associations in the region include Beard Vegetation Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.), 110 (Hummock grassland, shrub steppe and red mallee over spinifex) and 389 (Succulent steppe with open low woodland; mulga over saltbush) (Table 1).

Table 1: Vegetation associations (Beard, 1976) in project area in comparison with South Laverton area (SLA), total area in WA and area within conservation reserves

Veg Assn	Description	SLA Area km ²	Reserve priority	Western Australia		
				Area km ²	Within reserve km ²	%
20	Low woodland; mulga mixed with <i>Casuarina obesa</i> and <i>Eucalyptus</i> spp.	7892	L	13045	2173	16.7
24	Low woodland; <i>Casuarina obesa</i>	15.2	L	265.6	2.4	0.9
110	Hummock grassland; shrub steppe and red mallee over spinifex	356	M	4746	1201	25.3
389	Succulent steppe with open low woodland; mulga over salt bush	2344	M	6465	230	3.6
529	Succulent steppe with open low woodland; mulga and sheoak over salt bush	46.6	H	102.8	0.1	0.1

L*: Low; M: Medium; H: High priority for reservation

ASSESSMENT METHODOLOGY

Assessment personnel

The work was managed and conducted by Dr Alexander Holm (Alexander Holm & Associates). Dr Holm is an ecologist with over 35 years experience in arid environments and Goldfield regions and an accredited environmental consultant with the Environmental Consultants Association of Western Australia.

Mr Andrew Mitchell was assisting botanist to Western Australian Department of Agriculture's rangeland surveys, senior author of "Arid Shrubland Plants of Western Australia" (Mitchell and Wilcox 1994) and recently retired botanist with AQIS (Australian Quarantine and Inspection Service). Mr Mitchell provided off-site assistance in expert identification of flora specimens collected in the field and preliminary land unit mapping.

Mr Geoffrey Eliot was soil and landscape technician for the Western Australian Department of Agriculture's rangeland surveys and has over 20 years experience in Western Australian arid regions.

Field work for the vegetation and flora surveys was conducted by Mr Eliot and Dr Holm.

The identity of priority flora taxa *Eremophila arachanoides* subsp. *tenera* was confirmed by Mr Andrew Brown, recently retired botanist at the Western Australian Herbarium and author of "A field guide to the Eremophilas of Western Australia" (Brown and Buirchell 2011)

Dr Mike Bamford is a wildlife biologist, scientific illustrator and science communicator and with his wife Mandy, he has operated Bamford Consulting Ecologists since the mid 1980s. The business specialises in fauna investigations for Environmental Impact Assessment and to meet conditions of approval, such as monitoring of impacts and monitoring of rehabilitation. Some work is also done on environmental education and interpretation. Mike has extensive experience in the south-west of Western Australia, Western Australia's Goldfields, Pilbara, Kimberley, the Western Deserts, the Northern Territory, Christmas Island and far north Queensland.

Dr Barry Shepherd is an ecologist with more than 20 years working as an environmental consultant. Barry's core skills are around environmental and ecological impact assessment, and environmental approvals. Around this experience, he has conducted a large number of environmental baseline survey for birds, bats, small mammals and herpetofauna, and specialises in marine mammals and bats. He is also experienced in line transect population studies (Distance). Barry has undertaken extensive analysis of bat echolocation and calls and is competent on most ultra-sonic detection systems. Barry has written a large number of baseline survey reports, impact assessments and environmental approval documentation.

Field work for the fauna survey was conducted by Drs Bamford and Shepherd.

Timing of survey and seasonal conditions

Vegetation and flora reconnaissance survey from January 7 -12, 2019.

Fauna reconnaissance survey from January 14-17, 2019.

Flora targeted survey from February 4- 13, 2019.

Rainfall during winter in 2017 and 2018 was well below average (Figure 2). There were late winter rains in 2018 and as a result, some biannual herbs and grasses persisted from preceding seasons and were readily identified at the time of survey. On the other hand, there were very few annual species.

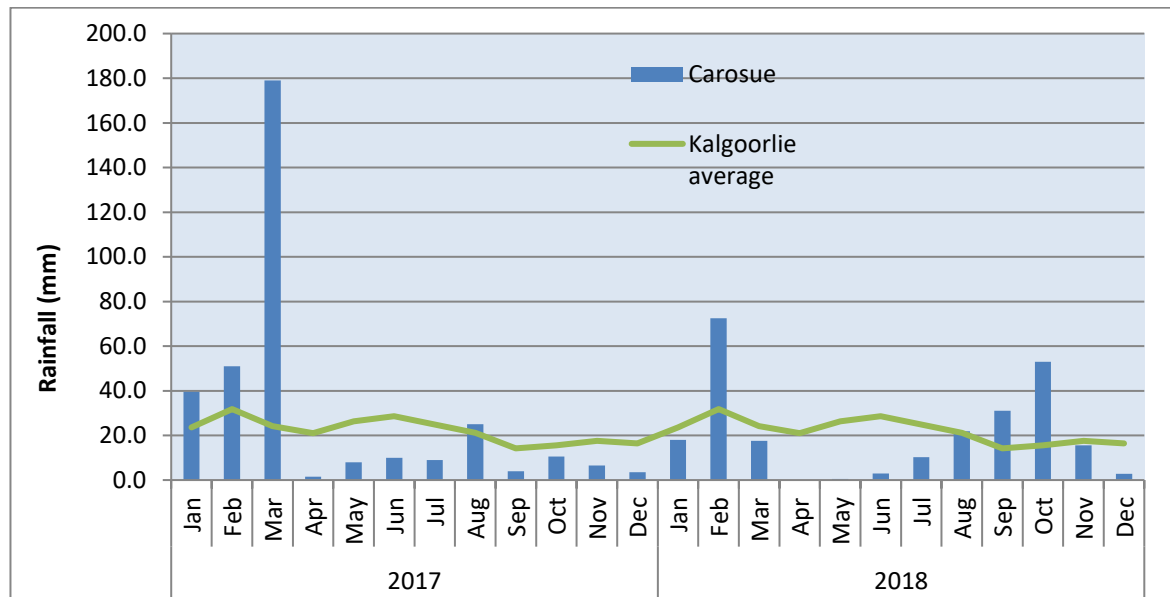


Figure 2: Monthly rainfall (mm) at Carosue Dam in comparison to averages at Kalgoorlie airport

Declared flora and fauna

The Department of Parks and Wildlife and the Western Australian Museum's "NatureMap"² was interrogated for records of all collected flora within a 40 km radius of the study area (Attachment 1). The list was augmented by other recent searches from nearby survey areas (Alexander Holm & Associates 2012a, Alexander Holm & Associates 2012b, Alexander Holm & Associates 2012c, Alexander Holm & Associates 2012d).

Thryptomene eremaea, a Priority 2 taxon, is recorded in NatureMap as being located within 40km of the study area. It is an erect open shrub, 0.5 to 1.5m high, producing pink or white flowers from July to September and grows on red or yellow sands on sandplains and shallow sandy soils over granite.

Eremophila arachnoides subsp. *tenera*, a Priority 1 taxon, was recorded by Alexander Holm and Associates (2012d) in an adjacent survey during 2012.

Declared flora and fauna listed on Commonwealth Department of Environment and Energy database of threatened species were identified within a 100km radius of the study area using the protected matters search tool³ (Attachment 2).

Gastrolobium graniticum is classed as Endangered under the EPBC Act 1999 and as a Declared Rare taxa under the Wildlife Conservation Act 1950 [WA]. This member of the Fabaceae is an erect shrub 0.9 to 1.2 m high with purple branches, and ovate leaves 2.5 to 6 cm long. The distribution of this species is restricted to the Kalgoorlie ad Coolgardie districts where it is found in sandy or sandy loam soils near granite rocks.

Records of bird observations in Australia, 1998-2019 from BirdLife Australia Atlas Database (Birdlife Australia) within a 40km radius of the study area.

Records of biodiversity data from multiple sources across Australia from Atlas of Living Australia and within a 40km radius of the study area.

Significant conservation fauna which may be present in the survey area, include one reptile, 19 birds and two mammals. The single reptile is a Priority 2 skink that may occur under leaf-litter around trees and mallee. The majority (9) of the birds are waterbirds that are either vagrants or irregular visitors and would not utilise the actual project area due to the lack of wetlands. Most other significant birds are expected only as vagrants but three species may use the site regularly: Malleefowl, Peregrine Falcon and Rainbow Bee-eater. Only two significant mammals are expected, with the Central Long-eared Bat potentially roosting in large trees, and the Brush-tailed Mulgara probably being locally extinct or possibly being a vagrant.

Threatened and priority ecological communities

The likelihood of presence of threatened ecological communities within the general survey area was assessed using the protected matters search tool (Attachment 2).

²<https://naturemap.dpaw.wa.gov.au/default.aspx>

³<http://www.environment.gov.au/erin/ert/epbc/>

Other threatened ecosystems in the south-east of Eastern Murchison (MUR 1) biogeographic subregion, identified during “A Biodiversity Audit of Western Australia’s 53 Biogeographical Subregions in 2002”, are listed in Cowan (2001).

Priority ecological communities in the area were assessed from Department of Parks and Wildlife listing (Version 27, June 2017).

Land systems land units and vegetation communities

Land systems and land units were derived from a land resource survey of north eastern Goldfields (Pringle, Van Vreeswyk & Gilligan, 1994). Land systems for the region south of the north eastern Goldfield survey have been tentatively identified by desk-top photographic interpretation and extrapolation (Department of Agriculture and Food WA).

Vegetation communities were established firstly with reference to those listed in Pringle et al. (1994) where they are listed as ‘site types’, and secondly, where no comparable community could be found, with reference to those listed in adjacent surveys of Sandstone, Yalgoo Paynes Find (Payne et al., 1998) and Kambalda north (Payne, Mitchell & Hennig, 1998).

Tentative land units were identified by examination of high-resolution aerial photography. Boundaries were checked in the field, transferred to geo-referenced ortho-photo maps and captured digitally. Vegetation communities were visually associated with each land unit.

Field survey

Reconnaissance vegetation and flora survey

The survey and reporting were conducted to comply with the EPA’s “Technical Guidance – flora and vegetation surveys for environmental impact assessment” (Environmental Protection Authority 2016). A reconnaissance level survey was considered appropriate in the first instance in view of results of several vegetation and flora surveys in or adjacent to the study area (Figure 3).

Seventy two inventory sites (relevés) were selected to 1) sample each land unit within the survey area, 2) provide systematic coverage of the survey area, and 3) to encompass variations in pattern within each land unit. Each inventory site was located by GPS and the following information recorded:

- Digital photographs.
- All flora species within approximately 50 m of a central location and in the same land unit were inventoried and voucher specimens collected of all taxa which were also compiled within a reference field herbarium.
- Vegetation condition were visually estimated using rating scales of Environmental Protection Authority (2016) and soil erosion compared with standard rating scales used for rangeland surveys and described by Pringle *et al.* (2004).
- Vegetation community and land unit descriptions using terminology from Payne et al. (1998).

- Vegetation cover, landform, slope, relief, surface coarse fragment characteristics and surface water flow characteristics (Anon, 2009).
- Soil characteristics (texture, reaction to acid and fragment characteristics) of A horizon to maximum of 30cm (Anon, 2009).

These data were augmented by walking traverses by two surveyors along selected routes. The survey aimed to:

- Locate priority or threatened flora.
- Locate species not previously recorded at inventory sites.

Locations of inventory sites, vehicle traverse (150km) and walking traverses (2.5km) are shown in Figure 4.

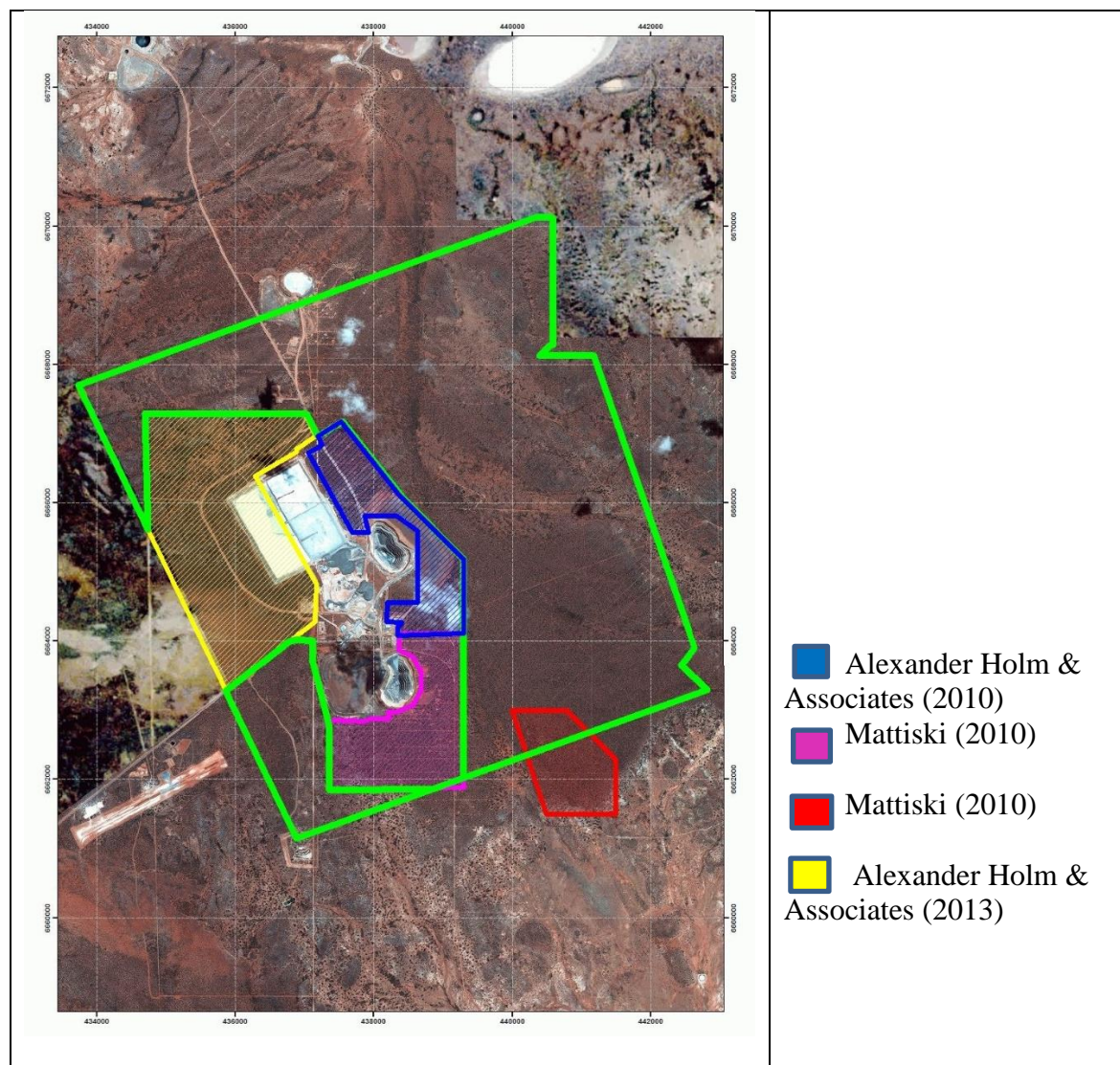


Figure 3: Proposed survey area (green) and locations of existing flora and vegetation surveys.

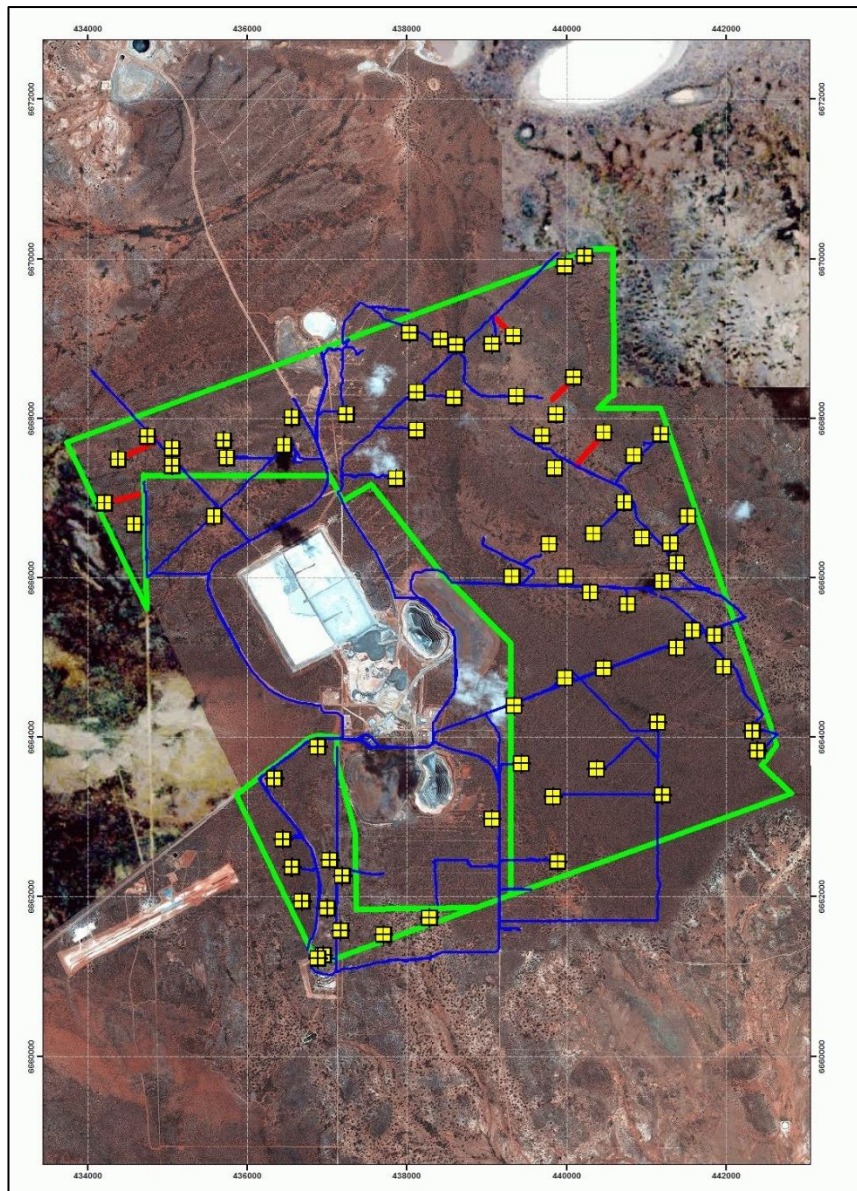


Figure 4: Location of inventory sites (yellow) vehicle traverse (blue) and walking traverses (red) during initial flora survey.

Targeted flora survey

Three main search areas were defined by locations of *Eremophila arachanoides* subsp. *tenura* found during the reconnaissance survey and earlier adjoining surveys: a northern area of about 600ha and southern areas of about 50ha and 40ha. Each area was searched by two operators along previously defined transects approximately 25m apart using GPS guidance to ensure a systematic coverage. Additional opportunistic traverses were done to cover possible habitat outside the pre-defined search area. Total foot-traverse distance was 209km.

Operators concentrated on defining population boundaries. About 40-50% of found plants in the northern area were tagged with tape and located by GPS including all outliers. All found plants in the southern areas were tagged and located by GPS.

Additional areas outside the two main search areas, which were considered as possibilities for occurrence of the target species, were also inspected.

Reconnaissance fauna survey

The site visit involved looking around as much of the project area as possible in daylight; as shown in Figure 5. This enabled environmental descriptions to be prepared and allowed opportunistic observations on fauna. Familiarity with the environment enables interpretation of species lists from databases. Targeted searching was undertaken for two significant species known from the general area: the Malleefowl (searching for nest mounds, foraging signs, tracks and direct observations); and the Brush-tailed Mulgara (searching for burrows, tracks and scats). In general, walks were unstructured and two personnel travelled 20-40m apart, with the track determined by areas of interest and intended to cover as much ground as possible. An exception to this was just north of the accommodation village where systematic transects were walked across a small area to search for Malleefowl mounds. Signs of all species observed, and other notable features of interest were recorded.

On the evening of 14th January, between c.19:30 and 21:10, the surveyors conducted a torch-light search of a rocky breakaway just north of the mine camp for nocturnal fauna. Both surveyors carried head torches and recorded species observed or heard.

Throughout the torch-light survey, bat echolocations and calls were recorded on a hand-held bat detector (Echo Meter Touch 2 Pro (EMT2)(Ser No: E2A00773). The EMT2 was run from a Samsung Galaxy S7 with Echo Meter software version 2.6.5. A Wildlife Acoustics Song Meter 4 BAT Full Spectrum (SM4BAT) was deployed next to three settling ponds that form part of the Mine Camp's sewerage treatment plant on the afternoon of 14th January and retrieved on the morning of 17th January 2019. The settling ponds were located approximately 1km due south of the Survey Area boundary and 0.75km south of the Mine Camp. Recordings from the EMT2 and SM4BAT were viewed in Kaleidoscope Viewer v4.5.4 from Wildlife Acoustics. More than 4,000 audio records were obtained over the three nights of sampling indicating very high levels of bat activity. Only a small sample was assessed to provide a preliminary list of bat fauna supporting the Level 1 survey.

The complete fauna memo report is attached

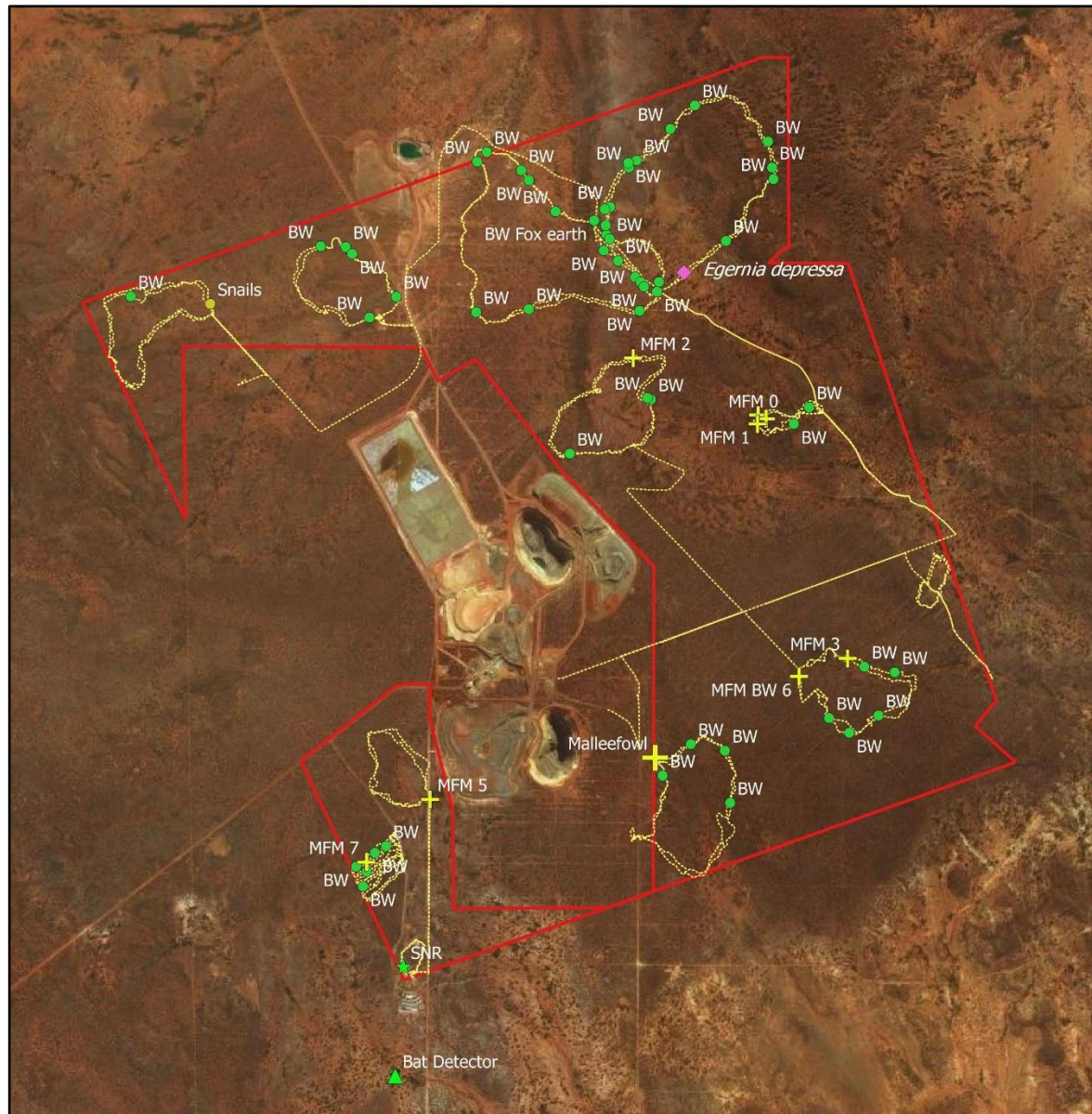


Figure 5: Vehicle traverse and walking traverses (yellow) during fauna survey. Locations of fauna observations are indicated: BW = Boodie warrens, MFM = Malleefowl mound

ENVIRONMENTAL ANALYSIS

Conservation estate

Beard Vegetation Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.) is the most common vegetation association in the survey area occupying 83%. Vegetation Association 529 (Succulent steppe with open low woodland; mulga and sheoak over salt bush) occupies 12% and the remaining 5% is Vegetation Association 24 (Low woodland; *Casuarina obesa*) (Beard 1976).

Vegetation Association 20 occupies approximately 13,000 km² in Western Australia of which 16.7% is within conservation reserves and although less than 1% of Vegetation Association 24, which occupies approximately 266 km² in Western Australia, is within reserves, both have a low priority for conservation (Table 1). Vegetation Association 529 is very poorly conserved and has a high priority for conservation.

There are no conservation reserves within 50 km of the survey area (Appendix 1). The closest conservation area is Bullock Holes Reserve, approximately 60 km south west.

There are no listed sites of international or national significance or wetlands of International, National or sub-regional significance within the project area (Appendix 1) although Lake Rebecca is considered an ecologically significant component of inter-regional palaeo-channels.

There are no registered sites on State or National heritage registers.

Lake Rebecca is a registered mythological site.

Land systems and landforms

Approximately 55% of the survey area is occupied by plains with eucalypt woodlands with non-halophytic undershrubs of Deadman land system; 14% consists of low greenstone hills and stony plains, supporting chenopod shrublands with patchy eucalypt overstoreys of Moriarty land system; 4% is sandplain of Kirgella land system and the remainder by Leonora, Lawrence, Campsite and Gundockerta (Table 2).

Table 2: Descriptions of land systems within the survey area (Pringle, Van Vreeswyk & Gilligan, 1994 and Department of Agriculture and Food, WA).

Land type	Land system	Description	Soil and land management
Hills and ridges	Lawrence	Low greenstone hills with ironstone ridges, supporting pearl bluebush shrublands with mixed eucalypt overstoreys.	Narrow drainage tracts are susceptible to water erosion.
Erosional surfaces of low relief	Gundockerta	Extensive gently undulating plains on weathered greenstone with stony mantles and lower alluvial tracts	Saline plains and adjacent alluvial tracts are susceptible to water erosion.
Depositional plains with calcareous red earths	Deadman	Level to gently undulating plains with casuarina-acacia shrublands.	Generally not susceptible to soil erosion
	Moriarty	Low greenstone hills and stony plains, supporting chenopod shrublands with patchy eucalypt overstoreys.	Slopes of low rises, alluvial plains and narrow drainage tracts are moderately susceptible to soil erosion.
Sandplain spinifex hummock grasslands	Kirgella	Extensive sandplain with spinifex hummock grasslands and mulga and mallee shrublands	Prone to wildfires which temporarily render sands unstable.
Plains with saline alluvium	Campsite	Alluvial plains and minor gently undulating stony upper plains with groved eucalypt woodlands.	Moderately susceptible to erosion

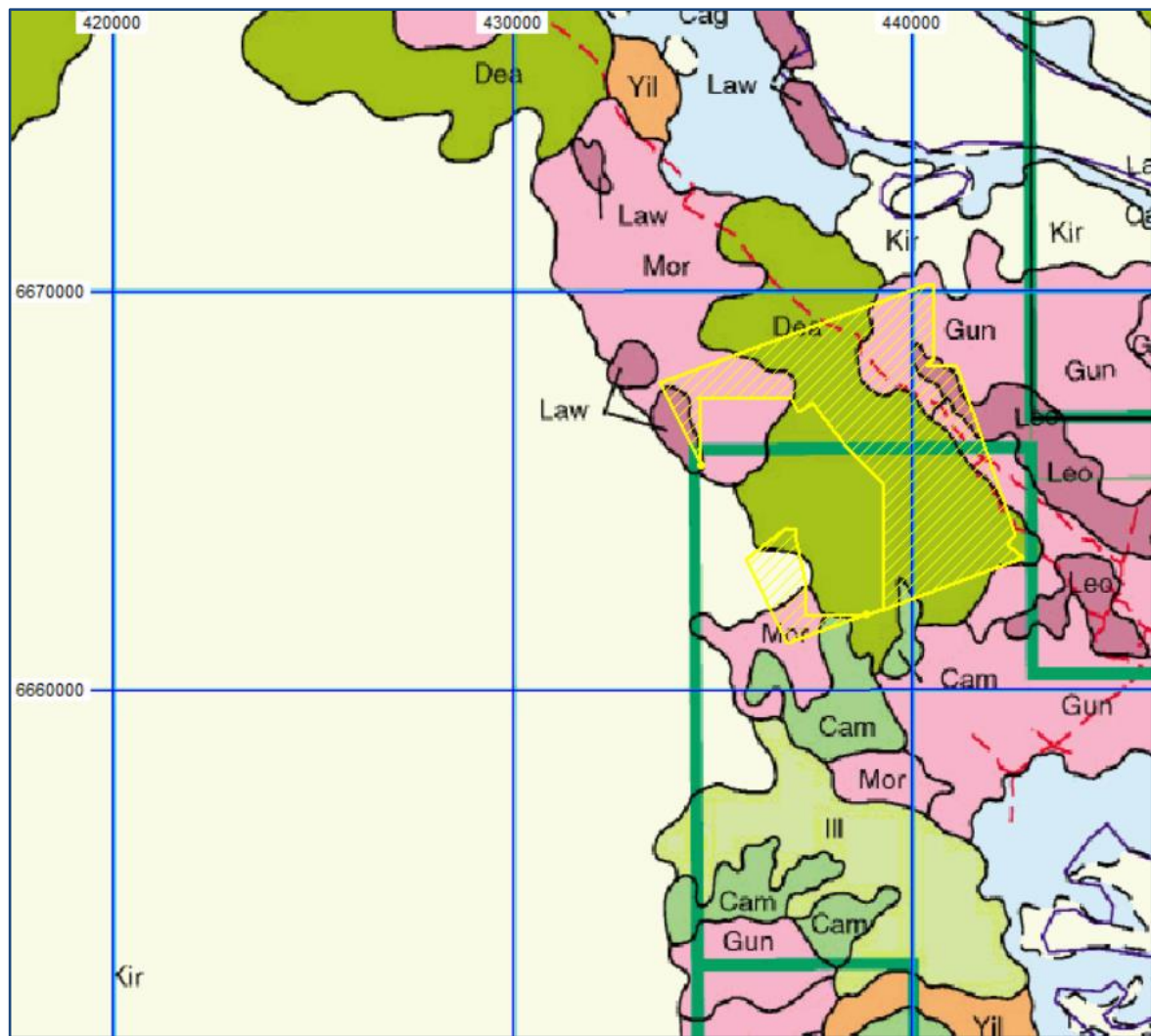


Figure 6: Land systems within the survey area (in yellow)



Land units, soil types and vegetation communities



Land unit descriptions and mapping



Thirteen land units and associated vegetation communities and soil types are described (Table 4).



A map of land units is overlain on an aerial photograph (Figure 7).



Table 3: Land unit descriptions, their soil type, vulnerability to erosion and associated vegetation communities.



Land unit	Land form and soil type	Vegetation community
1a. Lateritic hills		
	Lateritic hills with relief to 20m with slopes up to 8%, very abundant (>90%) surface mantles of ironstone coarse and medium gravel and occasional quartz.	Open mixed shrubland (PFC 6-15%) dominated by <i>Acacia stowardii</i> , <i>Dodoniaea lobulata</i> and <i>Ptilotus obovatus</i> with very sparse overstorey of <i>Casuarina pauper</i> , <i>Eucalyptus</i> spp and occasional <i>Acacia incurvaneura</i> .
	Shallow sandy loams or sandy clay loams over calcrete or parent laterite.	
	Run-off source zones, nil vulnerability to erosion.	“Stony ironstone acacia shrubland” (SIAS vegetation community)
1b. Basalt hills		
	Basalt hills with relief to 30m, slopes from 3-10%, abundant (50-90%) surface mantles of coarse gravel and cobbles of basalt and occasional quartz or calcrete.	Open mixed height shrubland (PFC 25-30%) dominated by <i>Acacia quadrimarginea</i> , <i>A. burkittii</i> , and <i>Dodoniaea lobulata</i> with very sparse overstorey of <i>Casuarina pauper</i> .
	Sandy loams less than 30cm in depth often highly calcareous.	
	Run-off source zones, nil vulnerability to erosion.	“Greenstone hill acacia shrubland” (GHAS vegetation community)


Land unit	Land form and soil type	Vegetation community
1c. Felsic hills breakaways and footslopes		
	Breakaways with relief of 25m and scarp slopes of 20%, low hills to 12m with slopes of 5% and footslopes with slopes of 2%, Common to very abundant (20->90% surface mantles of medium to coarse gravel and cobbles of felsic rocks and occasional quartz.	Open low or mixed height shrubland (PFC 10-30%) dominated by <i>Scaevola spinescens</i> , <i>Acacia erinacea</i> , <i>Eremophila scoparia</i> and <i>Senna artemisioides</i> subsp. <i>filifolia</i> with very sparse overstorey of <i>Casuarina pauper</i> or <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i> and occasionally open woodlands of <i>Eucalyptus lesouefii</i> .
	Skeletal sandy loams less than 15cm. Non-calcareous.	“Breakaway mixed shrubland” (BRXS vegetation community)
	Run-off source zones, nil vulnerability to erosion.	.
1d. Sandy rises		
	Broad sandy rise to 10m and slopes to 3%.	Sparse woodlands (PFC 5 -10%) dominated by <i>Acacia incurvaneura</i> and low mallees (4 -10m) including <i>Eucalyptus eremicola</i> , <i>E. ceratocorys</i> and <i>E. oldfieldii</i> over a diverse sparse (PFC 20 -30%) shrubland (<1.5 m) with spinifex (<i>Triodia irritans</i>) often dominated by myrtaceous shrubs. Shrubs include <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Thryptomene kochii</i> , <i>Verticordia pritzelii</i> , <i>Prostanthera althoferi</i> subsp. <i>althoferi</i> and <i>Acacia effusifolia</i>
	Deep sandy soils.	“Sandplain mallee spinifex woodland” (SAMA vegetation community).
	Most rain water infiltrates and in high intensity rainfall sheds water to lower parts of the landscape. Slight vulnerability to erosion.	

Land unit	Land form and soil type	Vegetation community
2a. Low lateritic rises 	<p>Gentle low rises with slopes to 2%, relief up to 2 – 3 m, common to very abundant (20 - >90%) surface mantles of fine and medium gravel of laterite with occasional calcrete and quartz.</p> <p>Sandy loams to 30cm occasionally highly calcareous at surface and overlaying calcrete.</p> <p>Run-off source zones, nil to slight vulnerability to erosion.</p>	<p>Very sparse to open mid-height shrubland (PFC 10-25%) dominated by <i>Eremophila forrestii</i>, <i>E. scoparia</i>, <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i> and <i>Acacia colletioides</i> with sparse overstorey of <i>Acacia incurvaneura</i> or isolated <i>Casuarina pauper</i></p> <p>“Calcareous casuarina acacia shrubland” (CCAS vegetation community).</p>
2b. Low rises on basalt 	<p>Gently rounded hills, rises and gentle slopes to 7%, relief to 5 m, many to abundant mantles (20 –90%) fine to coarse gravels of dolerite, ironstone, shale, quartz and calcrete. Often with abundant cryptogams.</p> <p>Shallow calcareous sandy loams over calcrete.</p> <p>Run –off source zones to lower parts of the landscape occasionally via shallow incised drainage channels. Nil to slight vulnerability to erosion.</p>	<p>Very sparse to open (PFC 10 – 20%) mixed height shrublands dominated by <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Acacia burkittii</i>, <i>Ptilotus obovatus</i> or less frequently, <i>Maireana sedifolia</i> and <i>Atriplex nummularia</i> subsp. <i>spathulata</i> with isolated to very sparse overstorey of <i>Casuarina pauper</i> and occasionally <i>Acacia incurvaneura</i>, <i>Grevillea nematophylla</i> subsp. <i>nematophylla</i> and/or <i>Alectryon oleifolius</i></p> <p>“Greenstone hill mixed shrubland” (GHMW vegetation community).</p>

Land unit	Land form and soil type	Vegetation community
4a. Plains supporting acacia shrublands 	<p>Very gently inclined to level plains (slopes <1.5%); mostly few to common (2-20%) mantles of ironstone fine gravel, calcrete nodules and quartz fragments, often abundant cryptogams.</p> <p>Deep sandy loam to sandy clay loams mostly non-calcareous.</p> <p>Broad transfer zones receiving water from upper units and shedding onto lower parts of landscape with occasional sheet and rill erosion. Nil to slight vulnerability to erosion.</p>	<p>Open tall acacia shrublands (PFC 10 - 30%) dominated by <i>Acacia incurvaneura</i>, <i>A. ayersiana</i>, <i>A. burkittii</i>, <i>A. hemiteles</i>, <i>A. tetragonophylla</i> and very sparse lower shrubs including <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>filifolia</i>, and <i>Ptilotus obovatus</i> with overstoreys of isolated <i>Casuarina pauper</i> or <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>.</p> <p>Plain acacia eucalypt shrubland (PAES)</p>
4b. Plains supporting acacia shrublands on hardpan. 	<p>Gently inclined plains (slopes <1.5%); mostly few to common (2-20%) mantles of ironstone fine to coarse gravel, calcrete nodules and quartz fragments, often abundant cryptogams.</p> <p>Non-calcareous sandy loams over ferruginous hardpan at >30cms.</p> <p>Broad transfer zones receiving water from upper units and shedding onto lower parts of landscape. Not vulnerable to erosion.</p>	<p>Open tall acacia shrublands (PFC 15 - 30%) dominated by <i>Acacia incurvaneura</i>, <i>A. ayersiana</i>, <i>A. burkittii</i>, <i>A. ramulosa</i> and very sparse lower shrubs including <i>Dodonaea rigida</i>, <i>D. lobulata</i> and <i>Ptilotus obovatus</i> with overstoreys of isolated <i>Casuarina pauper</i> or <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>.</p> <p>“Hardpan plain mulga shrubland” (HPMS vegetation community)</p>

Land unit	Land form and soil type	Vegetation community
4c. Calcareous plains supporting chenopod shrublands		
	<p>Gently inclined plains (slopes 1%); mostly very few to few (<2-10%) mantles of fine to medium ironstone gravel, calcrete nodules and quartz fragments.</p> <p>Calcareous sandy clay loams greater than 30cms.</p> <p>Broad transfer zones receiving water from upper units and shedding onto lower parts of landscape. Nil to slightly vulnerable to erosion with very minor soil surface deflation.</p>	<p>Open, mostly degraded <i>Maireana sedifolia</i> shrubland (PFC 10-25%) with colonizing shrubs including <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila scoparia</i> and <i>Acacia burkittii</i> and with very sparse overstorey of <i>Acacia incurvaneura</i> or <i>Casuarina pauper</i>.</p> <p>“Plain mixed halophyte shrubland” (PXHS vegetation community).</p>
4d. Spinifex sandplain		
	<p>Extensive level to gently sloping sand plain (slopes 0 -2%) with sandy or slightly crusted soil surfaces and abundant patchy litter.</p> <p>Deep sandy loam.</p> <p>Moderate vulnerability to wind erosion if cover removed.</p> <p>Fire susceptible.</p>	<p>Fire-climax community. Very sparse (PFC 5%) eucalypt woodland (6 -10m) of <i>Eucalyptus yilgarnensis</i> and <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i> over mixed height (0.5 – 4m), very sparse (PFC 5 -15%) shrubs including, <i>Acacia colletioides</i>, <i>A. ramulosa</i>, <i>A. burkittii</i>, <i>Eremophila caperata</i> and <i>Westringia rigida</i> and variable density (PFC 5-50%) <i>Triodia irritans</i>.</p> <p>“Sandplain mallee spinifex woodland” (SAMA vegetation community).</p>

Land unit	Land form and soil type	Vegetation community
5a. Alluvial plains supporting chenopod shrublands.		
	<p>Near level to gently sloping (slopes <1 -1%) plains with very few to common surface mantles (<2 – 20%) of fine and medium gravels of quartz, ironstone and calcrete nodules. Common to abundant cryptogams.</p> <p>Sandy clay loam often calcareous especially at depth.</p> <p>Subject to occasional shallow sheet flow, occasionally more concentrated. Stripped soils surfaces common. Moderate vulnerability to erosion.</p>	<p>Very sparse to open, often degraded (PFC 5 – 30%) chenopod shrublands dominated by <i>Maireana sedifolia</i> <i>M. georgei</i>, <i>M. pyramidata</i>, <i>Atriplex vesicaria</i>, <i>Ptilotus obovatus</i> and others or in poor condition dominated by <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila scorparia</i>, <i>Dodonaea lobulata</i>, <i>Acacia burkittii</i> and <i>A. hemiteles</i> with isolated, occasionally clumped overstorey of <i>Acacia incurvaneura</i>, <i>Casuarina pauper</i>, <i>Eucalyptus brachycorys</i> or <i>E. lesouefii</i></p> <p>“Plain mixed halophyte shrubland” (PXHS vegetation community).</p>
5b. Alluvial plains supporting chenopod shrublands and salmon gums		
	<p>Gently sloping plains (slopes 1-2%) with very few to few mantles (<2-10%) of fine to medium gravels of ironstone, basalt and quartz fragments.</p> <p>Sandy clay loam, occasionally light clay, often saline.</p> <p>Subject to shallow sheet flow, occasionally more concentrated. Stripped soil surfaces common. Moderate vulnerability to erosion.</p>	<p>Open, often degraded, chenopod shrublands dominated by either <i>Maireana sedifolia</i>, <i>Atriplex vesicaria</i>, <i>A. nummularia</i>, or <i>Tecticornia disarticulata</i> and in poor condition dominated by <i>Senna artemisioides</i> subsp. <i>filifolia</i>, <i>Eremophila scorparia</i>, <i>Acacia hemiteles</i>, with sparse overstorey, and groves of <i>Eucalyptus salmonophlioia</i> and <i>E. salubris</i>.</p> <p>“Plain eucalypt chenopod shrubland” (PECW vegetation community).</p>

Land unit	Land form and soil type	Vegetation community
6. Drainage tracts		
	<p>Gently sloping (1%) drainage tracts 50 – 200m wide with occasional minor channels, mostly without surface mantles, and abundant litter trains.</p> <p>Sandy clay loam to sandy clay greater than 30cms.</p> <p>Slight to moderate vulnerability to water erosion.</p>	<p>Open to mid-close (PFC: 20 – 60%), tall acacia shrubland and occasional thickets dominated by <i>Acacia incurvaneura</i>, <i>A. ayersiana</i> and <i>A. burkittii</i> with isolated <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>, <i>Brachychiton gregorii</i> or <i>Casuarina pauper</i> or less commonly <i>Bursaria occidentalis</i>, <i>Senna artemisioides</i> ssp. <i>filifolia</i>, <i>Grevillea nematophylla</i> subsp. <i>nematophylla</i> and <i>Teucrium teucriiflorum</i>.</p> <p>“Drainage tract acacia shrubland” (DRAS vegetation community)</p>

* (PFC): Projected foliar cover

** (CCAS etc.) vegetation types see Table 6.

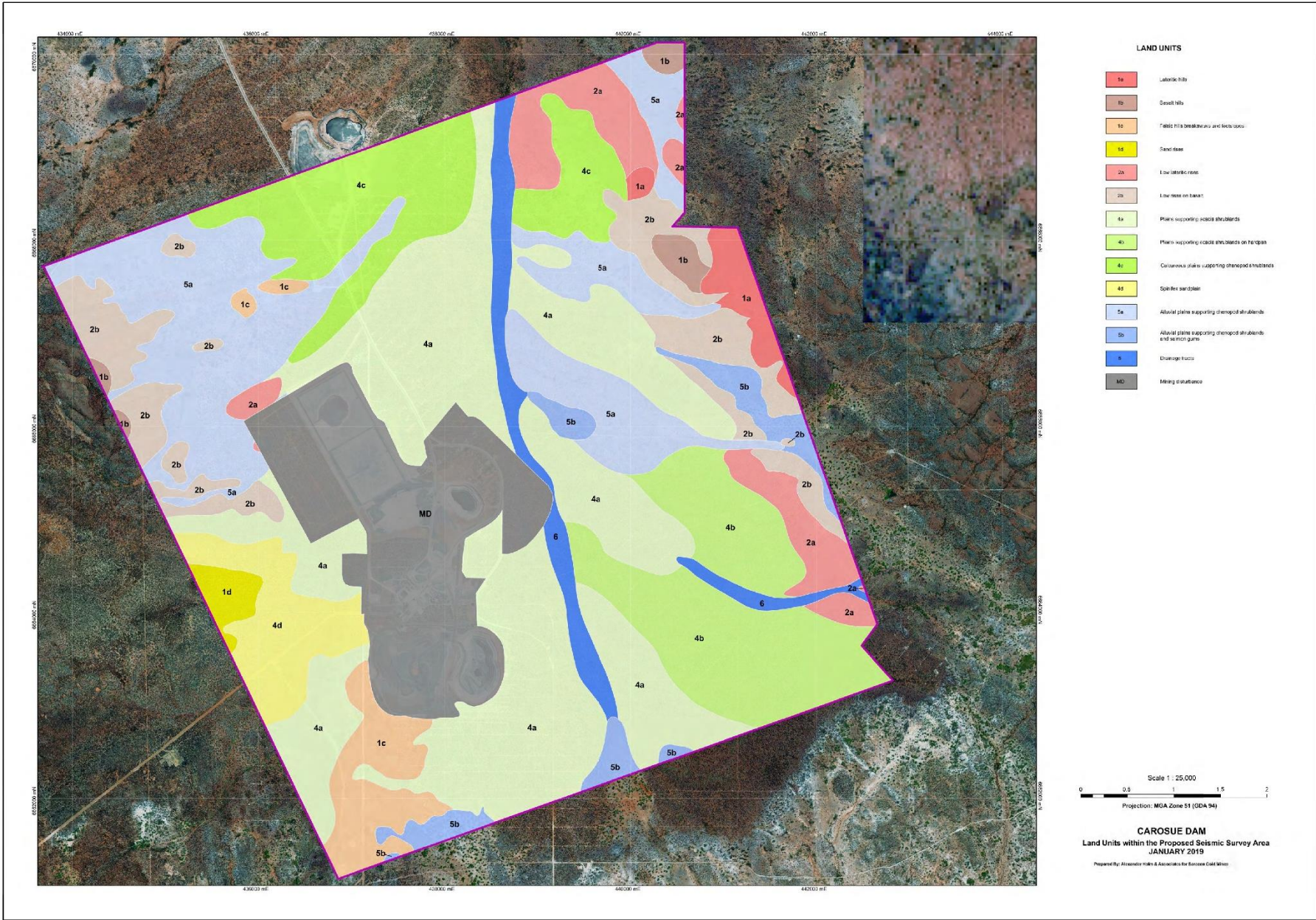


Figure 7: Map of land units

Land unit areas

Approximately 40% of the survey area is occupied by plains supporting acacia shrublands with sparse overstoreys of eucalypts and casuarina (land units 4a and 4b). Chenopod shrublands occur on approximately 25% of the area either on calcareous plains (land unit 4c) or alluvial plains (land units 5a and 5b). Sand plains and sandy rises occupy 4% of the area and typically support spinifex tussock grasslands with sparse eucalypt overstoreys. Low hills and rises on laterite, basalt or felsic rocks occupy the remainder (Table 5).

Table 4: Area of each land unit within the extended survey area

Land unit	Description	Hectares	%
1a.	Lateritic hills	70.08	1.43
1b.	Basalt hills	43.92	0.90
1c.	Felsic hills breakaways and footslopes	166.45	3.40
1d.	Sandy rises	37.85	0.77
2a.	Low lateritic rises	233.41	4.77
2b.	Low rises on basalt	335.56	6.85
4a.	Plains supporting acacia shrublands	1327.78	27.12
4b.	Plains supporting acacia shrublands on hardpan	476.59	9.73
4c.	Calcareous plains supporting chenopod shrublands	411.70	8.41
4d.	Spinifex sandplain	175.69	3.57
5a.	Alluvial plains supporting chenopod shrublands	716.20	14.63
5b.	Alluvial plains supporting chenopod shrublands and salmon gums	127.16	2.60
6.	Drainage tracts	154.11	3.15
MD	Mining disturbance	619.44	12.65
Total		4895.93	100.00

Vegetation communities

Fire-susceptible ‘Sandplain mallee spinifex grassland’ (SAMA) occupies central western areas (Table 5). Elevated land units on laterite are mostly occupied by ‘Stony ironstone acacia shrubland’ (SIAS) while lower lateritic slopes are occupied by ‘Calcareous casuarina acacia shrubland’ (CCAS). Elevated land unit on basalt are occupied by ‘Greenstone hill shrubland’ (GHAS and GHMW) while those on felsic geology, mostly in the south west, are ‘Breakaway mixed shrubland’ (BRXS).

‘Plain acacia eucalypt shrubland’ (PAES) and ‘Hardpan plain mulga shrubland’ (HPMS) occupy extensive plains throughout the central areas through which pass a significant drainage tract occupied by ‘Drainage tract acacia shrubland’ (DRAS).

‘Plain mixed halophyte low shrublands’ (PXHS) occur on plains in northern areas and on adjacent alluvial plains which are often degraded. The lowest parts of the landscape, discharging overland flows to Lake Rebecca in the south, are occupied with ‘Plain eucalypt chenopod woodland’ (PECW).

Table 5: Vegetation communities, associated land units and vulnerability to disturbance.

Vegetation community	Description	Land unit	Vulnerable
BRXS	Breakaway mixed shrubland (N)	1c	
CCAS	Calcareous casuarina acacia shrubland or woodland (N)	2a	Yes (C)
DRAS	Drainage tract acacia shrubland (S)	6	
GHAS	Greenstone hill acacia shrubland (N)	1b	
GHMW	Greenstone hill mixed shrubland (N)	2b	
HPMS	Hardpan plain mulga shrubland (N)	4b	
PAES	Plain acacia eucalypt shrubland (new)	4a	
PECW	Plain eucalypt chenopod woodland (N)	5b	Yes
PXHS	Plain mixed halophyte low shrublands (N)	4c 5a	Yes (C)
SAMA	Sandplain mallee spinifex woodland (N)	1d 4d	
SIAS	Stony ironstone acacia shrubland (N)	1a	

*(N)(Pringle, Van Vreeswyk & Gilligan, 1994); (S) (Payne, Van Vreeswyk, Pringle, Leighton and Hennig 1998) (C) (Cowan, 2001)

Vegetation and soil condition

The survey area has been disturbed by recent and historic mining activity and is mostly within a pastoral lease and has been grazed. Vehicle tracks, cut lines and pastoral fences cross the area.

Land units supporting chenopod vegetation, preferentially grazed by livestock, are mostly degraded and few areas are in good condition (Table 6). Spinifex communities (SASP) on sandplains and sandy rises are not suitable for grazing and are in excellent condition. Hills on laterite, basalt and felsic geology are mostly in excellent condition. (Table 5) while lower slopes on laterite and basalt are often in poorer condition.

Minor to moderate soil erosion is evident on alluvial plains (land unit 5a and 5b) and these land units are rated as moderately vulnerable to erosion (Table 6). Other land units are mostly rated nil or slight vulnerable to soil erosion and only small areas on these units are

slightly eroded (Table 7). Spinifex sand plain and rises are susceptible to wind erosion following fire.

Table 6: Vegetation and soil surface condition ratings for each land unit

Land unit	Vulnerability to erosion	Erosion status	Vegetation condition
1a. Lateritic hills	Nil	100% nil	100% excellent
1b. Basalt hills	Nil	100% nil	100% excellent/v.good
1c. Felsic hills breakaways and footslopes	Nil	100% nil	100% excellent/good
1d. Sandy rises	Slight	100% nil	100% excellent
2a. Low lateritic rises	Nil -slight	100% nil to minor	80% excellent/good 20% poor
2b. Low rises on basalt	Nil -slight	93% nil to minor 7% moderate	50% excellent/good 50% poor
4a. Plains supporting acacia shrublands	Nil -slight	94% nil to minor 6% moderate	75% excellent/good 25% poor
4b. Plains supporting acacia shrublands on hardpan	Nil	100% nil to minor	100% excellent/good
4c. Calcareous plains supporting chenopod shrublands	Nil -slight	83% nil to minor 17% moderate	17% good 17% poor 66% degraded
4d. Spinifex sandplain	Moderate	100% nil to minor	100% excellent/ v.good
5a. Alluvial plains supporting chenopod shrublands	Moderate	71% nil to minor 29% moderate	14% good 29% poor 57% degraded/ completely degraded
5b. Alluvial plains supporting chenopod shrublands and salmon gums	Moderate	67% nil to minor 33% moderate	33% good 29% poor 28% degraded
6. Drainage tracts	Slight to moderate	60% nil 40% minor	60% excellent/good 20% poor 20% degraded

Threatened ecosystems and wetlands.

Threatened and priority ecological communities

There are no identified threatened ecological communities (TECs) on Saracen tenements or in the entire MUR1 biogeographic subregion (Cowan, 2001).

There are no listed priority ecological communities (PECs) in the area.

Ecosystems at risk

Cowan, (2001) lists PXHS vegetation community (Plain mixed halophyte low shrublands) as an ecosystem at risk to disturbance (Table 5). PXHS vegetation community is associated with land unit 5a, 57% of which was degraded through over grazing. This current survey also identifies PECW (Plain eucalypt chenopod woodland) as an ecosystem at risk in that over 50% is in poor or degraded condition. PXHS and PECW occur on land unit 5a and 5b which are moderately vulnerable to erosion and erosion is evident (Table 6).

Significant wetlands

There are no nationally significant wetlands in the area (Appendix 1). Lake Rebecca is a major wetland with local and regional significance.

Riparian vegetation

The survey landscape mainly drains via overland flow to a main drainage tract (land unit 6a) which flows into Lake Rebecca 5 km to the north. Southern areas drain southerly through various drainage systems also to Lake Rebecca.

Flora

General

One hundred and twenty-nine flora taxa representing 26 families were found during the reconnaissance survey (Table 7). Chenopodiaceae accounted for 24 taxa, Fabaceae 19 taxa and Scrophulariaceae 17 taxa. There were four sterile specimens which were identified to genera level.

An additional 14 taxa were found on the sandy rises of land unit 1D during the November 2013 survey (Table 7).

A list of species within each family found at each inventory site is presented in Attachment 3. Species typifying the survey area include: *Acacia tetragonophylla*, *Scaevola spinescens*; *Ptilotus obovatus*, *Acacia burkittii*, *Casuarina pauper*, *Dodonaea lobulata* and *Senna artemisioides* subsp. *filifolia*, all present on at least 70% of sites.

Local endemics

No taxa are considered to be locally endemic.

Range extension

The collection of the following species at this location indicates a significant extension of their known distribution range:

- *Eucalyptus oleosa* subsp. *cylindroidea*
- *Sclerolaena glabra*
- *Thryptomene kochii*

Declared weed species

No alien to Western Australia (weed) species were located during survey although *Carthamus lanatus* (saffron thistle) was noted growing along road verges.

Table 7: List of flora taxa found during field survey in January 2019 and on land unit 1D during field survey in November 2012.

Family	Taxa	Land units											
		1A	1B	1C	1D	2A	2B	4A	4B	4C	5A	5B	6
Amaranthaceae	<i>Ptilotus obovatus</i>	y	y	y		y	y	y	y	y	y	y	y
Apocynaceae	<i>Alyxia buxifolia</i>			y			y	y			y	y	
Apocynaceae	<i>Marsdenia australis</i>	y	y			y	y	y	y	y	y	y	y
Asteraceae	<i>Brachyscome ciliaris</i>		y					y			y		y
Asteraceae	<i>Brachyscome trachycarpa</i>										y		
Asteraceae	<i>Cratystylis subspinescens</i>					y				y	y	y	
Asteraceae	<i>Minuria cunninghamii</i>									y	y		
Asteraceae	<i>Olearia exiguifolia</i>							y					y
Asteraceae	<i>Olearia muelleri</i>	y		y		y	y	y	y	y	y	y	
Asteraceae	<i>Vittadinia eremaea</i>									y	y		
Boraginaceae	<i>Halgania cyanea</i>							y					y
Boraginaceae	<i>Halgania erecta*</i>				Y								
Casuarinaceae	<i>Allocasuarina helmsii</i>												
Casuarinaceae	<i>Casuarina pauper</i>	y	y	y		y	y	y	y	y	y	y	
Chenopodiaceae	<i>Atriplex bunburyana</i>						y	y	y	y	y	y	
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	y	y	y		y	y	y	y	y	y	y	
Chenopodiaceae	<i>Atriplex vesicaria</i>			y			y			y	y	y	
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>		y				y	y		y	y	y	
Chenopodiaceae	<i>Enchylaena lanata</i>			y			y	y			y	y	y
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	y		y			y	y			y	y	y
Chenopodiaceae	<i>Enchyleana x Maireana</i> hybrid							y		y	y		y
Chenopodiaceae	<i>Eriochiton sclerolaenoides</i>	y											
Chenopodiaceae	<i>Maireana georgei</i>	y	y	y			y	y		y	y	y	y
Chenopodiaceae	<i>Maireana pentatropis</i>	y	y	y		y	y				y	y	
Chenopodiaceae	<i>Maireana planifolia</i>										y	y	
Chenopodiaceae	<i>Maireana pyramidata</i>							y		y	y	y	
Chenopodiaceae	<i>Maireana sedifolia</i>	y	y	y		y	y	y		y	y	y	
Chenopodiaceae	<i>Maireana tomentosa</i>			y							y	y	
Chenopodiaceae	<i>Maireana triptera</i>	y		y			y	y		y	y	y	y
Chenopodiaceae	<i>Rhagodia drummondii</i>	y	y				y	y		y	y	y	
Chenopodiaceae	<i>Rhagodia eremaea</i>	y	y	y		y	y	y			y	y	y
Chenopodiaceae	<i>Salsola australis</i>									y		y	
Chenopodiaceae	<i>Sclerolaena cuneata</i>											y	

Family	Taxa	Land units											
		1A	1B	1C	1D	2A	2B	4A	4B	4C	5A	5B	6
Chenopodiaceae	<i>Sclerolaena diacantha</i>	y	y	y		y	y	y		y	y	y	
Chenopodiaceae	<i>Sclerolaena gardneri</i>									y	y	y	
Chenopodiaceae	<i>Sclerolaena glabra</i>	y										y	
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>										y	y	
Chenopodiaceae	<i>Tecticornia disarticulata</i>			y								y	
Convolvulaceae	<i>Convolvulus clementii</i>									y			y
Convolvulaceae	<i>Duperreya commixta*</i>				Y								
Euphorbiaceae	<i>Bertya dimerostigma*</i>				Y								
Fabaceae	<i>Acacia aptaneura</i>			y					y	y	y	y	
Fabaceae	<i>Acacia ayersiana</i>	y	y	y		y		y	y				y
Fabaceae	<i>Acacia burkittii</i>	y	y	y		y	y	y	y	y	y	y	y
Fabaceae	<i>Acacia caesaneura</i>					y		y	y				
Fabaceae	<i>Acacia effusifolia*</i>				Y								
Fabaceae	<i>Acacia erinacea</i>	y		y									
Fabaceae	<i>Acacia hemiteles</i>	y	y				y	y	y	y	y	y	y
Fabaceae	<i>Acacia incurvaneura</i>	y	y	y	Y	y	y	y	y	y	y		y
Fabaceae	<i>Acacia kempeana</i>					y	y		y		y		
Fabaceae	<i>Acacia ligulata</i>			y			y	y		y			
Fabaceae	<i>Acacia nyssophylla</i>	y	y	y		y	y	y		y	y	y	
Fabaceae	<i>Acacia oswaldii</i>		y	y		y	y	y	y	y	y	y	
Fabaceae	<i>Acacia quadrimarginea</i>		y										
Fabaceae	<i>Acacia ramulosa</i> var. <i>linophylla</i>		y	y		y	y	y	y				
Fabaceae	<i>Acacia sibirica</i>	y	y			y	y	y	y			y	
Fabaceae	<i>Acacia tetragonophylla</i>	y	y	y	Y	y	y	y	y	y	y	y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>filifolia</i>	y	y	y		y	y	y	y	y	y	y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>x artemisioides</i>		y				y	y	y		y	y	y
Fabaceae	<i>Senna cardiosperma</i>	y	y										
Fabaceae	<i>Templetonia incrassata</i>			y		y		y	y		y		
Frankeniaceae	<i>Frankenia interioris</i>			y						y	y	y	
Goodeniaceae	<i>Scaevola spinescens</i>	y	y	y		y	y	y	y	y	y	y	y
Lamiaceae	<i>Physopsis viscida</i>												
Lamiaceae	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>		y		Y	y		y	y		y		y
Lamiaceae	<i>Teucrium disjunctum</i>										y		
Lamiaceae	<i>Teucrium teucriiflorum</i>					y		y	y		y		y
Lamiaceae	<i>Westringia rigida</i>				Y					y			

Family	Taxa	Land units											
		1A	1B	1C	1D	2A	2B	4A	4B	4C	5A	5B	6
Loranthaceae	<i>Amyema fitzgeraldii</i>							y		y	y		y
Loranthaceae	<i>Amyema gibberula</i> var. <i>gibberula</i>							y	y				y
Loranthaceae	<i>Amyema preissii</i>						y						
Loranthaceae	<i>Lysiana casuarinae</i>							y		y	y		
Malvaceae	<i>Abutilon cryptopetalum</i>									y			
Malvaceae	<i>Abutilon otocarpum</i>										y		
Malvaceae	<i>Brachychiton gregorii</i>		y			y		y	y		y		y
Malvaceae	<i>Sida calyxhymenia</i>			y				y	y				
Malvaceae	<i>Sida intricata</i>						y	y			y		
Malvaceae	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)					y							
Malvaceae	<i>Sida spodochroma</i>									y	y	y	y
Myrtaceae	<i>Aluta aspera</i> subsp. <i>aspera</i> *				Y								
Myrtaceae	<i>Calytrix</i> sp.			y									
Myrtaceae	<i>Enekbatus cryptandroides</i> *				Y								
Myrtaceae	<i>Eucalyptus ewartiniana</i>					y							
Myrtaceae	<i>Eucalyptus ceratocorys</i> *				Y								
Myrtaceae	<i>Eucalyptus concinna</i>	y						y	y				
Myrtaceae	<i>Eucalyptus eremicola</i> *				Y								
Myrtaceae	<i>Eucalyptus eremicola</i> subsp. <i>peeneri</i>			y									
Myrtaceae	<i>Eucalyptus lesouefii</i>			y			y					y	
Myrtaceae	<i>Eucalyptus oldfieldii</i> *				Y								
Myrtaceae	<i>Eucalyptus oleosa</i> subsp. <i>cylindroidea</i> *				Y								
Myrtaceae	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>			y				y	y		y		y
Myrtaceae	<i>Eucalyptus salmonophloia</i>			y								y	
Myrtaceae	<i>Eucalyptus salubris</i>						y					y	
Myrtaceae	<i>Eucalyptus yilgarnensis</i>	y											
Myrtaceae	<i>Melaleuca hamata</i>					y							
Myrtaceae	<i>Thryptomene kochii</i> *				Y								
Myrtaceae	<i>Verticordia pritzelii</i> *				Y								
Pittosporaceae	<i>Bursaria occidentalis</i>				Y			y			y		y
Pittosporaceae	<i>Marianthus bicolor</i> *				Y								
Pittosporaceae	<i>Pittosporum angustifolium</i>										y		
Poaceae	<i>Aristida contorta</i>		y							y			
Poaceae	<i>Astrostipa</i> sp.	y	y			y	y			y	y		
Poaceae	<i>Austrostipa elegantissima</i>	y		y		y	y			y	y	y	

Family	Taxa	Land units											
		1A	1B	1C	1D	2A	2B	4A	4B	4C	5A	5B	6
Poaceae	<i>Austrostipa eremophila</i>							y					
Poaceae	<i>Enneapogon avenaceus</i>						y				y	y	
Poaceae	<i>Enneapogon caerulescens</i>									y	y		
Poaceae	<i>Enneapogon polyphyllus</i>										y		
Poaceae	<i>Eragrostis eriopoda</i>					y		y	y				
Poaceae	<i>Monachather paradoxus</i>					y		y					
Poaceae	<i>Paspalidium constrictum</i>						y			y	y	y	y
Poaceae	<i>Thyridolepis</i> sp								y				
Poaceae	<i>Triodia irritans</i>				Y					y			
Proteaceae	<i>Grevillea juncifolia</i> subsp. <i>juncifolia</i> *				Y								
Proteaceae	<i>Grevillea nematophylla</i> subsp. <i>nematophylla</i>				Y								
Proteaceae	<i>Hakea preissii</i>			y							y		
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>		y			y							
Rubiaceae	<i>Psyrdrax suaveolens</i>			y	Y	y							
Rutaceae	<i>Phebalium canaliculatum</i>	y	y		Y					y	y	y	y
Santalaceae	<i>Exocarpos aphyllus</i>			y							y	y	
Santalaceae	<i>Santalum acuminatum</i>											y	
Santalaceae	<i>Santalum spicatum</i>	y	y	y		y	y	y	y	y	y		y
Sapindaceae	<i>Alectryon oleifolius</i> subsp. <i>canescens</i>	y	y	y		y	y	y		y	y	y	
Sapindaceae	<i>Dodonaea amblyophylla</i> *				Y								
Sapindaceae	<i>Dodonaea lobulata</i>	y	y	y		y	y	y	y	y	y	y	y
Sapindaceae	<i>Dodonaea rigida</i>			y		y		y	y		y		y
Scrophulariaceae	<i>Eremophila alternifolia</i>			y				y		y	y		
Scrophulariaceae	<i>Eremophila arachnoides</i> subsp. <i>tenera</i>										y	y	
Scrophulariaceae	<i>Eremophila caperata</i>												
Scrophulariaceae	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>	y		y	Y	y	y	y	y	y	y	y	y
Scrophulariaceae	<i>Eremophila eriocalyx</i>	y	y			y	y	y	y		y		y
Scrophulariaceae	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>				Y	y		y	y				
Scrophulariaceae	<i>Eremophila georgei</i>	y	y	y			y	y	y		y		
Scrophulariaceae	<i>Eremophila glabra</i> subsp. <i>glabra</i>		y			y	y	y	y	y	y		y
Scrophulariaceae	<i>Eremophila granitica</i>				Y			y	y				y
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	y	y	y		y	y	y	y				
Scrophulariaceae	<i>Eremophila longifolia</i>						y	y	y		y	y	y
Scrophulariaceae	<i>Eremophila maculata</i>											y	
Scrophulariaceae	<i>Eremophila metallicorum</i>					y		y		y	y		y

Family	Taxa	Land units											
		1A	1B	1C	1D	2A	2B	4A	4B	4C	5A	5B	6
Scrophulariaceae	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>	y	y	y		y	y	y	y	y	y		y
Scrophulariaceae	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	y		y			y	y				y	y
Scrophulariaceae	<i>Eremophila scoparia</i>	y	y	y		y	y			y	y	y	
Scrophulariaceae	<i>Eremophila</i> sp									y	y		
Solanaceae	<i>Lycium australe</i>										y		
Solanaceae	<i>Solanum nummularium</i>					y		y			y		
Solanaceae	<i>Solanum lasiophyllum</i>		y				y	y	y	y	y	y	y
Violaceae	<i>Hybanthus floribundus</i> subsp. <i>curvifolius</i>	y											
Zygophyllaceae	<i>Roepera aurantiaca</i> subsp. <i>aurantiaca</i>										y		

* 2013 survey

Threatened and priority flora

There are three threatened flora taxa (WA Wildlife Conservation Act 1950 – Wildlife Conservation (Rare Flora) Notice 2010(2) likely to occur in the general area: *Thryptomene wittweri*, *Eucalyptus articulata* and *Gastrolobium graniticum* which is also an endangered species under the Commonwealth EPBC Act (Table 2).

No threatened (rare) or endangered flora taxa were found during reconnaissance or targetted surveys.

Eremophila arachnoides subsp. *tenera* (P1) was located at:

- Northern area of approximately 125ha containing about 2500, mostly adult, plants (Figure 8). The vast majority of these are located on land unit 5a: Alluvial plains supporting chenopod shrublands.
- A southern area of approximately 3.4ha containing 28 adult plants.
- A southern area of approximately 3.4ha containing 13 adult plants.
- A southern area of approximately 1.2ha containing 5 adult plants
- Two singletons in the southern area.

Southern areas shown in Figure 9 and all occurring on land unit 5b: Alluvial plains supporting chenopod shrublands and salmon gums.

It is likely that other populations exist in similar land units to the south of the survey area.



Eremophila arachnoides subsp. *tenera*
P1

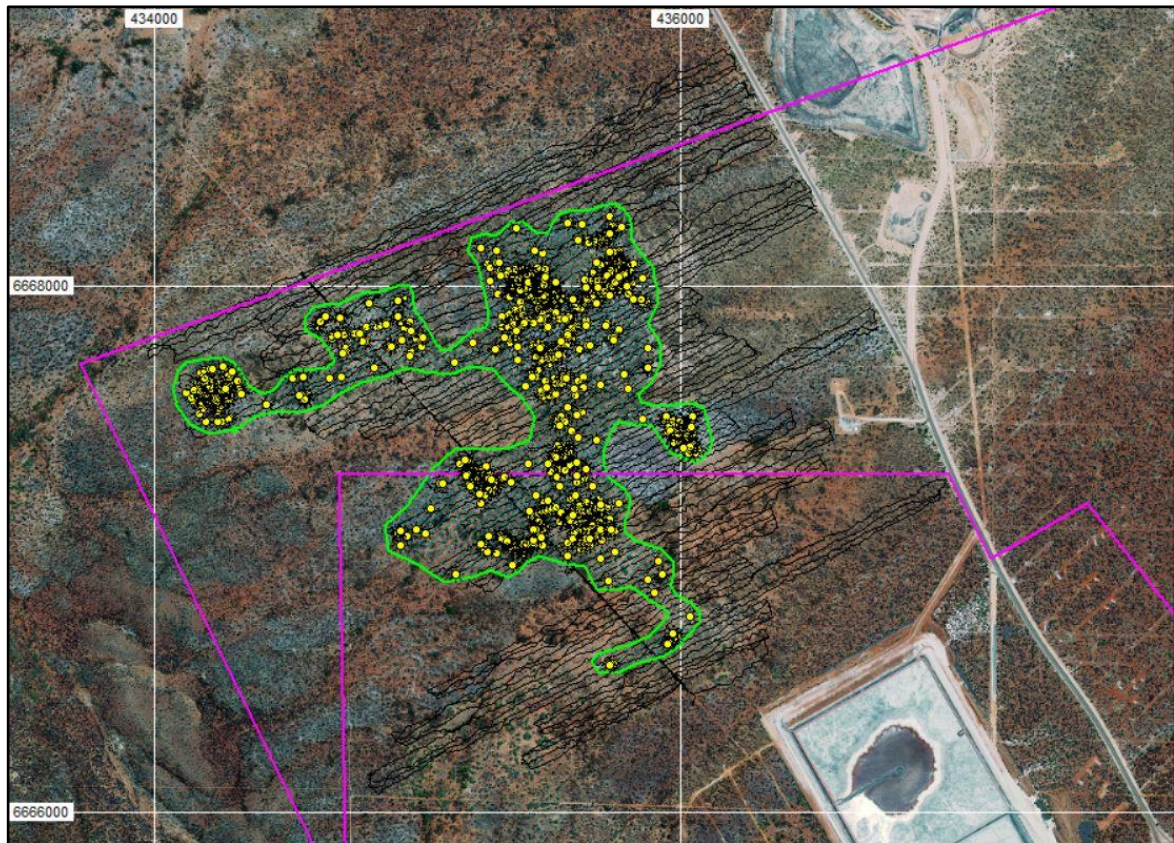


Figure 8: Location of *Eremophila arachnoides* subsp. *tenera* (yellow dots) and search traverses (black lines) in the northern area.

