



ABRA BASE METALS MINE

PURPOSE CLEARING PERMIT APPLICATION

22 MAY 2023

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# 1. INTRODUCTION

The Abra base metals project is located in the eastern Gascoyne region, approximately 180 kilometres north of Meekatharra, 170 kilometres south of Newman and 100 kilometres west of the Great Northern Highway. The mine has an approximate life span of 12 years based on the current mine plan and production rate.

The project comprises of a new underground mining operation and ore processing via a conventional flotation process plant to produce a lead / silver concentrate. The concentrate will be transported on public roads to the Port of Geraldton for export.

The base metals orebody commences at approximately 250 metres below ground level (mbgl), with the bulk of high-grade ore located between 350-500 mbgl. Metallurgical test-work has delivered results of up to 96% lead recovery and up to 78% silver recovery using conventional flotation methods.

The project is based on a design nameplate process plant capacity of 1.2 million tonnes per annum (mtpa). This will produce approximately 100,000 tonnes per annum (tpa) of lead/silver concentrate and 1,100,000 tpa of process residue that will be deposited in a tailings storage facility (TSF). Approximately one third of the total tailings produced during the life of mine will be processed in a paste plant and used as backfill in completed mine voids.

The dot points below show that the project's initial Mining Proposal and Clearing Permit were obtained in 2019. Subsequent amendments were approved to add additional tenements, with an additional Clearing Permit.

- Mining Proposal ID 76773 was approved on 10/6/2019.
- Clearing Permit CPS 8234/1 (mine) approved on 12/1/2019.
- Clearing Permit CPS 8558/1 (airstrip) approved on 14/9/2019.
- Mining Proposal ID 80761 was approved on 9/10/2019.
- Mining Proposal ID 92251 (Doolgunna) was approved on 2/7/2021.

A new Mining Proposal (ID 115096) has been prepared to add a further tenement to the development envelope, L52/240. The new tenement is required to establish additional water abstraction bores on the airstrip tenement and include an access corridor between the airstrip tenement and the mine group of tenements.

This new clearing permit has been prepared to cover clearing associated with these works plus allow for additional infrastructure on the mine tenement. Clearing will occur within tenements G52/292 and L52/240. Clearing of up to 70.0000 ha within a disturbance envelope of 1066 ha is required. (Figure 1).

## 1.1 EXISTING CLEARING PERMITS

Figure 1 shows the proposed new clearing permit boundary that would bridge the two existing clearing permits CPS 88558/1 and CPS 8234/1.

### **CPS 88558/1**

Construction of the airstrip has been completed and the airstrip is now operational. CPS 8558/1 is complete. The annual report in July 2022 has closed out this permit.

### **CPS 8234/1**

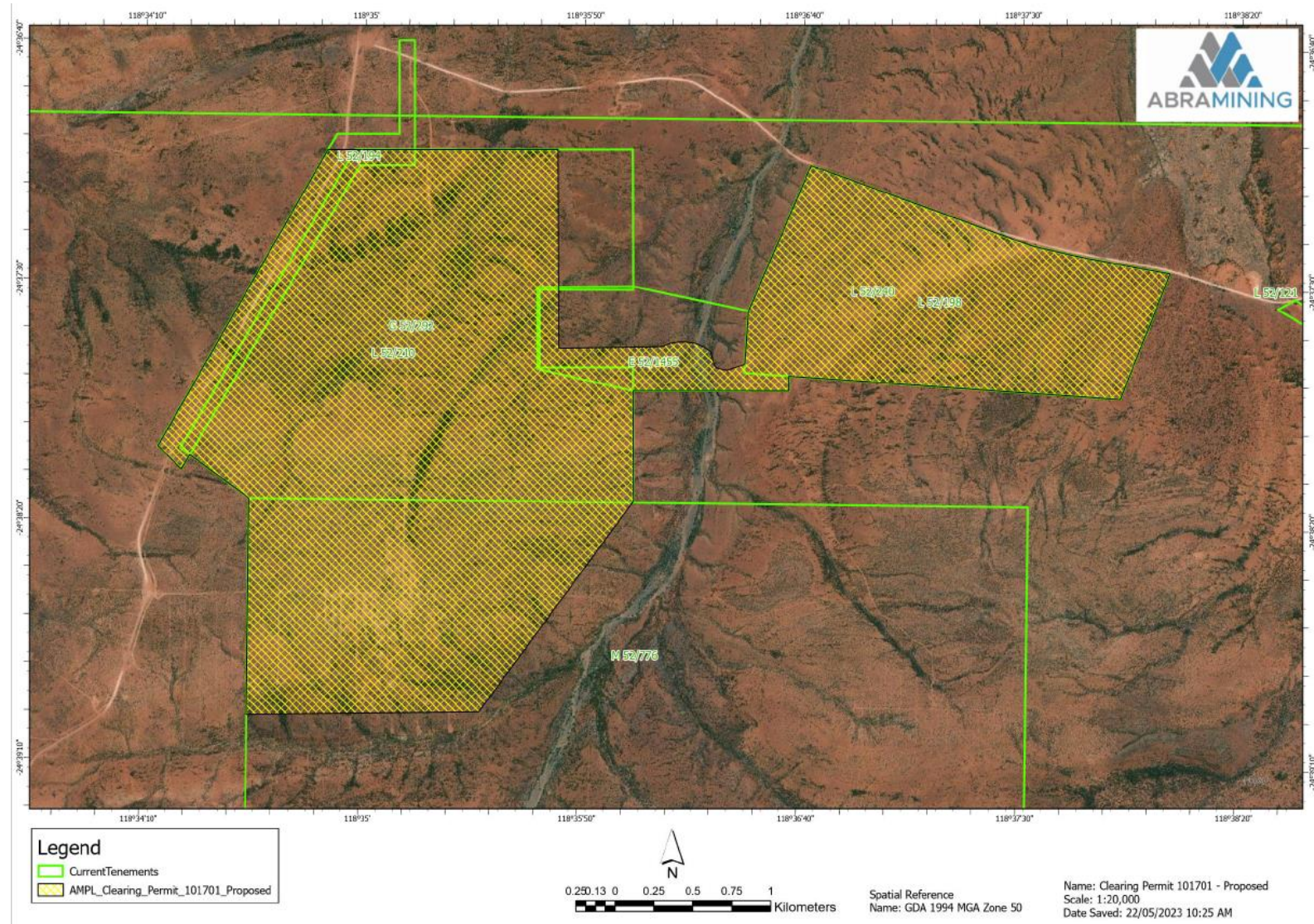
Clearing for the majority of infrastructure needed to commence operation on the mine group of tenements has occurred under CPS 8234/1. CPS 8234/1 included allocation for clearing the entire footprint of TSF Cell A and B. Cell A has been cleared and construction of TSF embankments will have commenced.

A portion of Cell B footprint has also been cleared and used as a borrow pit, however the Cell B storage area is not scheduled to be needed for approximately three years (est 2025). CPS 8234/1 duration is from 12 January 2019 to 11 January 2024.

AMPL propose to include the balance of the area remaining to clear Cell B on CPS8234/1 in the new clearing permit associated with Mining Proposal ID 115096. This will provide an approved clearing permit



with duration from 2023 to 2028, which is the period when Cell B will be required. The 2022 – 2023 annual clearing report for CPS 8234/1 will document these details and close out this clearing permit.



**Figure 1: Proposed Clearing Permit Boundary**

## 2. LAND OWNERSHIP

Abra Mining Pty Limited (AMPL) is a 60:40% Joint Venture between Galena Mining Limited (60%) and Toho Zinc Company Japan (40%). The address for AMPL is:

Second Floor, 1100 Hay Street

West Perth WA 6005

Proponent contact is

Tom Mitchell

Stakeholder and Compliance Manager

6183 3216

The tenements covering this clearing permit are as follows:

G52/292. Holder - Abra Mining Pty Limited. Status – Live. Expiry 9/7/2039

L52/194. Holder - Abra Mining Pty Limited. Status – Live. Expiry 27/09/2039

L52/198. Holder - Abra Mining Pty Limited. Status – Live. Expiry 30/01/2040

L52/210. Holder - Abra Mining Pty Limited. Status – Live. Expiry 24/09/2040

L52/240. Holder - Abra Mining Pty Limited. Status – Live. Expiry 26/7/2043

M52/776. Holder - Abra Mining Pty Limited. Status – Live. Expiry 21/12/2042

### 3. DESCRIPTION OF CLEARING ACTIVITIES

Vegetation clearing will be required for the following activities:

- construction of remaining mine infrastructure 'transferred' from CPS 8234/1 comprising, balance of area for tailings storage facility, roads, topsoil, borrow pit and vegetation stockpiles; and
- low grade stockpile area, water bores, pipeline corridor and roadway.

Clearing of native vegetation will be undertaken using standard earthmoving equipment, such as bulldozers and graders, to provide a surface free of vegetative matter, though some roots may remain. Table 1 and Figure 1 show the disturbance areas required for the project. A shapefile of the disturbance envelope will be provided to DMIRS with the clearing application.

Table 1: Disturbance areas

Mine Feature	Type	G52/292 (ha)	L52/240 (ha)	Total (ha)
Low grade stockpile	Major	3.00		3.00
Tailings Storage Facility (Cell B)	Major	40.00 <sup>1</sup>		40.00
Borrow pit	minor	5.00		5.00
Fresh water dam/sump	minor	1.00		1.00
Topsoil & vegetation stockpiles	minor	5.00	5.00	10.00
Bores and pipeline	minor		5.00	5.00
Roadways	minor	1.00	5.00	6.00
<b>total</b>		<b>55.00</b>	<b>15.00</b>	<b>70.00</b>

1. Previously approved in CPS 8234/1

### 4. BASELINE ENVIRONMENT

A number of baseline studies and assessments have been undertaken for the Abra project. These comprise:

- Flora, vegetation and terrestrial fauna survey;
- Subterranean fauna survey;
- Aboriginal heritage survey;
- Groundwater assessment; and
- Materials characterisation.

The scope of the flora and vegetation survey for the mine included a zone east of G52/292 that contained Five Mile creek and some land between the creek and the airstrip. In combination with the survey for the airstrip tenement (L52/198), the two surveys effectively cover the new tenement L52/240.

The sections below provide a summary of the project's baseline information that was also provided in the previous clearing permit applications. References to the appendix where the complete reports are located are also included.

#### 4.1 CLIMATE

Payne et.al. (1988) undertook an inventory and condition survey of the Ashburton River catchment, which covers an area of approximately 93,600 square kilometres. The region lies between the winter rainfall parts of the State to the south and the summer rainfall parts to the north.



Table 2 provides Bureau of Meteorology (BoM) rainfall information from Tangadee (Station number 007179), located approximately 45 km north east of the Abra project site. The data shows the local area has a 'combination (summer and winter rainfall) climate,' with rainfall of 20 mm/month or above falling over a seven-month period from December to June.

**Table 2: Rainfall Data Tangadee Station (BoM 2018)**

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Rainfall	49.7	55.6	39.5	23.3	18.9	20.7	15.2	6.2	2.8	4.6	11.0	21.6	269.1

## 4.2 BIODIVERSITY AND ECOSYSTEM

Stantec (2018) undertook a Detailed flora and vegetation survey and a Level 1 terrestrial fauna survey over a study area of approximately 1,357 hectares (ha) in size that encompasses all the tenements of the Abra projects. Reports are attached in Appendix 1. A summary of key points from the reports are provided below:

### Flora

- There were 101 vascular flora species recorded, representing 25 families and 58 genera.
- No Threatened flora from either the State or Commonwealth databases were recorded in the survey.
- One Commonwealth listed threatened species *Pityrodia augustensis*, was identified in the Protected Matters Search Tool, which listed the species or species habitat as 'likely to occur within the area'. The species was not detected in the site survey and a review of the recorded specimens of this taxa held by the WA Herbarium indicate that the closest record of this species is approximately 150 km west of the study area.
- No State listed Priority species were recorded during the survey.
- Review of the Priority species *Acacia tuberculata*, *Eremophila appressa*, *Eremophila coacta*, *Owenia acidula*, *Ptilotus actinocladus* T.Hammer & R.W.Davis and *Thysanotus* sp. Desert East of Newman (R.P. Hart 964) indicated that all of the above taxa records within the last 20 years do not occur in close proximity to the study area. The closest of these occurs greater than 90 km from the study area, with some occurring over 200km from the study area. Further, none of these species have been recorded during previous surveys within the vicinity of the study area.
- One species, *Centipeda minima* subsp. *macrocephala*, recorded from one quadrat is considered to be a range extension. This species is recorded further to the west in the Augustus subregion and right through the Carnarvon, Central Kimberley, Dampierland, Great Sandy Desert, Little Sandy Desert, Northern Kimberley and the Ord Victoria Plain IBRA regions.
- Weed diversity is considered to be low, with only two introduced species recorded. \**Bidens bipinna* and \**Malvastrum americanum*, were recorded in low densities growing in association with 5 Mile Creek and other smaller incised drainage lines. Neither of these species represents a declared pest or Weed of National Significance.

### Vegetation

- No Threatened Ecological Community (TEC) or Priority Ecological Community (PEC) from either the State or Commonwealth databases was recorded in the study area. The nearest State listed PEC (Diorite Land System P3) is located approximately 12 km south west.
- Eight vegetation types, including one mosaic vegetation type, were described and mapped.
- Vegetation condition ranged from 'Degraded' to 'Excellent' with the majority of the study area mapped as either 'Very Good' or 'Excellent'. Vegetation considered to be in 'Degraded' condition had been cleared for exploration drilling or historical access tracks.
- Two vegetation system associations intersect with the project area, Augustus 18 and August 39. The current extents suggest that minimal land clearing has occurred across four scales of assessment (State, bioregion, subregion and Local Government Area).
- Table 3 summarises the vegetation system associations and their extent in the study area.
- The vegetation system association extent remaining across State, bioregion, subregion and Local Government Area is described in Table 4.

**Table 3: Vegetation system associations in the Study Area**

System	System Code	Extent (ha)	Description
Augustus	18	1068.62	Low woodland; mulga ( <i>Acacia aneura</i> )
	39	288.02	Shrublands; mulga scrub

**Table 4: Vegetation system associations (Stantec 2018)**

System	Scale	Pre-European Extent	Current Extent	% Remaining	Current extent within IUCN Class I-IV Reserves (ha)	% of current extent protected within IUCN Class I-IV Reserves
Augustus 18	State-wide	1,723.47	31,698.27	99.92	-	-
	Bioregion	2,831.02	2,831.02	100	-	-
	Sub – region	2,736.93	2,736.93	100	-	-
	LGA	3,737.92	3,737.92	100	-	-
Augustus 39	State-wide	6,613,569.14	6,602,580.10	99.83	479,205.99	7.25
	Bioregion	2,338,128.28	2,337,580.69	99.98	55,523.47	2.37
	Sub – region	1,404,073.25	1,403,525.66	99.96	55,523.47	3.95
	LGA	157,356.02	157,356.02	100	-	-

## Fauna

- A total of 27 species of vertebrate fauna were recorded during the field survey, none of which were of conservation significance.
- Only one fauna species of conservation significance was considered to possibly occur based on habitat suitability, species range and previous records; the Peregrine Falcon (S7).
- Five fauna habitats were identified:
  - 1) Banded mulga on plain;
  - 2) Riparian;
  - 3) Open shrubland on stony plain,
  - 4) Drainage; and
  - 5) Gully.

Of these habitats, Riparian habitat was considered locally significant owing to the potential foraging suitability for the Peregrine Falcon (S7).

## 4.3 ABORIGINAL HERITAGE

Archaeological and ethnographic site avoidance surveys of the project area were undertaken in 2018. A heritage survey was undertaken in February 2022 over a portion of L52/240 that AMPL proposed as a service corridor. The corridor, and hence the tenement boundary was re-aligned in consultation with Traditional Owners during the survey to avoid heritage sites. The heritage reports are considered confidential information, which should not be available for public distribution. These are attached as Appendix 3: Confidential Information.

## 4.4 LAND USE

The Abra project occupies a relatively small footprint (approximately 200 hectares (ha)) in the extensive rangeland region of Western Australia. It is located on the Mugul pastoral lease, which is approximately 279,850 ha in area. The current strategy for post mining land use is to return the site for pastoral use activities.

During the life of mine, AMPL will consult with stakeholders to obtain agreement on the final post mining land use. Often, mining operations install infrastructure that may continue to have a beneficial use after the mine is closed. Examples of this include groundwater abstraction bores, access roads and portable accommodation, ablution or office buildings. Any nomination for retention of infrastructure must have a sequential use agreement between the parties and approval from relevant stakeholders that include the Pastoral Lands Board.

Further identification and definition of potential land uses will be discussed in consultation with stakeholders and regulatory agencies closer to mine closure.

## 4.5 GEOLOGY

The Abra project site is located in the south east corner of the Ashburton region. The general geology of the area (about 90%) is based on Proterozoic rocks of the Bangemall, Bresnahan, Wyloo, Hamersley, and Fortescue geological groups. The Proterozoic rocks have been extensively folded and eroded and form the major hill and mountain land systems that form the watersheds between the Ashburton and Fortescue River to the north and the Ashburton and Gascoyne River to the south.

A baseline study conducted by Rockwater (2018) describes the local geology as follows:

The hydrothermal nature of the Abra deposit indicates emplacement during significant faulting events. The deposit is located along the east-west striking Quartzite Well Fault that is thought to be an eastern extension of the Lyons River Fault. The deposit is located within the southern limb of an east-west trending anticline, near the fold axial plane. It takes the form of a funnel shaped brecciated zone, overlain by vertically zoned strata bound mineralisation. The depth of weathering is variable but saprolite (clay) generally extends down to about 50m depth or less; saprock is generally 50 to 100m deep and grades down to transition zone rocks which are oxidised along joints and fractures.

## 4.6 LAND SYSTEMS AND SOILS

Payne et.al. (1988) describes the project area as falling within three broad natural ecological regions as recognised by Beard (1975). These are the Pilbara region, Gascoyne region and the Carnarvon basin. Eight geomorphic provinces were recognised. The Abra project falls within the Bangemall province. This province extends along the southern edge of the survey area and forms the watershed between the Ashburton and Gascoyne Rivers.

Soils of the Bangemall province have formed insitu on stripped surfaces or have accumulated on lower slopes and narrow drainage floors by colluvial and alluvial action. The rugged topography of the Bangemall region is responsible for its chief soil characteristic, which is the high proportion (70%) of skeletal and shallow stony loams. Cracking and non-cracking alkaline clays are characteristic of the lower plains. The narrow drainage floors have widely different drainage conditions and as a result, the soils are variable and may be sands, texture contrast soils or cracking clays.

## 4.7 HYDROLOGY

Rockwater (2018) undertook an assessment of local hydrogeology resources. Previous reports indicated much of the host rocks around the Abra deposit are of low permeability. Groundwater level measurements indicate a northerly direction of flow and a possible higher permeability zone centred near the ore body.

Rockwater (2018) report that Geopeko drilled at least 22 holes in 1990 for the purpose of obtaining water samples and drill cuttings to depths of 28 – 76m. Groundwater quality is regarded as fresh, with salinities in a range around 500 mg/L Total Dissolved Solids (TDS).

Local water table ranges from about 16 to 54 m below ground surface (depending on local elevation). Results of water quality analysis from a range of bores show groundwater in the locality is generally slightly alkaline (pH 7.9-8.4) and of calcium / sodium bicarbonate type. Metals are mostly at or below limits of reporting, total nitrogen ranges from 3-16.7 mg/L and phosphorous is low.

Of the existing bores, previous pump testing identified three bores (AB10, EP1 and HY1) which had yields of 7, 6 and 8 L/sec respectively. These three bores are within a two kilometre radius of the project site. This information indicates a dedicated water boring exploration programme on approved tenements M52/776 and G52/292 in the vicinity of existing bores will provide a sufficient water resource for the project. To build future redundancy into the water resource system, AMPL will undertake further groundwater exploration during the first 3 years of mine life to establish additional bores and approved miscellaneous licences. This will enable rotation from each extraction source and resting/recovery of individual bores.

Rockwater (2018) reported on regional bores, wells and springs recorded in the Department of Water and Environmental Regulation (DWER) Water Information Reporting (WIR) database. Only two sites are located within 15km of the Abra project; Bedford bore and Chalk Spring in the Ethel River. They conclude there is no possibility that pumping from bores at Abra would have any impact on these features.

The report also states there are no known groundwater dependent vegetation or ecosystems that could be impacted by the project.

## **5. CLEARING PRINCIPLES**

Table 5 provides an assessment against the 10 clearing principles.

## **6. ENVIRONMENTAL MANAGEMENT**

AMPL has developed an EMS to manage environmental impacts associated with its mining operations. While the EMS is structured to be consistent with ISO 14001, AMPL does not intend to apply for certification under this standard. The EMS is provided in Appendix 2.

**Table 5: Clearing Principles**

No.	Principle	Existing Environment	Potential Impact	Management Action	Outcome
	Native vegetation should not be cleared if-				
<b>Biodiversity Significance</b>					
1.	it comprises a high level of biological diversity.	The botanical surveys recorded generally low biodiversity flora values and no unique or high quality fauna habitat values. Vegetation communities and flora species in the project area are also well represented in the wider region.	The project will result in only minor biodiversity loss through localised clearing	If available, collect seed from the cleared area for use in rehabilitation programmes	Project is not at variance with this principle
2.	it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to WA.	Fauna surveys have not identified significant fauna habitat unique to the project area.	The project will result in only minor local habitat loss in a region that is well covered in native vegetation.	Rehabilitation at the completion of operations will return habitat to the majority of the project area.	Project is not at variance with this principle
3.	it includes, or is necessary for the continued existence of, rare flora.	No Declared Rare Flora (DRF) has been located in the project area	No impact to DRF	No specific management measures necessary for this principle	Project is not at variance with this principle
4.	it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.	No Threatened Ecological Community (TEC) is located in the project area	No impact to TEC	No specific management measures necessary for this principle	Project is not at variance with this principle
5.	it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The region is predominantly covered by native vegetation (see Appendix 1).	No remnant vegetation communities in the project area	No specific management measures necessary for this principle	Project is not at variance with 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 region.	One access road crossing will be constructed across Five mile creek. Water pipelines will be buried in a trench under the creek bed.	A Bed and Banks permit will be obtained from DWER.	Project is not at variance with this principle
<b>Land Degradation</b>					
7.	the clearing of vegetation is likely to cause appreciable land degradation.	The region is predominantly covered by native vegetation.	The 70 hectares of clearing associated with this permit in a region extensively covered by native vegetation, is unlikely to cause appreciable land degradation.	Clearing procedure is to be implemented as a control measure. Appendix 2: EMS: Vegetation management procedure	Project is not at variance with this principle
<b>Conservation Estate</b>					
8.	the clearing of vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The nearest gazetted conservation area (Collier Range National Park (R 35104)) is approximately 8.7 km to the east of the mine and outside the tenements associated with this mining proposal	No impact to the conservation estate	No specific management measures necessary for this principle	Project is not at variance with this principle
<b>Ground and Surface Water Quality</b>					
9.	the clearing of vegetation is likely to cause deterioration in the quality of surface or underground water.	There are no permanent surface water bodies in the vicinity. Short duration surface water flows follow intermittent heavy rainfall. Local water table levels range from 16 to 54 m below ground level (depending on local elevation).	Turbid water from intense rainfall events may enter local watercourses.  Impact to groundwater from TSF seepage.	Detention basins contain sediment off disturbed areas prior to discharge to the environment. Appendix 2: EMS Water Monitoring Procedure Baseline assessment indicates tailings has low solubility and leachate is likely to be within ANZECC stock drinking water quality guidelines	Project is not at variance with this principle
10.	clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	The project is located in an arid climate, on a local topographic high.	The project is unlikely to cause or exacerbate the incidence of flooding.	Detention basins contain sediment off potential lead contamination area and designed to completely contain a 1:100yr:72 hr rain event.	Project is not at variance with this principle

## 7. REFERENCES

Bureau of Meteorology (BoM) 2018, Daily Rainfall: Tangadee, Australian Government. Available from: [http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p\\_nccObsCode=136&p\\_display\\_type=dailyDataFile&p\\_startYear=&p\\_c=&p\\_stn\\_num=007179](http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=007179), Accessed 25 July 2018.

Payne, AL, Mitchell, AA, & Holman, WF 1988, Technical Bulletin No. 62: An inventory and condition survey of rangelands in the Ashburton River catchment, Western Australia, Department of Agriculture, Pastoral Appraisal Board, Perth, Western Australia.

Rockwater Hydrogeological and Environmental Consultants (Rockwater) 2018, Abra Lead-Silver Project: Potential Water Sources, Internal report prepared for Galena Mining Ltd.

Stantec Australia Pty Ltd (Stantec) 2018, Abra Flora, Fauna and Vegetation Survey, Internal report prepared for Galena Mining Ltd.

## **APPENDICES**

**APPENDIX 1:**  
**FLORA AND FAUNA SURVEYS**



# ABRA FLORA, FAUNA AND VEGETATION SURVEY

PREPARED FOR **GALENA MINING LTD**

15 November 2018

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## REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
V1.0	29/06/2018	Draft for client comment	CH	AB	PB	PB
V2.0	15/11/2018	Final	CH	ABB	PB	AB

# Executive Summary

Galena Mining Limited proposes to develop a lead mining operation in the Gascoyne Region of Western Australia, entitled the Abra Base Metals Project. The Project is located on Mining Lease M52/766 and Exploration Lease E52/1455, approximately 220 kilometres north of Meekatharra and 180 kilometres southwest of Newman, Western Australia. Stantec Australia Pty Ltd were commissioned to undertake a Detailed flora and vegetation survey and Level 1 fauna survey of to inform the approval process for the project.

The flora, fauna and vegetation survey was undertaken between 26 and 30 April 2018 with additional fauna observations made between 28<sup>th</sup> May and 1<sup>st</sup> June 2018. There were 101 vascular flora species recorded within the Study Area, representing 25 families and 58 genera. The most represented families were Fabaceae, Poaceae and Malvaceae. No Threatened flora or state-listed Priority flora were recorded during the survey and based on the results of the post-survey likelihood of occurrence assessment, none are expected to occur. One species, *Centipeda minima* subsp. *macrocephala*, recorded from one quadrat within the Study Area is considered to be outside of its normal range of distribution. This species is however recorded further to the west in the Augustus subregion and right through the Carnarvon, Central Kimberley, Dampierland, Great Sandy Desert, Little Sandy Desert, Northern Kimberley and the Ord Victoria Plain IBRA regions.

Eight vegetation types, including one mosaic vegetation type, were described and mapped within the Study Area. None of these vegetation types are analogous to any Threatened or Priority Ecological Communities. Vegetation condition ranged from 'Degraded' to 'Excellent' with the majority of the Study Area mapped as either 'Very Good' or 'Excellent'. Vegetation considered to be in 'Degraded' condition had been cleared for exploration drilling or historical access tracks. Weed diversity is low, with only two introduced flora species recorded within the Study Area. Both of these species, *\*Bidens bipinnata* and *\*Malvastrum americanum*, were recorded in low densities growing in association with 5 Mile Creek and other smaller incised drainage lines. Neither of these species represents a declared pest or Weed of National Significance.

Five fauna habitats were identified within the Study Area; Banded mulga on plain; Riparian; Open shrubland on stony plain, Drainage; and Gully. Of these habitats, Riparian habitat was considered significant owing to the potential foraging suitability for the Peregrine Falcon (S7).

A total of 27 species of vertebrate fauna were recorded during the field survey, none of which were of conservation significance. Only one fauna species of conservation significance was considered to possibly occur based on habitat suitability, species range and previous records; the Peregrine Falcon (S7). All other conservation significant fauna were considered unlikely to occur.

# Galena Mining Ltd

## Abra Flora, Fauna and Vegetation Survey

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## APPENDICES

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# 1. Introduction

## 1.1 Project Background and Location

Galena Mining Limited (Galena) proposes to develop a lead mining operation entitled the Abra Base Metals Project (the Project). The Project is located within the Gascoyne Region of Western Australia (WA), 220 kilometres (km) north of Meekatharra and 180km southwest of Newman (**Figure 1-1**).