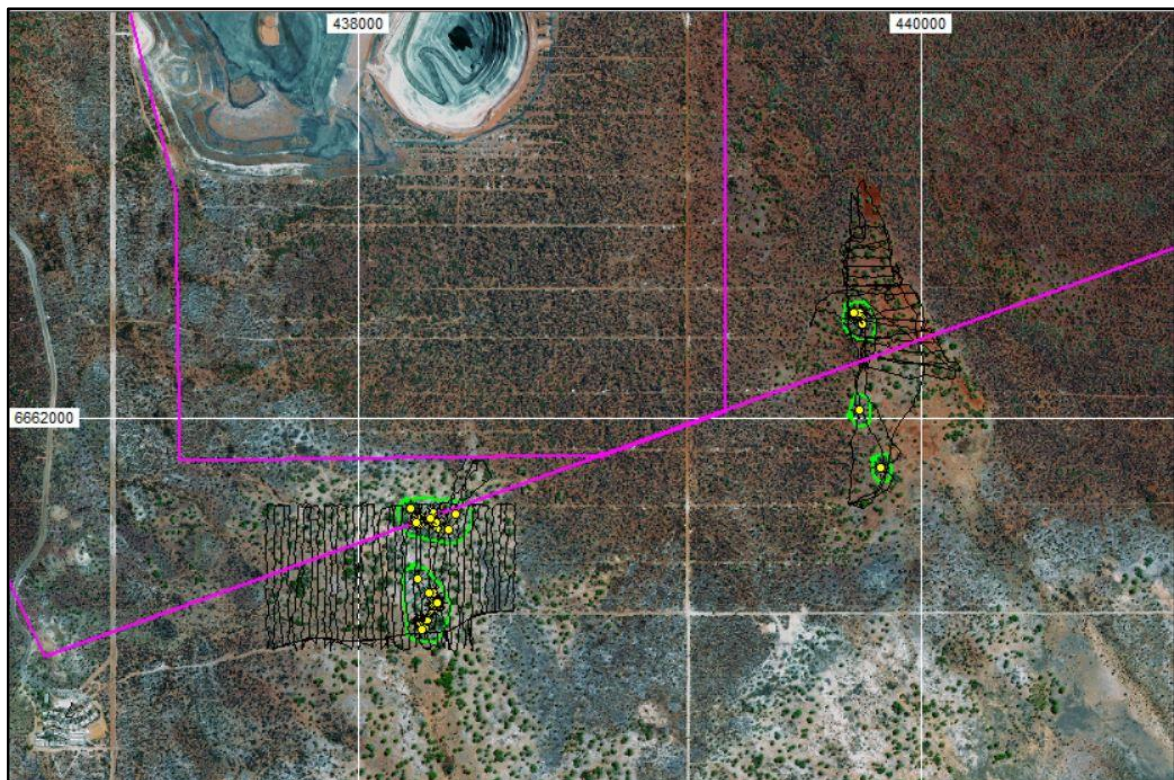


Figure 9: Location of *Eremophila arachnoides* subsp. *tenera* (yellow dots) and search traverses (black lines) in the southern area.

Fauna

Conservation significant fauna

Malleefowl

Malleefowl are active in the survey area. There were three sightings of birds during field work for this survey and active mounds have been found in previous studies (Coffey Environment 2010, Alexander Holm and Associates 2012d), and in the airport area just to the west. Several Malleefowl mounds were found during this survey but most were long-inactive (Figure 5). The species is therefore clearly resident, but density of mounds is low. Furthermore, several mounds were very small, little more than small pits with a slightly raised edge of excavated soil, and it is unlikely they had ever been used for breeding; possibly they were dug by young males. These tended to be in heavy loamy-clay soils which are not usually the preferred substrate, with sands and gravels generally favoured. Malleefowl is probably more abundant to the west where there are extensive sandy soils associated with land unit 1d and 4d together occupying about 4.5% of the survey area. They may also be more abundant in rocky hills and low rises (land unit 1a, 1b, 1c 2a and 2b) collectively occupying 17% of the survey area.

Peregrine Falcon

Peregrine Falcon were not observed but are a widespread species and considered likely to be a regular visitor if not resident. It could also breed in tall eucalypts in the area, probably by utilising old nests of the Australian Raven.

Rainbow Bee-eater.

This species is only considered of local significance but was formerly listed as Migratory under legislation. It is still considered locally significant as it is a true migrant and breeds in burrows in the area, making it vulnerable to disturbance and predation. It will also often nest along tracks, increasing its vulnerability.

Habitat

The sandy soils supporting spinifex and mallee in the south-west (land units 1d and 4d) are likely to be rich in reptiles as the soils allow for burrowing and the spinifex provides abundant cover. Such areas are also likely to be rich in shrubland-dependent birds and some small mammals. During the site inspection, it was noted that the transition between eucalypt woodland and acacia shrublands appeared to be rich in birds; south of the current operations this is where species such as the Red-capped Robin, White-eared and Brown-headed Honeyeaters and White-browed Babblers were observed. It was also where a Malleefowl was seen. Tall shrublands of acacia with little understorey, found across large areas of loamy-clay soils (land unit 4a and 4b), are probably less rich in species. The low rocky hills (land units 1a, 1b, 1c) have potential for short range endemic invertebrates and appeared to be floristically rich, so may be seasonally important for nectar-dependent birds and invertebrates.

Impacting processes on fauna

Habitat loss leading to population decline.

Habitat loss from clearing 3m wide drill-lines at 90m intervals will affect about 3% of the landscape, and there will inevitably be some mortality during this clearing. Note that the habitat loss will be temporary except where lines are maintained as access tracks, and

therefore populations should recover from this loss eventually. The effect of habitat loss can be reduced by avoiding sensitive environmental features such as Malleefowl mounds.

Habitat loss leading to population fragmentation.

This is unlikely to be a concern with the proposal as the clearing is in narrow lines through otherwise more or less continuous vegetation.

Ongoing mortality from operations.

Main sources of ongoing mortality will be from vehicle strike and entrapment in drilling sumps. There are standard procedures for minimising these risks.

Species interactions including feral and overabundant native species.

Feral predators are present and affect fauna assemblage. Creation of multiple tracks will improve their access into areas where currently tracks are few. The presence of personnel in these areas can also lead to an increase in activity of feral species.

Hydrological change.

There may be some disruption of surface flow especially on the lower slopes of hills. Wastewater from drilling is usually contained in lined sumps so should have no impact.

Altered fire regimes.

Drilling activities and the presence of personnel will increase the risk of unplanned bushfire.

Disturbance (dust, light, noise).

Some level of disturbance during drilling is inevitable but temporary. If drilling occurs at night, lighting may be a source of mortality for insects. While only a temporary effect there are means by which this sort of mortality can be reduced. It is not known if the specially protected jewel beetles known from the general area are present, or how they might be affected by light.

Hydrological summary

The survey landscape mainly drains via overland flow to a main drainage tract (land unit 6) which flows into Lake Rebecca 5 km to the north. Southern areas drain southerly through various drainage systems again to Lake Rebecca.

Groundwater within the vicinity of the existing tailings facility is hypersaline (30,000 to 120,000 mg/l TDS) and between 15 and 60m below ground level (Saracen annual ground water report). Groundwater beneath the sandplain and sandy rise to the west of the survey area is likely to be less saline however no data exists for this aquifer.

ASSESSMENT IN RELATION TO CLEARING PRINCIPLES

Results of this survey are used to assess clearing within the survey area in relation to ten clearing principles prescribed in Schedule 5 under amendments in 2004 to the Environmental Protection Act (1986):

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

The survey area is in the south-east of Eastern Murchison (MUR 1) bio-geographic subregion and adjacent to Shield and Eastern Goldfields bio-geographic sub-regions. Lake Ballard/Lake Rebecca form a major vegetation divide with characteristic *Acacia aneura* (mulga) low woodlands associated with red loams over siliceous hard pan to the north and low woodlands of mixed mulga and casuarina (black oak) and *Eucalyptus* species on alkaline and calcareous soils to the south. The survey area straddles this vegetation divide.

Beard Vegetation Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.) is the most common vegetation association in the survey area occupying 83%. Vegetation Association 529 (Succulent steppe with open low woodland; mulga and sheoak over salt bush) occupies 12% and the remaining 5% is Vegetation Association 24 (Low woodland; *Casuarina obesa*) (Beard 1976).

One hundred and twenty nine flora taxa representing 26 families were found during the reconnaissance survey. An additional 14 taxa were found on the sandy rises of land unit 1D during the November 2013 survey.

Vegetation associations and species composition are typical of the area and most are not unusually diverse.

Proposal is not at variance to this principle.

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

Malleefowl are active in the survey area. Malleefowl mounds are of importance for the birds, whether or not they are active or recently-used, while active mounds (containing eggs) are of special value. Even very old mounds have been found to be re-used, possibly after an interval of several decades (M. Bamford pers. obs; Mt Jackson area). Malleefowl is probably more abundant to the west where there are extensive sandy soils associated with land unit 1d and 4d together occupying about 4.5% of the survey area. They may

also be more abundant in rocky hills and low rises (land unit 1a, 1b, 1c 2a and 2b) collectively occupying 17% of the survey area.

Large Eucalypt trees, common in land unit 5b, may support nesting by the Peregrine Falcon (and other birds).

Proposal is at variance to this principle

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

No listed species of rare or critically endangered flora were found during this survey.

A search of the Department of Environment and Conservation's Rare and Priority Flora Database revealed no records of Declared Rare Flora (DRF) in or nearby the survey area.

Three populations consisting of over 2500 plants of *Eremophila arachnoides* subsp. *tenera*, a Priority 1 listed taxa (P1) were located within the survey envelope. Priority flora are under consideration for listing as threatened species and as such require protection until their status is decided.

The proposal is likely to be at variance to this principle.

(d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community.

There are no Threatened Ecological Communities (TECs) within the north east Goldfields subregion (Cowan, 2001).

There are no Priority Ecological Communities within or adjacent to the survey area.

The proposal is not at variance to this principle.

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

Beard Vegetation Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.) is the most common vegetation association in the survey area occupying 83%. Vegetation Association 529 (Succulent steppe with open low woodland; mulga and sheoak over salt bush) occupies 12% and the remaining 5% is Vegetation Association 24 (Low woodland; *Casuarina obesa*) (Beard 1976).

Vegetation Association 20 occupies approximately 13,000 km² in Western Australia of which 16.7% is within conservation reserves and although less than 1% of Vegetation Association 24, which occupies approximately 266 km² in Western Australia, is within reserves, both have a low priority for conservation (Table 1). Vegetation Association 529 is very poorly conserved and has a high priority for conservation.

Vegetation Association 529 has not been extensively cleared and clearing within this survey area will have minimal effect on extent of this vegetation community.

Proposal is not at variance to this principle.**(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**

The survey landscape mainly drains via overland flow to a main drainage tract (land unit 6) which flows into Lake Rebecca 5 km to the north. Southern areas drain southerly through various drainage systems again to Lake Rebecca. Lake Rebecca is a major wetland with local and regional significance.

Survey lines will intercept these watercourses.

Proposal is at variance with this principle.**(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.**

The survey area has been disturbed by recent mining activity, is mostly within a pastoral lease and has been grazed. Vehicle tracks and pastoral fences cross the area.

Land units supporting chenopod vegetation, preferentially grazed by livestock, are mostly degraded and few areas are in good condition. Spinifex communities (SASP) on sandplains and sandy rises are not suitable for grazing and are in excellent condition. Hills on laterite, basalt and felsic geology are mostly in excellent condition while lower slopes on laterite and basalt are often in poorer condition.

Minor to moderate soil erosion is evident on alluvial plains (land unit 5a and 5b) and these land units are rated as moderately vulnerable to erosion. Other land units are mostly rated nil or slight vulnerable to soil erosion and only small areas on these units are slightly eroded. Spinifex sand plain and rises are susceptible to wind erosion following fire.

Extensive clearing within alluvial land units 5a and 5b are likely to lead to further soil erosion. Limited strip clearing, as proposed, is unlikely to cause extensive land degradation.

Water tables are a) below the rooting depth of vegetation growing in these areas and b) hypersaline. Extensive clearing of vegetation at catchment-scale or artificial recharge of the water table may raise saline water tables and lead to secondary salinity in surrounding landscapes.

Clearing of vegetation at local scales will have minimal, if any, effect on water tables and associated risk of secondary salinity.

Proposal is unlikely to be at variance to this principle.**(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**

No conservation areas are nearby.

Proposal is not at variance to this principle.

- (i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.**

Approximately 17% of the survey area is occupied by alluvial plains supporting halophytic low shrubland with sparse overstoreys of eucalypts and casuarina (land units 5a and 5b). Minor to moderate soil erosion is evident on alluvial plains and these land units are rated as moderately vulnerable to erosion. Other land units are mostly rated nil or slightly vulnerable to soil erosion.

While, disturbance to land units 5a and 5b has the potential to increase sediment discharge to drainage tracts down-slope and ultimately, and through extreme events, to Lake Rebecca, the proposed strip clearing is unlikely to result in significant increases in sediment discharge.

Proposal is unlikely to be at variance with this principle.

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

The climate is arid to semi-arid with about 230 mm of annual rainfall. Rain falls on an average of 43 days a year.

Most rainfall events will cause little runoff, however extreme rainfall events such as those recorded in summers of 1984 and 1967, will result in runoff.

Clearing in this proposal will have negligible effect on the volume of runoff discharged.

Proposal is unlikely to be at variance with this principle.

DISCUSSION AND RECOMMENDATIONS

Saracen operates the Carosue Gold Mine and is proposing intensive exploration around its existing mine. A seismic survey is proposed over a 4300ha area requiring clearing of 3m wide access-lines at 90m spacing. Parts of this area have been covered by earlier environmental assessments. The current environmental assessment envelope covers the balance of 3136ha.

Flora composition and vegetation associations are typical of the region and not considered unusually diverse. There are no Threatened Ecological Communities (TECs) and no Priority Ecological Communities within or adjacent to the survey area.

No listed species of rare or critically endangered flora were found during this survey and no records of Declared Rare Flora (DRF) found in or nearby the survey area. Three populations consisting of over 2500 plants of *Eremophila arachnoides* subsp. *tenera*, a Priority 1 listed taxa (P1), were located within the survey envelope. Priority flora are under consideration for listing as threatened species and as such require protection until their status is decided.

No alien to Western Australia (weed) species were located during survey although *Carthamus lanatus* (saffron thistle) was noted growing along road verges.

Approximately 17% of the survey area is occupied by alluvial plains (land units 5a and 5b) where moderate soil erosion is evident, and these land units are rated as moderately vulnerable to erosion. These alluvial systems support PXHS vegetation community (Plain mixed halophyte low shrublands) and PECW (Plain eucalypt chenopod woodland) which are degraded through over grazing. While, disturbance to land units 5a and 5b has the potential to increase sediment discharge to drainage tracts down-slope and ultimately, and through extreme events, to Lake Rebecca, the proposed strip clearing is unlikely to result in significant increases in sediment discharge.

The survey landscape mainly drains via overland flow to a main drainage tract (land unit 6) which flows into Lake Rebecca 5 km to the north. Southern areas drain southerly through various drainage systems again to Lake Rebecca. Lake Rebecca is a major wetland with local and regional significance. Survey lines will intercept these watercourses.

Malleefowl are active in the survey area. There were three sightings of birds during field work for this survey and active mounds have been found in previous studies. Malleefowl is probably more abundant to the west where there are extensive sandy soils associated with land unit 1d and 4d together occupying about 4.5% of the survey area. They may also be more abundant in rocky hills and low rises (land unit 1a, 1b, 1c 2a and 2b) collectively occupying 17% of the survey area. Malleefowl mounds are of importance for the birds, whether or not they are active or recently-used. Malleefowl mounds are active from about May to December and depending on rainfall into January. Active mounds containing eggs are of special value.

Large Eucalypt trees, common in land unit 5b, may support nesting by the Peregrine Falcon (and other birds).

It is recommended that, in planning and implementing seismic operations within the survey area, the proponent:

- 1. Avoids disturbance to *Eremophila arachnoides* subsp. *tenera*.**
- 2. Undertakes a Malleefowl survey especially within land units 1a, 1b, 1c, 1d, 2a and 2b and avoids disturbance within 50m of active Malleefowl nests during nesting and incubation.**
- 3. Installs signage on access roads to the exploration area if Malleefowl are seen or suspected.**
- 4. Avoids destruction of mature Eucalyptus trees with nesting hollows.**
- 5. Takes measures to minimise erosion through soil disturbance and concentration of overland water flows on vulnerable land units, especially alluvial plains (land unit 5a and 5b).**
- 6. Avoids disturbance to watercourses within land unit 6.**

REFERENCES

- Alexander Holm & Associates (2010). Environmental assessment: Proposed expansion of Whirling Dervish mine. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 45.
- Alexander Holm & Associates (2012a). Environmental assessment: Montys' dewatering pipeline to Lake Rebecca. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 100.
- Alexander Holm & Associates (2012b). Environmental assessment: Old Plough Dam. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 96.
- Alexander Holm & Associates (2012c). Environmental assessment: Pinnacles. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 82.
- Alexander Holm & Associates (2012d). Environmental assessment: Tailings storage facility expansion. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 81.
- Beard, J. S. (1976). Vegetation Survey of Western Australia - Sheet 6. Murchison. Nedlands, Western Australia, University of Western Australia Press.
- Brown, A. and B. Buirchell (2011). A field guide to the Eremophilas of Western Australia, Simon Nevill Publications.
- Cowan, M. (2001). Murchison 1 (MUR1 - East Murchison subregion). A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002. N. L. McKenzie and J. E. May. Perth, The Department of Conservation and Land Management: 466-479.
- Desmond, A., M. Cowan and A. Chant (2003). Murchison 2 (MUR2 - Western Murchison subregion). A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. N. L. McKenzie and J. E. May. Perth The Department of Conservation and Land Management: 480-496.
- Environmental Protection Authority (2016). Technical guidance. Flora and Vegetation Surveys for Environmental Impact Assessment. Perth Western Australia: 42.
- Mitchell, A. A. and D. G. Wilcox (1994). Arid Shrubland Plants of Western Australia. Perth, University of Western Australia Press.
- Payne, A. L., A. M. E. Van Vreeswyk, H. J. R. Pringle, K. A. Leighton and P. Hennig (1998). An inventory and condition survey of the Sandstone-Yalgoo- Paynes Find area, Western Australia. South Perth, Agriculture Western Australia: 372.

Disclaimer

While Alexander Holm & Associates has carried out some enquiries concerning data, assumptions and information supplied to it, those enquiries were limited and Alexander Holm & Associates does not accept responsibility for their accuracy. Accordingly, Alexander Holm & Associates does not accept any legal responsibility to any person, organisation or company for any loss or damage suffered by them resulting from their use of the report however caused, and whether by breach of contract, negligence or otherwise

Within the limitation imposed by the scope of review, the data assessment and preparation of the report have been undertaken in a professional manner and in accordance with generally accepted practices using a degree of care ordinarily exercised by professional environmental consultants. No other warranty, expressed or implied, is made.

ATTACHMENTS

Attachment 1: ‘NatureMap’ report

NatureMap Species Report

Created By Alexander Holm on 18/01/2019

Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)

Current Names Only Yes

Core Datasets Only Yes

Method 'By Circle'

Centre 122° 21' 56" E, 30° 08' 16" S

Buffer 40km

Group By Kingdom

Kingdom	Species	Records
Animalia	1	54
Plantae	1	4
TOTAL	2	58

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Animalia				
1.	24557 <i>Leipoa ocellata</i> (Malleefowl)		T	
Plantae				
2.	19695 <i>Thryptomene eremaea</i>		P2	

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Attachment 2: ‘Protected matters’ search tool output



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 18/01/19 21:08:05

[Summary](#)

[Details](#)

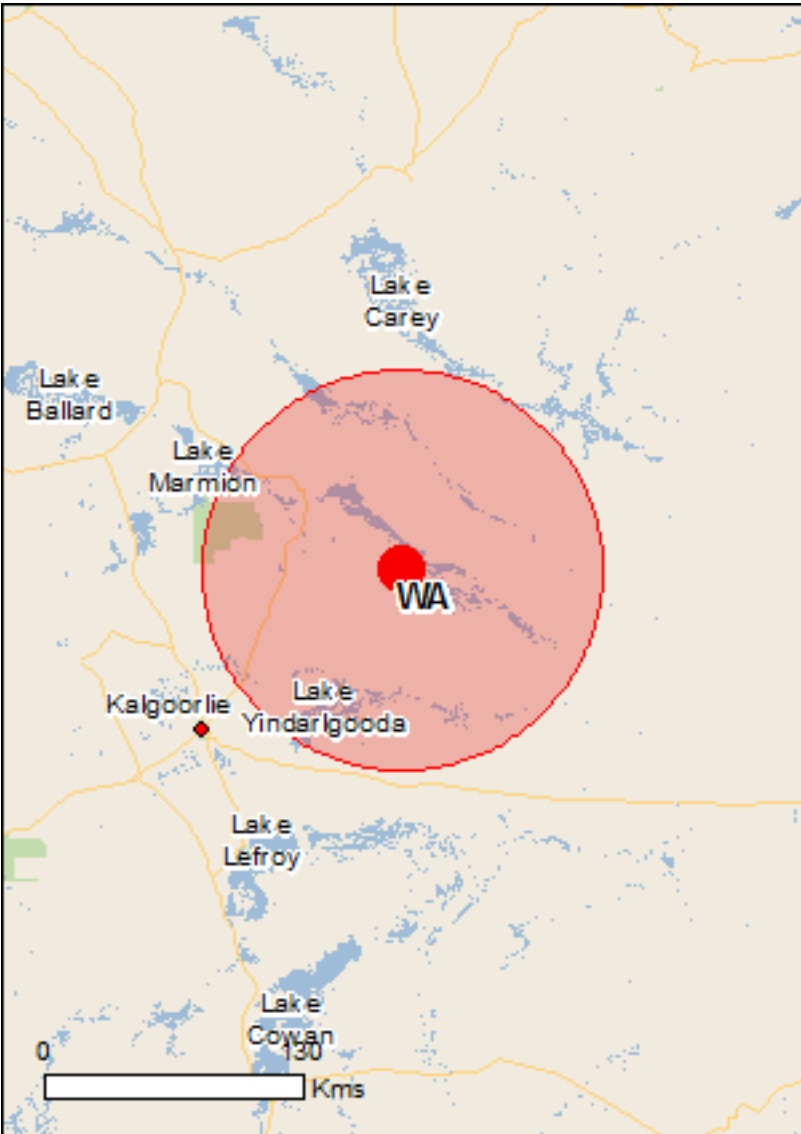
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 100.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	6
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat likely to occur within area
Plants		
Eucalyptus articulata Ponton Creek Mallee [56772]	Vulnerable	Species or species habitat likely to occur within area
Gastrolobium graniticum Granite Poison [14872]	Endangered	Species or species habitat likely to occur within area
Hibbertia crispula Ooldea Guinea-flower [15222]	Vulnerable	Species or species habitat may occur within area
Tecticornia flabelliformis Bead Glasswort [82664]	Vulnerable	Species or species habitat known to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
habitat likely to occur within area		
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bullock Holes Timber Reserve	WA
Cardunia Rocks	WA
Coonana Timber Reserve	WA
Goongarrie	WA
Queen Victoria Spring	WA
Wallaby Rocks Timber Reserve	WA

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua Ward's Weed [9511]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Nationally Important Wetlands		[Resource Information]
Name		State
Lake Marmion		WA

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-30.13825 122.36587

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.

Attachment 3: List of flora taxa found at each inventory site

Family	Taxa	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Amaranthaceae	<i>Ptilotus obovatus</i>	y		y	y	y	y		y	y	y	y		y		y
Apocynaceae	<i>Alyxia buxifolia</i>															
Apocynaceae	<i>Marsdenia australis</i>	y				y	y	y	y		y	y	y	y	y	y
Asteraceae	<i>Brachyscome ciliaris</i>						y									
Asteraceae	<i>Brachyscome trachycarpa</i>															
Asteraceae	<i>Cratystylis subspinescens</i>		y													
Asteraceae	<i>Minuria cunninghammii</i>															
Asteraceae	<i>Olearia exiguiifolia</i>										y	y				
Asteraceae	<i>Olearia muelleri</i>				y	y					y			y		y
Asteraceae	<i>Vittadinia eremaea</i>															
Boraginaceae	<i>Halgania cyanea</i>															
Casuarinaceae	<i>Allocasuarina helmsii</i>															
Casuarinaceae	<i>Casuarina pauper</i>				y			y		y	y			y		y
Chenopodiaceae	<i>Atriplex bunburyana</i>		y											y		
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>		y		y									y		
Chenopodiaceae	<i>Atriplex vesicaria</i>		y											y		
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>															
Chenopodiaceae	<i>Enchylaena lanata</i>									y				y		
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>													y		
Chenopodiaceae	<i>Enchyleana x Maireana</i> hybrid															
Chenopodiaceae	<i>Eriochiton sclerolaenoides</i>															
Chenopodiaceae	<i>Maireana georgei</i>				y					y	y			y		
Chenopodiaceae	<i>Maireana pentatropis</i>															y
Chenopodiaceae	<i>Maireana planifolia</i>															
Chenopodiaceae	<i>Maireana pyramidata</i>															
Chenopodiaceae	<i>Maireana sedifolia</i>		y		y											
Chenopodiaceae	<i>Maireana tomentosa</i>															
Chenopodiaceae	<i>Maireana triptera</i>		y		y									y		
Chenopodiaceae	<i>Rhagodia drummondii</i>															
Chenopodiaceae	<i>Rhagodia eremaea</i>		y				y	y			y	y		y		y
Chenopodiaceae	<i>Salsola australis</i>															
Chenopodiaceae	<i>Sclerolaena cuneata</i>															
Chenopodiaceae	<i>Sclerolaena diacantha</i>		y											y		y
Chenopodiaceae	<i>Sclerolaena gardneri</i>															
Chenopodiaceae	<i>Sclerolaena glabra</i>															
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>															
Chenopodiaceae	<i>Tecticornia disarticulata</i>															
Convolvulaceae	<i>Convolvulus clementii</i>															
Fabaceae	<i>Acacia aptaneura</i>															
Fabaceae	<i>Acacia ayersiana</i>	y		y		y			y		y	y				
Fabaceae	<i>Acacia burkittii</i>	y		y	y	y	y	y	y	y	y	y				y
Fabaceae	<i>Acacia caesaneura</i>												y		y	
Fabaceae	<i>Acacia erinacea</i>															

[illegible]

Family	Taxa	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Pittosporaceae	<i>Pittosporum angustifolium</i>															
Poaceae	<i>Aristida contorta</i>															
Poaceae	<i>Astrostipa</i> sp.												y			
Poaceae	<i>Austrostipa elegantissima</i>													y		
Poaceae	<i>Austrostipa eremophila</i>							y								
Poaceae	<i>Enneapogon avenaceus</i>															
Poaceae	<i>Enneapogon caeruleus</i>															
Poaceae	<i>Enneapogon polyphyllus</i>															
Poaceae	<i>Eragrostis eriopoda</i>			y									y		y	
Poaceae	<i>Monachather paradoxus</i>												y		y	
Poaceae	<i>Paspalidium constrictum</i>															
Poaceae	<i>Thyridolepis</i> sp.															
Poaceae	<i>Triodia irritans</i>															
Proteaceae	<i>Grevillea nematophylla</i> subsp. <i>nematophylla</i>															
Proteaceae	<i>Hakea preissii</i>															
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>														y	
Rubiaceae	<i>Psyrax suaveolens</i>														y	
Rutaceae	<i>Phebalium canaliculatum</i>											y				
Santalaceae	<i>Exocarpos aphyllus</i>															
Santalaceae	<i>Santalum acuminatum</i>															
Santalaceae	<i>Santalum spicatum</i>						y		y		y	y		y		y
Sapindaceae	<i>Alectryon oleifolius</i> subsp. <i>canescens</i>		y		y						y			y		y
Sapindaceae	<i>Dodonaea lobulata</i>	y		y		y	y		y	y	y	y		y		y
Sapindaceae	<i>Dodonaea rigida</i>			y		y	y	y	y	y	y		y		y	
Scrophulariaceae	<i>Eremophila alternifolia</i>															
Scrophulariaceae	<i>Eremophila arachnoides</i> subsp. <i>tenera</i>															
Scrophulariaceae	<i>Eremophila caperata</i>															
Scrophulariaceae	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>		y					y				y		y		
Scrophulariaceae	<i>Eremophila eriocalyx</i>	y		y	y	y			y	y	y		y	y		
Scrophulariaceae	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>								y				y		y	
Scrophulariaceae	<i>Eremophila georgei</i>			y					y					y		
Scrophulariaceae	<i>Eremophila glabra</i> subsp. <i>glabra</i>															
Scrophulariaceae	<i>Eremophila granitica</i>	y			y	y	y	y		y						
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>								y				y	y	y	
Scrophulariaceae	<i>Eremophila longifolia</i>		y				y							y		
Scrophulariaceae	<i>Eremophila maculata</i>		y													
Scrophulariaceae	<i>Eremophila metallicorum</i>											y				
Scrophulariaceae	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>						y		y		y			y		y
Scrophulariaceae	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>						y				y			y		
Scrophulariaceae	<i>Eremophila scoparia</i>		y													
Scrophulariaceae	<i>Eremophila</i> sp.															
Solanaceae	<i>Lycium australe</i>															
Solanaceae	<i>Solanum nummularium</i>										y		y			

[illegible]

[illegible]

Family	Taxa	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Fabaceae	<i>Acacia hemiteles</i>		y	y	y	y	y	y	y	y		y				y
Fabaceae	<i>Acacia incurvaneura</i>	y			y	y	y	y						y		y
Fabaceae	<i>Acacia kempeana</i>	y					y	y								
Fabaceae	<i>Acacia ligulata</i>															
Fabaceae	<i>Acacia nyssophylla</i>								y			y			y	
Fabaceae	<i>Acacia oswaldii</i>			y		y						y				
Fabaceae	<i>Acacia quadrimarginea</i>															
Fabaceae	<i>Acacia ramulosa</i> var. <i>linophylla</i>	y					y									
Fabaceae	<i>Acacia sibirica</i>									y	y	y	y		y	y
Fabaceae	<i>Acacia tetragonophylla</i>	y	y	y	y			y	y			y	y		y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>filifolia</i>		y	y	y	y	y	y	y	y		y	y			y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>x artemisioides</i>									y				y		
Fabaceae	<i>Senna cardiosperma</i>										y					
Fabaceae	<i>Templetonia incrassata</i>			y		y										
Frankeniaceae	<i>Frankenia interioris</i>															
Goodeniaceae	<i>Scaevola spinescens</i>	y		y		y	y		y	y	y	y		y	y	y
Lamiaceae	<i>Physopsis viscida</i>															
Lamiaceae	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>	y														
Lamiaceae	<i>Teucrium disjunctum</i>															
Lamiaceae	<i>Teucrium teucriiflorum</i>	y												y		
Lamiaceae	<i>Westringia rigida</i>															
Loranthaceae	<i>Amyema fitzgeraldii</i>				y			y								
Loranthaceae	<i>Amyema gibberula</i> var. <i>gibberula</i>															
Loranthaceae	<i>Amyema preissii</i>															
Loranthaceae	<i>Lysiana casuarinae</i>			y												
Malvaceae	<i>Abutilon cryptopetalum</i>															
Malvaceae	<i>Abutilon otocarpum</i>				y											
Malvaceae	<i>Brachychiton gregorii</i>	y												y		
Malvaceae	<i>Sida calyxthymenia</i>	y														
Malvaceae	<i>Sida intricata</i>											y	y	y		
Malvaceae	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)															
Malvaceae	<i>Sida spodochroma</i>							y	y							
Myrtaceae	<i>Calytrix</i> sp.															
Myrtaceae	<i>Eucalyptus ewartianiana</i>															
Myrtaceae	<i>Eucalyptus concinna</i>	y									y			y		
Myrtaceae	<i>Eucalyptus eremicola</i> subsp. <i>peeneri</i>															
Myrtaceae	<i>Eucalyptus lesouefii</i>															
Myrtaceae	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>				y			y								
Myrtaceae	<i>Eucalyptus salmonophloia</i>		y						y	y		y				
Myrtaceae	<i>Eucalyptus salubris</i>								y							
Myrtaceae	<i>Eucalyptus yilgarnensis</i>														y	
Myrtaceae	<i>Melaleuca hamata</i>															
Pittosporaceae	<i>Bursaria occidentalis</i>							y								

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Family	Taxa	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Amaranthaceae	<i>Ptilotus obovatus</i>	y	y	y	y	y		y	y	y	y	y	y	y	y	y
Apocynaceae	<i>Alyxia buxifolia</i>							y		y	y			y		
Apocynaceae	<i>Marsdenia australis</i>		y	y	y		y	y	y		y	y			y	
Asteraceae	<i>Brachyscome ciliaris</i>			y				y		y					y	
Asteraceae	<i>Brachyscome trachycarpa</i>							y								
Asteraceae	<i>Cratystylis subspinescens</i>						y									
Asteraceae	<i>Minuria cunninghamii</i>				y			y								
Asteraceae	<i>Olearia exiguiifolia</i>															
Asteraceae	<i>Olearia muelleri</i>	y	y			y	y				y	y	y			y
Asteraceae	<i>Vittadinia eremaea</i>															
Boraginaceae	<i>Halgania cyanea</i>															
Casuarinaceae	<i>Allocauarina helmsii</i>															
Casuarinaceae	<i>Casuarina pauper</i>	y	y		y	y	y	y	y	y	y	y	y	y	y	
Chenopodiaceae	<i>Atriplex bunburyana</i>															
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	y					y		y	y	y	y	y			y
Chenopodiaceae	<i>Atriplex vesicaria</i>							y				y	y			y
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>								y	y	y	y	y			
Chenopodiaceae	<i>Enchylaena lanata</i>								y		y	y				
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>						y		y	y		y				
Chenopodiaceae	<i>Enchyleana x Maireana</i> hybrid				y	y						y				
Chenopodiaceae	<i>Eriochiton sclerolaenoides</i>															
Chenopodiaceae	<i>Maireana georgei</i>			y		y			y			y				y
Chenopodiaceae	<i>Maireana pentatropis</i>													y		
Chenopodiaceae	<i>Maireana planifolia</i>											y				
Chenopodiaceae	<i>Maireana pyramidata</i>								y							y
Chenopodiaceae	<i>Maireana sedifolia</i>	y			y	y	y	y	y	y	y	y	y	y	y	y
Chenopodiaceae	<i>Maireana tomentosa</i>															y
Chenopodiaceae	<i>Maireana triptera</i>	y	y	y		y										y
Chenopodiaceae	<i>Rhagodia drummondii</i>		y							y						
Chenopodiaceae	<i>Rhagodia eremaea</i>															
Chenopodiaceae	<i>Salsola australis</i>				y	y										
Chenopodiaceae	<i>Sclerolaena cuneata</i>															y
Chenopodiaceae	<i>Sclerolaena diacantha</i>			y			y		y	y		y				y
Chenopodiaceae	<i>Sclerolaena gardneri</i>								y							y
Chenopodiaceae	<i>Sclerolaena glabra</i>															
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>							y								
Chenopodiaceae	<i>Tecticornia disarticulata</i>															y
Convolvulaceae	<i>Convolvulus clementii</i>															
Fabaceae	<i>Acacia aptaneura</i>			y	y		y			y		y				
Fabaceae	<i>Acacia ayersiana</i>		y													
Fabaceae	<i>Acacia burkittii</i>	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
Fabaceae	<i>Acacia caesaneura</i>															
Fabaceae	<i>Acacia erinacea</i>															

Fabaceae	<i>Acacia hemiteles</i>						y				y					y
Fabaceae	<i>Acacia incurvaneura</i>	y	y	y	y	y		y	y							
Fabaceae	<i>Acacia kempeana</i>															
Fabaceae	<i>Acacia ligulata</i>				y									y		
Fabaceae	<i>Acacia nyssophylla</i>										y	y		y		
Fabaceae	<i>Acacia oswaldii</i>					y						y		y		y
Fabaceae	<i>Acacia quadrimarginea</i>													y		y
Fabaceae	<i>Acacia ramulosa</i> var. <i>linophylla</i>															
Fabaceae	<i>Acacia sibirica</i>	y														y
Fabaceae	<i>Acacia tetragonophylla</i>	y	y	y	y		y		y	y	y	y	y	y	y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>filifolia</i>	y	y	y	y	y	y	y		y		y	y	y	y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>x artemisioides</i>							y	y							
Fabaceae	<i>Senna cardiosperma</i>															
Fabaceae	<i>Templetonia incrassata</i>										y	y				
Frankeniaceae	<i>Frankenia interioris</i>							y								y
Goodeniaceae	<i>Scaevola spinescens</i>	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
Lamiaceae	<i>Physopsis viscida</i>															
Lamiaceae	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>		y	y												
Lamiaceae	<i>Teucrium disjunctum</i>						y					y				
Lamiaceae	<i>Teucrium teucriiflorum</i>		y	y					y							
Lamiaceae	<i>Westringia rigida</i>															
Loranthaceae	<i>Amyema fitzgeraldii</i>									y						
Loranthaceae	<i>Amyema gibberula</i> var. <i>gibberula</i>															
Loranthaceae	<i>Amyema preissii</i>												y			
Loranthaceae	<i>Lysiana casuarinae</i>			y					y	y						
Malvaceae	<i>Abutilon cryptopetalum</i>															
Malvaceae	<i>Abutilon otocarpum</i>															
Malvaceae	<i>Brachychiton gregorii</i>								y	y						
Malvaceae	<i>Sida calyxhymenia</i>															
Malvaceae	<i>Sida intricata</i>						y			y	y					
Malvaceae	<i>Sida</i> sp. <i>Excedentifolia</i> (J.L. Egan 1925)															
Malvaceae	<i>Sida spodochroma</i>				y											
Myrtaceae	<i>Calytrix</i> sp.															
Myrtaceae	<i>Eucalyptus ewartianiana</i>															
Myrtaceae	<i>Eucalyptus concinna</i>															
Myrtaceae	<i>Eucalyptus eremicola</i> subsp <i>peeneri</i>															
Myrtaceae	<i>Eucalyptus lesouefii</i>															y
Myrtaceae	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>		y					y								
Myrtaceae	<i>Eucalyptus salmonophloia</i>															y
Myrtaceae	<i>Eucalyptus salubris</i>															y
Myrtaceae	<i>Eucalyptus yilgarnensis</i>															
Myrtaceae	<i>Melaleuca hamata</i>															
Pittosporaceae	<i>Bursaria occidentalis</i>															
Pittosporaceae	<i>Pittosporum angustifolium</i>															

[illegible]

Zygophyllaceae *Roepera aurantiaca* subsp. *aurantiaca*

y

Family	Taxa	61	62	63	64	65	66	67	68	69	70	71	72	Counts
Amaranthaceae	<i>Ptilotus obovatus</i>	y		y	y	y	y	y	y	y	y	y	y	64
Apocynaceae	<i>Alyxia buxifolia</i>	y						y	y	y	y	y	y	11
Apocynaceae	<i>Marsdenia australis</i>										y			37
Asteraceae	<i>Brachyscome ciliaris</i>													8
Asteraceae	<i>Brachyscome trachycarpa</i>													1
Asteraceae	<i>Cratystylis subspinescens</i>	y												5
Asteraceae	<i>Minuria cunninghamii</i>													3
Asteraceae	<i>Olearia exiguiifolia</i>													2
Asteraceae	<i>Olearia muelleri</i>	y						y		y		y		29
Asteraceae	<i>Vittadinia eremaea</i>													3
Boraginaceae	<i>Halgania cyanea</i>													2
Casuarinaceae	<i>Allocasuarina helmsii</i>			y										1
Casuarinaceae	<i>Casuarina pauper</i>	y					y	y	y	y	y	y		47
Chenopodiaceae	<i>Atriplex bunburyana</i>	y									y			14
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	y						y	y				y	29
Chenopodiaceae	<i>Atriplex vesicaria</i>	y						y						15
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>	y									y			11
Chenopodiaceae	<i>Enchylaena lanata</i>										y		y	13
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	y						y			y		y	16
Chenopodiaceae	<i>Enchyleana x Maireana</i> hybrid										y			7
Chenopodiaceae	<i>Eriochiton sclerolaenoides</i>													1
Chenopodiaceae	<i>Maireana georgei</i>							y			y			25
Chenopodiaceae	<i>Maireana pentatropis</i>							y						8
Chenopodiaceae	<i>Maireana planifolia</i>													2
Chenopodiaceae	<i>Maireana pyramidata</i>										y			7
Chenopodiaceae	<i>Maireana sedifolia</i>	y						y		y	y	y		39
Chenopodiaceae	<i>Maireana tomentosa</i>							y						4
Chenopodiaceae	<i>Maireana triptera</i>							y		y	y		y	24
Chenopodiaceae	<i>Rhagodia drummondii</i>	y									y			12
Chenopodiaceae	<i>Rhagodia eremaea</i>												y	15
Chenopodiaceae	<i>Salsola australis</i>													6
Chenopodiaceae	<i>Sclerolaena cuneata</i>													1
Chenopodiaceae	<i>Sclerolaena diacantha</i>	y			y	y	y				y			24
Chenopodiaceae	<i>Sclerolaena gardneri</i>	y												5
Chenopodiaceae	<i>Sclerolaena glabra</i>													2
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>													4
Chenopodiaceae	<i>Tecticornia disarticulata</i>	y						y					y	4
Convolvulaceae	<i>Convolvulus clementii</i>													4
Fabaceae	<i>Acacia aptaneura</i>												y	15
Fabaceae	<i>Acacia ayersiana</i>		y		y	y	y			y				19
Fabaceae	<i>Acacia burkittii</i>		y	y	y	y	y		y		y		y	55
Fabaceae	<i>Acacia caesaneura</i>													5
Fabaceae	<i>Acacia erinacea</i>								y					2

[illegible]

[illegible]

Attachment 4: Inventory site data on landform, soil type and erosion.

Site	LU code	Land system	Geology	Land unit	Slope %	Relief	Landform	Soil texture	Erosion score	Vulnerability to erosion
SE01	6	Deadman	CZc	PLO	0%	0m	Flat	Sandy clay loam	nil	slightly
SE02	5b	Campsite	CZc	PLA	0%	0m	Flat	Light clay	nil	moderately
SE03	4b	Deadman	Sit	PLO	1%	1m	Flat	Sandy loam	nil	nil
SE04	4a	Deadman	CZc	PLO	1%	1m	Flat	sandy loam	nil	nil
SE05	4b	Deadman	CZc	PLO	0%	0m	Flat	Sandy loam	nil	nil
SE06	6	Deadman	CZc	CHM	1%	1m	Flat	Sandy loam	nil	slightly
SE07	4a	Deadman	CZc	PLO	0%	0m	Flat	Sandy loam	nil	nil
SE08	4b	Deadman	CZl	PLC	3%	3m	Upper slope	Sandy loam	nil	nil
SE09	4a	Deadman	CZc	PLO	1%	1m	Flat	Sandy loam	nil	nil
SE10	4a	Deadman	CZc	PLC	1%	1m	Flat	Sandy loam	nil	nil
SE11	6	Deadman	CZc	CHM	1%	1m	Flowline	Sandy clay loam	nil	nil
SE12	2a	Deadman	CZl	RIL	2%	10m	Crest	Sandy loam	nil	nil
SE13	2b	Moriarty	CZc	PLC	2%	3m	Lower slope	Sandy loam	nil	nil
SE14	2a	Deadman	CZc	RIL	1%	1m	Upper slope	Sandy loam	nil	nil
SE15	2a	Deadman	CZl	RIL	2%	1m	Lower slope	Sandy loam	nil	nil
SE16	4b	Deadman	CZl	PLO	1%	0m	Flat	Sandy loam	nil	nil
SE17	5b	Deadman	CZc	CHM	2%	1m	Broad wash	Sandy clay loam	minor	moderately
SE18	5a	Deadman	CZc	PLC	1%	0m	Flat	Sandy clay loam	minor	slightly
SE19	5a	Deadman	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE20	4b	Deadman	CZc	PLC	1%	0m	Flat	Sandy clay loam	minor	slightly
SE21	2b	Deadman	CZc	HIL	3%	2 -3m	Upper slope	Sandy loam	nil	nil
SE22	5a	Deadman	CZc	PLS	2%	0m	Flat	Sandy clay loam	moderate	moderately
SE23	5b	Moriarty	CZc	PLS	2%	0m	Flat	Sandy clay loam	moderate	moderately
SE24	5b	Moriarty	CZc	PLC	1%	1m	Flat	Sandy clay loam	nil	nil
SE25	1a	Leonora	Czu	HIL	5%	6m	Upper slope	Sandy loam	nil	nil
SE26	5b	Moriarty	CZc	PLO	1%	0m	Flat	Sandy clay loam	nil	slightly
SE27	2b	Moriarty	CZc	HIL	5%	5m	Upper slope	Sandy loam	nil	nil
SE28	4a	Deadman	CZc	PLO	0%	0m	Flat	loamy sand	nil	nil
SE29	1a	Leonora	Ab	HIL	8%	10m	Upper slope	Sandy clay loam	nil	nil
SE30	1a	Leonora	CZc	PLC	1%	1m	Flat	Sandy loam	nil	nil
SE31	4a	Deadman	CZc	PLO	0%	0m	Flat	Sandy loam	nil	nil
SE32	2b	Moriarty	CZc	PLC	1%	1m	Low rise	Sandy loam	nil	nil
SE33	5a	Moriarty	CZc	PLA	1%	1m	Flat	Sandy clay	minor	moderately
SE34	1b	Leonora	Ab	HIL	10%	17m	Lower slope	Sandy loam	nil	nil
SE35	4c	Deadman	CZc	PLC	1%	0m	Flat	Sandy clay loam	nil	nil
SE36	4a	Deadman	CZc	PLO	1%	1m	Flat	Sandy clay loam	nil	nil
SE37	6	Deadman	CZc	CHM	1%	1m	Flat	sandy clay	minor	slightly
SE38	1b	Gunadocketa	CZc	HIL	3%	3 - 4m	Lower slope	Sandy loam	nil	nil

Site	LU code	Land system	Geology	Land unit	Slope %	Relief	Landform	Soil texture	Erosion score	Vulnerability to erosion
SE39	5a	Gunadocketa	CZc	PLO	1%	1m	Flat	Sandy clay loam	minor	slightly
SE40	4c	Gunadocketa	CZc	PLC	1%	1m	Broad flowline	Sandy clay loam	moderate	moderately
SE41	2a	Gunadocketa	CZc	HIL	2%	2m	Low rise	Sandy loam	minor	slightly
SE42	4c	Deadman	CZc	PLC	1%	1m	Flat	Sandy clay loam	nil	nil
SE43	6	Deadman	CZc	PLO	1%	1m	Flat	Sandy clay loam	minor	slightly
SE44	4a	Deadman	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE45	4c	Gunadocketa	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE46	1a	Leonora	Ab	HIL	8%	17 - 20m	Crest	Sandy loam	nil	nil
SE47	4a	Deadman	CZc	PLC	1%	1m	Flat	Sandy clay loam	nil	nil
SE48	5a	Deadman	CZc	PLO	1%	1m	Flat	Sandy clay loam	minor	slightly
SE49	4c	Deadman	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE50	4c	Moriarty	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE51	5a	Moriarty	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE52	5a	Moriarty	CZc	PLC	2%	2m	Flat	Sandy clay loam	moderate	moderately
SE53	5a	Moriarty	CZc	PLH	1%	1m,	Flat	Sandy loam	moderate	moderately
SE54	5a	Moriarty	CZc	PLH	1%	1m	Flat	Sandy clay loam	moderate	moderately
SE55	5a	Moriarty	CZc	PLC	1%	1m	Flat	Sandy clay loam	minor	slightly
SE56	5a	Moriarty	CZc	PLC	2%	2m	Flat	Sandy clay loam	moderate	moderately
SE57	2b	Moriarty	CZc	PLC	2%	2m	Lower slope	Sandy loam	moderate	moderate
SE58	2b	Moriarty	CZc	PLC	3%	3m	Lower slope	Sandy loam	nil	nil
SE59	1b	Lawrance	Ab	HIL	8%	30m	Upper slope	Sandy loam	nil	nil
SE60	5b	Campsite	CZc	PLA	2%	2m	Flat	Sandy clay loam	moderate	moderately
SE61	5b	Campsite	CZc	PLA	1%	1m	Flat	Sandy clay loam	moderate	moderately
SE62	4d	Deadman	CZc	SSH/PLO	0%	0m	Flat	Sandy loam	minor	slightly
SE63	4d	Deadman	CZc	SSH/PLO	0%	0m	Flat	Sandy loam	minor	slightly
SE64	4a	Kirgella	CZc	PLO	0%	0	Flat	Sandy loam	nil	nil
SE65	4a	Kirgella	CZc	PLC	0%	0m	Flat	Sandy loam	minor	slightly
SE66	4a	Moriarty	CZc	PLO	0%	0m	Flat	Sandy loam	nil	nil
SE67	1c	Moriarty	CZc	HIL	6%	25m	Upper slope	Sandy loam	nil	nil
SE68	1c	Moriarty	CZc	HIL	5%	12m	Upper slope	Sandy loam	nil	nil
SE69	1c	Kirgella	CZc	HIL	2%	6m	Mid slope	Sandy loam	nil	nil
SE70	4a	Moriarty	CZc	PLC	2%	2m	Broad drainage plain	Sandy loam	moderate	moderately
SE71	1c	Moriarty	CZc	PLO	2%	2m	Mid slope	Sandy clay loam	nil	nil
SE72	1c	Moriarty	CZc	PTX	20%	25m	Crest	Durey crust	nil	nil

Attachment 5: Inventory site data on dominant flora vegetation cover and condition.

Site	Upper storey		Mid storey		Lower storey		Total cover	Veg condition
	US % cover	US Dominant	MS cover	MS Dominant	LS Cover	LS Dominant		
SE01	20%	acaaye ⁴	5%	acabur	0%		20%	2
SE02	10%	eucsalmon	0%		2%	eremac	10%	3
SE03	5%	eucole	10%	acaaye	2%	scvspi	15%	2
SE04	5%	eucole	5%	acabur	0%		10%	3
SE05	10%	eucole	10%	acabur	0%		20%	3
SE06	10%	acainc	15%	acabur	0%		25%	3
SE07	2%	eucole	25%	acainc	5%	dodrig	30%	2
SE08	2%	eucole	15%	acalin	0%		15%	3
SE09	5%	eucole	20%	acainc	0%		20%	2
SE10	2%	caspau	10%	acainc	2%	ptiobo	10%	2
SE11	20%	eucole	40%	acainc	1%	ptiobo	60%	2
SE12	5%	acainc	20%	erefor	0%		25%	2
SE13	2%	caspau	5%	ereold	3%	ptiobo	10%	2
SE14	5%	acainc	15%	erefor	0%		20%	3
SE15	2%	caspau	10%	acainc	3%	ptiobo	15%	3
SE16	10%	acainc	4%	acalin	1%	ptiobo	15%	3
SE17	10%	eucsalmon	20%	acahem	0%		25%	5
SE18	1%	caspau	10%	acahem	0%		10%	6
SE19	2%	eucole	5%	acabur	0%		5%	6
SE20	5%	caspau	10%	snnfil	5%	ptiobo	15%	3
SE21	1%	caspau	20%	dodlob	2%	ptiobo	20%	4
SE22	1%	acainc	5%	acahem	1%	ptiobo	5%	6
SE23	5%	eucsalmon	5%	atrnum	10%	atrves	20%	3
SE24	1%	caspau	15%	eresco	1%	ptiobo	15%	4
SE25	2%	caspau	15%	acasib	1%	ptiobo	15%	2
SE26	2%	eucsalmon	15%	atrnum	10%	atrves	25%	4
SE27	5%	caspau	4%	dodlob	1%	ptiobo	10%	4
SE28	30%	acainc	1%	erefor	0%		30%	3
SE29	4%	euccon	4%	eresco	2%	ptiobo	10%	2
SE30	2%	caspau	10%	acasib	3%	ptiobo	15%	2
SE31	8%	acainc	2%	scvspi	0%		10%	2
SE32	2%	caspau	3%	acabur	15%	maigeo	20%	3
SE33	2%	acainc	5%	maised	0%		7%	5
SE34	1%	acainc	30%	acaqua	0%		30%	2
SE35	2%	acainc	3%	acabur	5%	maised	10%	3
SE36	1%	acainc	15%	acabur	5%	eremet	20%	4

⁴ Field codes see following table for taxa

Site	Upper storey		Mid storey		Lower storey		Total cover	Veg condition
	US % cover	US Dominant	MS cover	MS Dominant	LS Cover	LS Dominant		
SE37	1%	eucole	60%	acabur	1%	snnart	60%	4
SE38	3%	caspau	20%	acabur	2%	ptiobo	25%	3
SE39	1%	caspau	25%	acabur	0%		25%	4
SE40	1%	caspau	25%	maised	0%		25%	5
SE41	3%	caspau	5%	eresco	5%	ptiobo	10%	4
SE42	4%	acainc	5%	snnfil	2%	maised	10%	5
SE43	5%	acainc	10%	acabur	1%	ptiobo	15%	5
SE44	1%	acainc	20%	acabur	0%		20%	5
SE45	1%	acainc	10%	snnfil	15%	maised	25%	4
SE46	2%	acainc	6%	acasib	2%	scvspi	10%	2
SE47	2%	eucole	5%	acabur	3%	olemue	10%	4
SE48	4%	acainc	5%	snnfil	2%	maised	10%	4
SE49	1%	acaapt	15%	snnfil	1%	maised	15%	5
SE50	5%	caspau	5%	snnfil	1%	ptiobo	10%	5
SE51	2%	caspau	4%	snnfil	15%	maised	20%	3
SE52	1%	caspau	4%	snnfil	10%	maised	15%	4
SE53	1%	acainc	10%	acabur	2%	maised	10%	5
SE54	1%	caspau	15%	acabur	1%	maised	15%	5
SE55	1%	caspau	4%	acabur	15%	maised	20%	3
SE56	5%	caspau	20%	snnfil	5%	maised	30%	4
SE57	1%	caspau	10%	snnfil	5%	maised	15%	4
SE58	2%	caspau	15%	dodlob	2%	ptiobo	15%	3
SE59	2%	caspau	25%	acaqua	0%		25%	2
SE60	5%	eucsalmon	5%	eresco	10%	maised	20%	3
SE61	2%	eucsalmon	0%		15%	maised	15%	4
SE62	5%	eucole	15%	acabur	5%	spinifex	25%	2
SE63	18%	eucole	12%	acahem	20%	wesrig	50%	2
SE64	4%	eucole	30%	acabur	0%		35%	2
SE65	4%	eucole	10%	acabur	0%		15%	3
SE66	2%	eucole	30%	acabur	3%	scvspi	35%	2
SE67	4%	eucole	1%	eresco	10%	scvspi	15%	3
SE68	20%	eucles	2%	eresco	5%	acaeri	25%	1
SE69	4%	caspau	30%	acacol	5%	scvspi	35%	1
SE70	1%	caspau	40%	dodlob	2%	ptiobo	40%	3
SE71	5%	caspau	2%	dodlob	3%	scvspi	10%	2
SE72	1%	caspau	2%	acajen	2%	sidcal	5%	3

Fieldcode	Taxa
acaapt	<i>Acacia aptaneura</i>
acaaye	<i>Acacia ayersiana</i>
acaaye	<i>Acacia ayersiana</i>
acabur	<i>Acacia burkittii</i>
acacol	<i>Acacia nyssophylla</i>
acaeri	<i>Acacia erinacea</i>
acahem	<i>Acacia hemiteles</i>
acainc	<i>Acacia incurvaneura</i>
acainc	<i>Acacia incurvaneura</i>
acajen	<i>Acacia ligulata</i>
acalin	<i>Acacia ramulosa</i> var. <i>linophylla</i>
acaqua	<i>Acacia quadrimarginea</i>
acasib	<i>Acacia sibirica</i>
atrnum	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>
atrves	<i>Atriplex vesicaria</i>
caspau	<i>Casuarina pauper</i>
dodlob	<i>Dodonaea lobulata</i>
dodrig	<i>Dodonaea rigida</i>
erefor	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>
eremac	<i>Eremophila maculata</i>
eremet	<i>Eremophila metallicorum</i>
ereold	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>
eresco	<i>Eremophila scoparia</i>
eucon	<i>Eucalyptus concinna</i>
eucles	<i>Eucalyptus lesouefii</i>
eucole	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>
eucsalmon	<i>Eucalyptus salmonophloia</i>
maigeo	<i>Maireana georgei</i>
maised	<i>Maireana sedifolia</i>
maised	<i>Maireana sedifolia</i>
olemue	<i>Olearia muelleri</i>
ptiobo	<i>Ptilotus obovatus</i>
scvspi	<i>Scaevola spinescens</i>
scvspi	<i>Scaevola spinescens</i>
sidcal	<i>Sida calyxhymenia</i>
snnart	<i>Senna artemisioides</i> subsp. x <i>artemisioides</i>
snnfil	<i>Senna artemisioides</i> subsp. <i>filifolia</i>
spinifex	<i>Triodia irritans</i>
wesrig	<i>Westringia rigida</i>

Attachment 6: Location of inventory sites

Site		Zone		Easting	Northing
SE01	UTM	GDA94	51J	439437	6663669
SE02	UTM	GDA94	51J	439895	6662441
SE03	UTM	GDA94	51J	441203	6663268
SE04	UTM	GDA94	51J	439847	6663259
SE05	UTM	GDA94	51J	440379	6663600
SE06	UTM	GDA94	51J	441148	6664178
SE07	UTM	GDA94	51J	440474	6664857
SE08	UTM	GDA94	51J	441383	6665118
SE09	UTM	GDA94	51J	439979	6664741
SE10	UTM	GDA94	51J	439072	6662978
SE11	UTM	GDA94	51J	439349	6664400
SE12	UTM	GDA94	51J	441592	6665331
SE13	UTM	GDA94	51J	441870	6665276
SE14	UTM	GDA94	51J	441973	6664879
SE15	UTM	GDA94	51J	442345	6664079
SE16	UTM	GDA94	51J	442396	6663827
SE17	UTM	GDA94	51J	439324	6666014
SE18	UTM	GDA94	51J	439997	6666014
SE19	UTM	GDA94	51J	440303	6665814
SE20	UTM	GDA94	51J	440763	6665669
SE21	UTM	GDA94	51J	441206	6665957
SE22	UTM	GDA94	51J	439781	6666421
SE23	UTM	GDA94	51J	441383	6666174
SE24	UTM	GDA94	51J	441311	6666433
SE25	UTM	GDA94	51J	441518	6666766
SE26	UTM	GDA94	51J	440951	6666503
SE27	UTM	GDA94	51J	440727	6666945
SE28	UTM	GDA94	51J	440335	6666555
SE29	UTM	GDA94	51J	440838	6667523
SE30	UTM	GDA94	51J	441184	6667793
SE31	UTM	GDA94	51J	439852	6667376
SE32	UTM	GDA94	51J	439875	6668046
SE33	UTM	GDA94	51J	439689	6667781
SE34	UTM	GDA94	51J	440466	6667821
SE35	UTM	GDA94	51J	438025	6669069
SE36	UTM	GDA94	51J	438417	6668982
SE37	UTM	GDA94	51J	438607	6668926
SE38	UTM	GDA94	51J	440221	6670024
SE39	UTM	GDA94	51J	439973	6669890
SE40	UTM	GDA94	51J	439322	6669020
SE41	UTM	GDA94	51J	439061	6668928
SE42	UTM	GDA94	51J	438122	6668327
SE43	UTM	GDA94	51J	438585	6668258
SE44	UTM	GDA94	51J	438125	6667846
SE45	UTM	GDA94	51J	439373	6668271
SE46	UTM	GDA94	51J	440081	6668511
SE47	UTM	GDA94	51J	437857	6667239
SE48	UTM	GDA94	51J	437236	6668045
SE49	UTM	GDA94	51J	436547	6668009

Site		Zone		Easting	Northing
SE50	UTM	GDA94	51J	436454	6667663
SE51	UTM	GDA94	51J	435737	6667504
SE52	UTM	GDA94	51J	435701	6667722
SE53	UTM	GDA94	51J	435584	6666770
SE54	UTM	GDA94	51J	435056	6667408
SE55	UTM	GDA94	51J	435051	6667626
SE56	UTM	GDA94	51J	434747	6667777
SE57	UTM	GDA94	51J	434371	6667489
SE58	UTM	GDA94	51J	434570	6666681
SE59	UTM	GDA94	51J	434206	6666935
SE60	UTM	GDA94	51J	437709	6661531
SE61	UTM	GDA94	51J	438287	6661738
SE62	UTM	GDA94	51J	436884	6663887
SE63	UTM	GDA94	51J	436344	6663481
SE64	UTM	GDA94	51J	436447	6662715
SE65	UTM	GDA94	51J	436552	6662378
SE66	UTM	GDA94	51J	436693	6661952
SE67	UTM	GDA94	51J	436958	6661272
SE68	UTM	GDA94	51J	437001	6661861
SE69	UTM	GDA94	51J	437035	6662469
SE70	UTM	GDA94	51J	437188	6662265
SE71	UTM	GDA94	51J	437176	6661585
SE72	UTM	GDA94	51J	436884	6661238

Attachment 7: Fauna memo report



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Saracen Carosue Project
Fauna assessment of proposed exploration drilling program
M. Bamford, B. Shepherd and K. Chuk

Background

Saracen operates the Carosue Gold Mine and is proposing intensive exploration around its existing mine, with a spread of 3m cleared drill-lines at 90m spacing. Environmental Impact Assessment for this proposal is being prepared by Alexander Holm and Assoc. (AHA), and Bamford Consulting Ecologists (BCE) has been asked to provide information on the fauna component of this assessment.

BCE uses a 'values and impacts' assessment process with the following components:

- The identification of fauna values:
 - Assemblage characteristics: uniqueness, completeness and richness;
 - Species of conservation significance;
 - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
 - Patterns of biodiversity across the landscape;
 - Ecological processes upon which the fauna depend.
- The review of impacting processes such as:
 - Habitat loss leading to population decline;
 - Habitat loss leading to population fragmentation;
 - Degradation of habitat due to weed invasion leading to population decline;
 - Ongoing mortality from operations;
 - Species interactions including feral and overabundant native species;
 - Hydrological change;
 - Altered fire regimes; and
 - Disturbance (dust, light, noise).

The following memo provides information on the approach to the assessment, the fauna values and reviews impacting processes in relation to these values and the proposed exploration program.

Methods

Desktop Assessment

Sources of information

Information on the fauna assemblage of the survey area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies. Databases accessed were the Atlas of Living Australia (ALA), Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap (incorporating the Western Australian Museum's FaunaBase and the DBCA Threatened and Priority Fauna Database), BirdLife Australia's Atlas Database (BA) and the EPBC Protected Matters Search Tool of the Department of Energy and the Environment (DEE) (Table). Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

Frogs: Tyler *et al.* (2009) and Anstis (2013);

Reptiles: Storr *et al.* (1983, 1990, 1999 and 2002) and Wilson and Swan (2017);

Birds: Johnstone and Storr (1998, 2005) and Barrett *et al.* (2003); and

Mammals: Menkhorst & Knight (2004); Armstrong (2011); Churchill (2008); and Van Dyck and Strahan (2008).

Table 1. Sources of information used for the desktop assessment.

Database	Type of records held on database	Area searched
Atlas of Living Australia.	Records of biodiversity data from multiple sources across Australia.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.
NatureMap (DBCA)	Records in the WAM and DBCA databases. Includes historical data and records on Threatened and Priority species in WA.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.
BirdLife Australia Atlas Database (Birdlife Australia)	Records of bird observations in Australia, 1998-2019.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.
EPBC Protected Matters (DEE)	Records on matters of national environmental significance protected under the EPBC Act.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.

In addition, information on fauna was available from a number of previous studies in the area. These included:

- Alexander Holm and Assoc. (2017). Malleefowl survey of proposed airstrip. Saracen Gold Mines.
- Coffey environments (2010). Level 1 vertebrate fauna survey for the Carosue Dam Project, Saracen Gold.

- Biologic. (2010). Level 1 survey for a proposed pipeline from GGT to Carosue Dam and powerline from Black Swan to Carosue Dam. Tropicana JV and Saracen Gold Mine Pty Ltd.
- Henry-Hall *et al.* (1990). Report on survey of Goongarrie Nature Reserve.
- ABRS (2013). Bush Blitz; Biological survey of Credo Station Reserve WA.

Nomenclature and taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2016. The authorities used for each vertebrate group were: amphibians (Doughty *et al.* 2016a), reptiles (Doughty *et al.* 2016b), birds (Johnstone and Darnell 2016), and mammals (Travouillon 2016). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds). This includes the use of capital letters in English names. English names of species where available are used throughout the text; Latin species names are presented with corresponding English names in tables in the appendices.

Interpretation of species lists

Species lists generated from the review of sources of information are generous as they include records drawn from a large region and possibly from environments not represented in the survey area. Therefore, some species that were returned by one or more of the data searches have been excluded because their ecology, or the environment within the survey area, meant that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the project area is of no importance. Similarly, waterbirds were generally excluded even though they could over-fly the site, since the site provides little habitat for them. The only exceptions were species that might use the water treatment wetlands near the village. Species returned from databases but excluded from species lists due to lack of suitable habitat (and some database errors) are not presented.

Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the survey area at least occasionally, whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. This list of expected species is therefore subject to interpretation by assigning each a predicted status in the survey area.

The status categories used are:

Resident: species with a population permanently present in the survey area;

Migrant or regular visitor: species that occur within the project area regularly in at least moderate numbers, such as part of annual cycle;

Irregular Visitor: species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the project area in at least moderate numbers and for some time;

Vagrant: species that occur within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species; and

Locally extinct: species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the project area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation context, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times, or may have been previously confirmed as present. The status categories are assigned conservatively. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence that the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status.

Field Investigation and Personnel

The project area was visited between 14th and 17th January 2019 by Drs Mike Bamford (B.Sc. Hons. Ph.D. Biol.) and Barry Shepherd (B.Sc. Hons. Env. Biol., Ph.D. Ecol.). The site visit involved looking around as much of the project area as possible in daylight; tracks and effort of this search are shown in Figure 1. This enabled environmental descriptions to be prepared and some opportunistic observations on fauna to be made. Familiarity with the environment enables interpretation of species lists from databases. Targeted searching was undertaken for two significant species known from the general area: the Malleefowl (searching for nest mounds, foraging signs, tracks and direct observations); and the Brush-tailed Mulgara (searching for burrows, tracks and scats). In general, walks were unstructured and two personnel travelled 20-40m apart, with the track determined by areas of interest and intended to cover as much ground as possible. An exception to this was just north of the accommodation village where systematic transects were walked across a small area to search for Malleefowl mounds. Signs of all species observed, and other notable features of interest were recorded.

On the evening of 14th January, between c.19:30 and 21:10, the surveyors conducted a torch-light search of a rocky breakaway just north of the mine camp for nocturnal fauna. Both surveyors carried head torches and recorded species observed or heard.

Throughout the torch-light survey, bat echolocations and calls were recorded on a hand-held bat detector (Echo Meter Touch 2 Pro (EMT2)(Ser No: E2A00773). The EMT2 was run from a Samsung Galaxy S7 with Echo Meter software version 2.6.5. A Wildlife Acoustics Song Meter 4 BAT Full Spectrum (SM4BAT) was deployed next to three settling ponds that form part of the Mine Camp's sewerage treatment plant on the afternoon of 14th January and retrieved on the morning of 17th January 2019. The settling ponds were located approximately 1 km due south of the Survey Area boundary and 0.75 km south of the Mine Camp. Recordings from the EMT2 and SM4BAT were viewed in Kaleidoscope Viewer v4.5.4 from Wildlife Acoustics. More than 4,000 audio records were obtained over the three nights of sampling indicating very high levels of bat activity. Only a small sample was assessed to provide a preliminary list of bat fauna supporting the Level 1 survey.

Vegetation and Substrate Associations

Vegetation and Substrate Associations (VSAs) in the project area were assessed during the desktop review and as part of the field investigations. Within the project area, all major VSAs were visited to develop an understanding of major fauna habitat types present and to assess the likelihood of conservation significant species being present in the area. VSAs correspond to the Land Units described by AHA.

Survey Limitations

The EPA Guidance Statement 56 (EPA 2004) outlines a number of limitations that may arise during surveying. These survey limitations are discussed in the context of the BCE investigation of the survey area in Table 2.

Table 2. Survey limitations as outlined by EPA.

EPA Limitation	BCE Comment
Level of survey.	Level 1 (desktop study and site inspection). Survey intensity was deemed adequate for the various habitat types viewable from aerial photograph, scale of the project and the amount of data records available in the region. The entire area was not searched for Malleefowl mounds and though the survey results are deemed representative for the Project Area as a whole, only a small percentage of the habitats inside the Project Area boundary was surveyed.
Competency/experience of the consultant(s) carrying out the survey.	The ecologists have had extensive experience in conducting fauna surveys and have conducted several fauna studies in the region (over three decades).
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	The survey focussed on vertebrate fauna and fauna values.
Proportion of fauna identified, recorded and/or collected.	All vertebrate fauna observed were identified.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Abundant information from databases and previous studies.
The proportion of the task achieved and further work which might be needed.	The survey was completed and the report provides fauna values for the project area.
Timing/weather/season/cycle.	Timing is not of great importance for level 1 investigations.

EPA Limitation	BCE Comment
Disturbances (e.g. fire, flood, accidental human intervention etc.) that affected results of survey.	None
Intensity. (In retrospect, was the intensity adequate?)	The survey area is approximately 3135 ha and was traversed by vehicle and on foot and thus was adequately comprehensive to assess fauna and fauna values.
Completeness (e.g. was relevant area fully surveyed).	Site was fully surveyed to the level appropriate for a level 1 assessment. Fauna database searches covered a 10 to 20 km radius beyond the survey area boundary.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Field personnel have extensive experience with fauna and habitat in the region.
Remoteness and/or access problems.	There were no remoteness/access problems encountered.
Availability of contextual (e.g. bio-geographic) information on the region.	Extensive regional information was available and was consulted.

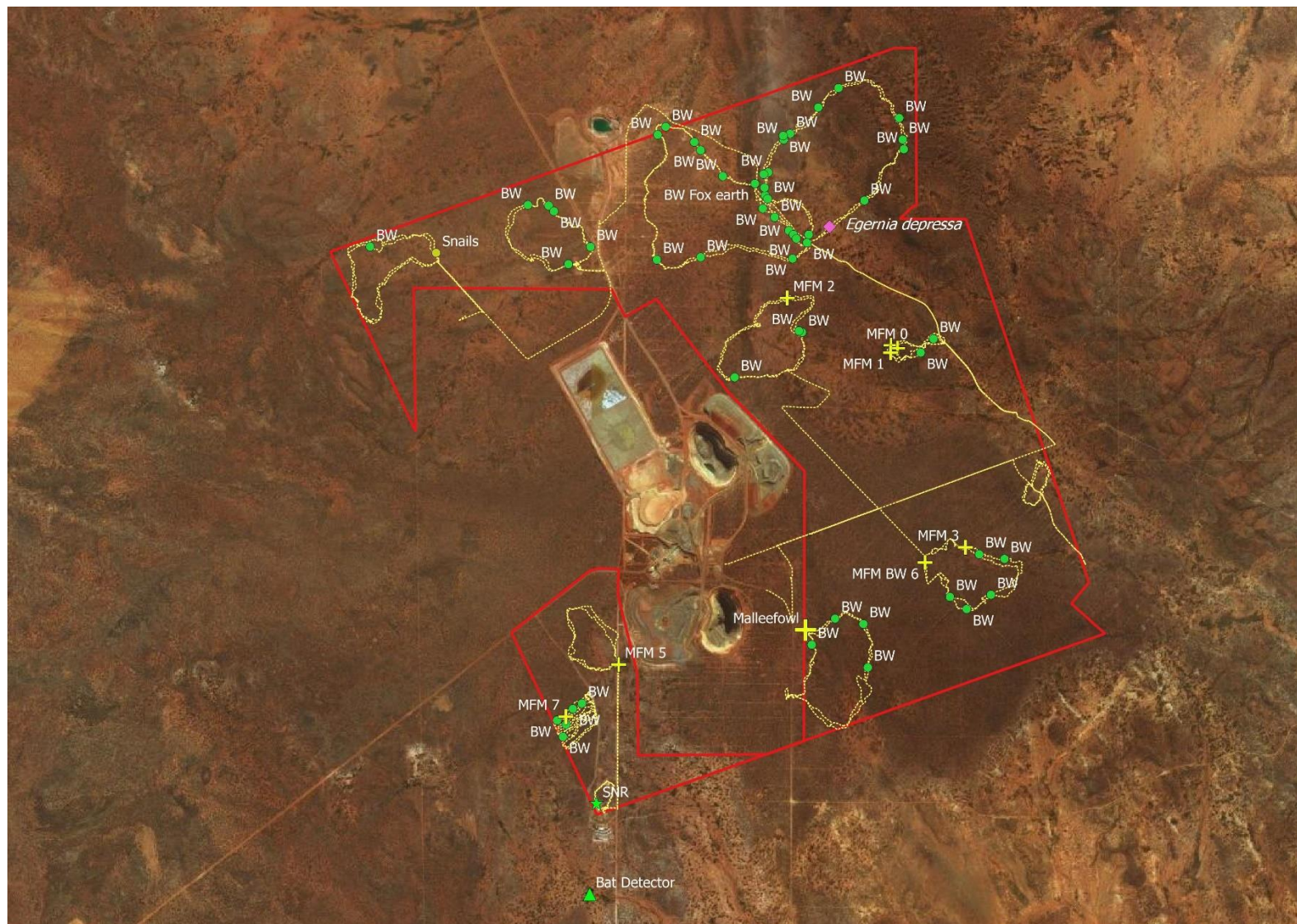


Figure 1. Areas of the project area visited by vehicle and on foot, indicating tracks taken. Locations of fauna observations are indicated: BW = Boodie warrens, MFW = Malleefowl mound.

Fauna assemblage

The vertebrate fauna assemblage potentially includes 285 species, with a further six species considered locally extinct (Table 3). A complete list of all species appears in Appendix 1, indicating those of conservation significance and assigning each species a status category in the area. Appendix 1 includes a list of jewel beetles known from the general area but no other information on invertebrates is available. Appendix 2 provides notes on fauna observations made during the January 2019 site inspection.

- Assemblage characteristics. A rich assemblage which reflects the fairly complex environment ranging from low rocky hills to shrublands on gravelly loams and open woodland on clayey-loams. Broadly typical of the eastern goldfields with some southern elements present. The extinct species are those that have disappeared from vast areas of Australia, due largely to predation by feral species. The Boodie was clearly abundant in the region (see Figure 1).
- Species of conservation significance. Numbers of conservation significant species are summarised in Table 4. The 11 invertebrates are all jewel beetles that have special protection, primarily to prevent over-collection by entomologists. The remaining significant species include one reptile, 19 birds and two mammals. The single reptile is a Priority 2 skink that may occur under leaf-litter around trees and mallee. The majority (9) of the birds are waterbirds that are either vagrants or irregular visitors, and would not utilise the actual project area due to the lack of wetlands. Most other significant birds are expected only as vagrants but three species may use the site regularly: Malleefowl (CS1), Peregrine Falcon (CS1) and Rainbow Bee-eater (CS3). These are discussed below. Only two significant mammals are expected, with the Central Long-eared Bat (CS2) potentially roosting in large trees in the area, and the Brush-tailed Mulgara (CS2) probably being locally extinct or possibly being a vagrant, as much of the project area lacked suitable habitat (sandy soil with spinifex), and there was no evidence of the species.
- Vegetation and Substrate Associations (VSAs). These provide habitat for fauna and are represented by the land units described by AHA. Notable features of the landscape are low rocky hills in the north-west, north-east and south-east, a broad area of loam-clay soils that are part of a broad drainage system through the centre of the area, and sandy soils in the far west. The drainage system soils support tall eucalypts and the sandy soils support mallee over spinifex. Other areas support a range of shrublands largely dominated by acacia. These have some significance to patterns of biodiversity.
- Patterns of biodiversity across the landscape. Massive sample efforts are required to determine patterns of biodiversity, but some can be surmised from the landscape and VSAs. The sandy soils supporting spinifex and mallee in the south-west are likely to be rich in reptiles as the soils allow for burrowing and the spinifex provides abundant cover. Such areas are also likely to be rich in shrubland-dependent birds and some small mammals. During the site inspection, it was noted that the transition between eucalypt woodland and acacia shrublands appeared to be rich in birds; south of the current operations this is where species such as the Red-capped Robin, White-eared and Brown-headed Honeyeaters and White-browed Babblers were observed. It was also where a Malleefowl was seen. Tall shrublands of acacia with little understorey,

found across large areas of loamy-clay soils, are probably less rich in species. The low rocky hills have potential for short range endemic invertebrates and appeared to be floristically rich, so may be seasonally important for nectar-dependent birds and invertebrates.

- Ecological processes upon which the fauna depend. A range of ecological processes can be important for fauna, but a major feature of the project area is surface hydrology/drainage. There is extensive drainage via small ephemeral watercourses from the low rocky hills, as well as broad drainage through the centre of the area. These patterns of drainage affect productivity for both flora and fauna. Introduced species (in particular the European Fox and Feral Cat) have probably led to local extinction of several species, and may be suppressing the populations of some species that are still present. Some of the vegetation, notably mallee over spinifex and shrublands on low rocky hills, are likely to be fire-prone and this can have both negative and positive effects on fauna.

Malleefowl

Several Malleefowl mounds were found (Figure 1) but all were long-inactive. Mounds have been found in previous studies (Coffey Environment 2010, Alexander Holm and Assoc. 2017), and in the airport area just to the west some of these were active or recently active. There was also one sighting of a bird in January 2019. Malleefowl mounds are active from about May to December, even into January depending on rainfall.

The species is clearly resident but from past experience the density of mounds is low. Furthermore, several of the mounds were very small, little more than small pits with a slightly raised edge of excavated soil, and it is unlikely they had ever been used for breeding; possibly they were dug by young males. These tended to be in heavy loamy-clay soils which are not usually the preferred substrate, with sands and gravels generally favoured. The Malleefowl is probably more abundant to the west where there are extensive sandy soils.

Peregrine Falcon

Not observed but a widespread species and considered likely to be a regular visitor if not resident. It could also breed in tall eucalypts in the area, probably by utilising old nests of the Australian Raven.

Rainbow Bee-eater.

This species is only considered of local significance but was formerly listed as Migratory under legislation. It is still considered locally significant as it is a true migrant and breeds in burrows in the area, making it vulnerable to disturbance and predation. It will also often nest along tracks, increasing its vulnerability.

Table 3. Composition of the vertebrate fauna of the project area.

Taxon	Number of species expected	Number of species in each status category				
		Resident	Regular visitor or migrant	Irregular visitor	Vagrant	Locally extinct
frogs	5	4	-	1	-	-
reptiles	74	67	5	1	1	-
birds	165	64	43	36	22	-
mammals	41	28	3	2	2	6
Total	285 (including 9 int.)	163	51	40	25	6

Table 4. Numbers of species of conservation significance in each major taxon (excluding locally extinct species).

Taxon	Conservation Significant (CS) fauna		
	CS1	CS2	CS3
Invertebrates	11	-	-
Frogs	-	-	-
Reptiles	-	1	-
Birds	15	3	1
Mammals	-	2	-

CS1 = listed under legislation

CS2 = listed as priority by DBCA

CS3 = locally significant

Impacts

Impacts are a result of the interaction of the proposed development and the fauna values, and can be interpreted from the nature of both. For example, the assessment of fauna values identifies minor drainage lines, Malleefowl mounds and large trees as notable features for biodiversity. Impacting processes are discussed below.

- Habitat loss leading to population decline. Habitat loss from clearing 3m wide drill-lines at 90m intervals will affect about 3% of the landscape, and there will inevitably be some mortality during this clearing. Note that the habitat loss will be temporary except where lines are maintained as access tracks, and therefore populations should recover from this loss eventually. The effect of habitat loss can be reduced by avoiding sensitive environmental features (such as Malleefowl mounds; see recommendations below).
- Habitat loss leading to population fragmentation. This is unlikely to be a concern with the proposal as the clearing is in narrow lines through otherwise more or less continuous vegetation.

- Degradation of habitat due to weed invasion leading to population decline. The native vegetation in the area appears to have very low levels of weed invasion currently. There are standard procedures for minimising the risk of introducing weeds (discussed in recommendations below).
- Ongoing mortality from operations. Main sources of ongoing mortality will be from vehicle strike and entrapment in drilling sumps. There are standard procedures for minimising these risks (discussed in recommendations below).
- Species interactions including feral and overabundant native species. Feral predators are already present and affecting the fauna assemblage, but the creation of multiple tracks will improve their access into areas where currently tracks are few. The presence of personnel in these areas can also lead to an increase in activity of feral species. Recommendations to limit these affects are discussed below.
- Hydrological change. There may be some disruption of surface flow especially on the lower slopes of hills. Wastewater from drilling is usually contained in lined sumps so should have no impact.
- Altered fire regimes. Drilling activities and the presence of personnel will increase the risk of unplanned bushfire.
- Disturbance (dust, light, noise). Some level of disturbance during drilling is inevitable but temporary. If drilling occurs at night, lighting may be a source of mortality for insects. While only a temporary effect there are means by which this sort of mortality can be reduced. It is not known if the specially protected jewel beetles known from the general area are actually present, or how they might be affected by light.

Recommendations

Impacts outlined above clearly indicate a range of recommendations to ensure that adverse effects are minimised.

- Habitat loss leading to population decline.
 - Malleefowl mounds are of importance for the birds, whether or not they are active or recently-used, while active mounds (containing eggs) are of special value. Even very old mounds have been found to be re-used, possibly after an interval of several decades (M. Bamford pers. obs; Mt Jackson area). Therefore, no mounds should be damaged or otherwise disturbed if this is possible. If this is not possible, then it should be ensured that mounds are not active or disturbance should be delayed until breeding is complete. This requires a mound survey along all areas to be cleared, but given the apparent low density of mounds it is suggested that this could be carried out by exploration personnel with guidance from an experienced zoologist. For example, exploration personnel could be shown known mounds and could take photographs of suspected mounds for confirmation and interpretation by a zoologist. The protocol for searching for mounds needs to be discussed with government agencies, but in similar projects searching involves walking the alignment and ensuring that mounds can be avoided, while in areas of dense vegetation with poor visibility, searching needs to extend 50m from the centreline. This is to avoid clearing activity within c. 50m of an active mound.
-

This sort of detailed searching involves a small team of 3-4 people, but would only be needed in areas most likely to have mounds such as in the sandy soils in the west, and amongst the low rocky hills, particularly of the north-west and north-east.

- Large trees may support nesting by the Peregrine Falcon (and other birds) but it is assumed that clearing for exploration lines will go around trees wherever possible. Clearing should also avoid, if possible, mallee and tall shrubs with extensive beds of leaf-litter as these are important for some fauna.
 - In general, the clearing footprint should be minimised and vegetation retained where possible. Even tall shrubs and small trees can harbour colonies of lizards and bats that can survive if the vegetation is pushed over slowly and is not roughly wind-rowed. Clearing from mid winter to mid spring runs the risk of destroying nests of small birds. While this may be unavoidable, retaining shrubs will reduce the risk. Consideration could be given to having a 'spotter' present during clearing, especially in areas of dense vegetation.
 - To encourage regeneration, drill-lines should be ripped. Large branches and logs can be moved back over the drill-line, but there is a risk of killing fauna that may have colonised pushed-over vegetation.
 - Degradation of habitat due to weed invasion leading to population decline. There are standard equipment hygiene practices to minimise the risk of introducing weeds, and these should be practiced.
 - Ongoing mortality from operations.
 - Vehicle strike. There are existing speed limits and signage where Malleefowl have been seen near roads. These need to be installed on access roads to the exploration area if birds are seen or suspected.
 - Entrapment in drilling sumps. It is standard practice to create a ramp in drilling sumps, but plastic linings (required to prevent drill wastewater from soaking into the ground) can render such ramps more or less useless. Rope ladders, heavy rope mesh and even branches can be placed into sumps to assist egress by small animals. Drilling sumps should be filled as soon as they are no longer required. Capping drill-holes is standard practice but should be reiterated in inductions.
 - Species interactions including feral and overabundant native species. Personnel should be encouraged not to feed feral fauna and to report Foxes and Cats. Rapid rehabilitation of drill-lines will reduce their attractiveness to these feral species.
 - Hydrological change. Where drill lines cross minor drainage lines, soil should not cause damming of the drainage line, and should not form an alternative route for water flow.
 - Altered fire regimes. Personnel should be educated on the need to avoid bushfire. Spinifex areas in particular can readily be set alight so special care may be needed.
 - Disturbance (dust, light, noise). Dust and noise should be suppressed where possible. Lighting should not be left on overnight unless needed.
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References

- ABRS (2013). Credo Station Reserve WA, 2011. A Bush Blitz survey report. Australian Biological Resources Study: Canberra. Accessed online at: <http://bushblitz.org.au/credo-station-reserve-wa-2011/>
- Alexander Holm and Assoc. (2017). Malleefowl survey of proposed airstrip. Saracen Gold Mines Pty Ltd.
- Anstis, M. (2013). Tadpoles and Frogs of Australia. New Holland Publishers, Sydney.
- Armstrong, K.N. (2011). The current status of bats in Western Australia. In Law *et al.* (2011). *The Biology and Conservation of Australasian Bats*. Royal Zoological Society of NSW, Mosman, NSW, Australia.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Hawthorn East, Victoria.
- Biologic. (2010). Level 1 survey for a proposed pipeline from GGT to Carosue Dam and powerline from Black Swan to Carosue Dam. Tropicana JV and Saracen Gold Mine Pty Ltd.
- Churchill, S. (2008) *Australian Bats*. 2nd Edition. Jacana Books, Allen & Unwin. Crows Nest NSW.
- Coffey environments (2010). Level 1 vertebrate fauna survey for the Carosue Dam Project, Saracen Gold.
- Henry-Hall, N.J., Hopper, S.D., McKenzie, N.L. and Keighery, G.J. (1990). Report on survey of Goongarrie Nature Reserve.
- Johnstone, R. E. and Storr, G. M. (1998). *Handbook of Western Australian birds. Volume 1: Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth, Western Australia.
- Johnstone, R. E. and Storr, G. M. (2005). *Handbook of Western Australian birds. Volume 2: Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth, Western Australia.
- Menkhorst, P. and Knight, F. (2011). *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne, Victoria.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1983). *Lizards of Western Australia. II. Dragons and Monitors*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1990). *Lizards of Western Australia. III. Geckos and Pygopods*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1999). *Lizards of Western Australia. I. Skinks*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (2002). *Snakes of Western Australia*. Western Australian Museum, Perth, Western Australia.
- Tyler, M. J. and Doughty, P. (2009). *Field Guide to Frogs of Western Australia*. Western Australian Museum, Welshpool, Western Australia.
- Van Dyck, S. and Strahan, R. (Eds.) (2008). *Mammals of Australia*. 3rd Edition. Australian Museum, Sydney.
- Wilson, S. and Swan, G. (2017). *A Complete Guide to Reptiles of Australia*. Fifth Ed. New Holland, Australia.
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Appendix 1. Vertebrate fauna assemblage of the project area, based upon database and literature searches and the January 2019 site inspection. Sources of information are:

- ALA = Atlas of Living Australia, searched January 2019;
- N = Naturemap Database, searched January 2019;
- EPBC = EPBC Protected Matters, searched January 2019;
- BA = Birdlife Australia's Birddata database, searched January 2019;
- GNP 1990 = fauna survey of Goongarrie nature reserve (Henry-Hall *et al.* 1990);
- BB 2011 = fauna survey of Credo Station (ABRS 2013).
- BCE 2018 = species observed in the project area in January 2019;

Conservation significance (CS) codes:

- CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 4 for full explanation.
- EPBC Act listings: Cr = Critically Endangered, E = Endangered, V = Vulnerable, Mig = Migratory (see Appendix 3).
- Biodiversity Conservation Act listings: for all CS1 species S1 to 7 = Schedules 1 to 7 respectively, (see Appendix 3).
- DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 4).

Expected status as outlined in Methods.

FROGS	CS	ALA	N	GNP 1990	BB 2011	BCE 2018	Expected status in area
HYLIDAE							
Water-holding Frog <i>Cyclorana platycephala</i>		X	X				Resident
Desert Tree Frog <i>Litoria rubella</i>							Irregular visitor
LIMNODYNASTIDAE							
Kunapalari Frog <i>Neobatrachus kunapalari</i>		X	X		X		Resident
Shoemaker Frog <i>Neobatrachus sutor</i>		X	X				Resident
MYOBATRACHIDAE							
Western Toadlet <i>Pseudophryne occidentalis</i>					X		Resident

REPTILES	CS	ALA	N	GNP 1990	BB 2011	BCE 2018	Expected status in area
AGAMIDAE							
Bicycle Dragon <i>Ctenophorus cristatus</i>		X	X	X	X	X	Resident
Mallee Sand Dragon <i>Ctenophorus fordi</i>		X	X				Resident
Military Dragon <i>Ctenophorus isolepis</i>					X		Resident
Central Netted Dragon <i>Ctenophorus nuchalis</i>							Resident
Western Netted Dragon <i>Ctenophorus reticulatus</i>		X	X	X	X	X	Resident
Lozenge-marked Dragon <i>Ctenophorus scutulatus</i>		X	X	X	X	X	Resident
Mulga Dragon <i>Diporiphora amphiboluroides</i>		X					Resident
Thorny Devil <i>Moloch horridus</i>		X	X				Resident

REPTILES		CS	ALA	N	GNP 1990	BB 2011	BCE 2018	Expected status in area
Western Bearded Dragon	<i>Pogona minor</i>		X	X	X			Resident
DIPLODACTYLIDAE								
Fat-tailed Gecko	<i>Diplodactylus conspicillatus</i>						X	Resident
Goldfields Stone Gecko	<i>Diplodactylus granariensis</i>					X		Resident
Western Saddled Ground Gecko	<i>Diplodactylus pulcher</i>		X	X	X	X		Resident
Reticulated Velvet Gecko	<i>Hesperoedura reticulata</i>					X		Resident
Main's Ground Gecko	<i>Lucasium maini</i>				X			Resident
Beaked Gecko	<i>Rhynchoedura ornata</i>		X	X	X	X		Resident
Thorn-tailed Gecko	<i>Strophurus assimilis</i>							Resident
Jewelled Gecko	<i>Strophurus elderi</i>							Resident
Western Ring-tailed Gecko	<i>Strophurus strophurus</i>				X			Resident
Western Shield Spiny-tailed Gecko	<i>Strophurus wellingtonae</i>					X		Resident
CARPHODACTYLIDAE								
Knob-tailed Gecko	<i>Nephurus vertebralis</i>							Resident
Barking Gecko	<i>Underwoodisaurus milii</i>		X	X		X		Resident
GEKKONIDAE								
Purple Arid Dtella	<i>Gehyra purpurascens</i>		X	X	X	X		Resident
Variegated Dtella	<i>Gehyra variegata</i>		X	X	X	X		Resident
Bynoe's Gecko	<i>Heteronotia binoei</i>		X	X	X	X		Resident
PYGOPODIDAE								
Marble-faced Delma	<i>Delma australis</i>					X		Resident
Unbanded Delma	<i>Delma butleri</i>		X	X				Resident
Burton's Legless Lizard	<i>Lialis burtonis</i>		X	X		X		Resident
Western Hooded Scaly-foot	<i>Pygopus nigriceps</i>		X					Resident
SCINCIDAE								
	<i>Cryptoblepharus australis</i>		X	X				Resident
Buchanan's Snake-eyed Skink	<i>Cryptoblepharus buechananii</i>					X		Resident
Peron's Fence Skink	<i>Cryptoblepharus plagiocephalus</i>				X			Resident
	<i>Ctenotus atlas</i>		X	X	X			Resident
Leonhardi's Ctenotus	<i>Ctenotus leonhardii</i>		X	X	X	X	X	Resident
	<i>Ctenotus mimetes</i>						X	Resident
Leopard Skink	<i>Ctenotus pantherinus</i>							Resident
Barred Wedge-snout Ctenotus	<i>Ctenotus schomburgkii</i>		X	X	X	X		Resident
Spotted Ctenotus	<i>Ctenotus uber</i>		X	X	X	X		Resident
Wide-striped Ctenotus	<i>Ctenotus xenopleura</i>					X		Resident
Slender Blue-tongue	<i>Cyclodomorphus melanops</i>		X	X				Resident

REPTILES		CS	ALA	N	GNP 1990	BB 2011	BCE 2018	Expected status in area
Pygmy Spiny-tailed Skink	<i>Egernia depressa</i>		X	X		X	X	Resident
Goldfields Crevice Skink	<i>Egernia formosa</i>		X	X		X		Resident
South-Western Crevice-Skink	<i>Egernia napolensis</i>		X					Resident
Broad-banded Sand-swimmer	<i>Eremiascincus richardsonii</i>					X	X	Resident
	<i>Lerista desertorum</i>							Resident
	<i>Lerista kingi</i>		X	X				Resident
Unpatterned Robust Slider	<i>Lerista macropisthopus</i>	P2				X		Resident
Southern Robust Slider	<i>Lerista picturata</i>					X		Resident
Timid Slider	<i>Lerista timida</i>		X	X		X		Resident
Desert Skink	<i>Liopholis inornata</i>		X	X		X	X	Resident
Common Dwarf Skink	<i>Menetia greyii</i>		X	X	X	X	X	Resident
Saltbush Morethia Skink	<i>Morethia adelaidensis</i>					X	X	Resident
Woodland Dark-flecked Morethia	<i>Morethia butleri</i>		X	X	X	X		Resident
Western Blue-tongue	<i>Tiliqua occipitalis</i>		X	X		X		Resident
Bobtail	<i>Tiliqua rugosa</i>		X	X		X		Resident
VARANIDAE								
Stripe-tailed Monitor	<i>Varanus caudolineatus</i>		X	X	X	X		Resident
Perentie	<i>Varanus giganteus</i>					X		Resident
Sand Goanna	<i>Varanus gouldii</i>		X	X		X	X	Resident
Black-headed Monitor	<i>Varanus tristis</i>			X				Resident
TYPHLOPIDAE								
Southern Blind Snake	<i>Anilius australis</i>					X		Resident
Dark-spined blind snake	<i>Anilius bicolor</i>							Resident
Prong-snouted Blind Snake	<i>Anilius bituberculatus</i>					X		Resident
Northern Hook-snouted Blind Snake	<i>Anilius hamatus</i>						X	Resident
Beaked Blind Snake	<i>Anilius waitii</i>							Resident
ELAPIDAE								
Desert Death Adder	<i>Acanthophis pyrrhus</i>		X	X				Resident
Southern Shovel-nosed Snake	<i>Brachyuropsis semifasciata</i>							Resident
Yellow-faced Whipsnake	<i>Demansia psammophis</i>							Resident
Moon Snake	<i>Furina ornata</i>					X		Resident
Monk Snake	<i>Parasuta monachus</i>		X	X		X		Resident
Mulga Snake	<i>Pseudechis australis</i>		X	X		X		Resident
Ringed Brown Snake	<i>Pseudonaja modesta</i>		X	X	X			Resident
Gwardar	<i>Pseudonaja mengdeni</i>							Resident
Jan's Banded Snake	<i>Simoselaps bertholdi</i>		X	X		X	X	Resident
Rosen's Snake	<i>Suta fasciata</i>							Resident

[illegible]

BIRDS		CS	ALA	N	EPBC	BA	GNP 1990	BB 2011	BCE 2018	Expected status in area
Crested Pigeon	<i>Ocyphaps lophotes</i>		X	X		X		X	X	Resident
Common Bronzewing	<i>Phaps chalcoptera</i>		X	X		X		X		Resident
CUCULIDAE										
Fan-tailed Cuckoo	<i>Cacomantis flabelliformi</i>							X		Irregular visitor
Horsfield's Bronze-Cuckoo	<i>Chalcites basalys</i>		X	X		X		X		Regular migrant
Black-eared Cuckoo	<i>Chalcites osculans</i>		X	X	X	X		X		Regular migrant
Pallid Cuckoo	<i>Cuculus pallidus</i>		X			X		X		Regular migrant
APODIDAE										
Fork-tailed Swift	<i>Apus pacificus</i>	M S5			X			X		Regular migrant
RALLIDAE										
Eurasian Coot	<i>Fulica atra</i>					X		X	X	Regular visitor
Australian Spotted Crake	<i>Porzana fluminea</i>							X		Irregular visitor
Black-tailed Native-hen	<i>Gallinula ventralis</i>							X		Irregular visitor
RECURVIROSTRIDAE										
Banded Stilt	<i>Cladorhynchus leucocephalus</i>							X		Vagrant
Black-winged Stilt	<i>Himantopus himantopus</i>					X		X		Irregular visitor
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>					X		X		Vagrant
CHARADRIIDAE										
Inland Dotterel	<i>Charadrius australis</i>									Irregular visitor
Black-fronted Dotterel	<i>Charadrius melanops</i>							X		Irregular visitor
Red-capped Plover	<i>Charadrius ruficapillus</i>							X		Irregular visitor
Red-kneed Dotterel	<i>Erythronyx cinctus</i>							X		Regular visitor
Hooded Plover	<i>Thinornis rubricollis</i>	P4			X					Vagrant
Banded Lapwing	<i>Vanellus tricolor</i>			X				X		Regular visitor
SCOLOPACIDAE										
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	M S5			X					Irregular visitor
Curlew Sandpiper	<i>Calidris ferruginea</i>	Cr M S1 S5			X					Vagrant
Pectoral Sandpiper	<i>Calidris melanotos</i>	M S5			X					Vagrant

BIRDS		CS	ALA	N	EPBC	BA	GNP 1990	BB 2011	BCE 2018	Expected status in area
Red-necked Stint	<i>Calidris ruficollis</i>	M S5						X		Irregular visitor
Wood Sandpiper	<i>Tringa glareola</i>	M S5								Vagrant
Common Sandpiper	<i>Tringa hypoleucos</i>	M S5			X					Irregular visitor
Common Greenshank	<i>Tringa nebularia</i>	M S5								Irregular visitor
Marsh Sandpiper	<i>Tringa stagnatalis</i>	M S5								Irregular visitor
ARDEIDAE										
White-faced Heron	<i>Egretta novaehollandiae</i>					X		X		Irregular visitor
White-necked Heron	<i>Ardea pacifica</i>					X		X		Irregular visitor
Eastern Great Egret	<i>Ardea modesta</i>				X					Vagrant
Nankeen Night Heron	<i>Nycticorax caledonicus</i>									Vagrant
THRESKIORNITHIDAE										
Yellow-billed Spoonbill	<i>Platalea flavipes</i>							X		Vagrant
Glossy Ibis	<i>Plegadis falcinellus</i>	M S5						X		Vagrant
Australian White Ibis	<i>Threskiornis molucca</i>							X		Vagrant
Straw-necked Ibis	<i>Threskiornis spinicollis</i>							X		Vagrant
PHALACROCORACIDAE										
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>					X		X		Irregular visitor
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>									Vagrant
ACCIPITRIDAE										
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>									Resident
Brown Goshawk	<i>Accipiter fasciatus</i>		X			X		X		Regular visitor
Wedge-tailed Eagle	<i>Aquila audax</i>		X	X		X		X		Resident
Spotted Harrier	<i>Circus assimilis</i>		X					X		Regular visitor
Black-shouldered Kite	<i>Elanus axillaris</i>									Regular visitor
Letter-winged Kite	<i>Elanus scriptus</i>	P4								Irregular visitor
Whistling Kite	<i>Haliastur sphenurus</i>		X			X		X		Regular visitor
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>					X				Regular visitor
Little Eagle	<i>Hieraaetus morphnoides</i>					X		X		Regular visitor
Square-tailed Kite	<i>Lophoictinia isura</i>							X		Irregular visitor

BIRDS		CS	ALA	N	EPBC	BA	GNP 1990	BB 2011	BCE 2018	Expected status in area
Black Kite	<i>Milvus migrans</i>									Irregular visitor
FALCONIDAE										
Brown Falcon	<i>Falco berigora</i>		X	X		X		X		Regular visitor
Nankeen Kestrel	<i>Falco cenchroides</i>		X	X		X		X	X	Regular visitor
Grey Falcon	<i>Falco hypoleucos</i>	S3								Vagrant
Australian Hobby	<i>Falco longipennis</i>		X			X		X	X	Regular visitor
Peregrine Falcon	<i>Falco peregrinus</i>	S7						X		Regular visitor
Black Falcon	<i>Falco subniger</i>									Irregular visitor
STRIGIDAE										
Southern Boobook	<i>Ninox novaeseelandiae</i>		X			X		X		Resident
TYTONIDAE										
Barn Owl	<i>Tyto alba</i>			X				X		Resident
PODARGIDAE										
Tawny Frogmouth	<i>Podargus strigoides</i>			X		X		X		Resident
CAPRIMULGIDAE										
Spotted Nightjar	<i>Eurostopodus argus</i>			X		X				Regular visitor
AEGOTHELIDAE										
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>		X	X		X				Resident
MEROPIIDAE										
Rainbow Bee-eater	<i>Merops ornatus</i>	CS3	X	X	X	X		X	X	Regular migrant
ALCEDINIDAE										
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>		X					X		Resident
Sacred Kingfisher	<i>Todiramphus sanctus</i>							X		Regular visitor
CACATUIDAE										
Major Mitchell's Cockatoo	<i>Cacatua leadbeateri</i>									Irregular visitor
Little Corella	<i>Cacatua sanguinea</i>									Vagrant
Galah	<i>Eolophus roseicapilla</i>		X	X		X		X		Regular visitor
Cockatiel	<i>Nymphicus hollandicus</i>		X					X		Regular visitor
PSITTACIDAE										
Australian Ringneck	<i>Barnardius zonarius</i>		X	X		X		X	X	Resident
Purple-crowned Lorikeet	<i>Glossopsitta porphyrocephala</i>		X			X		X		Regular visitor

BIRDS		CS	ALA	N	EPBC	BA	GNP 1990	BB 2011	BCE 2018	Expected status in area
Budgerigar	<i>Melopsittacus undulatus</i>							X		Regular visitor
Scarlet-chested Parrot	<i>Neophema splendida</i>					X				Irregular visitor
Night Parrot	<i>Pezoporus occidentalis</i>	E S1			X					Vagrant
Princess Parrot	<i>Polytelis alexandrae</i>	V P4			X					Vagrant
Regent Parrot	<i>Polytelis anthopeplus</i>		X					X		Regular visitor
Mulga Parrot	<i>Psephotus varius</i>		X	X		X		X	X	Resident
CLIMACTERIDAE										
White-browed Treecreeper	<i>Climacteris affinis</i>		X	X				X		Resident
Rufous Treecreeper	<i>Climacteris rufa</i>							X		Resident
PTILONORHYNCHIDAE										
Western Bowerbird	<i>Ptilonorhynchus guttatus</i>			X		X				Resident
MALURIDAE										
White-winged Fairy-wren	<i>Malurus leucopterus</i>		X	X		X	X	X		Resident
Splendid Fairy-wren	<i>Malurus splendens</i>		X	X		X	X	X	X	Resident
MELIPHAGIDAE										
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>		X	X		X		X	X	Resident
Red Wattlebird	<i>Anthochaera carunculata</i>		X	X		X		X		Regular visitor
Pied Honeyeater	<i>Certhionyx variegatus</i>									Regular visitor
White-fronted Chat	<i>Epthianura albifrons</i>		X	X				X		Regular visitor
Orange Chat	<i>Epthianura aurifrons</i>		X							Irregular visitor
Crimson Chat	<i>Epthianura tricolor</i>		X	X		X		X		Regular visitor
Grey-fronted Honeyeater	<i>Lichenostomus plumulus</i>		X							Irregular visitor
Singing Honeyeater	<i>Lichenostomus virescens</i>		X			X		X	X	Resident
Brown Honeyeater	<i>Lichmera indistincta</i>		X	X		X		X		Resident
Yellow-throated Miner	<i>Manorina flavigula</i>		X	X		X		X	X	Resident
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>		X	X		X		X	X	Resident
White-eared Honeyeater	<i>Nesoptilotis leucotis</i>		X	X		X		X	X	Resident
White-fronted Honeyeater	<i>Phylidonyris albifrons</i>		X	X		X		X		Regular visitor
Yellow-plumed Honeyeater	<i>Ptilotula ornata</i>		X			X		X		Regular visitor

BIRDS		CS	ALA	N	EPBC	BA	GNP 1990	BB 2011	BCE 2018	Expected status in area
Black Honeyeater	<i>Sugomel niger</i>							X		Irregular visitor
PARDALOTIDAE										
Striated Pardalote	<i>Pardalotus striatus</i>		X	X		X		X		Resident
ACANTHIZIDAE										
Inland Thornbill	<i>Acanthiza apicalis</i>		X	X		X		X	X	Resident
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>		X	X		X		X	X	Resident
Slender-billed Thornbill	<i>Acanthiza iredalei</i>									Vagrant
Slaty-backed Thornbill	<i>Acanthiza robustirostris</i>		X	X		X				Resident
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>		X	X		X		X	X	Resident
Southern Whiteface	<i>Aphelocephala leucopsis</i>		X	X		X		X		Resident
Rufous Fieldwren	<i>Calamanthus campestris</i>									Regular visitor
Western Gerygone	<i>Gerygone fusca</i>							X		Resident
Redthroat	<i>Pyrrholaemus brunneus</i>		X	X		X		X	X	Resident
Weebill	<i>Smicrornis brevirostris</i>		X	X		X		X	X	Resident
NEOSITTIDAE										
Varied Sittella	<i>Daphoenositta chrysoptera</i>		X			X		X		Resident
POMATOSTOMIDAE										
White-browed Babbler	<i>Pomatostomus superciliosus</i>		X	X		X		X	X	Resident
CINCLOSOMATIDAE										
Chestnut Quail-thrush	<i>Cinclosoma castanotum</i>		X			X		X		Regular visitor
Copper-backed Quail-thrush	<i>Cinclosoma castaneothorax</i>									Irregular visitor
Chiming Wedgebill	<i>Psophodes occidentalis</i>									Vagrant
CAMPEPHAGIDAE										
Ground Cuckoo-shrike	<i>Coracina maxima</i>		X	X		X		X		Resident
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>		X	X		X		X		Resident
White-winged Triller	<i>Lalage tricolor</i>		X	X		X		X		Resident
PACHYCEPHALIDAE										
Grey Shrike-thrush	<i>Colluricincla harmonica</i>		X	X		X	X	X	X	Resident
Crested Bellbird	<i>Oreoica gutturalis</i>		X	X		X	X	X	X	Resident
Gilbert's Whistler	<i>Pachycephala inornata</i>							X		Irregular visitor

BIRDS		CS	ALA	N	EPBC	BA	GNP 1990	BB 2011	BCE 2018	Expected status in area
Brown Songlark	<i>Cinclorhamphus cruralis</i>		X					X		Resident
Rufous Songlark	<i>Cinclorhamphus mathewsi</i>							X		Resident
HIRUNDINIDAE										
White-backed Swallow	<i>Cheramoeca leucosternum</i>		X			X		X	X	Resident
Welcome Swallow	<i>Hirundo neoxena</i>		X	X		X		X	X	Resident
Fairy Martin	<i>Petrochelidon ariel</i>									Irregular visitor
Tree Martin	<i>Petrochelidon nigricans</i>		X	X		X		X		Resident

MAMMALS		CS	ALA	N	EPBC	GNP 1990	BB 2011	BCE 2018	Expected status in area
TACHYGLOSSIDAE									
Echidna	<i>Tachyglossus aculeatus</i>			X			X	X	Resident
DASYURIDAE									
Kultarr	<i>Antechinomys laniger</i>								Resident
Brush-tailed Mulgara	<i>Dasycercus blythi</i>	P4							Vagrant
Chuditch	<i>Dasyurus geoffroii</i>	V S3			X				Locally extinct
Wongai Ningau	<i>Ningau ridei</i>		X	X					Resident
Southern Ningau	<i>Ningau yvonneae</i>						X		Resident
Woolley's Pseudantechinus	<i>Pseudantechinus woolleyae</i>						X		Resident
Fat-tailed Dunnart	<i>Sminthopsis crassicaudata</i>		X	X			X		Resident
Little Long-tailed Dunnart	<i>Sminthopsis dolichura</i>		X	X			X		Resident
Hairy-footed Dunnart	<i>Sminthopsis hirtipes</i>								Resident
Ooldea Dunnart	<i>Sminthopsis ooldea</i>						X		Resident
THYLACOMYIDAE									
Greater Bilby	<i>Macrotis lagotis</i>	V S3							Locally extinct
BURRAMYIDAE									
Western Pygmy Possum	<i>Cercartetus concinnus</i>						X		Resident
POTOROIDAE									
Boodie	<i>Bettongia lesueur</i>	Ex S4						*	Locally extinct
PERAMELIDAE									

MAMMALS		CS	ALA	N	EPBC	GNP 1990	BB 2011	BCE 2018	Expected status in area
Pig-footed Bandicoot	<i>Chaeropus ecaudatus</i>	Ex S4							Extinct
Golden Bandicoot	<i>Isoodon auratus</i>	V S3							Locally extinct
Western Barred Bandicoot	<i>Perameles bougainville</i>	E S3	X						Locally extinct
MACROPODIDAE									
Rufous Hare-Wallaby	<i>Lagorchestes hirsutus</i>	Ex S4							Locally extinct
Western Grey Kangaroo	<i>Macropus fuliginosus</i>		X	X		X	X		Resident
Euro, Biggada	<i>Macropus robustus</i>			X			X	X	Resident
Red Kangaroo, Marlu	<i>Macropus rufus</i>		X	X		X	X		Resident
MOLOSSIDAE									
White-striped Freetail-Bat	<i>Austronomus australis</i>						X	X	Resident
Southern Freetail-Bat	<i>Mormopterus planiceps</i>						X		Resident
VESPERTILIONIDAE									
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>						X	X	Resident
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>						X		Resident
Central Long-eared Bat	<i>Nyctophilus major tor</i>	P3							Resident
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>								Resident
Inland Forest Bat	<i>Vespadelus baverstocki</i>								Regular visitor
Southern Forest Bat	<i>Vespadelus regulus</i>								Irregular visitor
MURIDAE									
Stick-nest Rat	<i>Leporillus</i> sp	Ex S4						*	Extinct
Spinifex Hopping-Mouse	<i>Notomys alexis</i>								Irregular visitor
Mitchell's Hopping-Mouse	<i>Notomys mitchellii</i>						X	X	Resident
Bolam's Mouse	<i>Pseudomys bolami</i>		X	X			X		Resident
Sandy Inland Mouse	<i>Pseudomys hermannsburgensis</i>		X	X					Resident
INTRODUCED MAMMALS									
European Cattle	<i>Bos taurus</i>	Int.		X				X	Regular visitor
Camel	<i>Camelus dromedarius</i>	Int.			X		X	X	Regular visitor

MAMMALS		CS	ALA	N	EPBC	GNP 1990	BB 2011	BCE 2018	Expected status in area
Dog, Dingo	<i>Canis lupus</i>	Int.	X		X		X	X	Resident
Goat	<i>Capra hircus</i>	Int.		X	X		X	X	Resident
Horse	<i>Equus caballus</i>	Int.			X				Vagrant
Cat	<i>Felis catus</i>	Int.		X	X		X	X	Resident
House Mouse	<i>Mus musculus</i>	Int.	X	X	X		X		Resident
Rabbit	<i>Oryctolagus cuniculus</i>	Int.		X	X		X	X	Resident
Red Fox	<i>Vulpes vulpes</i>	Int.			X		X	X	Resident

CS INVERTEBRATES	CS	BB 2011
BUPRESTIDAE		
jewel beetle <i>Castiarina acuticeps</i>	SP	X
jewel beetle <i>Castiarina aeraticollis</i>	SP	X
jewel beetle <i>Castiarina bakeri</i>	SP	X
jewel beetle <i>Castiarina pallidiventris</i>	SP	X
jewel beetle <i>Castiarina recta</i>	SP	X
jewel beetle <i>Castiarina rufolimbata</i>	SP	X
jewel beetle <i>Castiarina subacuticeps</i>	SP	X
jewel beetle <i>Chalcophorotaenia martinii</i>	SP	X
jewel beetle <i>Diadoxus regius</i>	SP	X
jewel beetle <i>Pseudotaenia gigas</i>	SP	X
jewel beetle <i>Temognatha pascoei</i>	SP	X

SP = special protection under the WA Biodiversity Conservation Act.

Appendix 2. Annotated species list from site inspection, 16-17 January 2019.

1. *Diplodactylus conspicillatus*. One dead in drill pit in north.
 2. *Strophurus* sp.. Several dead in drill pit in north. Very spiny tail with spines apparently not in clear lines.
 3. *Lucasium* sp.. One dead in drill pit in north.
 4. *Ctenophorus scutulatus*. Seen regularly in mixed shrubland on loam and gravelly loam flats.
 5. *Ctenophorus reticulatus*. One seen in south-east.
 6. *Ctenophorus cristatus*. One seen in woodland in east.
 7. *Varanus gouldii*. Young animal (year 2?) on track in east, and a slightly larger animal seen in south-east. Also one record in north-east.
 8. *Ctenotus mimetes*. One seen in north-west.
 9. *Ctenotus leonhardi*. Hatchling seen in south.
 10. *Eremiascincus richardsonii*. Adult and neonate at base of dead tree; seen head-torching at breakaway near camp. Also one dead animal in pit in south of area.
 11. *Liopholis inornata*. Burrow systems probably this species throughout. Several dead specimens in drill-pits.
 12. *Menetia greyii*. Several seen active.
 13. *Morethia ?adelaidensis*. One seen in shrubland in north-west. Appeared strongly-marked but could be *M. obscura*.
 14. *Anilius hamatus*. One removed from pit near drilling site in south.
 15. *Simoselaps bertholdi*. Two in pit in south; one dead and one rescued.
-
1. Emu. Dropping near camp wastewater treatment ponds. Droppings also found around Sandalwood in north-west. Fresh tracks across soft ground in south. Old nest (scattered eggshell) in south-west.
 2. Malleefowl. Reported near camp and three fairly old mounds found in east. All are quite small (3, 3.5m and 1.5-2m across) with clear central crater but no plant material in crater. One had possible scratch marks from Malleefowl in clay and raised soil still a bit loose, so maybe only 5-10 years since last used. The very small one also looked like it had been excavated within the last few years and uncertain if it had ever been filled with vegetation. Perhaps an experimental mound started by a young animal? One flushed from eucalypts and scrub in south at about 51J 439316E, 6663325N.
 3. Australasian Grebe. Four adults and a juvenile on treatment ponds.
 4. Grey Teal. Flock of 45 on treatment ponds.
 5. Pink-eared Duck. One on treatment ponds.
 6. Eurasian Coot. One on treatment ponds (17/01; had not been present on 14/01).
 7. Australian Hobby. One seen in north.
 8. Nankeen Kestrel. One over east.
 9. Crested Pigeon. One in camp.
 10. Australian Ringneck. Several around camp regularly and occasionally in woodlands.
 11. Mulga Parrot. Pair in north-west and pair in north-east.
 12. Rainbow Bee-eater. Seen occasionally; group of about five in east might be a pre-migratory gathering. Similar group seen in south.
 13. Splendid Fairy-wren. Parties throughout and coloured males present.
 14. Redthroat. Calling from thickets and few seen throughout.
 15. Inland Thornbill. Few parties throughout.
 16. Chestnut-rumped Thornbill. Few parties throughout.
-

17. Yellow-rumped Thornbill. Party in north-east.
 18. Weebill. Common among eucalypts.
 19. Singing Honeyeater. Small numbers throughout.
 20. Yellow-throated Miner. Parties throughout.
 21. Spiny-cheeked Honeyeater. Seen and heard throughout.
 22. White-eared Honeyeater. Several seen and heard in tall eucalypts in south.
 23. Brown-headed Honeyeater. Party in tall shrubs and eucalypts in south.
 24. Mistletoebird. Several seen and heard in south.
 25. Red-capped Robin. At least two pairs in south.
 26. Rufous Whistler. Occasional birds seen and heard throughout.
 27. Grey Shrike-thrush. Calling in dense thickets and one sheltering from heat in small cave.
 28. Crested Bellbird. Calling throughout.
 29. Quail-thrush. Species not determined. Heard in north-west area.
 30. White-browed Babbler. Parties throughout.
 31. Willie Wagtail. One in north-west and one in south.
 32. White-tailed Fantail. One in south and one in north-east. Pale tail very prominent.
 33. White-backed Swallow. Seen occasionally.
 34. Welcome Swallow. Several over south.
 35. Magpie-lark. One in camp.
 36. Masked Woodswallow. Group of five over east and similar group seen in north-east; included juveniles.
 37. Black-faced Woodswallow. Several on powerlines near offices.
 38. Australian Raven. Small numbers throughout.
 39. Little Crow. Two in north-west area and also small group in north-east.
 40. Grey Currawong. Several in south-west area and one seen in north-west area. Juvenile seen in south-west.
 41. Pied Butcherbird. Adults and a juvenile in south-west. Juvenile also seen in north.
 42. Grey Butcherbird. Several seen and heard in south.
 43. Australian Magpie. Single bird seen in north.
 44. Australian Pipit. Few along roads.
-
1. Echidna. Diggings throughout and scats in small caves in breakaway.
 2. Boodie. Old warrens widespread (56 recorded) especially in areas where calcrete present. Extinct on the mainland (except for translocated populations).
 3. Stick-nest Rat. Old nests in breakaway overhangs. Coordinates for a large nest in good condition: 51J 436877E, 6661282N. Uncertain if *Leporillus conditor* or *L. apicalis*. Both extinct on the mainland; *L. conditor* survives on one island and some translocated populations.
 4. Euro. Scats in breakaways.
 5. White-striped Bat *Austronomus australis*. Detected near camp and almost constant activity over settling ponds late into evenings.
 6. Gould's Wattled Bat *Chalinolobus gouldii*. Detected near camp and almost constant activity over settling ponds late into evenings.
 7. Chocolate Wattled Bat *Chalinolobus morio*. Occasional records at settling ponds in morning.
 8. Southern Forest Bat *Vespadelus regulus*. Almost constant activity through all nights over settling ponds. Active until 04:43.
-

9. Inland Freetail Bat *Ozimops planiceps*. Occasional records from settling ponds in early morning.
10. Long-eared Bat *Nyctophilus* sp. Probable; could not be identified to species.
11. Mitchell's Hopping-Mouse *Notomys ?mitchelli*. Burrows in old Boodie warrens.
12. Rabbit. Scats and diggings throughout.
13. Goat. Scats in breakaway caves.
14. Cow. Old scats and tracks seen at several locations.
15. Camel. Old scats in north-west.
16. Red Fox. Scats found at a few locations.
17. Feral Cat. Tracks at one location in south.
18. Dingo. Fresh tracks in north.

Appendix 3. Locations and descriptions of fauna records.

Eastings	Northings	Date_Time	Notes
436804	6660228	17/01/19	Bat detector
439104	6669114	17/01/2019 8:06	Boodie warren
439029	6669044	17/01/2019 8:08	Boodie warren
438849	6668661	17/01/2019 8:19	Boodie warren
438815	6668391	17/01/2019 8:27	Boodie warren
438844	6668352	17/01/2019 8:28	Boodie warren
439328	6667937	17/01/2019 8:46	Boodie warren
439140	6667656	17/01/2019 9:15	Boodie warren
437549	6667634	17/01/2019 10:00	Boodie warren
437644	6669186	17/01/2019 11:15	Boodie warren
437981	6669010	17/01/2019 11:22	Boodie warren
438056	6668915	17/01/2019 11:25	Boodie warren
438317	6668613	17/01/2019 11:32	Boodie warren
438694	6668529	17/01/2019 11:40	Boodie warren and Fox earth
439309	6667842	17/01/2019 12:07	Boodie warren
439979	6668338	17/01/2019 6:40	Boodie warren
440424	6669052	17/01/2019 7:13	Boodie warren
439096	6667982	17/01/2019 11:59	Boodie warren
436411	6662253	16/01/2019 15:49	Boodie warren
439390	6663152	16/01/2019 8:07	Boodie warren
441348	6664218	16/01/2019 10:03	Boodie warren
441644	6664165	16/01/2019 10:11	Boodie warren
441204	6663577	16/01/2019 10:48	Boodie warren
441007	6663719	16/01/2019 10:56	Boodie warren
436700	6662452	16/01/2019 15:36	Boodie warren
436594	6662388	16/01/2019 15:39	Boodie warren
434185	6667767	15/01/2019 7:56	Boodie warren
436511	6667576	15/01/2019 9:09	Boodie warren
439256	6666797	15/01/2019 17:12	Boodie warren
436032	6668264	15/01/2019 9:51	Boodie warren
436276	6668258	15/01/2019 10:08	Boodie warren
436339	6668192	15/01/2019 10:11	Boodie warren
436770	6667779	15/01/2019 10:32	Boodie warren
440649	6666567	15/01/2019 12:19	Boodie warren
440798	6666729	15/01/2019 12:24	Boodie warren
438469	6666267	15/01/2019 15:59	Boodie warren
439220	6666812	15/01/2019 17:11	Boodie warren
440049	6662891	16/01/2019 7:01	Boodie warren
439994	6663397	16/01/2019 7:19	Boodie warren
439662	6663458	16/01/2019 7:28	Boodie warren
441488	6663746	16/01/2019 10:36	Boodie warren
436514	6662206	16/01/2019 15:55	Boodie warren
436480	6662062	16/01/2019 16:27	Boodie warren

Eastings	Northings	Date_Time	Notes
440438	6668940	17/01/2019 7:10	Boodie warren
440382	6669304	17/01/2019 7:19	Boodie warren
438928	6668138	17/01/2019 11:55	Boodie warren
439149	6667936	17/01/2019 12:00	Boodie warren
439184	6667889	17/01/2019 12:02	Boodie warren
439668	6669650	17/01/2019 7:43	Boodie warren
439432	6669422	17/01/2019 7:54	Boodie warren
439022	6669090	17/01/2019 8:07	Boodie warren
438795	6668639	17/01/2019 8:18	Boodie warren
438806	6668482	17/01/2019 8:22	Boodie warren
438062	6667666	17/01/2019 9:43	Boodie warren
437551	6669093	17/01/2019 11:12	Boodie warren
438788	6668239	17/01/2019 11:51	Boodie warren
439571	6668030	17/01/2019 6:22	<i>Egernia depressa</i> colony
440300	6666651	14/01/2019 11:59	Malleefowl mound
437128	6662908	14/01/2019 11:29	Malleefowl mound
439316	6663325	16/01/2019 7:46	Malleefowl
440713	6664119	16/01/2019 11:15	Malleefowl mound and Boodie warren
436512	6662297	16/01/2019 15:43	Malleefowl mound
440377	6666617	15/01/2019 11:50	Malleefowl mound
440296	6666565	15/01/2019 11:57	Malleefowl mound
439080	6667196	15/01/2019 16:47	Malleefowl mound
441185	6664298	16/01/2019 9:55	Malleefowl Mound
436877	6661282	14/01/2019 14:49	old Stick-nest Rat nest in cave
434960	6667699	15/01/2019 8:30	Land snails

Appendix 4. Categories used for the assessment of conservation significance.

IUCN categories (based on review by Mace and Stuart 1994) as used for the Environment Protection and Biodiversity Conservation Act 1999 and the Western Australian Biodiversity Conservation Act 2018.

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (Ex)	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 (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern.	Taxa that are not Threatened.

Schedules used in the WA Biodiversity Conservation Act 2018

Schedule 1 (S1)	Critically Endangered fauna.
Schedule 2 (S2)	Endangered fauna
Schedule 3 (S3)	Vulnerable Migratory species listed under international treaties.
Schedule 4 (S4)	Presumed extinct fauna
Schedule 5 (S5)	Migratory birds under international agreement
Schedule 6 (S6)	Conservation dependant fauna
Schedule 7 (S7)	Other specially protected fauna

WA Department of Biodiversity, Conservation and Attractions Priority species (species not listed under the Biodiversity Conservation Act 2018, but for which there is some concern).

Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands. Taxa in need of monitoring.
Priority 4. (P4)	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.

ENVIRONMENTAL ASSESSMENT:

RELIEF HILL SURVEY AREA

SARACEN GOLD MINES



Alexander Holm & Associates
Natural Resource Management Services

February 2020

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Attachments

Attachment 1: 'NatureMap' report
Attachment 2: 'Protected matters' search tool output
Attachment 3: List of flora taxa found at each inventory site
Attachment 4: Inventory site data on landform, soil type and erosion.
Attachment 5: Inventory site data on dominant flora vegetation cover and condition.
Attachment 6: Location of inventory sites
Attachment 7: Fauna memo report

SUMMARY

This report for Saracen Gold Mines Pty Ltd covers environmental assessments within a 2080ha area approximately 6km east of Carosue Dam Operations and 115km north east of Kalgoorlie.

The environmental assessment had two components:

- A reconnaissance vegetation and flora survey from January 7 -12, 2020.
- A reconnaissance fauna survey from January 20 - 23, 2020.

Rainfall during winter in 2017 and 2018 was well below average. There were late winter rains in 2018 and as a result, some biannual herbs and grasses persisted from preceding seasons and were readily identified at the time of survey. There were few annual species.

Sixty-eight inventory sites were assessed during the reconnaissance vegetation and flora survey which provided systematic coverage of the area and encompassed variations in photo-pattern. A systematic assessment of land-type, geology, relief, soil type and vegetation at each site enabled the area to be mapped into readily identifiable land units.

Ten land units were identified, and ten associated vegetation communities described. Over 50% of the survey area is occupied by low hills and rises on basalt supporting very sparse to open mixed height shrublands with very sparse overstoreys of casuarina. Low hills and rises on laterite, commonly supporting acacia-dominated, very sparse to open shrublands with very sparse overstoreys of casuarina or eucalyptus, occupy approximately 20% of the area. Chenopod shrublands occur on approximately 20% of the area either on calcareous plains or alluvial plains. Felsic breakaways, acacia shrublands on hardpan and drainage tracts are minor components of the landscape.

Ninety-nine flora taxa representing 22 families were found during the reconnaissance survey. Chenopodiaceae accounted for 19 taxa, Fabaceae 24 taxa and Scrophulariaceae 16 taxa. There were two sterile specimens which were identified to genera level.

No threatened (rare) or endangered flora taxa were found during this survey.

Eremophila arachnoides subsp. *tenera*, a Priority 1 taxa is known to occur on nearby tenements with similar landunits. None were found during this survey.

Several populations, each with scores of individuals, of *Thryptomene eremaea*, a Priority 2 taxa, were found mostly confined to Land Unit 1e (Upland basalt surfaces).

No alien to Western Australia (weed) species were located during survey.

Minor to moderate soil erosion is evident on felsic footslopes, calcareous and alluvial plains and these land units are rated as slightly to moderately vulnerable to erosion. Disturbance to these land units has the potential to increase sediment discharge to drainage tracts and ultimately, and through extreme events, to Lake Rebecca.

The survey landscape mainly drains via overland flow to several broad drainage systems which flow indeterminately into Lake Rebecca 5 km to the north east and south. Lake Rebecca is a major wetland with local and regional significance.

Malleefowl are active in the survey area. Two fresh mounds were found during limited survey suggesting that there are likely to be many more in the survey area.

There are no Threatened Ecological Communities (TECs) within the north east Goldfields subregion and no Priority Ecological Communities within or adjacent to the survey area. No conservation areas are nearby.

It is recommended that, in planning and implementing operations within the survey area, the proponent:

- 1. Avoids disturbance to land unit 1e (Upland basalt surfaces) preferred habitat for *Thryptomene eremaea* a Priority 2 taxa.**
- 2. Undertakes a Malleefowl survey especially within land units 1a, 2a and 4b and avoids disturbance within 50m of active Malleefowl nests during nesting and incubation.**
- 3. Avoids destruction of mature Eucalyptus trees with nesting hollows**
- 4. Old trees, dead trees, fallen logs and termite mounds should be “gently” tipped over and left overnight to allow fauna to disperse**
- 5. Takes measures to minimise erosion through soil disturbance and concentration of overland water flows on vulnerable land units, especially calcareous plains (land unit 4c) and alluvial plains (land unit 5b).**
- 6. Avoids disturbance to drainage channels (land unit 6).**

SCOPE OF WORKS

Saracen Gold Mines Pty Ltd (Saracen) is proposing extensive exploration to the east of Safari and Whirling Dervish gold mines. Alexander Holm & Associates were contracted by Saracen to conduct an environmental assessment of a 2080ha area in the Relief Hill area. Bamford Consulting Ecologists (BCE), were sub-contracted by Alexander Holm & Associates to undertake and report on the fauna component of the assessment.

The environmental assessment to include:

- A review of available information on likelihood of a) presence of threatened (rare) or priority plant species and b) threatened plant communities in the general search area.
- A reconnaissance level fauna, flora and vegetation survey.
- An assessment of landscape stability and condition.
- A description of land units and relate information on fauna, flora, vegetation communities and landscape stability to these units.
- A map of land units, associated vegetation communities, soil type and vulnerability to erosion.
- A report on findings within a local and regional context
- An assessment of the proposal in relation to impacts on fauna.
- An assessment of the proposal against clearing principles.

The scope of works is to comply with Western Australian Environmental Protection Authority (EPA) objectives for protection of the environment specifically to “ensure that flora and vegetation surveys provide sufficient information to address both biodiversity conservation and ecological function values within the context of the type of proposal being considered” and to “enable an assessment of impacts on the conservation values and status of the site in a regional and local context” (Environmental Protection Authority, 2004).

The work takes into account the following surveys that are either nearby or adjoin the proposed project envelope and will produce a unified landunit/ vegetation association map to cover these surveys:

- Matiske Consulting Pty Ltd (2010) Flora and vegetation survey of the proposed airstrip.
- Matiske Consulting Pty Ltd (2010) Flora and vegetation survey of the Karari pit extension.
- Alexander Holm & Associates (2010) Environmental assessment-proposed expansion of Whirling Dervish mine.
- Alexander Holm & Associates (2012b) Environmental assessment – proposed expansion of Tailings Storage Facility.
- Alexander Holm & Associates (2019). Environmental assessment of proposed seismic survey area.

In addition, information on fauna was available from a number of previous studies in the area. These include:

- Alexander Holm and Assoc. (2017). Malleefowl survey of proposed airstrip. Saracen Gold Mines.
- Coffey environments (2010). Level 1 vertebrate fauna survey for the Carosue Dam Project, Saracen Gold.
- Biologic. (2010). Level 1 survey for a proposed pipeline from GGT to Carosue Dam and powerline from Black Swan to Carosue Dam. Tropicana JV and Saracen Gold Mine Pty Ltd.
- Henry-Hall *et al.* (1990). Report on survey of Goongarrie Nature Reserve.
- ABRS (2013). Bush Blitz; Biological survey of Credo Station Reserve WA.

REGIONAL OVERVIEW

Regional setting

The survey area is approximately 115 km north east of Kalgoorlie Boulder, and adjacent to Lake Rebecca (Figure 1). It is within Kalgoorlie-Boulder and Menzies local government areas. It falls mainly within Common 17325 and partly within Edjudina, Gindalbie and Pinjin pastoral leases. It is located in the south-east of Eastern Murchison (MUR 1) bio-geographic subregion and adjacent to Shield and Eastern Goldfields bio-geographic sub-regions (Cowan 2001, Desmond, Cowan and Chant 2003).

The most extensive land use in the region is pastoralism and over 80% of this region is pastoral leasehold. Most of the remainder is unallocated crown land and less than 1% is set aside for nature conservation.

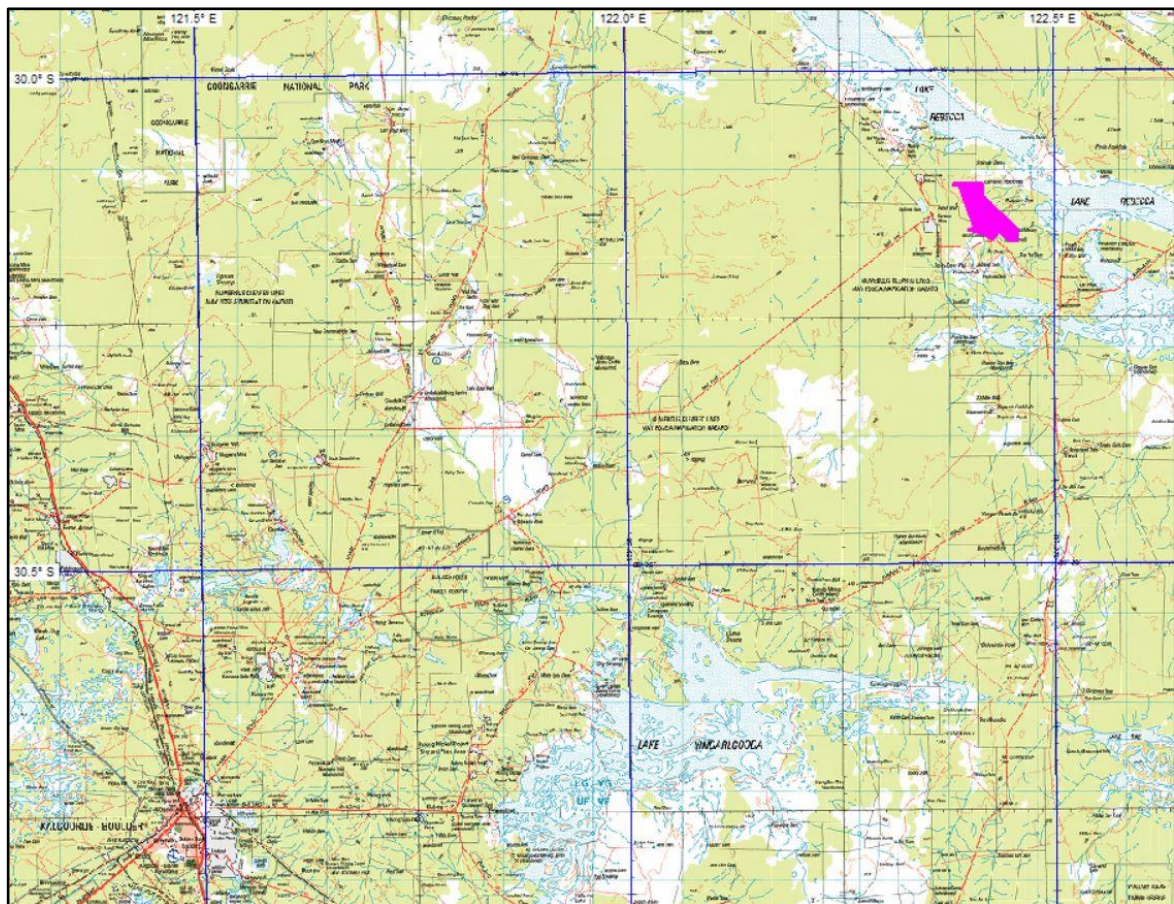


Figure 1: Survey area (in pink) in relation to Lake Rebecca and Kalgoorlie Boulder in the south west.

Climate

Rainfall in the region is unreliable and inconsistent. Winter rainfall consists of light showers from April to October. Significant summer rainfall events originating from the north-west as tropical cyclones are most likely between January and March. The highest recorded daily rainfall at Kalgoorlie is 177.8 mm (in February) and 92.6 mm (in January) at Laverton. For Kalgoorlie, one in one hundred years rainfall events of 1 hour and 72 hours are estimated to result in 43 and 173 mm of rain respectively. (Data from www.bom.gov.au).

The average potential pan evaporation rate at Carosue Dam is approximately 2800 mm per annum¹.

Winds are mostly light easterlies.

Topography and drainage

Landform patterns in the general area comprise extensive sand plain, sub-parallel greenstone belts and breakaways with often extensive lower pediments which give way to level to very gently inclined sheet flood plains. Relief is subdued. There are no major river systems. South-east trending, broad, saline, palaeo-drainage systems traverse the region and are defining features of the Yilgarn block of south-western Australia (Gentili, 1979). These drainage systems have very low gradients and contain playa lakes including Lake Rebecca, Carey and Raeside. Lakes form local depo-centres with poorly developed radial drainage systems. During occasional intense rainfall events lakes may fill, and in very rare events some may overflow, link-up and discharge to the Nullarbor Plain through Ponton Creek (Pringle, Van Vreeswyk & Gilligan, 1994).

Hydrogeology

Groundwater occurs throughout the region within sparse fractures in basement rocks, within the weathering profile, and in alluvial sediments. Regional water table elevations vary from around 350 m above sea level around Lake Raeside to 400 – 450 m above sea level around Lake Carey and are generally 30 to 100 m below surface. Groundwater recharge occurs from major, but infrequent, rainfall events, mainly on drainage divides, and locally at site specific intake areas such as drainage lines or sandplains and dune fields. Groundwater is in hydraulic continuity and flows from drainage divides towards palaeo-drainages and then south-easterly toward the Nullarbor Plain. Groundwater beneath catchment divides occurs as lenses of less than 5000 mg/l TDS which are superimposed on a regional field of saline groundwater with linear bodies of hypersaline groundwater along palaeo-drainages, and local brine pools associated with salt lakes.

Vegetation and soils

The region lies within the Eremaean botanical province, mainly in the Austin botanical district, with the eastern edge approaching the Helms botanical district (Beard, 1976). Lake Ballard/Lake Rebecca form a major vegetation divide with characteristic *Acacia aneura* (mulga) low woodlands associated with red loams over siliceous hardpan to the north and low woodlands of mixed mulga and *Casuarina obesa* (black oak) and

¹ http://www.bom.gov.au/cgi-bin/climate/cgi_bin_scripts/evaporation.cgi.

Eucalyptus species on alkaline and calcareous soils to the south. Spinifex hummock grassland with eucalypt overstory on sand plain is common. Halophytic vegetation occurs throughout the region on palaeo-drainage systems, breakaways and on some stony and alluvial plains. Highly saline soils support *Atriplex* (saltbush), *Maireana* (bluebush) and *Tecticornia* (samphire) shrublands, while less saline soils support eucalypt or mulga with saltbush or bluebush understoreys.

The most common vegetation associations in the region include Beard Vegetation Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.), 110 (Hummock grassland, shrub steppe and red mallee over spinifex) and 389 (Succulent steppe with open low woodland; mulga over saltbush) (Table 1).

Table 1: Vegetation associations (Beard, 1976) in project area in comparison with South Laverton area (SLA), total area in WA and area within conservation reserves

Veg Assn	Description	SLA Area km ²	Reserve priority	Western Australia		
				Area km ²	Within reserve km ²	%
20	Low woodland; mulga mixed with <i>Casuarina obesa</i> and <i>Eucalyptus</i> spp.	7892	L	13045	2173	16.7
24	Low woodland; <i>Casuarina obesa</i>	15.2	L	265.6	2.4	0.9
110	Hummock grassland; shrub steppe and red mallee over spinifex	356	M	4746	1201	25.3
389	Succulent steppe with open low woodland; mulga over salt bush	2344	M	6465	230	3.6
529	Succulent steppe with open low woodland; mulga and sheoak over salt bush	46.6	H	102.8	0.1	0.1

L*: Low; M: Medium; H: High priority for reservation

ASSESSMENT METHODOLOGY

Assessment personnel

The work was managed and reported by Dr Alexander Holm (Alexander Holm & Associates). Field work for the vegetation and flora survey was conducted by Mr Eliot and Dr Holm. Mr Mitchell provided off-site assistance in expert identification of flora specimens collected in the field.

Dr Holm is an ecologist with over 35 years experience in arid environments and Goldfield regions and an accredited environmental consultant with the Environmental Consultants Association of Western Australia.

Mr Andrew Mitchell was assisting botanist to Western Australian Department of Agriculture's rangeland surveys, senior author of "Arid Shrubland Plants of Western Australia" (Mitchell and Wilcox 1994) and recently retired botanist with AQIS (Australian Quarantine and Inspection Service).

Mr Geoffrey Eliot was soil and landscape technician for the Western Australian Department of Agriculture's rangeland surveys and has over 20 years experience in Western Australian arid regions.

The fauna survey was conducted and reported by Dr Barry Shepherd and Mr Tim Gamlin.

Dr Barry Shepherd is an ecologist with more than 20 years working as an environmental consultant. Barry's core skills are around environmental and ecological impact assessment, and environmental approvals. Around this experience, he has conducted a large number of environmental baseline survey for birds, bats, small mammals and herpetofauna, and specialises in marine mammals and bats. He is also experienced in line transect population studies. Barry has undertaken extensive analysis of bat echolocation and calls and is competent on most ultra-sonic detection systems. Barry has written a large number of baseline survey reports, impact assessments and environmental approval documentation.

Tim Gamblin is an experienced fauna ecologist working across a range of industry sectors within the WA bioregions. He has technical and practical skills, specialised knowledge of vertebrate fauna ecology, sampling and detection methods, and can communicate results and advice to clients and other stakeholders in the natural resource management, mining and energy sectors. He has over 20 years' experience as a zoologist and has worked within the WA government as well as in the private sector as a fauna consultant. He has a proven ability to provide high quality results whether this be preparing an impact assessment, ecological reporting or working effectively within a fauna survey team. He also enjoys teaching and training students in fauna sampling techniques.

Timing of survey and seasonal conditions

Vegetation and flora reconnaissance survey from January 7 -12, 2020.

Fauna reconnaissance survey from January 20 – 23, 2020.

Rainfall during winter in 2017 and 2018 was well below average (Figure 2). There were spring rains in 2018, however 2019 has been one of the driest years on record and as a result, very few biannual herbs and grasses have persisted from preceding seasons and there were no annual species.

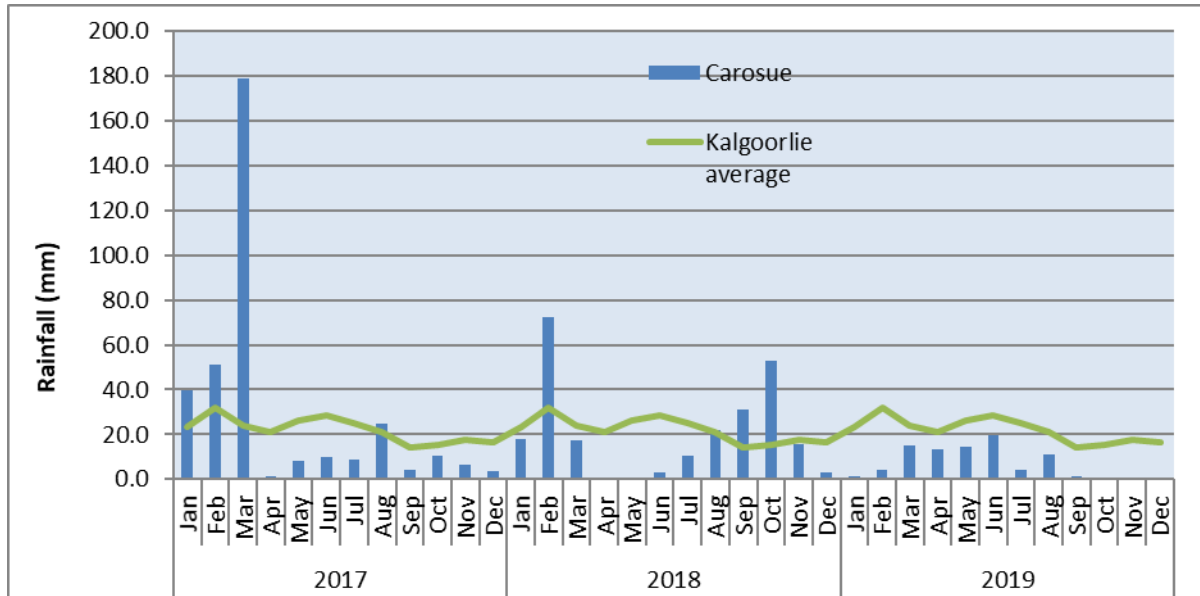


Figure 2: Monthly rainfall (mm) at Carosue Dam in comparison to averages at Kalgoorlie airport

Declared flora and fauna

The Department of Parks and Wildlife and the Western Australian Museum's "NatureMap"² was interrogated for records of all collected flora within a 40 km radius of the study area (Attachment 1). The list was augmented by other recent searches from nearby survey areas (Alexander Holm & Associates 2012a, Alexander Holm & Associates 2012b, Alexander Holm & Associates 2012c, Alexander Holm & Associates 2012d, Alexander Holm & Associates 2019).

Thryptomene eremaea, a Priority 2 taxon, is recorded in NatureMap as being located within 40km of the study area. It is an erect open shrub, 0.5 to 1.5m high, producing pink or white flowers from July to September and grows on red or yellow sands on sandplains and shallow sandy soils over granite.

Eucalyptus pimpiniana, a Priority 3 taxon, is recorded in Nature Map as being located within 40km of the study area. It is a straggly mallee 0.7-2m high, with smooth bark, producing white flowers from May to October and grows on red sands on sandplains and dunes.

Eremophila arachnoides subsp. *tenera*, a Priority 1 taxon, was recorded in adjacent surveys during 2012 and 2019 (Alexander Holm & Associates 2012d, Alexander Holm & Associates 2019).

Declared flora and fauna listed on Commonwealth Department of Environment and Energy database of threatened species were identified within a 100km radius of the study area using the protected matters search tool³ (Attachment 2).

Gastrolobium graniticum is classed as Endangered under the EPBC Act 1999 and as a Declared Rare taxon under the Wildlife Conservation Act 1950 [WA]. This member of the Fabaceae is an erect shrub 0.9 to 1.2 m high with purple branches, and ovate leaves 2.5 to 6 cm long. The distribution of this species is restricted to Kalgoorlie and Coolgardie districts where it is found in sandy or sandy loam soils near granite rocks.

Eucalyptus articulata is classed as Vulnerable under the EPBC Act 1999 and as a Declared Rare taxon under the Wildlife Conservation Act 1950 [WA]. It is a low scraggly mallee to 3m high grow in red sand, sandy loam, arkose gravel and sand dunes.

Hibbertia crispula is classed as Vulnerable under the EPBC Act 1999 and as a Priority 1 taxon (Priority Flora and Priority Fauna List (Western Australia)). It is a small wiry glabrous shrub growing up to 50 cm high with typical yellow flowers in leaf axils.

Tecticornia flabelliformis is classed as Vulnerable under the EPBC Act 1999 and as a Priority 1 taxon (Priority Flora and Priority Fauna List (Western Australia)). It is an erect shrub to 0.2m high growing on clays on saline flats.

Records of bird observations in Australia, 1998-2019 from BirdLife Australia Atlas Database (Birdlife Australia) within a 40km radius of the study area.

²<https://naturemap.dpaw.wa.gov.au/default.aspx>

³ <http://environment.gov.au/epbc/protected-matters-search-tool>

Records of biodiversity data from multiple sources across Australia from Atlas of Living Australia and within a 40km radius of the study area.

Significant conservation fauna which may be present in the survey area, include one reptile, 19 birds and two mammals. The single reptile is a Priority 2 skink that may occur under leaf-litter around trees and mallee. The majority (9) of the birds are waterbirds that are either vagrants or irregular visitors and would not utilise the actual project area due to the lack of wetlands. Most other significant birds are expected only as vagrants but three species may use the site regularly: Malleefowl, Peregrine Falcon and Rainbow Bee-eater. Only two significant mammals are expected, with the Central Long-eared Bat potentially roosting in large trees, and the Brush-tailed Mulgara probably being locally extinct or possibly being a vagrant.

Threatened and priority ecological communities

The likelihood of presence of threatened ecological communities within the general survey area was assessed using the protected matters search tool (Attachment 2).

Other threatened ecosystems in the south-east of Eastern Murchison (MUR 1) biogeographic subregion, identified during “A Biodiversity Audit of Western Australia’s 53 Biogeographical Subregions in 2002”, are listed in Cowan (2001).

Priority ecological communities in the area were assessed from Department of Parks and Wildlife listing (Version 27, June 2017).

Land systems land units and vegetation communities

Land systems and land units were derived from a land resource survey of north eastern Goldfields (Pringle, Van Vreeswyk & Gilligan, 1994). Land systems for the region south of the north eastern Goldfield survey have been tentatively identified by desk-top photographic interpretation and extrapolation (Department of Agriculture and Food WA).

Vegetation communities were established firstly with reference to those listed in Pringle et al. (1994) where they are listed as ‘site types’, and secondly, where no comparable community could be found, with reference to those listed in adjacent surveys of Sandstone, Yalgoo Paynes Find (Payne et al., 1998) and Kambalda north (Payne, Mitchell & Hennig, 1998).