The proposed Project consists of a single granted mining lease, M52/766, of approximately 10 square kilometres (km<sup>2</sup>) surrounded by a single granted Exploration Licence, E52/1455, of approximately 180 km<sup>2</sup>. The area that forms the basis of this flora, fauna and vegetation survey includes part of mining lease M52/766 and part of exploration licence E52/1455 (the 'Study Area'). The current Study Area is approximately 1,357 hectares (ha) in size (**Figure 1-2**) and is located within the Shire of Meekatharra.

The current project design includes an underground mine and an ore processing plant with resulting lead-rich sulfide concentrate to be exported through Geraldton port (transport via road along the Great Northern Highway and other major highways and roads). The proposed underground mine would mine ore from 260 metres (m) below ground with the bulk of high-grade ore located between 350-500 m. Metallurgical test-work has delivered results of up to 96% lead recovery and up to 90% silver recovery using conventional flotation methods Galena Mining Limited (2017).

Stantec Australia Pty Ltd (Stantec) has been commissioned by Galena to complete the environmental assessment process for the Project. This detailed flora and vegetation and level 1 fauna survey was informed by a desktop survey conducted by Stantec within the Study Area (Stantec 2018). The surveys are to inform the environmental assessment process.

## 1.2 Scopes and Objectives

The overarching objective of this survey was to undertake a Detailed flora and vegetation survey and a Level 1 fauna survey to inform the environmental assessment for the Project. More specifically, the objectives were to:

- Undertake a Detailed Flora and Vegetation survey to:
  - develop a list of flora species recorded as occurring within the Study Area, including introduced weed species;
  - identify, describe and map vegetation communities and their condition within the Study Area;
  - complete a targeted survey for conservation significant vascular flora identified as potentially occurring in the Study Area based on the desktop study; and
  - assess the survey findings in a local and regional context by comparing them with available data from the desktop study.
- Undertake a Level 1 Fauna survey to:
  - develop a list of fauna species recorded as occurring within the Study Area, including introduced fauna;
  - identify, describe and map fauna habitats within the Study Area and assess their value to fauna of conservation significance;
  - complete a targeted survey for conservation significant fauna identified as potentially occurring in the Study Area based on the desktop study; and
  - assess the survey findings in a local and regional context by comparing them with available data from the desktop study.

The objectives and methods adopted for these surveys are aligned with the following relevant regulatory guidelines:

- EPA Factor Guideline (EPA 2016e) Environmental Factor Guideline: Flora and Vegetation;
- EPA Technical Guide (EPA 2016b), Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment;
- EPA Factor Guideline (EPA 2016a), Environmental Factor Guideline: Terrestrial Fauna;
- EPA Technical Guide (EPA 2016d), Technical Guidance – Terrestrial Fauna Surveys; and
- EPA Technical Guide (EPA 2016c), Technical Guidance – Sampling methods for Terrestrial Vertebrate Fauna.

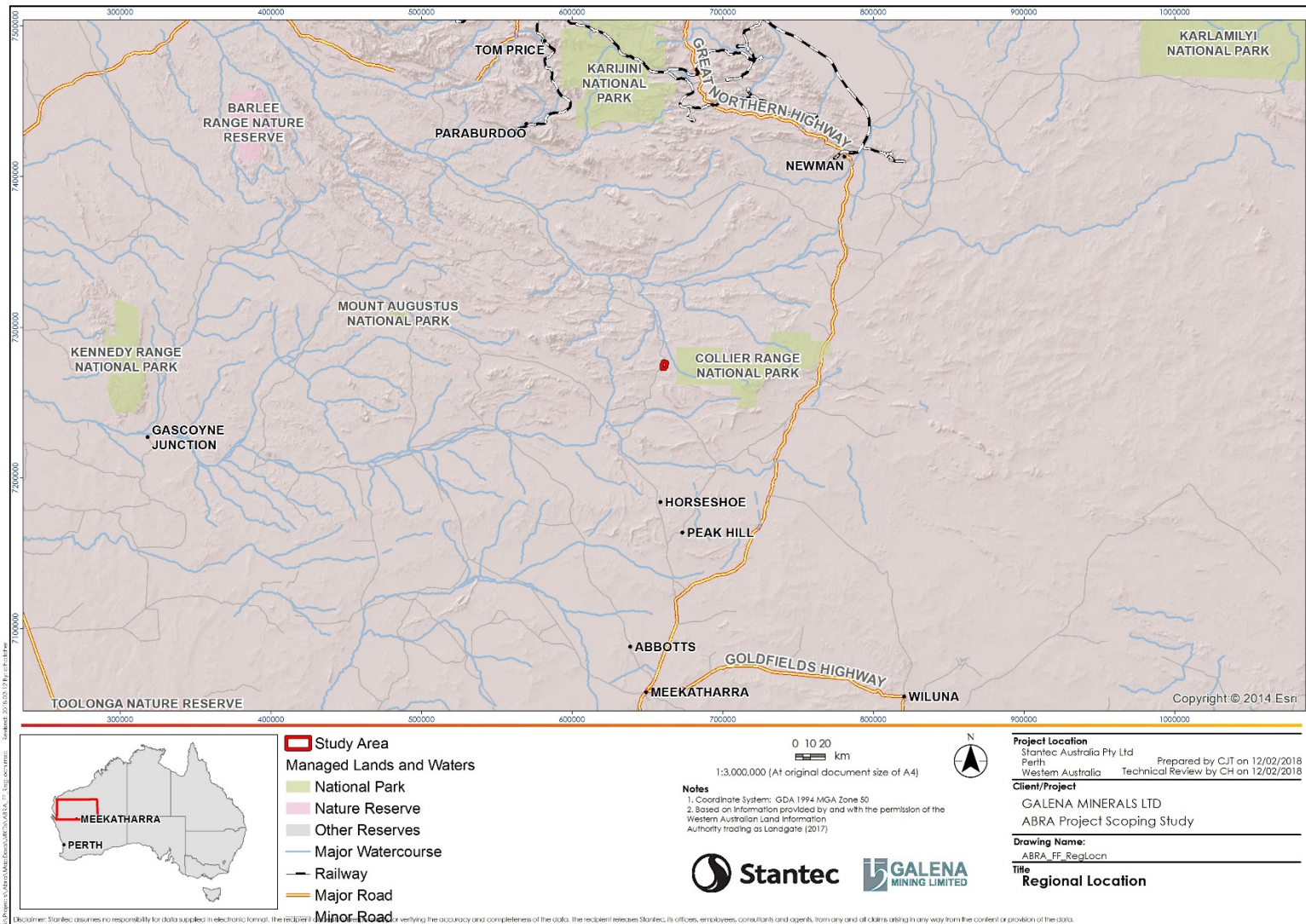


Figure 1-1: Regional locality of the Study Area



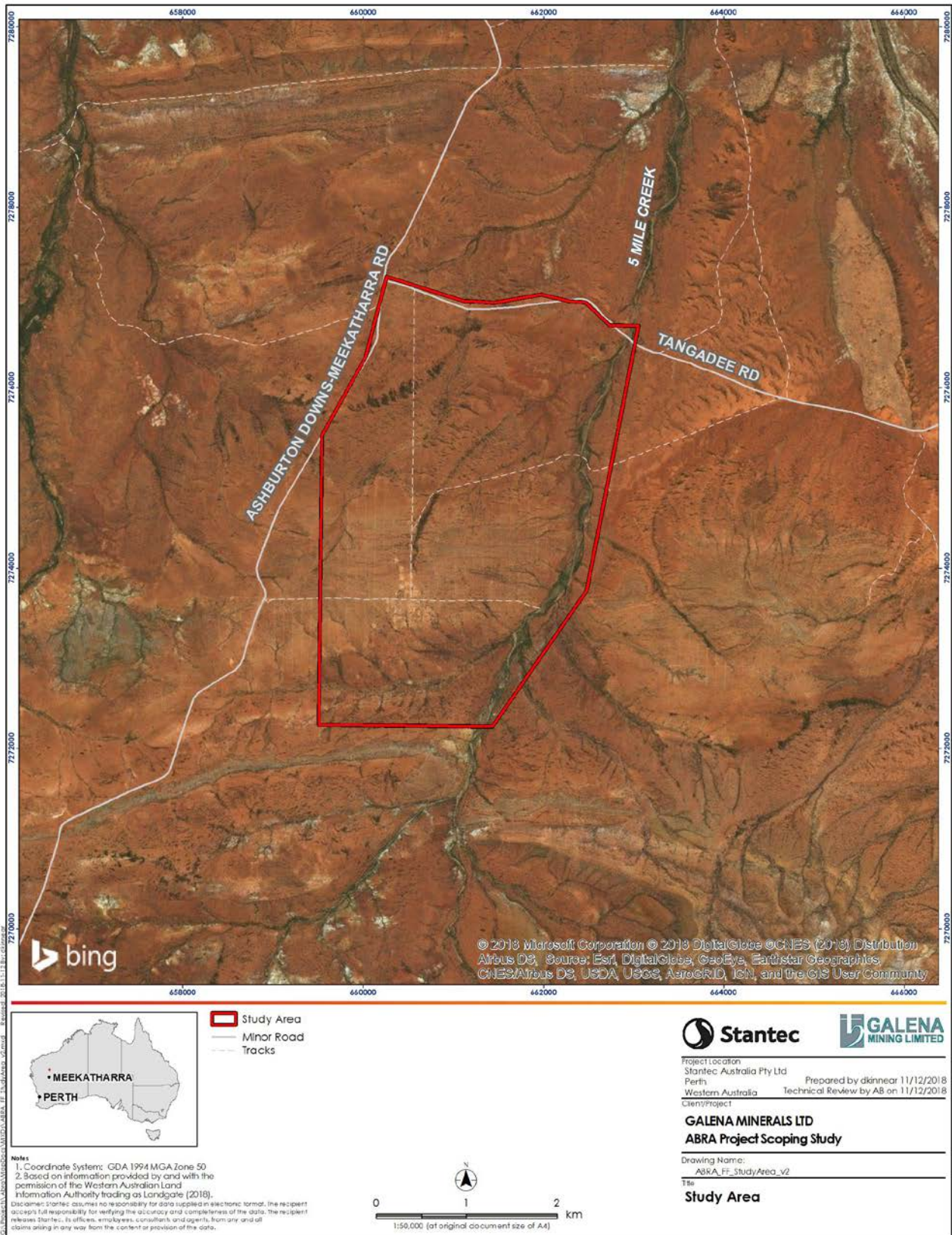


Figure 1-2: The Study Area

## 2. Existing Environment

### 2.1 Physical Environment

#### 2.1.1 Climate

The Study Area is located 170 km southwest of Newman within the Gascoyne province of WA. The Gascoyne region typically receives low amounts of variable rainfall influenced by northern cyclonic events (GDC 2015). Within this, the Augustus subregion is a desert area characterised by bimodal rainfall (Desmond *et al.* 2001, GDC 2015). Long term climate data was collected from the nearest Bureau of Meteorology (BoM) weather stations. Rainfall data was collected from Neds Creek (007103), approximately 138 km southeast of the Study Area. The closest temperature records were collected at Three Rivers (007080), approximately 75 km southeast of the Study Area, however recordings ceased during 2004 (BoM 2018). As such, this study incorporates data collected from Newman Aerodrome (007176) and Meekatharra Airport (007045), approximately 175 km northeast and 215 km south of the Study Area respectively (BoM 2018). The mean annual rainfall recorded at the Neds Creek weather station is 238.5 mm, with the majority received between January and March each year (**Figure 2-1**). Newman Aero has an annual average maximum temperature of 32.0°C and an annual average minimum temperature of 16.4°C (**Figure 2-1**). Meekatharra Airport has an annual average maximum temperature of 29.0°C and an annual average minimum temperature of 15.9°C (**Figure 2-2**).

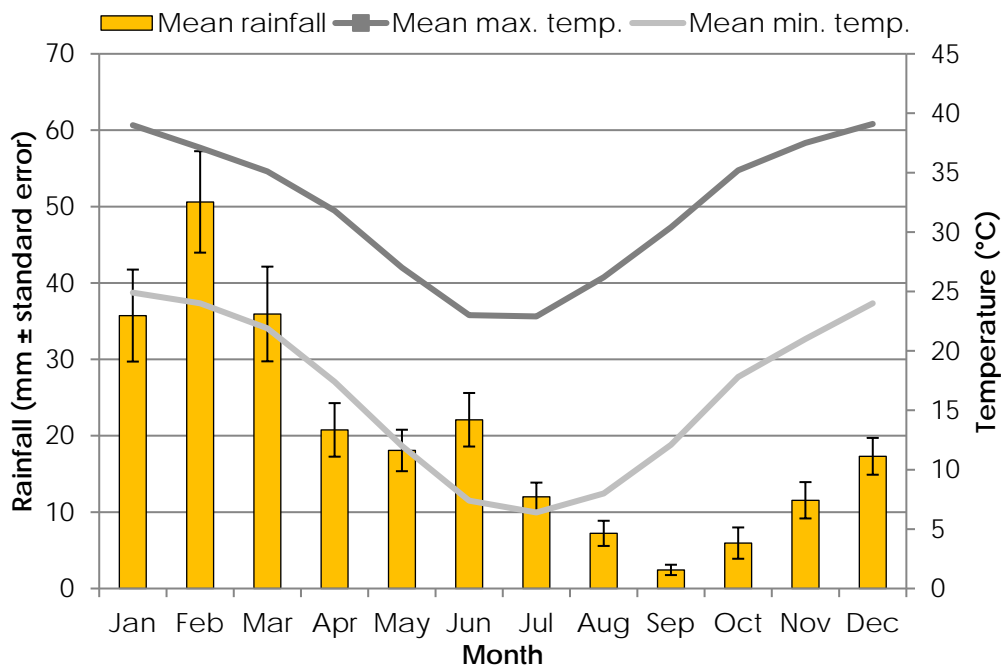


Figure 2-1: Mean maximum and minimum temperatures recorded at Newman Aero (007176) and mean rainfall recorded at Neds Creek (007103) (BoM 2018).

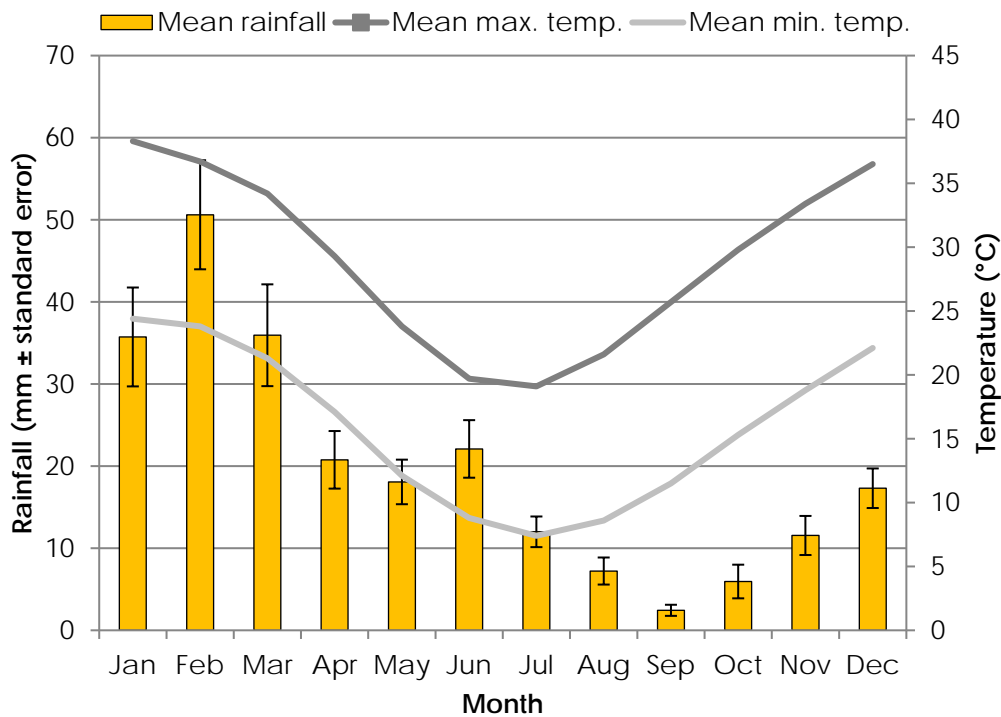


Figure 2-2: Mean maximum and minimum temperatures recorded at Meekatharra Airport (007045) and mean rainfall recorded at Neds Creek (007103) (BoM 2018).

### 2.1.2 Landforms, Geology and Soils

The Project is located within the Mesoproterozoic Bangemall Basin and is the youngest of a series of sedimentary basins that unconformably lie over the Capricorn Orogen, a metamorphic terrain that represents amalgamation of the Yilgarn and Pilbara Cratons during the Paleoproterozoic (Payne *et al.* 1988). The Mulgool project lies within the south eastern boundary of the Bangemall Geomorphic Province, as described by Payne *et al.* (1988). This province is 18,590 km<sup>2</sup> in size and forms the watershed between the Ashburton and Gascoyne Rivers. It consists predominantly of rugged mountains and hill and ridge country of Bangemall series Middle Proterozoic sedimentary rocks (Payne *et al.*, 1988).

The more weather resistant rocks of the area, such as sandstone, form massive parallel ridges and ranges, predominantly trending north-west. The lower slopes, restricted valley plains and floors associated with the hills are covered with a dense surface strew of rock fragments of variable lithology. The sediments are frequently intruded by dolerite dykes and sills which are now exposed to form rounded hills and ridges.

### 2.1.3 Hydrology

The main source of drainage within the Augustus subregion is the Gascoyne River system, however drainage is also provided by the Ashburton and Fortescue River headwaters (Desmond *et al.* 2001). The Gascoyne River reaches 760 km, flowing westward to drain into the Indian Ocean.

The Ashburton River and Ethel Creek, located immediately north and east of the survey area respectively, are seasonal water courses with several permanent pools. A small tributary of the Ethel River, 5 Mile Creek, runs south to north through the eastern portion of the Study Area.

The area of drilling at Abra has some generalisations that can be made regarding the slope of the water table and the variable permeability of the lithologies. The relative elevation of the water table is estimated to slope gently from south to north from a range of <5 m to <15 m (Whitford *et al.* 1994). There appears to be some consistent spatial variation in the depth of the water table. It is relatively high in the southwest and appears to drop to the north and northeast. The mean groundwater flow should follow this slope, although on more local scales the anisotropic permeability of the rocks will probably result in a more complex pattern of groundwater movement (Whitford *et al.* 1994).

The Project area's groundwater is highly enriched with calcium, sodium, potassium, sulfate, phosphorus, lithium, rubidium, gallium and especially strontium and measured pH ranges from 6.1 to 8.9, with most values either neutral or slightly alkaline. All analysed samples have very low total dissolved salts (TDS) (Whitford *et al.* 1994).

#### 2.1.4 Land Use

The majority of land within the Gascoyne is used for pastoral purposes, with leases covering 84% of the area (GDC 2015). Smaller areas serve horticultural or mining purposes (GDC 2015). Land within the Augustus subregion is mainly used for native pasture grazing, with smaller areas classified as unallocated Crown land (UCL), Crown and Aboriginal reserves (Desmond *et al.* 2001). The Study Area lies within the Mulgul Pastoral Lease with cattle grazing occurring across Galena's leases. The exploration lease E52/1455 is dissected by the Fortescue Cue Stock Route Reserve # 9698. The Department of Mines, Industry Regulation and Safety (DMIRS) has a management order over this reserve. Historical mining exploration activities have occurred over the Project area since 1976. The Project was previously known as the Mulgul which was acquired by Galena from Abra Mining Limited.

#### 2.1.5 Reserves and Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the *Environmental Protection Act 1986* (EP Act) to prevent incremental degradation of important environmental values such as declared rare flora (DRF), threatened ecological communities (TECs) or significant wetlands.

The Study Area lies approximately 6.3 km west of Collier Range National Park, which is managed by the Department of Biodiversity, Conservation and Attractions (DBCA). The reserve was established due to the potential value of hills and freshwater pools serving as refuge from fire and harsh arid conditions (Desmond *et al.* 2001). Collier Range National Park receives annual baiting for wild dogs and is visited by staff, however there is limited information available regarding the biodiversity of the area (Desmond *et al.* 2001). Significant damage has been recorded from feral donkeys and cattle and there is no current fire regime (Desmond *et al.* 2001).

## 2.2 Biophysical Environment

### 2.2.1 Biogeographic Region

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 89 biogeographic regions and 419 subregions on the basis of climate, geology, landforms, vegetation, and fauna (Thackway and Cresswell 1995). It was developed through collaboration between state and territory conservation agencies with coordination by the Commonwealth Department of the Environment, Water, Heritage and the Arts (now the Commonwealth Department of the Environment and Energy, DoEE).

The Project area lies within the Ashburton Botanical District, as classified by Beard (1990). This district is almost entirely mulga (*Acacia aneura*) shrublands, sometimes with snakewood (*Acacia xiphophylla*) and other *Acacia* species as scrub on the hills, and as low woodland on the plains. Areas of dwarf scrub of *Eremophila* and *Senna* species also occur (Beard 1990).

The Study Area is located in the Augustus subregion (GAS3) within the Gascoyne bioregion. The Augustus subregion makes up 10,687,739ha and is classified as a Desert and Xeric Shrubland ecoregion, characterised by ranges separated by wide flat valleys (Desmond *et al.* 2001, DoEE 2013). Vegetation mainly consists of Mulga woodland over *Triodia* species on shallow stony loams and rises, and Mulga parkland on shallow earthy loams over hardpan on plains (Hughes and Jones 2010).

### 2.2.2 Land Systems

Land systems across the Murchison have been mapped by the Natural Resources Assessment Group of the former Department of Agriculture (now Department of Primary Industries and Regional Development, DPIRD) and provide a comprehensive description of biophysical resources within the area (Payne *et al.* 1988). The majority of the Study Area falls within the Collier system (98%) with a small proportion of the Study Area occurring in the Jamindie system and a negligible proportion of the Study Area occurring in the Three Rivers system (**Table 2-1, Figure 2-3**). The Jamindie and Three Rivers land systems are mapped along the eastern boundary of the Study Area.

Table 2-1: Land systems and their extent within the Study Area

Land System	Description	Extent within Study Area	
		Hectare (ha)	Percentage (%)
Collier system	Undulating stony uplands, low hills and ridges and stony lower plains with mulga shrublands.	1325.89	98
Jamindie system	Stony hardpan plains and stony rises with groved mulga shrublands.	30.55	2
Three Rivers system	Broad hardpan plains with minor sandy banks and sparse mulga shrublands, in the far south-east of the area.	0.18	0.01
<b>Total</b>		<b>1357</b>	<b>100</b>

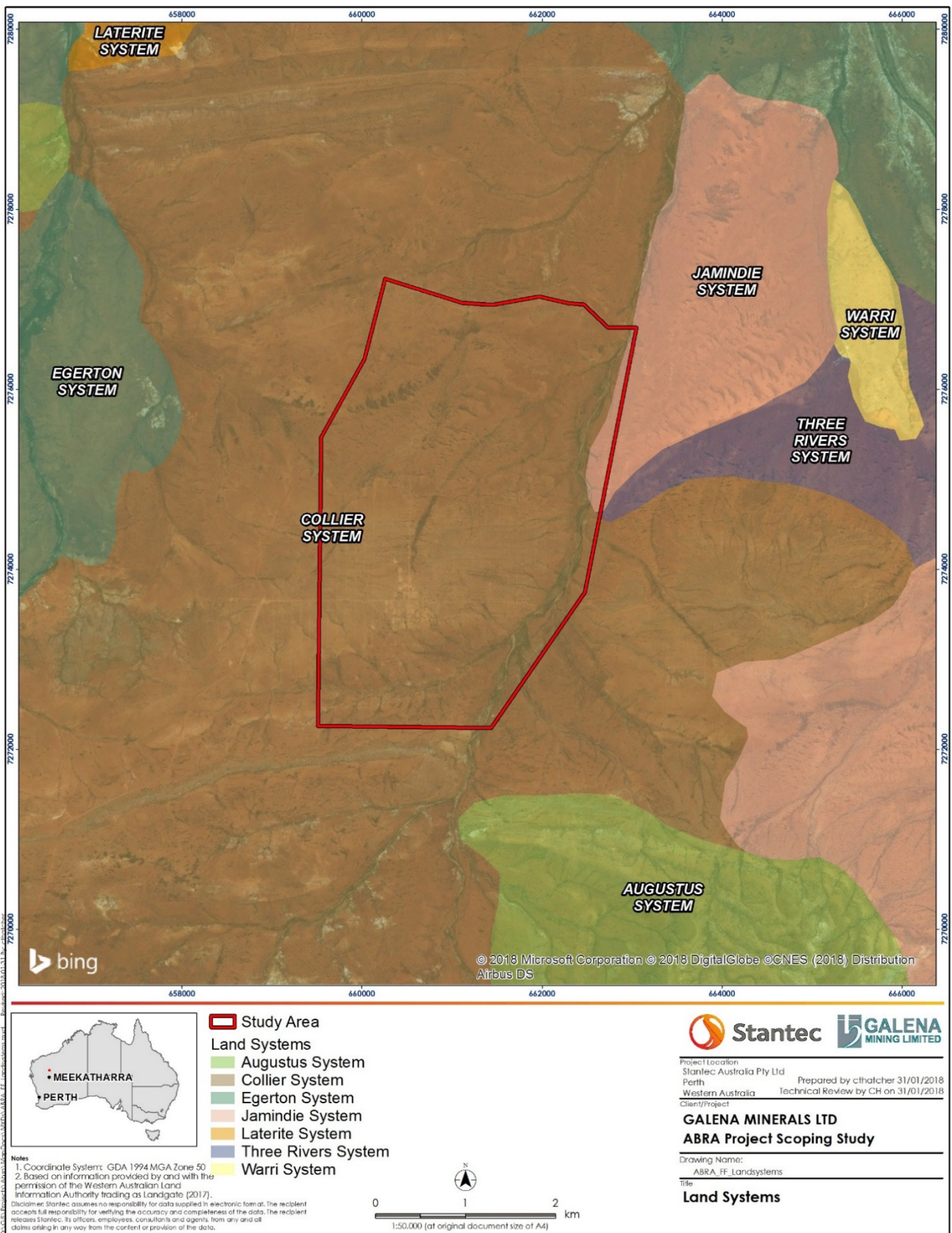


Figure 2-3: Land systems within and surrounding the Study Area

## 2.2.3 Pre-European Vegetation

Vegetation mapping of Western Australia was completed on a broad scale (1:1,000,000 and 1:250,000) by Beard (1975a), who classified vegetation into broad vegetation associations. These vegetation associations were re-assessed by Shepherd *et al.* (2002) to account for clearing in the intensive land use zone, and to divide some larger vegetation units into smaller units. Shepherd *et al.* (2002) developed a series of systems to assist in the removal of mosaics; however, some mosaics still occur. Vegetation system associations described by Shepherd *et al.* (2002) correspond with that of Beard (1975a). The majority of the Study Area has been mapped as 'low woodland; mulga (*Acacia aneura*), with small areas of Mulga (*Acacia aneura*) scrub (Beard 1975a, Shepherd *et al.* 2002) (Figure 2-4). Two vegetation system associations intersect the Study Area, Augustus 18 and Augustus 39 (Table 2-2, Figure 2-4). The current extents suggest that minimal land clearing has occurred across four scales of assessment (State, bioregion, subregion and Local Government Area, LGA) (Table 2-3).

Table 2-2: Vegetation system associations and their extent within the Study Area

System	System Code	Extent	Description
Augustus	18	1068.62ha	Low woodland; mulga ( <i>Acacia aneura</i> )
	39	288.02ha	Shrublands; mulga scrub

Table 2-3: Vegetation system association extent remaining across four scales (State, Bioregion, Subregion and Local Government Area)

System	Scale	Pre-European Extent	Current Extent	% Remaining	Current extent within IUCN Class I-IV Reserves (ha)	% of current extent protected within IUCN Class I-IV Reserves
Augustus 18	State-wide	31,723.47	31,698.27	99.92	-	-
	Bioregion	2,831.02	2,831.02	100	-	-
	Sub-region	2,736.93	2,736.93	100	-	-
	LGA	3,737.92	3,737.92	100	-	-
Augustus 39	State-wide	6,613,569.14	6,602,580.10	99.83	479,205.99	7.25
	Bioregion	2,338,128.28	2,337,580.69	99.98	55,523.47	2.37
	Sub-region	1,404,073.25	1,403,525.66	99.96	55,523.47	3.95
	LGA	157,356.02	157,356.02	100	-	-

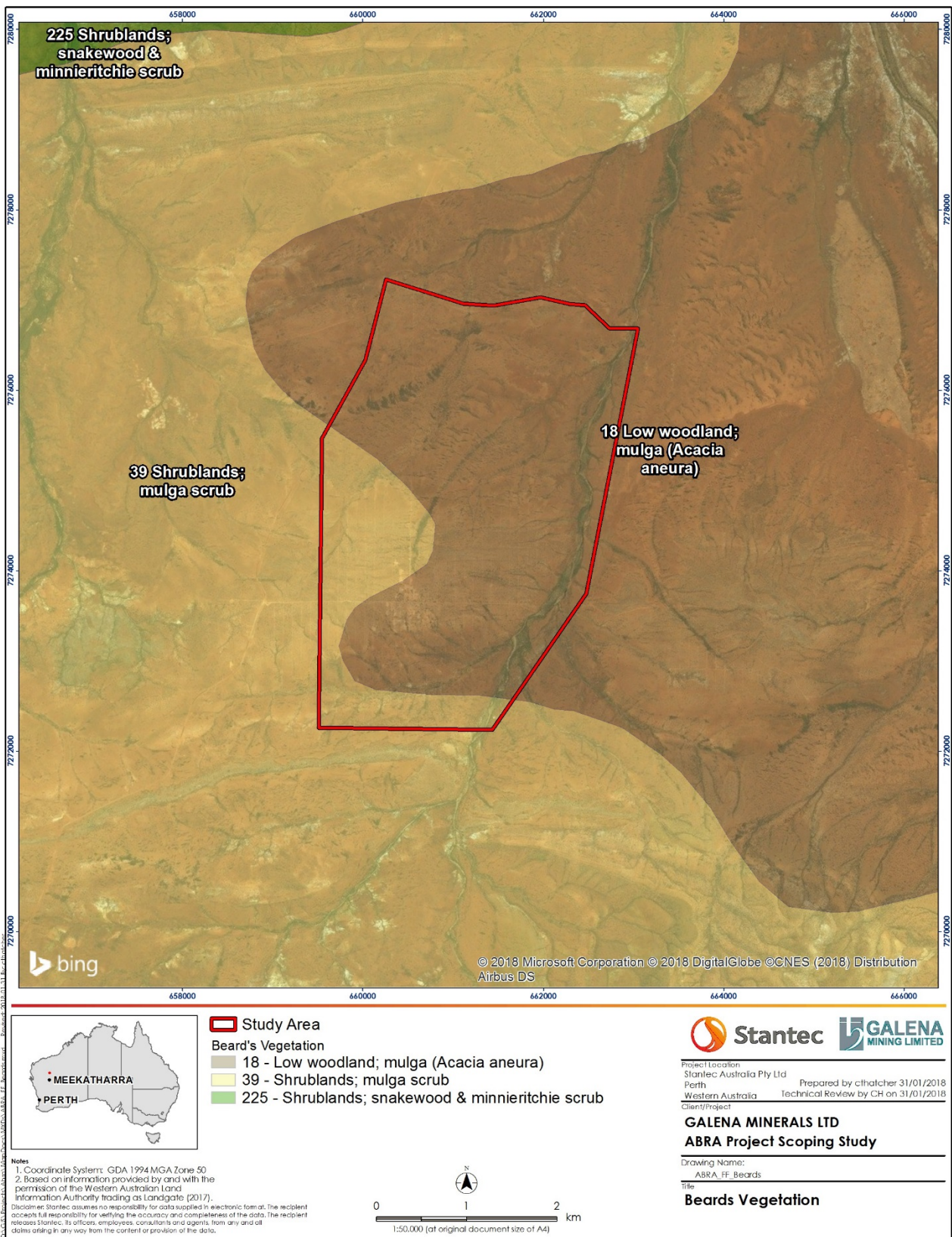


Figure 2-4: Pre-European vegetation associations of the Project Area



### 3. Desktop Assessment

A desktop assessment, comprising database searches and a literature review, was undertaken prior to the field survey by Stantec staff (Stantec 2018) to gather contextual information on the area to be surveyed. The purpose of the desktop assessment was to identify flora, vegetation and terrestrial fauna potentially occurring in the Study Area, in particular species of conservation significance. Conservation significance and conservation rankings used under the EPBC Act and Biodiversity Conservation Act 2016 (BC Act), as well as the DBCA Priority list, are defined in **Appendix A**.

#### 3.1 Database Searches

Database searches were completed to generate a list of vascular flora and vertebrate fauna previously recorded within, and in the vicinity of the Study Area, with an emphasis on species of conservation significance and introduced species. Six database searches were interrogated utilising a central coordinate (50J, 660525 m E, 7273300 m S) (**Table 2-1**).

**Table 3-1: Database searches conducted for the desktop assessment**

Custodian	Database	Ecological Group	Reference	Buffer (km)
Department of the Environment and Energy (DoEE)	Protected Matters Search Tool (PMST)	Flora and fauna	DoEE (2017)	100
DBCA	NatureMap	Flora and fauna	(DBCA 2018a)	40
DBCA	Threatened and Priority Ecological Communities	Flora and Fauna	DBCA (2017a)	50
DBCA	Threatened and Priority Flora (TPFL, TP, WAHerb) and Fauna	Flora	DBCA (2017c)	50
DBCA	Threatened and Priority Fauna	Fauna	DBCA (2017b)	100
Birdlife Australia	Birdlife Bird data	Fauna	Birdlife Australia (2017)	50

#### 3.2 Literature Review

Background information on the Study Area and surrounds was compiled to provide broad, contextual knowledge of the vegetation and habitats likely to be encountered in the Study Area. Historic vegetation mapping conducted by Beard (1975b, 1990), Shepherd *et al.* (2002), soil and landform mapping (Payne *et al.* 1988), IBRA classification system information (Desmond *et al.* 2001) and previous flora and fauna surveys conducted in the area. Previous survey reports were only considered if they were publicly available and undertaken in close proximity to the Study Area. This comprised four flora and vegetation surveys (**Table 3-2**) and four terrestrial fauna surveys (**Table 3-3**). As available relevant and recent literature for the locality was relatively limited, studies that preceded more recent work were reviewed to supplement the literature review.

Table 3-2: Key findings of flora studies conducted within the vicinity of the Study Area

Reference	Study details	Proximity to Study Area	Vegetation Units	Flora Recorded	Vegetation Condition	Species and communities of conservation significance
Dames and Moore (1988)	<u>Location:</u> Fortnum Project, 40km northwest of Peak Hill <u>Study Type:</u> Level 1 survey <u>Survey Date:</u> 28-30 September 1988	78.9km south of Study Area	N/A	Taxa: 59	N/A	None.
(Outback Ecology 2007)	<u>Location:</u> Mining tenement M52/766; exploration tenement E52/1455. <u>Study Type:</u> Level 2 survey for M52/766 and level 1 reconnaissance survey for E52/1455. <u>Survey Date:</u> 26-30 June 2006	Southern portion of Study Area	Twenty-one vegetation associations grouped according to the following landforms: major creekline, minor creeklines, stony plain and stony hills/ridgeline.	Taxa: 133 Families: 38 Genera: 81	Excellent to Degraded	None.
G & G Environmental (2011)	<u>Location:</u> North-east of Newman – includes a rail corridor <u>Study Type:</u> Level 2 survey <u>Survey date:</u> October 2010 and March 2011	Approximately 205 km north-east of the Study Area	Forty-one (41) vegetation formations were identified, comprised broadly of: <ul style="list-style-type: none"> <li>• Hummock Grasslands</li> <li>• Acacia forests and woodlands</li> <li>• Acacia open woodlands</li> <li>• Acacia shrublands</li> <li>• Other shrublands</li> <li>• Eucalypt woodlands</li> <li>• Tussock grasslands</li> <li>• Grasslands.</li> </ul>	Taxa: 340 Families: 46 Genera: 147	Very Good to Pristine (96% of vegetation was considered as Excellent to Pristine)	None.
Desmond <i>et al.</i> (2001)	<u>Location:</u> Augustus subregion <u>Study Type:</u> Government report (overview of priority flora in Augustus subregion) <u>Survey Date:</u> Published 2001	Regional assessment	N/A	N/A	N/A	<ul style="list-style-type: none"> <li>• Acacia wilcoxii (P1);</li> <li>• Eremophila arguta (P1);</li> <li>• Eremophila flaccida subsp. attenuata;</li> <li>• Eremophila gracillima (P3);</li> <li>• Eremophila lanata (P3);</li> <li>• Eremophila prolata (P1);</li> <li>• Eremophila rigida (P3);</li> <li>• Goodenia berringbinensis (P4);</li> <li>• Hemigenia pachyphylla (P1);</li> <li>• Homalocalyx chapmanii (P2);</li> <li>• Pityrodia augustensis (VU);</li> <li>• Ptilotus luteolus (P3);</li> <li>• Ptilotus lazaridis (P3);</li> <li>• Ptilotus trichocephalus (P4);</li> <li>• Rhodanthe frenchii (P2) and</li> <li>• Stylidium weeliwolli (P3).</li> </ul>

Table 3-3: Key findings of fauna studies conducted within the vicinity of the Study Area

Reference	Study Details	Proximity to Study Area	Fauna Habitats	Fauna Assemblages Recorded	Species of Conservation Significance
Outback Ecology (2006)	<u>Location:</u> Mining tenement M52/776. <u>Study Type:</u> Level 1 survey. <u>Survey Date:</u> 26-30 June 2006	Within Study Area	Four fauna habitats were identified: <ul style="list-style-type: none"> <li>• Hills and Ridges;</li> <li>• Stony Uplands;</li> <li>• Stony Plains and</li> <li>• Drainage lines.</li> </ul>	41 taxa including: <ul style="list-style-type: none"> <li>• 31 families</li> <li>• 37 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pebble-mound Mouse (P4, disused mounds recorded)</li> </ul>
Dames and Moore (1988)	<u>Location:</u> Fortnum Project, 40km northwest of Peak Hill <u>Study Type:</u> Level 1 survey <u>Survey Date:</u> 28-30 September 1988	78.9km south of Study Area	Two fauna habitats were identified: <ul style="list-style-type: none"> <li>• Low Mulga Woodland on Hills; and</li> <li>• Sparse Mulga Woodland on Plains.</li> </ul>	53 taxa including: <ul style="list-style-type: none"> <li>• 38 families</li> <li>• 47 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pebble-mound Mouse (P4, disused mounds recorded)</li> </ul>
Desmond et al. (2001)	<u>Location:</u> Augustus subregion <u>Study Type:</u> Government report (overview of priority fauna in Augustus subregion) <u>Survey Date:</u> Published 2001	Overview of Augustus subregion	Habitats associated with priority fauna include: <ul style="list-style-type: none"> <li>• Low Mulga Woodland;</li> <li>• Open Mulga Woodland;</li> <li>• Sparse, low Mulga Woodland;</li> <li>• Mulga Scrublands;</li> <li>• Hummock Grassland (Mulga and <i>Eucalyptus</i> over <i>Triodia</i>)</li> </ul>	6 taxa including: <ul style="list-style-type: none"> <li>• 6 families</li> <li>• 6 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Crest-tailed Mulgara (Vu, P4)</li> <li>• Bilby (Vu, S3)</li> <li>• Peregrine Falcon (S7)</li> <li>• Princess Parrot (Vu, P4)</li> <li>• Yinnietharra Rock Dragon (Vu, S3)</li> </ul>
Phoenix (2017)	<u>Location:</u> Beyondie Potash Project <u>Study Type:</u> Level 2 survey including systematic trapping, motion cameras, bat recording units, and targeted searches <u>Survey Date:</u> 13-23 April 2015	170km east of Study Area	Ten fauna habitats were identified: <ul style="list-style-type: none"> <li>• Shrubland and Grassland on Sandplain;</li> <li>• Woodland on Stony Plain;</li> <li>• Salt Lake;</li> <li>• Rocky Hill;</li> <li>• Shrubland and Grassland Mosaic on Sandplain and Dune;</li> <li>• Shrubland and Grassland on Dune;</li> <li>• Freshwater Lake;</li> <li>• Creek and Drainage Line;</li> <li>• Shrubland and Grassland on Calcrete; and</li> <li>• Woodland on Dune.</li> </ul>	128 taxa including: <ul style="list-style-type: none"> <li>• 55 families</li> <li>• 98 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Brush-tailed Mulgara (P4)</li> <li>• Bilby (Vu, S3)</li> <li>• Northern Marsupial Mole (P4)</li> <li>• <i>Lerista macropisthopus remota</i> (P2)</li> </ul>

### 3.3 Likelihood of Occurrence of Flora and Fauna

The likelihood of occurrence of each flora and fauna species of conservation significance in the Study Area was assessed and ranked. The rankings were assigned using the following definitions:

**Confirmed** – the presence of the species in the Study Area has been recorded unambiguously during the last ten years (i.e. during recent surveys of the Study Area or from reliable records obtained via database searches);

**Very Likely** – the Study Area lies within the known distribution of the species and is likely to contain suitable habitat(s), plus the species generally occurs in suitable habitat and has been recorded nearby within the last 20 years;

**Likely** – the Study Area lies within the known distribution of the species and the species has been recorded nearby within the last 20 years; however, either:

- the Study Area is likely to contain only a small area of suitable habitat, or habitat that is only marginally suitable; or
- the species is generally rare and patchily distributed in suitable habitat;

**Possible** – there is an outside chance of occurrence, because:

- the Study Area is just outside the known distribution of the species, but is likely to contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
- the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
- the Study Area lies on the edge of, or within, the known distribution and is likely to contain suitable habitat, but the species has not been recorded in the area for over 20 years.

**Unlikely** – the Study Area lies outside the known distribution of the species, the Study Area is unlikely to contain suitable habitat, and the species has not been recorded in the area for over 20 years.

## 4. Survey Methodology

### 4.1 Survey Timing

The optimal timing for surveying flora and fauna in the Eremaean Province (where the Study Area is located) is 6 to 8 weeks following the season which normally contributes the most rainfall (EPA 2016b). The Gascoyne bioregion tends to receive low levels of variable rainfall, largely influenced by cyclonic events. Long term rainfall data displays a bimodal rainfall pattern, with most rain occurring in summer followed by winter (Section 2.1.1).

The flora, fauna and vegetation survey was undertaken between 26 and 30 April 2018 with additional fauna observations made between 28<sup>th</sup> May and 1<sup>st</sup> June 2018. Annual rainfall in the 12 months preceding the field survey was 55.2 mm below the average annual rainfall of 177.8 mm (1947 to 2018) (Figure 4-1).

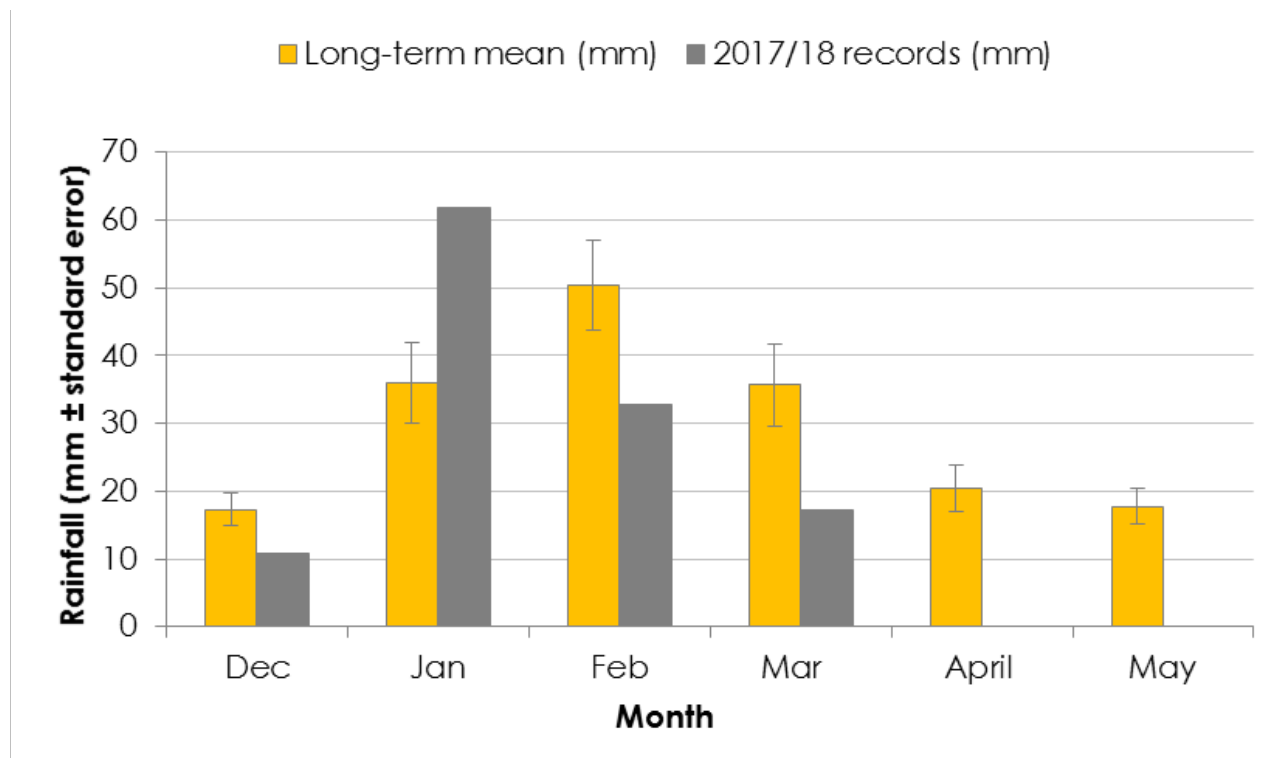


Figure 4-1: Long-term mean monthly rainfall (1947 to 2018) at Ned Creek weather station (007103), commencing five months preceding the flora, fauna and vegetation survey (April) and 6 months preceding the additional fauna survey (May).

### 4.2 Survey Team and Licensing

The field survey was undertaken by Alice Bott (senior botanist) and Crystal Heydenrych (botanist). Alice is an experienced arid-zone botanist, with extensive experience spanning over eight years conducting vegetation and flora surveys in WA and was the technical lead for the field survey. All plant collections were made under flora collecting permits SL012176 pursuant to the WC Act Section 23C and Section 23F.

The additional fauna field survey was undertaken by Samantha Lostrom (Zoologist), who has completed a variety of targeted and/ or monitoring fauna survey work throughout Western Australia. She is experienced in survey methods including tracking, motion camera recording and avifauna identification.

### 4.3 Flora and Vegetation Assessment

Prior to the field survey, broad vegetation types were mapped on aerial imagery based on vegetation signatures and landscape features. Proposed quadrat locations were identified prior to the field survey and according to the estimated number of vegetation types within the Study Area. These habitats were assessed in the field and a detailed flora and vegetation survey, consistent with EPA (2016b), was

employed to sample the flora and vegetation within the Study Area. Twenty two permanent quadrats, of 20 m x 20 m in dimension, were sampled to compile a representative species list and to characterise the vegetation types identified (**Figure 4-2** and Floristic Data - Flora Sampling Sites). Quadrats were established by measuring a square of 20 m x 20 m and permanently marked with a galvanised steel fence dropper in the north-western corner. In some instances, to account for landform features and drainage lines, dimensions of the quadrats were adjusted to represent 400 m<sup>2</sup>. In addition, six detailed mapping notes were taken. The remainder of the Study Area was traversed on foot and via vehicle to map vegetation types and to sample flora opportunistically. **Table 4-1** presents the information that was recorded at each quadrat.

**Table 4-1: Summary of data recorded at each quadrat.**

Parameter	Description
Quadrat ID	The unique name that was assigned to the site that was sampled
Coordinates	Measured using a handheld GPS device from the north-west corner of the site. To be in GDA94 format
Quadrat dimensions	Specific dimensions of the quadrat in meters
Recorder and Date	The recorder(s) involved in sampling the site and date.
Site photograph	At least one landscape photograph taken from the north-west corner looking towards the south-west corner
Soil description	A description of the soil colour and types based on the guide in the Australian Soil and Land Survey Field Handbook
Geology type	A description of the outcropping geology (if present) and course fragments.
Habitat type	A description of the landform type and aspect
Vegetation Condition	Assessed according to the Trudgen (1988) 5 point condition scale
Vascular flora species	A record of each flora species present
Height	The average height of each species in meters
Percent Foliar Cover (PFC)	An estimate of the PFC for each species will be recorded
Specimen ID	A unique identifier code will be assigned to any species that cannot be identified in the field.
Vegetation structure	A description of the vegetation in accordance with Aplin (Aplin 1979) adaptation of the vegetation classification system of Specht (Specht 1970) and the National Vegetation Information System (NVIS), Level 5 - Association
Reconciled vegetation type	Where applicable, the vegetation will be assigned to an Ecologia (2014) vegetation code
Disturbances	A list of any disturbances in the quadrat and surrounding, if present
Time since fire	An estimation of the time since the vegetation was last burnt

### 4.3.1 Targeted Survey

Targeted searches were conducted for conservation significant flora identified from the desktop assessment. Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before the survey and actively searched for them in and around quadrats, while traversing on foot within the Study Area and in preferred habitat encountered in the field.

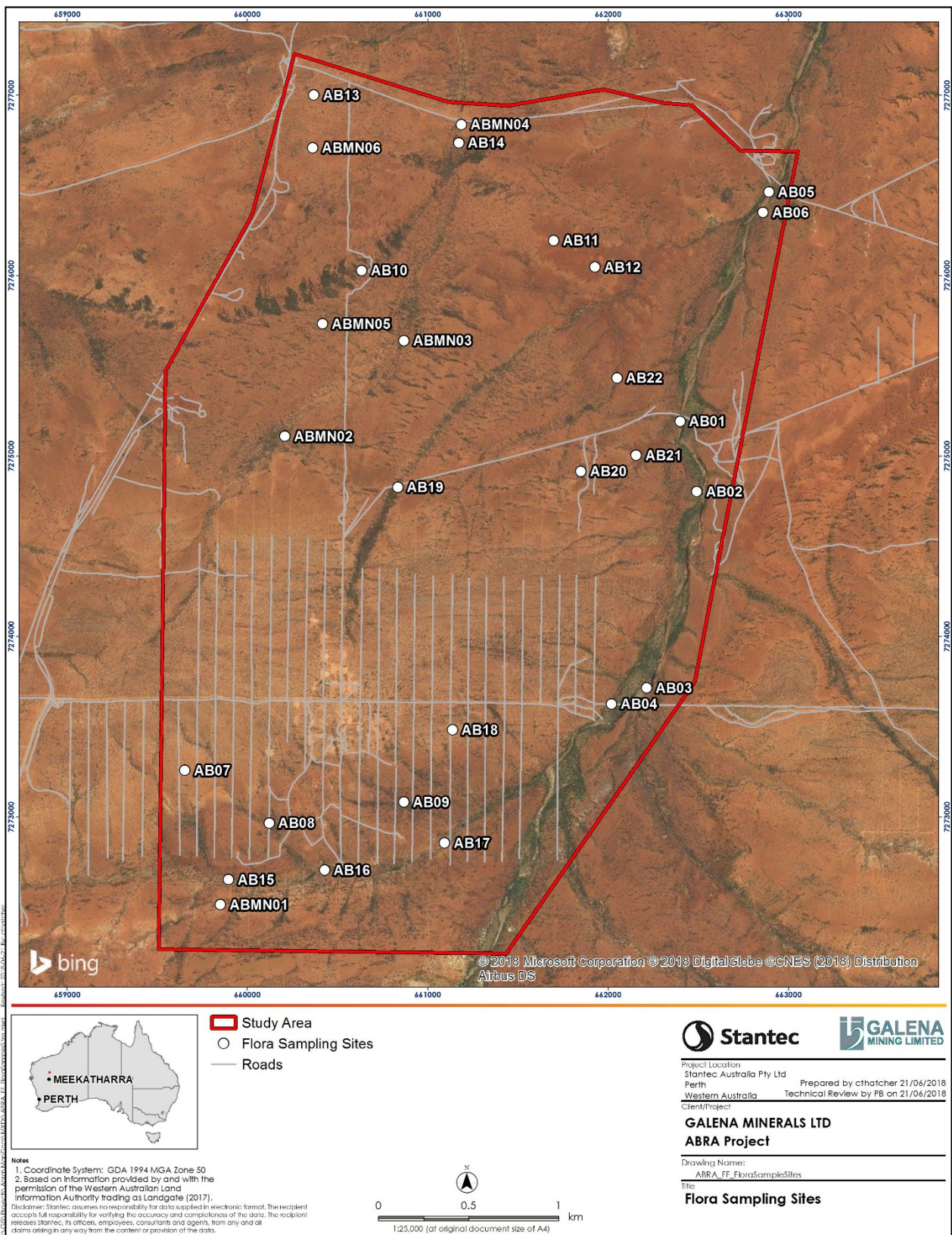


Figure 4-2: Location of flora sampling sites

## 4.4 Specimen Identification

The flora taxa that were not identified in the field were collected and taken to the Western Australian Herbarium (WAH) for identification by senior taxonomist Sharnya Thomson. Species nomenclature was assigned according to the current listing of scientific names recognised by the WAH. Where specimens were lacking in diagnostic characteristic or in poor condition, they were assigned the 'sp.' epithet, indicating that identification could only be confirmed to genus level.

Flora taxa that belong to the Western Australia Mulga Flora Group (*Acacia aneura* F.Muell. ex Benth. and its close relatives) (Maslin and Reid 2012) are variable due to hybridisation and show superficial similarities within the group. All specimens from this group were collected at each quadrat to account for this.

## 4.5 Vegetation Type and Condition Mapping

Vegetation types were delineated and described from aerial imagery utilising the flora quadrat and mapping note data. The broad mapping that was completed during the desktop assessment was changed on maps in the field, where necessary, as a result of ground-truthing. The vegetation types have been described to Level V (Vegetation Association) in the NVIS hierarchical structure (ESCAVI 2003). Vegetation condition was assigned based on the six categories described by Trudgen (1988) (Vegetation Structure Scale).

## 4.6 Floristic Analysis

Hierarchical classification (cluster analysis) was performed in the multivariate statistical package Primer version 6.1. This procedure was undertaken to assess the relationship between vegetation community structure within the Study Area. Prior to analysis, unconfirmed species were removed from the dataset, and the final dataset comprised a site-by-species matrix of floristic taxa (presence/absence data) recorded from the 22 quadrats surveyed. The Bray-Curtis similarity coefficient was used to calculate similarities between sites (quadrats) and generate a resemblance matrix. A cluster analysis was applied, using the group-average linking algorithm, the results of which were presented in the form of a dendrogram (link-tree). The dendrogram indicates the percentage similarity between sites (quadrats), according to vegetation community structure (Clarke and Warwick 2001).

## 4.7 Terrestrial Fauna Assessment

Broad fauna habitat assessments were undertaken at the flora sampling locations (**Figure 4-2**). At each location, the following key habitat parameters were recorded:

- description of broad vegetation community;
- hollow bearing trees and dead stag trees (average size and abundance);
- substrate (description of composition, presence of algal crust and percentage cover of leaf litter);
- wetland habitats and water courses including drainage lines, sumplands, floodplains, etc.; and
- nests, roosts or other evidence of breeding habitat present.

The Study Area was traversed on foot with searches undertaken for fauna taxa of conservation significance and to develop a fauna species list for the Study Area.