Tentative land units were identified by examination of high-resolution aerial photography and Google imagery. Boundaries were checked in the field, transferred to geo-referenced ortho-photo maps and captured digitally. Vegetation communities were visually associated with each land unit.

Field survey

Reconnaissance vegetation and flora survey

The survey and reporting were conducted to comply with the EPA's "Technical Guidance – flora and vegetation surveys for environmental impact assessment" (Environmental Protection Authority 2016). A reconnaissance level survey was considered appropriate in the first instance in view of results of several vegetation and flora surveys nearby or adjacent to the study area (Figure 3).

Sixty eight inventory sites (relevés) were selected to 1) sample each land unit within the survey area, 2) provide systematic coverage of the survey area, and 3) to encompass variations in pattern within each land unit. Each inventory site was located by GPS and the following information recorded:

- Digital photographs.
- All flora species within approximately 50 m of a central location and in the same land unit were inventoried and voucher specimens collected of all taxa which were also compiled within a reference field herbarium.
- Vegetation condition were visually estimated using rating scales of Environmental Protection Authority (2016) and soil erosion compared with standard rating scales used for rangeland surveys and described by Pringle *et al.* (2004).
- Vegetation community and land unit descriptions using terminology from Payne *et al.* (1998).
- Vegetation cover, landform, slope, relief, surface coarse fragment characteristics and surface water flow characteristics (Anon, 2009).
- Soil characteristics (texture, reaction to acid and fragment characteristics) of surface horizons to maximum of 30cm (Anon, 2009).

These data were augmented by walking traverses by two surveyors along selected routes. The survey aimed to:

- Locate priority or threatened flora.
- Locate species not previously recorded at inventory sites.

Locations of inventory sites, vehicle traverse (120km) and walking traverses (20km) are shown in Figure 4.

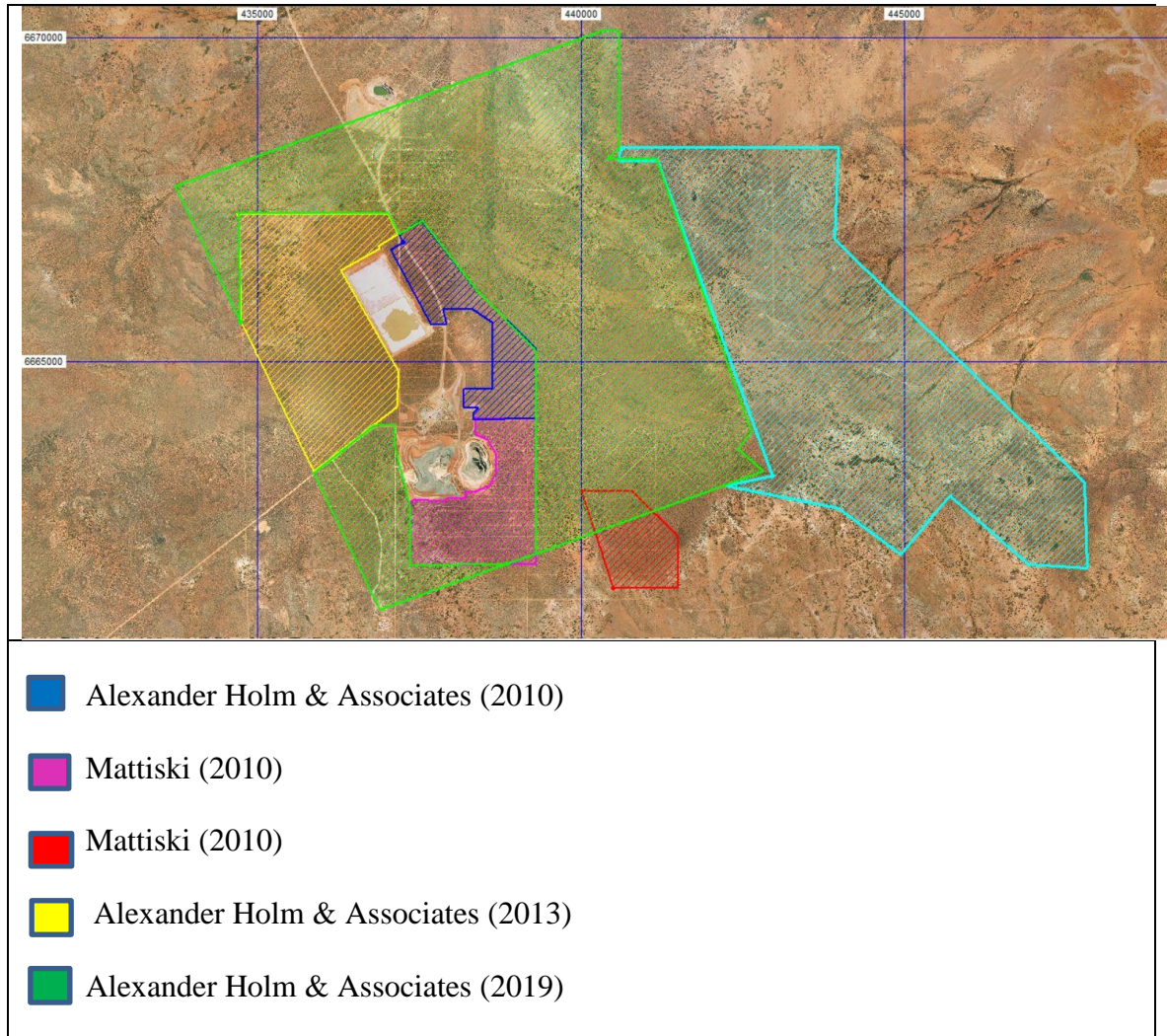


Figure 3: Proposed survey area (light blue) and locations of existing flora and vegetation surveys.

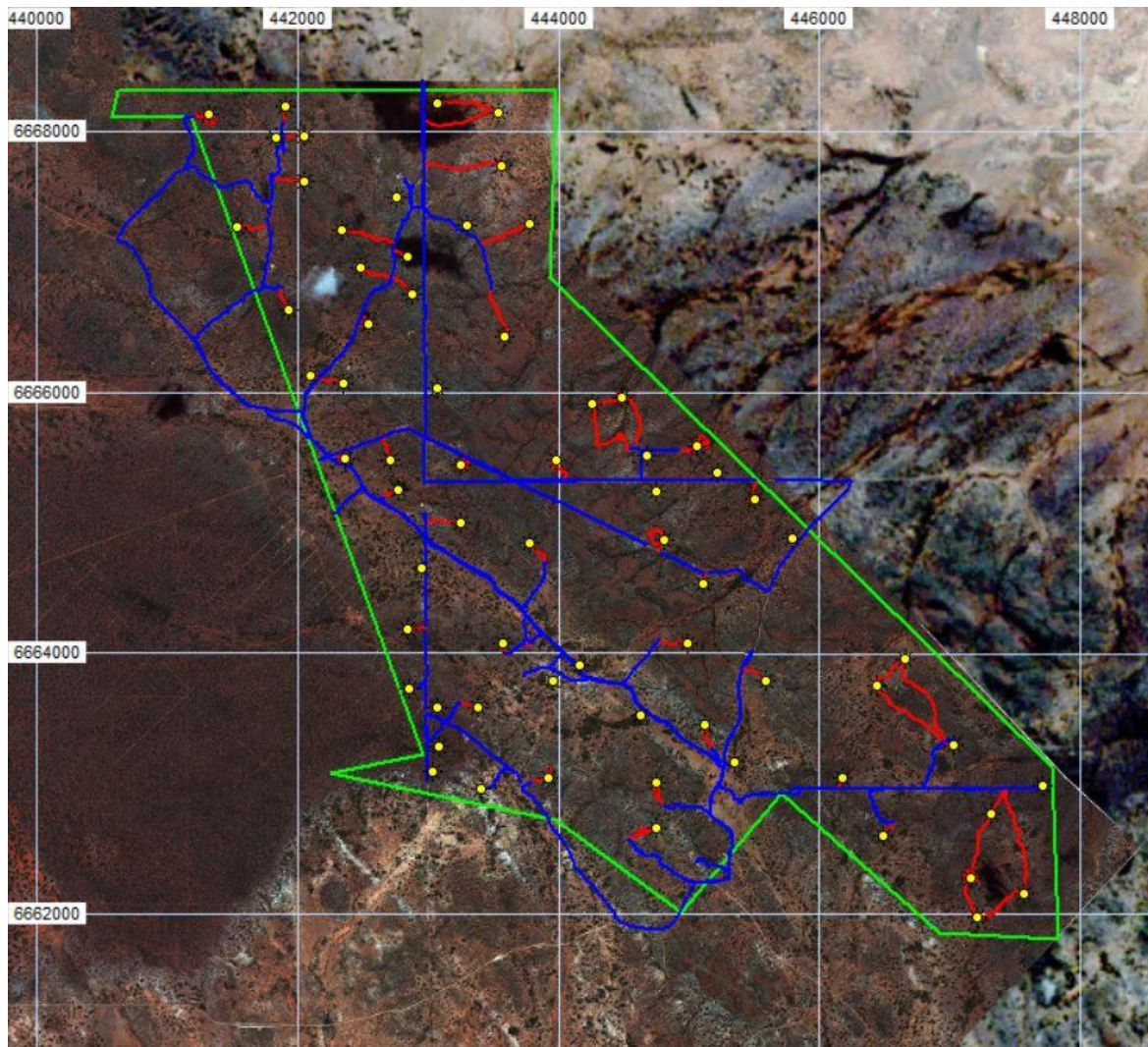


Figure 4: Location of inventory sites (yellow) vehicle traverse (blue) and walking traverses (red) during flora survey.

Reconnaissance fauna survey

The site visit involved looking around as much of the project area as possible in daylight and the tracks and effort of this search are shown in Figure 5. This enabled environmental descriptions to be prepared and some opportunistic observations on fauna to be made. Targeted searching was undertaken for two significant species known from the general area; in particular for nest mounds, foraging signs, tracks and direct observations of Malleefowl (*Leipoa ocellata*). Surveyors were also mindful of the burrows of Brush-tailed Mulgara (*Dasyercus blythi*), although it is likely this species is locally extinct. Signs of all species observed, and other notable features of interest were recorded.

An Anabat Swift full spectrum ultrasonic acoustic detector was placed next to an old mine shaft for two full nights. It was deployed on the afternoon of 21st January and retrieved on the morning of 23rd January 2020. All calls obtained were assessed to provide a list of bat fauna supporting the Level 1 survey.

The complete fauna memo report is attached (Attachment 7).

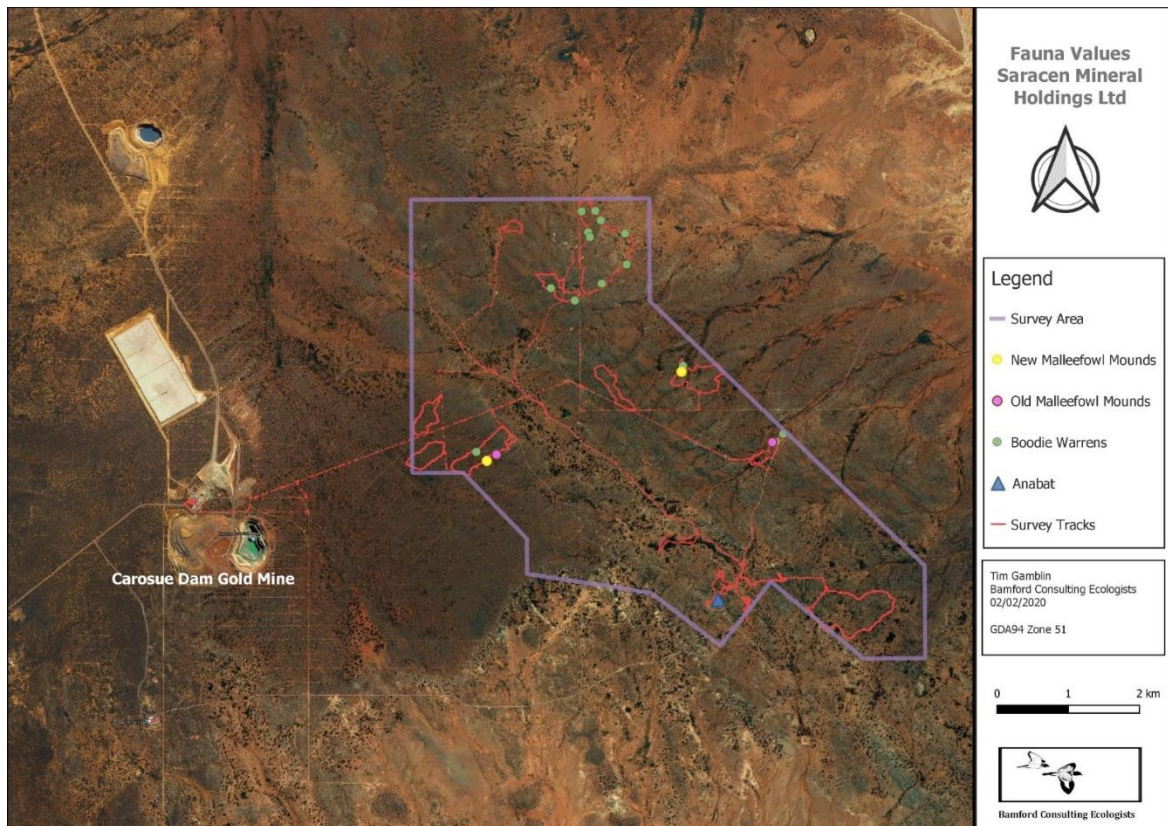


Figure 5: Vehicle traverse and walking traverses during fauna survey and locations of significant fauna observations.

ENVIRONMENTAL ANALYSIS

Conservation estate

Beard Vegetation Association 529 (Succulent steppe with open low woodland; mulga and sheoak over salt bush) is the most common vegetation association in the survey area occupying 69%. Vegetation Association 24 (Low woodland; *Casuarina obesa*) occupies 28% and the remaining 3% is Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.) (Beard 1976).

Vegetation Association 20 occupies approximately 13,000 km² in Western Australia of which 16.7% is within conservation reserves and although less than 1% of Vegetation Association 24, which occupies approximately 266 km² in Western Australia, is within reserves, both have a low priority for conservation (Table 1). Vegetation Association 529 is very poorly conserved and has a high priority for conservation.

There are no conservation reserves within 50 km of the survey area (Appendix 1). The closest conservation area is Bullock Holes Reserve, approximately 60 km south west.

There are no listed sites of international or national significance or wetlands of International, National or sub-regional significance within the project area (Appendix 1) although Lake Rebecca is considered an ecologically significant component of inter-regional palaeo-channels.

There are no registered sites on State or National heritage registers.

Lake Rebecca is a registered mythological site.

Land systems and landforms

Approximately 42% of the survey area is occupied by low basalt hills of the Leonora land system with acacia woodlands and halophytic undershrubs; 36% consists of low greenstone hills and stony plains, supporting chenopod shrublands with patchy eucalypt overstoreys of Moriarty land system; 19% is gently undulating plains on erosional surfaces of Gundockerta land system (Table 2).

Table 2: Descriptions of land systems within the survey area (Pringle, Van Vreeswyk & Gilligan, 1994 and Department of Agriculture and Food, WA).

Land type	Land system	Description	Soil and land management
Erosional surfaces of low relief	Gundockerta	Extensive gently undulating plains on weathered greenstone with stony mantles and lower alluvial tracts	Saline plains and adjacent alluvial tracts are susceptible to water erosion.
Depositional plains with calcareous red earths	Deadman	Level to gently undulating plains with casuarina-acacia shrublands.	Generally not susceptible to soil erosion
Low rises to 20m with ferruginous duricrust	Moriarty	Low greenstone hills and stony plains, supporting chenopod shrublands with patchy eucalypt overstoreys.	Slopes of low rises, alluvial plains and narrow drainage tracts are moderately susceptible to soil erosion.
Low, rounded hills to 40m with gently inclined fringing plains	Leonora	Low greenstone hills with eucalypt or acacia woodlands with halophytic undershrubs	Drainage tracts are highly susceptible to soil erosion. Vegetation highly preferred by grazing animals.

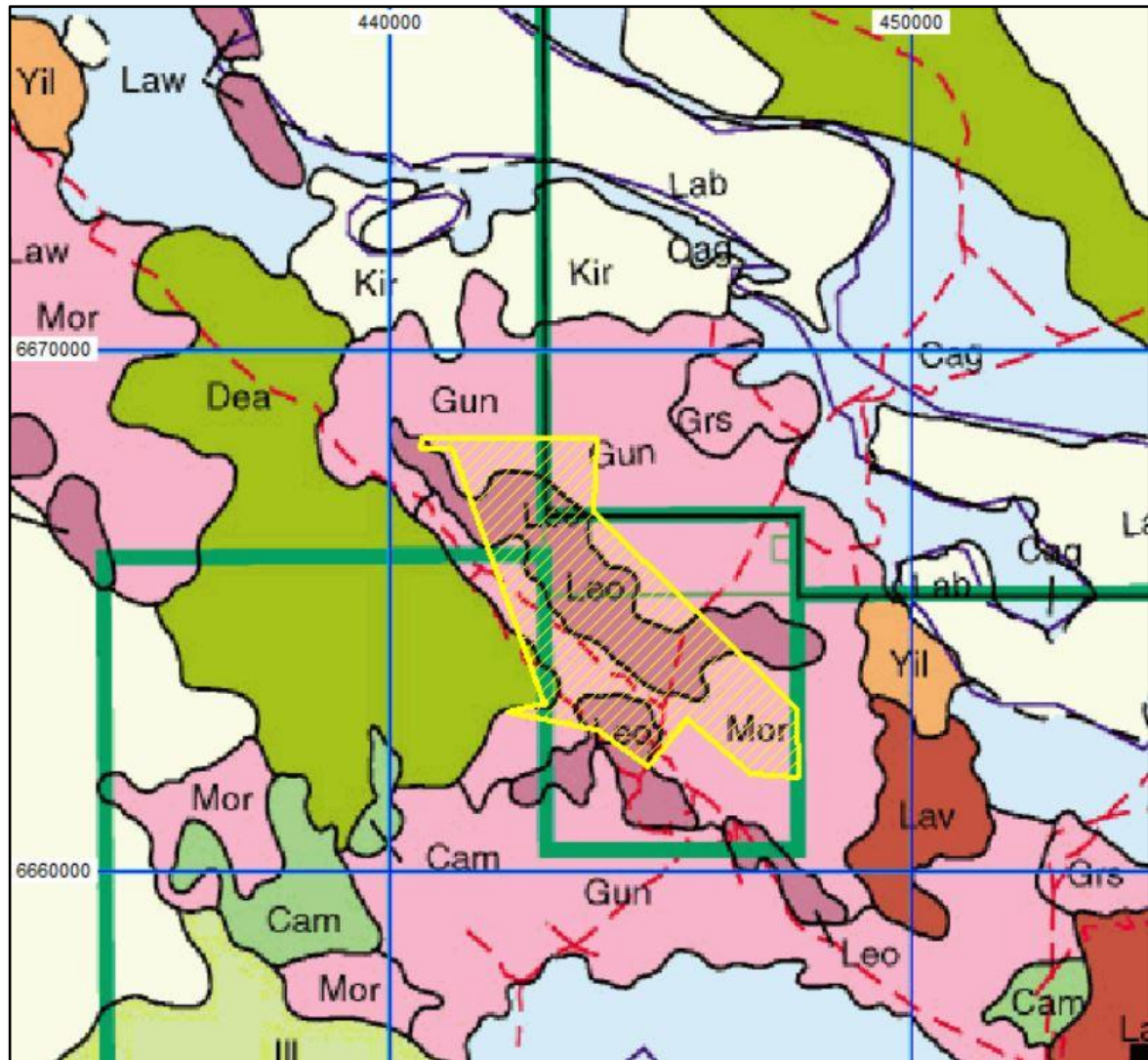


Figure 6: Land systems within the survey area (in yellow)



Land units, soil types and vegetation communities



Land unit descriptions and mapping



Ten land units and associated vegetation communities and soil types are described (Table 4).



A map of land units is overlain on an aerial photograph (Figure 7).



Table 3: Land unit descriptions, their soil type, vulnerability to erosion and associated vegetation communities.


Land unit	Land form and soil type	Vegetation community
1a. Lateritic hills 	<p>Lateritic hills with relief to 20m with slopes up to 8%, very abundant (>90%) surface mantles of ironstone medium to coarse gravel and cobbles with and occasional quartz fragments and calcrete nodules.</p> <p>Shallow sandy loams or sandy clay loams over calcrete or parent laterite.</p> <p>Run-off source zones, nil vulnerability to erosion.</p>	<p>Very sparse to open mixed shrubland (PFC 5-25%) dominated by <i>Acacia</i> sp., <i>A. stowardii</i>, <i>Dodonaea lobulata</i>, <i>Eremophila scoparia</i> and <i>Scaevola spinescens</i> with very sparse overstorey of <i>Casuarina pauper</i> or <i>Eucalyptus lesouefii</i>.</p> <p>“Stony ironstone acacia shrubland” (SIAS vegetation community) or “Breakaway mixed shrubland” (BRXS vegetation community)</p>
1b. Basalt hills 	<p>Basalt hills with relief to 50m, slopes from 3-10%, abundant (50-90%) surface mantles of coarse gravel and cobbles of basalt and occasional quartz or calcrete.</p> <p>Sandy loams or sandy clay loams less than 30cm in depth often highly calcareous.</p> <p>Run-off source zones, nil vulnerability to erosion.</p>	<p>Open to very sparse mixed height shrubland (PFC 10-30%) dominated by <i>Acacia quadrimarginea</i>, <i>Acacia</i> sp., <i>Dodonaea lobulata</i> and <i>Eremophila scoparia</i> with very sparse overstorey of <i>Casuarina pauper</i>.</p> <p>Mid-dense <i>A. quadrimarginea</i> and <i>Acacia</i> sp shrublands (PFC 40-50%) are common on mid slopes.</p> <p>“Greenstone hill acacia shrubland” (GHAS vegetation community)</p>

Land unit	Land form and soil type	Vegetation community
1b. Basalt hills continued 		<p>Occasional pockets of very sparse <i>Eucalyptus lesouefii</i> woodlands with minimal understory.</p> <p>“Greenstone hill non-halophytic woodlands” (GNEW vegetation community)</p>
1c. Felsic hills breakaways and footslopes 	<p>Breakaways and low hills with relief of 10m and footslopes with slopes of 2-4%, Common to many (20-50%) surface mantles of medium to coarse gravel and cobbles of felsic rocks and quartz fragments.</p> <p>Deep sandy loam gradational to light clay. Non-calcareous.</p> <p>Run-off source zones, slight to moderate vulnerability to erosion.</p>	<p>Very sparse woodland of <i>Eucalyptus salubris</i>, <i>E. griffithsii</i> and <i>E. oleosa</i> subsp. <i>oleosa</i> (PFC 10-15%) over very sparse chenopod shrubland of <i>Atriplex</i> spp. with <i>Eremophila scoparia</i>.</p> <p>“Breakaway footslope eucalypt woodland with chenopod understory” (BECW vegetation community).</p>

Land unit	Land form and soil type	Vegetation community
1e. Upland basalt surfaces 	<p>Upper slopes of basalt hills with slopes to 5%, very abundant (>90%) surface mantles of medium to coarse gravel and cobbles of basalt.</p> <p>Skeletal sandy loam to sandy clay loams less than 15cm. Non-calcareous.</p> <p>Run-off source zones, nil vulnerability to erosion.</p>	<p>Very sparse (PFC 10%) low shrubland dominated by <i>Thryptomene eremaea</i> with very sparse <i>Acacia quadrimarginea</i> overstorey and emergent <i>Casuarina pauper</i>.</p> <p>“Greenstone hill mixed shrubland” (GHMS vegetation community)</p>
2a. Low lateritic rises 	<p>Low hillocks and gentle low rises with slopes to 3%, relief up to 5m, abundant (90%) surface mantles of fine to coarse gravel of laterite with occasional calcrete and quartz.</p> <p>Mostly shallow sandy loams or sandy clay loams often gradational to calcareous light clay and overlaying calcrete.</p> <p>Run-off source zones, nil to slight vulnerability to erosion.</p>	<p>Very sparse to open mixed-height shrubland (PFC 10-25%) dominated by <i>Acacia hemiteles</i>, <i>Acacia</i> sp, <i>Dodonaea lobulata</i>, <i>Scaevola spinescens</i> and <i>Ptilotus obovatus</i> with sparse overstorey of <i>Casuarina pauper</i>, <i>A. stowardii</i> and/or <i>Eucalyptus lesouefii</i>.</p> <p>“Stony ironstone acacia shrubland” (SIAS vegetation community)</p>

Land unit	Land form and soil type	Vegetation community
2b. Low rises on basalt 	<p>Low hills and rises with slopes to 2%, relief to 5 m and common to abundant mantles (10–90%) fine to coarse gravels of basalt, quartz and calcrete.</p> <p>Mostly, shallow highly calcareous sandy loams to sandy clay loams over calcrete.</p> <p>Run –off source zones to lower parts of the landscape occasionally via shallow incised drainage channels. Slight to moderate vulnerability to erosion.</p>	<p>Very sparse to open (PFC 10 – 20%) mixed height shrublands dominated by <i>Senna artemisioides</i> subsp. <i>petiolaris</i>, <i>Dodonaea lobulata</i>, <i>Acacia burkittii</i>, <i>A. hemiteles</i> and <i>Ptilotus obovatus</i> with isolated to very sparse overstorey of <i>Casuarina pauper</i> and occasionally <i>Acacia incurvaneura</i> or <i>Eucalyptus salmonophloia</i></p> <p>“Greenstone hill acacia shrubland” (GHAS vegetation community)</p>
4b. Plains supporting acacia shrublands on hardpan. 	<p>Gently inclined to level plains (slopes <1%); mostly many to abundant (20-90%) mantles of ironstone fine to medium gravel and quartz fragments.</p> <p>Non-calcareous sandy loam to sandy clay loams over ferruginous hardpan at >30cms.</p> <p>Broad transfer zones receiving water from upper units and shedding onto lower parts of landscape. Not vulnerable to erosion.</p>	<p>Very sparse to open tall acacia shrublands (PFC 10 -30%) dominated by <i>Acacia incurvaneura</i>, <i>A. ramulosa</i> and very sparse lower shrubs commonly <i>Dodonaea rigida</i>, with overstoreys of isolated <i>Casuarina pauper</i> or <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>.</p> <p>“Hardpan plain mulga shrubland” (HPMS vegetation community)</p>

Land unit	Land form and soil type	Vegetation community
4c. Calcareous plains supporting chenopod shrublands		
	Gently inclined to level plains (slopes <1%); with variable mantles of fine to coarse ironstone or basalt gravel, calcrete nodules and quartz fragments.	<p>Very sparse to open, mostly degraded <i>Maireana sedifolia</i> shrubland (PFC 10-25%) with colonizing shrubs including <i>Dodonaea lobulata</i>, <i>Senna artemisioides</i> subsp. <i>petiolaris</i> and <i>Eremophila scoparia</i> with very sparse overstorey of <i>Casuarina pauper</i>.</p> <p>“Plain mixed halophyte shrubland” (PXHS vegetation community).</p>
	Mostly calcareous sandy clay loams gradational to light clays greater than 30cms.	
	Broad transfer zones receiving water from upper units and shedding onto lower parts of landscape. Slightly to moderately vulnerable to erosion with minor to moderate sheet and rill erosion.	
5b. Alluvial plains supporting chenopod shrublands and salmon gums		
	Gently sloping plains (slopes 1%) with very few to few mantles (<2-10%) of fine to coarse gravels of ironstone, basalt and quartz fragments.	<p>Open, often degraded, chenopod shrublands (PFC 20-30%) dominated by <i>Atriplex vesicaria</i>, <i>A. bunburyana</i>, <i>A. nummularia</i> or <i>Maireana pyrimidata</i>, and in poor condition dominated by <i>Senna artemisioides</i> subsp. <i>petiolaris</i>, <i>Eremophila scorparia</i>, <i>Acacia hemiteles</i> with very sparse <i>Eucalyptus salmonophloia</i>, <i>E. salubris</i> overstorey and mid-dense groves of <i>E. salubris</i>.</p> <p>“Plain eucalypt chenopod shrubland” (PECW vegetation community).</p>
	Deep sandy clay loam gradational to light clay or deep light clay often calcareous.	
	Subject to shallow sheet flow, occasionally more concentrated. Stripped soil surfaces common. Moderate vulnerability to erosion.	

Land unit	Land form and soil type	Vegetation community
6. Drainage tracts 	<p>Gently sloping (1%) drainage tracts 50 – 200m wide with occasional minor channels, mostly without surface mantles, and abundant litter trains.</p> <p>Deep, sandy loam to sandy clay.</p> <p>Slight to moderate vulnerability to water erosion.</p>	<p>Open to mid-dense (PFC: 20 – 60%), tall acacia shrubland and occasional thickets dominated by <i>Acacia ramulosa</i> and <i>A. burkittii</i> with very sparse undershrubs including <i>Senna artemisioides</i> ssp. <i>petiolaris</i> and <i>S. cardiosperma</i> with isolated <i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>, or <i>Casuarina pauper</i> overstorey.</p> <p>“Drainage tract acacia shrubland” (DRAS vegetation community)</p>

(PFC): Projected foliar cover

** (SIAS etc.) vegetation types see Table 6.

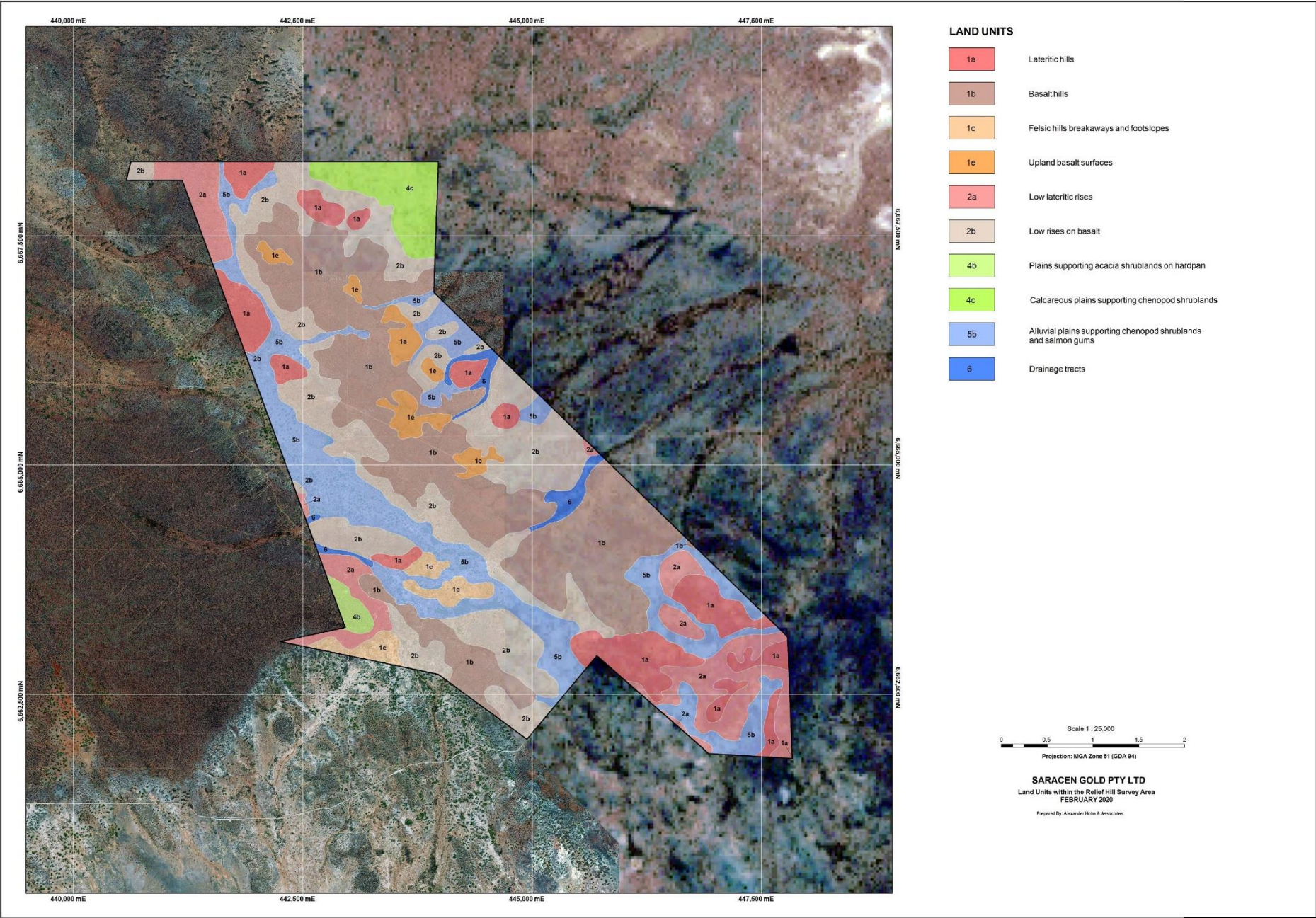


Figure 7: Map of land units

Land unit areas

Over 50% of the survey area is occupied by low hills and rises on basalt supporting very sparse to open mixed height shrublands with very sparse overstoreys of casuarina (land units 1b, 1e and 2b). Low hills and rises on laterite, commonly supporting acacia-dominated, very sparse to open shrublands with very sparse overstoreys of casuarina or eucalyptus, occupy approximately 20% of the area (land units 1a and 2a). Chenopod shrublands occur on approximately 20% of the area either on calcareous plains (land unit 4c) or alluvial plains (land unit 5b). Felsic breakaways, acacia shrublands on hardpan and drainage tracts are minor components of the landscape (Table 5).

Table 4: Area of each land unit within the extended survey area

Land unit	Description	Hectares	%
1a.	Lateritic hills	213.63	10.25
1b.	Basalt hills	596.21	28.60
1c.	Felsic hills breakaways and footslopes	43.98	2.11
1e	Upland basalt surfaces	58.28	2.80
2a.	Low lateritic rises	186.87	8.96
2b.	Low rises on basalt	484.61	23.25
4b.	Plains supporting acacia shrublands on hardpan	15.18	0.73
4c.	Calcareous plains supporting chenopod shrublands	77.99	3.74
5b.	Alluvial plains supporting chenopod shrublands and salmon gums	376.37	18.06
6.	Drainage tracts	31.43	1.51
Total		2084.55	100.00

Vegetation communities

Land units on laterite are mostly occupied by ‘Stony ironstone acacia shrubland’ (SIAS) or ‘Breakaway mixed shrubland’ (BRXS). (Table 5). Land units on basalt are occupied by ‘Greenstone hill acacia shrubland’ and ‘Greenstone hill mixed shrubland’ (GHAS and GHMS) with pockets of ‘Greenstone hill non-halophytic woodlands’ (GNEW) on lower slopes while those on felsic geology, in the south west, are ‘Breakaway footslope eucalypt woodland with chenopod understory’ (BECW).

‘Hardpan plain mulga shrubland’ (HPMS) occupy extensive plains extending west from the south western margin of the survey area. ‘Plain mixed halophyte low shrublands’ (PXHS) occur on plains in north eastern areas which are often degraded. The lowest parts of the landscape are occupied with ‘Plain eucalypt chenopod woodland’ (PECW) discharging overland flows through ‘Drainage tract acacia shrubland’ (DRAS) to Lake Rebecca.

Table 5: Vegetation communities, associated land units and vulnerability to disturbance.

Vegetation community	Description	Land unit	Vulnerable
BECW	Breakaway footslope eucalypt woodland with chenopod understory (S)	1c	
BRXS	Breakaway mixed shrubland (N)	1a	
DRAS	Drainage tract acacia shrubland (S)	6	
GHAS	Greenstone hill acacia shrubland (N)	1b 2b	
GHMW	Greenstone hill mixed shrubland	1e	
GNEW	Greenstone hill non-halophytic woodlands (N)	1b	
HPMS	Hardpan plain mulga shrubland (N)	4b	
PECW	Plain eucalypt chenopod woodland (N)	5b	Yes
PXHS	Plain mixed halophyte low shrublands (N)	4c	Yes (C)
SIAS	Stony ironstone acacia shrubland (N)	1a 2a	

*(N)(Pringle, Van Vreeswyk & Gilligan, 1994); (S) (Payne, Van Vreeswyk, Pringle, Leighton and Hennig 1998) (C) (Cowan, 2001)

Vegetation and soil condition

The survey area has been disturbed by recent and historic mining activity and is mostly within a pastoral lease and has been grazed. Vehicle tracks, cut lines and pastoral fences cross the area.

Land units supporting chenopod vegetation, preferentially grazed by livestock, are mostly degraded and few areas are in good condition (Table 6). Hills on laterite and basalt geology are mostly in good to excellent condition while lower slopes on basalt are often in poorer condition.

Minor to moderate soil erosion is evident on felsic footslopes, calcareous and alluvial plains (land units 1c, 4c and 5b) and these land units are rated as slightly to moderately vulnerable to erosion (Table 6). Other land units are mostly rated nil or slightly vulnerable to soil erosion and some areas on these units are slightly eroded.

Table 6: Vegetation and soil surface condition ratings for each land unit

Land unit	Vulnerability to erosion	Erosion status	Vegetation condition
1a. Lateritic hills	Nil-slight	70% nil 30% minor	90% excellent/good 10% fair
1b. Basalt hills	Nil-slight	94% nil to minor 6% moderate	94% excellent/good 6% fair
1c. Felsic hills breakaways and footslopes	Slight - moderate	50% slight 50% moderate	100% good
1e. Upland basalt surfaces	Nil	100% nil	100% excellent
2a. Low lateritic rises	Nil -slight	100% nil to minor	100% excellent/good
2b. Low rises on basalt	Nil -slight	100% nil to minor	28% excellent/good 29% fair 43% poor
4b. Plains supporting acacia shrublands on hardpan	Nil -slight	100% nil	100% excellent/good
4c. Calcareous plains supporting chenopod shrublands	Slight to moderate	20% minor 80% moderate	60% fair 40% degraded
5b. Alluvial plains supporting chenopod shrublands and salmon gums	Slight to Moderate	67% nil to minor 33% moderate	33% excellent/good 50% fair 17% degraded
6. Drainage tracts	Slight to moderate	100% minor	50% good 50% fair

Threatened ecosystems and wetlands.

Threatened and priority ecological communities

There are no identified threatened ecological communities (TECs) on Saracen tenements or in the entire MUR1 biogeographic subregion (Cowan, 2001).

There are no listed priority ecological communities (PECs) in the area.

Ecosystems at risk

Cowan, (2001) lists PXHS vegetation community (Plain mixed halophyte low shrublands) as an ecosystem at risk to disturbance (Table 5). PXHS vegetation community is associated with land unit 4c, 40% of which was degraded through over grazing. This current survey also identifies PECW (Plain eucalypt chenopod woodland) as an ecosystem at risk in that over two thirds is in fair or degraded condition. PXHS and PECW occur on land unit 4c and 5b which are moderately vulnerable to erosion and erosion is evident (Table 6).

Significant wetlands

There are no nationally significant wetlands in the area (Appendix 1). Lake Rebecca is a major wetland with local and regional significance.

Riparian vegetation

The survey landscape mainly drains via overland flow to drainage tracts (land unit 6) which flows into Lake Rebecca. These drainage tracts carry ephemeral flows for short periods and do not support riparian vegetation.

Flora

General

Ninety-nine flora taxa representing 22 families were found during the reconnaissance survey (Table 7). Chenopodiaceae accounted for 19 taxa, Fabaceae 24 taxa and Scrophulariaceae 16 taxa. There were two sterile specimens which were identified to genera level.

A list of species within each family found at each inventory site is presented in Attachment 3. Species typifying the survey area include: *Ptilotus obovatus*, *Dodonaea lobulata*, *Scaevola spinescens*, *Acacia tetragonophylla*, *Casuarina pauper* and *Senna artemisioides* subsp. *petiolaris* all present on at least 70% of sites.

Local endemics

No taxa are considered to be locally endemic.

Range extension

No taxa were collected outside of their known distribution range.

Declared weed species

No alien to Western Australia (weed) species were located during survey.

Threatened and priority flora

There are two threatened flora taxa (WA Wildlife Conservation Act 1950 – Wildlife Conservation (Rare Flora) Notice 2010(2) likely to occur in the general area: *Eucalyptus articulata* and *Gastrolobium graniticum* which is also an endangered species under the Commonwealth EPBC Act.

No threatened (rare) or endangered flora taxa were found during this survey.

Eremophila arachnoides subsp. *tenera*, a Priority 1 taxa is known to occur on nearby tenements with similar landunits. None were found during this survey.

Several populations, each with scores of individuals, of *Thryptomene eremaea*, a Priority 2 taxa, were mostly found confined to Land Unit 1e (Upland basalt surfaces) and occasionally on other basaltic units.

Table 7: List of flora taxa found during field survey in January 2020.

Family	Taxa	1a	1b	1c	1e	2a	2b	4b	4c	5b	6
Amaranthaceae	<i>Ptilotus obovatus</i>	y	y			y	y	y	y	y	y
Apocynaceae	<i>Alyxia buxifolia</i>	y	y				y			y	
Apocynaceae	<i>Marsdenia australis</i>		y			y	y		y		y
Apocynaceae	<i>Vincetoxicum lineare</i>		y								
Asteraceae	<i>Cratystylis microphylla</i>	y									
Asteraceae	<i>Olearia muelleri</i>	y	y	y		y	y		y	y	y
Asteraceae	<i>Podolepis capillaris</i>	y	y		y						
Casuarinaceae	<i>Casuarina pauper</i>	y	y		y	y	y	y	y	y	y
Chenopodiaceae	<i>Atriplex codonocarpa</i>									y	
Chenopodiaceae	<i>Atriplex stipitata</i>									y	
Chenopodiaceae	<i>Atriplex bunburyana</i>		y	y		y	y		y	y	
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>		y	y		y	y		y	y	
Chenopodiaceae	<i>Atriplex vesicaria</i>			y		y			y	y	
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>									y	
Chenopodiaceae	<i>Enchylaena lanata</i>									y	
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>		y	y					y	y	
Chenopodiaceae	<i>Maireana georgei</i>		y				y		y	y	
Chenopodiaceae	<i>Maireana integra</i>						y			y	
Chenopodiaceae	<i>Maireana pentatropis</i>	y	y	y			y		y		
Chenopodiaceae	<i>Maireana pyramidata</i>		y			y			y	y	
Chenopodiaceae	<i>Maireana sedifolia</i>	y	y	y		y	y		y	y	y
Chenopodiaceae	<i>Maireana tomentosa</i>			y		y				y	
Chenopodiaceae	<i>Maireana triptera</i>		y	y		y	y		y	y	
Chenopodiaceae	<i>Rhagodia drummondii</i>								y	y	
Chenopodiaceae	<i>Rhagodia eremaea</i>		y							y	
Chenopodiaceae	<i>Sclerolaena cuneata</i>								y	y	
Chenopodiaceae	<i>Sclerolaena diacantha</i>		y	y		y	y		y	y	y
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>						y		y	y	
Chenopodiaceae	<i>Tecticornia disarticulata</i>			y						y	
Fabaceae	<i>Acacia aptaneura</i>	y	y								
Fabaceae	<i>Acacia ayersiana</i>	y	y			y	y	y	y	y	
Fabaceae	<i>Acacia burkittii</i>	y	y	y	y	y	y		y	y	y

Family	Taxa	1a	1b	1c	1e	2a	2b	4b	4c	5b	6
Fabaceae	<i>Acacia erinacea</i>	y	y	y		y	y			y	
Fabaceae	<i>Acacia hemiteles</i>	y	y			y	y	y	y	y	y
Fabaceae	<i>Acacia incurvaneura</i>	y	y		y		y	y	y		
Fabaceae	<i>Acacia kempeana</i>					y					
Fabaceae	<i>Acacia ligulata</i>	y	y			y	y		y	y	y
Fabaceae	<i>Acacia nyssophylla</i>	y	y				y			y	
Fabaceae	<i>Acacia oswaldii</i>	y	y			y	y			y	y
Fabaceae	<i>Acacia quadrimarginea</i>	y	y		y	y	y	y			y
Fabaceae	<i>Acacia ramulosa</i> var. <i>linophylla</i>	y	y			y		y			y
Fabaceae	<i>Acacia sibirica</i>	y	y		y	y	y	y		y	y
Fabaceae	<i>Acacia tetragonophylla</i>	y	y		y	y	y	y	y	y	
Fabaceae	<i>Acacia</i> sp	y	y		y	y	y	y	y	y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>×sturtii</i>								y		
Fabaceae	<i>Senna artemisioides</i> subsp. <i>filifolia</i>	y	y			y	y			y	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>petiolaris</i>	y	y	y	y	y	y		y	y	y
Fabaceae	<i>Senna artemisioides</i> subsp. <i>x artemisioides</i>		y			y		y		y	y
Fabaceae	<i>Senna cardiosperma</i>		y		y		y				y
Fabaceae	<i>Templetonia incrassata</i>	y					y		y		
Frankeniaceae	<i>Frankenia</i> sp.			y		y				y	
Goodeniaceae	<i>Scaevola spinescens</i>	y	y		y	y	y	y	y	y	
Lamiaceae	<i>Prostanthera althoferi</i> subsp. <i>althoferi</i>		y		y			y			
Lamiaceae	<i>Teucrium disjunctum</i>						y				y
Lamiaceae	<i>Westringia rigida</i>	y									
Malvaceae	<i>Brachychiton gregorii</i>		y		y			y		y	
Malvaceae	<i>Sida calyxhymenia</i>					y		y			
Myrtaceae	<i>Eucalyptus gracilis</i>		y								
Myrtaceae	<i>Eucalyptus lesouefii</i>	y	y			y	y			y	
Myrtaceae	<i>Eucalyptus loxophleba</i> subsp. <i>lissophloia</i>								y		
Myrtaceae	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>	y	y	y		y	y	y	y		y
Myrtaceae	<i>Eucalyptus salmonophloia</i>		y			y	y			y	
Myrtaceae	<i>Eucalyptus salubris</i>	y	y	y		y				y	
Myrtaceae	<i>Eucalyptus concinna</i>								y		
Myrtaceae	<i>Eucalyptus yilgarnensis</i>									y	
Myrtaceae	<i>Thryptomene eremaea</i>				y		y				

Family	Taxa	1a	1b	1c	1e	2a	2b	4b	4c	5b	6
Pittosporaceae	<i>Pittosporum angustifolium</i>								y	y	
Poaceae	<i>Austrostipa elegantissima</i>	y	y		y	y	y		y	y	
Poaceae	<i>Austrostipa scabra</i>								y		
Poaceae	<i>Triodia irritans</i>				y						
Proteaceae	<i>Grevillea acuaria</i>	y				y				y	
Proteaceae	<i>Grevillea nematophylla</i> subsp. <i>nematophylla</i>		y								
Proteaceae	<i>Grevillea stenobotrya</i>	y									
Proteaceae	<i>Hakea preissii</i>		y						y		
Rubiaceae	<i>Psydrax suaveolens</i>	y							y	y	
Rutaceae	<i>Philotheca brucei</i> subsp. <i>brucei</i>	y									
Santalaceae	<i>Exocarpos aphyllus</i>	y		y			y		y	y	
Santalaceae	<i>Santalum acuminatum</i>			y		y				y	
Santalaceae	<i>Santalum spicatum</i>	y	y		y	y	y	y	y	y	
Sapindaceae	<i>Alectryon oleifolius</i>		y			y	y		y	y	
Sapindaceae	<i>Dodonaea lobulata</i>	y	y		y	y	y		y	y	y
Sapindaceae	<i>Dodonaea rigida</i>	y	y		y	y		y			
Sapindaceae	<i>Dodonaea stenozyga</i>	y									
Scrophulariaceae	<i>Eremophila alternifolia</i>						y		y		
Scrophulariaceae	<i>Eremophila caperata</i>			y							
Scrophulariaceae	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>	y	y			y	y		y	y	y
Scrophulariaceae	<i>Eremophila eriocalyx</i>					y					
Scrophulariaceae	<i>Eremophila georgei</i>	y	y		y	y	y	y	y	y	y
Scrophulariaceae	<i>Eremophila glabra</i> subsp. <i>glabra</i>		y								
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	y	y		y	y	y	y	y		
Scrophulariaceae	<i>Eremophila longifolia</i>					y	y			y	
Scrophulariaceae	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>	y	y	y	y	y	y	y	y	y	y
Scrophulariaceae	<i>Eremophila oppositifolia</i> subsp. <i>angustifolia</i>	y	y			y				y	
Scrophulariaceae	<i>Eremophila parvifolia</i> subsp. <i>auricampa</i>	y	y	y		y					
Scrophulariaceae	<i>Eremophila pustulata</i>	y		y							
Scrophulariaceae	<i>Eremophila scoparia</i>	y	y	y		y	y		y	y	y
Scrophulariaceae	<i>Eremophila</i> sp. Plumridge Lakes (S.G.M. Carr 534)			y				y		y	
Solanaceae	<i>Solanum lasiophyllum</i>	y	y	y	y	y	y	y	y	y	
Violaceae	<i>Hybanthus floribundus</i> subsp. <i>curvifolius</i>				y						

Fauna

Survey results

Four reptiles and fifteen mammals were recorded during this survey. Of the mammals six were introduced species. Twenty-six species of bird were recorded (Attachment 7).

Conservation significant fauna

Malleefowl

Malleefowl have been long-term breeding residents in the Relief Hill area as evidenced by old and new mounds. Vegetation associations with sparse through to dense acacia on loam and gravelly hills were present – providing suitable habitat for this species. Two fresh (i.e. active at the time of the site inspection) mounds found by a limited survey effort (level 1 and few days), suggests the likelihood of many more in the proposed project area.



Figure 8: Recently active Malleefowl mound at 441659E, 6664603N

All Malleefowl mounds are of interest; not just active mounds containing eggs. Well-established, recently used and those mounds used over an extended period of time should all be considered important and included in the impact assessment, as loss of such mounds can adversely affect the local Malleefowl population. Similarly, where significant mounds exist, the surrounding habitat must be considered important in terms of impact assessment for the species given their decline over the recent few decades. However, active and closed mounds should be actively protected until the chicks have hatched and dispersed.

Peregrine Falcon

Peregrine Falcon were not observed but are a widespread species and considered likely to be a regular visitor if not resident. It could also breed in tall eucalypts in the area, probably by utilising old nests of the Australian Raven which were observed during this assessment.

Rainbow Bee-eater.

This species is only considered of local significance but was formerly listed as Migratory under legislation. It is still considered locally significant as it is a true migrant and breeds in burrows in the area, making it vulnerable to disturbance and predation. It will also often nest along tracks, increasing its vulnerability. No nests were observed however this species is a likely visitor.

Hydrological summary

The survey landscape mainly drains via overland flow to broad drainage tracts (land unit 6) which flow indeterminately into Lake Rebecca.

ASSESSMENT IN RELATION TO CLEARING PRINCIPLES

Results of this survey are used to assess clearing within the survey area in relation to ten clearing principles prescribed in Schedule 5 under amendments in 2004 to the Environmental Protection Act (1986):

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

The survey area is in the south-east of Eastern Murchison (MUR 1) bio-geographic subregion and adjacent to Shield and Eastern Goldfields bio-geographic sub-regions. Lake Ballard/Lake Rebecca form a major vegetation divide with characteristic *Acacia aneura* (mulga) low woodlands associated with red loams over siliceous hard pan to the north and low woodlands of mixed mulga and casuarina (black oak) and *Eucalyptus* species on alkaline and calcareous soils to the south. The survey area straddles this vegetation divide.

Beard Vegetation Association 529 (Succulent steppe with open low woodland; mulga and sheoak over salt bush) is the most common vegetation association in the survey area occupying 69%. Vegetation Association 24 (Low woodland; *Casuarina obesa*) occupies 28% and the remaining 3% is Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.) (Beard 1976).

Ninety-nine flora taxa representing 22 families were found during the reconnaissance survey (Table 7). Chenopodiaceae accounted for 19 taxa, Fabaceae 24 taxa and Scrophulariaceae 16 taxa.

Vegetation associations and species composition are typical of the area and are not unusually diverse.

Proposal is not at variance to this principle.

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

Malleefowl are active in the survey area. Malleefowl mounds are of importance for the birds, whether or not they are active or recently-used, while active mounds (containing eggs) are of special value.

Large Eucalypt trees, common in land unit 5b, may support nesting by the Peregrine Falcon (and other birds).

Proposal is at variance to this principle**(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**

No listed species of rare or critically endangered flora were found during this survey.

A search of the Department of Environment and Conservation's Rare and Priority Flora Database revealed no records of Declared Rare Flora (DRF) in or nearby the survey area.

The proposal is not at variance to this principle.**(d) Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a threatened ecological community.**

There are no Threatened Ecological Communities (TECs) within the north east Goldfields subregion (Cowan, 2001).

There are no Priority Ecological Communities within or adjacent to the survey area.

Several populations, each with scores of individuals, of *Thryptomene eremaea*, a Priority 2 taxa, were found mostly confined to Land Unit 1e (Upland basalt surfaces).

The proposal is likely to be at variance to this principle.**(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.**

Beard Vegetation Association 529 (Succulent steppe with open low woodland; mulga and sheoak over salt bush) is the most common vegetation association in the survey area occupying 69%. Vegetation Association 24 (Low woodland; *Casuarina obesa*) occupies 28% and the remaining 3% is Association 20 (Low woodland: mulga mixed with *Casuarina obesa* and *Eucalyptus* spp.) (Beard 1976).

Vegetation Association 20 occupies approximately 13,000 km² in Western Australia of which 16.7% is within conservation reserves and although less than 1% of Vegetation Association 24, which occupies approximately 266 km² in Western Australia, is within reserves, both have a low priority for conservation (Table 1). Vegetation Association 529 is very poorly conserved and has a high priority for conservation.

Vegetation Association 529 has not been extensively cleared and clearing within this survey area will have minimal effect on extent of this vegetation community.

Proposal is not at variance to this principle.**(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.**

The survey landscape mainly drains via overland flow through drainage tracts (land unit 6) into Lake Rebecca 5 km to the north. Lake Rebecca is a major wetland with local and regional significance.

Proposal maybe at variance with this principle.

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

The survey area has been disturbed by recent mining activity, is mostly within a pastoral lease and has been grazed. Vehicle tracks and pastoral fences cross the area.

Land units supporting chenopod vegetation, preferentially grazed by livestock, are mostly degraded and few areas are in good condition. Hills on laterite and basalt geology are mostly in good to excellent condition while lower slopes on basalt are often in poorer condition.

Minor to moderate soil erosion is evident on felsic footslopes, calcareous and alluvial plains (land units 1c, 4c and 5b) and these land units are rated as slightly to moderately vulnerable to erosion. Other land units are mostly rated nil or slightly vulnerable to soil erosion and some areas on these units are slightly eroded.

Extensive clearing within land units 4c and 5b is likely to lead to further soil erosion. Limited strip clearing is unlikely to cause extensive land degradation.

Water tables are a) below the rooting depth of vegetation growing in these areas and b) mostly hypersaline. Extensive clearing of vegetation at catchment-scale or artificial recharge of the water table may raise saline water tables and lead to secondary salinity in surrounding landscapes.

Clearing of vegetation at local scales will have minimal, if any, effect on water tables and associated risk of secondary salinity.

Proposal is unlikely to be at variance to this principle.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

No conservation areas are nearby.

Proposal is not at variance to this principle.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Minor to moderate soil erosion is evident on felsic footslopes, calcareous and alluvial plains (land units 1c, 4c and 5b) and these land units are rated as slightly to moderately susceptible to erosion. Disturbance to these land units has the potential to increase

sediment discharge to drainage tracts and ultimately, and through extreme events, to Lake Rebecca.

Proposal maybe at variance with this principle.

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

The climate is arid to semi-arid with about 230 mm of annual rainfall. Rain falls on an average of 43 days a year.

Most rainfall events will cause little runoff, however extreme rainfall events such as those recorded in summers of 1984 and 1967, will result in runoff.

Clearing in this proposal will have negligible effect on the volume of runoff discharged.

Proposal is unlikely to be at variance with this principle.

DISCUSSION AND RECOMMENDATIONS

Saracen operates the Carosue Gold Mine and is proposing extensive exploration around its existing mine. This environmental assessment covers 2080ha approximately 6km east of Carosue Dam Operations in the Relief hill area. Adjoining areas to the west have been covered by earlier environmental assessments.

Flora composition and vegetation associations are typical of the region and not considered unusually diverse. There are no Threatened Ecological Communities (TECs) and no Priority Ecological Communities within or adjacent to the survey area.

No listed species of rare or critically endangered flora were found during this survey and no records of Declared Rare Flora (DRF) found in or nearby the survey area. Several populations, each with scores of individuals, of *Thryptomene eremaea*, a Priority 2 taxa, were found mostly confined to Land Unit 1e (Upland basalt surfaces).

No alien to Western Australia (weed) species were located during survey.

The survey landscape mainly drains via overland flow to drainage tracts (land unit 6) which flow into Lake Rebecca. Lake Rebecca is a major wetland with local and regional significance.

Chenopod shrublands occur on approximately 20% of the area either on calcareous plains (land unit 4c) or alluvial plains (land unit 5b) where soil erosion is evident. These systems support PXHS vegetation community (Plain mixed halophyte low shrublands) and PECW (Plain eucalypt chenopod woodland) which are degraded through over grazing. Disturbance to land units 4c and 5b has the potential to increase sediment discharge to drainage tracts and ultimately, and through extreme events, to Lake Rebecca.

Malleefowl are active in the survey area. Malleefowl mounds are of importance for the birds, whether or not they are active or recently-used. Malleefowl mounds are active from about May to December and depending on rainfall into January. Active mounds containing eggs are of special value.

Large Eucalypt trees, common in land unit 5b, may support nesting by the Peregrine Falcon (and other birds).

It is recommended that, in planning and implementing seismic operations within the survey area, the proponent:

- 1. Avoids disturbance to land unit 1e (Upland basalt surfaces) preferred habitat for *Thryptomene eremaea* a Priority 2 taxa.**
- 2. Undertakes a Malleefowl survey especially within land units 1a, 2a and 4b and avoids disturbance within 50m of active Malleefowl nests during nesting and incubation.**

- 3. Avoids destruction of mature Eucalyptus trees with nesting hollows**
- 4. Old trees, dead trees, fallen logs and termite mounds should be “gently” tipped over and left overnight to allow fauna to disperse**
- 5. Takes measures to minimise erosion through soil disturbance and concentration of overland water flows on vulnerable land units, especially calcareous plains (land unit 4c) and alluvial plains (land unit 5b).**
- 6. Avoids disturbance to drainage channels (land unit 6).**

REFERENCES

- Alexander Holm & Associates (2010). Environmental assessment: Proposed expansion of Whirling Dervish mine. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 45.
- Alexander Holm & Associates (2012a). Environmental assessment: Montys' dewatering pipeline to Lake Rebecca. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 100.
- Alexander Holm & Associates (2012b). Environmental assessment: Old Plough Dam. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 96.
- Alexander Holm & Associates (2012c). Environmental assessment: Pinnacles. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 82.
- Alexander Holm & Associates (2012d). Environmental assessment: Tailings storage facility expansion. Perth, Western Australia, Unpublished report for Saracen Gold Mines: 81.
- Alexander Holm & Associates (2019). Environmental assessment: Proposed Seismic Survey Perth, Western Australia, Unpublished report for Saracen Gold Mines: 136.
- Beard, J. S. (1976). Vegetation Survey of Western Australia - Sheet 6. Murchison. Nedlands, Western Australia, University of Western Australia Press.
- Cowan, M. (2001). Murchison 1 (MUR1 - East Murchison subregion). A biodiversity audit of Western Australia's 53 biogeographical subregions in 2002. N. L. McKenzie and J. E. May. Perth, The Department of Conservation and Land Management: 466-479.
- Desmond, A., M. Cowan and A. Chant (2003). Murchison 2 (MUR2 - Western Murchison subregion). A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. N. L. McKenzie and J. E. May. Perth The Department of Conservation and Land Management: 480-496.
- Environmental Protection Authority (2016). Technical guidance. Flora and Vegetation Surveys for Environmental Impact Assessment. Perth Western Australia: 42.
- Mitchell, A. A. and D. G. Wilcox (1994). Arid Shrubland Plants of Western Australia. Perth, University of Western Australia Press.
- Payne, A. L., A. M. E. Van Vreeswyk, H. J. R. Pringle, K. A. Leighton and P. Hennig (1998). An inventory and condition survey of the Sandstone-Yalgoo- Paynes Find area, Western Australia. South Perth, Agriculture Western Australia: 372.

Disclaimer

While Alexander Holm & Associates has carried out some enquiries concerning data, assumptions and information supplied to it, those enquiries were limited and Alexander Holm & Associates does not accept responsibility for their accuracy. Accordingly, Alexander Holm & Associates does not accept any legal responsibility to any person, organisation or company for any loss or damage suffered by them resulting from their use of the report however caused, and whether by breach of contract, negligence or otherwise

Within the limitation imposed by the scope of review, the data assessment and preparation of the report have been undertaken in a professional manner and in accordance with generally accepted practices using a degree of care ordinarily exercised by professional environmental consultants. No other warranty, expressed or implied, is made.

ATTACHMENTS

Attachment 1: ‘NatureMap’ report

NatureMap Species Report

Created By Guest user on 16/12/2019

Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)

Current Names Only Yes

Core Datasets Only Yes

Method 'By Circle'

Centre 122° 25' 17" E, 30° 08' 47" S

Buffer 40km

Group By Kingdom

Kingdom	Species	Records
Animalia	1	56
Plantae	2	4
TOTAL	3	60

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Animalia				
1.	24557 <i>Leipoa ocellata</i> (Malleefowl)		T	
Plantae				
2.	5746 <i>Eucalyptus pimpleiniana</i>		P3	
3.	19695 <i>Thryptomene eremaea</i>		P2	

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Attachment 2: ‘Protected matters’ search tool output



EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 16/12/19 15:29:50

[Summary](#)

[Details](#)

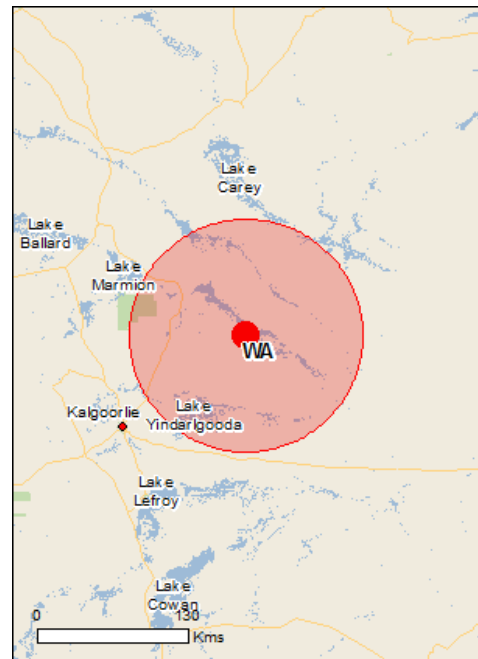
[Matters of NES](#)

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

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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

[Coordinates](#)

Buffer: 100.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	6
Regional Forest Agreements:	None
Invasive Species:	14
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat may occur within area
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat likely to occur within area
Plants		
Eucalyptus articulata Ponton Creek Mallee [56772]	Vulnerable	Species or species habitat likely to occur within area
Gastrolobium graniticum Granite Poison [14872]	Endangered	Species or species habitat likely to occur within area
Hibbertia crispula Oldea Guinea-flower [15222]	Vulnerable	Species or species habitat may occur within area
Tecticornia flabelliformis Bead Glasswort [82664]	Vulnerable	Species or species habitat known to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
habitat likely to occur within area		
Migratory Terrestrial Species		
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]	
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Bullock Holes Timber Reserve	WA
Cardunia Rocks	WA
Coonana Timber Reserve	WA
Goongarrie	WA
Queen Victoria Spring	WA
Wallaby Rocks Timber Reserve	WA

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants

Carrichtera annua Ward's Weed [9511]	Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]	Species or species habitat may occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Lake Marmion		WA

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-30.14649 122.42139

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.

Attachment 3: List of flora taxa found at each inventory site

Family	Taxa	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Amaranthaceae	<i>Ptilotus obovatus</i>	y	y	y	y	y	y		y	y		y	y	y	y	y
Apocynaceae	<i>Alyxia buxifolia</i>															y
Apocynaceae	<i>Marsdenia australis</i>		y				y					y				
Asteraceae	<i>Cratystylis microphylla</i>															
Asteraceae	<i>Olearia muelleri</i>			y	y	y	y		y	y		y	y			y
Asteraceae	<i>Podolepis capillaris</i>			y							y					
Casuarinaceae	<i>Casuarina pauper</i>			y	y	y	y	y	y	y	y	y	y	y	y	y
Chenopodiaceae	<i>Atriplex codonocarpa</i>															
Chenopodiaceae	<i>Atriplex stipitata</i>	y														
Chenopodiaceae	<i>Atriplex bunburyana</i>					y	y	y	y							y
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	y	y			y	y	y	y	y		y				y
Chenopodiaceae	<i>Atriplex vesicaria</i>															
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>															
Chenopodiaceae	<i>Enchylaena lanata</i>	y														
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>												y			
Chenopodiaceae	<i>Maireana georgei</i>					y		y	y				y			y
Chenopodiaceae	<i>Maireana integra</i>					y										
Chenopodiaceae	<i>Maireana pentatropis</i>					y						y	y			
Chenopodiaceae	<i>Maireana pyramidata</i>	y														
Chenopodiaceae	<i>Maireana sedifolia</i>	y			y	y	y	y	y	y						y
Chenopodiaceae	<i>Maireana tomentosa</i>															
Chenopodiaceae	<i>Maireana triptera</i>	y				y		y				y				
Chenopodiaceae	<i>Rhagodia drummondii</i>															
Chenopodiaceae	<i>Rhagodia eremaea</i>	y										y				
Chenopodiaceae	<i>Sclerolaena cuneata</i>	y														
Chenopodiaceae	<i>Sclerolaena diacantha</i>	y				y						y	y			y
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>					y			y							
Chenopodiaceae	<i>Tecticornia disarticulata</i>															
Fabaceae	<i>Acacia aptaneura</i>															
Fabaceae	<i>Acacia ayersiana</i>		y	y			y		y							
Fabaceae	<i>Acacia burkittii</i>	y	y		y		y	y	y		y			y		y
Fabaceae	<i>Acacia erinacea</i>											y	y			
Fabaceae	<i>Acacia hemiteles</i>	y			y	y	y	y	y	y					y	y
Fabaceae	<i>Acacia incurvaneura</i>										y					
Fabaceae	<i>Acacia kempeana</i>									y						
Fabaceae	<i>Acacia ligulata</i>		y			y	y	y	y	y						
Fabaceae	<i>Acacia nyssophylla</i>															
Fabaceae	<i>Acacia oswaldii</i>	y	y	y	y	y		y				y				y

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Family	Taxa	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Amaranthaceae	<i>Ptilotus obovatus</i>		y	y	y	y	y	y	y	y	y	y	y	y	y	y
Apocynaceae	<i>Alyxia buxifolia</i>	y														
Apocynaceae	<i>Marsdenia australis</i>				y											
Asteraceae	<i>Cratystylis microphylla</i>															y
Asteraceae	<i>Olearia muelleri</i>	y	y		y		y	y	y	y	y	y	y	y		y
Asteraceae	<i>Podolepis capillaris</i>															
Casuarinaceae	<i>Casuarina pauper</i>	y	y		y	y	y		y	y	y	y	y	y		
Chenopodiaceae	<i>Atriplex codonocarpa</i>															
Chenopodiaceae	<i>Atriplex stipitata</i>															
Chenopodiaceae	<i>Atriplex bunburyana</i>				y									y	y	
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>										y			y	y	
Chenopodiaceae	<i>Atriplex vesicaria</i>				y						y			y	y	
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>										y					
Chenopodiaceae	<i>Enchylaena lanata</i>															
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>				y						y				y	
Chenopodiaceae	<i>Maireana georgei</i>				y						y				y	
Chenopodiaceae	<i>Maireana integra</i>														y	
Chenopodiaceae	<i>Maireana pentatropis</i>				y											
Chenopodiaceae	<i>Maireana pyramidata</i>				y						y			y	y	
Chenopodiaceae	<i>Maireana sedifolia</i>				y						y			y	y	
Chenopodiaceae	<i>Maireana tomentosa</i>										y			y	y	
Chenopodiaceae	<i>Maireana triptera</i>				y						y			y	y	
Chenopodiaceae	<i>Rhagodia drummondii</i>															
Chenopodiaceae	<i>Rhagodia eremaea</i>															
Chenopodiaceae	<i>Sclerolaena cuneata</i>															
Chenopodiaceae	<i>Sclerolaena diacantha</i>				y	y					y			y	y	
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>				y						y				y	
Chenopodiaceae	<i>Tecticornia disarticulata</i>															
Fabaceae	<i>Acacia aptaneura</i>															
Fabaceae	<i>Acacia ayersiana</i>											y				
Fabaceae	<i>Acacia burkittii</i>	y	y	y	y	y		y						y		
Fabaceae	<i>Acacia erinacea</i>	y				y	y	y			y	y	y	y	y	y
Fabaceae	<i>Acacia hemiteles</i>	y	y		y										y	
Fabaceae	<i>Acacia incurvaneura</i>											y				
Fabaceae	<i>Acacia kempeana</i>															
Fabaceae	<i>Acacia ligulata</i>	y		y				y			y	y	y	y	y	
Fabaceae	<i>Acacia nyssophylla</i>	y						y	y							
Fabaceae	<i>Acacia oswaldii</i>	y					y		y				y			

[illegible]

[illegible]

Family	Taxa	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Amaranthaceae	<i>Ptilotus obovatus</i>	y		y	y	y	y	y			y		y		y	y
Apocynaceae	<i>Alyxia buxifolia</i>	y			y											
Apocynaceae	<i>Marsdenia australis</i>															
Asteraceae	<i>Cratystylis microphylla</i>															
Asteraceae	<i>Olearia muelleri</i>	y			y			y				y				
Asteraceae	<i>Podolepis capillaris</i>															
Casuarinaceae	<i>Casuarina pauper</i>	y	y	y	y	y	y	y			y	y	y			
Chenopodiaceae	<i>Atriplex codonocarpa</i>															y
Chenopodiaceae	<i>Atriplex stipitata</i>															
Chenopodiaceae	<i>Atriplex bunburyana</i>		y	y										y		y
Chenopodiaceae	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>		y													
Chenopodiaceae	<i>Atriplex vesicaria</i>		y													y
Chenopodiaceae	<i>Chenopodium gaudichaudianum</i>															
Chenopodiaceae	<i>Enchylaena lanata</i>															
Chenopodiaceae	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>		y											y		y
Chenopodiaceae	<i>Maireana georgei</i>		y													
Chenopodiaceae	<i>Maireana integra</i>															
Chenopodiaceae	<i>Maireana pentatropis</i>			y										y		
Chenopodiaceae	<i>Maireana pyramidata</i>		y													
Chenopodiaceae	<i>Maireana sedifolia</i>						y									
Chenopodiaceae	<i>Maireana tomentosa</i>		y											y		y
Chenopodiaceae	<i>Maireana triptera</i>		y											y		y
Chenopodiaceae	<i>Rhagodia drummondii</i>		y													
Chenopodiaceae	<i>Rhagodia eremaea</i>		y													
Chenopodiaceae	<i>Sclerolaena cuneata</i>		y													
Chenopodiaceae	<i>Sclerolaena diacantha</i>		y				y							y		y
Chenopodiaceae	<i>Sclerolaena obliquicuspis</i>															
Chenopodiaceae	<i>Tecticornia disarticulata</i>															
Fabaceae	<i>Acacia aptaneura</i>															
Fabaceae	<i>Acacia ayersiana</i>								y	y	y	y				
Fabaceae	<i>Acacia burkittii</i>		y	y	y	y	y	y				y		y		y
Fabaceae	<i>Acacia erinacea</i>	y		y	y									y	y	
Fabaceae	<i>Acacia hemiteles</i>		y								y					
Fabaceae	<i>Acacia incurvaneura</i>								y	y	y	y				
Fabaceae	<i>Acacia kempeana</i>															
Fabaceae	<i>Acacia ligulata</i>		y	y	y	y									y	
Fabaceae	<i>Acacia nyssophylla</i>				y											
Fabaceae	<i>Acacia oswaldii</i>		y		y	y						y				

[illegible]

[illegible]

[illegible]

[illegible]

Attachment 4: Inventory site data on landform, soil type and erosion.