## 4.8 Motion Cameras

Six Reconyx HC600 motion-sensor cameras were deployed to record fauna species unlikely to be sighted opportunistically during the field survey (**Table 4-2, Figure 4-3**). Cameras were placed in areas likely to support fauna of conservation significance and in areas displaying fauna activity e.g. burrows, foraging evidence. Cameras were spaced to ensure adequate coverage of available habitats and to achieve appropriate geographical coverage of the Survey Area.



Table 4-2: Motion camera locations within the Study Area

Camera	Habitat Type	Coordinates (50J)		Recording nights
		Easting	Northing	
REC 30	Drainage	661189.37 m E	7276838.30 m S	30
REC 40	Banded Mulga	660640.32 m E	7276003.38 m S	30
REC 06	Gully	661902.68 m E	7276221.69 m S	32
REC 43	Riparian	662951.25 m E	7276502.32 m S	33
REC 21	Drainage	662598.89 m E	7274936.21 m S	29
REC 16	Drainage	662236.84 m E	7273696.09 m S	32

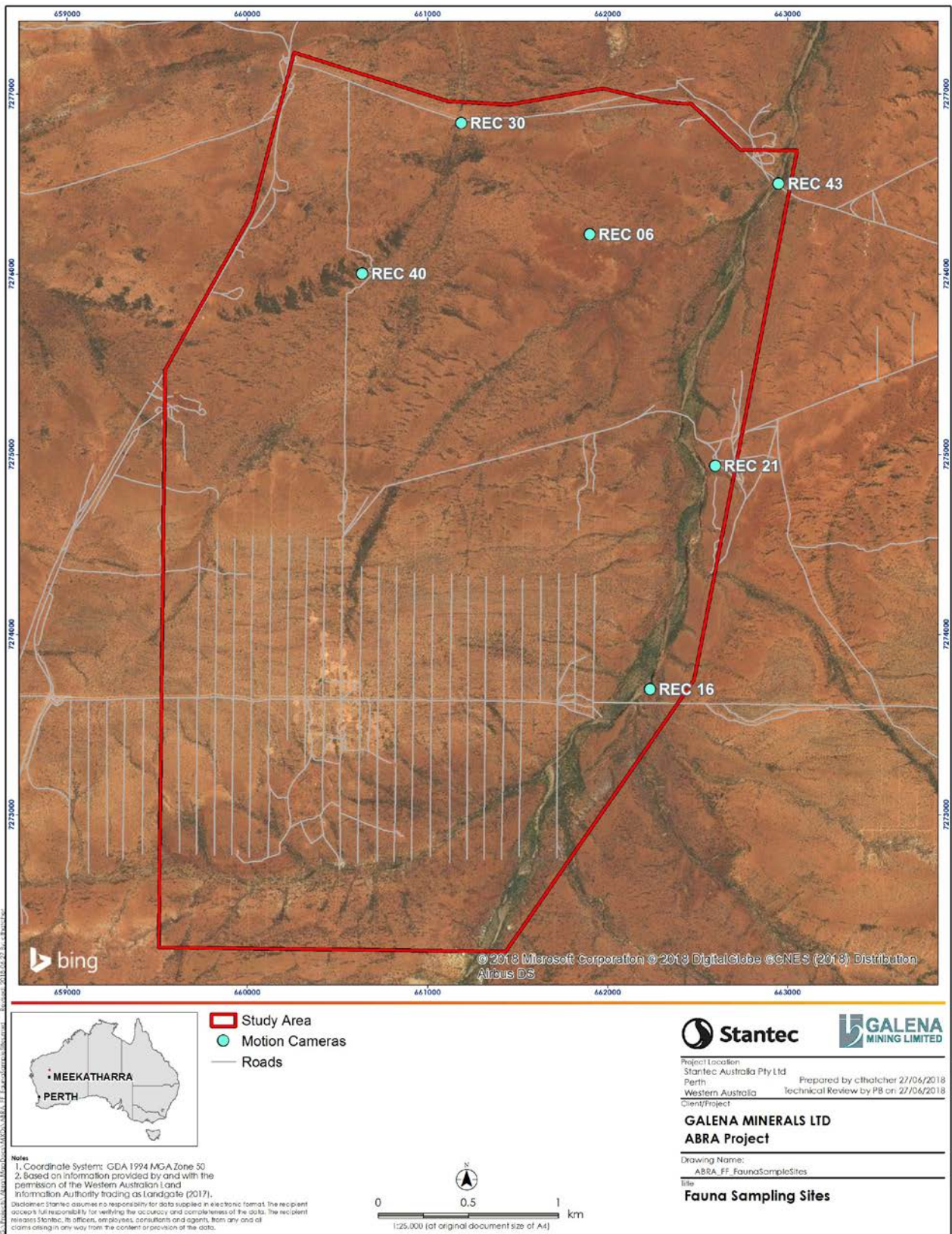


Figure 4-3: Location of motion cameras within the Study Area

## 5. Results and Discussion

### 5.1 Desktop Results

#### 5.1.1 Flora

Published information on the flora, vegetation and fauna in the region surrounding the Project was limited. A total of 177 flora taxa were listed from the desktop assessment, from 42 families and 108 genera; including 44 non-native taxa and 133 native taxa. Of these, 22 flora taxa were of conservation significance (**Appendix B**). One taxon, *Pityrodia augustensis*, is listed as Vulnerable under the BC Act, seven taxa were listed as Priority 1, three were listed as Priority 2, nine were listed as Priority 3 and two were listed as Priority 4. The likelihood of occurrence of these taxa within the Study Area was assessed based on the criteria detailed in **Section 3.3**. Two taxa are considered likely to occur (*Eremophila gracillima* [P3] and *Eremophila humilis* [P1]), four taxa were considered to possibly occur (two P1 taxa and two P3 taxa) and the remaining 16 taxa of conservation significance are considered unlikely to occur within the Study Area (**Appendix B**).

The threatened species, *Pityrodia augustensis*, was detected via the Protected Matters Search Tool, which listed the species or species habitat as 'likely to occur within the area' (DoEE 2018a). A review of the recorded specimens of this taxa held by the WA Herb indicates that the closest record of this species is over approximately 150 km west of the Study Area (WAH 2018). The species was not recorded during previous surveys within the vicinity of the Study Area, however was included in the subregion overview, which provides context rather than data specific to the Study Area (**Section 0**).

The species *Acacia tuberculata*, *Eremophila appressa*, *Eremophila coacta*, *Owenia acidula*, *Ptilotus actinocladus* and *Thysanotus* sp. Desert East of Newman (R.P. Hart 964) were listed on the DBCA TP List, which is searched according to place names rather than coordinates. A review of the recorded specimens held by the WA Herb indicates that all of the above taxa records within the last 20 years do not occur in close proximity to the Study Area; the closest of these occurs greater than 90km from the Study Area, with some occurring over 200km from the Study Area (WAH 2018). Further to this, these species have not been recorded during any previous surveys within the vicinity of the Study Area (**section 0**).

The pre-survey assessment of likelihood identified two taxa as 'Likely' to occur based on habitat requirements and previous recorded locations: *Eremophila humilis* (P1) and *Eremophila gracillima* (P3).

#### 5.1.2 Vegetation

No TECs or PECs were identified from the Threatened and Priority Ecological Community database (DPaW 2017) or the DoEE PMST (DoEE 2018a) as occurring within the Study Area. One PEC occurs in close proximity to the Study Area, the Diorite Land System (P3), which is located just under 12 km to the south-west. The Diorite Land System consists of low bald or sparse *Acacia* shrublands on basaltic domes and low rough hills. Desmond *et al.* (2001) lists 19 ecosystems that are at risk within the Augustus subregion. Several of the ecosystems include invertebrate assemblages of river pools and springs that are restricted and do not occur in the Study Area (Desmond *et al.* 2001). The remaining ecosystems include terrestrial vegetation, however they are restricted to landforms or habitat that do not occur within the Study Area (plant assemblages of Robinson Range) (Desmond *et al.* 2001).

#### 5.1.3 Fauna

The desktop study identified 219 species of vertebrate fauna which have been recorded and/or have the potential to occur within the Study Area (**Appendix G**). This total comprises 27 native mammals, nine introduced mammal, 112 native bird, 63 native reptile, and eight amphibian species. Many of these species are unlikely to occur in the Study Area because, as is leading practice, these records have been collected from a large area encompassing a wide range of habitats, many of which do not occur within the Study Area. Furthermore, some small, common, ground-dwelling reptile and mammal species tend to be patchily distributed even where appropriate habitats are present, and many species of bird can occur as regular migrants, occasional visitors or vagrants.

Of the 219 species of vertebrate fauna identified during the desktop, 26 species are listed as being of conservation significance, comprising eight mammals, 15 birds and three reptiles (**Table 5-1**).

Table 5-1: Fauna of conservation significance identified during the desktop assessment

Species Name	Common Name	EPBC <sup>1</sup>	WA <sup>1</sup>
<i>Anas querquedula</i>	Garganey	Mi	S5
<i>Apus pacificus</i>	Fork-tailed Swift	Mi	S5
<i>Charadrius veredus</i>	Oriental Plover	Mi	S5
<i>Falco peregrinus</i>	Peregrine Falcon		S7
<i>Hirundo rustica</i>	Barn Swallow	Mi	S5
<i>Motacilla cinerea</i>	Grey Wagtail	Mi	S5
<i>Motacilla flava</i>	Yellow Wagtail	Mi	S5
<i>Pezoporus occidentalis</i>	Night Parrot	En	S1
<i>Polytelis alexandrae</i>	Princess Parrot	Vu	P4
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	S5
<i>Calidris ferruginea</i>	Curllew Sandpiper	Cr; Mi	S3; S5
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	S5
<i>Calidris ruficollis</i>	Red-necked Stint	Mi	S5
<i>Tringa hypoleucos</i>	Common Sandpiper	Mi	S5
<i>Tringa nebularia</i>	Common Greenshank	Mi	S5
<i>Dasyercus blythi</i>	Brush-tailed Mulgara		P4
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Vu	P4
<i>Dasyurus hallucatus</i>	Northern Quoll	En	S2
<i>Macroderma gigas</i>	Ghost Bat	Vu	S3
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse		P4
<i>Notoryctes caurinus</i>	Northern Marsupial Mole		P4
<i>Rhinoicteris aurantius Pilbara form'</i>	Pilbara Leaf-nosed Bat	Vu	S3
<i>Macrotis lagotis</i>	Bilby	Vu	S3
<i>Ctenophorus yinnietharra</i>	Yinnietharra Rock Dragon	Vu	S3
<i>Liasis olivaceus barroni</i>	Pilbara Olive Python	Vu	S3
<i>Lerista macropisthopus remota</i>			P2

<sup>1</sup>= Conservation codes and descriptions are detailed within **Appendix A**.

## 5.2 Field Survey Results

### 5.2.1 Flora

#### 5.2.1.1 Flora Composition

A total of 101 flora taxa (including subspecies, varieties and forms) were recorded from the Study Area, representing 25 families and 58 genera (**Appendix E**). Of these, eight could not be identified confidently to species level and four could not be identified confidently to infraspecies level. An additional 15 could not be identified beyond family level due to poor material and lack of diagnostic characteristics and therefore may represent additional species. The most represented families were Fabaceae (legumes), Poaceae (grasses) and Malvaceae (malvas) and the most represented genera were *Acacia* (wattles), *Senna* (sennas) and *Eremophila* (poverty bush) (**Table 5-2**).

Four of the *Acacia* species recorded within the Study Area belong to the Western Australian Mulga Flora Group (*Acacia aneura* F.Muell. ex Benth. and its close relatives) (Maslin and Reid 2012).

Table 5-2: Families and genera most represented in the Study Area.

Family	Total taxa
Fabaceae	29
Poaceae	18
Malvaceae	9
Genus	Total taxa
<i>Acacia</i>	16
<i>Senna</i>	7
<i>Eremophila</i>	7

#### 5.2.1.2 Flora of Conservation Significance

Despite extensive sampling and targeted searching no state or Commonwealth listed Threatened flora or DBCA listed Priority flora were recorded within the Study Area.

#### 5.2.1.3 Post-survey Likelihood of Occurrence of Conservation Significant Flora

Following the field survey, with a greater understanding of the habitat types that occur within the Study Area, four Priority species, *Eremophila arguta* (P1), *Ptilotus ectinocladius* (P1), *Eremophila coacta* (P3) and *Eremophila rigida* (P3), are considered 'Possible' to occur within the Study Area but were not recorded during the field survey. All four species are perennial species that have previously been recorded within 150 km of the Study Area. It is unlikely that, if present, they would have gone unnoticed at the time of the survey and none of these species would be restricted to the Study Area as indicated by the vouchered records listed by the WAH (WAH 2018).

#### 5.2.1.4 Flora of Other Significance

Although there are records in the Augustus subregion, *Centipeda minima* subsp. *macrocephala*, which was recorded from one quadrat site (AB01), is beyond its normal range of occurrence (Plate 5-1). According to vouchered records listed by the WAH, *C. minima* subsp. *macrocephala* generally occurs further to the west in the Augustus subregion. *C. minima* subsp. *macrocephala* is an erect of ascending, aromatic annual herb, and was recorded growing within the Study Area in association with 5 Mile Creek.



Plate 5-1: *Centipeda minima* subsp. *Macrocephala*

#### 5.2.1.5 Introduced Flora

Two introduced flora taxa, *Bidens bipinnata* and *Malvastrum americanum*, were recorded within the Study Area (Plate 5-2). Neither of these species are declared pests under Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) or to be a Weed of National Significance (WoNS) identified by the Commonwealth Government. *B. bipinnata* was recorded from four quadrats within the Study Area (AB01, AB03, AB05 and AB06) growing in association with 5 Mile Creek and other smaller drainage lines associated with the creek. *M. americanum* was recorded from three quadrats (AB01, AB05 and AB06) also in association with 5 Mile Creek (Floristic Data - Flora Sampling Sites).



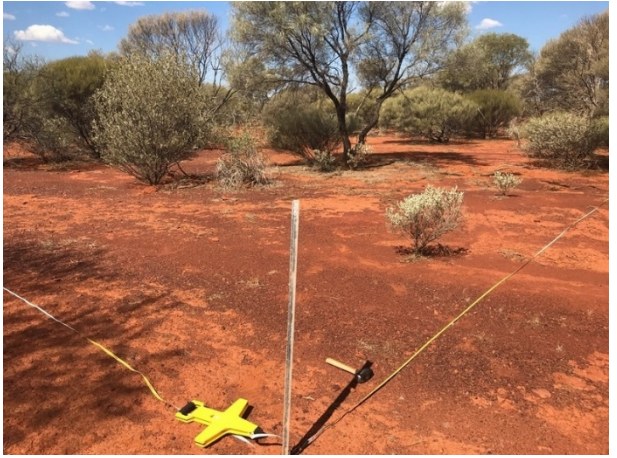
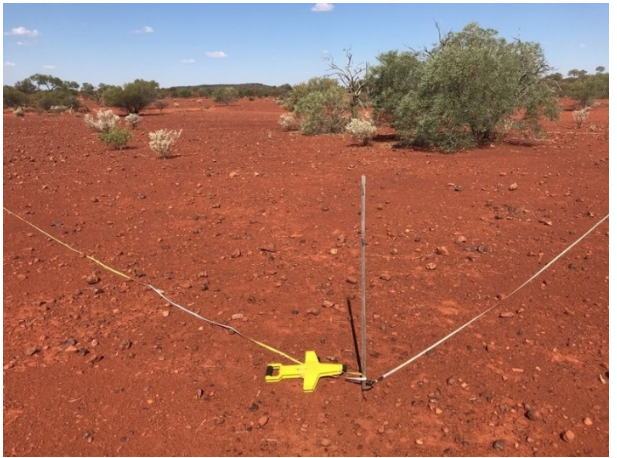
Plate 5-2: \**Bidens bipinnata* and \**Malvastrum americanum*



## 5.2.2 Vegetation

A total of eight broad vegetation types were identified in the Study Area (**Table 5-3**). This included one mosaic vegetation type, GbArrAiEf/GbArrExEjjEm, (265.3 ha, 39%), which was mapped throughout the Study Area. This vegetation included an intricate network of mulga groves (*Acacia aneura* complex) and stony plains that occurred at a scale that was too fine to capture individually on the mapping. Vegetation type mapping is presented in **Figure 5-1** and the data collected from each quadrat and mapping note is provided in **Appendix F**.



In general, the vegetation of the plains and low hills consisted of mixed *Acacia* open shrublands over a mid-layer of predominantly *Eremophila* spp. over a very open tussock grass layer. Five Mile Creek, a small tributary of the Ethel River, runs along the eastern boundary of the Study Area. This ephemeral drainage system was incised and was characterised by an upper canopy layer of trees (*Eucalyptus victix* and *Acacia citrinoviridis*) as well as a higher density in the low-shrub layer (*Tephrosia rosea* var. *clementii*). Two other ephemeral and temporary drainage systems were recorded within the Study Area, from narrowly-incised to not-incised systems. These vegetation types were different to the surrounding areas as they comprised of a denser upper-canopy layer of trees and tall shrubs, as well as a denser mid-shrub layer.



Table 5-3: Summary of Vegetation Types recoded in the Survey Area

Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
GbArrAiEf	<p>Vegetation Description:  <i>Grevillea berryana</i> open low woodland over <i>Acacia ?ramulosa</i> var. <i>ramulosa</i> and <i>Acacia incurvaneura</i> tall shrubland to open scrub over <i>Eremophila forrestii</i> subsp. <i>?forrestii</i> open low shrubland</p> <p>Associated Species:  <i>Acacia citrinoviridis</i>, <i>Acacia ramulosa</i> var. <i>linophylla</i> and <i>Ptilotus schwartzii</i></p>	AB10 AB14 AB20	65.0	5	
ApPo	<p>Vegetation Description:  <i>Acacia pruinocarpa</i> open tall shrubland to open low woodland over <i>Ptilotus obovatus</i> open low shrubland</p> <p>Associated Species:  <i>Eremophila</i> sp.</p>	AB11 AB21 AB12	23.44	2	

Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
EvAcTrcCa Ea	<p>Vegetation Description: <i>Eucalyptus victrix</i> and <i>Acacia citrinoviridis</i> woodland to open tall woodland over <i>Tephrosia rosea</i> var. <i>clementii</i> low shrubland over <i>Cymbopogon ambiguus</i> and <i>Eulalia aurea</i> very open tussock grassland</p> <p>Associated Species: <i>Abutilon cryptopetalum</i>, <i>Acacia tetragonophylla</i>, *<i>Bidens bipinnata</i>, <i>Cleome viscosa</i>, <i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>, <i>Duperraya commixta</i>, <i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>, <i>Glycine canescens</i>, *<i>Malvastrum americanum</i>, <i>Rhynchosia minima</i>, <i>Sida</i> sp. spiciform panicles (E. Leyland 14/08/90), <i>Solanum sturtianum</i>, <i>Sporobolus australasicus</i>, <i>Stemodia viscosa</i> and <i>Themeda triandra</i>.</p>	AB01 AB03 AB05	25.8	2	
AcApTrcCc Sah	<p>Vegetation Description: <i>Acacia citrinoviridis</i> open tall shrubland to open low woodland over <i>Acacia pyrifolia</i> open shrubland over <i>Tephrosia rosea</i> var. <i>clementii</i>, <i>Corchorus crozophorifolius</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> low shrubland</p> <p>Associated Species: <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>, <i>Acacia tetragonophylla</i>, <i>Androcalva loxophylla</i>, <i>Aristida contorta</i>, <i>Cleome viscosa</i>, <i>Cymbopogon ambiguus</i>, <i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>, <i>Duperreya commixta</i>, <i>Eremophila fraseri</i> subsp. <i>fraseri</i>, <i>Eriachne benthamii</i>, <i>Indigofera monophylla</i>, <i>Paraneurachne muelleri</i>, <i>Pterocaulon ?sphaeranthoides</i>, <i>Ptilotus obovatus</i>, <i>Senna</i></p>	AB02 AB04 AB06	66.2	5	



Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
	<i>artemisioides</i> subsp. <i>filifolia</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Setaria dielsii</i> , <i>Sida</i> sp. spiciform panicles (E. Leyland 14/08/90) and <i>Solanum lasiophyllum</i> .				
AcAcPISpS cHs	<p>Vegetation Description:  <i>Acacia citrinoviridis</i> (<i>Grevillea berryana</i>) low woodland over <i>Acacia citrinoviridis</i> and <i>Psyrax latifolia</i> (<i>Acacia aneura</i> and <i>Acacia ?ramulosa</i> var. <i>ramulosa</i>) tall shrubland over <i>Sida</i> ?sp. spiciform panicles (E. Leyland 14/08/90), <i>Senna cuthbertsonii</i> and <i>Hibiscus sturtii</i> var. <i>forrestii</i>) open shrubland to shrubland</p> <p>Associated Species:  <i>Acacia incurvaneura</i>, <i>Acacia kempeana</i>, <i>Eremophila forrestii</i> subsp. ?<i>forrestii</i>, <i>Eriachne benthamii</i>, <i>Indigofera chamaeclada</i>, <i>Sida ?ectogama</i> and <i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32).</p>	AB22 AB08 AB09 AB19 ABMn02 ABMn03 ABMn04	134.58	10	
AcCfEbEmT t	<p>Vegetation Description:  <i>Acacia citrinoviridis</i> and <i>Corymbia ?ferriticola</i> open low woodland over <i>Eriachne benthamii</i>, <i>Eriachne mucronata</i> and <i>Themeda triandra</i> very open tussock grassland.</p> <p>Associated Species:  <i>Acacia aneura</i>, <i>Eremophila exilifolia</i>, <i>Hibiscus sturtii</i> var. <i>forrestii</i>, <i>Mirbelia rhagadioides</i>, <i>Psyrax latifolia</i>, <i>Senna cuthbertsonii</i> and <i>Senna glaucifolia</i>.</p>	AB15 AB16 AB17	18.5	1	

Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
GbArrAiEf/ GbArrExEjEm	<p>Vegetation Description: Mosaic vegetation type of GbArrAiEf/GbArrExEjEm</p> <p>This vegetation included a dense network of mulga groves (<i>Acacia aneura</i> complex) and plains that occurred on a scale too fine to capture on the mapping.</p>	ABMn05	530.6	39	
GbArrExEjEm	<p>Vegetation Description: <i>Grevillea berryana</i> open low woodland over <i>Acacia ?ramulosa</i> hybrid open shrubland to tall open shrubland over <i>Eremophila exilifolia</i> and <i>Eremophila jucunda</i> subsp. <i>jucunda</i> low shrubland over <i>Eriachne mucronata</i> very open tussock grassland to open tussock grassland.</p> <p>Associated Species: <i>Fimbristylis dichotoma</i>, <i>Neurachne minor</i>, <i>Ptilotus schwartzii</i>, <i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32) and <i>Solanum lasiophyllum</i>.</p>	AB07 AB13 AB18 ABMn06 ABMn01	492.5	36	

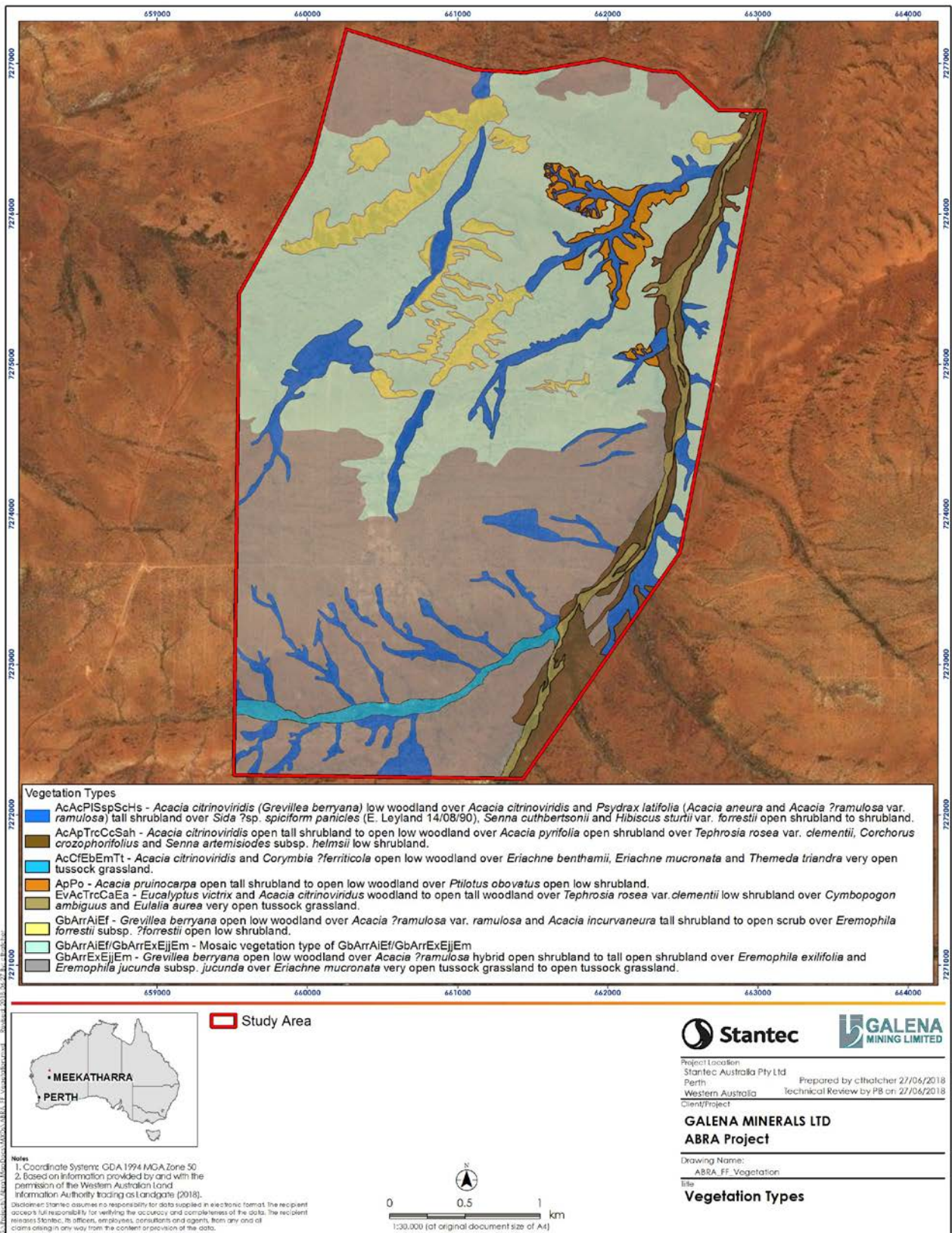


Figure 5-1: Vegetation types identified in the Study Area

#### 5.2.2.1 Vegetation Condition

Vegetation condition ranged from 'Degraded' to 'Excellent' with the majority of the Study Area considered to be in 'Very Good' (1,228.6 ha) or 'Excellent' (108.8 ha) condition. The remainder was in 'Good' (2.7 ha) or 'Degraded' (17.2 ha) condition (**Figure 5-2**). This was due to vegetation clearing for exploration drilling and historical access tracks. Other disturbances included some minimal grazing by domestic animals including cattle and camels. Two weed species, *\*Bidens bipinnata* and *\*Malvastrum americanum*, were recorded within the Study Area, both species were recorded in low densities and only growing in association with 5 Mile Creek and other smaller incised drainage lines.

#### 5.2.2.2 Floristic Community Type Determination

Based on the dendrogram produced from statistical analysis, 11 floristic groups with a similarity of 50 – 60% were identified within the Study Area. Of the 22 quadrat sample sites used in the assessment, 18 grouped with other quadrat sample sites. In general, vegetation types from similar landforms grouped together in the classification analysis, particularly drainage lines (major and minor) and shrubland on stony plain. The results of the dendrogram analysis are presented in **Appendix G.1**.

Eight vegetation types, including one mosaic type, were mapped within the Study Area and 11 groups were identified from the analysis at 50 – 60% similarity, indicating that the scale of vegetation mapping based on informed post-field interpretation was conservative for the floristic diversity present in the Study Area.

#### 5.2.2.3 Vegetation of Significance

None of the vegetation types described and mapped within the Study Area are analogous to any TECs or PECs that have been recorded in the wider region. The Priority 3 PEC Diorite Land System, which is known to occur to the south-west of the Study Area was not recorded and suitably habitat is not present within the Study Area.

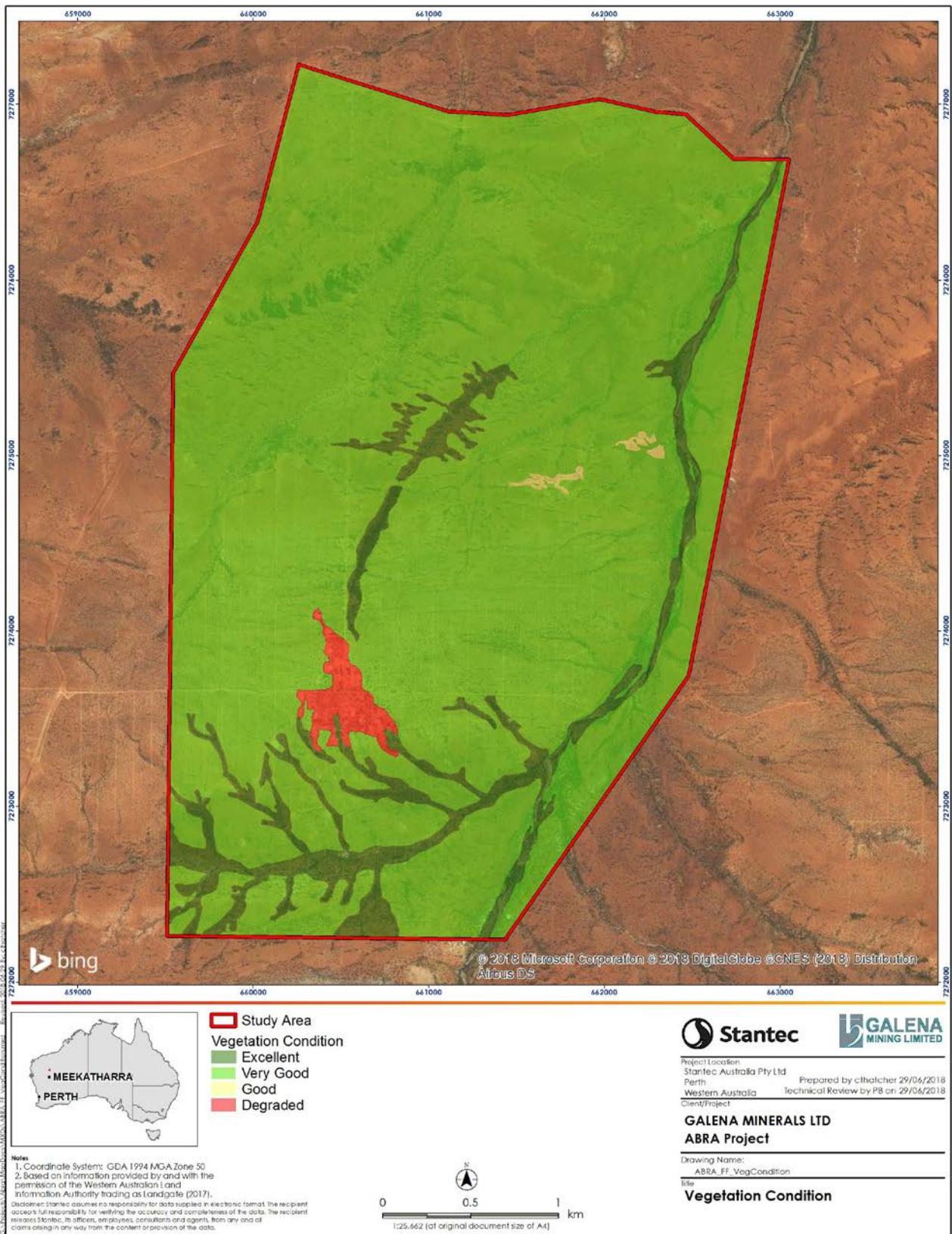


Figure 5-2: Vegetation condition within the Study Area

## 5.2.3 Terrestrial Fauna

### 5.2.3.1 Fauna Habitat




Five broad fauna habitats were identified and delineated from fauna habitat assessments conducted across the Study Area (**Table 5-4**, **Figure 5-3**). These comprised;






- Banded mulga on plain;
- Riparian;
- Open shrubland on stony plain;
- Drainage; and
- Gully.

These habitats differed primarily in the composition of their vegetation and structure, particularly vegetation density, presence of breakaways and steep banks with alcoves and the likelihood of seasonal water inundation. Most habitats contained rocky substrates. The habitat types in the Study Area were assessed on their extents and levels of significance according to the following criteria:

- **Distribution:** those habitats widespread and common within the surrounding regions were categorised as widespread; otherwise they were categorised as being of limited extent. All fauna habitats were considered widespread.
- **Significance:** those habitats considered important to species of conservation significance or distinct fauna assemblages are deemed significant; otherwise they were categorised as being of limited significance. Riparian habitat was considered significant owing to the potential foraging suitability for the Peregrine Falcon (S7).

Table 5-4: Broad fauna habitats identified within the Study Area

Habitat type	Proportion of Study Area		Veg. units	Condition	Value to fauna	Reference Photographs
	ha	%				
Banded mulga on plain <ul style="list-style-type: none"> <li>Widespread</li> <li>Limited significance</li> </ul>	65.0	5	GbArrAiEf	Good – Excellent	<p>Comprised a relatively dense <i>Acacia</i> sp. shrubland including <i>Acacia</i> ?ramulosa var. ramulosa and <i>Acacia</i> incurvaneura, under <i>Grevillea berryana</i> woodland, over an open layer of <i>Eremophila forrestii</i> subsp. ?forrestii shrubs. Substrates largely comprised bare soil, with no rocky cover and minimal leaf litter. Some areas of banded mulga had a moderate degree of woody debris and peeling bark.</p> <p>The relatively dense areas of mulga would provide nesting and roosting habitat for species of birds. Along with the debris and peeling bark, these would provide shelter for small reptiles and mammals.</p>	
Open shrubland on stony plain <ul style="list-style-type: none"> <li>Widespread</li> <li>Limited significance</li> </ul>	1023.2	75	GbArrExEjjEm GbArrAiEf/ GbArrExEjjEm	Degraded – Very Good	<p>Varied from open stony plains with a sparse cover of low shrubs and tussock grasses to areas comprising open <i>Grevillea berryana</i> and <i>Acacia</i> ?ramulosa hybrid over open <i>Eremophila exilifolia</i>, <i>Eremophila jucunda</i> subsp. jucunda and sparse tussock grasses. Some areas of this habitat contained dense networks of mulga groves (<i>Acacia aneura</i> complex), associated with vegetation type GbArrAiEf/ GbArrExEjjEm. This habitat contained minimal peeling bark and woody debris, and were only disturbed in some areas by tracks.</p> <p>These areas are unlikely to serve as significant habitat for fauna owing to the open vegetation and lack of debris, litter, crevices and hollows. Taller trees may provide nesting and/ or roosting for bird species, and the small networks of dense mulga may provide shelter for fauna.</p>	
Riparian <ul style="list-style-type: none"> <li>Widespread</li> <li>Significant</li> </ul>	25.8	2	EvAcTrcCaEa	Excellent	<p>The Riparian habitat included a major drainage along the East boundary of the Study Area. This contained an upper storey of tall <i>Eucalyptus victrix</i> and <i>Acacia citrinoviridis</i> over <i>Tephrosia rosea</i> var. clementii and tussock grasses including <i>Cymbopogon ambiguous</i> and <i>Eulalia aurea</i>. The Riparian habitat contained relatively dense vegetation, a substantial amount of woody debris (including large branches washed along the banks), trees with exposed roots forming crevices and a relatively large amount of leaf litter. Furthermore, the east side of the river bank included a steep bank which contained small alcoves, and various hollows were observed within larger <i>Eucalyptus victrix</i> trees.</p> <p>The abundance of dense vegetation, debris, crevices and alcoves would provide shelter for a variety of mammal and reptile species. The habitat contained water supporting amphibian species during the initial Subterranean Fauna Survey (Feb/Mar), and when inundated may provide habitat for wetland bird species. Tall <i>Eucalyptus</i> trees may provide nesting and roosting habitat for a variety of bird species, particularly those containing hollows. This includes the Peregrine Falcon (S7), which inhabits wooded water</p>	

Habitat type	Proportion of Study Area		Veg. units	Condition	Value to fauna	Reference Photographs	
	ha	%					
					courses and is assessed as possibly occurring within the Study Area (section 5.2.3.3).		
Drainage <ul style="list-style-type: none"> <li>• Widespread</li> <li>• Limited significance</li> </ul>	219.2	16.2	AcAcPIsSpScHs AcApTrcCcSah AcCfEbEmTt	Very Good – Excellent	<p>Drainage areas varied in structure, however all were likely to be seasonally flooded and comprised a relatively complex fauna habitat. Areas were characterised by an upper and mid storey, including taller vegetation. Species included <i>Acacia citrinoviridis</i>, <i>Acacia aneura</i>, <i>Psydrax latifolia</i> and <i>Acacia pyrifolia</i>, over tussock grasses and low vegetation such as <i>Senna</i> sp., <i>Hibiscus sturtii</i> var. <i>forrestii</i>, <i>Sid</i> sp. and <i>Tephrosia</i> sp.. Drainage areas tended to contain leaf litter and woody debris, and in some areas clay boundaries formed small crevices.</p> <p>When inundated, drainage habitats may support wetland birds and amphibians. These habitats tended to contain woody debris, leaf litter and dense vegetation, potentially serving as shelter for various mammals and reptiles. Evidence of foraging, potentially by Varanid species, was recorded within the drainage along the southern Study Area.</p>	 	
Gully <ul style="list-style-type: none"> <li>• Widespread</li> <li>• Limited significance</li> </ul>	23.4	2	ApPo	Good – Very Good	<p>The majority of gully habitat contained eroded depressions surrounded by breakaways (northern areas, pictured top row). The southernmost gullies on a smaller drainage branch comprised eroded rocky plains leading into the drainage (pictured below). Overall, vegetation was open and comprised an upper storey of <i>Acacia pruinocarpa</i> over low shrubs such as <i>Ptilotus obovatus</i>. Soils were orange-brown and rocky, with relatively large coarse fragments near the breakaways. Breakaways supported a high level of small caves, alcoves and crevices along the majority of their length. This habitat was affected by cattle and camel grazing and trampling.</p> <p>Alcoves and crevices would provide substantial shelter for a variety of mammals and reptiles. However only old Macropod and Varanid scat was recorded within searched alcoves. The eroded plains and depressions only contain open shrubland and minimal shelter, and would be of minimal significance to fauna unless inundated, which may occur in the northern eroded depressions. In this case, a water source coupled with numerous shelter would increase the suitability for reptiles and mammals while also potentially supporting wetland birds and amphibians.</p>	  	



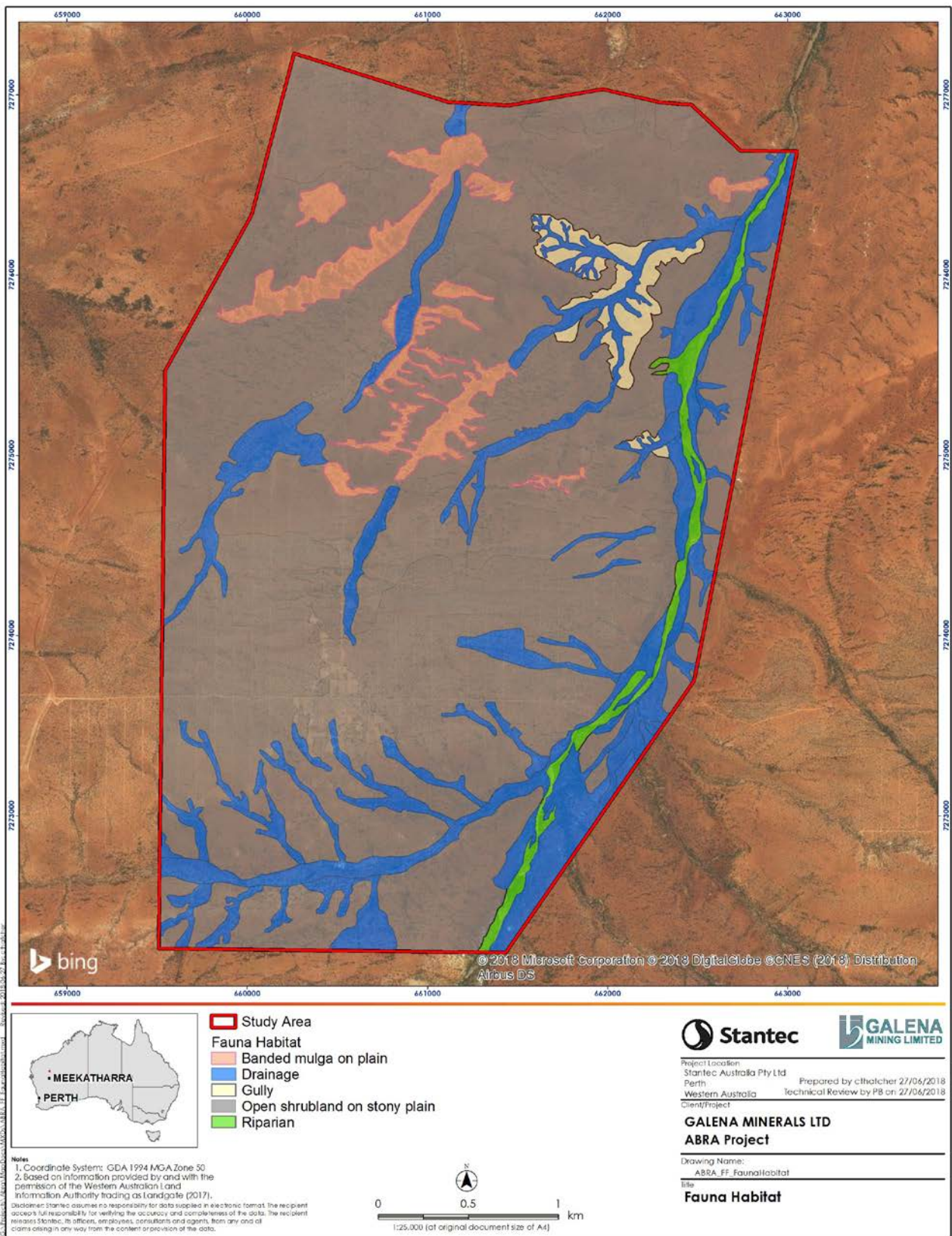


Figure 5-3: Broad fauna habitats identified within the Study Area

### 5.2.3.2 Fauna Assemblages

The field survey identified a total of 27 species of vertebrate fauna, of which eight were mammals, 19 were birds, two were reptiles and two were amphibians (**Table 5-5**). No fauna of conservation significance was recorded. Three species of introduced species were recorded; the cat, dog and European Cattle.

**Table 5-5: Vertebrate fauna species recorded from the Study Area during field survey**

Species Name	Common Name	EPBC	WA
<i>Bos taurus</i>	*European Cattle		
<i>Canis familiaris</i>	*Dog		
<i>Felis catus</i>	*Cat		
<i>Osphranter rufus</i>	Red Kangaroo		
<i>Acanthiza apicalis</i>	Inland Thornbill		
<i>Gerygone fusca</i>	Western Gerygone		
<i>Artamus cinereus</i>	Black-faced Woodswallow		
<i>Eurostopodus argus</i>	Spotted Nightjar		
<i>Ocyphaps lophotes</i>	Crested Pigeon		
<i>Phaps chalcoptera</i>	Common Bronzewing		
<i>Corvus orru</i>	Torresian Crow		
<i>Cracticus nigrogularis</i>	Pied Butcherbird		
<i>Cracticus tibicen</i>	Australian Magpie		
<i>Taeniopygia guttata</i>	Zebra Finch		
<i>Falco cenchroides</i>	Australian Kestrel		
<i>Gavicalis virescens</i>	Singing Honeyeater		
<i>Oreoica gutturalis</i>	Crested Bellbird		
<i>Melanodryas cucullata</i>	Hooded Robin		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		
<i>Platycercus varius</i>	Mulga Parrot		
<i>Platycercus zonarius</i>	Australian Ringneck		
<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush		
<i>Rhipidura leucophrys</i>	Willie Wagtail		
<i>Gehyra variegata</i>			
<i>Ctenophorus caudicinctus mensarum</i>			
<i>Litoria rubella</i>	Little Red Tree Frog		
<i>Cyclorana maini</i>	Sheep Frog		

### 5.2.3.3 Fauna of Conservation Significance

Of the 219 species of vertebrate fauna identified during the desktop study, 26 species are listed as being of conservation significance, comprising eight mammals, 15 birds and three reptiles (**Table 5-6**). Of the 26 vertebrate species in the desktop study:

- Ten are listed as Threatened under the EPBC Act and/or BC Act;
- Six are recognised by DBCA as Priority fauna. DBCA recognises several species that are not listed under the BC Act or the EPBC Act but for which there is some conservation concern, and has produced a supplementary list of Priority fauna;
- One species and its subspecies is listed as recognised by state (BC Act) to be in need of special protection; and
- Twelve species are listed as Migratory under the EPBC Act and/or Schedule 5 under the BC Act.

Some of the species referred to above, listed as Threatened, Migratory and/or Priority fauna, may be included in multiple groups. The likelihood for species of conservation significance occurring in the Study Area was assessed and ranked (**Table 5-6**).

The rankings were assigned following definitions described in the desktop study methodology (**Section 3.3**) and conservation significance codes were determined using DBCA and EPBC Act guidelines (**Appendix A**). Of the conservation significant fauna, one species was considered Possible to occur; the Peregrine Falcon (S7). The remaining were assessed as Unlikely.

Table 5-6: Conservation significant fauna identified during desktop assessment and likelihood of occurrence within the Study Area

Common name ( <i>Scientific name</i> )	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
<b>Mammals</b>				
Brush-tailed Mulgara ( <i>Dasyercus blythi</i> )		P4	Known to inhabit spinifex grasslands (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area occurs within the species range, however there are no nearby records of the species since 1993 (DBCA 2018a, van Dyck and Strahan 2008) The species was trapped in an area ~170km east of the Study Area, and numerous signs of activity were noted in suitable sandplain habitat (Phoenix 2017). However, the Study Area lacks spinifex sandplains, and therefore the species is considered unlikely to occur.
Crest-tailed Mulgara ( <i>Dasyercus cristicauda</i> )	Vu	P4	Known to inhabit open sand dunes with limited canegrass cover and near salt lakes with Nitre Bush (van Dyck and Strahan 2008).	<b>Unlikely</b> Although two species of Mulgara are known to occur in Australia, it is now recognised that only the Brush-tailed Mulgara ( <i>Dasyercus blythi</i> ) (Priority 4 DBCA) occurs within Western Australia (DoEE 2018, (DoEE 2018b, van Dyck and Strahan 2008). The Crest-tailed Mulgara ( <i>Dasyercus cristicauda</i> ) (Vulnerable EPBC Act) is restricted in its distribution to the eastern portion of the Northern Territory, South Australia and potentially Queensland (DoEE 2018b, van Dyck and Strahan 2008).
Northern Quoll ( <i>Dasyurus hallucatus</i> )	En	S2	Favour rocky habitats, also found in eucalyptus woodlands and forests and near settlements (van Dyck and Strahan 2008).	<b>Unlikely</b> While the species or species habitat was listed as 'likely to occur' (DoEE 2018a), the Study Area occurs well outside of the species current range and the species has not been recorded nearby (van Dyck and Strahan 2008).
Bilby ( <i>Macrotis lagotis</i> )	Vu	S3	Patchily distributed in the northern arid to semi-arid regions (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area lies outside of the species current range, and the species has not been recorded nearby since 1970 (DBCA 2018a, van Dyck and Strahan 2008). As such, the species is considered unlikely to occur.
Northern Marsupial Mole ( <i>Notoryctes caurinus</i> )		P4	Sand dune deserts, particularly the Great and Little Sandy Deserts (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area occurs well outside of the species current range, and the species has not been recorded nearby (van Dyck and Strahan 2008). The species was recorded ~170km east of the Study Area within suitable dune habitat, however as the Study Area does not contain dunes the species is considered unlikely to occur (Phoenix 2017).

Common name ( <i>Scientific name</i> )	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
Western Pebble-mound Mouse ( <i>Pseudomys chapmanii</i> )		P4	Gentle rocky spinifex slopes (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area lies outside of the species current range, which is largely restricted to the central and southern Pilbara, Little Sandy Desert and an isolated population in the Gascoyne recorded in 1997 (van Dyck and Strahan 2008). The closest sighting of the species occurred in 1995 55km east of the Study Area (Strahan 2004). Only inactive mounds were recorded within the Study Area in 2006 (Outback Ecology 2006).
Pilbara Leaf-nosed Bat ( <i>Rhinonictis aurantius</i> Pilbara form')	Vu	S3	Inhabit humid roosts, which occur in rocky gorges or abandoned mine shafts (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area lies outside the species current range, which is restricted to the Pilbara, and lacks suitable gorge habitat (van Dyck and Strahan 2008). The closest record of the species lies 56km to the northwest and was recorded in 1999 (DBCA 2018b). As such, the species is considered unlikely to occur.
Ghost Bat ( <i>Macroderma gigas</i> )	Vu	S3	Inhabits a wide range of habitats, from arid areas of the Pilbara to northern rainforests (van Dyck and Strahan 2008).	<b>Unlikely</b> The species or species habitat was listed as 'likely to occur' (DoEE 2018a). However the Study Area lies outside of the species range, which occurs within the Pilbara and Kimberley in WA (van Dyck and Strahan 2008). The species has not been recorded nearby, and is considered unlikely to occur.
<b>Birds</b>				
Garganey ( <i>Anas querquedula</i> )	Mi	S5	Sewage ponds and well vegetated freshwater wetlands (Pizzey and Knight 2007).	<b>Unlikely</b> The species has not been recorded nearby since 1980, and the Study Area does not contain suitable habitat (DBCA 2018b, Pizzey and Knight 2007). The species is uncommon within Australia, migrating to Northern tropical areas in summer and remaining vagrant elsewhere (Pizzey and Knight 2007).
Fork-tailed Swift ( <i>Apus pacificus</i> )	Mi	S5	The species has an aerial habitat mainly over open areas ranging from coasts to semi-deserts, and may also occur over forests and urban areas (Pizzey and Knight 2007).	<b>Unlikely</b> The species or species habitat was listed as 'likely to occur', and the Study Area lies within the known species range (Pizzey and Knight 2007). However the species has not been recorded in the area.
Oriental Plover ( <i>Charadrius veredus</i> )	Mi	S5	Large open areas including plains, muddy and sandy wastes near swamps and mudflats, ploughed land, claypans and open turf e.g. airfields (Pizzey and Knight 2007).	<b>Unlikely</b> The species or species habitat was listed as 'may occur', however the Study Area does not contain suitable habitat (DoEE 2018a, Pizzey and Knight 2007). The species has not been recorded nearby, and the Study Area lies outside of the species range (Pizzey and Knight 2007).

Common name (Scientific name)	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
Peregrine Falcon ( <i>Falco peregrinus</i> )		S7	The species occurs along cliffs, gorges, wooded rivers, wetlands, plains and open woodlands, as well as in association with pylons and buildings (Pizzey and Knight 2007). Nests on cliffs, in crevices, large tree hollows, in nests of other large birds or on building ledges (Pizzey and Knight 2007).	<b>Possible</b> The Study Area occurs within the species range and the species has been recorded between 90 and 95km from the Study Area, most recently in 2012 (DBCA 2017b, Pizzey and Knight 2007). However three of the four records occur along the Great Northern Highway, where the species is likely to rest on pylons (DBCA 2017b, Pizzey and Knight 2007). The Study Area contains suitable habitat along the main drainage line. This area may provide suitable foraging habitat and supports large Eucalyptus trees, some of which contain hollows.
Barn Swallow ( <i>Hirundo rustica</i> )	Mi	S5	Open areas, particularly near water, such as agricultural land, also in urban areas and rail yards (Pizzey and Knight 2007).	<b>Unlikely</b> Species or species habitat was listed as may occur, however the Study Area occurs outside of the species range, does not contain suitable habitat and the species has not been recorded nearby (DoEE 2018a, Pizzey and Knight 2007).
Yellow Wagtail ( <i>Motacilla flava</i> ) and Grey Wagtail ( <i>Motacilla cinerea</i> )	Mi	S5	Both species inhabit sewage ponds and lawn fields, however the Grey Wagtail also occurs along streams in escarpments, rainforests and unused quarries while the Yellow Wagtail occurs in swamp edges, short grass, bare ground and saltmarshes (Pizzey and Knight 2007).	<b>Unlikely</b> The species or species habitat was listed as 'may occur', however the species are summer vagrants that inhabit areas well outside the Study Area (closest range occurs along the northern coast) (Pizzey and Knight 2007). The species have not been recorded nearby and are considered unlikely to occur.
Night Parrot ( <i>Pezoporus occidentalis</i> )	En	S1	Known to inhabit treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed with chenopods (Pyke and Ehrlich 2014).	<b>Unlikely</b> The Study Area does not contain suitable habitat and the species is rare and has not been recorded nearby since 1912 (DBCA 2017b, Strahan 2004). As such, the species is considered unlikely to occur.
Princess Parrot ( <i>Polytelis alexandrae</i> )	Vu	P4	Areas with spinifex or near succulents around salt lakes, usually far from freshwater (Pizzey and Knight 2007).	<b>Unlikely</b> The Study Area occurs within the species irregular range, does not contain suitable habitat and the species has not been recorded nearby since 1919 (DBCA 2017b, Pizzey and Knight 2007). As such, the species is considered unlikely to occur.

Common name ( <i>Scientific name</i> )	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
Sandpipers, stints and greenshanks from the family <i>Scolopacidae</i> .	Mi	S5	Habitats associated with water including wetland and lake margins, floodwaters, mudflats, saltmarshes and salt fields, swamps, intertidal flats and estuaries (Pizzey and Knight 2007).	<b>Unlikely</b> Six species were listed within this family. However, these species favour shallow aquatic habitats not present within the Study Area, and the species have not been recorded recently nearby (DBCA 2017b, Pizzey and Knight 2007). Due to this, they are considered unlikely to occur.
<b>Reptiles</b>				
Yinnietharra Rock Dragon ( <i>Ctenophorus yinnietharra</i> )	Vu	S3	Low weathered granite outcrops; basks on low rocks and shrubs (Wilson and Swan 2013).	<b>Unlikely</b> The species is limited to granite outcrops near Yinnietharra Station (outside of the Study Area), and has not been recorded nearby (Wilson and Swan 2013).
Unpatterned robust slider (subsp.) <i>Lerista macropisthopus remota</i>		P2	Acacia shrublands and woodlands in semi-arid and arid areas (Wilson and Swan 2013).	<b>Unlikely</b> The Study Area may contain suitable habitat, however the subspecies is restricted to a small range to the east of the Study Area (Wilson and Swan 2013). The species has also not been recorded nearby, and is therefore considered unlikely to occur.
Pilbara Olive Python ( <i>Liasis olivaceus barroni</i> )	Vu	S3	Gorges and escarpments, often associated with water (Wilson and Swan 2013).	<b>Unlikely</b> The subspecies is restricted to the Pilbara, the Study Area contains unsuitable habitat and the subspecies has not been recorded nearby (Wilson and Swan 2013).

### 5.3 Survey Limitations and Constraints

There are several possible limitations and constraints that can impinge on the adequacy of vegetation, flora and fauna surveys (DPaW 2016a, EPA 2016). These are summarised in **Table 5-7**, with respect to the survey of the Study Area.