Land unit	Site	Landsystem	Geology	Land Code*	Land form	Slope %	Relief m	Soil texture A horizon	Soil texture Subsoil	Acid reaction	Erosion
1a	RH03	Leonora	Czu	HIL	Hillock	3	10	Sandy loam		no	Nil
1a	RH20	Leonora	Ab	HIL	Hillock	3	10	Sandy loam		no	Nil
1a	RH28	Gunadocketa	Czc	HIL	Mid slope	6	15	Sandy loam		no	Nil
1a	RH37	Moriarty	Czl	PGS	Crest	2	15	Sandy clay loam		yes	Nil
1a	RH38	Moriarty	Czc	PGS	Mid slope	4	10	Sandy clay loam		yes	Moderate
1a	RH41	Moriarty	Czl	PGS	Crest	1	18	Sandy loam		yes	Nil
1a	RH42	Moriarty	Czl	HIL	Crest	1	5	Sandy clay loam		no	Nil
1a	RH45	Moriarty	Czu	PGS	Upper slope	2	2	Sandy clay loam	Light clay	yes	Moderate
1a	RH46	Moriarty	Czu	PGS	Mid slope	8	10	Sandy clay loam		yes	Minor
1a	RH63	Moriarty	Czl	HIL	Upper slope	4	4	Sandy loam		no	Nil
1b	RH11	Leonora	Ab	PGS	Mid slope	3	3	Sandy clay loam		yes	Nil
1b	RH12	Leonora	Ab	PGS	Lower slope	12		Sandy loam		yes	Nil
1b	RH13	Leonora	Abp	HIL	Mid slope	9	9	Sandy clay loam		no	Minor
1b	RH14	Leonora	Ab	PGS	Mid slope	5	5	Sandy loam		yes	Nil
1b	RH18	Leonora	Aur	PGS	Mid slope	5	5	Sandy clay loam		yes	Minor
1b	Rh24	Leonora	Ab	PGS	Mid slope	2	4	Sandy clay loam		no	Nil
1b	RH27	Leonora	Ab	PGS	Crest	10	50	Sandy clay loam		no	Nil
1b	RH32	Leonora	Ab	PGS	Upper slope	3	20	Sandy loam		yes	Minor
1b	RH35	Leonora	Ab	PGS	Upper slope	8	18	Sandy clay loam		no	Nil
1b	RH48	Leonora	Aur	FOO	Lower slope	8	10	Sandy clay loam		yes	Moderate
1b	RH49	Leonora	Aur	PGS	Crest	2	20	Sandy loam		yes	Nil
1b	RH50	Leonora	Apq	PGS	Upper slope	9	20	Sandy clay loam		yes	Nil
1b	RH51	Leonora	Aur	PGS	Mid slope	7	8	Sandy loam		yes	Nil
1b	RH56	Moriarty	Czl	HIL	Upper slope	4	8	Sandy loam		no	Nil
1b	RH64	Leonora	Aur	PGS	Crest	3	15	Sandy clay loam		yes	Nil
1b	RH65	Leonora	Ab	HIL	Crest	3	12	Sandy clay loam		no	Nil
1b	RH66	Leonora	Aus	HIL	Upper slope	5	10	Sandy clay loam		no	Nil
1c	RH58	Moriarty	ASF	PGS	Mid slope	4	6	Sandy loam	Light clay	no	Moderate
1c	RH62	Moriarty	ASF	FOO	Lower slope	2	3	Light clay		no	Minor

Land unit	Site	Landsystem	Geology	Land Code*	Land form	Slope %	Relief m	Soil texture A horizon	Soil texture Subsoil	Acid reaction	Erosion
1e	RH10	Leonora	Ab	HIL	Upper slope	4	4	Sandy loam		no	Nil
1e	RH19	Leonora	Ab	HIL	Hillock	15	25	Sandy clay loam		no	Nil
1e	RH26	Leonora	Ab	HIL	Mid slope	8	16	Sandy clay loam		no	Nil
2a	RH04	Gunadocketa	Czl	PGS	Hillock	2	2	Sandy loam		yes	Nil
2a	RH06	Gunadocketa	Czc	PGS	Mid slope	2	2	Sandy loam		yes	Nil
2a	RH09	Gunadocketa	Czc	PLC	Flat	<1		Sandy clay loam		yes	Nil
2a	RH39	Moriarty	CZu	PGS	Mid slope	4	8	Sandy clay loam	Light clay	yes	Nil
2a	RH43	Moriarty	Czc	FOO	Lower slope	3	4	Sandy loam	Light clay	yes	Minor
2a	RH52	Deadman	Czl	PGS	Mid slope	2	3	Sandy clay loam		yes	Minor
2a	RH57	Moriarty	ASF	HIL	Mid slope	2	4	Sandy loam		no	Nil
2b	RH02	Moriarty	Ab	PGS	Lower slope	2	2	Sandy clay loam		yes	Minor
2b	RH05	Leonora	Ab	PGS	Lower slope	2	2	Sandy loam		yes	Minor
2b	RH15	Leonora	Ab	PGS	Lower slope	2	2	Loamy sand		yes	Minor
2b	RH17	Moriarty	Aus	PGS	Lower slope	2	2	Sandy clay loam	Light clay	yes	Minor
2b	RH31	Gunadocketa	Czc	FOO	Lower slope	2	5	Sandy clay loam		yes	Minor
2b	RH33	Gunadocketa	Czc	PLC	Flat	1	1	Light clay		yes	Nil
2b	RH36	Leonora	Ab	PGS	Mid slope	3	10	Sandy clay loam		yes	Nil
2b	RH59	Leonora	AUR	PGS	Upper slope	6	10	Sandy loam		yes	Minor
4b	RH53	Deadman	Czl	PLO	Flat	1	1	Sandy loam		no	Nil
4b	RH54	Deadman	Czl	PLO	Flat	1	1	Sandy loam		no	Nil
4b	RH55	Deadman	Czl	PLO	Flat	1	1	Sandy clay loam		no	Nil
4c	RH21	Gunadocketa	Czc	PLC	Flat	2	4	Sandy clay loam	Light clay	yes	Moderate
4c	RH22	Gunadocketa	CZC	PLO	Flat	10	1	Sandy clay loam	Light clay	no	Moderate
4c	RH23	Gunadocketa	CZC	PLC	Flat	1	1	Light clay		yes	Minor
4c	RH25	Gunadocketa	Czc	PLO?	Flat	<1	1	Sandy loam	Light clay	no	Moderate
4c	RH34	Gunadocketa	Czc	PLC	Flat	2	2	Sandy clay loam	Light clay	yes	Moderate
5b	RH01	Moriarty	Czc	PLA	Alluvial plain	1	1	Sandy clay loam	Light clay	yes	Minor
5b	RH07	Gunadocketa	Czc	PLA	Alluvial plain	1	1	Sandy clay loam		yes	Nil
5b	RH08	Gunadocketa	Czc	PLA	Alluvial plain	1		Sandy loam	Sandy clay loam	No	Moderate
5b	RH16	Moriarty	Czc	PLA	Alluvial plain	1	1	Sandy loam	Light clay	yes	Minor

Land unit	Site	Landsystem	Geology	Land Code*	Land form	Slope %	Relief m	Soil texture A horizon	Soil texture Subsoil	Acid reaction	Erosion
5b?	RH40	Moriarty	Czc	FOO	Lower slope	2	4	Light clay		yes	Minor
5b	RH44	Moriarty	Czc	PLA	Alluvial plain	1	2	Sandy clay loam	Light clay	yes	Minor
5b	RH47	Moriarty	Czc	PLA	Alluvial plain	2	3	Sandy clay loam	Light clay	no	Moderate
5b	RH60	Moriarty	Czc	PLA	Alluvial plain	1	1	Light clay		no	Moderate
5b	RH61	Moriarty	Czc	PLA	Alluvial plain	1	1	Light clay		yes	Nil
5b	RH67	Moriarty	Czc	PLA	Alluvial plain	1	1	Light clay		yes	Moderate
5b	RH68	Moriarty	Czc	PLA	Alluvial plain	0	0	Light clay		no	Nil
6	RH29	Gunadocketa	Qa	DRN	Drainage	1	1	Loamy sand	Sandy loam	no	Minor
6	RH30	Gunadocketa	Qa	DRN	Drainage	1	1	Sandy loam	Sandy clay loam	yes	Minor

* Land code: DRN: Drainage tracts; FOO: Footslopes; HIL: Hills; PGS: Saline stony slopes; PLA: Saline alluvial plains; PLC: Plains with underlying calcrete; PLO: Loamy plains.

Attachment 5: Inventory site data on dominant flora vegetation cover and condition.

Land unit	Site	Vegetation type	Beard code	Upper stratum		Mid stratum		Lower stratum		Total cover %	Vegetation condition
				Cover %	Dominant	Cover %	Dominant	Cover %	Dominant		
1a	RH03	SIAS	529	5	caspau*	10	dodrig			15	Excellent
1a	RH20	SIAS	529	1	caspau	10	acacia sp	1	ptiobo	10	Excellent
1a	RH28	SIAS	529	2	caspau	15	acacia sp	3	ptiobo	20	Excellent
1a	RH37	SIAS	529	2	eucles	15	acalig	1	ptiobo	15	Good
1a	RH38	SIAS	529	3	eucole	10	acacia sp	1	olemue	15	Good
1a	RH41	SIAS	24	3	eucles	15	acacia sp			20	Excellent
1a	RH42	SIMS	24	3	eucles	15	acasto			20	Fair
1a	RH45	BXSW	24	15	eucles	10	erepus			25	Good
1a	RH46	BXSW	24	5	eucles	5	acacia sp	5	erepav	15	Good
1a	RH63	SIAS	24	1	caspau	3	acacia sp	1	ptiobo	5	Excellent
1b	RH11	GHAS	529	2	caspau	10	eresco	2	ptiobo	15	Excellent
1b	RH12	GNEW	529	10	eucles	2	eresco			10	Excellent
1b	RH13	GHAS	529	1	caspau	40	acaqua			40	Excellent
1b	RH14	GHAS	529	2	caspau	25	acacia sp	3	ptiobo	30	Excellent
1b	RH18	GHMW	529	2	caspau	20	eresco	2	ptiobo	25	Excellent
1b	Rh24	GHAS	529	1	caspau	20	acacia sp	1	ptiobo	20	Good
1b	RH27	GHMW	529	2	caspau	10	eresco	2	ptiobo	15	Excellent
1b	RH32	GHMW	529	1	caspau	20	acacia sp	2	ptiobo	20	Excellent
1b	RH35	GHMW	529	2	caspau	20	dodlob	2	ptiobo	25	Excellent
1b	RH48	GNEW	24	5	eucles	5	eresco	1	erepav	10	Fair
1b	RH49	GHMW	24	2	caspau	20	acalig	1	ptiobo	25	Good
1b	RH50	GHMW	24	1	caspau	25	dodlob	5	ptiobo	30	Excellent
1b	RH51	GHMW	24	1	eucsalub	15	dodlob	1	ptiobo	15	Good
1b	RH56	GHMW	24	2	caspau	15	scvspi	1	ptiobo	20	Excellent
1b	RH64	GHMW	529	2	caspau	15	eresco	2	ptiobo	20	Excellent
1b	RH65	GHAS	529	1	caspau	10	acacia sp	1	podcan	10	Excellent
1b	RH66	GHAS	529	1	acaincur	10	acacia sp	5	podcan	15	Excellent
1c	RH58	BECW	24	5	eucsalub	5	eresco	5	atrbus	15	Good
1c	RH62	BECW	24	2	eucsalub	3	eresco	5	atrves	10	Good

Land unit	Site	Vegetation type	Beard code	Upper stratum		Mid stratum		Lower stratum		Total cover %	Vegetation condition
				Cover %	Dominant	Cover %	Dominant	Cover %	Dominant		
1e	RH10	GHMW	529	1	caspau	4	acaqua	5	thryptere	10	Excellent
1e	RH19	GHMW	529			1	acaqua	10	thryptere	10	Excellent
1e	RH26	GHMW	529			5	acacia sp	5	thryptere	10	Excellent
2a	RH04	SIAS	529	2	caspau	10	snnfil	2	ptiobo	15	Good
2a	RH06	SIAS	529	5	caspau	10	acahem	1	ptiobo	15	Excellent
2a	RH09	CCAS	529	5	caspau	10	dodlob	1	ptiobo	15	Good
2a	RH39	GEHS	24	10	eucles	5	eresco			15	Excellent
2a	RH43	PEXW	529	1	caspau	10	atrum	1	atrabun	10	Fair
2a	RH52	SIAS	20	3	caspau	15	dodlob	1	ptiobo	20	Excellent
2a	RH57	SIAS	24	1	eucles	10	acacia sp			10	Good
2b	RH02	GHAS	529	1	eucsalmon	30	acabur	1	ptiobo	30	Fair
2b	RH05	GHAS	529	3	caspau	20	acahem	2	ptiobo	25	Good
2b	RH15	GHMW	529	2	caspau	10	eresco	1	ptiobo	15	Degraded
2b	RH17	GHAS	529	1	acaincur	25	acabur			25	Degraded
2b	RH31	GHMW	529	2	caspau	20	snnpet			20	Fair
2b	RH33	CCAS	529	5	caspau	15	acalig			20	Good
2b	RH36	GHMW	529	2	caspau	10	snnpet	2	ptiobo	15	Excellent
2b	RH59	GHMW	24	20	eucles	10	acalig			25	Fair
4b	RH53	HCAS	20	1	acaincur	10	acaram			10	Good
4b	RH54	PLMS	20	1	acaincur	25	acaram			25	Excellent
4b	RH55	PLMS	24	2	eucole	20	acaincur			20	Excellent
4c	RH21	PXHS	529	1	caspau	10	dodlob	10	maised	20	Fair
4c	RH22	PXHS	529	2	caspau	10	eresco	15	maised	25	Fair
4c	RH23	PXHS	529	2	caspau	5	dodlob	5	maised	15	Fair
4c	RH25	PXHS	529	1	caspau	10	dodlob	5	maised	15	Degraded
4c	RH34	PXHS	529	2	caspau	20	eresco	1	ptiobo	20	Degraded
5b	RH01	PECW	529	2	eucsalub	15	eresco	2	atrsti	20	Fair
5b	RH07	PXHS	529	5	caspau	15	acalig	1	atrbun	20	Degraded
5b	RH08	PECW	529	4	caspau	15	snnpet	2	ptiobo	20	Degraded

Land unit	Site	Vegetation type	Beard code	Upper stratum		Mid stratum		Lower stratum		Total cover %	Vegetation condition
				Cover %	Dominant	Cover %	Dominant	Cover %	Dominant		
5b	RH16	PESW	529	2	eucsalmon	1	atnum	20	atrves	20	Good
5b	RH40	PEEW	24	3	eucsalmon	10	eresco	1	atrves	15	Fair
5b	RH44	PESW	529	5	eucsalmon	20	atnum	1	atrves	25	Good
5b	RH47	PECW	24	2	eucsalmon	3	eresco	15	maipyr	20	Fair
5b	RH60	PESW	24	5	eucsalub			15	atrves	20	Fair
5b	RH61	PESW	24	5	eucsalub	1	eresco	25	atrves	30	Excellent
5b	RH67	PESW	529	2	eucsalub	2	eresco	15	atrves	20	Fair
5b	RH68	PDFT	529	5	eucsalub	90	acabur			90	Excellent
6	RH29	DRAS	529	2	eucole	40	acabur			40	Good
6	RH30	DRAS	529	5	eucole	10	acacia sp	1	ptiobo	15	Fair

*see table below for taxa

Field code	Taxa
acaaye	<i>Acacia ayersiana</i>
acabur	<i>Acacia burkittii</i>
acacia sp	<i>Acacia</i> sp
acaeri	<i>Acacia erinacea</i>
acahem	<i>Acacia hemiteles</i>
acaincur	<i>Acacia incurvaneura</i>
acalig	<i>Acacia ligulata</i>
acaosw	<i>Acacia oswaldii</i>
acaqua	<i>Acacia quadrimarginea</i>
acaram	<i>Acacia ramulosa</i> var. <i>linophylla</i>
acasto	<i>Acacia sibirica</i>
atrbun	<i>Atriplex bunburyana</i>
atrnum	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>
atrsti	<i>Atriplex stipitata</i>
atrves	<i>Atriplex vesicaria</i>
caspau	<i>Casuarina pauper</i>
dodlob	<i>Dodonaea lobulata</i>
dodrig	<i>Dodonaea rigida</i>
dodste	<i>Dodonaea stenozyga</i>
dodvis	<i>Dodonaea viscosa</i>
erelat	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>
ereold	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>
erepav	<i>Eremophila parvifolia</i> subsp. <i>auricampa</i>
erepus	<i>Eremophila pustulata</i>
eresco	<i>Eremophila scoparia</i>
eucgra	<i>Eucalyptus gracilis</i>
eucles	<i>Eucalyptus lesouefii</i>
eucole	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>
eucsalmon	<i>Eucalyptus salmonophloia</i>
eucsalub	<i>Eucalyptus salubris</i>
frank	<i>Frankenia</i> sp
greacu	<i>Grevillea acuarina</i>
maipyr	<i>Maireana pyramidata</i>
maised	<i>Maireana sedifolia</i>
maised	<i>Maireana sedifolia</i>
maitrip	<i>Maireana triptera</i>
olemue	<i>Olearia muelleri</i>
phibru	<i>Philotheca brucei</i> subsp. <i>brucei</i>
podcap	<i>Podolepis capillaris</i>
ptiobo	<i>Ptilotus obovatus</i>
scvspi	<i>Scaevola spinescens</i>
snnkar	<i>Senna cardiosperma</i>
snnfil	<i>Senna artemisioides</i> subsp. <i>filifolia</i>
snnpet	<i>Senna artemisioides</i> subsp. <i>petiolaris</i>
thryptere	<i>Thryptomene eremaea</i>

Attachment 6: Location of inventory sites

Site		Zone	Latitude	Longitude
RH01	UTM	51J	442091	6666126
RH02	UTM	51J	442344	6666075
RH03	UTM	51J	441928	6666631
RH04	UTM	51J	441535	6667273
RH05	UTM	51J	442045	6667622
RH06	UTM	51J	441908	6668189
RH07	UTM	51J	441827	6667954
RH08	UTM	51J	442040	6667966
RH09	UTM	51J	441311	6668130
RH10	UTM	51J	442332	6667248
RH11	UTM	51J	442750	6667501
RH12	UTM	51J	442839	6667042
RH13	UTM	51J	442869	6666752
RH14	UTM	51J	442476	6666952
RH15	UTM	51J	442535	6666520
RH16	UTM	51J	442356	6665493
RH17	UTM	51J	442702	6665483
RH18	UTM	51J	443248	6665442
RH19	UTM	51J	443979	6665486
RH20	UTM	51J	444676	6665513
RH21	UTM	51J	443529	6668149
RH22	UTM	51J	443063	6668213
RH23	UTM	51J	443556	6667742
RH24	UTM	51J	443293	6667277
RH25	UTM	51J	443780	6667295
RH26	UTM	51J	443582	6666430
RH27	UTM	51J	443062	6666031
RH28	UTM	51J	444255	6665917
RH29	UTM	51J	444481	6665967
RH30	UTM	51J	445061	6665595
RH31	UTM	51J	445219	6665389
RH32	UTM	51J	444741	6665238
RH33	UTM	51J	445505	6665187
RH34	UTM	51J	445785	6664876
RH35	UTM	51J	445102	6664535
RH36	UTM	51J	444801	6664868
RH37	UTM	51J	447710	6662990
RH38	UTM	51J	447315	6662767
RH39	UTM	51J	447157	6662280
RH40	UTM	51J	447203	6661981
RH41	UTM	51J	447567	6662153
RH42	UTM	51J	447025	6663299
RH43	UTM	51J	446650	6663959
RH44	UTM	51J	446442	6663756
RH45	UTM	51J	446485	6662601
RH46	UTM	51J	446178	6663046
RH47	UTM	51J	445340	6663163
RH48	UTM	51J	445118	6663454
RH49	UTM	51J	445591	6663790

Site		Zone	Latitude	Longitude
RH50	UTM	51J	444741	6662663
RH51	UTM	51J	444750	6663007
RH52	UTM	51J	442842	6664186
RH53	UTM	51J	442847	6663728
RH54	UTM	51J	443070	6663583
RH55	UTM	51J	443081	6663285
RH56	UTM	51J	443380	6663581
RH57	UTM	51J	443034	6663095
RH58	UTM	51J	443402	6662962
RH59	UTM	51J	443919	6663047
RH60	UTM	51J	444622	6663526
RH61	UTM	51J	444160	6663909
RH62	UTM	51J	443953	6663790
RH63	UTM	51J	443567	6664077
RH64	UTM	51J	443776	6664841
RH65	UTM	51J	444985	6664083
RH66	UTM	51J	443240	6665003
RH67	UTM	51J	442946	6664659
RH68	UTM	51J	442764	6665259

Attachment 7: Fauna memo report



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Saracen Relief Hill Project
Fauna assessment
M. Bamford, B. Shepherd and T. Gamblin

February 2020

Methods

1.1 Desktop Assessment

1.1.1 Sources of information

Information on the fauna assemblage of the survey area was drawn from a wide range of sources. These included state and federal government databases and results of regional studies. Databases accessed were the Atlas of Living Australia (ALA), Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap (incorporating the Western Australian Museum's FaunaBase and the DBCA Threatened and Priority Fauna Database), BirdLife Australia's Atlas Database (BA) and the EPBC Protected Matters Search Tool of the Department of Energy and the Environment (DEE) (Table). Databases were searched in January 2019 and the search was not repeated for the current project, as the likelihood of new records being added during that period is very low. Information from the above sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns were:

Frogs: Tyler *et al.* (2009) and Anstis (2013);
Reptiles: Storr *et al.* (1983, 1990, 1999 and 2002) and Wilson and Swan (2017);
Birds: Johnstone and Storr (1998, 2005) and Barrett *et al.* (2003); and
Mammals: Menkhorst & Knight (2004); Armstrong (2011); Churchill (2008); and Van Dyck and Strahan (2008).

Table 1 Sources of information used for the desktop assessment.

Database	Type of records held on database	Area searched
Atlas of Living Australia.	Records of biodiversity data from multiple sources across Australia.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.
NatureMap (DBCA)	Records in the WAM and DBCA databases. Includes historical data	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km

Database	Type of records held on database	Area searched
	and records on Threatened and Priority species in WA.	buffer. Searched: January 2019.
BirdLife Australia Atlas Database (Birdlife Australia)	Records of bird observations in Australia, 1998-2019.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.
EPBC Protected Matters (DEE)	Records on matters of national environmental significance protected under the EPBC Act.	Point search: 30° 10' 05"S, 122° 22' 20"E plus 40 km buffer. Searched: January 2019.

1.1.2 Nomenclature and taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2016. The authorities used for each vertebrate group were: amphibians (Doughty *et al.* 2016a), reptiles (Doughty *et al.* 2016b), birds (Johnstone and Darnell 2016), and mammals (Travouillon 2016). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds). English names of species where available are used throughout the text; Latin species names are presented with corresponding English names in tables in the appendices.

1.1.3 Interpretation of species lists

Species lists generated from the review of sources of information are generous as they include records drawn from a large region and possibly from environments not represented in the survey area. Therefore, some species that were returned by one or more of the data searches have been excluded because their ecology, or the environment within the survey area, meant that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the project area is of no importance. Similarly, waterbirds were generally excluded even though they could over-fly the site, since the site provides little habitat for them. The only exceptions were species that might nest on the site, such as some duck species that nest in tree hollows, and species that might use seasonally inundated paddocks. Species returned from databases but excluded from species lists due to lack of suitable habitat are presented in Appendix 6. Locally extinct species are included in Appendix 6.

Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the survey area at least occasionally, whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. This list of expected species is therefore subject to interpretation by assigning each a predicted status in the survey area.

The status categories used are:

Resident: species with a population permanently present in the survey area;
Migrant or regular visitor: species that occur within the project area regularly in at least moderate numbers, such as part of annual cycle;
Irregular Visitor: species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the project area in at least moderate numbers and for some time;
Vagrant: species that occur within the project area unpredictably, in small numbers and/or for very brief periods. Therefore, the project area is unlikely to be of importance for the species; and
Locally extinct: species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the project area.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the site is not important in a conservation context, and species which use the site in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times, or may have been previously confirmed as present. The status categories are assigned conservatively. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence that the site will not support it, and even then it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status.

1.2 Field Investigation and Personnel

The project area was visited between 20th and 23rd January 2020 by Dr Barry Shepherd (B.Sc. Hons. Env. Biol., Ph.D. Ecol.) and Tim Gamblin (B.Sc. Zool., Cert Env. Man). The site visit involved looking around as much of the project area as possible in daylight and the tracks and effort of this search are shown in Appendix 1, Figure 1. This enabled environmental descriptions to be prepared and some opportunistic observations on fauna to be made. Targeted searching was undertaken for two significant species known from the general area; in particular for nest mounds, foraging signs, tracks and direct observations of Malleefowl (*Leipoa ocellata*). Surveyors were also mindful of the burrows of Brush-tailed Mulgara (*Dasyurus blythi*), although it is likely this species is locally extinct. Signs of all species observed, and other notable features of interest were recorded.

An Anabat Swift full spectrum ultrasonic acoustic detector was placed next to an old mine shaft for two full nights. It was deployed on the afternoon of 21st January and retrieved on the morning of 23rd January 2020. All calls obtained were assessed to provide a list of bat fauna supporting the Level 1 survey (Table 3).

1.3 Vegetation and Substrate Associations

Vegetation and Substrate Associations (VSAs) in the project area were assessed and photographed during the desktop review and as part of the field investigations. Within the project area, all major VSAs were visited to develop an understanding of major fauna habitat types present and to assess the likelihood of conservation significant species being present in the area.

1.4 Survey Limitations

The EPA Guidance Statement 56 (EPA 2004) outlines a number of limitations that may arise during surveying. (Table 2)

Table 2 Survey limitations as outlined by EPA.

EPA Limitation	BCE Comment
Level of survey.	Level 1 (desktop study and site inspection). Survey intensity was deemed adequate for the various habitat types viewable from aerial photograph, scale of the project and the amount of data records available in the region. The entire area was not searched for Malleefowl mounds and though the survey results are deemed representative for the Project Area as a whole, only a small percentage of the habitats inside the Project Area boundary was surveyed intensively.
Competency/experience of the consultant(s) carrying out the survey.	The ecologists have had extensive experience in conducting fauna surveys including targeted Malleefowl surveys and have conducted several fauna studies in the region.
Scope. (What faunal groups were sampled and were some sampling methods not able to be employed because of constraints?)	The survey focussed on vertebrate fauna and fauna values.
Proportion of fauna identified, recorded and/or collected.	All vertebrate fauna observed were identified.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	Abundant information from databases and previous studies.
The proportion of the task achieved and further work which might be needed.	The survey was completed and the report provides fauna values for the project area.
Timing/weather/season/cycle.	Timing is not of great importance for level 1 investigations.
Disturbances (e.g. fire, flood, accidental human intervention etc.) that affected results of survey.	None
Intensity. (In retrospect, was the intensity adequate?)	The survey area is approximately 2649 ha and was traversed by vehicle and on foot and thus was adequately comprehensive to assess fauna and fauna values for a level 1 investigation.
Completeness (e.g. was relevant area fully surveyed).	Site was fully surveyed to the level appropriate for a level 1 assessment. Fauna database searches covered a 10 to 20 km radius beyond the survey area boundary.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Field personnel have extensive experience with fauna and habitat in the region.
Remoteness and/or access problems.	There were no remoteness/access problems encountered.
Availability of contextual (e.g. bio-geographic) information on the region.	Extensive regional information was available and was consulted.

1.5 Species

Four reptiles and fifteen mammals were recorded during this survey. Of the mammals six were introduced species. Twenty-six species of bird were recorded.

Peregrine Falcon

Not observed but a widespread species and considered likely to be a regular visitor if not resident. It could also breed in tall eucalypts observed in the Relief Hill survey area, probably by utilising old nests of the Australian Raven which were observed in this assessment.

Rainbow Bee-eater.

This species is only considered of local significance but was formerly listed as Migratory under legislation. It is still considered locally significant as it is a true migrant and breeds in burrows in the area, making it vulnerable to disturbance and predation. It will also often nest along tracks, increasing its vulnerability. No nests were observed however this species is a likely visitor.

1.6 Impacts and Recommendations

1. Malleefowl have been present as breeding residents in the Relief Hill survey polygon for a significant period of time as evidenced by old and new mounds. Vegetation associations with sparse through to dense acacia on loam and gravelly hills were present – providing suitable habitat for this species. Two fresh (i.e. active at the time of the site inspection) mounds found by a limited survey effort (level 1 and few days), suggests the likelihood of many more in the proposed project area.
 2. All Malleefowl mounds are of interest; not just active mounds containing eggs. Well-established, recently used and those mounds used over an extended period of time should all be considered important and included in the impact assessment, as loss of such mounds can adversely affect the local Malleefowl population. Similarly, where significant mounds exist, the surrounding habitat must be considered important in terms of impact assessment for the species given their decline over the recent few decades. However, active and closed mounds should be actively protected until the chicks have hatched and dispersed.
 3. Prior to vegetation clearing, an intensive search for other Malleefowl mounds should be conducted using a team spaced 15-20 m apart depending on density of vegetation in accordance with standard Malleefowl search methods. Ideally, the team should be comprised of trained and experienced ecologists.
 4. All temporary or permanent settling ponds, drainage ditches and other excavations that are present within the survey area and are left open overnight, should be provided with an escape/egress ramp. The egress ramp should allow fauna to crawl out of the excavation but if liners are used, a rope ladder, or other means offering traction should be laid from the bottom of the excavation to the top.
 5. Lighting should not be left on overnight near temporary settlement ponds unless there is a safety need. Lights attracts insects and insects attract bats and birds which can become trapped in water and drown.
 6. Old trees, dead trees, fallen logs and termite mounds should be “gently” tipped over and left overnight to allow fauna inside to disperse .See Appendices.
 7. The plant and operator conducting the clearance works should have a spotter who can usher emerging fauna out of harm’s way.
 8. Personnel conducting the Malleefowl mound search should also advise of active nests of other birds (if found). Active bird nests should be avoided until the young have hatched and fledged.
-

Table 1. Mammal and Reptile Annotated Species List

Species	Notes
White-striped Freetail Bat <i>Austronomus australis</i>	A few calls.
Gould's Wattled Bat <i>Chalinolobus gouldii</i>	A few calls.
Chocolate Wattled Bat <i>Chalinolobus morio</i>	A few calls.
Southern Forest Bat <i>Vespadelus regulus</i>	Many calls.
Inland Freetail Bat <i>Ozimops planiceps</i>	Many calls. Formerly <i>Mormopterus</i> sp 3. Slight possibility that <i>Ozimops kitcheneri</i> may also be present but is difficult to differentiate and <i>O. planiceps</i> is most likely.
Long-eared bat <i>Nyctophilus</i> spp.	Probable. A few calls. Calls from <i>V. regulus</i> can be variable and can be confused with <i>Nyctophilus</i> species when calls are cluttered. Under-represented and may include the P3 <i>N. major tor</i> .
Inland broad-nosed bat <i>Scotorepens balstoni</i>	A few calls.
Boodie Warrens <i>Bettongia lesueur</i>	14 historic and abandoned Boodie warrens were recorded during the survey. Many showed signs of occupation from other recent fauna including rabbits, fox and varanids (goannas).
Western Grey Kangaroo <i>Macropus fuliginosus</i>	A few individuals seen most days on the red loam flats.
Euro (Common Wallaroo) <i>Macropus robustus</i>	Two individuals seen on the rocky hills in the SE region of the survey area.
Dingo/Dog <i>Canis lupus dingo/Canis lupus</i>	Tracks and scats
Red Fox <i>Vulpes vulpes</i>	Tracks and scats
Cow <i>Bos taurus</i>	Tracks and scats
Goat <i>Capra hircus</i>	Skull
Rabbits <i>Oryctolagus cuniculus</i>	Tracks and scats

Cat <i>Felis catus</i>	Scats
Pygmy Spiny-tailed Skink <i>Egernia depressa</i>	Many suitable habitat trees with latrine scats of suitable size and on one occasion an animal observed at 443103.86E, 6668231.94N.
Western blue-tongued lizard <i>Tiliqua occipitalis</i>	Found beneath cow carcass eating maggots and beetles that were consuming the deceased animal (in the north eastern section).
Crested dragon, Bicycle dragon <i>Ctenophorus cristatus</i>	Seen regularly throughout site.
Goldfields Crevice Skink <i>Egernia formosa</i>	Not seen for 100% confirmation but many scats of suitable size, habitat and consistency.

Table 2. Malleefowl *Leipoa ocellata* mounds found in the Relief Hill Polygon 21st – 23rd Jan 2020.

Age	Easting	Northing	Details
Recent	441659.798	6664603.447	4.2m diameter, 500mm deep, 350mm rim height – nil debris in centre, egg shell/feathers present possibly used late 2019
Recent	444394.987	6665856.113	5.5 m diameter, 1200mm deep, 500 rim height - nil debris, in centre, egg shell/feathers present possibly used late 2019
Old	441795.311	6664693.263	5.2 m diameter, 300 mm deep, 130 mm rim height
Old	445670.728	6664864.485	5.0 m diameter, 350 mm deep, 150 mm rim height



Figure 1. Recently active mound at 441659.798E, 6664603.447N.



Figure 2. Malleefowl evidence (feathers and shell) in and adjacent to both recently active mounds.



Figure 3. Recent mound at 444394.987E, 6665856.113N. (Image: Barry Shepard).



Figure 4. Long furrow of raked leaf-litter extending out from new Malleefowl mound.

Annotated Bird List **Birds**

1. Malleefowl – two recently active nests, several old disused nests and several possible scats and feathers throughout.
2. Quail (sp. Unknown) – one bird flushed from acacia scrub
3. Common Bronzewing – one pair seen near haul roads and one individual in survey area
4. Brown Goshawk – One bird seen flying at ground level along a track
5. Common Bronzewing – one pair seen near haul roads and one individual in survey area
6. Australian Ringneck – group of three individuals seen flying in centre of site
7. Purple-crowned Lorikeet – One group of eight and two groups of five on last day only in SE section of survey area
8. Splendid Fairy-wren – males and females frequently seen and heard throughout
9. Yellow-throated Miner – a few individuals seen around mine camp
10. Brown Honeyeater – two individuals heard in eastern half
11. Spiny-cheeked Honeyeater – a few seen and heard throughout
12. Singing Honeyeater – a few individuals heard calling throughout
13. Black Honeyeater – Small group seen in agricultural area in north east
14. Weebill – occasional groups heard and seen in Eucalypt woodlands
15. Redthroat – two or three individuals heard in central eastern area of site
16. Inland Thornbill – several heard across the survey area
17. White-browed Babbler – mobs frequently seen and heard throughout
18. Crested Bellbird – individuals frequently seen and heard throughout
19. Rufous Whistler – frequently heard and seen throughout
20. Black-faced Cuckoo-shrike – Several individuals seen across the survey area
21. Pied Butcherbird – One pair seen in centre of survey area
22. Grey Butcherbird – Individual seen in camp area
23. Grey Currawong – One individual seen in centre of survey area
24. Hooded Robin – male and female seen in north-east area
25. Willie Wagtail – one seen in north east.
26. Rufous Songlark – couple seen in NE corner in ranching area

References

- Anstis, M. (2013). *Tadpoles and Frogs of Australia*. New Holland Publishers, Sydney.
- Armstrong, K.N. (2011). The current status of bats in Western Australia. In Law *et al.* (2011). *The Biology and Conservation of Australasian Bats*. Royal Zoological Society of NSW, Mosman, NSW, Australia.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Hawthorn East, Victoria.
- Churchill, S. (2008) *Australian Bats*. 2nd Edition. Jacana Books, Allen & Unwin. Crows Nest NSW.
-

- Johnstone, R. E. and Storr, G. M. (1998). *Handbook of Western Australian birds. Volume 1: Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth, Western Australia.
- Johnstone, R. E. and Storr, G. M. (2005). *Handbook of Western Australian birds. Volume 2: Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth, Western Australia.
- Menkhorst, P. and Knight, F. (2011). *A Field Guide to the Mammals of Australia*. Oxford University Press, Melbourne, Victoria.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1983). *Lizards of Western Australia. II. Dragons and Monitors*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1990). *Lizards of Western Australia. III. Geckos and Pygopods*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (1999). *Lizards of Western Australia. I. Skinks*. Western Australian Museum, Perth, Western Australia.
- Storr, G. M., Smith, L. A. and Johnstone, R. E. (2002). *Snakes of Western Australia*. Western Australian Museum, Perth, Western Australia.
- Tyler, M. J. and Doughty, P. (2009). *Field Guide to Frogs of Western Australia*. Western Australian Museum, Welshpool, Western Australia.
- Van Dyck, S. and Strahan, R. (Eds.) (2008). *Mammals of Australia*. 3rd Edition. Australian Museum, Sydney.
- Wilson, S. and Swan, G. (2017). *A Complete Guide to Reptiles of Australia*. Fifth Ed. New Holland, Australia.
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Appendices



Figure 1. The Pygmy Spiny-tailed skink *Egernia depressa* and associated latrine. Example of a species that commonly lives in dead trees that, if cleared, require “gentle felling” and being left overnight to enhance escape and survival.

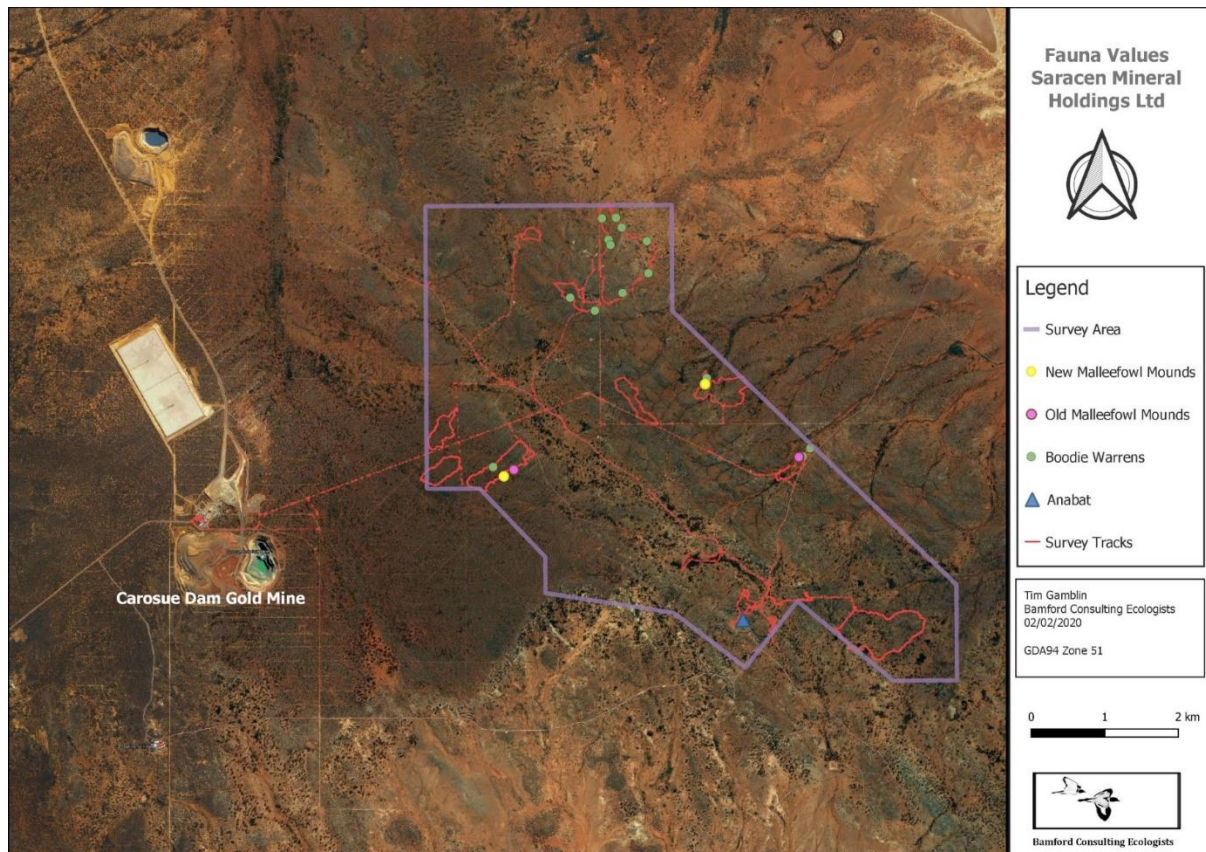


Figure 2. The survey area, indicating tracks followed and locations of significant features.

Basic vertebrate fauna survey and assessment

Mulgabbie North Project Area

Prepared for: Line Hydrogen Pty Ltd

Version 1. April, 2025



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Appendix D. Rapid habitat assessment results

EXECUTIVE SUMMARY

Line Hydrogen proposes clearing additional vegetation in an irregularly shaped project area (349ha). The project area is approximately 110km northeast of Kalgoorlie, southwest of the main part of Lake Rebecca and 10km southeast of the Carosue Dam mine. Immediately south of the project area is a part of Lake Rebecca. To support the native vegetation clearing permit application and works approvals, Terrestrial Ecosystems were contracted to complete a Basic vertebrate fauna survey and assessment.

There are five broad fauna habitats in the project area: chenopod shrubland, Eucalypt woodland over mixed shrubland, mixed shrubland, Salmon gum woodland over mixed shrubs and Mulga woodland over mixed shrubs. There is evidence of exploration activity and prior disturbance.

Although not recorded by Western Wildlife (2022) in its survey of part of the Lake Rebecca mining project area, the Southern Whiteface is potentially in the project area. This bird will readily move if disturbed into the suitable adjacent habitat, so vegetation clearing would not significantly impact this species. Malleefowl and their mounds and tracks were not recorded during the site survey, so it is unlikely to be present. Other avifauna of conservation significance potentially in the project area (e.g. Peregrine Falcon, Princess Parrot) are unlikely to be significantly impacted by the proposed vegetation clearing activities.

Clearing native vegetation is likely to result in the loss of small vertebrate fauna on-site that cannot move away during the clearing process, however, this loss is not expected to be significant when viewed in a bioregional context. The few larger animals, such as kangaroos, large goannas and snakes, and most birds, will move into adjacent areas once vegetation clearing commences, so potential impacts will be low. There may be an ongoing loss of small native fauna to vehicle strikes on haul roads, but overall, this impact will be very low.

Development in the project area is unlikely to significantly impact any fauna of conservation significance, so a referral under the *EPBC Act 1999* is not recommended.

It is recommended that:

- An induction program that includes managing fauna is a mandatory component of working on the mining project;
- Pets are not permitted on site;
- All waste and rubbish should be contained in bins and regularly removed from the site or buried so it is unavailable to pest species;
- Feeding of native fauna should be actively discouraged;
- A feral and pest animal management program focussing on feral cats is implemented to reduce the predation on native fauna;
- Speed limits are implemented and enforced on-site. These should be determined based on the quality and condition of the roads, but be a maximum of 80km/hr;
- Signage is erected to indicate the maximum travelling speeds and the possible presence of wildlife crossing roads;
- The impact of dust on adjacent vegetation and fauna habitat is managed and monitored against appropriate KPIs; and
- A vertebrate fauna management plan is prepared and implemented for the project.

INTRODUCTION

1.1 BACKGROUND

Line Hydrogen Pty Ltd (Line Hydrogen), in a joint venture with Oz Aurum, wishes to clear vegetation to enable further development of the Mulgabbie North project area. The project area (349ha) is ~110km northeast of Kalgoorlie, southwest of the main part of Lake Rebecca (Figure 1) and 10km southeast of the Carosue Dam mine. Immediately south of the project area is a part of Lake Rebecca.

A Basic vertebrate fauna survey assessment was requested to support an application for environmental approvals.

1.2 PROJECT OBJECTIVES AND SCOPE OF WORKS

Line Hydrogen commissioned Terrestrial Ecosystems to undertake a Basic level fauna risk assessment and to search the project area for Malleefowl and their mounds. The purpose of this survey and assessment was to provide information to the Department of Mines, Industry Regulation and Safety and/or the Department of Water and Environmental Regulation on the potential impacts on the vertebrate fauna assemblage in the project area to enable the proposed development to be adequately assessed. The methodology broadly follows that described in the Environmental Protection Authority (EPA; 2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*.

A Basic level fauna risk assessment involves undertaking a desktop review and site visit. The objectives of this fauna risk assessment were to:

- indicate the vertebrate fauna assemblage (i.e. reptiles, amphibians, mammals and birds) on and near the project area so that potential impacts on the fauna and fauna assemblage might be adequately assessed;
- identify the presence and/or potential risk of impacts on species of conservation significance that are present or likely to be present in the project area;
- assess the impact and environmental risks associated with the proposed development on the vertebrate fauna assemblage;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area, in particular, impacts on species of conservation significance; and
- make recommendations that avoid, mitigate or minimise potential impacts on resident fauna.

To achieve these objectives, Terrestrial Ecosystems:

- searched the Commonwealth Government database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC 1999)* or international migratory bird agreements (JAMBA/CAMBA);
- searched Terrestrial Ecosystems' database (includes Atlas of Living Australia and Western Australian Museum (WAM) collection) to identify potential vertebrate fauna within the area;
- reviewed previous fauna surveys conducted near the project area;
- undertook a search of the project area for Malleefowl and their mounds and to identify available fauna habitat types;
- discussed the likelihood of species listed under the *EPBC Act* and the Western Australian *Biodiversity Conservation Act 2016 (BC Act 2016)* being present in the project area; and
- provided management recommendations to avoid, mitigate and minimise potential impacts on the fauna in the project area.

2. EXISTING ENVIRONMENT

2.1 LOCATION OF PROJECT AREA

The project area is in the Murchison 1 (MUR1 - East Murchison subregion) IBRA bioregion. An old report by Cowan (2001) described the subregion as mostly dominated by mulga woodlands that are often rich in ephemerals, hummock grasslands, saltbush shrublands, and halosarcia shrublands. Cowan (2001) recorded no threatened ecological communities in the vicinity of the project areas. Threatening processes for species of conservation significance were listed as foxes and cats (Cowan 2001).

The project area is west of Lake Rebecca and has an area of approximately 349ha.

2.2 LAND USE HISTORY

The dominant land uses for the bioregion are native pasture to support grazing on pastoral leases and crown land reserves, and mining, exploration, and mining to a lesser extent. The region surrounding the project area has largely been used for pastoral activities.

2.3 CLIMATE

The project area is characterised as semi-arid. Kalgoorlie, ~110km to the southwest, has an annual rainfall of approximately 266mm, although this varies considerably yearly. The highest mean maximum and minimum temperatures in Kalgoorlie are in January, with an average of 34°C and 19°C, respectively (Bureau of Meteorology, 2024). The lowest mean daily maximum and minimum temperatures occur in July (Chart 1). The average monthly rainfall is heaviest in February. Summer rain is unpredictable and often results from thunderstorms coming from the north and the west or decaying cyclonic activity as low-pressure cells move from the Pilbara through the Goldfields.

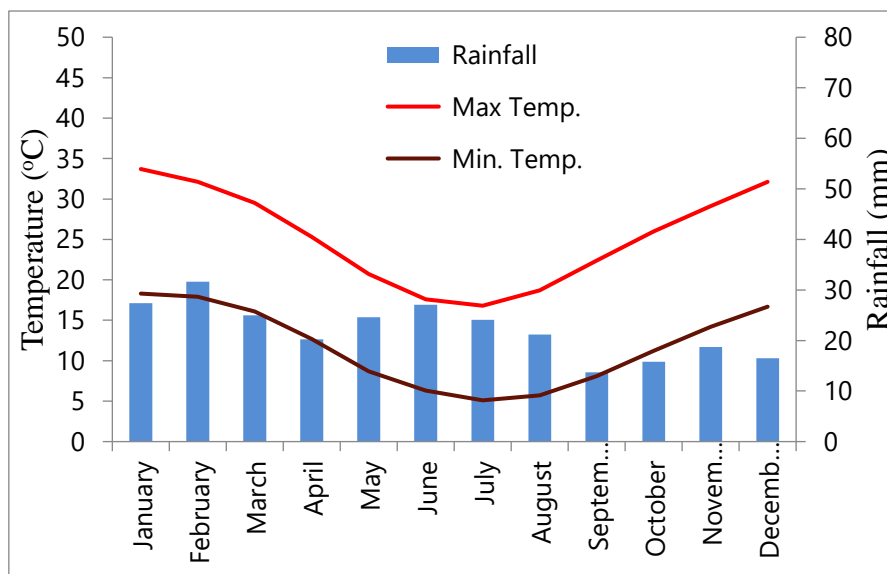


Chart 1. Climatic averages for Kalgoorlie

2.4 REGIONAL BIOLOGICAL FAUNA CONTEXT OF THE PROJECT AREA

Western Wildlife (2022) undertook a Detailed survey of part of the Ramelius Lake Rebecca project area, which is ~35km to the southeast. In addition, other vertebrate fauna survey reports are available for similar habitats in nearby areas. Individual records for fauna are contained in the Atlas of Living Australia, which incorporates data from the Western Australian Museum collection, have also been accessed.

Fauna survey data used in this assessment come from:

- Atlas of Living Australia
- Alexander Holm and Associates (2022) *Assessment of Malleefowl Activity on location EEL55*, Unpublished report for Northern Star Resources Limited, Perth.
- Bamford Consulting Ecologists (2002) *Vertebrate Fauna of the Proposed Carosue Dam – Safari Haul Road*, Unpublished report for Sons of Gwalia, Perth.
- Bamford Consulting Ecologists (2019) *Saracen Carosue Project Fauna Assessment of Proposed Exploration Drilling Program*, Unpublished letter report for Saracen, Perth.
- Biologic (2010) *Level 1 Survey for a Proposed Pipeline from GGT to Carosue Dam and Power line from Black Swan to Carosue Dam*, Unpublished report for Tropicana JV and Saracen Gold Mines Pty Ltd, Perth.
- Dell, J and How, R.A. (1988) Vertebrate fauna. In: The biological survey of the Eastern Goldfields of Western Australia, Part 5, Edjudina - Menzies Study Area. *Records of the Western Australian Museum*, Supplement No 31., pp. 38-77.
- Saracen Gold Mines Pty Ltd (2017) *Saracen Gold- Carosue Dam Aerodrome*, EPBC referral, Saracen Gold Mines Pty Ltd, Perth.
- Ecologia Environment (2007) *Jump Up Dam Fauna Assessment*. Unpublished report for Heron Resources, Perth.
- Hart, Simpson and Associates (2000) *Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey*. Unpublished report for Anaconda Nickel Ltd, Perth.
- McKenzie, N.L., Rolfe, J.K. and Youngson, W.K. (1992) Vertebrate fauna. In: The biological survey of the Eastern Goldfields of Western Australia; Part 8; Kurnalpi - Kalgoorlie Study Area. *Records of the Western Australian Museum*, Supplement No 41, 37-65.
- Northern Star Resources Ltd (2022) *Northern Star Resources Limited Carouse Dam TSF Cell 4 Project Preliminary Documentation EPBC Act Referral: 2021/9026*, Internal report for Northern Star Resources Ltd, Perth.
- Phoenix Environmental Sciences (2022) *Malleefowl Offset Site Survey of EEL55 for Northern Star Resources Ltd*, Unpublished report for Northern Star Resources Ltd, Perth.
- Terrestrial Ecosystems (2010) *Fauna Assessment for the Majestic Gold Project*, Unpublished report for Botanica Consulting Pty Ltd and Integra Mining Ltd, Perth.
- Western Wildlife (2022) *Rebecca Gold Project: Detailed Vertebrate Fauna Survey 2021-2022*, Unpublished reported Ramelius Resources, Perth.

2.5 FAUNA SPECIES AT RISK

Cowan (2001) reported the fauna species at risk in the East Murchison subregion as Bilby (*Macrotis lagotis*), Marsupial Mole (*Notoryctes typhlops*), Mulgara (*Dasycercus cristicauda / blythi*), Malleefowl (*Leipoa ocellata*), Princess Parrot (*Polytelis alexandrae*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Giant Desert Skink (*Liopholis kintorei*) and Peregrine Falcon (*Falco peregrinus*). This report assesses the potential for these species in the project area, the potential impact that the proposed vegetation clearing might have on these species, and other species of conservation significance.

Since 2001, the Night Parrot (*Pezoporus occidentalis*) has been rediscovered in Western Australia and is also considered a species at risk in the region, and Southern Whiteface (*Aphelocephala leucopsis*) has been listed as vulnerable under the EPBC Act.

METHODOLOGY

3.1 DATABASE SEARCHES

A review of the *EPBC Act 1999* list of protected species was undertaken for the area around the project area to identify species of conservation interest to the Commonwealth Government. In addition, a desktop search of Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in relevant sections of the bioregion near the project area.

Other more general texts were also used to provide supplementary information on vertebrates in the bioregion, including Tyler et al. (2000) for frogs; Storr et al. (1983, 1990, 1999b, 2002) and Thompson and Thompson (2006) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively, these sources of information were used to create lists of species expected to utilise the project area and broader bioregion. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants. Vagrants can be recorded almost anywhere. Many of the records are historical, and the species is no longer present in the area. Many bird, mammal, reptile, and amphibian species have specific habitat requirements that may be present in the general area but not in the project area. Also, the ecology of many of these species is often poorly understood. Consequently, it can sometimes be difficult to indicate species whose specific habitat requirements are absent in the project area. Therefore, many species will be included in the lists produced from database searches but will not be present in the actual project area.

There are errors in most databases, including the Atlas of Living Australia and the Western Australian Museum (WAM) collection. These errors occur because of a misidentification of individuals, taxonomic name changes, and incorrect coordinates entered into the database. Terrestrial Ecosystems could not verify the primary records, so it has used the information provided. Readers should appreciate that species lists and fauna surveys reported in the appendices may include these errors.

3.2 SITE INSPECTION AND FAUNA HABITAT ASSESSMENT

A site survey was undertaken on 13 December 2024 to assess fauna habitat types and habitat conditions. This information included a description of the habitat structure, habitat condition, landform, soils, vegetation, and time since the last fire.

The fauna habitat assessment had two foci:

- assessing fauna habitat types and their condition; and
- assessing the possible presence of and recording evidence of species of conservation significance.

Dr Scott Thompson undertook the site assessment with Eren Reid, Native Vegetation Solutions. Dr Thompson stopped at multiple locations within the project area and recorded data about the fauna habitats and their condition. Table 1 indicates the variables recorded at each location.

Table 1. Fauna habitat assessment variables

Observer's Name:		
Coordinates of the location as UTM (GDA94):		
Fire history – options		
<input type="checkbox"/> > 5 years		
<input type="checkbox"/> 1-5 years		
<input type="checkbox"/> < 1 year		
Landform – options		
<input type="checkbox"/> Beach	<input type="checkbox"/> Lower slope	
<input type="checkbox"/> Clay plain	<input type="checkbox"/> Mid slope	
<input type="checkbox"/> Cliff	<input type="checkbox"/> Ridge	
<input type="checkbox"/> Creek line	<input type="checkbox"/> River	
<input type="checkbox"/> Dam	<input type="checkbox"/> Rocky outcrop / breakaway	
<input type="checkbox"/> Drainage line	<input type="checkbox"/> Salt lake	
<input type="checkbox"/> Dune crest	<input type="checkbox"/> Sand dune	
<input type="checkbox"/> Dune slope	<input type="checkbox"/> Sand plain	
<input type="checkbox"/> Dune swale	<input type="checkbox"/> Stony plain	
<input type="checkbox"/> Escarpment	<input type="checkbox"/> Swamp	
<input type="checkbox"/> Flat	<input type="checkbox"/> Undulating	
<input type="checkbox"/> Gorge	<input type="checkbox"/> Upper slope	
<input type="checkbox"/> Gully	<input type="checkbox"/> Wetland	
<input type="checkbox"/> Intertidal / mangrove	<input type="checkbox"/> Water hole	
<input type="checkbox"/> Lake / lake edge		
Habitat quality – options		
<input type="checkbox"/> <i>High quality fauna habitat</i> – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.		
<input type="checkbox"/> <i>Very good fauna habitat</i> - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally affected by disturbance.		
<input type="checkbox"/> <i>Good fauna habitat</i> – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.		
<input type="checkbox"/> <i>Disturbed fauna habitat</i> – These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, containing weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.		
<input type="checkbox"/> <i>Highly degraded fauna habitat</i> – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Fauna		

Observer's Name:	
assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.	
Soil Type – options	
<input type="checkbox"/> Sand	<input type="checkbox"/> Silty loam
<input type="checkbox"/> Loamy sand	<input type="checkbox"/> Sand clay loam
<input type="checkbox"/> Clayey sand	<input type="checkbox"/> Clay
<input type="checkbox"/> Clay loam	<input type="checkbox"/> Peat / organic
<input type="checkbox"/> Silty clay loam	<input type="checkbox"/> Stony
<input type="checkbox"/> Sandy loam	
Soil colour - options	
<input type="checkbox"/> Black	<input type="checkbox"/> Red
<input type="checkbox"/> Brown	<input type="checkbox"/> White
<input type="checkbox"/> Grey	<input type="checkbox"/> Yellow
<input type="checkbox"/> Orange	
Surface stones – options	
<input type="checkbox"/> None	<input type="checkbox"/> Boulders (>250mm)
<input type="checkbox"/> Pebbles (0-50mm)	<input type="checkbox"/> Rocks
<input type="checkbox"/> Cobbles (51-250)	

The project area was searched for Malleefowl, their tracks, and mounds. This search was undertaken using a UTV or walking in the more densely vegetated areas. If a Malleefowl mound was found, then its status, location, and dimensions were recorded in accordance with the National Malleefowl Monitoring Manual (National Malleefowl Recovery Team 2016) and an image of the mound taken. The GPS coordinates of all Malleefowl tracks would also be recorded.

3.3 REPORTING STAFF

Dr Graham Thompson prepared this report and Dr Scott Thompson reviewed it before it was sent to the client. Simon Pitt prepared the habitat maps.

Senior scientists have appropriate, relevant post-graduate qualifications, extensive experience in conducting fauna assessments in the Goldfields, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques, and temporal variations in trapped fauna assemblages in Goldfields surveys, and are therefore appropriately trained and experienced for the task of preparing this assessment.

Dr. Scott Thompson is the only environmental practitioner in Western Australia with independent specialist certification (CEnvP – Ecology Specialist) combined with post-graduate tertiary qualifications and is a licensed pest management technician (LPMT). This unique set of skills and qualifications ensures Scott undertakes fauna surveys, assessments, and control programs to the highest standard and quality assurance. The qualifications and experience of the survey personnel are shown in Table 2.

Table 2. Project personnel and their qualifications

Name	Qualifications	Experience	Role
Dr Scott Thompson	BSc. (Env. Sc.), MSc. (Env. Mngt.), PhD (Env. Sc./Mngt). CEnvP (Ecology Specialist)	> 20 years	Survey coordinator and Principal zoologist
Dr Graham Thompson	Post Grad. Dip. (Zool.), PhD (Zoology)	> 20 years	Principal zoologist
Simon Pitt	BSc (NRM)	> 15 years	Senior Zoologist

3.4 TAXONOMY AND NOMENCLATURE

The taxonomy and nomenclature for fauna species used in this report are generally based on the WA Museum species list. Terrestrial Ecosystems presumed that the identifications referred to in the appendices or reports used to provide local and regional comparative data were correct, and we have only corrected obvious records where the nomenclature was known to be incorrect.

3.5 LIMITATIONS

This vertebrate fauna survey and risk assessment included a site assessment, information in the Commonwealth Government database, and other published and unpublished fauna survey data for the bioregion and personal experience over the past 20 years undertaking fauna surveys in the goldfields. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years, are necessary to appreciate the fauna assemblage in a project area fully.

The EPA's (2020) technical guidance for terrestrial fauna surveys suggested that many variables may limit fauna surveys. Limitations associated with each of these variables are assessed in Table 3.

Table 3. Fauna survey limitations and constraints

Possible limitations	Constraint	Comment
Availability of data and information	No	There is one Detailed vertebrate fauna survey for the Lake Rebecca operations, ~35km to the southeast, and other fauna survey reports for similar habitats in nearby areas.
Competency/experience of the survey team, including experience in the bioregion surveyed	No	The authors of this report have appropriate postgraduate qualifications, have undertaken multiple surveys and assessments in the Goldfields, have published a book and multiple refereed journal articles based on fauna surveys in the region, and are familiar with the vertebrate fauna in this bioregion.
Scope of the survey, e.g. where faunal groups were excluded from the survey	N/A	
Timing, weather, and season	No	The weather was suitable for a site survey.
Disturbance that may have affected results, e.g. fire, flood	No	Disturbances in the project area have been factored into this assessment.
The proportion of fauna identified, recorded or collected	N/A	

Possible limitations	Constraint	Comment
Adequacy of the survey intensity and proportion of survey achieved, e.g. the extent to which the area was surveyed	No	Basic survey requirements were met.
Access problems	No	The site was accessible using a UTV.
Problems with data and analysis, including sampling biases	N/A	

N/A = not applicable, Significant = major impact on outcome of the report, Moderate = impacted parts of the report, Negligible = almost no effect on the report.

RESULTS

4.1 FAUNA HABITAT

The following five fauna habitat types are present in the project area:

- Chenopod shrubland;
- Eucalypt woodland over mixed shrubland;
- Mixed shrubland;
- Salmon gum woodland over mixed shrubs;
- Mulga woodland over mixed shrubs; and
- Disturbed.

One hundred and thirty-seven habitat assessments were undertaken in the project area. The density of trees and shrubs varied across the project area. The fauna habitat quality varied in condition but was mostly very good. The results of the habitat assessment and associated photographs are provided in Appendix D.

Plates 1–14 indicate the variation in fauna habitats in the project area.



Plate 1. Fauna habitat



Plate 2. Fauna habitat



Plate 3. Fauna habitat



Plate 4. Fauna habitat



Plate 5. Fauna habitat



Plate 6. Fauna habitat



Plate 7. Fauna habitat



Plate 8. Fauna habitat



Plate 9. Fauna habitat



Plate 10. Fauna habitat



Plate 11. Disturbed area



Plate 12. Disturbed area



Plate 13. Disturbed area



Plate 14. Disturbed area

4.2 FAUNA ASSEMBLAGE

Western Wildlife (2022) undertook a Detailed vertebrate fauna survey of the Lake Rebecca mining area, ~35km to the southeast of the project area in 2021-22. McKenzie and Hall (1992) surveyed the Kurnalpi – Kalgoorlie region, which was part of the Eastern Goldfields regional government surveys, and Dell and How (1988) reported on a survey for the Edjudina-Menzies area. Terrestrial Ecosystems (2010) undertook a Level 2 survey for the Majestics project area, which is approximately 100km southwest of the project area. The Terrestrial Ecosystems' (2010) survey included pit trapping, funnel traps, echolocation bat detection surveys, avifauna surveys, and short-range invertebrate surveys. Collectively, the data from these surveys provide a comprehensive list of vertebrate fauna species for the project area.

4.3 BIOREGIONAL VERTEBRATE FAUNA ASSEMBLAGE

Appendix B provides a summary of the fauna survey data available near the project area. There are appreciable differences in the recorded fauna assemblages within and among fauna surveys shown in Appendix B. These differences are partially due to the low survey effort deployed by some of the surveys. They also reflect variations in soils and vegetation and temporal variations in the fauna assemblages.

Tables 4-6 provide a list of vertebrate species potentially found near the project area that have been compiled based on the fauna survey report results shown in Appendix B.

Table 4. Birds potentially found near the project area

Family	Species	Common Name	Family	Species	Common Name
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu		<i>Falco berigora</i>	Brown Falcon
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck	Cacatuidae	<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo
	<i>Anas superciliosa</i>	Pacific Black Duck		<i>Eolophus roseicapilla</i>	Galah
	<i>Anas gracilis</i>	Grey Teal		<i>Nymphicus hollandicus</i>	Cockatiel
Megapodiidae	<i>Leipoa ocellata</i>	Malleefowl	Psittaculidae	<i>Polytelis anthopeplus</i>	Regent Parrot
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail		<i>Neopsephotus bourkii</i>	Bourke's Parrot
Podicipedidae	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe		<i>Barnardius zonarius</i>	Australian Ringneck
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		<i>Psephotus varius</i>	Mulga Parrot
	<i>Ocyphaps lophotes</i>	Crested Pigeon		<i>Melopsittacus undulatus</i>	Budgerigar
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo		<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet
	<i>Chrysococcyx osculans</i>	Black-eared Cuckoo	Ptilonorhynchidae	<i>Chlamydera guttata</i>	Western Bowerbird
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth		<i>Climacteris rufus</i>	Rufous Treecreeper
Caprimulgidae	<i>Eurostopus argus</i>	Spotted Nightjar	Maluridae	<i>Malurus lamberti</i>	Variegated Fairywren
Apodidae	<i>Apus pacificus</i>	Pacific Swift		<i>Malurus splendens</i>	Splendid Fairywren
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew		<i>Malurus leucopterus</i>	White-winged Fairywren
Charadriidae	<i>Vanellus tricolor</i>	Banded Lapwing	Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater
	<i>Charadrius ruficapillus</i>	Red-capped Plover		<i>Purnella albifrons</i>	White-fronted Honeyeater
Scolopacidae	<i>Tringa glareola</i>	Wood Sandpiper		<i>Manorina flavigula</i>	Yellow-throated Miner
Turnicidae	<i>Turnix velox</i>	Little Buttonquail		<i>Anthochaera carunculata</i>	Red Wattlebird
Otididae	<i>Ardeotis australis</i>	Australian Bustard		<i>Gavicalis virescens</i>	Singing Honeyeater
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater
Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle		<i>Ptilotula plumula</i>	Grey-fronted Honeyeater
	<i>Aquila audax</i>	Wedge-tailed Eagle		<i>Conopophila whitei</i>	Grey Honeyeater
	<i>Circus assimilis</i>	Spotted Harrier		<i>Epthianura tricolor</i>	Crimson Chat
	<i>Accipiter fasciatus</i>	Brown Goshawk		<i>Epthianura aurifrons</i>	Orange Chat
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk		<i>Epthianura albifrons</i>	White-fronted Chat
	<i>Haliastur sphenurus</i>	Whistling Kite		<i>Lichmera indistincta</i>	Brown Honeyeater
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo		<i>Phylidonyris niger</i>	White-cheeked Honeyeater
Strigidae	<i>Ninox boobook</i>	Southern Boobook		<i>Nesoptilotis leucotis</i>	White-eared Honeyeater
Alcedinidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher		<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater	Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	Acanthizidae	<i>Pyrrholaemus brunneus</i>	Redthroat
	<i>Falco longipennis</i>	Australian Hobby			

Family	Species	Common Name
	<i>Calamanthus campestris</i>	Rufous Fieldwren
	<i>Hylacola cauta</i>	Shy Heathwren
	<i>Acanthiza apicalis</i>	Inland Thornbill
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill
	<i>Smicrornis brevirostris</i>	Weebill
	<i>Aphelocephala leucopsis</i>	Southern Whiteface
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler
Cinclosomatidae	<i>Cinclosoma castanotum</i>	Chestnut Quail-thrush
	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush
Campephagidae	<i>Coracina maxima</i>	Ground Cuckooshrike
	<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike
	<i>Lalage tricolor</i>	White-winged Triller
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella
Oreicidae	<i>Oreica gutturalis</i>	Crested Bellbird
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrikethrush
	<i>Pachycephala inornata</i>	Gilbert's Whistler
	<i>Pachycephala rufiventris</i>	Rufous Whistler
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow
	<i>Artamus superciliosus</i>	White-browed Woodswallow
	<i>Artamus cinereus</i>	Black-faced Woodswallow

	<i>Artamus cyanopterus</i>	Dusky Woodswallow
	<i>Cracticus torquatus</i>	Grey Butcherbird
	<i>Cracticus nigrogularis</i>	Pied Butcherbird
	<i>Gymnorhina tibicen</i>	Australian Magpie
	<i>Strepera versicolor</i>	Grey Currawong
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail
	<i>Rhipidura albiscapa</i>	Grey Fantail
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark
Corvidae	<i>Corvus orru</i>	Torresian Crow
	<i>Corvus bennetti</i>	Little Crow
	<i>Corvus coronoides</i>	Australian Raven
Petroicidae	<i>Microeca fascians</i>	Jacky Winter
	<i>Petroica goodenovii</i>	Red-capped Robin
	<i>Melanodryas cucullata</i>	Hooded Robin
Locustellidae	<i>Cincloramphus cruralis</i>	Brown Songlark
	<i>Cincloramphus mathewsi</i>	Rufous Songlark
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow
	<i>Petrochelidon nigricans</i>	Tree Martin
	<i>Cheramoeca leucosterna</i>	White-backed Swallow
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch (Australian)
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit

Table 5. Amphibians potentially found near the project area

Family	Species	Common Name
Limnodynastidae	<i>Neobatrachus kunapalari</i>	Wheatbelt Frog
	<i>Neobatrachus sutor</i>	Shoemaker Frog
	<i>Neobatrachus wilsmorei</i>	Plonking Frog

Family	Species	Common Name
	<i>Platyplectrum spenceri</i>	Spencer's Burrowing Frog
Myobatrachidae	<i>Pseudophryne occidentalis</i>	Western Toadlet
Pelodyadidae	<i>Cyclorana occidentalis</i>	Western Water-holding Frog

Table 6. Mammals potentially found near the project area

Family	Species	Common Name
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna
Bovidae	<i>Bos taurus</i>	Cow
	<i>Capra hircus</i>	Goat
	<i>Ovis aries</i>	Sheep
Camelidae	<i>Camelus dromedarius</i>	Dromedary

Family	Species	Common Name
Canidae	<i>Canis lupus</i>	Dingo
	<i>Vulpes vulpes</i>	Red Fox
Felidae	<i>Felis catus</i>	Cat
Molossidae	<i>Austronomus australis</i>	White-striped Freetail Bat
	<i>Mormopterus planiceps</i>	Southern Free-tail Bat

Family	Species	Common Name
	<i>Ozimops kitcheneri</i>	South-western Free-tail Bat
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat
	<i>Nyctophilus holtorum</i>	Holt's Long-eared Bat
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat
	<i>Vespadelus baverstocki</i>	Inland Forest Bat
	<i>Vespadelus regulus</i>	Southern Forest Bat
Dasyuridae	<i>Dasyercus blythi</i>	Brush-tailed Mulgara
	<i>Ningauai ridei</i>	Wongai Ningauai
	<i>Ningauai yvonneae</i>	Mallee Ningauai
	<i>Pseudantechinus woolleyae</i>	Woolley's False Antechinus
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart
	<i>Sminthopsis gilberti</i>	Gilbert's Dunnart

	<i>Antechinomys longicaudatus</i>	Long-tailed Dunnart
	<i>Sminthopsis murina</i>	Slender-tailed Dunnart
	<i>Sminthopsis ooldea</i>	Ooldea Dunnart
Burramyidae	<i>Cercartetus concinnus</i>	Southwestern Pygmy Possum
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo
	<i>Osphranter robustus</i>	Euro
	<i>Osphranter rufus</i>	Red Kangaroo
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit
Equidae	<i>Equus caballus</i>	Horse
Muridae	<i>Mus musculus</i>	House Mouse
	<i>Notomys alexis</i>	Spinifex Hopping Mouse
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse
	<i>Pseudomys bolami</i>	Bolam's Mouse
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse

Table 7. Reptiles potentially found near the project area

Family	Species	Common Name
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon
	<i>Ctenophorus cristatus</i>	Crested Dragon
	<i>Ctenophorus fordi</i>	Mallee Dragon
	<i>Ctenophorus inermis</i>	Military Dragon
	<i>Ctenophorus infans</i>	Ring-tailed Dragon
	<i>Ctenophorus isolepis</i>	Central Military Dragon
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon
	<i>Ctenophorus ornatus</i>	Ornate Crevice Dragon
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon
	<i>Ctenophorus salinarum</i>	Saltpan Dragon
	<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon
	<i>Diporiphora amphiboluroides</i>	Mulga Dragon
	<i>Diporiphora reginae</i>	Plain-backed Two-lined Dragon
	<i>Moloch horridus</i>	Thorny Devil
	<i>Pogona minor</i>	Western Bearded Dragon
	<i>Tympanocryptis cephalus</i>	Pebble Dragon
Carphodactylidae	<i>Nephurus laevis</i>	Smooth Knob-tail
	<i>Nephurus vertebralis</i>	Midline Knob-tail
	<i>Nephurus wheeleri</i>	Banded Knob-tail

	<i>Underwoodisaurus milti</i>	Barking Gecko
Diplodactylidae	<i>Amalosia reticulata</i>	Reticulated Velvet Gecko
	<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko
	<i>Diplodactylus granariensis</i>	Wheatbelt Stone Gecko
	<i>Diplodactylus pulcher</i>	Beautiful Gecko
	<i>Lucasium damaeum</i>	Beaded Gecko
	<i>Lucasium maini</i>	Main's Ground Gecko
	<i>Lucasium squarrosus</i>	Mottled Ground Gecko
	<i>Rhynchoedura ornata</i>	Beaked Gecko
	<i>Strophurus assimilis</i>	Goldfields Spiny-tailed Gecko
	<i>Strophurus ciliaris</i>	Spiny-tailed Gecko
	<i>Strophurus strophurus</i>	Western Spiny-tailed Gecko
	<i>Strophurus wellingtonae</i>	Western Shield Spiny-tailed Gecko
Elapidae	<i>Acanthophis pyrrhus</i>	Desert Death Adder
	<i>Brachyuropsis fasciolatus</i>	Narrow-banded Burrowing Snake
	<i>Brachyuropsis semifasciata</i>	Half-girdled Snake
	<i>Echiopsis curta</i>	Bardick
	<i>Elapognathus coronatus</i>	Crowned Snake

Family	Species	Common Name
	<i>Furina ornata</i>	Orange-naped Snake
	<i>Neelaps bimaculatus</i>	Black-naped Burrowing Snake
	<i>Suta gouldii</i>	Gould's Snake
	<i>Suta monachus</i>	Hooded Snake
	<i>Pseudechis australis</i>	Mulga Snake
	<i>Pseudechis butleri</i>	Spotted Mulga Snake
	<i>Pseudonaja mengdeni</i>	Western Brown Snake
	<i>Pseudonaja modesta</i>	Ringed Brown Snake
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake
	<i>Suta fasciata</i>	Rosen's Snake
Gekkonidae	<i>Christinus marmoratus</i>	Marbled Gecko
	<i>Gehyra purpurascens</i>	Purplish Dteila
	<i>Gehyra variegata</i>	Variegated Gehyra
	<i>Heteronotia binoei</i>	Bynoe's Gecko
Pygopodidae	<i>Delma australis</i>	Marble-faced Delma
	<i>Delma butleri</i>	Unbanded Delma
	<i>Delma nasuta</i>	Sharp-snouted Delma
	<i>Lialis burtonis</i>	Burton's Legless Lizard
	<i>Pygopus lepidopodus</i>	Common Scaly-foot
	<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot
Pythonidae	<i>Morelia spilota</i>	Carpet Python
Scincidae	<i>Cryptoblepharus australis</i>	Inland Snake-eyed Skink
	<i>Cryptoblepharus buechananii</i>	Buchanan's Snake-eyed Skink
	<i>Ctenotus atlas</i>	Southern Mallee Ctenotus
	<i>Ctenotus calurus</i>	Blue-tailed Finesnout Ctenotus
	<i>Ctenotus greeri</i>	Spotted-necked Ctenotus
	<i>Ctenotus helenae</i>	Clay-soil Ctenotus
	<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus
	<i>Ctenotus pantherinus</i>	Leopard Ctenotus
	<i>Ctenotus quattuordecimlineatus</i>	Fourteen-lined Ctenotus
	<i>Ctenotus schomburgkii</i>	Barred Wedgesnout Ctenotus
	<i>Ctenotus severus</i>	Stern Ctenotus
	<i>Ctenotus uber</i>	Spotted Ctenotus
	<i>Cyclodomorphus melanops</i>	Spinifex Slender Blue-tongue

Family	Species	Common Name
	<i>Egernia depressa</i>	Southern Pygmy Spiny-tailed Skink
	<i>Egernia formosa</i>	Goldfields Crevice Skink
	<i>Egernia napoleonis</i>	Southwestern Crevice Skink
	<i>Egernia stokesii</i>	Spiny-tailed Skink
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand-swimmer
	<i>Hemiergis initialis</i>	South-western Earless Skink
	<i>Hemiergis peronii</i>	Lowlands Earless Skink
	<i>Lerista bipes</i>	North-western Sandslider
	<i>Lerista desertorum</i>	Central Desert Robust Slider
	<i>Lerista kingi</i>	King's Slider
	<i>Lerista macropisthopus</i>	Unpatterned Robust Slider
	<i>Lerista picturata</i>	Southern Robust Slider
	<i>Lerista puncticauda</i>	Dotty-tailed Robust Slider
	<i>Lerista timida</i>	Timid Slider
	<i>Liopholis inornata</i>	Desert Skink
	<i>Liopholis striata</i>	Nocturnal Desert Skink
	<i>Menetia greyii</i>	Common Dwarf Skink
	<i>Morethia adelaidensis</i>	Saltbush Morethia Skink
	<i>Morethia butleri</i>	Woodland Morethia Skink
	<i>Morethia obscura</i>	Shrubland Pale-flecked Morethia
	<i>Saiphos equalis</i>	Three-toed Skink
	<i>Tiliqua occipitalis</i>	Western Blue-tongued Lizard
	<i>Tiliqua rugosa</i>	Bobtail
Typhlopidae	<i>Anilius australis</i>	Austral Blind Snake
	<i>Anilius bicolor</i>	Dark-spined Blind Snake
	<i>Anilius bituberculatus</i>	Prong-snouted Blind Snake
	<i>Anilius hamatus</i>	Pale-headed Blind Snake
	<i>Anilius waitii</i>	Waite's Blind Snake
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor
	<i>Varanus giganteus</i>	Perentie
	<i>Varanus gouldii</i>	Gould's Goanna
	<i>Varanus panoptes</i>	Yellow-spotted Monitor
	<i>Varanus tristis</i>	Black-headed Monitor

4.4 FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

Fauna species of conservation significance are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the *BC Act 2016*. The *BC Act 2016* provides for publishing the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, the DBCA maintains a list of fauna that require monitoring under four priorities based on the current knowledge of their distribution, abundance, and threatening processes. The *EPBC Act 1999* and *BC Act 2016* imply legislative requirements for managing anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection other than the DBCA wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *BC Act 2016* are provided in Appendix C.