**Table 5-7: Potential limitations and constraints of the field survey**

Factor	Constraint	Comments
Competency and experience of consultants	No	The field personnel, Alice Bott, Crystal Heydenrych and Samantha Lostrom all have appropriate qualifications and experience to undertake the relevant components of the flora, vegetation and fauna survey. The specimen identifications were undertaken by senior taxonomist Sharnya Thomson, who has extensive WA experience.
Scope	No	The scope was well-defined. Flora, vegetation, fauna and their habitats were surveyed using standardised and well-established techniques. The desktop study was undertaken prior to the surveys to inform surveyors of the potential occurrence of factors of environmental significance.
Proportion of species identified	No	<p>The desktop and field species inventories are comparable to counts obtained during previous surveys of a similar size and scope in the vicinity of the Study Area (<b>Section 3.2</b>).</p> <p>Survey sampling, timing, and intensity was considered adequate for the identification of most perennial species. Of the specimens collected from the Study Area, eight could not be identified confidently to species level and four could not be identified confidently to infraspecies level. Further to this, 15 species could not be identified confidently beyond family level due to poor material and/or lack of diagnostic characteristics. None of the 15 species that could not be identified beyond family level are likely to represent species of conservation significance.</p> <p>All flora of conservation significance identified during the desktop assessment that were considered 'possible' to in the post-survey assessment of likelihood were perennial species and could be identified at the time of the survey if present.</p> <p>All vertebrate fauna encountered were identified and habitats were assessed for their importance to vertebrate fauna and fauna of conservation significance.</p>
Information sources (e.g. historic or recent)	Partial	<p>Aside from the previous survey of the Study Area by Outback Ecology in 2006, there is a paucity of information in the immediate vicinity of the Project. To supplement this information, the literature review considered surveys that had been undertaken within a wide radius of the Study Area. This information was also supplemented by additional information from database searches which considered large search areas i.e. up to 100 km.</p> <p>Regional contextual information was also obtained from historic vegetation mapping conducted by Beard (1975b, 1990), Shepherd <i>et al.</i> (2002), soil and landform mapping (Payne <i>et al.</i> 1988), IBRA classification system information (Desmond <i>et al.</i> 2001) and previous flora and fauna surveys conducted in the wider region.</p>



Factor	Constraint	Comments
Completeness and intensity	No	A total of 22 quadrats and fauna habitat assessments and six mapping notes were established and sampled across the Study Area. This was sufficient to adequately sample all broad vegetation types, fauna habitats and flora within the Study Area. Additionally, six motion-sensor cameras were deployed to detect cryptic species not recorded during the Level 1 fauna survey. The Level 1 fauna survey was supplemented by additional fauna observations undertaken between 28 <sup>th</sup> May and 1 <sup>st</sup> June 2018.
Timing / weather / season / cycle	No	Seasonal conditions were considered adequate. Below average rainfall was received two months prior to and during the month of the flora and vegetation field survey, and as such some species could not be confidently identified due to lack of flowering and/or fruiting material. The field survey took place during the optimal time of year according to the guidelines for flora and vegetation surveys (EPA 2016f).
Disturbances	No	Owing to the presence of numerous tracks, parts of the Study Area were in a disturbed ecological state. Further to this, historical and present grazing and trampling by feral fauna including camels, cattle and rabbits had contributed to the alteration of vegetation from its natural state. None of these disturbances limited the outcomes of this report. Vegetation condition is presented within <b>Section 5.2.2.1</b> .
Resources	No	Resources were adequate to carry out the survey and the survey participants were competent in identification of species present. WAH herbarium specimens, taxonomic guides, DBCA database searches and the FloraBase database were all used to prepare for the survey and used for the confirmation of any flora or fauna species where identification was uncertain.
Remoteness / access problems	No	All survey sites were easily accessible by vehicle and on foot.

## 6. Discussion

A total of 101 flora species were recorded within the Study Area. Despite extensive sampling and targeted searching no Threatened or Priority flora species were recorded. One species, *Centipeda minima* subsp. *macrocephala*, was recorded from one quadrat in the Study Area and is considered to be outside of its normal range of distribution. Typically this species occurs in the Augustus subregion further to the west as well as in the Carnarvon, Central Kimberley, Dampierland, Great Sandy Desert, Little Sandy Desert, Northern Kimberley and the Ord Victoria Plain IBRA regions. The suite of species recorded within the Study Area is considered to be typical of what may be expected in the areas (Beard 1975a, Payne *et al.* 1988, Shepherd *et al.* 2002).

Weed diversity and density within the Study Area is low, with two introduced flora taxa (*Malvastrum americanum* and *Bidens bipinnata*) recorded, neither of which represent a declared pest or WONS. *B. bipinnata*, however, is easily dispersed via seed and has the potential to spread in response to disturbance. Both weed species were present within growing in association with 5 Mile Creek and other smaller incised drainage lines within the Study Area,

Eight vegetation types, including one mosaic vegetation type, were mapped within the Study Area. The vegetation types recorded represent what would be expected from similar landforms in the broader Augustus subregion and none are analogous to any Commonwealth or State listed TECs or PECs. Vegetation condition ranged from 'Degraded' to 'Excellent' with the majority of the Study Area in 'Very Good' and 'Excellent' condition. The main type of disturbance within the Study Area was clearing of vegetation for exploration drilling and historical tracks. The impact of other disturbances on vegetation condition within the Study Area were due to grazing by introduced herbivores and considered to be minimal.

Five broad fauna habitats were identified within the Study Area; banded mulga on plain, riparian, open shrubland on stony plain, drainage and gully. All were considered widespread, and riparian habitat was considered significant owing to the potential foraging suitability for the Peregrine Falcon (S7).

A total of 27 species of vertebrate fauna were recorded during the field survey, none of which were of conservation significance. One species of conservation significance was considered Possible to occur based on habitat suitability, species range and previous records; the Peregrine Falcon (S7). The remaining were assessed as Unlikely.

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# Appendices



# Appendix A Codes and Terms Used to Describe Species of Conservation Significance

Flora and fauna may be accorded legislative protection by being listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act) and/or the Biodiversity Conservation Act 2016 (WA) (BC Act), or by being listed on the WA Department of Environment and Conservation's Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

## Definitions of codes and terms used to describe flora and fauna of conservation significance

Categories used under the EPBC Act		
Status	Code	Description
<b>Critically Endangered</b>	<b>Cr</b>	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
<b>Endangered</b>	<b>En</b>	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
<b>Vulnerable</b>	<b>Vu</b>	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
<b>Migratory</b>	<b>Mi</b>	Species that migrate to, over and within Australia and its external territories

Schedules used under the BC Act			Description
Status	Code	Schedule	
<b>Critically Endangered</b>	<b>Cr</b>	<b>S1</b>	Taxa that is rare or likely to become extinct, as critically endangered taxa
<b>Endangered</b>	<b>En</b>	<b>S2</b>	Taxa that is rare or likely to become extinct, as endangered taxa
<b>Vulnerable</b>	<b>Vu</b>	<b>S3</b>	Taxa that is rare or likely to become extinct, as vulnerable taxa
<b>Presumed Extinct</b>	<b>Ex</b>	<b>S4</b>	Taxa that is presumed to be extinct
<b>Migratory</b>	<b>Mi</b>	<b>S5</b>	Birds that are subject to international agreements relating to the protection of migratory birds
<b>Conservation Dependent</b>	<b>CD</b>	<b>S6</b>	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
<b>Special Protection</b>	<b>SP</b>	<b>S7</b>	Taxa that is in need of special protection

Priorities assigned under the DBCA Priority Taxa List		
Priority 1	P1	Taxa with few, poorly known populations on threatened lands. These are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened taxa
Priority 2	P2	Taxa with few, poorly known populations on conservation lands. These are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened taxa
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands. These are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened taxa
Priority 4	P4	Taxa in need of monitoring. These 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. These taxa are usually represented on conservation lands
Priority 5	P5	Taxa in need of monitoring. These are not considered threatened but are subject to a specific conservation programme, the cessation of which would result in the species becoming threatened within five years



## **Appendix B Conservation Significant Flora Known to Occur, Likely to Occur, or Possibly Occurring in the Study Area Prior to the Field Survey**

Species	Conservation Code			Habitat	Life form	Nearest known locality (km)	Reason of Likelihood	Flowering time	Source
	EPBC Act	BC Act	DBCA						
<i>Pityrodia augustensis</i>	VU	VU	T	Amongst rocks on slopes or in drainage lines.	Perennial	~111.8	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	-	DBCA (2017b) Desmond et al. (2001)
<i>Acacia wilcoxii</i>			1	Granitic soils. Along creeks & adjacent stony plains & granite outcrops.	Perennial	44	<b>Unlikely:</b> No granite outcrops are known to occur in the study area.	-	DBCA (2017b) Desmond et al. (2001)
<i>Eremophila appressa</i>			1	Ironstone gravel. Ridge slopes.	Perennial	~115.89	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Apr. to Oct.	DBCA (2017b)
<i>Eremophila arguta</i>			1	The edge of floodplains, in dry creek beds and on road verges.	Perennial	~98	<b>Possible:</b> The Study Area lies outside of the known distribution but may contain suitable habitat	Sep.	Desmond et al. (2001)
<i>Eremophila humilis</i>			1	Stony clay, loam. Rocky ridges.	Perennial	1.7	<b>Likely:</b> The Study Area contains suitable habitat for this species and known records are located within close proximity.	Sep	DBCA (2017b) (DBCA 2018a)
<i>Eremophila prolata</i>			1	Red stony clay. Flats & rises.	Perennial	~90	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Aug. to Sep.	Desmond et al. (2001)
<i>Hemigenia pachyphylla</i>			1	-	-	~295	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	-	Desmond et al. (2001)
<i>Ptilotus actinocladus</i> T.Hammer & R.W.Davis			1	-	-	~150	<b>Possible:</b> There is limited information available regarding the distribution and habitat requirements for this species.	-	DBCA (2017b)
<i>Acacia tuberculata</i>			2	Granite outcrops	Perennial	~530	<b>Unlikely:</b> The Study Area lies outside of the known distribution range for this species and there are no granite outcrops known to occur in the Study Area.	-	DBCA (2017b)
<i>Rhodanthe frenchii</i>			2	Stony hills, rocky river banks & outcrops.	Annual	~180	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Aug. to Oct.	Desmond et al. (2001)
<i>Thysanotus</i> sp. Desert East of Newman (R.P. Hart 964)			2	Red-brown loamy sand or red sand, sometimes silty. Sand plain, pisolitic buckshot plain.	Perennial	~441.86	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	-	DBCA (2017b)
<i>Eremophila coacta</i>			3	Laterite, shale soils. Ironstone hills, creeklines.	Perennial	~96.5	<b>Possible:</b> The Study Area lies outside of the known distribution but may contain suitable habitat	-	DBCA (2017b) (DBCA 2018a)
<i>Eremophila flaccida</i> subsp. <i>attenuata</i>			3	Stony clay over quartzite. Hillslopes, ridges.	Perennial	~266	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	May	Desmond et al. (2001)
<i>Eremophila gracillima</i>			3	Stony flats	Perennial	0.85	<b>Likely:</b> The Study Area contains suitable habitat for this species and known records are located within close proximity.		DBCA (2017b) Desmond et al. (2001)
<i>Eremophila lanata</i>			3	Stony red clayey sand.	Perennial	~120	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Aug.	Desmond et al. (2001)
<i>Eremophila rigida</i>			3	Red sand alluvium. Hardpan plains, stony clay depressions.	Perennial	29	<b>Possible:</b> The Study Area lies outside of the known distribution but may contain suitable habitat	Sep.	DBCA (2017b) DoEE (2018a) Desmond et al. (2001)
<i>Owenia acidula</i>			3	Clay plains.	Perennial	~470	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Aug.	DBCA (2017b), (DBCA 2018a)
<i>Ptilotus lazaridis</i>			3	Clay loam. Floodplains.	Perennial	~62	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species.	Jul., Oct.	Desmond et al. (2001)
<i>Ptilotus luteolus</i>			3	Rocky slopes, screes and ridges.	-	~180	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	-	Desmond et al. (2001)
<i>Stylidium weeliwollii</i>			3	Gritty sand soil, sandy clay. Edge of watercourses.	Annual	~81	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Aug. to Sep.	Desmond et al. (2001)
<i>Ptilotus trichocephalus</i>			4	Sandy soils. Colluvial plains.	Perennial	47	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	-	DBCA (2017b) Desmond et al. (2001)
<i>Goodenia berringbinensis</i>			4	Red sandy loam. Along watercourses.	Annual	~127	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Oct.	Desmond et al. (2001)

## Appendix C Vegetation Condition Scale

Code	Description
Pristine	Pristine or nearly so. No obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	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	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

## Appendix D Vegetation Structure Scale

### NVIS Vegetation Structural Classifications

Cover Characteristics							
Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% Crown cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

Growth Form	Height ranges (m)	Structural Formation Classes						
		tree, palm	>30 Tall	closed forest	open forest	woodland	open woodland	isolated trees
10-30 Mid								
<10 Low								
tree mallee	10-30 Tall	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
<10 Mid								
<3 Low								
shrub, cycad, grass-tree, fern	>2 Tall	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
1-2 Mid								
<1 Low								
mallee shrub	10-30 Tall	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	mallee shrubs
<10 Mid								
<3 Low								

Growth Form	Height ranges (m)	Structural Formation Classes						
		heath shrub	>2 Tall	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs
1-2 Mid								
<1 Low								
chenopod shrub	>2 Tall	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
1-2 Mid								
<1 Low								
	>0.5 Mid							

Growth Form	Height ranges (m)	Structural Formation Classes						
samphire shrub	<0.5 Low	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
hummock grass	>2 Tall	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
	<2 Low							
tussock grass	>0.5 Mid	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
	<0.5 Low							
other grass	>0.5 Mid	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
	<0.5 Low							
sedge	>0.5 Mid	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
	<0.5 Low							
rush	>0.5 Mid	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
	<0.5 Low							
forb	>0.5 Mid	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
	<0.5 Low							
fern	>2 Tall	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
	1-2 Mid							
	<1 Low							
bryophyte	<0.5	closed bryophyte land	bryophyte land	open bryophyte land	sparse bryophyte land	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	>30 Tall	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
	10-30 Mid							
	<10 Low							
aquatic	<1 Tall	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
	0-0.5 Low							
seagrass	<1 Tall	closed seagrass bed	Seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses	seagrasses

## Appendix E Inventory of Vascular Flora Recorded

## Inventory of Vascular Flora Recorded

Family	Species
Acanthaceae	<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>
	<i>Alternanthera nodiflora</i>
Amaranthaceae	<i>Ptilotus obovatus</i>
	<i>Ptilotus schwartzii</i>
Asteraceae	* <i>Bidens bipinnata</i>
	<i>Centipeda minima</i> subsp. <i>macrocephala</i>
	<i>Pluchea dentex</i>
	<i>Pterocaulon sphaeranthoides</i>
	<i>Pterocaulon</i> sp.
Caryophyllaceae	<i>Polycarpaea corymbosa</i>
	<i>Polycarpaea longiflora</i>
Chenopodiaceae	<i>Dysphania rhadinostachya</i> subsp. <i>inflata</i>
	<i>Salsola australis</i>
	<i>Sclerolaena cornisheana</i>
	<i>Maireana</i> sp.
Cleomaceae	<i>Cleome viscosa</i>
Convolvulaceae	<i>Duperreya commixta</i>
	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>
Cyperaceae	<i>Cyperus rigidellus</i>
	<i>Fimbristylis dichotoma</i>
	<i>Cyperaceae</i> sp.
	<i>Cyperus</i> sp.
Euphorbiaceae	<i>Euphorbia biconvexa</i>
	<i>Euphorbiaceae</i> sp.
Fabaceae	<i>Acacia ?aptaneura</i>
	<i>Acacia ?ramulosa</i> hybrid
	<i>Acacia ?ramulosa</i> var. <i>ramulosa</i>
	<i>Acacia acradenia</i>
	<i>Acacia aneura</i>
	<i>Acacia ayersiana</i>
	<i>Acacia citrinoviridis</i>
	<i>Acacia incurvaneura</i>
	<i>Acacia kempeana</i>
	<i>Acacia pruinocarpa</i>
	<i>Acacia pyrifolia</i>
	<i>Acacia ramulosa</i> var. <i>linophylla</i>
	<i>Acacia rhodophloia</i>
	<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>
	<i>Acacia sibirica</i>
	<i>Acacia tetragonophylla</i>
	<i>Glycine canescens</i>
	<i>Indigofera chamaeclada</i>
	<i>Indigofera monophylla</i>
	<i>Mirbelia rhagadioides</i>
<i>Rhynchosia minima</i>	



Family	Species
	<i>Senna artemisioides</i> subsp. <i>filifolia</i>
	<i>Senna artemisioides</i> subsp. <i>helmsii</i>
	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>
	<i>Senna cuthbertsonii</i>
	<i>Senna glaucifolia</i>
	<i>Senna glutinosa</i> subsp. <i>pruinosa</i>
	<i>Senna stricta</i>
	<i>Tephrosia rosea</i> var. <i>clementii</i>
	<i>Acacia</i> sp.
	<i>Senna</i> sp.
Goodeniaceae	<i>Goodenia</i> sp.
Malvaceae	<i>Abutilon cryptopetalum</i>
	<i>Androcalva loxophylla</i>
	<i>Corchorus crozophorifolius</i>
	<i>Hibiscus sturtii</i> var. <i>forrestii</i>
	* <i>Malvastrum americanum</i>
	<i>Melhanianthus oblongifolia</i>
	<i>Sida</i> ? <i>ectogama</i>
	<i>Sida</i> ?sp. spiciform panicles (E. Leyland 14/08/90)
	<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)
	<i>Abutilon</i> sp.
	<i>Hibiscus</i> sp.
	Malvaceae sp.
Marsileaceae	<i>Marsilea hirsuta</i>
Myrtaceae	<i>Corymbia</i> ? <i>ferriticola</i>
	<i>Corymbia candida</i> subsp. ? <i>dipsodes</i>
	<i>Eucalyptus victrix</i>
	<i>Thryptomene decussata</i>
Nyctaginaceae	<i>Boerhavia coccinea</i>
Plantaginaceae	<i>Stemodia viscosa</i>
Poaceae	<i>Aristida contorta</i>
	<i>Cymbopogon ambiguus</i>
	<i>Enneapogon robustissimus</i>
	<i>Eragrostis</i> ? <i>elongata</i>
	<i>Eragrostis cumingii</i>
	<i>Eriachne benthamii</i>
	<i>Eriachne mucronata</i>
	<i>Eriachne pulchella</i>
	<i>Eulalia aurea</i>
	<i>Neurachne minor</i>
	<i>Paraneurachne muelleri</i>
	<i>Perotis rara</i>
	<i>Setaria dielsii</i>
	<i>Sporobolus australasicus</i>
	<i>Themeda triandra</i>
	<i>Trichodesma zeylanicum</i>
	<i>Triodia basedowii</i>

Family	Species
	<i>Triodia pungens</i>
	<i>Poaceae</i> sp.
	<i>Setaria</i> sp.
Portulacaceae	<i>Portulaca oleracea</i>
Proteaceae	<i>Grevillea berryana</i>
	<i>Grevillea stenobotrya</i>
Pteridaceae	<i>Cheilanthes</i> sp.
Rubiaceae	<i>Psydrax latifolia</i>
	<i>Psydrax suaveolens</i>
Santalaceae	<i>Santalum</i> ? <i>lanceolatum</i>
Sapindaceae	<i>Dodonaea petiolaris</i>
	<i>Dodonaea viscosa</i>
Scrophulariaceae	<i>Eremophila exillifolia</i>
	<i>Eremophila forrestii</i> subsp. ? <i>forrestii</i>
	<i>Eremophila fraseri</i> subsp. <i>fraseri</i>
	<i>Eremophila gielsii</i> subsp. ? <i>variabilis</i>
	<i>Eremophila jucunda</i> subsp. <i>jucunda</i>
	<i>Eremophila latrobei</i> subsp. ?
	<i>Eremophila latrobei</i> subsp. <i>latrobei</i>
<i>Eremophila</i> sp.	
Solanaceae	<i>Solanum lasiophyllum</i>
	<i>Solanum sturtianum</i>
Zygophyllaceae	<i>Tribulus suberosus</i>

# Appendix F Floristic Data - Flora Sampling Sites

# Galena Minerals – Abra – AB01

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## Site Details:

Described by: Crystal Heydenrych

Date: 2018-04-27

Type: Quadrat (20m x 20m)

MGA Zone: 50J 662398mE 7275191mN

## Environmental Variables:

Landform: Floodplain

Slope: Moderately included (5-15°)

### Soils:

Soil Texture: River sand

Soil Colour: Brown

Rock Type: River bed pebbles - alluvial

### Coarse Surface Particles:

Site coverage: 20-50

Size: 2-6, 6-20

Outcropping: 2-10

### Impacts:

Waterlogging: Prone to flooding

Erosion: -

Introduced species: \**Bidens bipinnata* and  
\**Malvastrum americanum*

Human disturbance: Grazing, Feral scats, Weeds

---

## FLORA AND VEGETATION DATA

### Description:

*Eucalyptus victrix*, *Acacia citrinoviridis* woodland over *Tephrosia rosea* var. *clementii* low shrubland over *Cymbopogon ambiguus* very open tussock grassland.

### Species List

Species	Height	Cover
<i>Eucalyptus victrix</i>	15	8
<i>Tephrosia rosea</i> var. <i>clementii</i>	0.45	12
<i>Acacia citrinoviridis</i>	11	12
<i>Cymbopogon ambiguus</i>	0.7	2
<i>Themeda triandra</i>	0.45	0.1
<i>Cleome viscosa</i>	0.35	0.1
* <i>Bidens bipinnata</i>	0.15	0.1
<i>Eulalia aurea</i>	0.5	0.1
<i>Polycarpaea corymbosa</i>	0.1	0.1
<i>Euphorbia biconvexa</i>	0.15	0.1
<i>Stemodia viscosa</i>	0.15	0.1
<i>Sporobolus australasicus</i>	0.15	0.1
<i>Eriachne mucronata</i>	0.15	0.1
<i>Marsilea hirsuta</i>	0.05	0.1
<i>Corchorus crozophorifolius</i>	0.25	0.1

Species	Height	Cover
<i>Perotis rara</i>	0.1	0.1
<i>Cyperus rigidellus</i>	0.55	0.1
<i>Eragrostis cumingii</i>	0.05	0.1
<i>Sclerolaena cornisheana</i>	0.15	0.1
<i>Salsola australis</i>	0.3	0.1
<i>Solanum sturtianum</i>	0.4	0.1
<i>Indigofera monophylla</i>	0.3	0.1
<i>Rhynchosia minima</i>	0.1	0.1
Malvaceae sp indet	0.4	0.1
<i>Duperraya commixta</i>	0	0.1
<i>Acacia tetragonophylla</i>	0.5	0.1
<i>Enneapogon robustissimus</i>	0.3	0.1
<i>Setaria</i> sp indet	0.3	0.1
<i>Centipeda minima</i> subsp. <i>macrocephala</i>	0.08	0.1
<i>Acacia rhodophloia</i>	0.7	0.1
* <i>Malvastrum americanum</i>	0.35	0.1
<i>Glycine canescens</i>	0	0.1

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
2	75	2	21

Veg Condition: Very Good      Fire Age: 5 to 15 years

Weeds: \**Bidens bipinnata*,      Fire Notes: N/A  
\**Malvastrum americanum*

#### SITE PHOTOGRAPH



## Galena Minerals – Abra – AB02

---

### Site Details:

Described by: Alice Bott  
Date: 2018-04-27  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662493mE 7274802mN

### Environmental Variables:

Landform: Levee of 5 Mile Creek

Slope: Level (0-3°)

#### Soils:

Soil Texture: Creek sand  
Soil Colour: Orange brown  
Rock Type: Alluvially deposited, Ironstone

#### Coarse Surface Particles:

Site coverage: 20-50  
Size: 6-20  
Outcropping: 0

#### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: Feral trampling, Grazing

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* open tall shrubland over *Rulingii* and *Acacia pyrifolia* open shrubland over *Tephrosia roses var clementii* and *Corchorus crozophorifolius* open low heath.

### Species List

Species	Height	Cover
<i>Acacia citrinoviridis</i>	3	5
<i>Androcalva loxophylla</i>	2.2	1
<i>Tephrosia rosea var. clementii</i>	0.7	40
<i>Acacia pyrifolia</i>	1.1	3
<i>Cleome viscosa</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.4	1
<i>Acacia sclerosperma subsp. sclerosperma</i>	0.9	0.1
<i>Senna artemisioides subsp. helmsii</i>	0.5	0.1
<i>Polycarpaea corymbosa</i>	0.05	0.1
<i>Corchorus crozophorifolius</i>	0.8	3
<i>Senna artemisioides subsp. filifolia</i>	0.3	0.1
<i>Eremophila fraseri subsp. fraseri</i>	0.4	0.1
<i>Indigofera monophylla</i>	0.45	0.1
<i>Rhynchosia minima</i>	0	0.1

Species	Height	Cover
<i>Sida</i> sp. <i>spiciform panicles</i> (E. Leyland 14/08/90)	0.6	0.1
<i>Melhania oblongifolia</i>	0.2	0.1
<i>Eriachne mucronata</i>	0.25	0.1
<i>Setaria dielsii</i>	0.35	0.1
<i>Perotis rara</i>	0.05	0.1
<i>Aristida contorta</i>	0.15	0.1
<i>Acacia tetragonophylla</i>	0.6	0.1
<i>Solanum lasiophyllum</i>	0.5	0.1
<i>Trichodesma zeylanicum</i>	0.5	0.1
<i>Paraneurachne muelleri</i>	0.4	0.1
<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	0.2	0.1
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Grevillea stenobotrya</i>	0.6	0.1
<i>Stemodia viscosa</i>	0.12	0.1
<i>Sporobolus australasicus</i>	0.08	0.1

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	40	25	45

Veg Condition: Very Good

Fire Age: 5 to 15 years

Weeds: None

Fire Notes: No fire scar, shrub layer dominant

#### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB03

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-27  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662215mE 7273713mN

## Environmental Variables:

Landform: Floodplain  
Slope: Moderately inclined (5-15°)

### Soils:

Soil Texture: River sand  
Soil Colour: Brown  
Rock Type: Alluvial river rock

### Coarse Surface Particles:

Site coverage: 20-50  
Size: 2-6, 6-20  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding  
Introduced species: \**Bidens bipinnata*  
Erosion: -  
Human disturbance: Weeds

---

## FLORA AND VEGETATION DATA

### Description:

*Eucalyptus victrix*, *Acacia citrinoviridis* woodland over *Tephrosia roses* low shrubland over *Cymbopogon ambiguus* very open tussock grassland.

### Species List

Species	Height	Cover
<i>Eucalyptus victrix</i>	18	15
<i>Acacia citrinoviridis</i>	11	10
<i>Eulalia aurea</i>	0.7	0.1
<i>Themeda triandra</i>	1.1	0.1
<i>Cymbopogon ambiguus</i>	0.7	0.1
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.15	0.1
<i>Sporobolus australasicus</i>	0.1	0.1
<i>Stemodia viscosa</i>	0.15	0.1
<i>Acacia pyrifolia</i>	0.8	0.1
<i>Alternanthera nodiflora</i>	0.4	0.1
<i>Pterocaulon</i> sp.	0.35	0.1
<i>Duperreya commixta</i>	0	0.1
<i>Boerhavia coccinea</i>	0.2	0.1
<i>Rhynchosia minima</i>	0.25	0.1
<i>Cleome viscosa</i>	0.4	0.1



Species	Height	Cover
<i>Corchorus crozophorifolius</i>	0.5	0.1
<i>Mirbelia rhagadioides</i>	0.1	0.1
<i>Polycarpha longiflora</i>	0.15	0.1
<i>Abutilon cryptopetalum</i>	0.4	0.1
<i>Abutilon cryptopetalum</i>	0.35	0.1
<i>Sida</i> sp. <i>spiciform panicles</i> (E. Leyland 14/08/90)	0.8	0.1
* <i>Bidens bipinnata</i>	0.15	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	0.5	0.1
<i>Sida</i> ? sp. <i>spiciform panicles</i> (E. Leyland 14/08/90)	0.5	0.1
<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	0.15	0.1
<i>Eucalyptus victrix</i>	18	15

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
2	75	2	21

Veg Condition: Excellent

Fire Age: 5 to 15 years

Weeds: \**Bidens bipinnata*

Fire Notes: N/A

### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB04

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## Site Details:

Described by: Alice Bott  
Date: 2018-04-27  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662029mE 7273620mN

## Environmental Variables:

Landform: Levee of Five Mile Creek

Slope: Level (0-3°)

### Soils:

Soil Texture: Sand  
Soil Colour: Orange brown  
Rock Type: Alluvially deposited gravels and rocks

### Coarse Surface Particles:

Site coverage: 20-50  
Size: 6-20, 60-200  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: Feral trampling, Grazing, Tracks

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* open low woodland over *Acacia pyrifolia* open shrubland over *Tephrosia rosea*, *Corchorus crozophorifolius* open low shrubland.

### Species List

Species	Height	Cover
<i>Acacia citrinoviridis</i>	4	4
<i>Indigofera monophylla</i>	0.8	1
<i>Tephrosia rosea</i> var. <i>clementii</i>	0.9	2
<i>Setaria dielsii</i>	0.4	0.1
<i>Pterocaulon sphaeranthoides</i>	0.6	0.1
<i>Ptilotus obovatus</i>	0.8	1
<i>Corchorus crozophorifolius</i>	0.9	3
<i>Eriachne benthamii</i>	0.05	0.1
<i>Solanum sturtianum</i>	0.9	0.1
<i>Acacia</i> sp.	1.4	0.1
<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	0.15	0.1
<i>Cleome viscosa</i>	0.5	0.1
<i>Enneapogon robustissimus</i>	0.2	0.1
<i>Paraneurachne muelleri</i>	0.25	0.1

Species	Height	Cover
<i>Goodenia</i> sp. <i>indeterminate</i>	0.15	0.1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	0.95	0.1
<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	0.8	0.1
<i>Duperreya commixta</i>	0	0.1
<i>Aristida contorta</i>	0.15	0.1
<i>Cymbopogon ambiguus</i>	0.9	0.1
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	0.7	0.1
<i>Acacia pyrifolia</i>	1.1	3

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	5	20	70

Veg Condition: Very Good

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: Mature trees with no scars.  
Shrub starts dominant.

### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB05

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-27  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662887mE 7276464mN

## Environmental Variables:

Landform: Floodplain

Slope: Level (0-3°)

### Soils:

Soil Texture: River sand  
Soil Colour: Brown  
Rock Type: Alluvial floodplain pebbles

### Coarse Surface Particles:

Site coverage: >90  
Size: 2-6, 20-60, 6-20  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding  
Erosion: -  
Introduced species: N/A  
Human disturbance: Feral scats, Feral trampling, Grazing

---

## FLORA AND VEGETATION DATA

### Description:

*Eucalyptus victrix* open tall woodland over *Acacia citrinoviridis* woodland over *Dodonaea viscosa* (*Acacia tetragonophylla*) open scrubland over *Eulalia aurea*, *Cymbopogon ambiguus* very open grassland.

### Species List

Species	Height	Cover
<i>Eucalyptus victrix</i>	22	8
<i>Acacia citrinoviridis</i>	18	25
<i>Psyrax latifolia</i>	3	0.1
<i>Eriachne pulchella</i>	0.15	0.1
<i>Themeda triandra</i>	0.7	0.1
<i>Cymbopogon ambiguus</i>	0.9	1
<i>Acacia tetragonophylla</i>	0.5	1
<i>Bidens bipinnata</i>	0.2	0.1
<i>Duperreya commixta</i>	0	0.1
<i>Dodonaea viscosa</i>	1	2
<i>Pterocaulon ?sphaeranthoides</i>	0.25	0.1
<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	0.15	0.1
<i>Solanum sturtianum</i>	0.8	0.1
<i>Eulalia aurea</i>	0.5	1

Species	Height	Cover
<i>Abutilon cryptopetalum</i>	0.3	0.1
<i>Ptilotus obovatus</i>	0.25	0.1
<i>Sporobolus australasicus</i>	0.1	0.1
<i>Tephrosia rosea</i> var. <i>clementii</i>	0.25	0.1
<i>Cleome viscosa</i>	0.15	0.1
<i>Cyperaceae</i> sp indet	0.15	0.1
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.15	0.1
<i>Rhynchosia minima</i>	0.2	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
65	5	0	25

Veg Condition: Excellent

Fire Age: 5 to 15 years

Weeds: None

Fire Notes: N/A

### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB06

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## Site Details:

Described by: Alice Bott  
Date: 2018-04-27  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662854mE 7276353mN

## Environmental Variables:

Landform: Levee of 5 Mile Creek

Slope: Level (0-3°)

### Soils:

Soil Texture: Sand  
Soil Colour: Orange  
Rock Type: Mudstone

### Coarse Surface Particles:

Site coverage: 20-50  
Size: 2-6, 20-60, 60-200  
Outcropping: 10-20

### Impacts:

Waterlogging: Prone to flooding  
Erosion: -  
Introduced species: \**Bidens bipinnata*,  
\**Malvastrum americanum*  
Human disturbance: Feral trampling, Grazing, Weeds

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* open tall shrubland over *Corchorus crozophorifolius*, *Senna artemisioides* subspecies *helmsii* and *Tephrosia roses* subspecies *clementii* low shrubland.

### Species List

Species	Height	Cover
<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	1	4
<i>Acacia citrinoviridis</i>	3.5	1
<i>Aristida contorta</i>	0.2	0.1
<i>Eriachne benthamii</i>	0.25	0.1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	0.4	4
<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	0.2	0.1
<i>Cymbopogon ambiguus</i>	0.9	0.1
<i>Tephrosia rosea</i> var. <i>clementii</i>	0.7	4
<i>Paraneurachne muelleri</i>	0.5	0.1
<i>Acacia pyrifolia</i>	0.7	2
<i>Corchorus crozophorifolius</i>	0.9	4
Malvaceae sp. indeterminate	0.5	0.1
<i>Sida</i> sp. <i>spiciform panicles</i> (E. Leyland 14/08/90)	0.9	1
<i>Androcalva loxophylla</i>	1.2	0.1

Species	Height	Cover
<i>Goodenia</i> sp. indeterminate	0.1	0.1
<i>Ptilotus obovatus</i>	0.9	0.1
<i>Evolvulus alsinoides</i> var. <i>alsinoides</i>	0.2	0.1
<i>Acacia tetragonophylla</i>	1.1	0.1
<i>Senna artemisioides</i> subspecies <i>oligophylla</i>	0.9	0.1
<i>Solanum sturtianum</i>	0.25	0.1
<i>Duperreya commixta</i>	0	0.1
<i>Cleome viscosa</i>	0.25	0.1
<i>Setaria dielsii</i>	0.4	0.1
* <i>Bidens bipinnata</i>	0.08	0.1
<i>Pterocaulon ?sphaeranthoides</i>	0.4	0.1
* <i>Malvastrum americanum</i>	0.6	0.1
	1.2	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	0.3	0.1
<i>Senna glaucifolia</i>	0.6	0.1
<i>Acacia ? aptaneura</i>	1.7	0.1
<i>Abutilon cryptopetalum</i>	0.4	0.1
<i>Psydrax latifolia</i>	0.4	0.1
<i>Solanum lasiophyllum</i>	0.3	0.1
<i>Eragrostis ? elongata</i>	0.5	0.1
<i>Indigofera monophylla</i>	0.3	0.1
<i>Eriachne pulchella</i>	0.15	0.1

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
10	10	10	50

Veg Condition: Very Good

Fire Age: 3 to 5 years

Weeds: \**Bidens bipinnata*,  
\**Malvastrum americanum*

Fire Notes: No fire scar, lots of debris

**SITE PHOTOGRAPH**





# Galena Minerals – Abra – AB07

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 659654mE 7273256mN

## Environmental Variables:

Landform: Hill  
Slope: Gently inclined (3-5°)

### Soils:

Soil Texture: Sandy loam  
Soil Colour: Red  
Rock Type: Dolerite

### Coarse Surface Particles:

Site coverage: 50-90  
Size: 2-6, 20-60, 6-20, 60-200  
Outcropping: 0

### Impacts:

Waterlogging: None  
Introduced species: N/A  
Erosion: -  
Human disturbance: N/A

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia ? ramulosa* hybrid open tall shrubland over *Acacia rhodophloia* open shrubland over *Eremophila exillifolia* and *Eremophila jucunda subsp. jucunda* low shrubland over *Eriachne mucronata* open tussock grassland.

### Species List

Species	Height	Cover
<i>Eremophila exillifolia</i>	0.4	10
<i>Acacia rhodophloia</i>	1.5	3
<i>Ptilotus schwartzii</i>	0.4	0.1
<i>Eremophila jucunda subsp. jucunda</i>	0.45	8
<i>Cyperaceae</i> sp.	0.15	0.1
<i>Solanum lasiophyllum</i>	0.4	0.1
<i>Neurachne minor</i>	0.35	0.1
<i>Goodenia</i> sp.	0.15	0.1
<i>Eriachne mucronata</i>	0.4	12
<i>Acacia ? ramulosa</i> hybrid	2.1	3
<i>Sida</i> sp. <i>Golden calyces glabrous</i> (H.N. Foote 32)	0.4	0.1
<i>Aristida contorta</i>	0.4	0.1
<i>Grevillea berryana</i>	3	1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
5	8	2	40

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB08

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## Site Details:

Described by: Alice Bott  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 660122mE 7272964mN

## Environmental Variables:

Landform: Channelled valley bottom. Incised, drainage line

Slope: Level (0-3°)

### Soils:

Soil Texture: Sand  
Soil Colour: Brown  
Rock Type: Mudstone

### Coarse Surface Particles:

Site coverage: 20-50  
Size: 20-60, 6-20, 60-200  
Outcropping: 2-10

### Impacts:

Waterlogging: Prone to flooding  
Erosion: -  
Introduced species: N/A  
Human disturbance: Feral trampling, Grazing

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia aneura* and *Acacia citrinoviridis* open forrest over *Psydrax latifolia* tall shrubland over *Hibiscus flowering*, *Tribulus*, *Sida* tall and *Eremophila spectabilis* shrubland over *Eriachne mucronata* very open tussock grassland.

### Species List

Species	Height	Cover
<i>Acacia citrinoviridis</i>	15	25
<i>Psydrax latifolia</i>	6	25
<i>Senna cuthbertsonii</i>	1.5	10
<i>Indigofera chamaeclada</i>	1.5	0.1
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	1.8	8
<i>Eriachne mucronata</i>	0.3	2
<i>Solanum lasiophyllum</i>	0.6	0.1
<i>Acacia aneura</i>	13	35
<i>Eremophila</i> sp.	0.8	2
<i>Sida</i> ? <i>ectogama</i>	1.6	2
<i>Poaceae</i> sp. indeterminate	0.3	0.1
<i>Eremophila forrestii</i> subsp. ? <i>forrestii</i>	1.4	0.1
<i>Eremophila latrobei</i> subsp. ?	1.8	0.1
<i>Abutilon cryptopetalum</i>	0.3	0.1

Species	Height	Cover
<i>Acacia incurvaneura</i>	0.8	0.1
<i>Sida</i> sp. <i>Golden calyces glabrous</i> (H.N. Foote 32)	0.15	0.1
<i>Acacia rhodophloia</i>	6	0.1

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
4	5	30	75

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: No fire scar, mature mulga

#### SITE PHOTOGRAPH



## Galena Minerals – Abra – AB09

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### Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 660868mE 7273080mN

### Environmental Variables:

Landform: Floodplain  
Slope: Gently inclined (3-5°)

#### Soils:

Soil Texture: Sandy loam  
Soil Colour: Red  
Rock Type: N/A

#### Coarse Surface Particles:

Site coverage: 10-20  
Size: 2-6, 6-20  
Outcropping: 0

#### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: N/A

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia aneura* and *Acacia pruinocarpa* woodland over *Acacia citrinoviridis* open low woodland over *Psydrax latifolius* open tall shrubland over *Eremophila* sp., *Eremophila forrestii* subsp. ? *forrestii*, *Senna cuthbertsonii* shrubland.

### Species List

Species	Height	Cover
<i>Psydrax latifolia</i>	3	4
<i>Eremophila</i> sp.	1.5	6
<i>Acacia aneura</i>	11	30
<i>Ptilotus obovatus</i>	0.9	0.1
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	0.8	0.1
<i>Senna stricta</i>	1.2	0.1
<i>Senna cuthbertsonii</i>	0.65	12
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0.8	0.1
<i>Acacia ayersiana</i>	2.2	1
<i>Eremophila forrestii</i> subsp. ? <i>forrestii</i>	0.5	3
<i>Acacia pruinocarpa</i>	12	3
<i>Grevillea berryana</i>	0.5	0.1
<i>Sida</i> ? <i>ectogama</i>	0.45	0.1
<i>Eriachne benthamii</i>	0.25	0.1

Species	Height	Cover
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0.9	0.1
<i>Poaceae</i> sp.	0.25	0.1
<i>Euphorbiaceae</i> sp indet	0.15	0.1
<i>Acacia citrinoviridis</i>	5	2
<i>Acacia aneura</i>	2.5	0.1

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
2	30	5	63

Veg Condition: Excellent

Fire Age: 5 to 15 years

Weeds: None

Fire Notes: Tall mulga present

#### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB10

---

## Site Details:

Described by: Alice Bott

Date: 2018-04-28

Type: Quadrat (20m x 20m)

MGA Zone: 50J 660635mE 7276028mN

## Environmental Variables:

Landform: Colluvial plain

Slope: Level (0-3°)

### Soils:

Soil Texture: Sandy loam

Soil Colour: Orange brown

Rock Type: N/A

### Coarse Surface Particles:

Site coverage: 10-20

Size: 2-6

Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding

Erosion: -

Introduced species: N/A

Human disturbance: Feral trampling, Grazing, Tracks

---

## FLORA AND VEGETATION DATA

### Description:

*Grevillea berryana* open low woodland over *Acacia ramulosa* var. *linophylla*, *Acacia* ? *ramulosa* hybrid and *Acacia incurvaneura* tall shrubland over *Eremophila forrestii* open low shrubland.

### Species List

Species	Height	Cover
<i>Acacia acradenia</i>	2.2	0.1
<i>Acacia sibirica</i>	3	20
<i>Grevillea berryana</i>	5	4
<i>Acacia ramulosa</i> var. <i>linophylla</i>	3	4
<i>Acacia incurvaneura</i>	5	5
<i>Eremophila forrestii</i> subsp. ? <i>forrestii</i>	1.2	6
<i>Senna cuthbertsonii</i>	1.1	1.5
<i>Ptilotus obovatus</i>	1.1	0.1
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	1.2	0.1
<i>Eremophila</i> sp.	2.3	1
<i>Acacia tetragonophylla</i>	3	1
<i>Acacia citrinoviridis</i>	1.1	0.1
<i>Acacia pruinocarpa</i>	0.9	0.1
<i>Duperreya commixta</i>	0	0.1

Species	Height	Cover
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Maireana sp. indeterminate</i>	0.15	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	70	5	40

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: Establish mulgas and no fire scar

### SITE PHOTOGRAPH





# Galena Minerals – Abra – AB11

## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 661700mE 7276194mN

## Environmental Variables:

Landform: Eroded depression  
Slope: Level (0-3°)

### Soils:

Soil Texture: Silty loam  
Soil Colour: Red  
Rock Type: N/A

### Coarse Surface Particles:

Site coverage: 50-90  
Size: 2-6, 20-60, 6-20  
Outcropping: 0

### Impacts:

Waterlogging: Temporary water presence  
Introduced species: N/A  
Erosion: -  
Human disturbance: Feral scats Feral trampling, Grazing

## FLORA AND VEGETATION DATA

### Description:

*Acacia pruinocarpa* open tall shrubland over *Ptilotus obovatus* open low shrubland.

### Species List

Species	Height	Cover
<i>Acacia pruinocarpa</i>	3.5	8
<i>Ptilotus obovatus</i>	0.65	2
<i>Ptilotus schwartzii</i>	0.4	0.1
<i>Acacia kempeana</i>	0.5	0.1
<i>Maireana</i> sp.	0.15	0.1
<i>Senna artemisioides subsp. helmsii</i>	0.4	0.1
<i>Eremophila</i> sp.	0.35	0.1
<i>Hibiscus</i> sp.	0.7	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
25	55	0	20

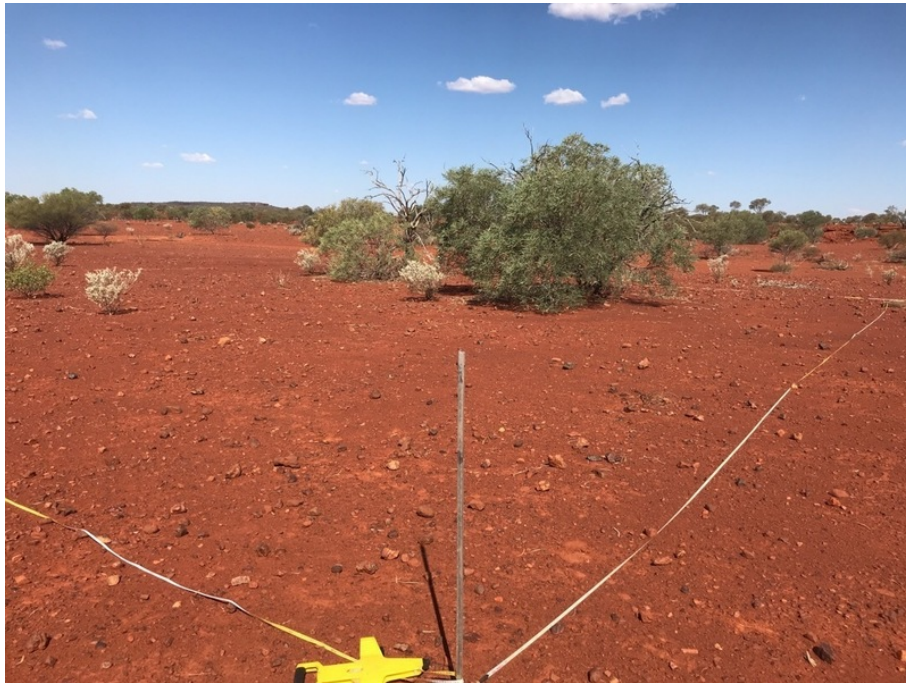
Veg Condition: Very Good

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

## SITE PHOTOGRAPH



# Galena Minerals – Abra – AB12

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 661928mE 7276046mN

## Environmental Variables:

Landform: Eroded hilly/depression surrounded by breakaway

Slope: Level (0-3°)

### Soils:

Soil Texture: Sandy loam  
Soil Colour: Orange brown  
Rock Type: Ironstone

### Coarse Surface Particles:

Site coverage: 20-50  
Size: 2-6, 6-20  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding

Erosion: -

Introduced species: N/A

Human disturbance: Feral trampling, Grazing

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia pruinocarpa* and *Acacia* sp. open tall shrubland.

### Species List

Species	Height	Cover
<i>Acacia pruinocarpa</i>	4	3
<i>Tribulus suberosus</i>	0.5	0.1
<i>Ptilotus obovatus</i>	0.5	0.1
<i>Acacia</i> sp.	4	6
<i>Eremophila</i> sp. indeterminate	0.4	0.1
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	0.8	0.1
<i>Senna</i> sp. indeterminate	1.2	0.1
<i>Acacia kempeana</i>	1.2	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	50	0	12

Veg Condition: Very Good

Weeds: None

Fire Age: 3 to 5 years

Fire Notes: No evidence, no scars

## SITE PHOTOGRAPH



# Galena Minerals – Abra – AB13

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 660369mE 7277000mN

## Environmental Variables:

Landform: Plain

Slope: Level (0-3°)

### Soils:

Soil Texture: Clay loam

Soil Colour: Brown

Rock Type: N/A

### Coarse Surface Particles:

Site coverage: 50-90

Size: 2-6, 20-60, 6-20

Outcropping: 0

### Impacts:

Waterlogging: None

Erosion: -

Introduced species: N/A

Human disturbance: N/A

---

## FLORA AND VEGETATION DATA

### Description:

*Grevillea berryana* open low woodland over *Acacia ? ramulosa* hybrid tall shrubland over *Eriachne* very open tussock grassland.

### Species List

Species	Height	Cover
<i>Acacia ? ramulosa</i> hybrid	2.1	32
<i>Grevillea berryana</i>	6	2
<i>Eremophila jucunda</i> subsp. <i>Jucunda</i>	0.4	0.1
<i>Eriachne mucronata</i>	0.4	2
<i>Ptilotus schwartzii</i>	0.4	0.1
<i>Sida</i> sp. <i>Golden calyces glabrous</i> (H.N. Foote 32)	0.65	0.1
<i>Goodenia</i> sp.	0.2	0.1
<i>Neurachne minor</i>	0.25	0.1
<i>Fimbristylis dichotoma</i>	0.25	0.1
<i>Eremophila</i> sp.	0.15	0.1
<i>Euphorbiaceae</i> sp. indeterminate	0.3	0.1
<i>Eriachne pulchella</i>	0.08	0.1
<i>Psydrax latifolia</i>	0.15	0.1
<i>Malvaceae</i> sp. indeterminate	0.25	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
45	15	0	40

Veg Condition: Very Good

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: *Grevillea berryana*

### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB14

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 661173mE 7276735mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

### Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Red  
Rock Type: N/A

### Coarse Surface Particles:

Site coverage: 10-20  
Size: 2-6, 6-20  
Outcropping: 0

### Impacts:

Waterlogging: None  
Introduced species: N/A  
Erosion: -  
Human disturbance: Feral scats

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia* sp., *Acacia incurvaneura*, *Acacia kempeana* and *Acacia ramulosa* var. *linophylla* tall shrubland over *Eremophila forrestii* open shrubland.

### Species List

Species	Height	Cover
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	2	0.1
<i>Eremophila forrestii</i> subsp. ? <i>forrestii</i>	1.6	2
<i>Ptilotus schwartzii</i>	0.4	0.1
<i>Maireana</i> sp. indeterminate	0.1	0.1
<i>Fimbristylis dichotoma</i>	0.25	0.1
<i>Hibiscus</i> sp.	0.35	0.1
<i>Euphorbiaceae</i> sp.	0.1	0.1
<i>Acacia ramulosa</i> var. <i>linophylla</i>	2.1	2
<i>Tribulus suberosus</i>	0.4	0.1
<i>Psydrax latifolia</i>	1.5	0.1
<i>Solanum lasiophyllum</i>	0.25	0.1
<i>Acacia kempeana</i>	2.2	2
<i>Acacia incurvaneura</i>	1.8	5
<i>Acacia</i> sp.	5	25

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	62	3	35

Veg Condition: Very Good

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

### SITE PHOTOGRAPH





# Galena Minerals – Abra – AB15

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 659896mE 7272650mN

## Environmental Variables:

Landform: Floodplain  
Slope: Gently inclined (3-5°)

### Soils:

Soil Texture: River sand  
Soil Colour: Brown  
Rock Type: Quartzite

### Coarse Surface Particles:

Site coverage: 50-90  
Size: 2-6, 20-60, 200-600, 6-20, 60-200  
Outcropping: 20-50

### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: N/A

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis*, *Corymbia ? ferriticola* low woodland over *Acacia ? ramulosa* hybrid open tall shrubland over *Eriachne benthamii*, *Eriachne mucronata* and *Themeda triandra*.

### Species List

Species	Height	Cover
<i>Themeda triandra</i>	0.4	1.5
<i>Eriachne benthamii</i>	0.4	5
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	0.4	0.1
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0.5	0.1
<i>Corymbia ? ferriticola</i>	6.5	5
<i>Acacia citrinoviridis</i>	8	12
<i>Mirbelia rhagadioides</i>	0.4	0.1
<i>Eriachne mucronata</i>	0.4	2
<i>Eremophila exillifolia</i>	0.45	0.1
<i>Hibiscus</i> sp.	0.35	0.1
<i>Fimbristylis dichotoma</i>	0.25	0.1
<i>Eremophila forrestii</i> subsp. <i>? forrestii</i>	0.65	0.1
<i>Acacia rhodophloia</i>	1.1	0.1
<i>Grevillea berryana</i>	2.1	0.1

Species	Height	Cover
<i>Acacia incurvaneura</i>	0.7	0.1
<i>Psydrax latifolia</i>	0.8	0.1
<i>Eremophila exillifolia</i>	0.65	0.1
<i>Eremophila</i> sp.	0.65	0.1
<i>Dodonaea petiolaris</i>	0.65	0.1
<i>Senna cuthbertsonii</i>	0.65	0.1
<i>Acacia ? ramulosa</i> hybrid	1.3	4

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
5	10	0	35

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

#### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB16

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## Site Details:

Described by: Alice Bott  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 660428mE 7272703mN

## Environmental Variables:

Landform: Creek

Slope: Level (0-3°)

### Soils:

Soil Texture: Sand  
Soil Colour: Orange brown  
Rock Type: Dolerite

### Coarse Surface Particles:

Site coverage: 2-10  
Size: 2-6, 6-20  
Outcropping: 50-90

### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: Feral trampling, Grazing, Tracks

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* open low woodland with *Corymbia candida* subsp. ? *dipsodes* and *Corymbia ? ferritcola* open tree mallee over *Acacia citrinoviridis* open shrubland over *Eriachne benthamii* and *Themeda triandra* very open grassland.

### Species List

Species	Height	Cover
<i>Corymbia candida</i> subsp. ? <i>dipsodes</i>	8	8
<i>Acacia citrinoviridis</i>	8	8
<i>Themeda triandra</i>	0.5	4
<i>Eriachne mucronata</i>	0.4	0.1
<i>Eriachne benthamii</i>	0.5	6
<i>Senna cuthbertsonii</i>	0.5	0.1
<i>Psyrax latifolia</i>	4	1
<i>Acacia aneura</i>	0.4	0.1
<i>Senna glaucifolia</i>	0.7	0.1
<i>Indigofera chamaeclada</i>	0.8	0.1
<i>Corymbia ? ferritcola</i>	6	6
<i>Eremophila exilifolia</i>	0.4	0.1
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0.7	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
55	10	8	40

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: No evidence, mature shrubs and trees and also grasses

### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB17

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 661094mE 7272853mN

## Environmental Variables:

Landform: Floodplain

Slope: Level (0-3°)

### Soils:

Soil Texture: River sand

Soil Colour: Brown

Rock Type: Quartzite

### Coarse Surface Particles:

Site coverage: 50-90

Size: 2-6, 20-60, 6-20, 60-200

Outcropping: 50-90

### Impacts:

Waterlogging: Prone to flooding

Erosion: -

Introduced species: N/A

Human disturbance: N/A

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## FLORA AND VEGETATION DATA

### Description:

*Corymbia ? ferritcola*, *Acacia citrinoviridis* open low woodland over *Hibiscus sturtii* var. *forrestii* open shrubland over *Eriachne benthamii*, *Themeda triandra* very open tussock grassland.

### Species List

Species	Height	Cover
<i>Corymbia ? ferritcola</i>	7	4
<i>Acacia citrinoviridis</i>	7	6
<i>Pluchea dentex</i>	0.25	0.1
<i>Cheilanthes</i> sp.	0.15	0.1
<i>Psydrax latifolia</i>	2.1	0.1
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.2	0.1
<i>Sporobolus australasicus</i>	0.15	0.15
<i>Cyperaceae</i> sp.	0.15	0.1
<i>Eriachne benthamii</i>	0.25	4
<i>Themeda triandra</i>	0.7	2
<i>Cyperus</i> sp.	0.2	0.1
<i>Sida ?</i> sp. <i>spiciform panicles</i> (E. Leyland 14/08/90)	0.6	0.1
<i>Abutilon</i> sp. indet	0.4	0.1
<i>Senna cuthbertsonii</i>	0.5	0.1

Species	Height	Cover
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0.55	2
<i>Acacia aneura</i>	1.7	0.1
<i>Dodonaea viscosa</i>	0.45	0.1
<i>Aristida contorta</i>	0.4	0.1
<i>Cymbopogon ambiguus</i>	0.7	0.1
<i>Ptilotus obovatus</i>	0.4	0.1
<i>Eremophila exilifolia</i>	0.45	0.1
<i>Acacia tetragonophylla</i>	0.5	0.1
<i>Acacia pruinocarpa</i>	0.45	0.1
<i>Senna glaucifolia</i>	0.45	0.1
<i>Eremophila</i> sp.	0.45	0.1
<i>Mirbelia rhagodioides</i>	0.45	0.1
<i>Acacia ? aptaneura</i>	6.5	2

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
70	5	2	23

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

#### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB18

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## Site Details:

Described by: Alice Bott  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 661138mE 7273481mN

## Environmental Variables:

Landform: Hill  
Slope: Gently inclined (3-5°)

### Soils:

Soil Texture: Clay loam  
Soil Colour: Orange  
Rock Type: Dolerite

### Coarse Surface Particles:

Site coverage: 50-90  
Size: 6-20  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: Tracks

---

## FLORA AND VEGETATION DATA

### Description:

*Grevillea berryana* open low woodland over *Acacia ? ramulosa* hybrid open shrubland over *Eremophila jucunda* subsp. *jucunda* open low shrubland over *Eriachne mucronata* open tussock grassland.