Migratory birds that are waders or shorebirds that seasonally visit inland salt lakes that contain substantial volumes of water have been excluded, as there is no suitable habitat in the project area. Although part of Lake Rebecca is south of the project area, the project area does not impact the lake. One threatened species of fauna and one migratory/marine species of birds identified under the *EPBC Act 1999* potentially occur in the project area, and one species listed in the WA *BC Act* potentially occurs in the project area. The following is an assessment of the likelihood of each species listed in Table 8 being found in the project area.

Table 8. Assessment of the potential presence of a species of conservation significance in the project area

Species	DBCA Schedule / Priority	Status under Commonwealth EPBC Act	Comment on the potential presence of a species
Night Parrot <i>Pezoporus occidentalis</i>	Critically Endangered	Endangered	There is no ring-forming spinifex in the project area. so, it is probably not present in the project area.
Sandhill Dunnart <i>Sminthopsis psammophila</i>	Endangered	Endangered	Not known in this area and not recorded by Western Wildlife (2022) in a nearby survey.
Great Desert Skink <i>Liopholis kintorei</i>	Vulnerable	Vulnerable	It is highly unlikely to be in the project area due to a lack of suitable habitat and because it is outside its known geographic range.
Malleefowl <i>Leipoa ocellata</i>	Vulnerable	Vulnerable	Present in the general area, but there was no evidence of this bird in the project area.
Grey Falcon <i>Falco hypoleucos</i>	Vulnerable	Vulnerable	Highly unlikely to be in the project area, as it has rarely been recorded in the eastern Goldfields.
Chuditch <i>Dasyurus geoffroii</i>	Vulnerable	Vulnerable	Highly unlikely to occur in the project area.
Princess Parrot <i>Polytelis alexandrae</i>	P4	Vulnerable	It may infrequently be seen in the region, however, clearing vegetation is unlikely to impact this species.
Southern Whiteface <i>Aphelocephala leucopsis</i>		Vulnerable	Possibly in the project area.
Long-tailed Dunnart <i>Antechinomys longicaudatus</i>	P4	Migratory	It is highly unlikely to be in the project area due to a lack of suitable habitat (i.e. rocky breakaways and ridgelines).
Woma <i>Aspidites ramsayi</i>	P1		It is unlikely to be in the project area due to predation by feral cats and wild dogs.
Brush-tailed Mulgara <i>Dasymercus blythi</i>	P4	Migratory	It is outside its known geographic range, so it is unlikely to be in the project area.
Fork-tailed Swift <i>Apus pacificus</i>	Migratory	Migratory	It may very infrequently be seen in the region, however, clearing vegetation is unlikely to impact this aerial species.

Species	DBCA Schedule / Priority	Status under Commonwealth EPBC Act	Comment on the potential presence of a species
Oriental Plover <i>Charadrius veredus</i>	Migratory	Migratory	It has not been recently recorded in the general area, so it is improbable that it is in the project area.
Grey Wagtail <i>Motacilla cinerea</i>	Migratory	Migratory	Highly unlikely to be present in the project area.
Peregrine Falcon <i>Falco peregrinus</i>	OS	Migratory	It may very infrequently be seen in the region; however, clearing vegetation is unlikely to impact this species.

OS – Other specially protected fauna

Night Parrot (*Pezoporus occidentalis*) - Critically Endangered under the *BC Act 2016* and Endangered under the *EPBC Act 1999*

The Night Parrot is a small, arid-adapted, nocturnal, ground-feeding parrot (Johnstone and Storr 1998, Threatened Species Scientific Committee 2016). Its length is 22-25cm with a body mass of approximately 104g (Threatened Species Scientific Committee 2016), although it was suggested that they were semi-nomadic, the Night Parrots in south-western Queensland appear to be sedentary (Murphy 2015).

The Night Parrot was probably originally distributed over much of semi-arid and arid Australia (Garnett et al. 1993, Threatened Species Scientific Committee 2016). It has been recently recorded in the northwest and western Queensland in the early 1990-2000s where there was a broad cross-section of the habitats available (Garnett et al. 1993, Cupitt and Cupitt 2008, Boles et al. 2016). There have been recent sightings in the Pilbara in 1980, 2005 and 2017, central WA in 1979, north-eastern South Australia in 1979, western Queensland (including Pullen-Pullen-Mt Windsor-Diamantina population) in 1980, 1990, 1993, 2006, and 2013-17 (Davis and Metcalf 2008, Garnett et al. 2011, Charalambous 2016, Pickrell 2016, AG staff 2017, Palaszczuk and Miles 2017, Rykers 2017, AG staff 2018), Pilbara in 2017 (Jones 2017) and the northern Goldfields (Jackett et al. 2017). Garnett et al. (2011) suggested that 50-250 mature individuals were in less than 5% of its previous range.

Wilson's (1937) summary of observations provided information on the early records of Night Parrots' preferred habitat and breeding sites. Recent information indicates its preferred habitat appears to be in *Triodia* grasslands, chenopod shrublands, shrubby samphire, and floristically diverse habitats dominated by large-seeded species (Threatened Species Scientific Committee 2016, McCarthy 2017, Murphy et al. 2017b). At Pullen Pullen Reserve it nests in large, more or less ring-shaped *Triodia*, and the nest consists of a tunnel (25-30° and 0° to the ground; 20-33cm long) through an apron of dead spinifex leaves that leads to a chamber under a live hummock, with a shallow depression (3-4cm) excavated into the gravelly/sandy soil (Murphy et al. 2017a). In the northern Goldfields the nest was again in a spinifex hummock, it was circular, with an excavated depression (~1.5-2.0cm) in sandy substrate (Hamilton et al. 2017, Jackett et al. 2017). The entrance tunnel was 62cm long, and was downward sloping (27°) with the entrance 28cm above the ground (Hamilton et al. 2017). It has clutches of two to four sub-elliptical, white eggs with a lustrous appearance (Murphy et al. 2017a). Breeding followed significant rains in March for the observations in Pullen-Pullen Reserve and in April in the northern Goldfields (Hamilton et al. 2017, Murphy et al. 2017a), but it is thought that breeding generally occurs between April and October (Murphy et al. 2017a).

Murphy et al. (2017b) placed a GPS tag on Night Parrots and reported that the two birds called at dusk from their diurnal roosts among spinifex hummocks and then flew to more floristically diverse habitats dominated by large-seeded, prolifically seeding species to feed.

The Department of Biodiversity, Conservation and Attractions' (2024) survey guidelines for Night Parrots indicated that at the local (site) level, roosting and nesting sites are in clumps of dense vegetation, primarily old and large spinifex clumps (often >50 years unburnt), especially hummocks that are ring-forming. These may be in expanses or isolated patches but are sometimes associated with other vegetation types, such as

dense chenopod shrubs. Spinifex hummocks that are collapsed (i.e. less than about 40-50 cm in height) are not likely to provide adequate shelter.

There is no mature, ring-forming spinifex in the project area, so it is unlikely to be present in the project area.

Sandhill Dunnart (*Sminthopsis psammophila*) - Endangered species under the *EPBC Act 1999* and *BC Act 2016*

The Sandhill Dunnart is a small (30-45g) arid adapted dasyurid found in the eastern part of the Western Australian section of the Great Victoria Desert, eastern Goldfields, and the western and southern parts of South Australia. Recent surveys undertaken for the Great Victoria Desert Trust and eastern Goldfields have increased its geographic range. The records of Sandhill Dunnarts near the project area in Riley's (2020) PhD thesis (Plate 15) indicate that this dunnart has been recorded multiple times to the northeast of the project area. Riley (2020; p.36) summarised the literature to indicate that the Sandhill Dunnart prefers 'to live on or near parallel, east-to-west oriented sand dunes with yellow, pale-orange or white sandy soils'. This habitat is not present in the project area, so it is improbable that they are in it.

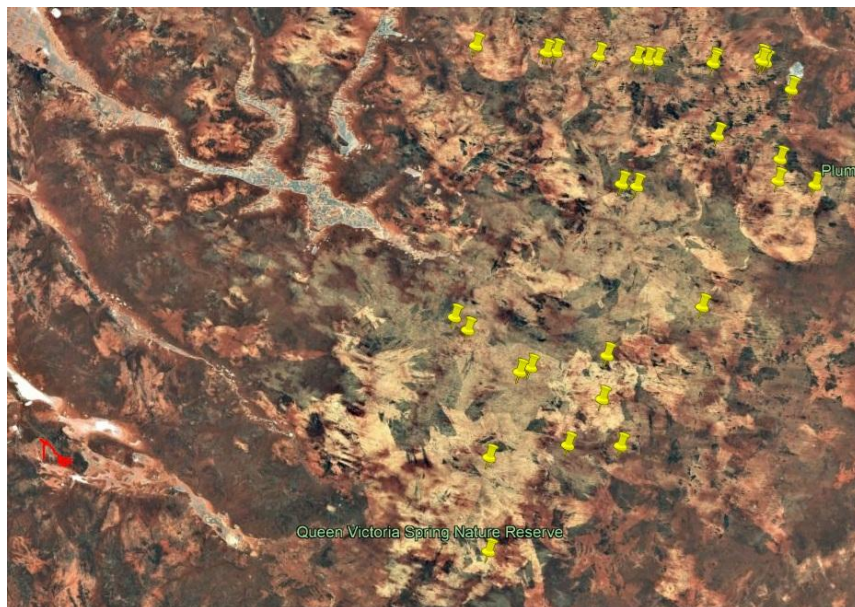


Plate 15. Records (yellow flags) of Sandhill Dunnarts (taken from Riley 2020)

Great Desert Skink (*Liopholis kintorei*) - Vulnerable species under the *EPBC Act 1999* and *BC Act 2016*

Liopholis kintorei is a large skink found in the sandy desert regions of Western Australia, Northern Territory, and South Australia. It is found on sandflats and clay-based or loamy soils vegetated with spinifex. It lives in a multi-entranced communal burrow system and uses shared defecation sites. Storr *et al.* (1999a) recorded them as being in the Wanjarri area of the Great Victoria Desert, and the DBCA threatened species database recorded them in the Laverton area in 1967.

The Giant Desert Skink prefers sandy soils vegetated with spinifex on dune systems. Records of this species in the Atlas of Living Australia indicated that it is unlikely to be found in the project area, and it was also not recorded by Western Wildlife (2022) in its survey. The assessment is that *Liopholis kintorei* is very unlikely to be found in the project area due to a lack of suitable habitat.

Malleefowl (*Leipoa ocellata*) - Vulnerable under the *BC Act 2016* and *EPBC Act 1999*

Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26th

parallel of latitude southwards. Prior to vegetation clearing for agriculture, Malleefowl were abundant in the WA Wheatbelt. Vegetation clearing for agriculture also opened adjacent bushland to predators, and in the southwest of WA, Malleefowl often only persist in isolated remnant patches of native vegetation. Sheep and other herbivores (e.g. goats, kangaroos) grazing in remnant vegetation removes or thins the undergrowth, and they also compete with Malleefowl for herbaceous foods and can cause changes to the structure and floristic diversity of foraging habitats (Benshemesh 2007).

Malleefowl and their eggs are vulnerable to predation by foxes, and newly hatched chicks are vulnerable to foxes, cats, and raptors (Priddel and Wheeler 1990, Benshemesh and Burton 1999, Benshemesh 2007, Lewis and Hines 2014). Their abundance in the Goldfields is low and sparsely distributed, favouring areas more densely vegetated. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter. These nest mounds range in diameter but can span more than five metres and may be up to one metre high. Malleefowl are generally monogamous; once breeding commences, they pair for life. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Alex Holm and Associates (2022) recorded 12 Malleefowl mounds for Northern Star Resources ~60km east of Kalgoorlie; two were active, one recently inactive, two inactive and abandoned and seven long unused. Bamford Consulting Ecologists (2019) reported several long-inactive Malleefowl mounds on the Carosue Dam site.

No Malleefowl tracks or mounds were recorded in the project area, so it is improbable that they are present.

Grey Falcon (*Falco hypoleucos*) - Vulnerable species under the *EPBC Act 1999* and *BC Act 2016*

The Grey Falcon is a moderately large raptor found mostly in the northern half of Western Australia, in lightly wooded, coastal, or riverine areas and nests in tall trees along watercourses.

There are multiple records of the Grey Falcon in the Pilbara but very few in the Goldfields. Based on this species' rarity and lack of records in the eastern Goldfields, it is unlikely that it is present in the project area.

Chuditch (*Dasyurus geoffroii*) – Vulnerable under the *BC Act 2016* and *EPBC Act 1999*.

The Chuditch is the largest extant carnivorous marsupial in WA. It is usually active from dusk to dawn. Formally known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of southwest WA and other isolated areas. Chuditch are solitary animals for most of their life and den in hollow logs, burrows, culverts, etc., and has also been recorded in tree hollows and rock cavities. Chuditch are opportunistic feeders and forage primarily on the ground at night. Their diet can include other mammals, birds, lizards, birds, and reptile eggs, but the majority is a mixture of large invertebrates (e.g., spiders, scorpions, and crickets).

How et al. (1988) reported Chuditch being found near the Norseman-Lake King Road and Mount Holland. DBCA records show that one specimen was recorded in 1974 in Kambalda East. There are multiple records south of Southern Cross and Marvel Loch, and there have been other reported sightings east of Kambalda and near Norseman, but Terrestrial Ecosystems can find none north or east of Kalgoorlie.

As the project area is a significant distance northeast of the species' known distribution, it is highly unlikely that the Chuditch would be found in the project area. Therefore, vegetation clearing is unlikely to have a significant impact on this species.

Princess Parrot (*Polytelis alexandrae*) - Vulnerable species under the *EPBC Act 1999* and a Priority 4 species with DBCA

The species is found mostly in the inland arid areas of Australia and Western Australia in the Gibson, Little Sandy, and Great Victoria Deserts (Johnstone and Storr 1998, Pavey et al. 2014). However, they occasionally occurred in lightly wooded areas adjacent to the sandy deserts (Moriarty 1972).

It is thought to be nomadic within the central desert regions of Australia, occupying arid shrublands, particularly those dominated by Mulga, Desert Oak, and spinifex. Due to the paucity of information on the species, accurate estimates of its conservation significance are difficult to make.

It is possible that the Princess Parrot may be an infrequent visitor to this area when resources are suitable. However, if it was present, then vegetation clearing is unlikely to significantly impact this species as it will move away to other areas if disturbed.

Southern Whiteface (*Aphelocephala leucopsis*) - Vulnerable species under the EPBC Act 1999

The Southern Whiteface is a recent addition to the EPBC Act listing of vulnerable species. It is a small bird found in the arid and semi-arid interior from the WA coast near Hamelin Bay through the Great Victoria Desert into the arid areas of South Australia, Victoria, NSW, and Queensland (Johnstone and Storr 2004, Department of Climate Change Energy and the Environment and Water 2023).

It is found in open woodlands and shrublands with an understorey of grasses and low shrubs (Department of Climate Change Energy and the Environment and Water 2023). It forages on the ground, feeding on insects, spiders, and seeds, mostly found in the leaf litter (Johnstone and Storr 2004, Department of Climate Change Energy and the Environment and Water 2023).

It was not recorded by Western Wildlife (2022) in its surveys but was recorded by McKenzie et al. (1992) at sites KK53 and 54, and by Ecologia Environment (2007) at Jump-up Dam mine sites, so it is potentially in the general area. This bird will readily move to adjacent areas if it is disturbed. There is an abundance of similar fauna habitats present in adjacent areas, so the proposed clearing of vegetation is unlikely to have a significant impact on this bird.

Brush-tailed Mulgara (*Dasyercus blythi*) - Priority 4 with the DBCA

Woolley (2005) recognises two species of 'Mulgara'; *Dasyercus blythi* and *D. cristicauda*. *Dasyercus blythi* has a non-crested tail, two upper premolars, and six nipples; *D. cristicauda* has a crested tail, three upper premolars and eight nipples. Both species potentially have overlapping distributions in arid Australia, but it is thought that *D. cristicauda* does not currently exist in Western Australia, although there are old records indicating its presence. Woolley (2005) suggested the common names for these two species be Brush-tailed Mulgara for *D. blythi* and Crest-tailed Mulgara for *D. cristicauda*. These two species can be sympatric in places but probably utilise different parts of the habitat locally when recorded in the same area. Currently, there are insufficient data to separate the spatial ecology, burrows, and reproductive biology of these two species. Information that follows is based on what is known for 'Mulgara' without distinguishing between the species.

Adult males are typically heavier than females (Gibson and Cole 1992, Dickman et al. 2001, Körtner et al. 2007), with females growing to 80g and males to 147g (Masters 1998, Dickman et al. 2001). Gibson and Cole (1992) reported pouched young in the winter and spring with lactating females as late as December. Litter sizes averaged five but ranged from 2-6 (Gibson and Cole 1992, Masters 1998), with a single litter being produced each year (Dickman et al. 2001). Woolley (2008a) reported *D. blythi* females to carry up to six young in central Australia when caught in September, and in captivity, mating has been observed from mid-May to mid-June, and young have been born in June to August after a gestation of five to six weeks. The breeding biology is similar for *D. cristicauda*, but because females have eight nipples they can carry up to eight young (Woolley 2008b). Adult males mostly die after mating.

The Mulgara diet includes insects, arachnids, and rodents as the main prey, but reptiles, centipedes, and small marsupials are also consumed (Chen et al. 1998, Masters 1998, Contos and Letnic 2019).

The reported distribution of Mulgara in Western Australia includes much of the inland spinifex-covered sandy desert and spinifex-vegetated areas in the Pilbara and northern goldfields. Within these areas their distribution is patchy, and it is most frequently confined to habitats dominated by mature spinifex (Gibson and Cole 1992,

Masters 2003, Masters *et al.* 2003). Relative abundance seems to be positively associated with rainfall in the previous 12 to 24 months (Gibson and Cole 1992, Masters 1998, Dickman *et al.* 2001, Letnic and Dickman 2005). Significant population fluctuations appear to be a characteristic of the ecology of Mulgara (Manson 1994, Barrick Plutonic Gold Mine 2006). For example, Pearson (2003-04) reported significant fluctuations at Mt Keith with 99 caught in 2001 and only 33 caught in 2002 in a repeated survey. The recent burning of spinifex does not seem to be sufficient to cause Mulgara to move out of an area (Thompson and Thompson 2007).

Mulgara are generally sedentary in contrast with some other small dasyurids and have high site fidelity and a low propensity for dispersal once a home range has been established (Masters 1998, Dickman *et al.* 2001, Masters 2003). Masters (2003) indicated home ranges vary in size from 1.0 to 14.4ha (mean 6.5ha), with some overlap; however, Kortner *et al.* (2007) reported home ranges for males to average 25.5ha and for females to average 10.8ha. Burrows are mostly used by a single individual, but males and females have been found together in a single burrow during the breeding season (Masters 2003, Thompson and Thompson 2007). Kortner *et al.* (2007) reported that 10 of 68 burrows they monitored were used by multiple Mulgara and one individual returned to the same burrow on 32 of 52 days monitored. Masters (2003) reported individual's burrows in her study area were concentrated in a relatively small area, as the average maximum distance across a home range was about 440m. In the Pilbara, Thompson and Thompson (2007, 2008) reported catching nine Mulgara in an area of 22ha and 50 in 210ha, and about 200 trap nights were required to catch each Mulgara in areas with a relatively high density.

Masters (2003) reported that both males and females use 2-9 burrows, but averaged about three, whereas Kortner *et al.* (2007) reported Mulgara used up to 15 burrows, with 47% of burrows used by an individual only once. Woolley (1990) described *D. cristicauda* burrows near Ayers Rock as having one large hole, around which there was loose soil, and either one or two smaller holes within 1m of the large hole. The tunnels to these pop holes were near vertical. Thompson and Thompson (2007) indicated that burrows in the Pilbara contained between two and nine entrances, tunnels were mainly on a single level and to a depth of about 300mm. Kortner *et al.* (Körtner *et al.* 2007) reported Mulgara burrows in the Uluru National Park varied in complexity, some with only a single entrance, but others had multiple entrances. The lumen for a burrow entrance was typically an arch over a flat bottom with a height of 70-80mm and a width of 80-100mm at the base. Internal tunnels were mostly 50-70mm wide. Masters (2008) suggested that the complexity of burrows varies geographically, with those in central Australia having a single entrance with two or three side tunnels and pop holes and those in Queensland having more than one entrance, deeper branching tunnels, and numerous pop holes. This difference may have been due to differences in species that were not recognised until recently.

According to the Atlas of Living Australia records, the project area is on the southwestern fringe of its geographical distribution, and it was not caught in the Western Wildlife (2022) survey, so it is unlikely to be present in the project area.

Long-tailed Dunnart (*Sminthopsis longicaudata*) - Priority 4 species with DBCA.

Burbidge *et al.* (2008) summarised the Long-tailed Dunnart distribution as widely scattered in arid zones where it inhabits rugged rocky areas. They suggested that its striated footpads, long tail, and behaviour in captivity indicated that it was an active and capable climber. Specimens in several rocky ranges in the Gibson Desert, West MacDonnell National Park, Murchison, Carnarvon Basin, and Pilbara have been recorded. Most capture sites for Long-tailed Dunnarts are within rugged rocky landscapes that support a low open woodland or shrubland of Acacias (especially mulga) with an understorey of spinifex hummocks and (occasionally) also perennial grasses and cassias.

There were very few rocky habitats in the project area, so Long-tailed Dunnarts are unlikely to be present.

Woma (*Aspidites ramsayi*) - Priority 1 species with DBCA

The southern Woma python was once recorded in a crescent-shaped geographic distribution from Shark Bay to Kitchener in WA. However, it is now mostly only found on the two extremes of this distribution, with a small population east of the Wheatbelt in relatively dense shrubs on a sandy substrate.

In Western Australia, it is found in arid woodland or shrubland areas, typically on sand plains. It has not been recorded recently near the project area, however, this area has not been well surveyed. There is a very low probability that the Woma python is present in the project area and, therefore, could be impacted by the proposed development.

Fork-tailed Swift (*Apus pacificus*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

This species breeds in northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara in November, and in the southwest land division in mid-December, and leaving by late April. The Fork-tailed swift is almost exclusively an aerial species, foraging and sleeping on the wing. It rarely comes to ground, usually only for breeding. It is common in the Kimberley, uncommon to moderately common near northwest, west, and southeast coasts, and rare to scarce elsewhere. It is rarely seen in the Goldfields (Plate 16), so it is unlikely to be impacted by the proposed development.

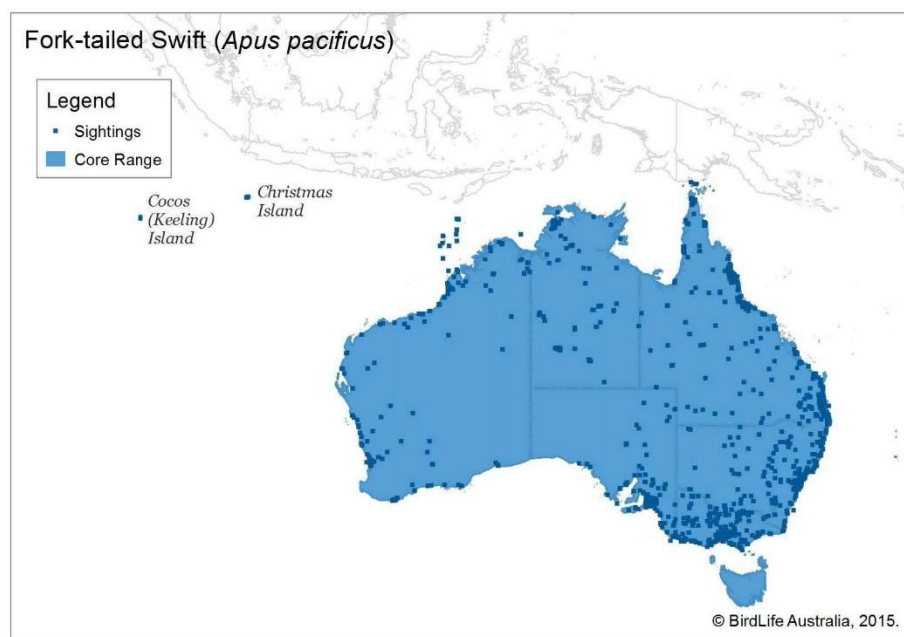


Plate 16. Range and actual reported sightings of the Fork-tailed Swift

(taken from <http://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-guidelines-migratory-birds>)

Oriental Plover (*Charadrius veredus*) - Migratory species under the *EPBC Act 1999* and *BC Act 2016*

A migrant species with patchy distribution in Australia, the Oriental Plover is sparsely distributed across arid and semi-arid Australia but avoids truly desert regions. Its preferred habitat is dry plains. It was not recorded in other fauna surveys undertaken near the project area. The species is threatened by habitat reduction due to agriculture and changing fire regimes.

This plover has not been recorded in the general area in other regional surveys. Therefore, Terrestrial Ecosystems assess that the Oriental Plover is unlikely to be seen in the project area and, therefore, unlikely to be impacted.

Grey Wagtail (*Motacilla cinerea*) - Migratory under the *EPBC Act 1999* and *BC Act 2016*

The Grey Wagtail is a small, yellow-breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in the Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea, and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water, including rivers, streams, and creeks, where it feeds on insects.

The Atlas of Living Australia records two sightings on the south coast of Western Australia and none around the project area. It is highly unlikely to be seen in the project area due to a lack of records and suitable habitat (Plate 17), so it is unlikely to be impacted by the proposed development.

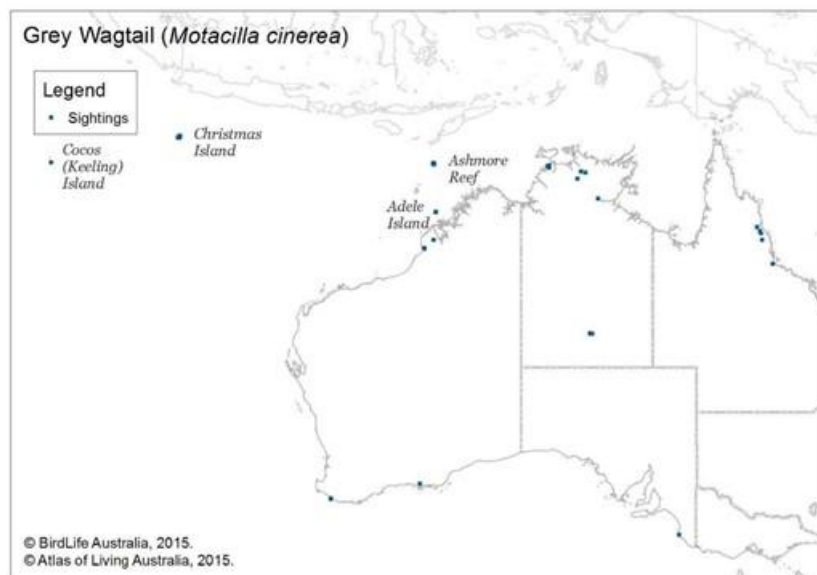


Plate 17. Reported sightings of the Grey Wagtail

(taken from <http://www.environment.gov.au/biodiversity/threatened/publications/epbc-act-referral-guidelines-migratory-birds>)

Peregrine Falcon (*Falco peregrinus*) - Otherwise specially protected under the *BC Act 2016*

The Peregrine Falcon is uncommon, although widespread throughout much of Australia, excluding the extremely dry areas, and has a wide and patchy distribution. It shows habitat preference for areas near cliffs along coastlines, rivers, and ranges, as well as within woodlands along watercourses and lakes. Nesting sites include ledges along cliffs, granite outcrops and quarries, hollow trees near wetlands, and old nests of other large bird species. There is no evidence to suggest any change in status in the last 50 years.

Terrestrial Ecosystems assesses that the Peregrine Falcon may infrequently be seen in the project area, however, vegetation clearing is unlikely to significantly impact this species as it will readily move away from disturbance, and there are abundant areas of similar habitat in the region.

DISCUSSION

5.1 ADEQUACY OF THE FAUNA SURVEY DATA FOR FAUNA HABITATS REPRESENTED IN THE PROJECT AREA

The EPA's (2020) Technical Guidance on terrestrial fauna surveys indicated that the type of survey should be determined based on:

- level of existing regional knowledge;
- type and comprehensiveness of recent local surveys;
- degree of existing disturbance or fragmentation at the regional scale;
- extent, distribution and significance of habitats;
- significance of species likely to be present;
- sensitivity of the environment to the proposed activities; and
- scale and nature of impact.

The project area is an irregular shape, and some areas have been disturbed by exploration activities. Western Wildlife (2022) undertook a vertebrate fauna survey for the Lake Rebecca operations, which is ~35km to the southeast, and there are data available from other surveys undertaken nearby in similar habitats (Dell et al. 1988, McKenzie and Hall 1992, Terrestrial Ecosystems 2010). Multiple reports are associated with the Carosue Dam project, which is ~10km northwest. All these reports (Bamford Consulting Ecologists 2002, Biologic 2010, Bamford Consulting Ecologists 2019, Northern Star Resources Limited & Northern Star Resources Limited 2022, Phoenix Environmental Sciences 2022) are Basic assessments without fauna surveys. It is unlikely that further survey effort in the project area would provide species not previously identified or provide additional information that would alter the assessment of potential impacts.

5.2 POTENTIAL IMPACTS ON VARIOUS TAXA

5.2.1 Amphibians

Frogs are normally only detected immediately after rainfall or around semi-permanent pools. It is likely that *Neobatrachus sutor*, *Neobatrachus kunapalari*, and *Neobatrachus wilsmorei* could also be found in the general area. Vegetation clearing in the project area is likely to result in a loss of individuals within the disturbed area; however, it is unlikely to significantly impact these species when assessed in a bioregional context, as all species are widespread and abundant.

5.2.2 Reptiles

Typically, between 25 and 35 species of reptiles are caught in open mulga woodland, open Eucalypt woodlands or chenopod shrublands (McKenzie and Hall 1992, Terrestrial Ecosystems 2010, 2012b, a). None of the species likely to be in the project area are of conservation significance. There were no characteristics of the reptile assemblage anticipated to be in the project area that indicated that there are reptiles of conservation significance or different to that in the neighbouring areas, and given that there were large expanses of similar habitat in adjacent areas, vegetation clearing in the project area is unlikely to have a significant impact on reptiles when assessed in a bioregional context.

5.2.3 Birds

The number of birds and bird species in the eastern Goldfields fluctuates based on seasons and recent rainfall (Craig and Chapman 2003). Semi-arid and arid areas of inland Australia support a diverse range of transient

and nomadic species that move through large areas in search of available resources. Heavy rain, followed by flowering and seeding of many plant species, is often sufficient to draw many of these nomadic species to the general area. These species move on to other areas once the resource is depleted or better resources are available in adjacent areas.

The project area is likely to support a similar assemblage to that present in the adjacent areas (McKenzie and Hall 1992, Terrestrial Ecosystems 2010, Western Wildlife 2022). Although not recorded by Western Wildlife (2022), the Southern Whiteface has been recorded in other regional fauna surveys, and there are records of this species occurring nearby in the Atlas of Living Australia. Therefore, it is potentially present in the project area. However, there are vast expanses of similar habitat in adjacent areas, so if it were present and disturbed, it would readily move into neighbouring areas and not be significantly impacted.

No Malleefowl; their tracks or mounds were recorded in the project area, so it is improbable that they are present.

5.2.4 Mammals

There is likely a diverse range of small mammals in the project area, given the diversity of habitats. However, none of the species likely to be present are of conservation significance. Rabbits, wild dogs and cats will likely be in the general area. Although not recorded during the fieldwork, camels are also present in the general area.

5.3 FERAL ANIMALS

Camels, wild dogs, rabbits, and cats are potentially present in the project area. Wild dog and cat abundance have the potential to increase once the mine becomes established, as they will feed on putrescible waste and are occasionally fed by on-site staff.

Camels can cause serious damage to vehicles if they collide. Station cattle have limited road sense, which is also a potential hazard on the existing tracks. Rabbits are in low abundance but ubiquitous in the Goldfields.

5.4 BIODIVERSITY VALUE

An ecological assessment of a site should consider its biodiversity value at the genetic, species, and ecosystem levels and its ecological functional value at the ecosystem level. Inadequate data exists to assess the ecological value at the genetic level.

Fauna habitats in the project area are abundant and in a similar condition to those in the adjacent areas. Therefore, the fauna assemblage present in the project area will also be abundant in the adjacent areas. The available fauna survey data (Appendix B) provides a good indication of the potential vertebrate fauna in the project area.

5.4.1 Ecological functional value at the ecosystem level

The most significant impacts on vertebrate fauna in the project area and its surroundings will be feral cats, wild dogs, and, to a much lesser extent, cattle grazing and rabbits. Fauna habitats in the project area are also abundant in adjacent areas, so the clearing of vegetation to construct a haul road is unlikely to impact the ecological functional value of the bioregion.

5.4.2 Maintenance of threatened ecological communities

No threatened ecological fauna communities were identified in the project area.

5.4.3 Condition of fauna habitat

A small quantity of the project area has been disturbed mostly for tracks, and cattle have grazed the area in low intensity for many years. The uncleared fauna habitat in the project area is similar to that in the many square kilometres of adjacent habitat. Therefore, when considered in a bioregional context, the proposed vegetation clearing is unlikely to impact the vertebrate fauna significantly.

5.4.4 Ecological linkages

The project area does not provide an important ecological linkage or fauna movement corridor.

5.4.5 Size and scale of the proposed disturbance

The project area is small (i.e. 349ha), and the fauna habitats are like those in the adjacent areas and bioregion. Given the available fauna survey data for these habitat types, clearing vegetation to build and operate a mine is unlikely to significantly impact the vertebrate fauna assemblage when considered in a bioregional context.

5.4.6 Abundance and distribution of similar habitats in the adjacent areas

Fauna habitats present in the project area are abundant in adjacent areas. Therefore, the fauna assemblage in the project area is likely similar to the many square kilometres of comparable habitat in adjacent areas and the bioregion.

5.4.7 Potential impacts on ecosystem function

Clearing native vegetation will likely result in the loss of small vertebrate fauna on-site that cannot move away during the clearing process. The few larger animals, such as kangaroos and large goannas, and most birds will move into adjacent areas once clearing commences. Shifting animals into adjacent areas will increase the pressure on resources in those areas, and there will likely be some disruption to the ecosystems in these areas for a short period until a balance is restored.

The sparseness of the vegetation and limited ground cover in many areas mean there is a low abundance of terrestrial vertebrate fauna in most of the project area. Impacts associated with clearing vegetation in the project area in a landscape or bioregional context on the vertebrate fauna are likely low as the proposed disturbance area is very small relative to the quantity of similar habitats in the bioregion.

The impact of feral and pest fauna (e.g., cats and wild dogs), which are present in the project area, will be doing more environmental damage than the combined impacts of the proposed vegetation clearing in the project area.

6. POTENTIAL ENVIRONMENTAL IMPACTS

The vegetation clearing to construct and operate a mine will potentially affect vertebrate fauna in numerous ways, including death/injury of fauna during vegetation clearing, impacts with vehicles on the haul road and the loss of habitat.

Although there are anticipated short-term impacts on fauna, they are not likely to significantly impact fauna habitat and assemblages in the long term.

6.1.1 Animal deaths during the clearing process and displacement of fauna

Clearing vegetation and activities associated with vegetation clearing will result in the loss of some small fauna that retreat to burrows, such as reptiles and mammals. Nocturnal species are unlikely to be active when most of the land clearing occurs, which may result in these individuals being adversely impacted when they attempt to escape. This loss of vegetation is unlikely to have a significant impact when considered in a bioregional context. Larger terrestrial animals and avian species will most often move to adjacent areas.

6.1.2 Edge effects

In addition to the obvious impact of vegetation clearing, there can be an equally significant or greater impact on the adjacent areas because of 'edge effects'. Small mammals can respond both positively and negatively to edges depending on their ecological traits (Laurance 1991, 1994, Goosem and Marsh 1997, Goosem 2000). Edge and disturbance effects can lead to altered and, most often, higher levels of predation, restricting or increasing fauna movements and altering assemblage structure (Oxley et al. 1974, Paton 1994, Baker et al. 1998, Temple 1998, Luck et al. 1999, Goosem et al. 2001).

Edge effects can disrupt ecological processes such as predation, dispersal, and animal displacement, changing the assemblage structure. Consequently, the impact area will always be much larger than the cleared area. However, for this project area, the sparseness of vegetation and ground cover means there will be few 'edge effects' due to vegetation clearing.

6.1.3 Habitat fragmentation

Clearing vegetation in linear tracks will likely isolate sections of established vertebrate fauna. It may alter short and medium-term movement patterns around established home ranges, particularly for small mammals and reptiles. A reduction in the population because of this development would be difficult to detect, given our current knowledge of the spatial ecology of most small mammals in the area. The impacts of habitat fragmentation due to the construction of a haul road would, therefore, be very low.

6.1.4 Introduced fauna and weeds

Increased habitat fragmentation and human activity can often increase the abundance of introduced species, such as feral cats (*Felis catus*) and wild dogs (*Canis lupus*). This increase may be due to a decline in habitat health, increased road kills, poor waste disposal, and easier access to areas via tracks.

Cats and wild dogs are known to be established in the area. Increases in dog or cat numbers can harm native fauna because they prey on and compete with native species, severely disrupting the natural balance. The feral cat is a particularly damaging predator of native fauna. Any increase in their numbers could have a detrimental effect on local native fauna (Kinnear 1993, Bamford 1995, Woinarski et al. 2017, Woinarski et al. 2018, Murphy et al. 2019). It is, therefore, important to ensure that populations of feral predators, such as feral cats, are under control.

6.1.5 Road fauna deaths

An increase in road fauna deaths is likely to occur where new tracks are constructed or upgraded, in particular affecting kangaroos, nocturnal birds, and ground-dwelling carnivorous predators (e.g. goannas). Species such as goannas and raptors are attracted to carrion on road verges, and therefore, there is an increased propensity for these species to be killed by vehicles.

Malleefowl have little road sense and can be easily killed or injured by vehicles on haul roads and tracks. Appropriate speed limits can reduce this impact.

6.1.6 Dust

High volumes of trucks entering and leaving the mining area could potentially result in dust plumes covering the adjacent vegetation, widening the impact area. Wider areas devoid of vegetation result in more habitat fragmentation, which can have a long-term impact on the vertebrate fauna assemblage. Dust management is, therefore, required to mitigate this potential impact.

6.1.7 Anthropogenic activity

Unnatural noises, vibrations, and frequent truck movements may be sufficient to force individuals or fauna species to move from adjacent areas or alter their activity periods. This form of disturbance is likely to occur during the initial operational period. The overall impact is expected to be confined to a relatively small area and is unlikely to be significant.

7. VERTEBRATE FAUNA RISK ASSESSMENT

7.1 RISK ASSESSMENT

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity of a particular area and region. Possible impacts on fauna from the proposed development are identified and briefly described above. Tables 9, 10, and 11 summarise the risk assessment associated with this project.

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the impacts. Disturbances and vegetation clearing impact the fauna at multiple scales – site, local, landscape, and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 11.

Table 9. Fauna impact risk assessment descriptors

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur, or one or more species of conservation significance may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur, or one or more species of conservation significance could be present at some time.
C	Moderate	The environmental event should occur, or one or more species of conservation significance should be present at some time.
D	Likely	The environmental event will probably occur, or one or more species of conservation significance will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur, or one or more species of conservation significance is expected to be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'endangered' under the EPBC Act (1999) at a regional scale.
Acceptability of Risk		
Level of risk	Management Action Required	
Low	No action required.	
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.	
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. May a referral to the Commonwealth under the EPBC Act 1999.	
Extreme	Unacceptable, project should be redesigned or not proceed.	

Table 10. Levels of acceptable risk

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequence	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 11. A risk assessment of the impact of ground disturbance activity on fauna

			Before management				With management		
	Potential impacts		Inherent risk			Risk controls	Residual risk		
Factor			Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Fauna survey data	Inadequate survey data to adequately assess the risks	Unknown loss of fauna, fauna of conservation significance, and fauna assemblages, and an incomplete fauna assessment.	B	2	Low				
	Inadequacy of comparative data	Limits on the availability of comparative data reduced the capacity to assess the uniqueness of the fauna assemblages in the project area.	B	2	Low				
Clearing vegetation	Loss of fauna habitat – local scale	Loss of terrestrial fauna in the project area.	E	2	Mod.				
	Loss of fauna habitat – landscape scale	Loss of some fauna during vegetation clearing.	A	1	Low				
	Loss of fauna habitat – regional scale	Small loss of some fauna from the region.	A	1	Low				
	Loss of a threatened ecological fauna community	Loss of an undetected threatened ecological fauna community.	A	3	Low				
	Habitat fragmentation	Fauna movement is restricted, resulting in fauna deaths and biodiversity loss.	A	2	Low				
Death or loss of conservation significant fauna	Loss of a unique terrestrial fauna ecosystem	Loss of an ecosystem function containing high species richness, high abundance, and numerous top-of-the-food chain predators.	A	2	Low				
	Night Parrot	Loss of a Night Parrot or small population of Night Parrots	A	3	Low				
	Southern Whiteface	Loss of a Southern Whiteface or small population of Southern Whiteface	A	2	Low				
	Malleefowl	Loss of a Malleefowl or small population of Malleefowl	B	2	Low				
	Chuditch	Loss of a Chuditch or small population of Chuditch	A	2	Low				
	Princess Parrot	Loss of a Princess Parrot or small population of Princess Parrot	A	2	Low				
	Mulgara	Loss of a Mulgara or small population of Mulgara	A	2	Low				
	Fork-tailed Swift	Loss of a Fork-tailed Swift or small population of Fork-tailed Swift	A	2	Low				

			Before management				With management		
	Grey Wagtail	Loss of a Grey Wagtail or small population of Grey Wagtail	A	2	Low				
	Peregrine Falcon	Loss of a Peregrine Falcon or small population of Peregrine Falcon	A	2	Low				
Human impacts	Increase or spread of weeds	Changed vegetation and a resulting loss of fauna habitat	E	2	Mod.	Implementation of a weed management plan.	D	2	Low
	Road kills	Animals being killed by vehicles as they cross roads	E	1	Low	Limiting speeds	E	1	Low
	Dust	Dust plumes from vehicle movement can kill vegetation adjacent to the haul road, increasing habitat fragmentation							
	Increase in feral mammals, specifically the dog and cat	Increased predation on the native fauna	C	2	Low				

7.2 NATIVE VEGETATION CLEARING PRINCIPLES AS THEY PERTAIN TO VERTEBRATE FAUNA

The *Environmental Protection Act (1986)* outlines 10 principles that are to be used in the assessment of native vegetation clearing permit applications which are also applicable for other assessments and approvals (Table 12). Where possible, native vegetation should not be cleared if any of the following principles are compromised.

Table 12. Assessment of impact using the native vegetation clearing principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation in the project area will not compromise a high level of biodiversity. Conservation significant species potentially in the project area (i.e. Southern Whiteface) are unlikely to be significantly impacted.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing vegetation will not result in the loss of significant habitat for indigenous fauna. Habitat potentially cleared will include that which Southern Whiteface utilises, but any potential impacts are not considered significant.
It includes, or is necessary for the continued existence or, rare flora.	N/A
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The project area does include an internally draining ephemeral creek line.
The clearing of the vegetation is likely to cause appreciable land degradation.	N/A
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact the environmental values of the bioregion.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	N/A
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	N/A

7.3 REFERRAL UNDER THE EPBC ACT

Clearing of vegetation to construct and operate a mine is unlikely to significantly impact on conservation significant vertebrate fauna species. A referral under the *EPBC Act 1999* is not recommended.

8. SUMMARY

Line Hydrogen proposes clearing additional vegetation in an irregularly shaped project area (349ha). The project area is approximately 110km northeast of Kalgoorlie, southwest of the main part of Lake Rebecca and 10km southeast of the Carosue Dam mine. Immediately south of the project area is a part of Lake Rebecca. To support the native vegetation clearing permit application and works approvals, Terrestrial Ecosystems were contracted to complete a Basic vertebrate fauna survey and assessment.

There are five broad fauna habitats in the project area: chenopod shrubland, Eucalypt woodland over mixed shrubland, mixed shrubland, Salmon gum woodland over mixed shrubs and Mulga woodland over mixed shrubs. There is evidence of exploration activity and prior disturbance.

Although not recorded by Western Wildlife (2022) in its survey of part of the Lake Rebecca mining project area, the Southern Whiteface is potentially in the project area. This bird will readily move if disturbed into the suitable adjacent habitat, so vegetation clearing would not significantly impact this species. Malleefowl and their mounds and tracks were not recorded during the site survey, so it is unlikely to be present. Other avifauna of conservation significance potentially in the project area (e.g. Peregrine Falcon, Princess Parrot) are unlikely to be significantly impacted by the proposed vegetation clearing activities.

Clearing native vegetation is likely to result in the loss of small vertebrate fauna on-site that cannot move away during the clearing process, however, this loss is not expected to be significant when viewed in a bioregional context. The few larger animals, such as kangaroos, large goannas and snakes, and most birds, will move into adjacent areas once vegetation clearing commences, so potential impacts will be low. There may be an ongoing loss of small native fauna to vehicle strikes on haul roads, but overall, this impact will be very low.

Development in the project area is unlikely to significantly impact any fauna of conservation significance, so a referral under the *EPBC Act 1999* is not recommended.

9. RECOMMENDATIONS

9.1 INDUCTION AND AWARENESS

All contractors and staff involved in exploration or mining activity should be made aware of the possible presence and issues associated with terrestrial fauna in the area through the induction process.

Recommendation 1: An induction program that includes managing fauna is a mandatory component of working on the mining project.

9.2 MINIMISING SECONDARY IMPACTS TO THE HABITAT

Pets and feral animals have the potential to impact on native fauna. Pets should not be permitted on site, and feral and pest fauna numbers should be monitored and controlled. All rubbish likely to attract animals should be suitably contained and disposed of so as not to encourage the feeding of fauna around the site.

Recommendation 2: Pets are not permitted on site.

Recommendation 3: All waste and rubbish should be contained in bins and regularly removed from the site or buried so it is not available to pest species.

Recommendation 4: Feeding of native fauna should be actively discouraged.

Recommendation 5: A feral and pest animal management program focussing on feral cats is implemented to reduce the predation on native fauna.

9.3 ROAD FAUNA DEATHS

Increased activity will result in increased traffic and consequential increased fauna deaths on tracks. Limiting vehicle speed on tracks and roads can reduce collisions with fauna, particularly larger animals such as kangaroos and emus. Dead animals on the road also tend to attract raptors, goannas and even cattle, which are likely to be killed.

Recommendation 6: Speed limits are implemented and enforced on-site. These should be determined based on the quality and condition of the roads, but be a maximum of 80km/hr.

Recommendation 7: Signage is erected to indicate the maximum travelling speeds and the possible presence of wildlife crossing roads.

9.4 DUST

Dust generated from mining activity and vehicles can potentially degrade surrounding vegetation, reducing its ability to absorb sunlight and influencing photosynthetic rates. Degradation of these areas will potentially render habitat unsuitable for fauna. Dust suppression and management programs are essential to minimising mining impacts on fauna in areas adjacent to the mine.

Recommendation 8: The impact of dust on adjacent vegetation and fauna habitat is managed and monitored against appropriate KPIs.

9.5 VERTEBRATE FAUNA MANAGEMENT PLAN

Fauna management plans describe the procedures and protocols that must be implemented to avoid, mitigate and minimise impacts on fauna during a project's vegetation clearing, infrastructure development and operational stages. Such plans deal with the method of vegetation clearing, reducing fauna deaths on the roads, the impacts of artificial light spill, vibration, dust, feral species management, monitoring and recording conservation species, monitoring impacts on fauna in adjacent areas, staff inductions, etc.

Recommendation 9: A vertebrate fauna management plan is prepared and implemented for the mining project.

REFERENCES

- AG staff. 2017. Night parrot feather discovered in South Australia gives hope to ecologists. Australian Geographic **September**.
- AG staff. 2018. Critically endangered night parrot fledging photographed on Queensland reserve. Australian Geographic **February**.
- Baker, J., R. L. Goldingay, and R. J. Whelan. 1998. Powerline easement through forests: a case study of impacts on avifauna. *Pacific Conservation Biology* **4**:79-89.
- Bamford Consulting Ecologists. 2002. Vertebrate Fauna of the Proposed Carosue Dam – Safari Haul Road.
- Bamford Consulting Ecologists. 2019. Saracen Carosue Project Fauna Assessment of Proposed Exploration Drilling Program. Perth.
- Bamford, M. J. 1995. Predation by feral cats upon lizards. *The Western Australian Naturalist* **20**:191-196.
- Barrick Plutonic Gold Mine. 2006. Management Plan for the Protection of the Mulgara. Perth.
- Benshemesh, J. 2007. National Recovery Plan for Malleefowl. South Australia.
- Benshemesh, J., and P. Burton. 1999. Fox predation on Malleefowl three years after the spread of RCD in Victoria. Unpublished report for Parks Victoria and Department of Natural Resources and Environment, Mildura.
- Biologic. 2010. Level 1 Survey for a Proposed Pipeline from GGT to Carosue Dam and Power line from Black Swan to Carosue Dam. Tropicana JV and Saracen Gold Mines Pty Ltd, Unpublished report,, Perth.
- Boles, W. E., N. W. Longmore, and M. C. Thompson. 2016. A Recent Specimen of the Night Parrot *Geopsittacus occidentalis*. *Emu* **94**:37-40.
- Burbidge, A. A., N. L. McKenzie, and P. J. Fuller. 2008. Long-tailed Dunnart *Sminthopsis longicaudata*. Pages 148-150 in S. van Dyck and R. Strahan, editors. *The Mammals of Australia*. Reed New Holland, Sydney.
- Charalambous, S. 2016. First night parrot fledgling spotted in 100 years spotted in western Queensland. Australian Geographic **November**.
- Chen, X., C. R. Dickman, and M. B. Thompson. 1998. Diet of the mulgara, *Dasyercus cristicauda* (Marsupialia: Dasyuridae), in the Simpson Desert, central Australia. *Wildlife Research* **25**:233-242.
- Contos, P., and M. Letnic. 2019. Diet of the crest-tailed mulgara (*Dasyercus cristicauda*) in the Strzelecki Desert. *Australian Mammalogy*.
- Cowan, M. 2001. Murchison 1 (MUR1 - East Murchison subregion). Pages 466-479 in N. L. McKenzie, J. E. May, and S. McKenna, editors. *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth.
- Craig, M. D., and A. Chapman. 2003. Effects of short-term drought on the avifauna of Wanjarri Nature Reserve: What do they tell us about drought refugia? *Journal of the Royal Society of Western Australia* **86**:133-137.
- Cupitt, R., and S. Cupitt. 2008. Another recent specimen of the Night Parrot *Pezoporus occidentalis* from Western Queensland. *Australian Field Ornithology* **25**:69-75.
- Davis, R. A., and B. M. Metcalf. 2008. The Night Parrot (*Pezoporus occidentalis*) in northern Western Australia: a recent sighting from the Pilbara region. *Emu* **108**:233-236.
- Dell, J., R. A. How, A. V. Milewski, and G. J. Keighery. 1988. The biological survey of the eastern goldfields of Western Australia Part 5: Edjudina - Menzies Study Area. *Records of the Western Australian Museum* **Supplement No. 31**:38-69.
- Department of Biodiversity Conservation and Attractions. 2024. Guidelines for determining the likely presence and habitat usage of night parrot (*Pezoporus occidentalis*) in Western Australia. Perth.
- Department of Climate Change Energy and the Environment and Water. 2023. Conservation Advice for *Aphelocephala leucopsis* (southern whiteface). Canberra.
- Dickman, C. R., A. S. Haythornthwaite, G. H. McNaught, P. S. Mahon, B. Tamayo, and M. Letnic. 2001. Population dynamics of three species of dasyurid marsupials in arid central Australia: a 10 year study. *Wildlife Research* **28**:493-506.

- ecologia Environment. 2007. Jump Up Dam Fauna Assessment.
- Environmental Protection Authority. 2020. Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment. Western Australia.
- Garnett, S., G. Crowley, R. Duncan, N. Baker, and P. Doherty. 1993. Notes on live Night Parrot sightings in north-western Queensland. *Emu* **93**:292-296.
- Garnett, S. T., J. K. Szabo, and G. Dutson. 2011. The Action Plan for Australian Birds 2010. CSIRO, Collingwood, Melbourne.
- Gibson, D., and J. Cole. 1992. The Mulgara Mirage: A vanishing species, or just unknown? *Wildlife Australia*.
- Goosem, M. 2000. Effects of tropical rainforest roads on small mammals: Edge changes in community composition. *Wildlife Research* **27**:151-163.
- Goosem, M., Y. Izumi, and S. Turton. 2001. Efforts to restore habitat connectivity for an upland tropical rainforest fauna: A trial of underpasses below roads. *Ecological Management and Restoration* **2**:196-202.
- Goosem, M. W., and H. Marsh. 1997. Fragmentation of small mammal community by a powerline corridor through tropical rainforest. *Wildlife Research* **24**:613-629.
- Hamilton, N., A. Burbidge, T. Douglas, and L. Gilbert. 2017. Piecing the puzzle together: the fate of the Night Parrot nest found in Western Australia by Jackett et al. (2017). *Australian Field Ornithology* **34**:151-154.
- Hart Simpson and Associates. 2000. Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey. Perth.
- How, R. A., J. Dell, and B. G. Muir. 1988. Vertebrate Fauna. Pages 44-94 in R. A. How, K. R. Newbey, J. Dell, B. G. Muir, and R. J. Hnatiuk, editors. *The Biological Survey of the Eastern Goldfields of Western Australia; Part 4, Lake Johnston - Hyden Study Area. Records of the Western Australian Museum*.
- Jackett, N., B. Greatwich, G. Swann, and A. Boyle. 2017. A nesting record and vocalisations of the Night Parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology* **34**:144-150.
- Johnstone, R. E., and G. M. Storr. 1998. Handbook of Western Australian Birds. Volume I - Non-Passerines (Emu to Dollarbird). Western Australian Museum, Perth.
- Johnstone, R. E., and G. M. Storr. 2004. Handbook of Western Australian Birds. Volume II - Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth.
- Jones, A. 2017. Night parrot sighting in Western Australia shocks birdwatching world. ABC News.
- Kinnear, J. 1993. Masterly marauders: The cat and the fox. *Landscape* **8**:20-28.
- Körtner, G., C. R. Pavey, and F. Geiser. 2007. Spatial ecology of the mulgara in arid Australia: impact of fire history on home range size and burrow use. *Journal of Zoology* **273**:350-357.
- Laurance, W. F. 1991. Edge effects in tropical forest fragments: application of a model for design of nature reserves. *Biological Conservation* **57**:205-219.
- Laurance, W. F. 1994. Rainforest fragmentation and the structure of small mammal communities in tropical Queensland. *Biological Conservation* **69**:23-32.
- Letnic, M., and C. R. Dickman. 2005. The responses of small mammals to patches regenerating after fire and rainfall in the Simpson Desert, central Australia. *Austral Ecology* **30**:24-39.
- Lewis, M., and M. Hines. 2014. Malleefowl activity at nesting sites increase fox and other feral animal visitation rates. Pages 242-247 *Proceedings of the 5th National Malleefowl Forum 2014*.
- Luck, G. W., H. P. Possingham, and D. C. Paton. 1999. Bird responses at inherent and induced edges in the Murray Mallee, South Australia. 1. Differences in abundance and diversity. *Emu* **99**:157-169.
- Manson, J. 1994. The implications of home range variation between sexes and seasons in an arid dwelling dasyurid, the Mulgara (*Dasyercus cristicauda*). University of Western Australia, Perth.
- Masters, P. 1998. The Mulgara *Dasyercus cristicauda* (Marsupialia: Dasyuridae) at Uluru National Park, Northern Territory. *Australian Mammalogy* **20**:403-407.
- Masters, P. 2003. Movement patterns and spatial organisation of the mulgara, *Dasyercus cristicauda* (Marsupialia: Dasyuridae), in central Australia. *Wildlife Research* **30**:339-344.

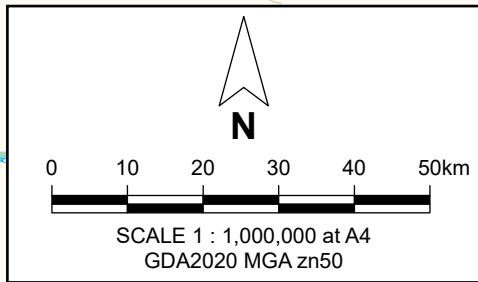
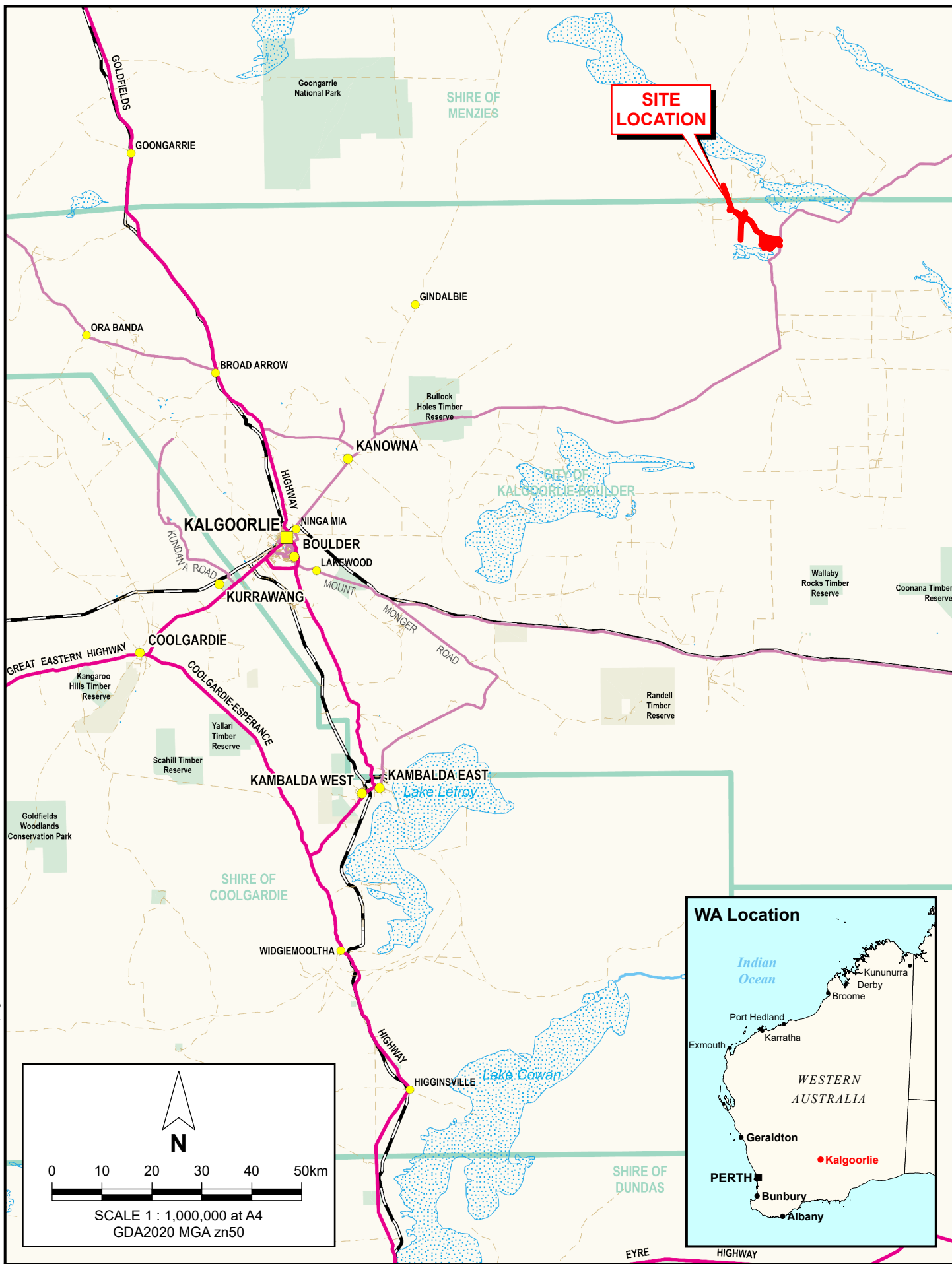
- Masters, P. 2008. Crest-tailed Mulgara. Pages 49-50 in S. Van Dyck and R. Strahan, editors. The Mammals of Australia. Reed New Holland, Sydney.
- Masters, P., C. R. Dickman, and M. Crowther. 2003. Effects of cover reduction on Mulgara *Dasyercus cristicauda* (Marsupialia: Dasyuridae), rodent and invertebrate populations in central Australia: Implications for land management. *Austral Ecology* **28**:658-665.
- McCarthy, M. 2017. Night parrot feather discovery proves Australia's most elusive bird is alive in South Australia. ABC News.
- McKenzie, N. L., and N. J. Hall. 1992. The Biological Survey of the Eastern Goldfields of Western Australia. Part 8. Kurnalpi-Kalgoorlie Study Area. Records of the Western Australian Museum **Supplement No. 41**.
- Moriarty, T. K. 1972. Birds of Wanjarri, W.A. (27°25'S, 120°40'E). *Emu* **72**:1-7.
- Murphy, B. P., L.-A. Woolley, H. M. Geyle, S. M. Legge, R. Palmer, C. R. Dickman, J. Augusteyn, S. C. Brown, S. Comer, T. S. Doherty, C. Eager, G. Edwards, D. A. Fordham, D. Harley, P. J. McDonald, H. McGregor, K. E. Moseby, C. Myers, J. Read, J. Riley, D. Stokeld, G. J. Trewella, J. M. Turpin, and J. C. Z. Woinarski. 2019. Introduced cats (*Felis catus*) eating a continental fauna: The number of mammals killed in Australia. *Biological Conservation* **237**:28-40.
- Murphy, S. 2015. Shining a light: The research unlocking the secrets of the mysterious Night Parrot. *Australian Birdlife* **4**:30-35.
- Murphy, S. A., J. J. Austin, R. K. Murphy, J. Silcock, L. Joseph, S. T. Garnett, N. P. Leseberg, J. E. M. Watson, and A. H. Burbidge. 2017a. Observations on breeding Night Parrots (*Pezoporus occidentalis*) in western Queensland. *Emu* **117**:107-113.
- Murphy, S. A., J. Silcock, R. Murphy, J. Reid, and J. J. Austin. 2017b. Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology*.
- National Malleefowl Recovery Team. 2016. National Malleefowl Monitoring Manual.
- Northern Star Resources Limited & Northern Star Resources Limited. 2022. Northern Star Resources Limited Carosue Dam TSF Cell 4 Project preliminary documentation: EPBC Act referral: 2021/9026. Subiaco, W.A.
- Northern Star Resources Ltd. 2022. Northern Star Resources Limited Carouse Dam TSF Cell 4 Project Preliminary Documentation EPBC Act Referral: 2021/9026. Perth.
- Oxley, D. J., M. B. Fenton, and G. R. Carmody. 1974. The effects of roads on populations of small mammals. *Journal of Applied Ecology* **11**:51-59.
- Palaszczuk, A., and S. Miles. 2017. New night parrot community discovered in central west Queensland.
- Paton, P. W. C. 1994. The effect of edge on avian nest success: How strong is the evidence? *Conservation Biology* **8**:17-26.
- Pavey, C. R., C. E. M. Nano, J. R. Cole, P. J. McDonald, P. Nunn, A. Silcocks, and R. H. Clarke. 2014. The breeding and foraging ecology and abundance of the Princess Parrot (*Polytelis alexandrae*) during a population irruption. *Emu*:NULL.
- Pearson, D. 2003-04. Mulgaras and mining. *Landscape* **19**:26-31.
- Phoenix Environmental Sciences. 2022. Malleefowl Offset Site Survey of EEL55 for Northern Star Resources Ltd. Perth.
- Pickrell, J. 2016. The night parrot's secret sanctuary. *Australian Geographic* **August**.
- Priddel, D., and R. Wheeler. 1990. Survival of Malleefowl *Leipoa ocellata* chicks in the absence of ground-dwelling predators. *Emu* **90**:81-87.
- Riley, J. L. 2020. Spatial ecology and conservation management of the endangered sandhill dunnart, *Sminthopsis psammophila*. University of Bristol, Bristol.
- Rykers, E. 2017. Night parrot call recordings released online for first time. *Australian Geographic* **February**.
- Saracen Gold Mines Pty Ltd. 2017. Saracen Gold- Carosue Dam Aerodrome EPBC referral,. Perth.
- Storr, G. M., and R. E. Johnstone. 1983. Part VI Amphibians and Reptiles. Pages 70-74 in N. L. McKenzie, editor. Wildlife of the Dampier Peninsula, south-west Kimberley, Western Australia. Western Australian Wildlife Research Centre, Department of Fisheries and Wildlife, Perth.
- Storr, G. M., L. A. Smith, and R. E. Johnstone. 1990. Lizards of Western Australia. III: Geckos and Pygopods. Western Australian Museum, Perth.

- Storr, G. M., L. A. Smith, and R. E. Johnstone. 1999a. Lizards of Western Australia I. Skinks. Western Australian Museum, Perth.
- Storr, G. M., L. A. Smith, and R. E. Johnstone. 1999b. Lizards of Western Australia. I: Skinks. Western Australian Museum, Perth.
- Storr, G. M., L. A. Smith, and R. E. Johnstone. 2002. Snakes of Western Australia. Western Australian Museum, Perth.
- Temple, S. A. 1998. The edge of the cut: implications for wildlife populations. *Journal of Forestry* **96**:22-26.
- Terrestrial Ecosystems. 2010. Fauna Assessment for the Majestic Gold Project. Perth.
- Terrestrial Ecosystems. 2012a. Fauna Assessment for the Santa Area. Perth.
- Terrestrial Ecosystems. 2012b. Level 2 Fauna Assessment for the Aldiss Area. Perth.
- Thompson, G. G., and S. A. Thompson. 2007. Shape and spatial distribution of Mulgara (*Dasycercus cristicauda*) burrows, with comments on their presence in a burnt habitat and a translocation protocol. *Journal of the Royal Society of Western Australia* **90**:195-202.
- Thompson, G. G., and S. A. Thompson. 2008. Abundance and spatial distribution of five small mammals at a local scale. *Australian Mammalogy* **30**:65-70.
- Thompson, S. A., and G. G. Thompson. 2006. Reptiles of the Western Australian Goldfields. Goldfields Environmental Management Group, Kalgoorlie, WA.
- Threatened Species Scientific Committee. 2016. Conservation Advice *Pezoporus occidentalis* Night Parrot. Canberra.
- Tyler, M. J., L. A. Smith, and R. E. Johnstone. 2000. Frogs of Western Australia. Western Australian Museum, Perth.
- Van Dyck, S., and R. Strahan. 2008. The Mammals of Australia. Reed New Holland, Sydney.
- Western Wildlife. 2022. Lake Rebecca Gold Project: Detailed Vertebrate Fauna Survey 2021-2022. Perth.
- Wilson, H. 1937. Notes on the Night Parrot, with references to recent occurrences. *Emu* **37**:79-87.
- Woinarski, J. C. Z., B. P. Murphy, S. M. Legge, S. T. Garnett, M. J. Lawes, S. Comer, C. R. Dickman, T. S. Doherty, G. Edwards, A. Nankivell, D. Paton, R. Palmer, and L. A. Woolley. 2017. How many birds are killed by cats in Australia? *Biological Conservation* **214**:76-87.
- Woinarski, J. C. Z., B. P. Murphy, R. Palmer, S. M. Legge, C. R. Dickman, T. S. Doherty, G. Edwards, A. Nankivell, J. L. Read, and D. Stokeld. 2018. How many reptiles are killed by cats in Australia? *Wildlife Research* **45**:247-266.
- Woolley, P. A. 1990. Mulgaras, *Dasycercus cristicauda* (Marsupialia: Dasyuridae); their burrows, and records of attempts to collect live animals between 1966 and 1979. *Australian Mammalogy* **13**:61-64.
- Woolley, P. A. 2005. The species of *Dasycercus* Peters, 1875 (Marsupialia: Dasyuridae). *Memoirs of Museum Victoria* **62**:213-221.
- Woolley, P. A. 2008a. Brush-tailed Mulgara. Pages 47-48 in S. Van Dyck and R. Strahan, editors. The Mammals of Australia. Reed New Holland, Sydney.
- Woolley, P. A. 2008b. Crest-tailed Mulgara. Pages 49-50 in S. Van Dyck and R. Strahan, editors. Mammals of Australia. Reed New Holland, Sydney.

Figures

**Basic vertebrate fauna survey and assessment
Mulgabbie North Project Area**





TERRESTRIAL ECOSYSTEMS

Drawn: S. Thompson

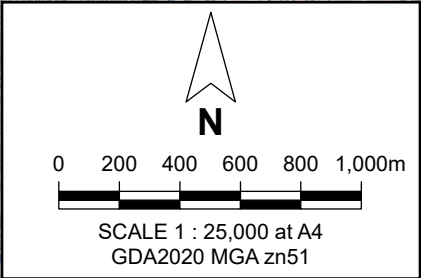
Date: 26 Feb 2025

OzAurum Resources Ltd
BASIC VERTEBRATE FAUNA SURVEY AND ASSESSMENT
MULGABBIE PROJECT AREA

REGIONAL LOCATION

Figure 1

Job: 2024-0161



Legend

Site Boundary

Habitat Assessment Location

Fauna Habitats

Disturbed

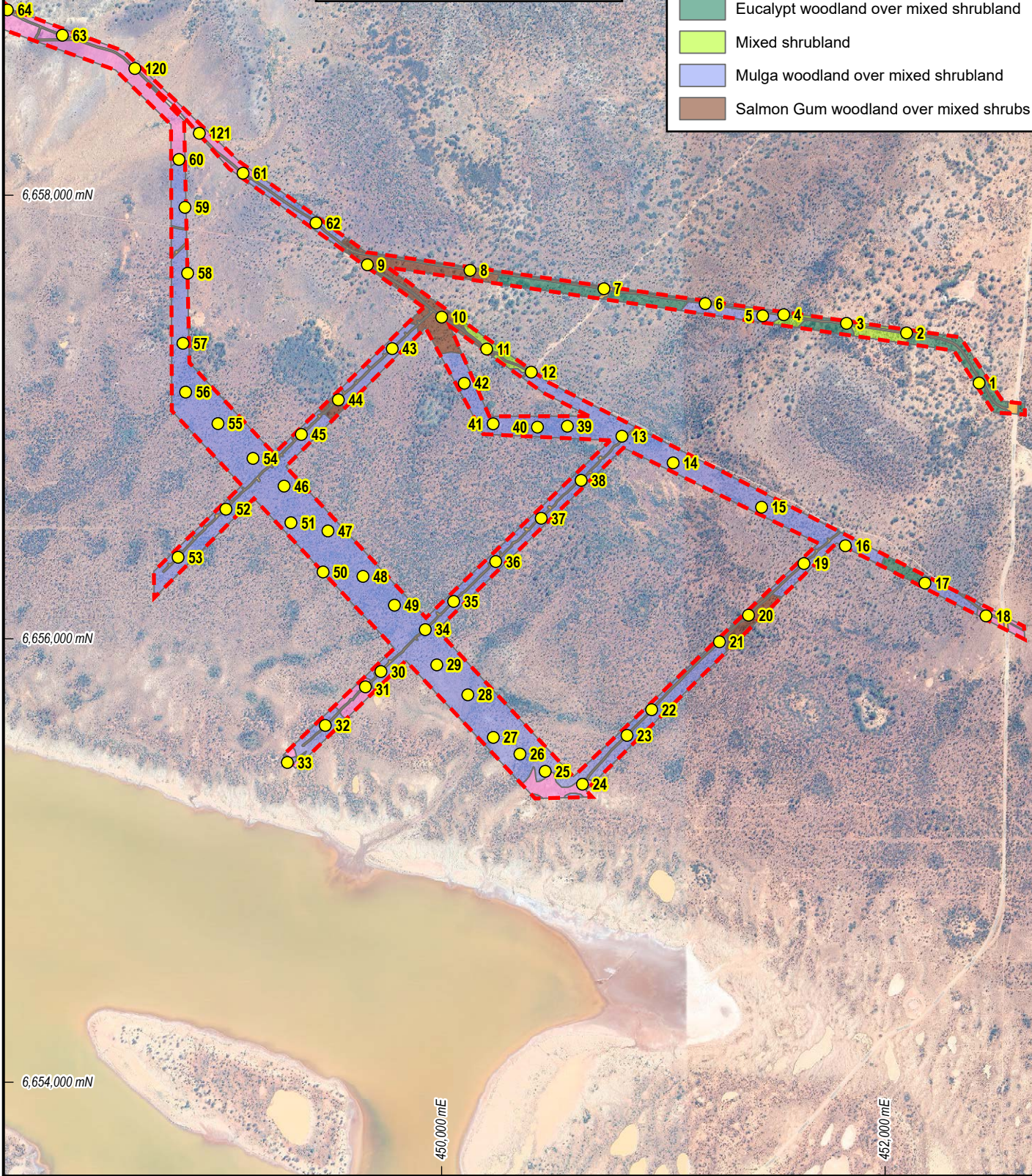
Chenopod shrubland

Eucalypt woodland over mixed shrubland

Mixed shrubland

Mulga woodland over mixed shrubland

Salmon Gum woodland over mixed shrubs



OzAurum Resources Ltd
BASIC VERTEBRATE FAUNA SURVEY AND ASSESSMENT
MULGABBIE PROJECT AREA

**FAUNA HABITAT TYPES AND
HABITAT ASSESSMENT LOCATIONS**

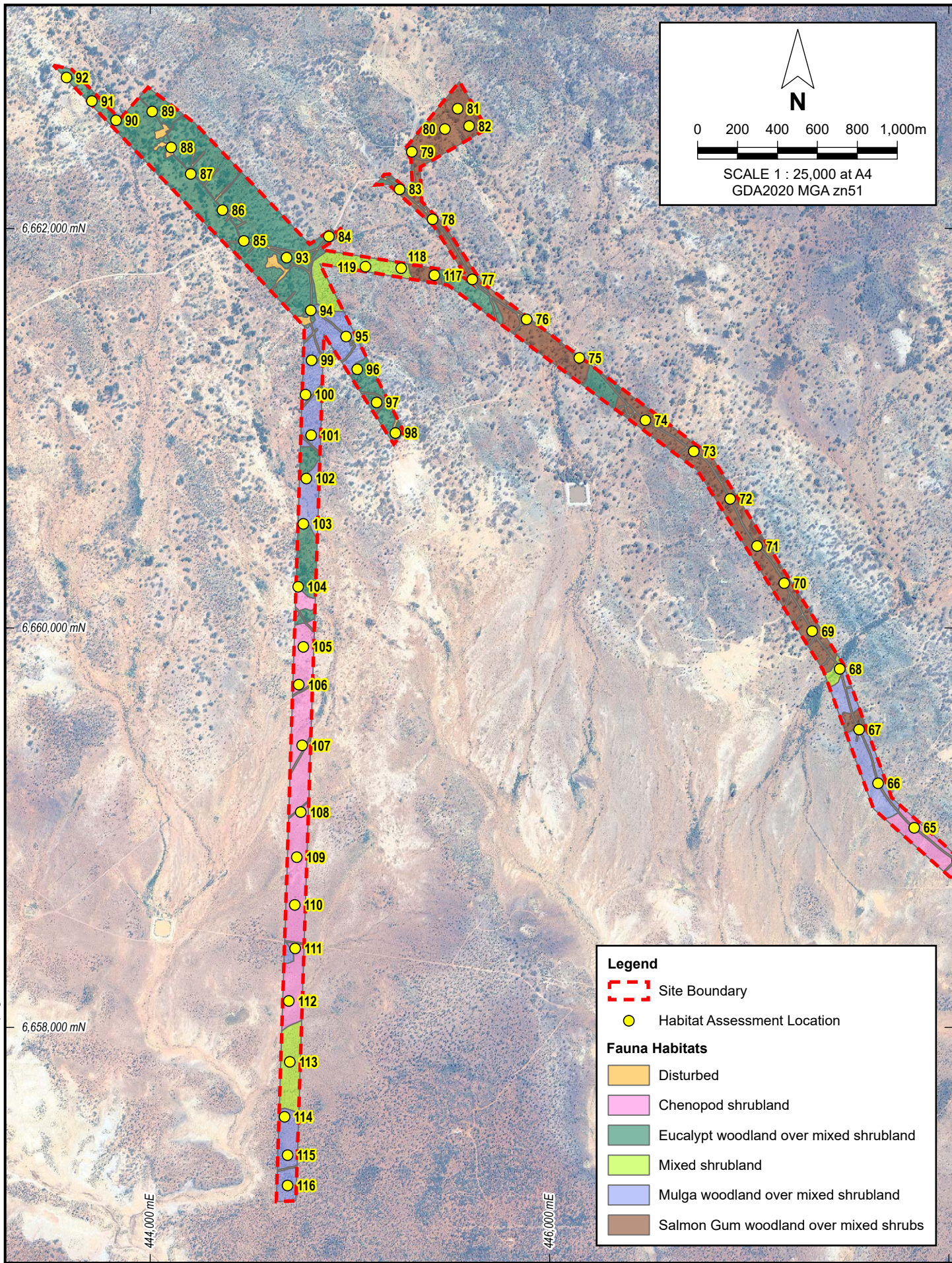
Figure 2

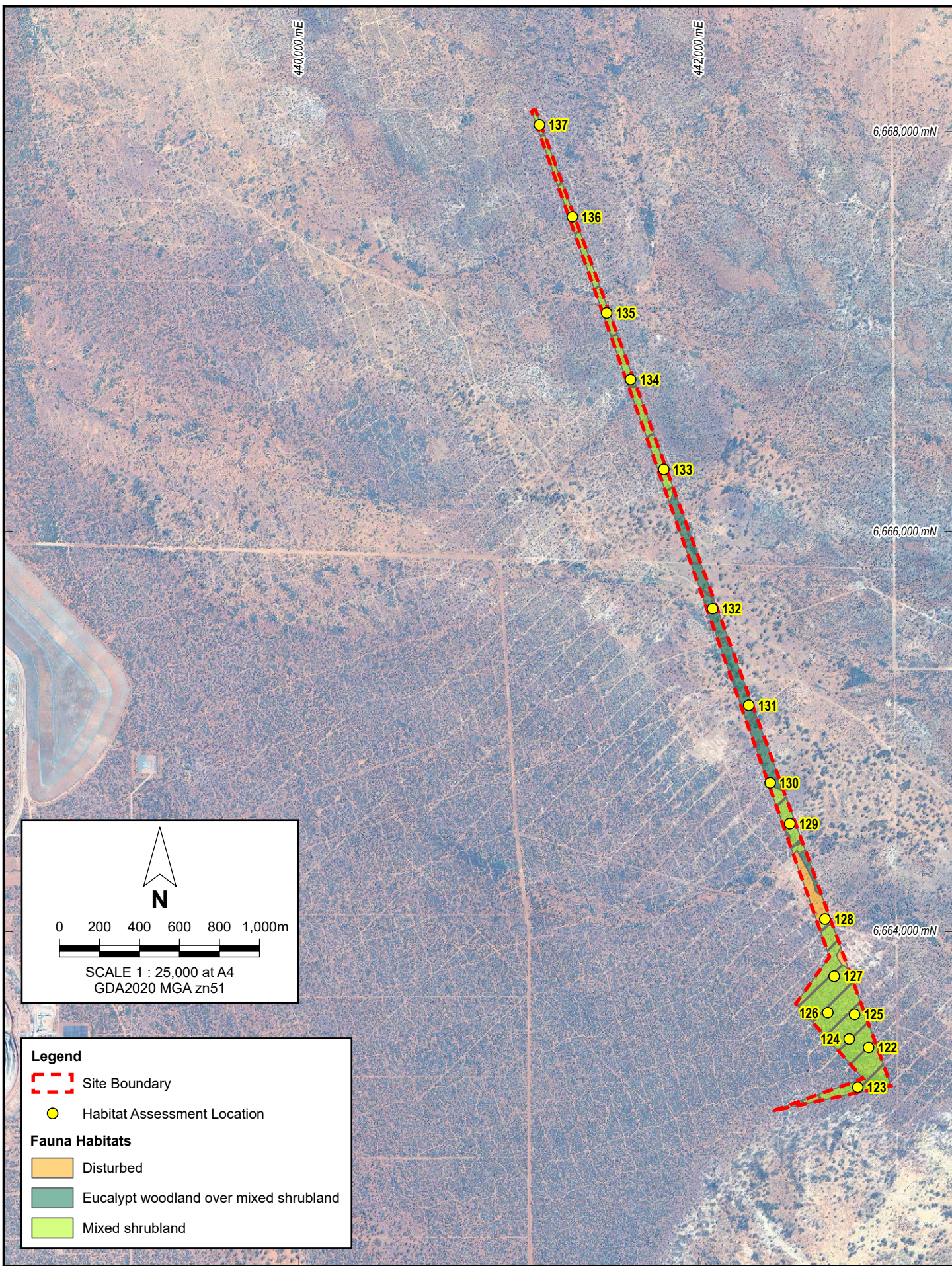
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**TERRESTRIAL
ECOSYSTEMS**

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Date: 26 Feb 2025





Appendix A.

Results of the *EPBC Act* Protected Matters Search

Basic vertebrate fauna survey and assessment
Mulgabbie North Project Area





Australian Government

Department of Climate Change, Energy,
the Environment and Water

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: 26-Feb-2025

[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:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/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:	82
Commonwealth Heritage Places:	None
Listed Marine Species:	13
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:	15
Regional Forest Agreements:	None
Nationally Important Wetlands:	2
EPBC Act Referrals:	12
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places		[Resource Information]
Name	State	Legal Status
Historic		
Goldfields Water Supply Scheme, Western Australia	WA	Listed place

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
BIRD		
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area
INSECT		
Ogyris petrina listed as Ogyris subterrestris petrina Arid Bronze Azure [94250]	Critically Endangered	Species or species habitat may occur within area
MAMMAL		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat known to occur within area
PLANT		
Eleocharis papillosa Dwarf Desert Spike-rush [2519]	Vulnerable	Species or species habitat known to occur within area
Gastrolobium graniticum Granite Poison [14872]	Endangered	Species or species habitat likely to occur within area
Ricinocarpos brevis [82879]	Endangered	Species or species habitat may occur within area
Tecticornia flabelliformis Bead Glasswort, Bead Samphire [82664]	Vulnerable	Species or species habitat known to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat may occur within area
REPTILE		
Liopholis kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji, Tjalapa, Nampu [83160]	Vulnerable	Species or species habitat may occur within area
Listed Migratory Species		
[Resource Information]		
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		

Scientific Name	Threatened Category	Presence Text
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat likely to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area

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
Defence	
Defence - AIRTC KALGOORLIE [50111]	WA
Defence - AIRTC KALGOORLIE [50110]	WA
Defence - KALGOORLIE RIFLE RANGE [50156]	WA
Defence - KALGOORLIE TRAINING DEPOT [50199]	WA
Defence - KALGOORLIE TRAINING DEPOT [50198]	WA
Unknown	
Commonwealth Land - [51962]	WA
Commonwealth Land - [51060]	WA
Commonwealth Land - [51059]	WA
Commonwealth Land - [52183]	WA
Commonwealth Land - [51985]	WA
Commonwealth Land - [51758]	WA
Commonwealth Land - [51765]	WA
Commonwealth Land - [52230]	WA
Commonwealth Land - [51759]	WA
Commonwealth Land - [52184]	WA
Commonwealth Land - [51750]	WA
Commonwealth Land - [51961]	WA
Commonwealth Land - [51963]	WA
Commonwealth Land - [51960]	WA
Commonwealth Land - [50310]	WA
Commonwealth Land - [51764]	WA
Commonwealth Land - [51766]	WA

Commonwealth Land Name	State
Commonwealth Land - [51767]	WA
Commonwealth Land - [51760]	WA
Commonwealth Land - [51761]	WA
Commonwealth Land - [51762]	WA
Commonwealth Land - [51768]	WA
Commonwealth Land - [51763]	WA
Commonwealth Land - [51949]	WA
Commonwealth Land - [51769]	WA
Commonwealth Land - [51430]	WA
Commonwealth Land - [51788]	WA
Commonwealth Land - [51789]	WA
Commonwealth Land - [51782]	WA
Commonwealth Land - [51783]	WA
Commonwealth Land - [51780]	WA
Commonwealth Land - [51781]	WA
Commonwealth Land - [51787]	WA
Commonwealth Land - [51786]	WA
Commonwealth Land - [51772]	WA
Commonwealth Land - [51955]	WA
Commonwealth Land - [51954]	WA
Commonwealth Land - [51951]	WA
Commonwealth Land - [51952]	WA
Commonwealth Land - [51957]	WA
Commonwealth Land - [51950]	WA
Commonwealth Land - [51785]	WA
Commonwealth Land - [51784]	WA
Commonwealth Land - [51953]	WA

Commonwealth Land Name	State
Commonwealth Land - [52211]	WA
Commonwealth Land - [51791]	WA
Commonwealth Land - [51790]	WA
Commonwealth Land - [51794]	WA
Commonwealth Land - [51796]	WA
Commonwealth Land - [51795]	WA
Commonwealth Land - [51778]	WA
Commonwealth Land - [51779]	WA
Commonwealth Land - [51062]	WA
Commonwealth Land - [51063]	WA
Commonwealth Land - [51958]	WA
Commonwealth Land - [51959]	WA
Commonwealth Land - [50334]	WA
Commonwealth Land - [51774]	WA
Commonwealth Land - [50336]	WA
Commonwealth Land - [51773]	WA
Commonwealth Land - [51956]	WA
Commonwealth Land - [51792]	WA
Commonwealth Land - [51793]	WA
Commonwealth Land - [51776]	WA
Commonwealth Land - [51777]	WA
Commonwealth Land - [51775]	WA
Commonwealth Land - [51406]	WA
Commonwealth Land - [50332]	WA
Commonwealth Land - [50329]	WA
Commonwealth Land - [51984]	WA
Commonwealth Land - [50333]	WA

Commonwealth Land Name	State
Commonwealth Land - [51061]	WA
Commonwealth Land - [50331]	WA
Commonwealth Land - [50335]	WA
Commonwealth Land - [51771]	WA
Commonwealth Land - [50337]	WA
Commonwealth Land - [51770]	WA

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

Scientific Name	Threatened Category	Presence Text
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat likely to occur within area overfly marine area

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Bullock Holes Timber Reserve	5(1)(g) Reserve	WA
Cardunia Rocks	Nature Reserve	WA
Coonana Timber Reserve	5(1)(g) Reserve	WA
Credo	NRS Addition - Gazettal in Progress	WA
Emu Rocks Timber Reserve	5(1)(g) Reserve	WA
Goongarrie	National Park	WA
Kalgoorlie Arboretum	5(1)(h) Reserve	WA

Protected Area Name	Reserve Type	State
Kangaroo Hills Timber Reserve	5(1)(g) Reserve	WA
Kurrawang	Nature Reserve	WA
Lakeside Timber Reserve	5(1)(g) Reserve	WA
Ngadju	Indigenous Protected Area	WA
Queen Victoria Spring	Nature Reserve	WA
Unnamed WA46847	Nature Reserve	WA
Wallaby Rocks Timber Reserve	5(1)(g) Reserve	WA
Yallari Timber Reserve	5(1)(h) Reserve	WA

Nationally Important Wetlands		[Resource Information]
Wetland Name		State
Lake Ballard		WA
Lake Marmion		WA

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	
Comet Vale Sand Project	2023/09460		Assessment	
Northern Star Resources - Carosue Dam TSF Cell 4	2021/9026		Post-Approval	

Controlled action			
Goldfields Water Supply Scheme Project	2019/8547	Controlled Action	Post-Approval
Nava-1 Cable System	2001/510	Controlled Action	Completed
Tropicana Gold Project-Develop open cut gold mine, and associated infrastructure	2008/4270	Controlled Action	Post-Approval

Not controlled action			
Construction of a bypass road, haulage contractor workshop & laydown yard	2012/6639	Not Controlled Action	Completed
Focus, Greenfields and Carins Intersection Upgrade,Great Eastern Highway, WA	2014/7171	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
Lynas Kalgoorlie Rare Earths Processing Facility	2020/8719	Not Controlled Action	Completed
Sale of Post Office, Hannan Street	2006/3084	Not Controlled Action	Completed
Saracen Gold-Carosue Dam Aerodrome, WA	2017/7925	Not Controlled Action	Completed
Ularring Hematite Project, WA	2012/6426	Not Controlled Action	Completed

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 is 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 on the contents of this report.

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 point locations and environmental data layers.

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 when time permits.

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 breeding sites; and
- 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 B.

Vertebrate Fauna Recorded in Biological Surveys in the Region

Basic vertebrate fauna survey and assessment
Mulgabbie North Project Area



			Surveys		A	B					C									
			Unknown	KK53	KK54	KK51	KK55	Site 14a	Site 5a	Site 1a	Site 17a	Site 14	Site 20a	Site 11	Site 11a	Site 8	Site 19	Site 14b		
Family	Species	Common name																		
Varanidae	<i>Varanus caudolineatus</i>	Stripe-tailed Monitor	X	3		4		1	2				6							
	<i>Varanus gigan-teus</i>	Perentie							1											
	<i>Varanus gouldii</i>	Gould's Goanna	X		1	1	1		1		1									
	<i>Varanus panoptes</i>	Yellow-spotted Monitor	X					2					1	1						
	<i>Varanus tristis</i>	Black-headed Monitor	X					1												
Bird																				
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu			23			1	2						2		2	5		
Anatidae	<i>Chenonetta jubata</i>	Australian Wood Duck																		
	<i>Anas superciliosa</i>	Pacific Black Duck																		
	<i>Anas gracilis</i>	Grey Teal																		
Megapodiidae	<i>Leipoa ocellata</i>	Malleefowl			1		1													
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail																1		
Podicipedidae	<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe																		
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing		1	1	2										1				
	<i>Ocyphaps lophotes</i>	Crested Pigeon						5	6		11	1	7			9		2		
Cuculidae	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo		3	5	4	1													
	<i>Chrysococcyx osculans</i>	Black-eared Cuckoo				2							2					1		
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				1		3				3				1		2		
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth		3									1							
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar							2	2										
Apodidae	<i>Apus pacificus</i>	Pacific Swift																		
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew																		
Charadriidae	<i>Vanellus tricolor</i>	Banded Lapwing							1		4			9				4		
	<i>Charadrius ruficapillus</i>	Red-capped Plover																		
Scolopacidae	<i>Tringa glareola</i>	Wood Sandpiper																		
Turnicidae	<i>Turnix velox</i>	Little Buttonquail											2					5		
Otididae	<i>Ardeotis australis</i>	Australian Bustard						4							1					
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant																		
Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle											1					3		
	<i>Aquila audax</i>	Wedge-tailed Eagle						2			2	6				3				
	<i>Circus assimilis</i>	Spotted Harrier				1												1		
	<i>Accipiter fasciatus</i>	Brown Goshawk															3			
	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk																		
	<i>Haliastur sphe-nurus</i>	Whistling Kite		2																
Cuculidae	<i>Heteroscenes pallidus</i>	Pallid Cuckoo		1								2	1			1	1			
Strigidae	<i>Ninox boobook</i>	Southern Boobook																		
Alcedinidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher									6		1					1		

Family	Species	Common name	Surveys															
			A	B					C									
			Unknown	KK53	KK54	KK51	KK55	Site 14a	Site 5a	Site 1a	Site 17a	Site 14	Site 20a	Site 11	Site 11a	Site 8	Site 19	Site 14b
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo	X	1		7			1						1			
	<i>Osphranter robustus</i>	Euro	X	4					1		1		1			1	1	
	<i>Osphranter rufus</i>	Red Kangaroo	X			3		1	1		1	1	1	1	1	1		
Vombatidae	<i>Lasiorhinus latifrons</i>	Southern Hairy-nosed Wombat	X															
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit	X						2		1			1		1		
Peramelidae	<i>Perameles bougainville</i>	Western Barred Bandicoot	X															
Equidae	<i>Equus caballus</i>	Horse																
Muridae	<i>Mus musculus</i>	House Mouse	X	8		11	4		2		1			2			3	
	<i>Notomys alexis</i>	Spinifex Hopping Mouse	X													1		
	<i>Notomys mitchellii</i>	Mitchell's Hopping Mouse				2	7											
	<i>Pseudomys bolami</i>	Bolam's Mouse	X															
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	X	1	2	2	2	1					2	1		1	7	

A Atlas of Living Australia

B McKenzie, N.L., Rolfe, J.K. and Youngson, W.K. (1992) Vertebrate fauna. In: The Biological Survey of the Eastern Goldfields of Western Australia; Part 8; Kurnalpi - Kalgoorlie Study Area. Records of the Western Australian Museum Supplement No 41, 37-65.

C Dell, J and How, R.A. (1988) Vertebrate fauna. In: The biological Survey of the Eastern Goldfields of Western Australia, Part 5, Edjudina - Menzies Study Area. Records of the Western Australian Museum, Supplement No 31., pp. 38-77.

		Surveys	A										B		C										D	
Family	Species	Common name	Site 6	Opportunistic	Site 5	Site 7	Site 4	Site 2	Site 8	Site 3	Site 1	Opportunistic:	Site 10	Site 9	Opportunistic	site 10	site 1	site 3	site 5	site 8	site 4	site 9	site 6	site 7	site 2	Jump Up Dam
	<i>Petroica goodenovii</i>	Red-capped Robin			1		6	2		3																1
	<i>Melanodryas cucullata</i>	Hooded Robin				1																				
Locustellidae	<i>Cincloramphus cruralis</i>	Brown Songlark													1											
	<i>Cincloramphus mathewsi</i>	Rufous Songlark																								
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow																								
	<i>Petrochelidon nigricans</i>	Tree Martin										X														
	<i>Cheramoeca leucosterna</i>	White-backed Swallow										X														
Zosteropidae	<i>Zosterops lateralis</i>	Silvereye																								
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird										X														1
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch																								1
Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian Pipit													1											1
Mammals																										
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna										X			1											1
Bovidae	<i>Bos taurus</i>	Cow										X														1
	<i>Capra hircus</i>	Goat																								1
	<i>Ovis aries</i>	Sheep													1											
Camelidae	<i>Camelus dromedarius</i>	Dromedary										X														
Canidae	<i>Canis lupus</i>	Dingo													1											
	<i>Vulpes vulpes</i>	Red Fox																								1
Felidae	<i>Felis catus</i>	Cat													1											1
Molossidae	<i>Austronomus australis</i>	White-striped Freetail Bat										X														
	<i>Mormopterus planiceps</i>	Southern Free-tail Bat																								
	<i>Ozimops kitcheneri</i>	South-western Free-tail Bat										X														1
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat										X														1
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat										X														1
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat										X														1
	<i>Vespadelus baverstocki</i>	Inland Forest Bat										X														
	<i>Vespadelus regulus</i>	Southern Forest Bat																								
Dasyuridae	<i>Dasyercus blythi</i>	Brush-tailed Mulgara																								
	<i>Ningaui ridei</i>	Wongai Ningau																								
	<i>Ningaui yvonneae</i>	Mallee Ningau				4																				
	<i>Pseudantechinus woolleyae</i>	Woolley's False Antechinus																								
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart				1																				
	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart	6			1	1	2	3							1			2			3	2			
	<i>Antechinomys longicaudatus</i>	Long-tailed Dunnart										X														
Burramyidae	<i>Cercartetus concinnus</i>	Southwestern Pygmy Possum											1	3								1				

		Surveys	A										B			C										D
Family	Species	Common name	Site 6	Opportunistic	Site 5	Site 7	Site 4	Site 2	Site 8	Site 3	Site 1	Opportunistic:	Site 10	Site 9	Opportunistic	site 10	site 1	site 3	site 5	site 8	site 4	site 9	site 6	site 7	site 2	Jump Up Dam
Macropodidae	<i>Macropus fuliginosus</i>	Western Grey Kangaroo										X														
	<i>Osphranter robustus</i>	Euro										X			1											1
	<i>Osphranter rufus</i>	Red Kangaroo										X														1
Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit										X			1											1
Equidae	<i>Equus caballus</i>	Horse										X														
Muridae	<i>Mus musculus</i>	House Mouse			8	2			9		5							2	1	3			2			
	<i>Notomys alexis</i>	Spinifex Hopping Mouse			2																					
	<i>Pseudomys bolami</i>	Bolam's Mouse			1	4							1													
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	1							3																

A Western Wildlife (2022) Rebecca Gold Project: Detailed Vertebrate Fauna Survey 2021-2022, Unpublished reported Remelius Resources, Perth.

B Hart, Simpson and Associates (2000) Anaconda Nickel Ltd, Cawse Expansion Project, Fauna Survey. Unpublished report for Anaconda Nickel Ltd, Perth.

C Terrestrial Ecosystems (2010) Fauna Assessment for the Majestic Gold Project, Unpublished report for Botanica Consulting Pty Ltd and Integra Mining Ltd, Perth.

D Ecologia Environment (2007) Jump Up Dam Fauna Assessment. Unpublished report for Heron Resources, Perth.

Appendix C.

Definitions of Significant Fauna under the WA Biodiversity Conservation Act 2016 and Priority Species

Basic vertebrate fauna survey and assessment
Mulgabbie North Project Area



APPENDIX C

DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WA BIODIVERSITY CONSERVATION ACT 2016

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.

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).

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 pwild. 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 birds protected under an international agreement

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 dependant 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

P1 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.

P2 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.

P3 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.

P4 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.

Appendix D.

Rapid habitat assessment results

Basic vertebrate fauna survey and assessment
Mulgabbie North Project Area



Date: 13/12/2024

Habitat Assessment #: 1

Observer: Dr Scott Thompson

GDA94 51; 452424 mE 6657153 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 2

Observer: Dr Scott Thompson

GDA94 51; 452097 mE 6657379 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 3

Observer: Dr Scott Thompson

GDA94 51; 451826 mE 6657422 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 4

Observer: Dr Scott Thompson

GDA94 51; 451543 mE 6657461 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 5

Observer: Dr Scott Thompson

GDA94 51; 451448 mE 6657456 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 6

Observer: Dr Scott Thompson

GDA94 51; 451189 mE 6657511 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 7

Observer: Dr Scott Thompson

GDA94 51; 450732 mE 6657578 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 8

Observer: Dr Scott Thompson

GDA94 51; 450128 mE 6657661 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 9

Observer: Dr Scott Thompson

GDA94 51; 449665 mE 6657686 mN

Fire History: > 5yrs

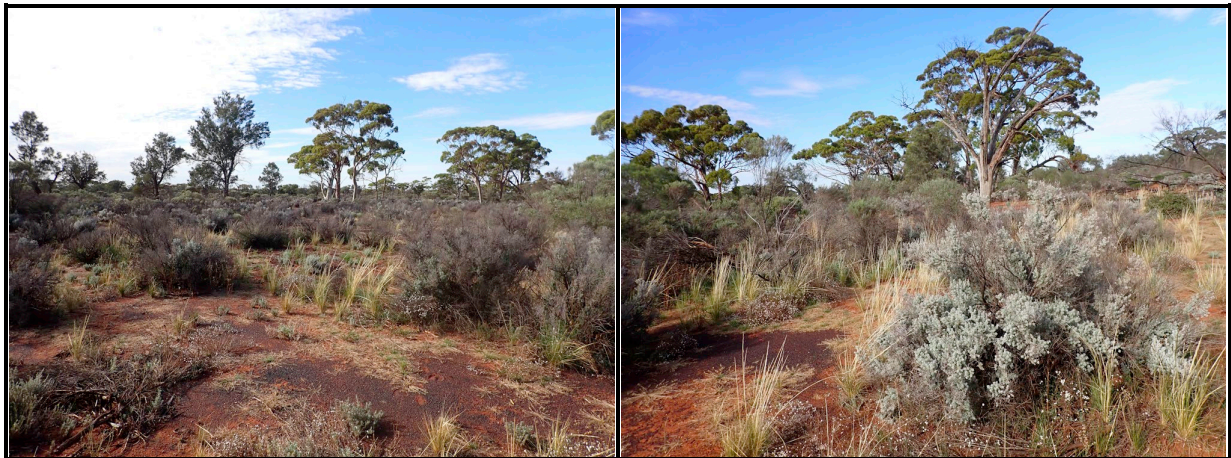
Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 10

Observer: Dr Scott Thompson

GDA94 51; 450000 mE 6657450 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 11

Observer: Dr Scott Thompson

GDA94 51; 450203 mE 6657306 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 12

Observer: Dr Scott Thompson

GDA94 51; 450404 mE 6657202 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 13

Observer: Dr Scott Thompson

GDA94 51; 450813 mE 6656913 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 14

Observer: Dr Scott Thompson

GDA94 51; 451044 mE 6656793 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 15

Observer: Dr Scott Thompson

GDA94 51; 451443 mE 6656593 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 16

Observer: Dr Scott Thompson

GDA94 51; 451821 mE 6656419 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 17

Observer: Dr Scott Thompson

GDA94 51; 452180 mE 6656251 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 18

Observer: Dr Scott Thompson

GDA94 51; 452455 mE 6656103 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 19

Observer: Dr Scott Thompson

GDA94 51; 451634 mE 6656339 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 20

Observer: Dr Scott Thompson

GDA94 51; 451384 mE 6656106 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 21

Observer: Dr Scott Thompson

GDA94 51; 451253 mE 6655986 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 22

Observer: Dr Scott Thompson

GDA94 51; 450947 mE 6655680 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 23

Observer: Dr Scott Thompson

GDA94 51; 450836 mE 6655564 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 24

Observer: Dr Scott Thompson

GDA94 51; 450635 mE 6655344 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 25

Observer: Dr Scott Thompson

GDA94 51; 450467 mE 6655402 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 26

Observer: Dr Scott Thompson

GDA94 51; 450353 mE 6655480 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 27

Observer: Dr Scott Thompson

GDA94 51; 450233 mE 6655555 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 28

Observer: Dr Scott Thompson

GDA94 51; 450118 mE 6655747 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 29

Observer: Dr Scott Thompson

GDA94 51; 449978 mE 6655882 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 30

Observer: Dr Scott Thompson

GDA94 51; 449726 mE 6655852 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 31

Observer: Dr Scott Thompson

GDA94 51; 449656 mE 6655783 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 32

Observer: Dr Scott Thompson

GDA94 51; 449475 mE 6655609 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 33

Observer: Dr Scott Thompson

GDA94 51; 449304 mE 6655442 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 34

Observer: Dr Scott Thompson

GDA94 51; 449926 mE 6656041 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 35

Observer: Dr Scott Thompson

GDA94 51; 450054 mE 6656168 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 36

Observer: Dr Scott Thompson

GDA94 51; 450244 mE 6656348 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 37

Observer: Dr Scott Thompson

GDA94 51; 450449 mE 6656543 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 38

Observer: Dr Scott Thompson

GDA94 51; 450629 mE 6656714 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 39

Observer: Dr Scott Thompson

GDA94 51; 450567 mE 6656958 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 40

Observer: Dr Scott Thompson

GDA94 51; 450432 mE 6656954 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 41

Observer: Dr Scott Thompson

GDA94 51; 450232 mE 6656969 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 42

Observer: Dr Scott Thompson

GDA94 51; 450102 mE 6657152 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 43

Observer: Dr Scott Thompson

GDA94 51; 449777 mE 6657308 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 44

Observer: Dr Scott Thompson

GDA94 51; 449534 mE 6657077 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 45

Observer: Dr Scott Thompson

GDA94 51; 449367 mE 6656921 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 46

Observer: Dr Scott Thompson

GDA94 51; 449289 mE 6656688 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 47

Observer: Dr Scott Thompson

GDA94 51; 449487 mE 6656486 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 48

Observer: Dr Scott Thompson

GDA94 51; 449645 mE 6656281 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 49

Observer: Dr Scott Thompson

GDA94 51; 449787 mE 6656151 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 50

Observer: Dr Scott Thompson

GDA94 51; 449465 mE 6656301 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 51

Observer: Dr Scott Thompson

GDA94 51; 449320 mE 6656523 mN

Fire History: > 5yrs

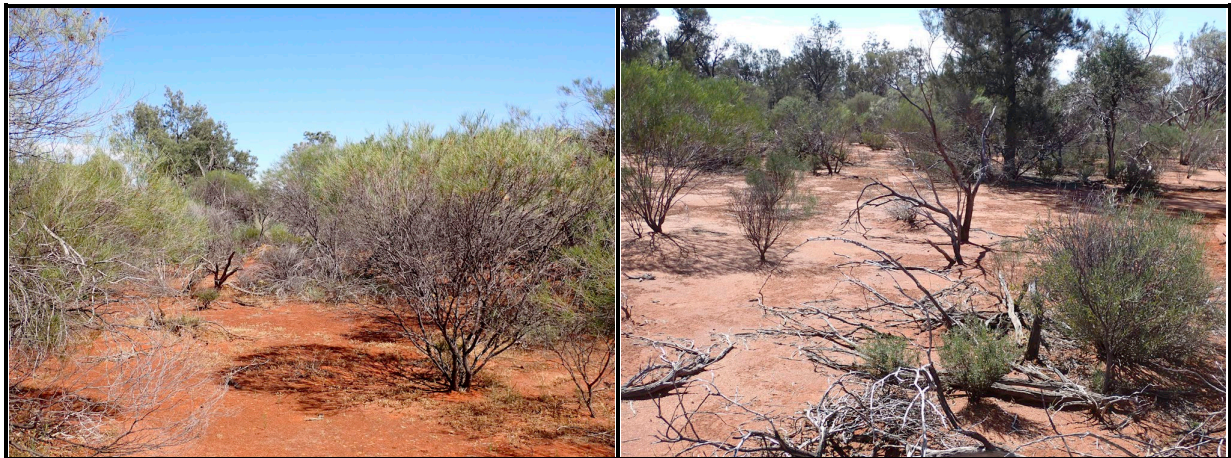
Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 52

Observer: Dr Scott Thompson

GDA94 51; 449027 mE 6656584 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 53

Observer: Dr Scott Thompson

GDA94 51; 448811 mE 6656367 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 54

Observer: Dr Scott Thompson

GDA94 51; 449149 mE 6656813 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 55

Observer: Dr Scott Thompson

GDA94 51; 448991 mE 6656970 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 56

Observer: Dr Scott Thompson

GDA94 51; 448845 mE 6657112 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 57

Observer: Dr Scott Thompson

GDA94 51; 448833 mE 6657332 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 58

Observer: Dr Scott Thompson

GDA94 51; 448854 mE 6657648 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 59

Observer: Dr Scott Thompson

GDA94 51; 448842 mE 6657945 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 60

Observer: Dr Scott Thompson

GDA94 51; 448815 mE 6658161 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 61

Observer: Dr Scott Thompson

GDA94 51; 449104 mE 6658099 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 62

Observer: Dr Scott Thompson

GDA94 51; 449433 mE 6657875 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 63

Observer: Dr Scott Thompson

GDA94 51; 448289 mE 6658721 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disurbed

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 64

Observer: Dr Scott Thompson

GDA94 51; 448041 mE 6658835 mN

Fire History: > 5yrs

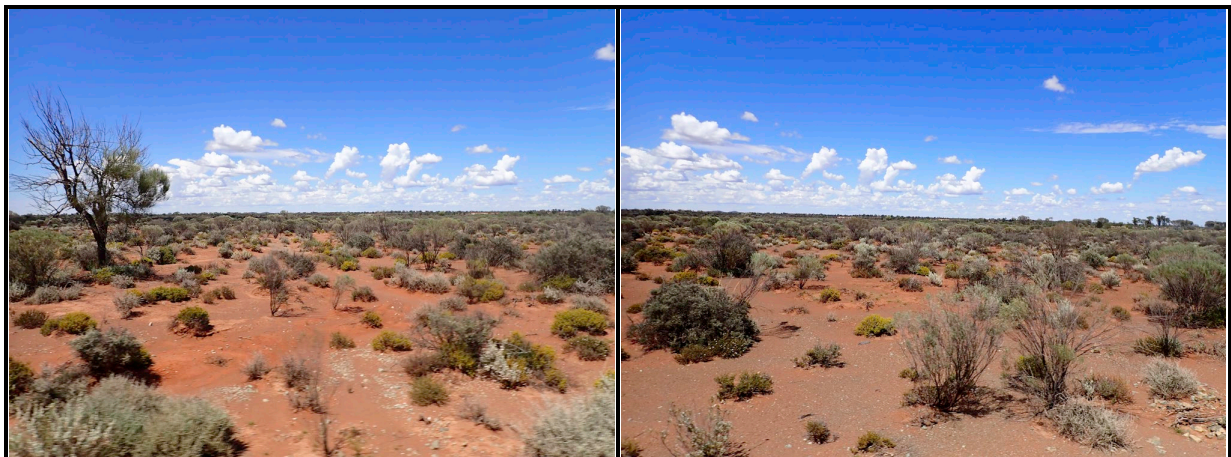
Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 65

Observer: Dr Scott Thompson

GDA94 51; 447826 mE 6658999 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 66

Observer: Dr Scott Thompson

GDA94 51; 447645 mE 6659222 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 67

Observer: Dr Scott Thompson

GDA94 51; 447550 mE 6659491 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 68

Observer: Dr Scott Thompson

GDA94 51; 447453 mE 6659795 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 69

Observer: Dr Scott Thompson

GDA94 51; 447315 mE 6659984 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 70

Observer: Dr Scott Thompson

GDA94 51; 447175 mE 6660224 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 71

Observer: Dr Scott Thompson

GDA94 51; 447039 mE 6660410 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 72

Observer: Dr Scott Thompson

GDA94 51; 446904 mE 6660646 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 73

Observer: Dr Scott Thompson

GDA94 51; 446722 mE 6660884 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 74

Observer: Dr Scott Thompson

GDA94 51; 446480 mE 6661040 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 75

Observer: Dr Scott Thompson

GDA94 51; 446149 mE 6661352 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 76

Observer: Dr Scott Thompson

GDA94 51; 445885 mE 6661545 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 77

Observer: Dr Scott Thompson

GDA94 51; 445613 mE 6661745 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 78

Observer: Dr Scott Thompson

GDA94 51; 445414 mE 6662046 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 79

Observer: Dr Scott Thompson

GDA94 51; 445310 mE 6662384 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 80

Observer: Dr Scott Thompson

GDA94 51; 445476 mE 6662498 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 81

Observer: Dr Scott Thompson

GDA94 51; 445540 mE 6662600 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 82

Observer: Dr Scott Thompson

GDA94 51; 445597 mE 6662513 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 83

Observer: Dr Scott Thompson

GDA94 51; 445249 mE 6662196 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 84

Observer: Dr Scott Thompson

GDA94 51; 444895 mE 6661960 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 85

Observer: Dr Scott Thompson

GDA94 51; 444469 mE 6661938 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 86

Observer: Dr Scott Thompson

GDA94 51; 444362 mE 6662092 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 87

Observer: Dr Scott Thompson

GDA94 51; 444203 mE 6662273 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Sand

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 88

Observer: Dr Scott Thompson

GDA94 51; 444105 mE 6662406 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 89

Observer: Dr Scott Thompson

GDA94 51; 444010 mE 6662586 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Good

Surface: Sand

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 90

Observer: Dr Scott Thompson

GDA94 51; 443829 mE 6662542 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Good

Surface: Sand

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 91

Observer: Dr Scott Thompson

GDA94 51; 443708 mE 6662638 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very Good

Surface: Sand

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 92

Observer: Dr Scott Thompson

GDA94 51; 443581 mE 6662756 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very Good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 93

Observer: Dr Scott Thompson

GDA94 51; 444683 mE 6661854 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very Good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 94

Observer: Dr Scott Thompson

GDA94 51; 444804 mE 6661590 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 95

Observer: Dr Scott Thompson

GDA94 51; 444981 mE 6661459 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 96

Observer: Dr Scott Thompson

GDA94 51; 445037 mE 6661295 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 97

Observer: Dr Scott Thompson

GDA94 51; 445134 mE 6661129 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 98

Observer: Dr Scott Thompson

GDA94 51; 445228 mE 6660976 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 99

Observer: Dr Scott Thompson

GDA94 51; 444808 mE 6661340 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 100

Observer: Dr Scott Thompson

GDA94 51; 444778 mE 6661168 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 101

Observer: Dr Scott Thompson

GDA94 51; 444806 mE 6660965 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 102

Observer: Dr Scott Thompson

GDA94 51; 444782 mE 6660748 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 103

Observer: Dr Scott Thompson

GDA94 51; 444767 mE 6660521 mN

Fire History: > 5yrs

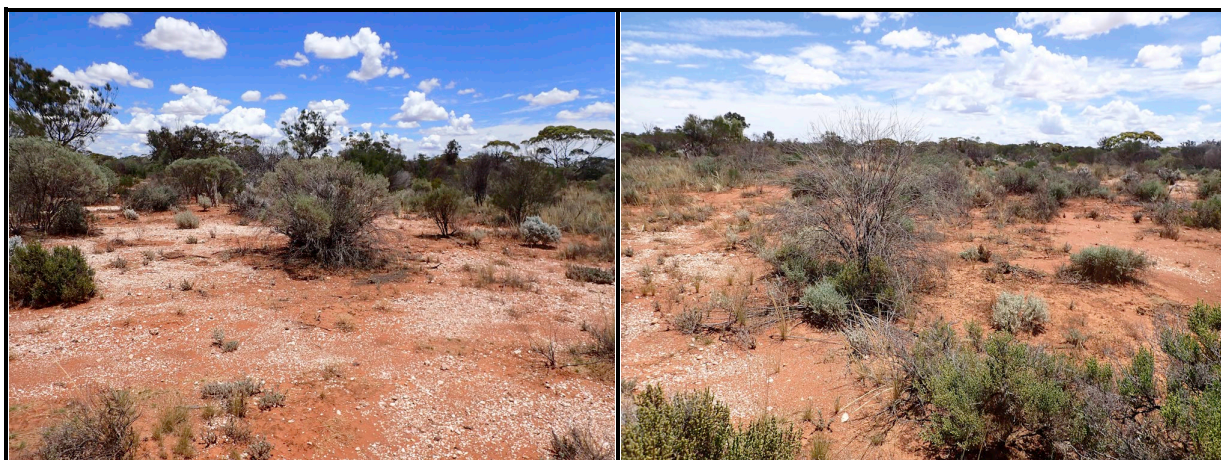
Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 104

Observer: Dr Scott Thompson

GDA94 51; 444741 mE 6660206 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 105

Observer: Dr Scott Thompson

GDA94 51; 444767 mE 6659905 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 106

Observer: Dr Scott Thompson

GDA94 51; 444744 mE 6659716 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 107

Observer: Dr Scott Thompson

GDA94 51; 444761 mE 6659412 mN

Fire History: > 5yrs

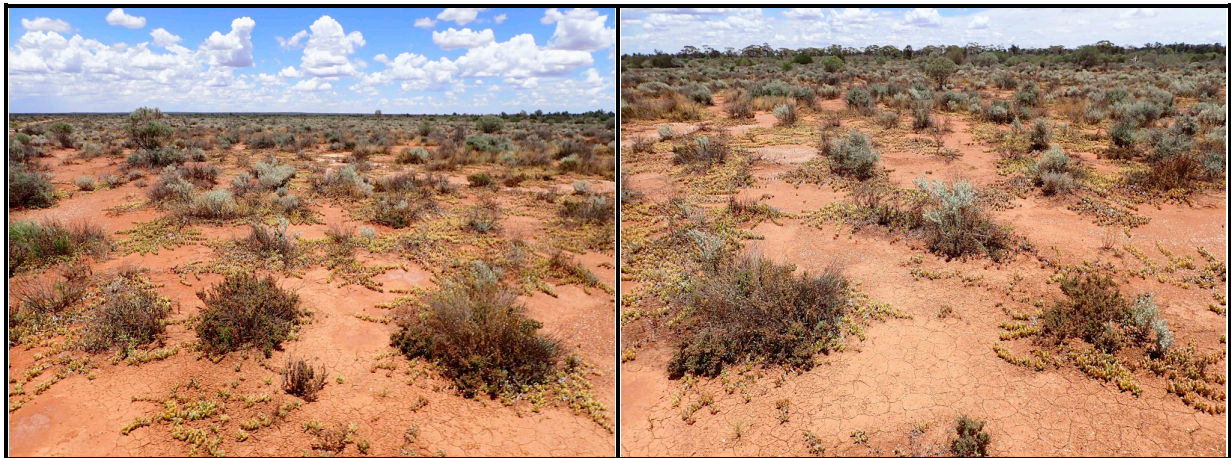
Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 108

Observer: Dr Scott Thompson

GDA94 51; 444754 mE 6659078 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 109

Observer: Dr Scott Thompson

GDA94 51; 444734 mE 6658852 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 110

Observer: Dr Scott Thompson

GDA94 51; 444724 mE 6658613 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 111

Observer: Dr Scott Thompson

GDA94 51; 444726 mE 6658395 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 112

Observer: Dr Scott Thompson

GDA94 51; 444694 mE 6658132 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 113

Observer: Dr Scott Thompson

GDA94 51; 444699 mE 6657827 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 114

Observer: Dr Scott Thompson

GDA94 51; 444673 mE 6657552 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 115

Observer: Dr Scott Thompson

GDA94 51; 444688 mE 6657360 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 116

Observer: Dr Scott Thompson

GDA94 51; 444688 mE 6657208 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mulga woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 117

Observer: Dr Scott Thompson

GDA94 51; 445423 mE 6661766 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 118

Observer: Dr Scott Thompson

GDA94 51; 445257 mE 6661801 mN

Fire History: > 5yrs

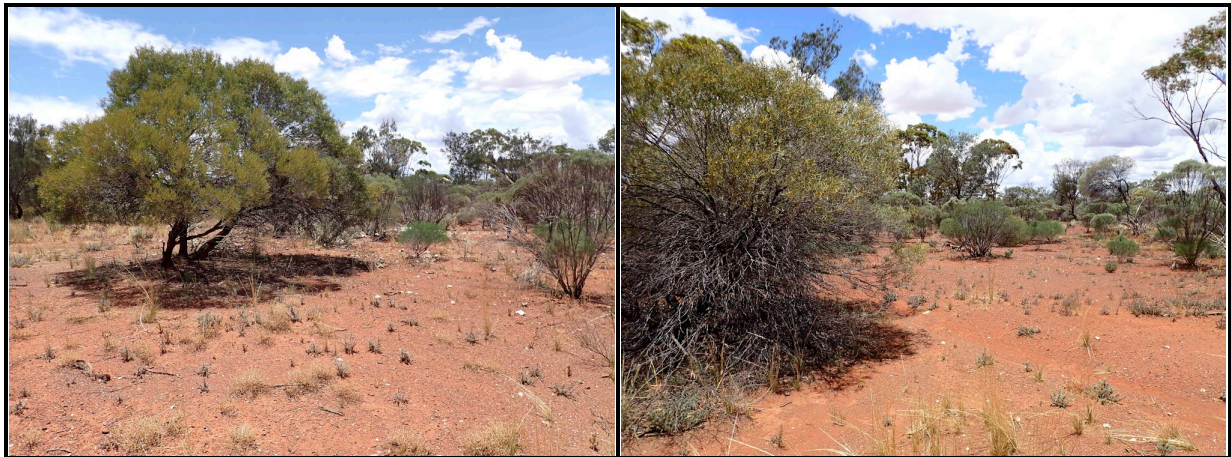
Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 119

Observer: Dr Scott Thompson

GDA94 51; 445078 mE 6661809 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Pebbles and cobbles

Habitat Type: Mixed shrubland



Date: 13/12/2024

Habitat Assessment #: 120

Observer: Dr Scott Thompson

GDA94 51; 448616 mE 6658571 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Disturbed

Surface: Pebbles and cobbles

Habitat Type: Chenopod shrubland



Date: 13/12/2024

Habitat Assessment #: 121

Observer: Dr Scott Thompson

GDA94 51; 448907 mE 6658279 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Chenopod shrubland



Date: 28/01/2024

Habitat Assessment #: 122

Observer: Dr Scott Thompson

GDA94 51; 442848 mE 6663420 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 123

Observer: Dr Scott Thompson

GDA94 51; 442794 mE 6663221 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 124

Observer: Dr Scott Thompson

GDA94 51; 442751 mE 6663463 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 125

Observer: Dr Scott Thompson

GDA94 51; 442778 mE 6663585 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 126

Observer: Dr Scott Thompson

GDA94 51; 442644 mE 6663594 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 127

Observer: Dr Scott Thompson

GDA94 51; 442676 mE 6663776 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 128

Observer: Dr Scott Thompson

GDA94 51; 442630 mE 6664063 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 129

Observer: Dr Scott Thompson

GDA94 51; 442454 mE 6664539 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 130

Observer: Dr Scott Thompson

GDA94 51; 442356 mE 6664743 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 131

Observer: Dr Scott Thompson

GDA94 51; 442249 mE 6665131 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 132

Observer: Dr Scott Thompson

GDA94 51; 442068 mE 6665615 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand

Habitat Type: Eucalyptus woodland over mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 133

Observer: Dr Scott Thompson

GDA94 51; 441824 mE 6666311 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 134

Observer: Dr Scott Thompson

GDA94 51; 441658 mE 6666760 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 135

Observer: Dr Scott Thompson

GDA94 51; 441538 mE 6667093 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 136

Observer: Dr Scott Thompson

GDA94 51; 441367 mE 6667574 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland



Date: 28/01/2024

Habitat Assessment #: 137

Observer: Dr Scott Thompson

GDA94 51; 441202 mE 6668034 mN

Fire History: > 5yrs

Landform: Undulating plain

Soil Type: Sandy clay

Habitat Quality: Very good

Surface: Sand and pebbles

Habitat Type: Mixed shrubland





**Reconnaissance Flora and
Vegetation Survey of the Mulgabbie
Project Borefield and Access
Roads- December 2024**

Prepared for



OzAurum Resources Ltd

FINAL V2.1
February 2025

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1 INTRODUCTION

OzAurum Resources Ltd (ASX:OZM) holds a 50% equity stake in the Mulgabbie Gold Joint Venture Project Development Agreement, signed with Line Hydrogen (Australia) Pty Ltd in October 2024. The agreement marks the beginning of development for the Mulgabbie Gold Project as Australia's first zero-emissions gold operation, located in Western Australia's Murchison Region (DCCEEW, 2023).

The project is currently under development. Part of this development requires the use of a borefield and associated access roads. OZM require a reconnaissance flora and vegetation survey to determine any impact to flora and vegetation within the proposed borefield area.

Native Vegetation Solutions (NVS) was supplied with a survey area located approximately 108 km northeast of Kalgoorlie, in the Murchison Region (MUR) of Western Australia (Figure 1).

The total survey area received from OZM covered approximately 342.49 ha. The survey area lies within Miscellaneous Licenses L28/48, L28/49, L28/71, L28/75 and L28/76. Actual disturbance footprints are not yet defined; however, clearing required within the boundary of the survey area is anticipated to be less than the total survey area.

This report will encompass results of the reconnaissance flora and vegetation survey within the Mulgabbie Project Borefield and Access Roads survey area.



Figure 1: Regional map of survey location

1.1 Purpose and Scope

The objective of this report is to document the results of the flora and vegetation component of a reconnaissance assessment conducted in accordance with:

- *Environmental Factor Guideline- Flora and Vegetation* (EPA, 2016); and
- *Technical Guidance- Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016a).

A reconnaissance assessment has two components:

- 1). Desktop study which includes a literature review and a search of the relevant databases;
- 2). Reconnaissance survey of the survey area to verify the desktop survey, to define vegetation units present in the area, search for species of conservation significance and to determine potential sensitivity to impact.

As part of the reporting for the reconnaissance assessment, NVS has conducted a flora and vegetation survey which includes broad-scale vegetation mapping and vegetation condition mapping of the survey area.

The scope of work for the reconnaissance flora and vegetation survey was to:

- conduct a desktop study that includes a literature review and search of the relevant databases;
- describe the vegetation associations in the survey area;
- prepare an inventory of species occurring in the survey area;
- identify any vegetation communities or flora species of conservation significance;
- map broad-scale vegetation groups found within the survey area, including vegetation condition; and
- provide recommendations, including the management of perceived impacts to flora and vegetation within the survey area.

1.2 Statutory Framework and Guidance

This assessment took into account relevant sections of Commonwealth and State legislation and guidelines:

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

The Minister for the Environment publishes lists of flora species in need of special protection because they are considered rare, likely to become extinct, or are presumed extinct. The current listings were published in the Government Gazette on 30 April 2024 (Lawn, 2024) and were taken into account.

As well as those listed above, the assessment took into account relevant sections of:

- EPA (2023) *Statement of environmental principles, factors, objectives and aims of EIA*;
- EPA (2016) *Environmental Factor Guideline: Flora and Vegetation*; and
- EPA (2016a) *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment*, known as *Flora and Vegetation Technical Guidance*

1.2.1 Western Australian Biodiversity Conservation Act 2016

The Western Australian *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia. The BC Act replaced the *Wildlife Conservation Act 1950*.

Threatened species (both flora and fauna) that meet the categories listed within the Act are highly protected and require authorisation by the Ministerial to take or disturb. These are known as

Threatened Flora and Threatened Fauna. The conservation categories of Critically Endangered, Endangered and Vulnerable have been aligned with those detailed in the EPBC Act, as below.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the BC Act. These are known as specially protected species in the BC Act.

Threatened Ecological Communities (TECs) are also protected under BC Act and are categorised using the same criteria as threatened species.

1.2.2 Environmental Protection Act 1986

The *EP Act 1986* was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information included in environmental assessments and provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

1.2.3 Environment Protection and Biodiversity Conservation Act 1999

At a Commonwealth level, Threatened taxa are protected under the EPBC Act, which lists species and ecological communities that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct, or Extinct in the Wild (Section 6 below).

1.2.4 Flora

1.2.4.1 Threatened and Priority Flora

Conservation significant flora species are those that are listed as TF (Threatened Flora) and (within Western Australia) as PF (Priority Flora). TF species are listed as threatened by the Western Australian Department of Biodiversity Conservation and Attractions (DBCA) and protected under the provisions of the BC Act. Some State-listed TF are provided with additional protection as they are also listed under the Commonwealth EPBC Act. Species can also be listed under the EPBC Act without being listed under the BC Act.

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and these may require a greater level of protection than unlisted species. Generally though, PF have no statutory protection. They are generally considered in environmental impact assessments under the state approval processes by Department of Mines, Industry Regulation and Safety (DEMIRS) under the *Mining Act 1978* and DBCA under the EP Act. Under this approval process measures are usually taken to protect and avoid PF.

There are seven categories covering State-listed TF and PF species (DBCA, 2023) which are defined in Section 7 below. PF for Western Australia are regularly reviewed by DBCA whenever new information becomes available, with species status altered or removed from the list (Lawn, 2024) when data indicates that they no longer meet the requirements outlined in Section 7 below.

1.2.4.2 Other Significant Flora

According to the Flora and Vegetation Technical Guidance (EPA 2016a) other than being listed as Threatened or Priority Flora, a species can be considered as significant if it is considered to be:

- locally endemic or association with a restricted habitat type (e.g., surface water or groundwater dependent ecosystems)
- a new species or has anomalous features that indicate a potential new species
- at the extremes of range, recently discovered range extensions (generally considered greater than 100 km or in a different bioregion), or isolated outliers of the main range
- unusual species, including restricted subspecies, varieties or naturally occurring hybrids and
- relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

1.2.5 Ecological Communities and Vegetation

1.2.5.1 Threatened and Priority Ecological Communities

Nationally Listed Threatened Ecological Communities

An ecological community is a naturally occurring group of plants, animals and other organisms interacting in a unique habitat. The complex range of interactions between the component species provides an important level of biological diversity in addition to genetics and species. At Commonwealth level, Threatened Flora and TECs are protected under the Commonwealth EPBC Act. An ecological community may be categorised into one of the three subcategories:

- Critically Endangered, if it is facing an extremely high risk of extinction in the wild in the immediate future
- Endangered, if it is not critically endangered and is facing a very high risk of extinction in the wild in the near future and
- Vulnerable, if it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

State Listed Threatened Ecological Communities

The Western Australian DBCA also maintains a list of TECs, protected under the BC Act, which are further categorised into three subcategories much like those of the EPBC Act.

State Listed Priority Ecological Communities

DBCA maintains a list of Priority Ecological Communities (PECs). PECs include potential TECs that do not meet survey criteria, or that are not adequately defined.

1.2.5.2 Other Significant Vegetation

According to the Flora and Vegetation Technical Guidance (EPA 2016a), other than being listed as a TEC or PEC, vegetation can be considered as significant if it is considered to have:

- restricted distribution
- a degree of historical impact from threatening processes
- a role as a refuge; and/or
- provides an important function required to maintain ecological integrity of a significant ecosystem.

1.2.5.3 Declared Pest Plants

The Western Australian Organism List (WAOL) details organisms listed as Declared Pests under the BAM Act). Under the BAM Act, Declared Pests are listed as one of the three categories, or exempt:

- C1 (exclusion), that applies to pests not established in Western Australia; control measures are to be taken to prevent their entry and establishment
- C2 (eradication), that applies to pests that are present in Western Australia but in low numbers or in limited areas where eradication is still a possibility

- C3 (management), that applies to established pests where it is not feasible or desirable to manage them in order to limit their damage; or
- Exempt (no category).

2. EXISTING ENVIRONMENT

2.1 Geology and Vegetation

The survey area lies in the Murchison (MUR) bioregion, more specifically the Eastern Murchison (MUR01) subregion. The Eastern Murchison subregion covers over 7 million hectares and contains the northern parts of the 'Southern Cross' and 'Eastern Goldfields' Terrains of the Yilgarn Craton. The landscape is characterised by extensive areas of elevated red desert sandplains with minimal dune development and internal drainage. The occluded Paleodrainage system generates Salt lake systems. Other features include broad plains of red-brown soils, breakaway complexes, and red sandplains. Mulga woodlands often rich in ephemerals; hummock grasslands, saltbush shrublands and *Tecticornia* shrublands dominate the vegetation (CALM, 2002)

2.2 Climate

The climate of the Murchison Region is classified as Arid with 200-300 mm of rainfall, sometimes in summer but usually in winter (CALM, 2002). The nearest official meteorological weather station with the most complete and up to date temperature information is Kalgoorlie-Boulder Airport (station number 012038), which is located approximately 115.7 km west of the survey area.

2.2.1 Temperature

Mean annual minimum temperature at Kalgoorlie-Boulder Airport is 11.8°C and mean annual maximum temperature is 25.4°C (BOM, 2025). The coldest temperatures are attained in July (mean minimum temperature 5.1°C), the hottest is January (mean maximum temperature 33.7°C) and diurnal temperature variations are relatively consistent throughout the year (Figure 2).

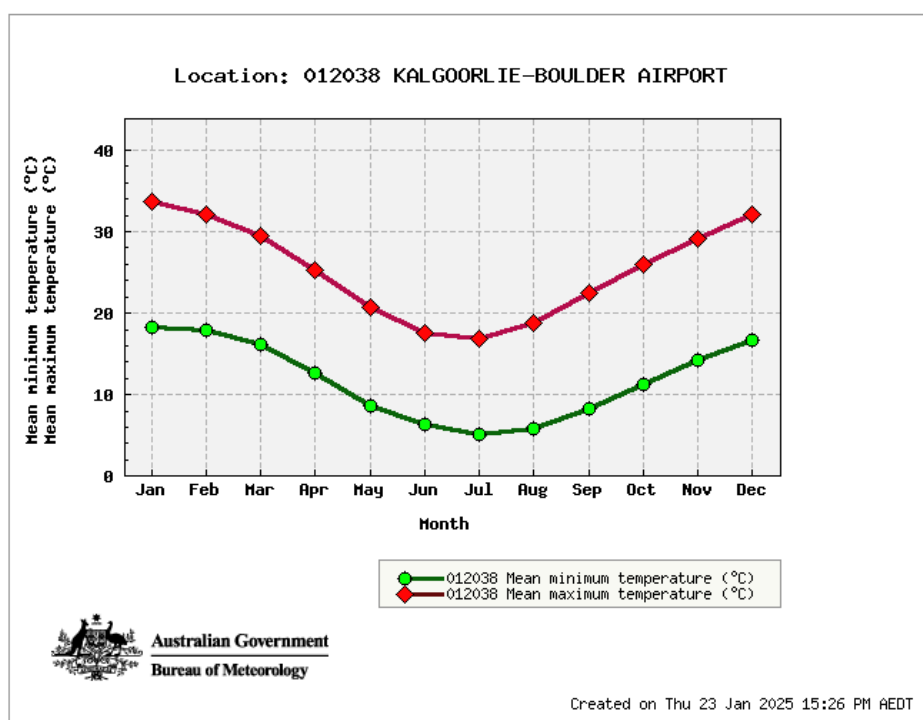


Figure 2: Mean temperature ranges for Kalgoorlie-Boulder Airport weather station

2.2.2 Rainfall

The annual average rainfall at Kalgoorlie-Boulder Airport is 265.3 mm, which falls (>1 mm) on an average of 39.1 rain-days (BOM, 2025). Larger rainfall events occur from January to August (Figure 3). Prior to the survey in 2024, rainfall in March, June, July and November exceeded monthly averages while rainfall for all other months remained below monthly averages (BOM, 2025).

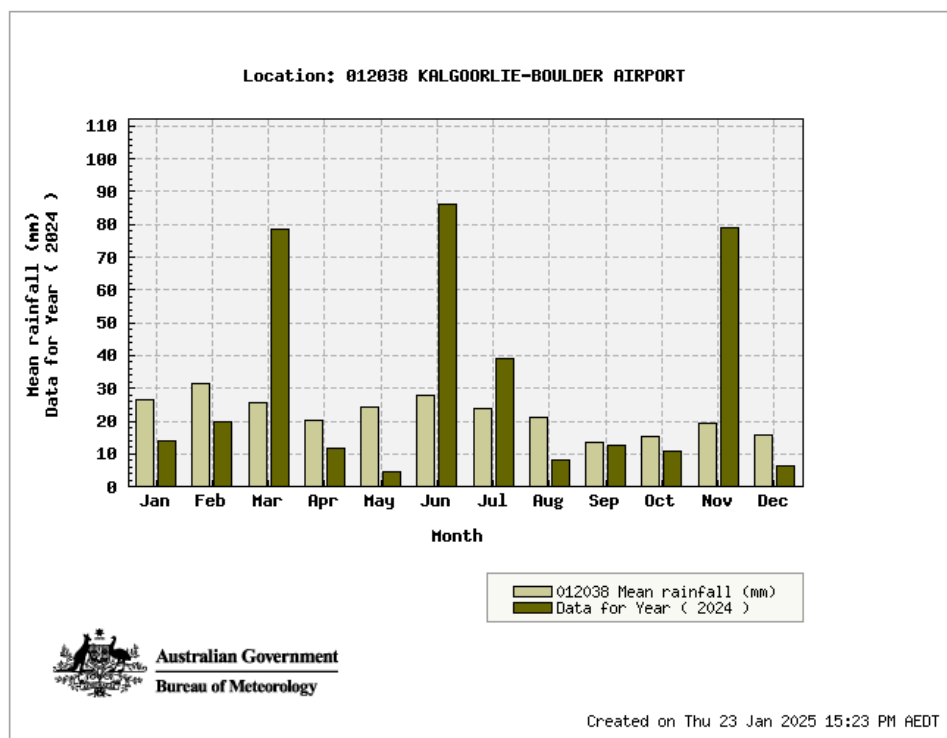


Figure 3: Monthly and mean rainfall for Kalgoorlie-Boulder Airport weather station

3. ASSESSMENT METHODOLOGY

3.1 Personnel and Reporting

The following personnel were involved in the Reconnaissance flora and vegetation survey:

- Mr Eren Reid (*BSc- Biological Science*), Principal Botanist, Native Vegetation Solutions, undertook the survey, vegetation mapping, data collation, field identification of flora, preparation and review of the report. Mr Eren Reid has over 20 years' experience in botanical surveys throughout the Murchison Region and over a variety of environments across Western Australia.

3.2 Preliminary Desktop Study

A preliminary assessment of the survey area and its potential constraints was undertaken by reviewing relevant government agency managed databases (Sections 3.2.1 to 3.2.6, and Appendices 1 & 2) and consulting with government agencies where necessary. The following sections provide a summary of desktop searches undertaken for the project.

3.2.1 Known Previous Flora and Vegetation Surveys

Two known Flora and Vegetation Surveys have previously been completed at the Mulgabbie Project in 2019 and 2020 by Alexander Holm & Associates (AHA, 2019 & AHA, 2020). The locations of these previous survey areas occur adjacent to the current survey area (Figure 4).

A summary of the findings of each survey is presented in Table 1 below.

Table 1: Previous Survey Findings

Survey Title	Dates	Survey Area Size (ha)	Conservation Significant Flora Identified	TEC/PEC Identified
Environmental Assessment: Proposed Seismic Survey Area Saracen Gold Mines- February 2019	January 7 -12, 2019 and February 4- 13, 2019.	3,136	<i>Eremophila arachnoides</i> subsp. <i>tenera</i> (P3)	No
Environmental Assessment: Relief Hill Survey Area Saracen Gold Mines- February 2020	January 7 -12, 2020.	2,080	<i>Thryptomene eremaea</i> (P2)	No

The assessments above also took into account the following surveys that were either within or adjoined them:

- Mattiske Consulting Pty Ltd (2010) Flora and vegetation survey of the proposed airstrip.
- Mattiske Consulting Pty Ltd (2010) Flora and vegetation survey of the Karari pit extension.
- AHA (2010) Environmental assessment-proposed expansion of Whirling Dervish mine.
- AHA (2012b) Environmental assessment – proposed expansion of Tailings Storage Facility.

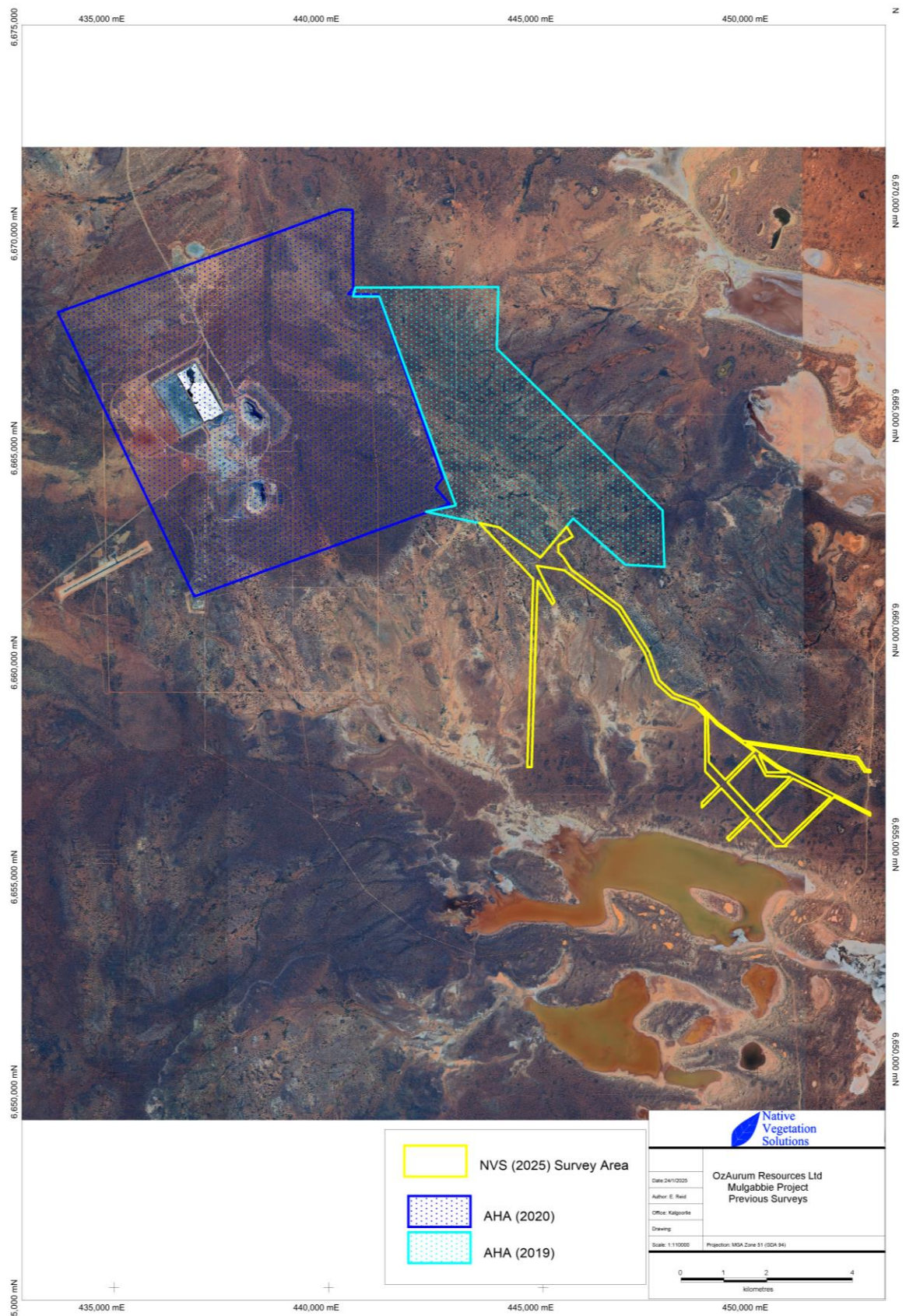


Figure 4: NVS survey area in comparison to AHA previous survey areas

3.2.2 Environment Protection and Biodiversity Conservation Act Protected Matters

The *EPBC Act* Protected Matters Search tool was utilised to provide results for matters of National Environmental Significance within the survey area using the survey area as the search criteria with a 20 km buffer (DCCEEW, 2025).

3.2.3 Threatened Flora and Communities

The “Dandjoo” Database managed by the Department of Biodiversity, Conservation and Attractions (DBCA) was interrogated for threatened and priority flora within a 20km radial area of the survey area (DBCA, 2025).

The likelihood of presence of threatened ecological communities within the general survey area was assessed using the protected matters search tool (DCCEEW, 2025)

Other threatened ecosystems in the MUR01 subregion, are listed in CALM (2002).

PECs in the area were also assessed from DBCA (2023a) listings (Version 35, June 2023).

3.2.4 Environmentally Sensitive Areas (ESAs) and Conservation Reserves

The Department of Water and Environmental Regulation (DWER, 2025) Clearing Permit System Map Viewer was used to determine the location of any ESAs and Conservation Reserves.

3.2.5 Vegetation Type, Extent and Status

Vegetation extent and status data was sourced from the Department of Agriculture and Food (DAFWA) report and its associated GIS file (Shepherd *et al*, 2002). This data comprises Beard’s Pre-European vegetation groups.

DBCA's Statewide Vegetation Statistics (DBCA, 2019) was also referenced for the current extent of Beard's Vegetation Groups. The purpose of examining this information is to determine if the survey area lies within any vegetation groups defined by Beard that may have been subjected to widescale clearing for European settlement. The national objectives and targets for biodiversity conservation recognise that the retention of 30% or more of the pre-clearing extent of a Beard vegetation association is necessary if Australia’s biological diversity is to be protected.

3.2.6 Wetlands

The potential of wetlands within the project area was determined by examining DWER’s Clearing Permit System Map Viewer (DWER, 2025).

3.2.7 Dieback

Under normal circumstances Dieback is only considered a potential issue for any project if the project area lies within the Southwest Land Division and the mean annual rainfall of the area is greater than 400 mm. There is no record of *Phytophthora cinnamomi* (Dieback) establishing in natural ecosystems in regions receiving <400mm rainfall per annum (CALM, 2003).

However, as indicated within the more recent Dieback guidelines (DBCA, 2020), other species of *Phytophthora* may persist east of the 400mm isohyet in unusually wet conditions. It is therefore recommended to conduct a risk assessment as per these guidelines.

3.3 Site Investigation

A site visit of the survey area was carried out by Botanist Eren Reid from Native Vegetation Solutions on the 13th of December 2024 to examine the flora and vegetation groups contained within the survey area. A total of 11 hours was spent on site traversing the survey area, by Yamaha Viking All-Terrain Vehicle (ATV) and on foot.

The survey was conducted in accordance with relevant Environmental Protection Authority's (EPA's) Statements and Technical Guidance (Section 1.1).

The EPA uses the Interim Biogeographic Regionalisation of Australia (IBRA) as the largest unit for Environmental Impact Assessment (EIA) decision making in relation to the conservation of biodiversity. Given the scale and nature of the proposed disturbance as well as the existing disturbance, and that the survey area is located within the Murchison (MUR) IBRA region, a reconnaissance flora and vegetation survey was deemed adequate.

A small strip of vegetation (35.5 ha) between the previous AHA (2019) and AHA (2020) survey areas was also subjected to a Targeted Threatened Flora survey. The vegetation groups from the two previous AHA reports align with each other; therefore a Targeted Threatened Flora survey was deemed adequate to cover this small area. The targeted survey was completed on 28th January 2025.

3.3.1 Licenses

A Scientific License was not required for the field work as no samples were collected for identification. All taxa were able to be identified in the field.

3.3.2 Field Methods

Prior to the field work, the aerial photography was examined and representative sample sites for relevés were chosen to provide coverage over all potential vegetation types.

In the field, 20m x 20m relevé sites were established at these sites, taking into account representation of surrounding vegetation and vegetation boundaries. Relevé sites are represented in Appendix 4.

Each relevé site was captured on a TwoNav Aventura GPS at $\pm 4\text{m}$ accuracy, using Universal Transverse Mercator location on GDA94 datum. Digital photographs were taken of each representative vegetation group present in the survey area.

Data collected at each relevé included:

- Photograph of representative vegetation group;
- GPS Location;
- Species Present;
- Population Count/Estimate of Conservation Significant Flora (if present);
- Disturbance Level; and
- Vegetation Condition

The vegetation structure was assessed using the method developed by Muir (1977). Definitions of the vegetation structure are presented in Appendix 3.

The condition of each relevé was assessed using the method developed by Keighery (1994). Definitions of the condition scale are presented in Appendix 3.

Vegetation groups were mapped using the methods listed in Section 3.3.4 below.

Opportunistic recording of plant taxa and vegetation group mapping was also utilised in the survey area between relevé sampling points, via wandering traverses. Smaller singular relevé sites were also utilised as opportunistic sample sites to record taxa and assist in mapping vegetation groups.

All relevé sample sites and GPS tracks are included in Appendix 4.

3.3.3 Post-Field Methods

Taxa were identified with the use of information published on Florabase (WAHERB, 2025). Threatened flora range extensions and new locations were submitted to the Western Australian Herbarium (WAHERB) as per the EPA Technical Guidelines (EPA 2016a).

Species information was transferred into Microsoft Excel® worksheets representing presence/absence of species per vegetation group.

3.3.4 Mapping

Vegetation mapping was produced via GPS recorded information in the field, cross-referenced with vegetation descriptions made in the field, overlaid on aerial imagery of the survey area. The GPS utilised (TwoNav Aventura GPS) displayed aerial imagery, hence real-time mapping of vegetation groups was available during field work.

Vegetation Health Condition was assessed in the field with reference to Keighery (1994).

GPS tracks and waypoints recorded during field work are presented in Appendix 4.

3.3.5 IBSA Data Package

The Environmental Protection Authority (EPA), Department of Water and Environmental Regulation (DWER) and Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) require Index of Biodiversity Surveys for Assessments (IBSA) Data Packages to be submitted to support assessment and compliance under the *Environmental Protection Act 1986*.

An IBSA data package is a single file in .zip format, containing:

- one survey report in .pdf format;
- one plain-text survey report in .txt format; and
- a set of electronic data files, comprising:
 - one survey details spatial dataset in shapefile (.shp, etc.) or MapInfo (.tab, etc.) format; and
 - one or more survey data spatial datasets, as required, in shapefile (.shp, etc.) or MapInfo (.tab, etc.) format.

The IBSA Data package for this survey will be submitted via the DWER IBSA Submission Portal.

3.4 Nomenclature And Taxonomy

Nomenclature follows that used by the WAHERB (2025).

The WAHERB has updated its sequence and arrangement of collections to conform to the systematic sequence of the Angiosperm Phylogeny Group (APGIII), with the result that many Families and Genera have been moved or renamed. This report attempts to follow those changes in relation to species recorded during this survey.

3.5 Limitations

Table 2 lists potential limitations that may have affected the survey.

Table 2: List of potential survey limitations

Potential Limitations	Constraint (Y/N)	Comment
Competency and experience of the consultants undertaking the survey	N	Experienced and competent personnel conducted the survey. Eren Reid (<i>BSc</i>) has over 20 years' experience in botanical surveys throughout the Murchison Region and over a variety of environments across Western Australia.
Scope	N	The Scope of work was adequately defined. Vascular flora species were the focus of the survey and were thoroughly sampled.
Proportion of flora identified during survey	N	As the survey was planned to target species of conservation significance and flora within a defined survey area, a complete census of the species present was attempted (Approx. 95%). Sufficient identifications were made to allow vegetation descriptions to be made.
Sources of information	N	Threatened and Priority Flora information was available from DBCA.
Proportion of the task achieved	N	All tasks completed.
Timing/Season	N	The reconnaissance flora and vegetation survey was conducted in December 2024. Flowering annual species were present within the survey area, suggesting recent above average rainfall in November 2024 was sufficient for the period of survey. The most recent rainfall received in the area was on 21 st November 2024.
Disturbance in survey area	N	Minor disturbance (historical mining access tracks and exploration) was observed within the survey area, however, did not compromise the results of the survey as these areas were avoided whilst collecting data.
Intensity of survey effort	N	The survey intensity is considered to have been sufficient for a reconnaissance survey according to EPA (2016) guidelines. Areas most likely to contain threatened and priority species were targeted. Vegetation mapping sites were selected to provide adequate coverage of the survey area.
Resources	N	Resources, in terms of time, equipment, support and personnel were adequate to undertake and complete the reconnaissance survey.
Access problems	N	All the areas in need of survey were easily accessible from existing tracks, or by foot.
Availability of contextual information on the region	N	Contextual information regarding vegetation and flora of the Murchison bioregion is readily available. Adequate information was able to be accessed from available databases.

4. RESULTS

4.1 Preliminary Desktop Assessment

4.1.1 EPBC Act Protected Matters

Results of the EPBC Protected Matters search tool are included in Appendix 1.

The EPBC Protected Matters report indicated no TF, TECs or Commonwealth Reserves within the requested survey area.

4.1.2 Threatened Flora and Communities

The DBCA “Dandjoo” database searches revealed a potential for no Threatened and four Priority Flora species to occur within a 20km radius of the survey area (DBCA, 2025).

Results of the “Dandjoo” database search are included in Appendix 2 which includes the likelihood of each species to occur within the survey area.

The assessment of PEC/TEC information (DCCEEW, 2025) revealed that no TECs occur within 20km of the survey area, and no vegetation groups recorded in this survey area are synonymous with PECs listed by DBCA (2023a).

4.1.3 Environmentally Sensitive Areas and Conservation Reserves

No ESA’s are located within the survey area. However, the survey area intersects within a ‘C’ Class Common Reserve (DWER, 2025). Reserve details are listed in Table 3 below and displayed in Appendix 1.

Table 3: Reserves located within the survey area

Reserve Number	Class	Purpose	Responsible Agency
R 17325	C	Common	DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

4.1.4 Land Systems

As part of the Rangeland resource surveys, the Department of Agriculture mapped the Land Systems of Western Australia (DPIRD, 2017). The Land Systems occurring within the survey area are listed in Table 4 below and displayed in Appendix 4.

Table 4: Land Systems occurring within the survey area (DPIRD, 2017)

Land System	Description	Extent of Survey Area (ha)	% Of Survey Area (%)
Campsite System	Alluvial plains supporting eucalypt woodlands with halophytic understoreys and acacia shrublands.	7.66	2.24%
Carnegie System	Salt lakes with fringing saline alluvial plains, kopi dunes and sandy banks, supporting halophytic shrublands and acacia tall shrublands.	93.04	27.17%
Gundockerta System	Extensive, gently undulating calcareous stony plains supporting bluebush shrublands.	117.92	34.44%
Leonora System	Low greenstone hills and stony plains supporting mixed chenopod shrublands.	79.32	23.16%
Moriarty System	Low greenstone rises and stony plains supporting chenopod shrublands with patchy eucalypt overstoreys.	44.50	12.99%

4.1.5 Vegetation Type, Extent and Status

Two vegetation units defined by Beard (1990) were identified as part of the desktop assessment. The vegetation units identify the Pre-European extent of vegetation, as mapped by Beard (1990). The national objectives and targets for biodiversity conservation recognise that the retention of 30% or more of the pre-clearing extent of Beard's vegetation associations is necessary if Australia's biological diversity is to be protected.

Information relating to known Beard (1990) vegetation units within the survey area has been summarised in Table 5, Table 6 and Table 7 below. This information has been compiled through both desktop assessments and the site visit.

The extent of the Beard vegetation units within the survey area at all scales is less than 1% of the total area at each scale (Table 5). The single Beard vegetation unit is above the 30% threshold at a State, bioregional and subregional scale.

Table 5: Extent of Beard Associations within the survey area

Beard Vegetation Association	Extent within survey area (ha)	% of survey area (%)	By Association WA	By IBRA Region (MUR)	By IBRA Sub-region (MUR01)	By Shire (City of Kalgoorlie-Boulder)
24	186.09	54.33	<1%	<1%	<1%	<1%
480	156.40	45.67	<1%	<1%	<1%	<1%

Table 6: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 24 within the survey area

Factor	Value				
Beard Vegetation Association*	24				
Vegetation Association Description*	Low woodland; Allocasuarina cristata				
Pre-European Extent (ha)	Scale				
	By Association* (WA)	By Association** (WA)	By IBRA Region** Murchison	By IBRA Sub-region** Eastern Murchison	By LGA** KALGOORLIE-BOULDER, CITY OF
	266,665	263,148	22,163	22,163	19,266
% Pre-European Extent Remaining**	100.00%	99.99%	99.91%	99.91%	99.90%
Surrounding Land Use***	Mining, Exploration, Prospecting, Pastoral Lease				
Weed prevalence***	Low				

* Source: Shepherd *et al.* (2002) Appendix 2

**Source: DBCA, (2019)

***Source: Field Assessment

Table 7: Summary of information regarding Pre-European and current vegetation extent of Vegetation Association 480 within the survey area

Factor	Value				
Beard Vegetation Association*	480				
Vegetation Association Description*	Succulent steppe with open low woodland; mulga & sheoak over saltbush				
Pre-European Extent (ha)	Scale				
	By Association* (WA)	By Association** (WA)	By IBRA Region** Murchison	By IBRA Sub-region** Eastern Murchison	By LGA** KALGOORLIE-BOULDER, CITY OF
	127,393	86,099	48,745	48,745	77,361
% Pre-European Extent Remaining**	100.00%	99.96%	99.93%	99.93%	100.00%
Surrounding Land Use***	Mining, Exploration, Prospecting, Pastoral Lease				
Weed prevalence***	Low				

* Source: Shepherd *et al.* (2002) Appendix 2

**Source: DBCA, (2019)

***Source: Field Assessment

4.1.6 Wetlands

The DWER Clearing Permit System Map Viewer revealed no waterbodies within the survey area (DWER, 2025).

4.1.7 Dieback

The survey area lies south of the 26th parallel, however receives average annual rainfall of 265.3 mm. There is no record of *Phytophthora cinnamomi* establishing in natural ecosystems in regions receiving less than 400mm rainfall per annum (CALM, 2003).

However, as indicated within the more recent Dieback guidelines (DBCA, 2020), other species of *Phytophthora* may persist east of the 400mm isohyet in unusually wet conditions. It is therefore recommended to conduct a risk assessment as per these guidelines.

Additionally, all measures should be taken to prevent any possible soil contamination (including seeds of non-native species *etc.*) which poses a risk in the survey area during seasonally favourable conditions.

4.2 Field Assessment

4.2.1 Threatened Flora

No Priority Flora or Threatened Flora were recorded in the survey area.

4.2.2 Vegetation Type, Extent and Status

A total of 30 Families, 61 Genera and 130 Species were recorded within the survey area. Twelve major vegetation groups were recorded in the survey area and range from Completely Degraded to Very Good condition (using the scale of Keighery 1994, see Appendix 3). Existing disturbance within the survey area is comprised of historic exploration activities, and access roads.

No unique or restricted vegetation communities were identified, and all vegetation types/communities are common, widespread and well represented in the Eastern Murchison subregion.

The summary of vegetation groups contained within the survey area is summarised in Table 8 below. Maps of the survey area can be seen in Appendix 4.

Table 8: Vegetation Group Summary

Vegetation Groups	Code	Family	Genus	Species	Area (ha)	Percentage of Survey area (%)
<i>Eucalyptus oleosa</i> woodland	A	16	20	27	22.75	6.64%
<i>Acacia</i> shrubland	B	13	19	26	3.33	0.97%
Mulga shrubland	C	24	39	68	111.40	32.53%
<i>Eucalyptus salmonophloia</i> woodland	D	15	19	27	48.33	14.11%
Chenopod shrubland	E	12	20	26	32.76	9.57%
Mulga over chenopod shrubland	F	16	22	34	23.16	6.76%
<i>Acacia burkittii</i> shrubland in creekline	G	14	19	24	0.72	0.21%
<i>Eucalyptus lesouefii</i> woodland	H	15	19	28	26.51	7.74%
<i>Eucalyptus loxophleba</i> woodland	I	8	13	21	28.16	8.22%
Chenopod shrubland over <i>Tecticornia</i>	J	7	11	14	5.71	1.67%
<i>Acacia kalgoorliensis</i> shrubland	K	13	15	22	4.17	1.22%
<i>Acacia</i> shrubland on rocky slopes	L	10	14	19	10.69	3.12%
Existing Disturbance		N/A	N/A	N/A	24.80	7.24%
Total		30*	61*	130*	342.49#	100%#

Note: * Within total survey area (not sum of column)

Sum of column

The vegetation groups within the survey area are described in more detail below.

4.2.2.1 *Eucalyptus oleosa* woodland (A)

This Open Tree Mallee (Muir, 1977) consisted of 16 Families, 20 Genera and 27 Species. The vegetation group was approximately 22.75 ha which makes up 6.64% of the survey area.



Figure 5: Vegetation Group A within the survey area

4.2.2.2 *Acacia* shrubland (B)

This Scrub (Muir, 1977) consisted of 13 Families, 19 Genera and 26 Species. The vegetation group was approximately 3.33 ha which makes up 0.97% of the survey area.



Figure 6: Vegetation Group B within the survey area

4.2.2.3 Mulga shrubland (C)

This Scrub (Muir, 1977) consisted of 24 Families, 39 Genera and 68 Species. The vegetation group was approximately 111.40 ha which makes up 32.53% of the survey area.



Figure 7: Vegetation Group C within the survey area

4.2.2.4 *Eucalyptus salmonophloia* woodland (D)

This Open Tall Woodland (Muir, 1977) consisted of 15 Families, 19 Genera and 27 Species. The vegetation group was approximately 48.33 ha which makes up 14.11% of the survey area.



Figure 8: Vegetation Group D within the survey area

4.2.2.5 Chenopod shrubland (E)

This Dwarf Scrub C (Muir, 1977) consisted of 12 Families, 20 Genera and 26 Species. The vegetation group was approximately 32.76 ha which makes up 9.57% of the survey area.



Figure 9: Vegetation Group E within the survey area

4.2.2.6 Mulga over chenopod shrubland (F)

This Scrub (Muir, 1977) consisted of 16 Families, 22 Genera and 34 Species. The vegetation group was approximately 23.16 ha which makes up 6.76% of the survey area.



Figure 10: Vegetation Group F within the survey area

4.2.2.7 *Acacia burkittii* shrubland in creekline (G)

This Thicket (Muir, 1977) consisted of 14 Families, 19 Genera and 24 Species. The vegetation group was approximately 0.72 ha which makes up 0.21% of the survey area.



Figure 11: Vegetation Group G within the survey area

4.2.2.8 *Eucalyptus lesouefii* woodland (H)

This Low Woodland A (Muir, 1977) consisted of 15 Families, 19 Genera and 28 Species. The vegetation group was approximately 26.51 ha which makes up 7.74% of the survey area.



Figure 12: Vegetation Group H within the survey area

4.2.2.9 *Eucalyptus loxophleba* woodland (I)

This Open Tree Mallee (Muir, 1977) consisted of 8 Families, 13 Genera and 21 Species. The vegetation group was approximately 28.16 ha which makes up 8.22% of the survey area.



Figure 13: Vegetation Group I within the survey area

4.2.2.10 Chenopod shrubland over *Tecticornia* (J)

This Open Dwarf Scrub C (Muir, 1977) consisted of 7 Families, 11 Genera and 14 Species. The vegetation group was approximately 5.71 ha which makes up 1.67% of the survey area.



Figure 14: Vegetation Group J within the survey area

4.2.2.11 *Acacia kalgoorliensis* shrubland (K)

This Scrub (Muir, 1977) consisted of 13 Families, 15 Genera and 22 Species. The vegetation group was approximately 4.17 ha which makes up 1.22% of the survey area.



Figure 15: Vegetation Group K within the survey area

4.2.2.12 *Acacia* shrubland on rocky slopes (L)

This Scrub (Muir, 1977) consisted of 10 Families, 14 Genera and 19 Species. The vegetation group was approximately 10.69 ha which makes up 3.12% of the survey area.



Figure 16: Vegetation Group L within the survey area

4.2.2.14 Existing Disturbance

Existing disturbance within the survey area consisted of historic exploration clearing and access roads and was approximately 24.80 ha which makes up 7.24% of the survey area.



Figure 17: Existing disturbance within the survey area

4.2.3 Weeds

Five weed species were recorded within the survey area, *Carrichtera annua* (Wards Weed), *Centaurea melitensis* (Maltese Cockspur), *Salvia verbenaca* (Wild Sage), *Sisymbrium irio* (London Rocket) and *Sonchus oleraceus* (Common Sow Thistle). None of these species are considered a Declared Pest under the BAM Act (DPIRD, 2025).

4.2.4 Vegetation Condition

Evidence of historic exploration and access tracks was observed during the field assessment.

Overall, the condition of the vegetation was determined to range from “Completely Degraded” to “Very Good” with most of the area falling into the “Good” Category. Areas which were affected by historic exploration and clearing were deemed in “Completely Degraded” condition. A map of the vegetation condition within the survey is depicted in Appendix 4.

5. DISCUSSION

The field assessment established that the condition of the vegetation in the proposed disturbance area ranged from “Completely Degraded” to “Very Good” with most of the area falling into the “Good” Category. Areas which were affected by historic exploration were deemed in “Completely Degraded” condition. No areas of vegetation were assessed to be in “Pristine” condition.

Five weed species were recorded within the survey area, *Carrichtera annua* (Wards Weed), *Centaurea melitensis* (Maltese Cockspur), *Salvia verbenaca* (Wild Sage), *Sisymbrium irio* (London Rocket) and *Sonchus oleraceus* (Common Sow Thistle). None of these species are considered a Declared Pest.

No Priority or Threatened Flora were recorded in the survey area.

No TECs or PECs were recorded in the survey area.

No unique or restricted vegetation communities were identified, and all vegetation types/communities are common, widespread and well represented in the Eastern Murchison subregion.

Any proposed disturbance/clearing of vegetation will result in a loss of some flora and vegetation. However, given the size of the area and the extent of the Beard (1990) vegetation association elsewhere, the impact on the vegetation and its component flora will not affect the conservation values of either, or create fragmentation or patches of remnant vegetation.

The following recommendations arise from the reconnaissance flora survey:

- Weed control measures should be implemented during and following earthworks; and
- Dust control measures should be implemented during earthworks.

6. REFERENCES

AHA (2010) *Environmental assessment-proposed expansion of Whirling Dervish mine*, Unpublished Report Prepared for Saracen Gold Mines.

AHA (2012b) *Environmental assessment – proposed expansion of Tailings Storage Facility*, Unpublished Report Prepared for Saracen Gold Mines

AHA, (2019), *Environmental Assessment: Proposed Seismic Survey Area Saracen Gold Mines- February 2019*, Unpublished Report Prepared for Saracen Gold Mines

AHA, (2020), *Environmental Assessment: Relief Hill Survey Area Saracen Gold Mines- February 2020*, Unpublished Report Prepared for Saracen Gold Mines

Beard, J.S., (1990), *Plant Life of Western Australia*, Kangaroo Press Pty Ltd, NSW

BOM, (2025), *Climate Data Online*, Bureau of Meteorology,
<http://www.bom.gov.au/climate/averages/>
Accessed: 23/01/2025

CALM, (2002), *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002- Murchison (MUR01 Eastern Murchison synopses)*, Department of Conservation and Land Management

CALM, (2003), *Phytophthora cinnamomi and Diseases Caused by It, Volume 1-Management Guidelines*, Department of Conservation and Land Management
<https://library.dbca.wa.gov.au/FullTextFiles/021873.pdf>
Accessed: 23/01/2025

DBCA, (2019), *2018 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report)- Current as of March 2019*, WA Department of Biodiversity, Conservation and Attractions, Perth
<https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics>
Accessed: 23/01/2025

DBCA, (2020), *Phytophthora Dieback Management Manual, October 2020*, Department of Biodiversity, Conservation and Attractions

DBCA, (2023) *Conservation Codes for Western Australian Flora and Fauna*. Department of Biodiversity, Conservation and Attractions, Western Australia, August 2023

DBCA, (2023a), *Priority Ecological Communities for Western Australia- Version 35*, Department of Biodiversity, Conservation and Attractions

DBCA, (2025), *Dandjoo search accessed on the 23/01/2025*, Department of Biodiversity, Conservation and Attractions

DCCEEW, (2023), *Interim Biogeographic Regionalisation for Australia (IBRA) Version 7 (Subregions)*, Published 4 April 2023, Department of Climate Change, Energy, the Environment and Water, Australian Government
<https://www.environment.gov.au/land/nrs/science/ibra>
Accessed: 23/01/2025

DCCEEW (2025), *Protected Matters Search Tool*, Department of Climate Change, Energy, the Environment and Water, Australian Government
<http://www.environment.gov.au/epbc/protected-matters-search-tool>
Accessed: 23/01/2025

DPIRD, (2017), *NRInfo Digital Mapping*, Department of Primary Industries and Regional Development
<https://maps.agric.wa.gov.au/nrm-info/>
Accessed: 23/01/2025

DPIRD, (2025), *Declared Plants Database*, Department of Primary Industries and Regional Development, Western Australia
<https://www.agric.wa.gov.au/pests-weeds-diseases/weeds/declared-plants>
Accessed: 23/01/2025

DWER, (2025), *Clearing Permit System Map Viewer*, Department of Water and Environmental Regulation
<https://cps.dwer.wa.gov.au/main.html>
Accessed: 23/01/2025

EPA, (2016), *Environmental Factor Guideline: Flora and Vegetation*, Environmental Protection Authority, Western Australia

EPA, (2016a), *Technical Guidance- Flora and Vegetation Surveys for Environmental Impact Assessment*, Environmental Protection Authority, Western Australia

EPA, (2023), *Statement of environmental principles, factors, objectives and aims of EIA*, Environmental Protection Authority, Western Australia

Keighery, B.J., (1994), *Bushland Plant Survey; A guide to plant community survey for the Community*, Wildflower Society of Western Australia (Inc.) Nedlands

Lawn, G., (2024), *Biodiversity Conservation (Listing of Native Species) (Flora) Order 2024*, published in the Gazette on 30 April 2024 at pages 1135 to 1140, Western Australian Government

Mattiske Consulting Pty Ltd, (2010), *Flora and vegetation survey of the proposed airstrip*, Unpublished Report Prepared for Saracen Gold Mines

Mattiske Consulting Pty Ltd, (2010), *Flora and vegetation survey of the Karari pit extension*, Unpublished Report Prepared for Saracen Gold Mines

Muir, B.G., (1977), *Biological Survey of the Western Australian Wheatbelt. Pt. 2. Vegetation and habitat of the Bendering Reserve. Records of the Western Australian Museum Supplement 3*

Shepherd, D.P., Beeston, G.R. and Hopkins, A.J.M., (2002), *Land-Use and Vegetation in Western Australia- National Land and Water Resources Audit Report*, Technical Report 250, Department of Agriculture Western Australia

WAHERB, (2025), *Florabase- the Western Australian Flora*, Department of Parks and Wildlife
<http://florabase.dpaw.wa.gov.au/>
Accessed 23/01/2025

7. GLOSSARY

Acronyms:

BOM	Bureau of Meteorology, Australian Government
BSc	Bachelor of Science
CALM	Department of Conservation and Land Management (now DBCA)
CPS	Clearing Permit System (DWER)
DBCA	Department of Biodiversity, Conservation and Attractions, Western Australia
DCCEEW	Department of Climate Control, Energy, the Environment and Water, Australian Government
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety, Western Australia
DPAW	Department of Parks and Wildlife, Western Australia (now DBCA)
DPIRD	Department of Primary Industries and Regional Development, Western Australia
DRF	Declared Rare Flora (now classed as Threatened Flora)
DWER	Department of Water and Environmental Regulation, Western Australia
EPA	Environmental Protection Authority, Western Australia
EP Act	Environmental Protection Act 1986, Western Australia
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth Act)
ESA	Environmentally Sensitive Area
GIS	Geographical Information System
ha	Hectare (10,000 square metres)
IBRA	Interim Biogeographic Regionalisation for Australia, DCCEEW
IUCN	International Union for the Conservation of Nature and Natural Resources – commonly known as the World Conservation Union
km	Kilometres
m	Metres
MUR	Murchison Bioregion (IBRA)
MUR01	Eastern Murchison Subregion (IBRA)
NVS	Native Vegetation Solutions
PEC	Priority Ecological Community, Western Australia
PF	Priority Flora
Ramsar	A wetland site designated of international importance under the Ramsar Convention (UNESCO)
TEC	Threatened Ecological Community
TF	Threatened Flora
UNESCO	United Nations Educational, Scientific and Cultural Organization
WA	Western Australia
WAHERB	Western Australian Herbarium (DBCA)
WAOL	Western Australian Organism List (DPIRD)

Definitions:

DBCA (2023) Conservation Codes for Western Australian Flora and Fauna. Department of Biodiversity, Conservation and Attractions, Western Australia, August 2023: -

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

Priority is not a listing category under the BC Act. The Priority Flora and Fauna lists are maintained by the department and are published on the department's website.

All fauna and flora are protected in WA following the provisions in Part 10 of the BC Act. The protection applies even when a species is not listed as threatened or specially protected, and regardless of land tenure (State managed land (Crown land), private land, or Commonwealth land).

Species that may possibly be threatened species that do not meet the criteria for listing under the BC Act because of insufficient survey 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 prioritisation for survey and evaluation of conservation status so that consideration can be given to potential listing as threatened.

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

Assessment of priority status 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.

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.

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.

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. These species need further survey.

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 a conservation dependent specially protected species.
- c) Species that have been removed from the list of threatened species or lists of conservation dependent or other specially protected species, during the past five years for reasons other than taxonomy.
- d) Other species in need of monitoring.

Appendix 1: Relevant Government Database Search 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-Jan-2025

[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:	6

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <https://www.dcceew.gov.au/parks-heritage/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:	9
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:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	4
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			
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	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 feature area
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			
Sminthopsis psammophila Sandhill Dunnart [291]	Endangered	Species or species habitat may occur within area	In buffer area only

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
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]	Vulnerable	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 feature area
Calidris melanotos			
Pectoral Sandpiper [858]		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 feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	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 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
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
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat may occur within area overfly marine area	In buffer area only

Extra Information

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Northern Star Resources - Carosue Dam TSF Cell 4	2021/9026		Post-Approval	In buffer area only
Not controlled action				
Construction of a bypass road, haulage contractor workshop & laydown yard	2012/6639	Not Controlled Action	Completed	In buffer area only

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
Saracen Gold-Carosue Dam Aerodrome, WA	2017/7925	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 is 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 on the contents of this report.

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 point locations and environmental data layers.

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 when time permits.

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 breeding sites; and
- 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.

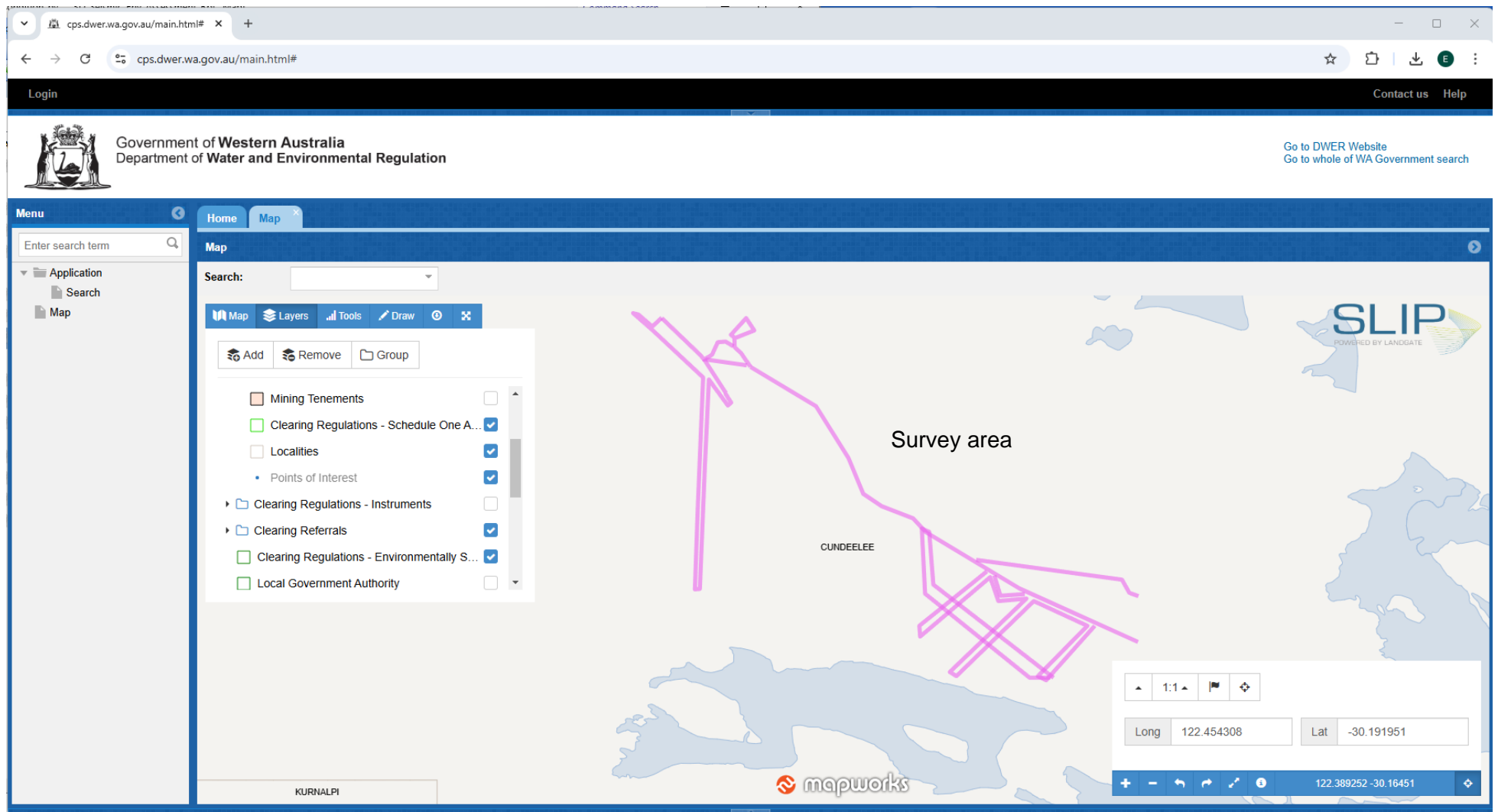
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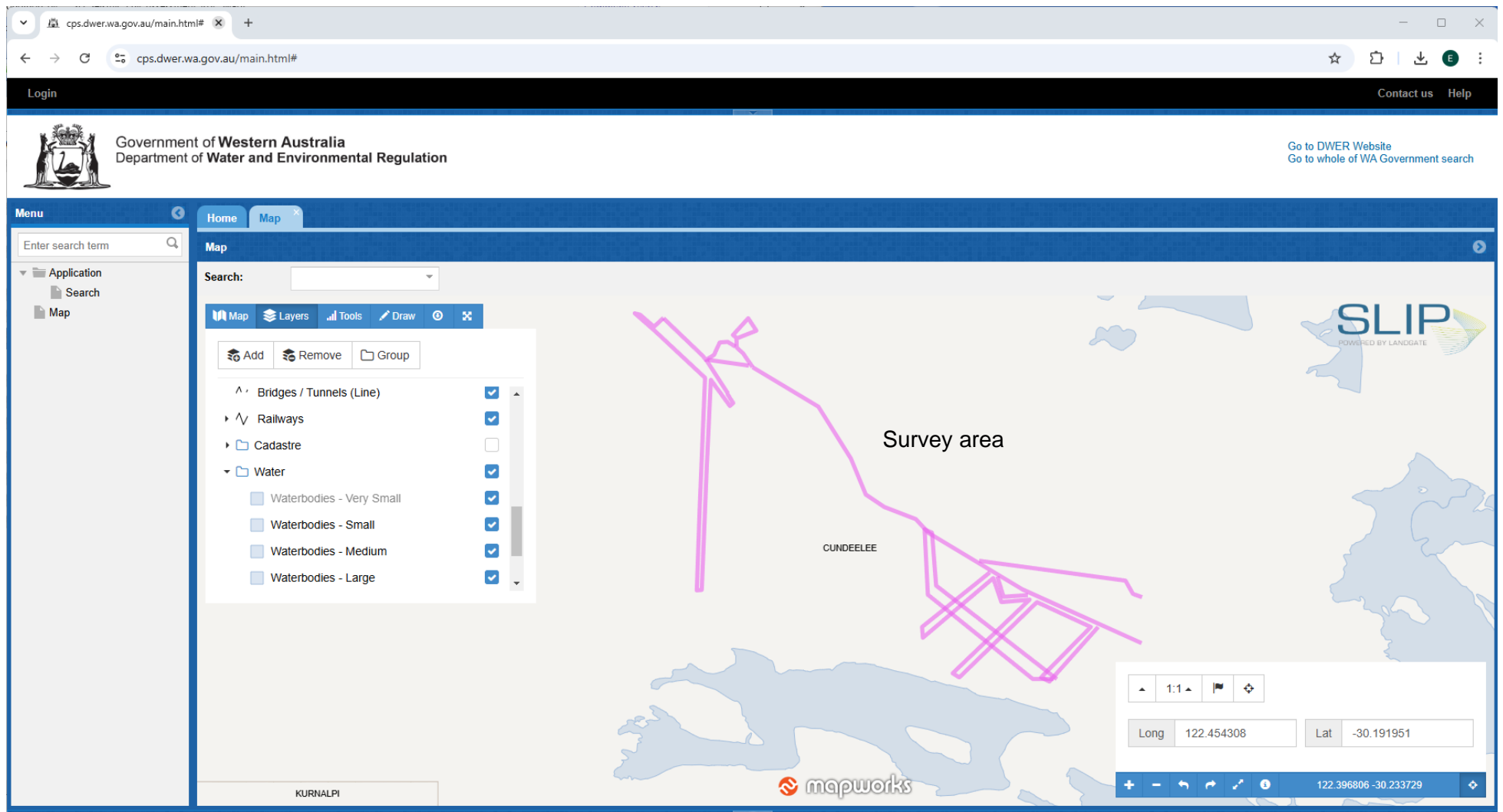
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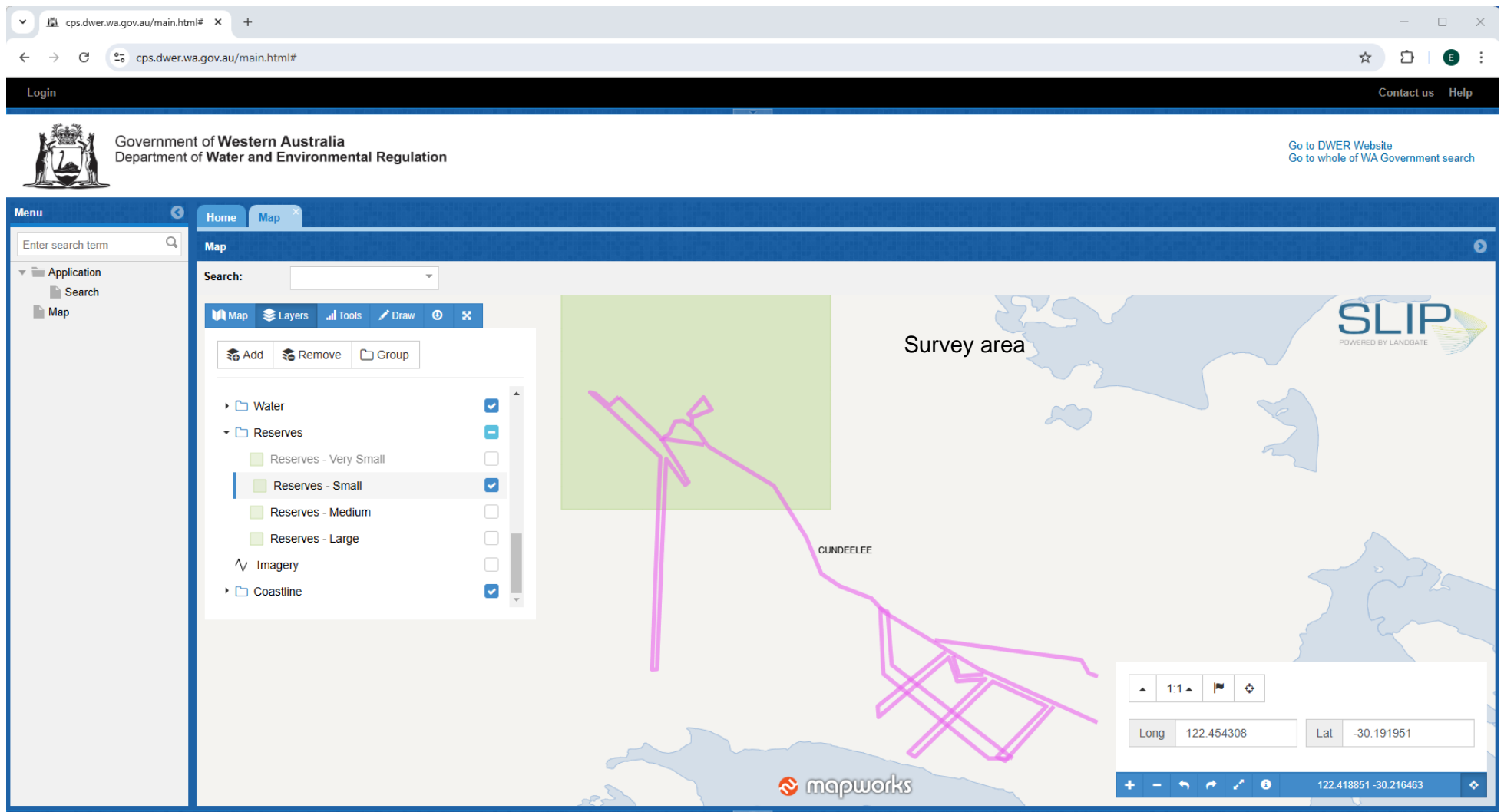
+61 2 6274 1111



DWER's Clearing Permit System Map Viewer showing no ESA's (dark green shaded areas) within the survey area (DWER, 2025)



DWER Clearing Permit System Map Viewer showing no waterbodies within the survey area (DWER, 2025)



DWER Clearing Permit System Map Viewer showing Class C reserve (R 17325) within the survey area (DWER, 2025)

Appendix 2: Threatened Flora Databases Search Results

“Dandjoo” listed the following species within a 20km radius of the survey area (DBCA, 2025):

Taxon	Conservation Code	Comment (Post field work)
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i>	P2	Unlikely- No suitable habitat
<i>Hysterobaeckea ochropetala</i> subsp. <i>cometes</i>	P3	Unlikely- Possible suitable habitat, searched extensively
<i>Thryptomene eremaea</i>	P2	Unlikely- No suitable habitat
<i>Eremophila arachnoides</i> subsp. <i>tenera</i>	P3	Unlikely- Possible suitable habitat, searched extensively

Appendix 3: Vegetation Definitions

Vegetation Condition Definitions (Keighery, 1994)

Pristine (1). Pristine or nearly so, no obvious signs of disturbance.

Excellent (2). Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

Very Good (3). Vegetation structure altered, obvious signs of disturbance.
For example, disturbance to vegetation structure caused by repeating fires, the presence of some more aggressive weeds, dieback, logging and grazing.

Good (4). Vegetation structure significantly altered by very obvious signs of multiple disturbance.

Retains basic vegetation structure or ability to regenerate it.

For example, disturbance to vegetation structure caused by frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (5). Basic vegetation structure severely impacted by disturbance.

Scope for regeneration but not to a state approaching good condition without intensive management.

For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

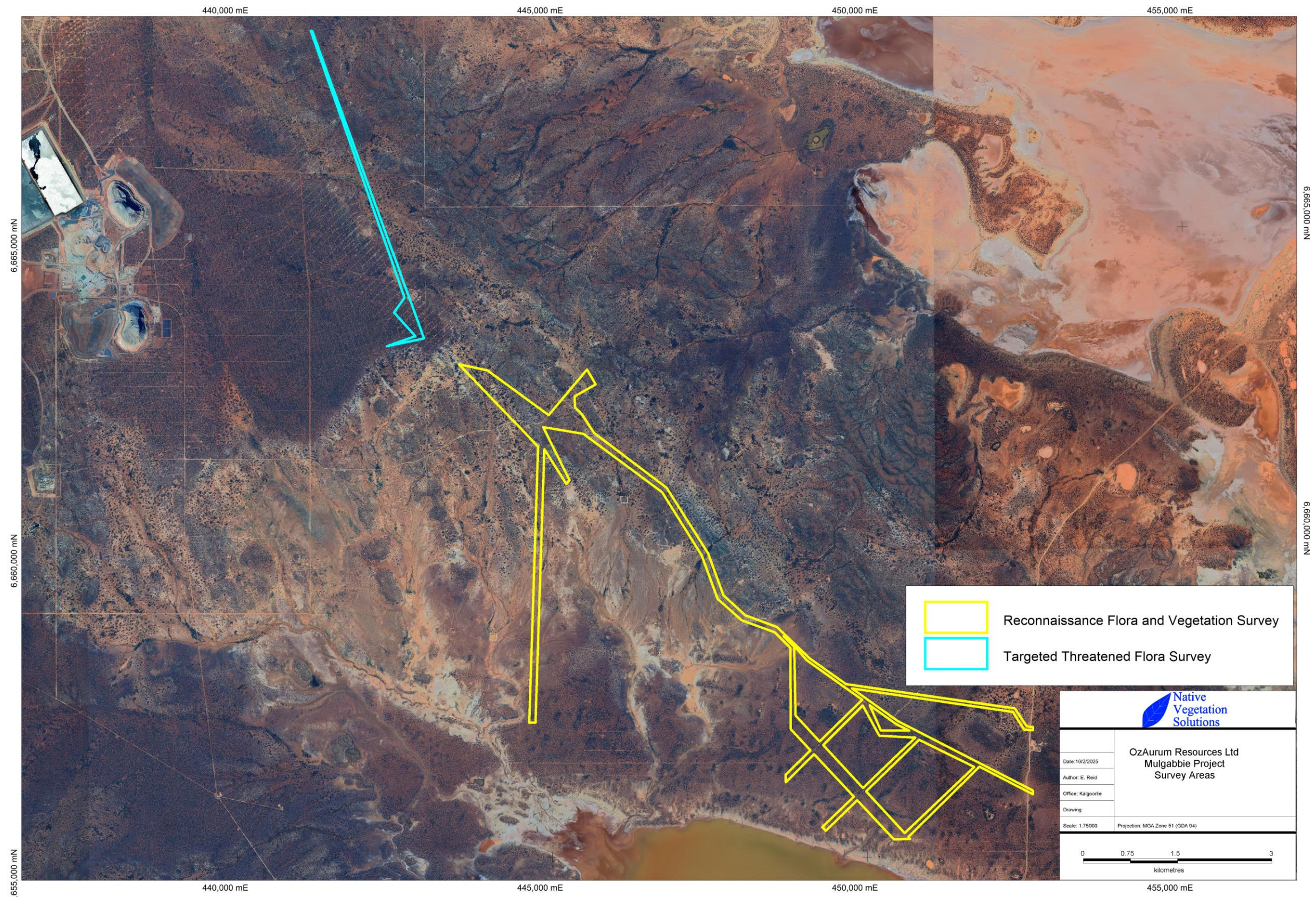
Completely Degraded (6). The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

These areas are often described as 'parkland cleared' with the flora compromising weed or crop species with isolated trees or shrubs.

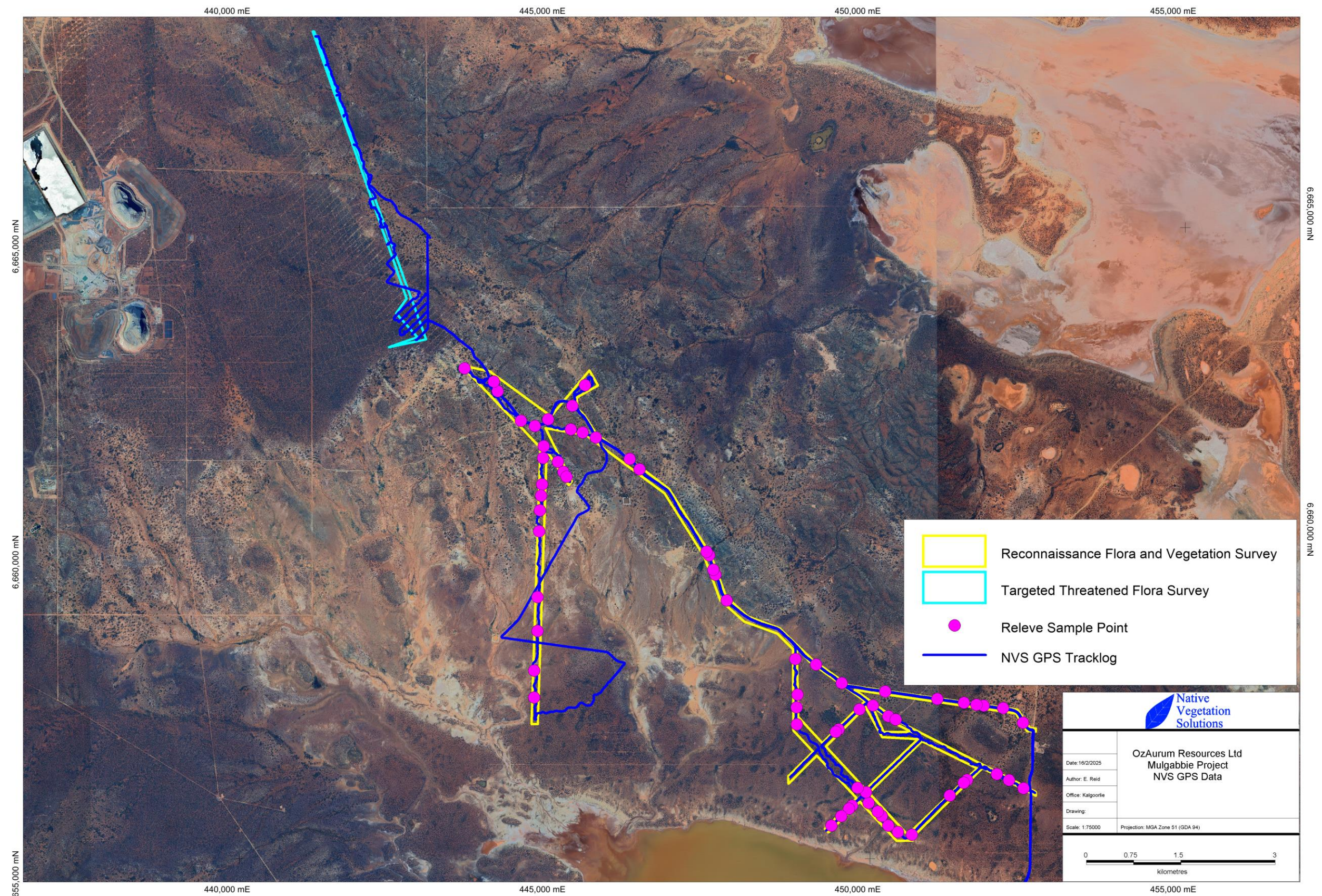
Vegetation Structure Definitions (Muir, 1977)

Life Form/Height Class	Canopy Cover			
	Dense 70-100% d	Mid-Dense 30-70% c	Sparse 10-30% i	Very Sparse 2-10% r
T Trees>30m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
M Trees 15-30m	Dense Forest	Forest	Woodland	Open Woodland
LA Trees 5-15m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
LB Trees<5m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
KT Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
KS Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
S Shrubs>2m	Dense Thicket	Thicket	Scrub	Open Scrub
SA Shrubs 1.5-2.0m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
SB Shrubs 1.0-1.5m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
SC Shrubs 0.5-1.0m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
SD Shrubs 0.0-0.5m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
P Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
H Hummock Grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
GT Bunch grass >0.5m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
GL Bunch grass <0.5m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
J Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
VT Sedges >0.5m	Dense Tall Sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
VL Sedges <0.5m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
X Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverwort	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

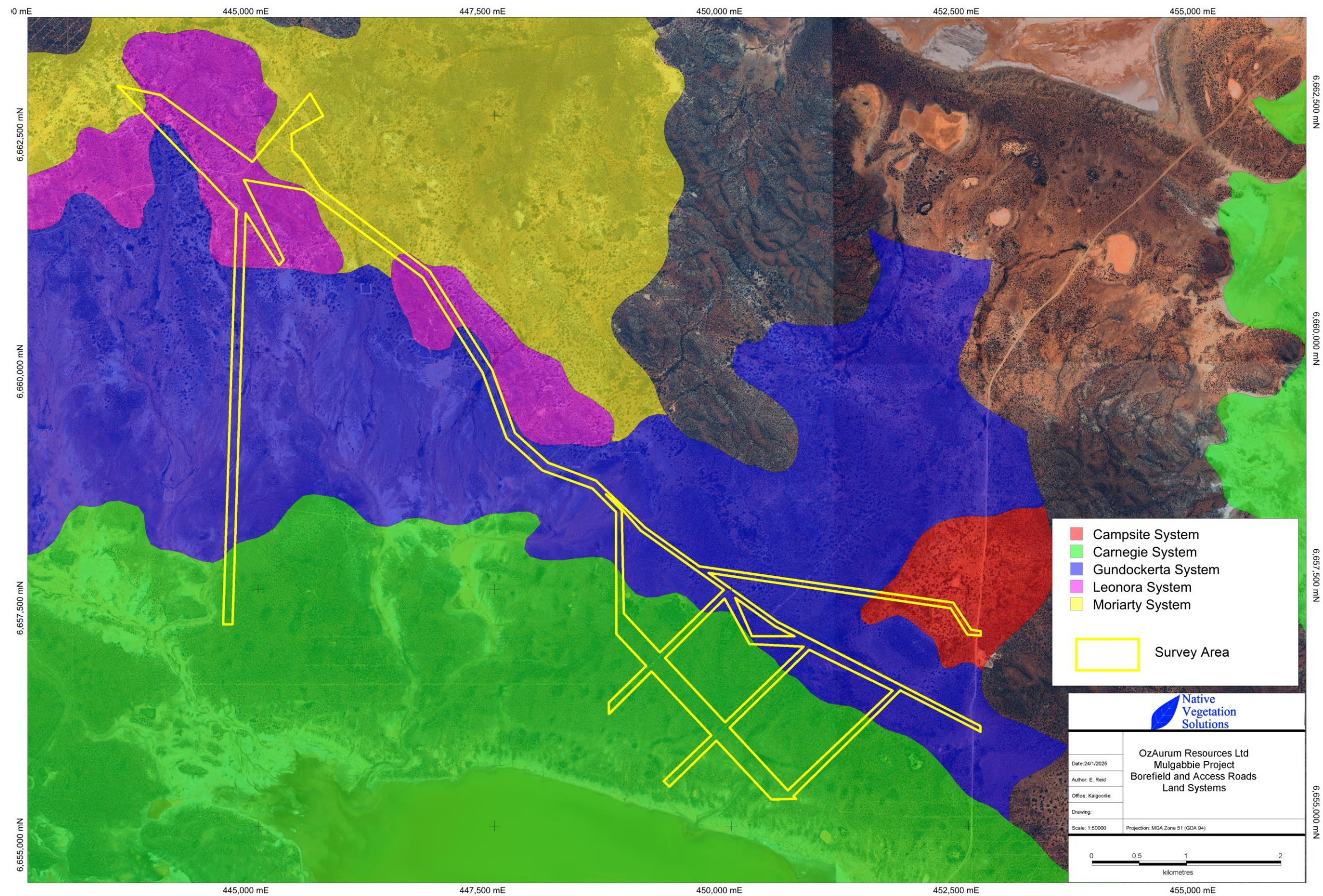
Appendix 4: Vegetation Mapping



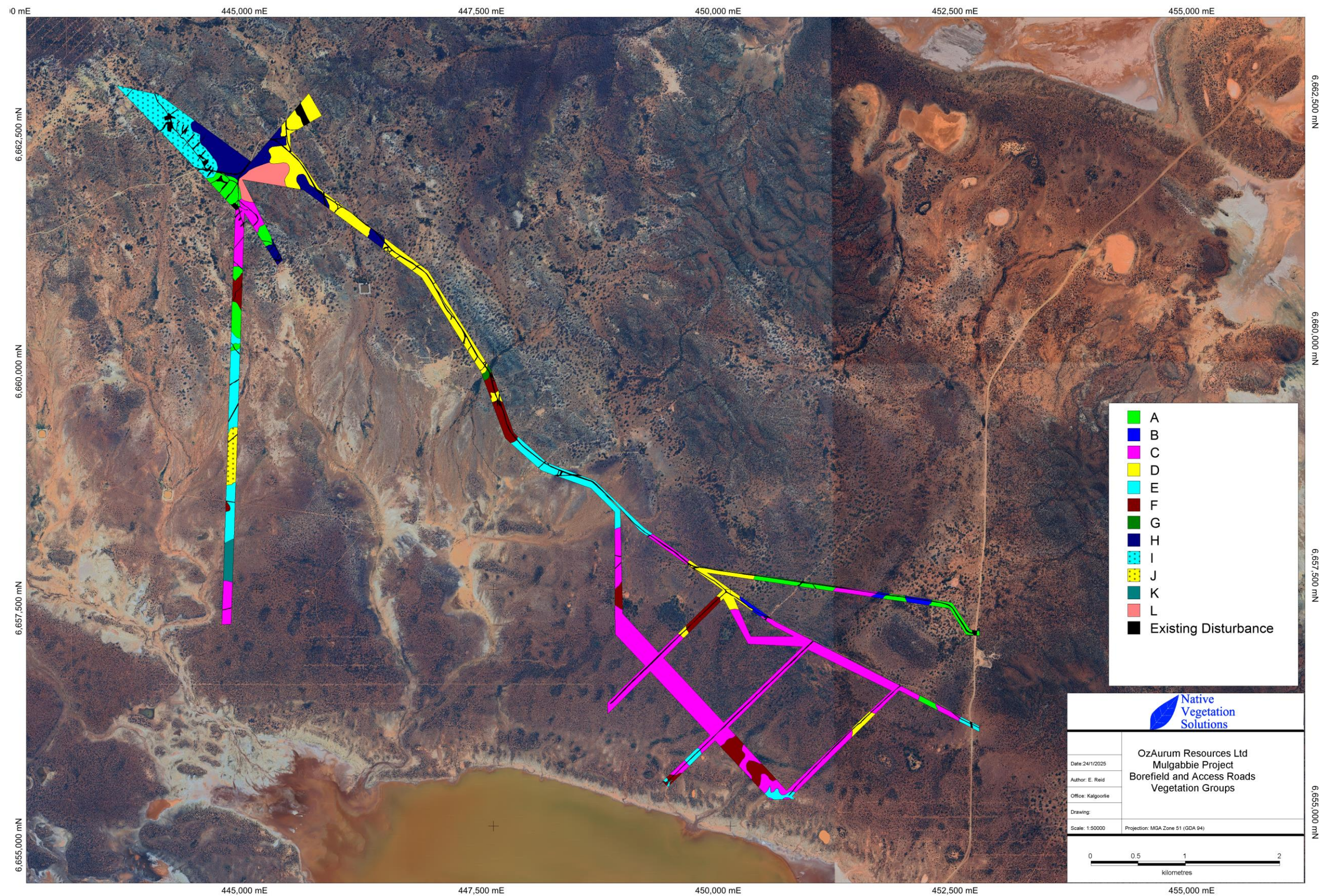
Map 1: Survey Area



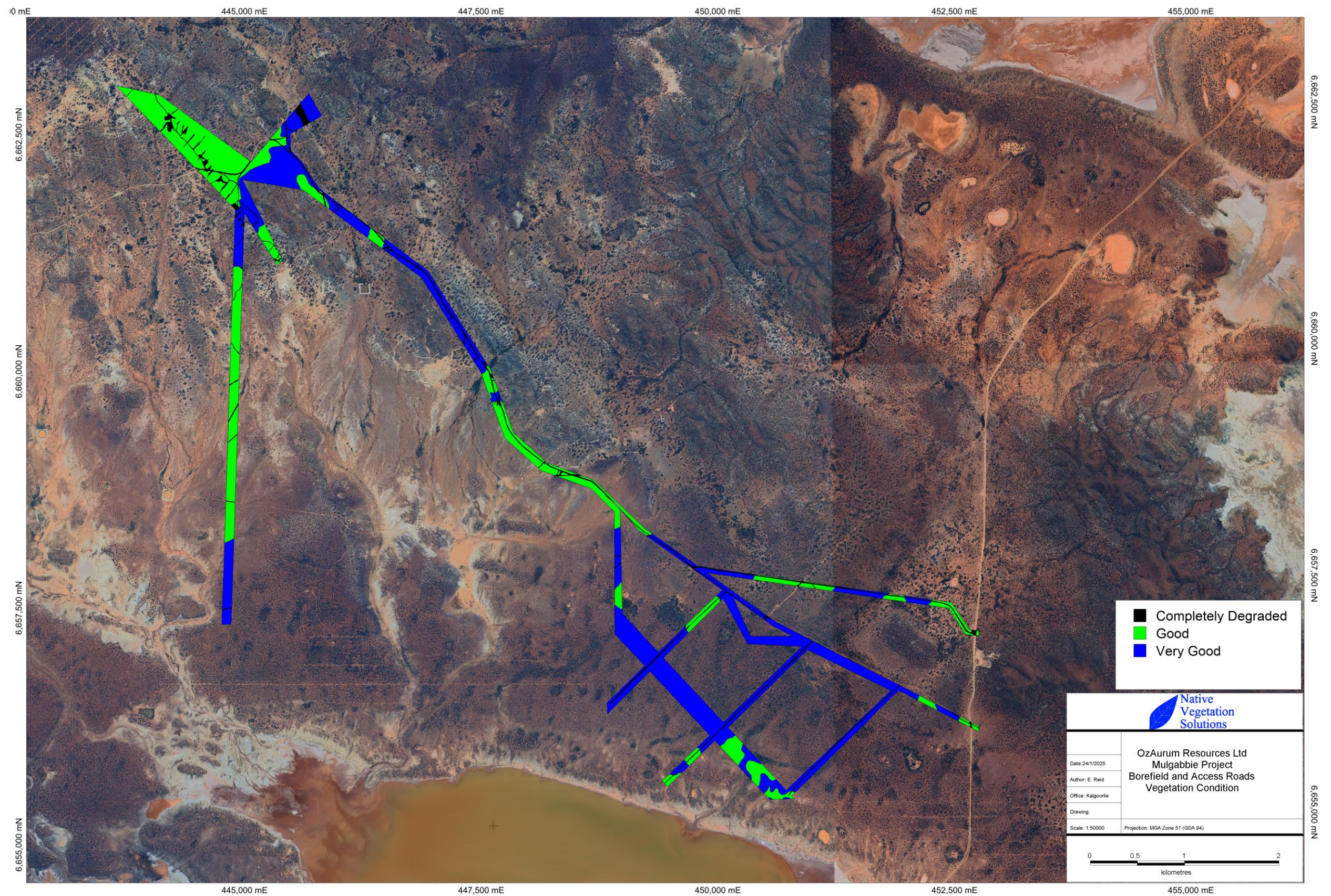
Map 2: NVS GPS Data



Map 3: Land Systems



Map 4: Vegetation Groups



Map 5: Vegetation Condition

Appendix 5: Species List

Species List per Vegetation Group

Family	Genus	Taxon	A, P, NN	A	B	C	D	E	F	G	H	I	J	K	L
Aizoaceae	<i>Gunnopsis</i>	<i>Gunnopsis quadrifida</i>	P					*	*				*	*	
Amaranthaceae	<i>Ptilotus</i>	<i>Ptilotus exaltatus</i>	A	*			*			*	*	*			
Amaranthaceae	<i>Ptilotus</i>	<i>Ptilotus obovatus</i>	P	*	*	*	*	*	*	*	*				*
Amaranthaceae	<i>Ptilotus</i>	<i>Ptilotus polystachyus</i>	A			*									
Apocynaceae	<i>Alyxia</i>	<i>Alyxia buxifolia</i>	P			*									
Apocynaceae	<i>Leichhardtia</i>	<i>Leichhardtia australis</i>	P			*				*					
Asparagaceae	<i>Thysanotus</i>	<i>Thysanotus patersonii</i>	P											*	
Asteraceae	<i>Brachyscome</i>	<i>Brachyscome ciliaris</i>	A		*	*		*							
Asteraceae	<i>Centaurea</i>	<i>Centaurea melitensis</i> *	A,NN		*					*					
Asteraceae	<i>Cratystylis</i>	<i>Cratystylis microphylla</i>	P			*			*					*	
Asteraceae	<i>Cratystylis</i>	<i>Cratystylis subspinescens</i>	P				*	*	*		*		*		
Asteraceae	<i>Olearia</i>	<i>Olearia muelleri</i>	P	*					*			*		*	
Asteraceae	<i>Podolepis</i>	<i>Podolepis rugata</i>	A			*									
Asteraceae	<i>Rhodanthe</i>	<i>Rhodanthe charsleyae</i>	A			*									
Asteraceae	<i>Rhodanthe</i>	<i>Rhodanthe citrina</i>	A			*									
Asteraceae	<i>Rhodanthe</i>	<i>Rhodanthe floribunda</i>	A		*										
Asteraceae	<i>Siemssenia</i>	<i>Siemssenia capillaris</i>	A					*						*	*
Asteraceae	<i>Sonchus</i>	<i>Sonchus oleraceus</i> *	A,NN			*		*		*		*			
Asteraceae	<i>Vittadinia</i>	<i>Vittadinia eremaea</i>	A			*									
Boraginaceae	<i>Halgania</i>	<i>Halgania cyanea</i> var. <i>Charleville</i>	P			*									
Brassicaceae	<i>Carrichtera</i>	<i>Carrichtera annua</i> *	A,NN	*			*				*				
Brassicaceae	<i>Sisymbrium</i>	<i>Sisymbrium irio</i> *	A,NN		*										
Casuarinaceae	<i>Casuarina</i>	<i>Casuarina pauper</i>	P	*	*	*	*		*	*	*	*		*	*
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex bunburyana</i>	P			*									
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex codonocarpa</i>	A	*			*	*			*				
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex nummularia</i> subsp. <i>spathulata</i>	P							*					*
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex stipitata</i>	P						*			*			
Chenopodiaceae	<i>Atriplex</i>	<i>Atriplex vesicaria</i>	P			*		*	*			*	*		
Chenopodiaceae	<i>Chenopodium</i>	<i>Chenopodium gaudichaudianum</i>	P		*										
Chenopodiaceae	<i>Enchylaena</i>	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	P	*			*				*	*			
Chenopodiaceae	<i>Eriochiton</i>	<i>Eriochiton sclerolaenoides</i>	P		*										
Chenopodiaceae	<i>Maireana</i>	<i>Maireana amoena</i>	P					*	*				*		
Chenopodiaceae	<i>Maireana</i>	<i>Maireana convexa</i>	P			*									
Chenopodiaceae	<i>Maireana</i>	<i>Maireana glomerifolia</i>	P					*					*	*	
Chenopodiaceae	<i>Maireana</i>	<i>Maireana pentatropis</i>	P									*			
Chenopodiaceae	<i>Maireana</i>	<i>Maireana planifolia</i>	P			*									
Chenopodiaceae	<i>Maireana</i>	<i>Maireana pyramidata</i>	P	*		*	*	*	*	*	*		*		
Chenopodiaceae	<i>Maireana</i>	<i>Maireana sedifolia</i>	P	*	*	*	*				*	*			*
Chenopodiaceae	<i>Maireana</i>	<i>Maireana thesioides</i>	P			*			*					*	
Chenopodiaceae	<i>Maireana</i>	<i>Maireana tomentosa</i>	P					*	*			*			
Chenopodiaceae	<i>Maireana</i>	<i>Maireana triptera</i>	P	*	*		*		*		*				*
Chenopodiaceae	<i>Rhagodia</i>	<i>Rhagodia drummondii</i>	P						*				*		
Chenopodiaceae	<i>Rhagodia</i>	<i>Rhagodia eremaea</i>	P			*				*					
Chenopodiaceae	<i>Salsola</i>	<i>Salsola australis</i>	A		*	*									
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena cuneata</i>	P				*	*			*	*	*		
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena densiflora</i>	P					*				*			*
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena diacantha</i>	P	*	*		*	*	*		*	*			*
Chenopodiaceae	<i>Sclerolaena</i>	<i>Sclerolaena patentiscuspis</i>	P									*			
Chenopodiaceae	<i>Tecticornia</i>	<i>Tecticornia disarticulata</i>	P					*					*		
Combretaceae	<i>Alectryon</i>	<i>Alectryon oleifolius</i> subsp. <i>canescens</i>	P	*	*		*				*				
Convolvulaceae	<i>Convolvulus</i>	<i>Convolvulus remotus</i>	P		*					*					
Convolvulaceae	<i>Frankenia</i>	<i>Frankenia interioris</i>	P						*						
Convolvulaceae	<i>Frankenia</i>	<i>Frankenia setosa</i>	P					*	*				*	*	
Euphorbiaceae	<i>Euphorbia</i>	<i>Euphorbia drummondii</i>	A			*									
Fabaceae	<i>Acacia</i>	<i>Acacia aneura</i>	P		*	*			*						
Fabaceae	<i>Acacia</i>	<i>Acacia ayersiana</i>	P						*						
Fabaceae	<i>Acacia</i>	<i>Acacia burkittii</i>	P		*	*				*					
Fabaceae	<i>Acacia</i>	<i>Acacia craspedocarpa</i>	P			*									
Fabaceae	<i>Acacia</i>	<i>Acacia hemiteles</i>	P	*	*		*			*	*				*
Fabaceae	<i>Acacia</i>	<i>Acacia incurvaneura</i>	P			*									
Fabaceae	<i>Acacia</i>	<i>Acacia kalgoorliensis</i>	P			*								*	

Family	Genus	Taxon	A, P, NN	A	B	C	D	E	F	G	H	I	J	K	L
Fabaceae	Acacia	<i>Acacia kempeana</i>	P			*									*
Fabaceae	Acacia	<i>Acacia ligulata</i>	P		*									*	
Fabaceae	Acacia	<i>Acacia mulganeura</i>	P			*			*						
Fabaceae	Acacia	<i>Acacia oswaldii</i>	P			*									
Fabaceae	Acacia	<i>Acacia pteraneura</i>	P		*										
Fabaceae	Acacia	<i>Acacia quadrimarginea</i>	P			*									*
Fabaceae	Acacia	<i>Acacia ramulosa</i> var. <i>ramulosa</i>	P			*									
Fabaceae	Acacia	<i>Acacia sibirica</i>	P	*			*				*				
Fabaceae	Acacia	<i>Acacia tetragonophylla</i>	P		*	*								*	
Fabaceae	Senna	<i>Senna artemisioides</i> subsp. <i>artemisioides</i>	P							*					
Fabaceae	Senna	<i>Senna artemisioides</i> subsp. <i>filifolia</i>	P	*			*	*		*	*	*			*
Goodeniaceae	Goodenia	<i>Goodenia connata</i>	A			*									
Goodeniaceae	Goodenia	<i>Goodenia mimuloides</i>	A			*									
Goodeniaceae	Scaevola	<i>Scaevola spinescens</i>	P	*	*	*	*		*		*			*	*
Gyrostemonaceae	Codonocarpus	<i>Codonocarpus cotinifolius</i>	P			*									
Haloragaceae	Haloragis	<i>Haloragis trigonocarpa</i>	A			*									
Lamiaceae	Salvia	<i>Salvia verbenaca</i> *	A,NN	*	*	*	*	*		*	*				
Loranthaceae	Amyema	<i>Amyema gibberula</i> var. <i>gibberula</i>	P			*									
Malvaceae	Brachychiton	<i>Brachychiton gregorii</i>	P			*									
Malvaceae	Lawrencia	<i>Lawrencia squamata</i>	P						*					*	
Malvaceae	Sida	<i>Sida calyxhymentia</i>	P							*					
Malvaceae	Sida	<i>Sida ectogama</i>	P			*									
Malvaceae	Sida	<i>Sida</i> sp. <i>Excedentifolia</i>	P			*				*					
Myrtaceae	Eucalyptus	<i>Eucalyptus lesouefii</i>	P	*							*				
Myrtaceae	Eucalyptus	<i>Eucalyptus loxophleba</i> subsp. <i>lissophloia</i>	P									*			
Myrtaceae	Eucalyptus	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i>	P	*		*					*				
Myrtaceae	Eucalyptus	<i>Eucalyptus salmonophloia</i>	P	*		*				*	*				
Myrtaceae	Eucalyptus	<i>Eucalyptus salubris</i>	P									*			
Pittosporaceae	Bursaria	<i>Bursaria occidentalis</i>	P			*									
Pittosporaceae	Pittosporum	<i>Pittosporum angustifolium</i>	P						*	*					
Poaceae	Aristida	<i>Aristida contorta</i>	A			*									
Poaceae	Austrostipa	<i>Austrostipa elegantissima</i>	P			*	*		*		*			*	
Poaceae	Austrostipa	<i>Austrostipa nitida</i>	P	*	*	*	*	*			*	*		*	*
Poaceae	Enneapogon	<i>Enneapogon caeruleus</i>	A			*				*					
Poaceae	Eragrostis	<i>Eragrostis dielsii</i>	A					*	*			*			
Poaceae	Eriachne	<i>Eriachne helmsii</i>	P			*									
Poaceae	Eriachne	<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	A					*	*					*	
Poaceae	Monachather	<i>Monachather paradoxus</i>	P			*				*					
Portulacaceae	Calandrinia	<i>Calandrinia creethae</i>	A						*						
Portulacaceae	Calandrinia	<i>Calandrinia eremaea</i>	A			*									
Portulacaceae	Calandrinia	<i>Calandrinia translucens</i>	A			*									
Proteaceae	Grevillea	<i>Grevillea acuaria</i>	P						*						
Proteaceae	Grevillea	<i>Grevillea nematophylla</i> subsp. <i>nematophylla</i>	P			*									
Proteaceae	Hakea	<i>Hakea preissii</i>	P					*					*		
Rubiaceae	Psyrax	<i>Psyrax rigidula</i>	P			*									
Santalaceae	Exocarpos	<i>Exocarpos aphyllus</i>	P	*					*					*	
Santalaceae	Santalum	<i>Santalum spicatum</i>	P			*									
Sapindaceae	Dodonaea	<i>Dodonaea lobulata</i>	P	*			*			*	*				*
Sapindaceae	Dodonaea	<i>Dodonaea rigida</i>	P			*									
Sapindaceae	Dodonaea	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	P			*		*	*				*	*	
Scrophulariaceae	Eremophila	<i>Eremophila alternifolia</i>	P		*	*									
Scrophulariaceae	Eremophila	<i>Eremophila decipiens</i> subsp. <i>decipiens</i>	P						*					*	
Scrophulariaceae	Eremophila	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	P			*									
Scrophulariaceae	Eremophila	<i>Eremophila glabra</i> subsp. <i>glabra</i>	P	*	*		*				*			*	
Scrophulariaceae	Eremophila	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	P			*									
Scrophulariaceae	Eremophila	<i>Eremophila longifolia</i>	P						*	*					
Scrophulariaceae	Eremophila	<i>Eremophila maculata</i> subsp. <i>brevifolia</i>	P			*							*		
Scrophulariaceae	Eremophila	<i>Eremophila metallicorum</i>	P			*									
Scrophulariaceae	Eremophila	<i>Eremophila miniata</i>	P						*					*	
Scrophulariaceae	Eremophila	<i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i>	P												*
Scrophulariaceae	Eremophila	<i>Eremophila parvifolia</i> subsp. <i>auricampa</i>	P	*			*				*				
Scrophulariaceae	Eremophila	<i>Eremophila platycalyx</i> subsp. <i>Leonora</i>	P										*		

Family	Genus	Taxon	A, P, NN	A	B	C	D	E	F	G	H	I	J	K	L
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila pustulata</i>	P									*			
Scrophulariaceae	<i>Eremophila</i>	<i>Eremophila scoparia</i>	P			*		*	*	*		*		*	*
Solanaceae	<i>Solanum</i>	<i>Solanum hoplopetalum</i>	P			*									
Solanaceae	<i>Solanum</i>	<i>Solanum lasiophyllum</i>	P	*		*	*				*				
Solanaceae	<i>Solanum</i>	<i>Solanum nummularium</i>	P			*									
Solanaceae	<i>Solanum</i>	<i>Solanum orbiculatum</i>	P			*									
Zygophyllaceae	<i>Roepera</i>	<i>Roepera eremaea</i>	A	*	*	*	*	*			*				*