### Species List

Species	Height	Cover
<i>Acacia ? ramulosa</i> hybrid	1.8	8
<i>Ptilotus schwartzii</i>	0.4	0.1
<i>Eriachne mucronata</i>	0.2	12
<i>Eremophila jucunda</i> subsp. <i>Jucunda</i>	0.4	2
<i>Grevillea berryana</i>	3.1	2
<i>Eremophila exilifolia</i>	0.3	0.1
<i>Sida</i> sp. <i>Golden calyces glabrous</i> (H.N. Foote 32)	0.25	0.1
<i>Solanum lasiophyllum</i>	0.2	0.1
<i>Acacia citrinoviridis</i>	2.1	0.1
<i>Eremophila</i> sp.	1.2	0.1
<i>Fimbristylis dichotoma</i>	0.08	0.1
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0.6	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	10	1	25

Veg Condition: Very Good

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: No evidence

### SITE PHOTOGRAPH





# Galena Minerals – Abra – AB19

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## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 660835mE 7274826mN

## Environmental Variables:

Landform: Floodplain  
Slope: Gently inclined (3-5°)

### Soils:

Soil Texture: Loamy sand  
Soil Colour: Brown  
Rock Type: N/A

### Coarse Surface Particles:

Site coverage: <2  
Size: 2-6  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding  
Erosion: -  
Introduced species: N/A  
Human disturbance: N/A

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* low woodland over *Acacia ? aptaneura*, *Acacia ? ramulosa* hybrid, *Psyrdrax latifolia* tall shrubland over *Eremophila* sp. open shrubland over *Senna cuthbertsonii* low shrubland over *Eriachne helmsii* very open hummock grassland.

### Species List

Species	Height	Cover
<i>Acacia citrinoviridis</i>	7	20
<i>Psyrdrax latifolia</i>	5	12
<i>Senna cuthbertsonii</i>	0.5	25
<i>Grevillea berryana</i>	8	0.1
<i>Acacia ? ramulosa</i> hybrid	2.5	15
<i>Acacia ? aptaneura</i>	5	6
<i>Eremophila</i> sp.	1.3	5
<i>Triodia basedowii</i>	0.5	5
<i>Acacia kempeana</i>	0.9	0.1
<i>Duperreya commixta</i>	0	0.1
<i>Eremophila gielsii</i> subsp. <i>? variabilis</i>	2.5	0.1
<i>Eriachne benthamii</i>	0.3	0.1
<i>Psyrdrax suaveolens</i>	0.45	0.1

Species	Height	Cover
<i>Sida</i> sp. <i>Golden calyces glabrous</i> (H.N. Foote 32)	0.5	0.1
<i>Indigofera chamaeclada</i>	0.2	0.1
<i>Fimbristylis dichotoma</i>	0.2	0.1

#### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
2	30	3	65

Veg Condition: Excellent

Fire Age: 5 to 15 years

Weeds: None

Fire Notes: Tall mulga

#### SITE PHOTOGRAPH



# Galena Minerals – Abra – AB20

## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 661850mE 7274914mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

### Soils:

Soil Texture: Loamy sand  
Soil Colour: Orange  
Rock Type: N/A

### Coarse Surface Particles:

Site coverage: <2  
Size: N/A  
Outcropping: 0

### Impacts:

Waterlogging: Prone to flooding  
Introduced species: N/A  
Erosion: -  
Human disturbance: Feral scats, Feral trampling, Grazing, Tracks

## FLORA AND VEGETATION DATA

### Description:

*Acacia ? ramulosa* hybrid, *Acacia* sp. and *Acacia incurvaneura* open scrub.

### Species List

Species	Height	Cover
<i>Acacia incurvaneura</i>	4	8
<i>Acacia ? ramulosa</i> var. <i>ramulosa</i>	4	15
<i>Acacia</i> sp.	4	15
<i>Poaceae</i> sp. indeterminate	0.4	0.1
<i>Acacia citrinoviridis</i>	4	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	55	2	45

Veg Condition: Good  
Weeds: None  
Fire Age: 3 to 5 years  
Fire Notes: No evidence

**SITE PHOTOGRAPH**



# Galena Minerals – Abra – AB21

---

## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662157mE 7275003mN

## Environmental Variables:

Landform: Eroded plain sloping to watercourse  
Slope: Moderately inclined (5-15°)

### Soils:

Soil Texture: Clay loam with concretions  
Soil Colour: Red  
Rock Type: N/A

### Coarse Surface Particles:

Site coverage: 10-20  
Size: 2-6, 6-20  
Outcropping: 50-90

### Impacts:

Waterlogging: None  
Introduced species: N/A  
Erosion: -  
Human disturbance: Erosion, Feral scats, Grazing

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia pruinocarpa* open low woodland.

### Species List

Species	Height	Cover
<i>Acacia pruinocarpa</i>	4.5	2
<i>Psyrax latifolia</i>	0.8	0.1
<i>Acacia citrinoviridis</i>	0.8	0.1
<i>Eremophila</i> sp.	0.4	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	90	0	10

Veg Condition: Good  
Weeds: None  
Fire Age: Unknown (no evidence)  
Fire Notes: N/A

SITE PHOTOGRAPH



# Galena Minerals – Abra – AB22

---

## Site Details:

Described by: Crystal Heydenrych  
Date: 2018-04-29  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 662050mE 7275432mN

## Environmental Variables:

Landform: Floodplain

Slope: Level (0-3°)

### Soils:

Soil Texture: River sand

Soil Colour: Red

Rock Type: N/A

### Coarse Surface Particles:

Site coverage: <2

Size: 2-6, 6-20

Outcropping: 10-20

### Impacts:

Waterlogging: Prone to flooding

Erosion: -

Introduced species: N/A

Human disturbance: Erosion, Feral scats, Grazing

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* low woodland over *Acacia citrinoviridis*, *Acacia ? incurvaneura*, *Psydrax latifolia* tall shrubland over *Sida ? sp. spiciform panicles* (E. Leyland 14/08/90), *Senna cuthbertsonii* (*Hibiscus sturtii* var. *forrestii*) shrubland.

### Species List

Species	Height	Cover
<i>Psydrax latifolia</i>	2.5	2
<i>Senna cuthbertsonii</i>	0.5	4
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0.5	2
<i>Acacia citrinoviridis</i>	7.5	12
<i>Sida ? sp. spiciform panicles</i> (E. Leyland 14/08/90)	0.5	4
<i>Eriachne benthamii</i>	0.5	0.1
<i>Acacia incurvaneura</i>	5	4
<i>Dodonaea viscosa</i>	1.7	0.1
<i>Indigofera chamaeclada</i>	1.6	0.1
<i>Acacia kempeana</i>	1	0.1
<i>Santalum ? lanceolatum</i>	2.5	0.1

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	70	0	30

Veg Condition: Very Good

Fire Age: Unknown (no evidence)

Weeds: None

Fire Notes: N/A

### SITE PHOTOGRAPH





# Galena Minerals – Abra – Mn01

---

## Site Details:

Described by: Crystal Heydenrych

Date: 2018-04-29

Type: Quadrat (20m x 20m)

MGA Zone: 50J      659851mE      7272511mN

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## FLORA AND VEGETATION DATA

### Description:

*Grevillea berryana*, *Acacia ? ramulosa* hybrid tall shrubland over *Eremophila exilifolia*, *Eremophila jucunda* subsp. *jucunda* open low shrubland over *Eriachne mucronata* very open tussock grassland.

## SITE PHOTOGRAPH



# Galena Minerals – Abra – Mn02

---

## Site Details:

Described by: Crystal Heydenrych

Date: 2018-04-29

Type: Quadrat (20m x 20m)

MGA Zone: 50J          660209mE          7275109mN

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## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* low open woodland over *Acacia incurvaneura*, *Acacia citrinoviridis*, *Psydrax latifolia*, *Acacia ? ramulosa* var. *ramulosa* tall shrubland over *Hibiscus sturtii* var. *forrestii*, *Senna cuthbertsonii* low shrubland.

## SITE PHOTOGRAPH



# Galena Minerals – Abra – Mn03

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## Site Details:

Described by: Crystal Heydenrych

Date: 2018-04-29

Type: Quadrat (20m x 20m)

MGA Zone: 50J      660869mE      7275639mN

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## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* low open woodland over *Acacia incurvaneura*, *Acacia citrinoviridis*, *Psydrax latifolia*, *Acacia ? ramulosa* var. *ramulosa* tall shrubland over *Hibiscus sturtii* var. *forrestii*, *Senna cuthbertsonii* low shrubland.

Veg Condition: Excellent

## SITE PHOTOGRAPH



# Galena Minerals – Abra – Mn04

---

## Site Details:

Described by: Alice Bott

Date: 2018-04-29

Type: Quadrat (20m x 20m)

MGA Zone: 50J      661188mE      7276837mN

## Environmental Variables:

Landform: Drainage Line

## Impacts:

Human disturbance: Erosion, Feral trampling, Grazing, Tracks

---

## FLORA AND VEGETATION DATA

### Description:

*Acacia citrinoviridis* (*Grevillea berryana*) open low woodland over *Acacia citrinoviridis* and *Psydrax latifolia* tall shrubland over *Sida* ? sp. spiciform panicles (E. Leyland 14/08/90) open shrubland.

Veg Condition: Very Good

## SITE PHOTOGRAPH



# Galena Minerals – Abra – Mn05

---

## Site Details:

Described by: Alice Bott

Date: 2018-04-30

Type: Quadrat (20m x 20m)

MGA Zone: 50J 660418mE 7275732mN

## Environmental Variables:

Landform: Stony plain

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## FLORA AND VEGETATION DATA

Description:

Mosaic.

Veg Condition: Very Good

## SITE PHOTOGRAPH



# Galena Minerals – Abra – Mn06

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## Site Details:

Described by: Alice Bott  
Date: 2018-04-28  
Type: Quadrat (20m x 20m)  
MGA Zone: 50J 660363mE 7276708mN

## Environmental Variables:

Landform: Hill  
Slope: Moderately inclined (5-15°)

### Soils:

Soil Texture: Skeletal  
Soil Colour: Brown  
Rock Type: Dolerite

### Coarse Surface Particles:

Site coverage: 50-90  
Size: 200-600, 600-2000  
Outcropping: 10-20

### Impacts:

Waterlogging: None  
Introduced species: N/A  
Erosion: -  
Human disturbance: Tracks

---

## FLORA AND VEGETATION DATA

### Description:

*Grevillea berryana* open low woodland over *Acacia ? ramulosa var. ramulosa* shrubland over *Eremophila exilifolia* low open shrubland over *Eriachne mucronata* open tussock grassland.

### Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
60	5	2	50

Veg Condition: Excellent  
Weeds: None  
Fire Age: 5 to 15 years  
Fire Notes: No evidence, mature shrubs, grasses present

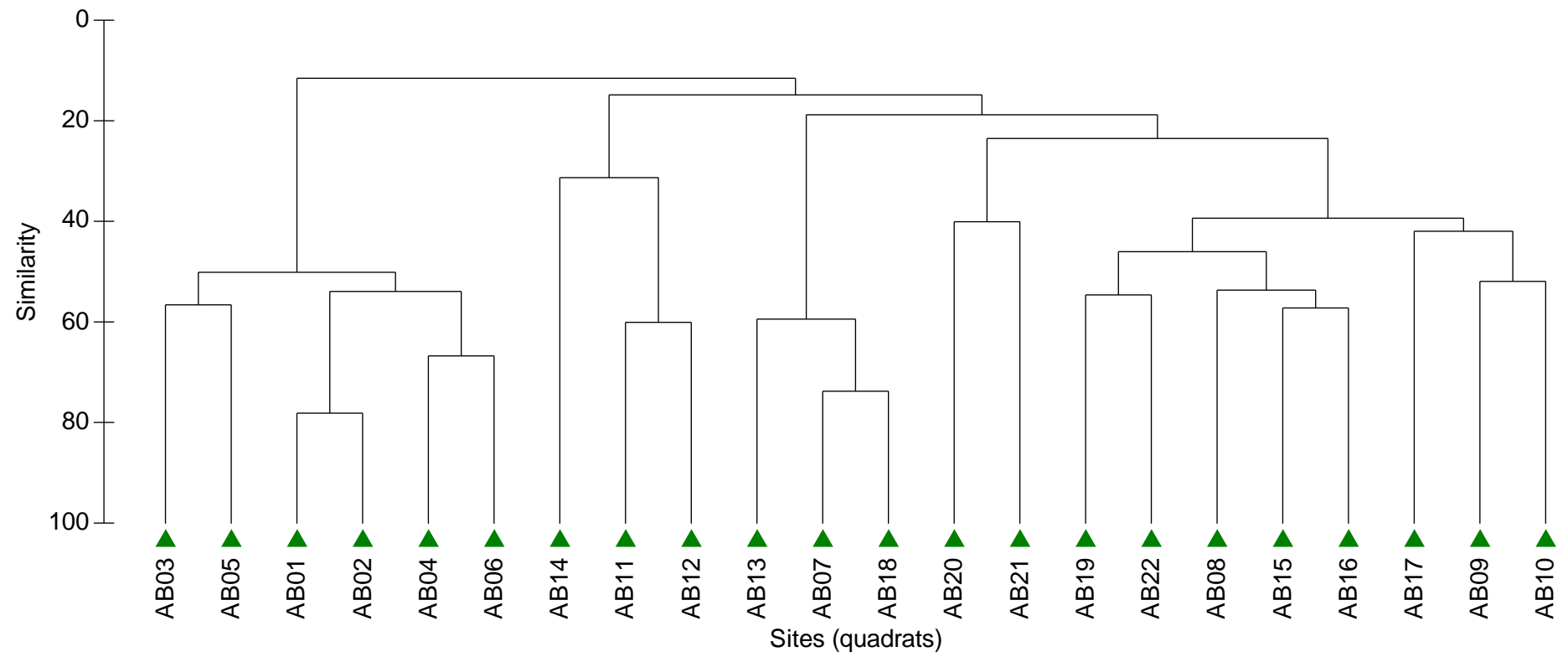
**SITE PHOTOGRAPH**



# Appendix G Floristic Community Structure

## G.1 Dendogram





## G.2 Site by Species Matrix

Species	AB01	AB02	AB03	AB04	AB05	AB06	AB07	AB08	AB09	AB10	AB11	AB12	AB13	AB14	AB15	AB16	AB17	AB18	AB19	AB20	AB21	AB22
<i>Abutilon cryptopetalum</i>	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia acradenia</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia aneura</i>	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0
<i>Acacia ayersiana</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia citrinoviridis</i>	1	1	1	1	1	1	0	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1
<i>Acacia incurvaneura</i>	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1	0	1
<i>Acacia kempeana</i>	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	1
<i>Acacia pruinocarpa</i>	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	1	0
<i>Acacia pyrifolia</i>	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia ramulosa</i> var. <i>linophylla</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
<i>Acacia rhodophloia</i>	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i>	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia sibirica</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
<i>Acacia tetragonophylla</i>	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
<i>Alternanthera nodiflora</i>	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Androcalva loxophylla</i>	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Aristida contorta</i>	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Bidens bipinnata</i>	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Boerhavia coccinea</i>	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Centipeda minima</i> subsp. <i>macrocephala</i>	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Cleome viscosa</i>	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Corchorus crozophorifolius</i>	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Corymbia candida</i> subsp. ? <i>dipsodes</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
<i>Cymbopogon ambiguus</i>	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Cyperus rigidellus</i>	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dipteracanthus australasicus</i> subsp. <i>australasicus</i>	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Dodonaea petiolaris</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
<i>Dodonaea viscosa</i>	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
<i>Duperreya commixta</i>	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
<i>Enneapogon robustissimus</i>	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eragrostis cumingii</i>	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eremophila exillifolia</i>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0
<i>Eremophila forrestii</i> subsp. ? <i>forrestii</i>	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eremophila gielsii</i> subsp. ? <i>variabilis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Eremophila jucunda</i> subsp. <i>jucunda</i>	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
<i>Eremophila latrobei</i> subsp. ?	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eremophila latrobei</i> subsp. <i>latrobei</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
<i>Eriachne benthamii</i>	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	1
<i>Eriachne mucronata</i>	1	1	0	0	0	0	1	1	0	0	0	0	1	0	1	1	0	1	0	0	0	0
<i>Eriachne pulchella</i>	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
<i>Eucalyptus victrix</i>	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Eulalia aurea</i>	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Euphorbia biconvexa</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0

Species	AB01	AB02	AB03	AB04	AB05	AB06	AB07	AB08	AB09	AB10	AB11	AB12	AB13	AB14	AB15	AB16	AB17	AB18	AB19	AB20	AB21	AB22
<i>Fimbristylis dichotoma</i>	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0
<i>Glycine canescens</i>	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Grevillea berryana</i>	0	0	0	0	0	0	1	0	1	1	0	0	1	0	1	0	0	1	1	0	0	0
<i>Grevillea stenobotrya</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Hibiscus sturtii</i> var. <i>forrestii</i>	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1
<i>Indigofera chamaeclada</i>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1
<i>Indigofera monophylla</i>	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Malvastrum americanum</i>	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Marsilea hirsuta</i>	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Melhania oblongifolia</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Mirbelia rhagodioides</i>	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
<i>Neurachne minor</i>	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
<i>Paraneurachne muelleri</i>	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Perotis rara</i>	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Pluchea dentex</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Polycarpha corymbosa</i>	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Polycarpha longiflora</i>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Psydrax latifolia</i>	0	0	0	0	1	1	0	1	1	0	0	0	1	1	1	1	1	0	1	0	1	1
<i>Psydrax suaveolens</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
<i>Pterocaulon sphaeranthoides</i>	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Ptilotus obovatus</i>	0	1	0	1	1	1	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0
<i>Ptilotus schwartzii</i>	0	1	0	0	0	0	1	0	0	1	1	0	1	1	0	0	0	1	0	0	0	0
<i>Rhynchosia minima</i>	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Salsola australis</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sclerolaena cornisheana</i>	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Senna artemisioides</i> subsp. <i>filifolia</i>	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	0	1	0	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Senna cuthbertsonii</i>	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	0	1	0	0	1
<i>Senna glaucifolia</i>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
<i>Senna stricta</i>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Setaria dielsii</i>	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sida</i> sp. Golden calyces glabrous (H.N. Foote 32)	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0
<i>Solanum lasiophyllum</i>	0	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
<i>Solanum sturtianum</i>	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sporobolus australasicus</i>	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
<i>Stemodia viscosa</i>	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tephrosia rosea</i> var. <i>clementii</i>	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Themeda triandra</i>	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
<i>Tribulus suberosus</i>	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
<i>Trichodesma zeylanicum</i>	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Triodia basedowii</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

# Appendix H Vertebrate Fauna Identified from the Desktop Assessment

## Legend:

A Current Survey

## Desktop Searches:

- B Birdata: Custom Atlas Bird List (Birdlife Australia 2017)
- C Threatened and Priority Fauna Database (DBCA 2017b)
- D NatureMap Database (DBCA 2018a)
- E Protected Matters Search Tool (DoEE 2018a)

## Literature Review

- F Gascoyne 3 (GAS3 - Augustus subregion) (Desmond *et al.* 2001)
- G Flora and Fauna Survey: Fortnum Project for Homestake Australia Limited (Dames and Moore 1988)
- H Desktop Vertebrate Fauna Assessment and Reconnaissance Survey of the Mulgul Project (Outback Ecology 2006)
- I Terrestrial fauna survey for the Beyondie Potash Project, Prepared for Kalium Lakes Ltd, Draft Report (Phoenix 2017)

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
<b>Amphibians</b>													
Hylidae	<i>Cyclorana maini</i>	Sheep Frog			x								x
	<i>Cyclorana platycephala</i>	Western Water-holding Frog						x					x
	<i>Litoria rubella</i>	Little Red Tree Frog			x			x					x
Limnodynastidae	<i>Neobatrachus aquilonius</i>	Northern Burrowing Frog											x
	<i>Neobatrachus sudellae</i>	Desert Trilling Frog											x
	<i>Neobatrachus sutor</i>	Shoemaker Frog											x
	<i>Notaden nichollsi</i>	Desert Spadefoot											x
Myobatrachidae	<i>Uperoleia micromeles</i>	Tanami Toadlet											x
<b>Birds</b>													
Acanthizidae	<i>Acanthiza apicalis</i>	Inland Thornbill			x	x		x				x	
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				x		x					
	<i>Acanthiza iredalei iredalei</i>									x			
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill				x		x					x
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill				x		x			x		x
	<i>Aphelocephala leucopsis</i>	Southern Whiteface				x		x					
	<i>Gerygone fusca</i>	Western Gerygone			x			x					x
	<i>Pyrrholaemus brunneus</i>	Redthroat				x		x					x
	<i>Smicronis brevirostris</i>	Weebill				x		x			x	x	x
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				x		x					
	<i>Accipiter fasciatus</i>	Brown Goshawk											x
	<i>Aquila audax</i>	Wedge-tailed Eagle				x		x			x		x
	<i>Elanus caeruleus</i>	Black-shouldered Kite											x
	<i>Haliastur sphenurus</i>	Whistling Kite				x		x					x
	<i>Hamirostra isura</i>	Square-tailed Kite									x		
	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard				x		x					x
	<i>Hieraaetus morphnoides</i>	Little Eagle											x
Alaudidae	<i>Mirafra javanica</i>	Horsfield's Bushlark											x
Alcedinidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher									x		
Anatidae	<i>Anas gracilis</i>	Grey Teal											x
	<i>Anas querquedula</i>	Garganey	Mi	S5			x						
	<i>Anas superciliosa</i>	Pacific Black Duck									x		
	<i>Cygnus atratus</i>	Black Swan											x
Apodidae	<i>Apus pacificus</i>	Fork-tailed Swift	Mi	S5					x				
Ardeidae	<i>Ardea modesta</i>	Eastern Great Egret					x		x				
	<i>Ardea novaehollandiae</i>	White-faced Heron									x		
	<i>Ardea pacifica</i>	White-necked Heron				x		x					x
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow			x	x		x				x	x
	<i>Artamus minor</i>	Little Woodswallow				x		x					
	<i>Artamus personatus</i>	Masked Woodswallow											x
Cacatuidae	<i>Cacatua roseicapilla</i>	Galah				x		x				x	x
	<i>Cacatua sanguinea</i>	Little Corella											x
	<i>Nymphicus hollandicus</i>	Cockatiel				x		x					
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				x		x					x
	<i>Coracina novaehollandiae subpallida</i>							x					

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Lalage tricolor</i>	White-winged Triller				x						x	
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar			x	x		x					
Charadriidae	<i>Charadrius melanops</i>	Black-fronted Dotterel						x					
	<i>Charadrius veredus</i>	Oriental Plover	Mi	S5					x				
	<i>Vanellus tricolor</i>	Banded Lapwing											x
Columbidae	<i>Geopelia cuneata</i>	Diamond Dove						x			x	x	
	<i>Geopelia striata</i>	Peaceful Dove				x		x					
	<i>Ocyphaps lophotes</i>	Crested Pigeon			x	x		x			x	x	x
	<i>Geophaps plumifera</i>	Spinifex Pigeon			x								
	<i>Phaps chalcoptera</i>	Common Bronzewing			x	x		x					
Corvidae	<i>Corvus bennetti</i>	Little Crow									x	x	
	<i>Corvus orru</i>	Torresian Crow			x						x		
Cracticidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird			x	x		x				x	x
	<i>Cracticus tibicen</i>	Australian Magpie			x	x		x			x		
	<i>Cracticus torquatus</i>	Grey Butcherbird				x		x			x		
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo									x		
	<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo									x		
Dromaiidae	<i>Dromaius novaehollandiae</i>	Emu				x		x			x		x
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch			x	x		x			x	x	x
Falconidae	<i>Falco berigora</i>	Brown Falcon				x		x				x	
	<i>Falco cenchroides</i>	Australian Kestrel			x	x		x			x	x	x
	<i>Falco peregrinus</i>	Peregrine Falcon		S7			x			x			
Hirundinidae	<i>Hirundo rustica</i>	Barn Swallow	Mi	S5					x				
	<i>Petrochelidon nigricans</i>	Tree Martin				x		x					
Locustellidae	<i>Megalurus cruralis</i>	Brown Songlark				x							
	<i>Megalurus mathewsi</i>	Rufous Songlark											x
Maluridae	<i>Malurus lamberti</i>	Variiegated Fairy-wren											x
	<i>Malurus leucopterus</i>	White-winged Fairy-wren											x
	<i>Malurus splendens</i>	Splendid Fairy-wren				x		x				x	
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				x		x			x	x	x
	<i>Certhionyx variegatus</i>	Pied Honeyeater				x		x				x	x
	<i>Epthianura tricolor</i>	Crimson Chat				x		x					
	<i>Gavicalis virescens</i>	Singing Honeyeater			x	x		x					x
	<i>Lacustroica whitei</i>	Grey Honeyeater						x					
	<i>Lichmera indistincta</i>	Brown Honeyeater									x		
	<i>Manorina flavigula</i>	Yellow-throated Miner				x		x					x
	<i>Melithreptus gularis</i>	Black-chinned Honeyeater											x
	<i>Ptilotula keartlandi</i>	Grey-headed Honeyeater											x
	<i>Ptilotula penicillatus</i>	White-plumed Honeyeater				x							x
	<i>Purnella albifrons</i>	White-fronted Honeyeater				x		x			x		x
	<i>Sugomel niger</i>	Black Honeyeater				x							x
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater					x		x		x		x
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark				x		x			x	x	x
Motacillidae	<i>Anthus australis</i>	Australian Pipit				x					x	x	x
	<i>Motacilla cinerea</i>	Grey Wagtail	Mi	S5					x				

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Motacilla flava</i>	Yellow Wagtail	Mi	S5					x				
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella										x	
Oreoicidae	<i>Oreoica gutturalis</i>	Crested Bellbird			x	x		x			x	x	x
Otididae	<i>Ardeotis australis</i>	Australian Bustard						x			x		x
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush			x	x		x				x	
	<i>Pachycephala rufiventris</i>	Rufous Whistler				x		x			x	x	x
Petroicidae	<i>Melanodryas cucullata</i>	Hooded Robin			x	x		x					x
	<i>Microeca fascinans</i>	Jacky Winter											x
	<i>Petroica goodenovii</i>	Red-capped Robin				x		x				x	
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant				x		x					
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail				x		x					
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler				x		x			x	x	
	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler				x		x					x
Psittacidae	<i>Melopsittacus undulatus</i>	Budgerigar				x		x				x	x
	<i>Neophema bourkii</i>	Bourke's Parrot									x		
	<i>Pezoporus occidentalis</i>	Night Parrot	En	S1			x	x	x				
	<i>Platycercus varius</i>	Mulga Parrot			x	x					x	x	
	<i>Platycercus zonarius</i>	Australian Ringneck			x	x		x			x	x	
	<i>Polytelis alexandrae</i>	Princess Parrot	Vu	P4			x		x	x			
Psophodidae	<i>Cinclosoma clarum</i>	Western Chestnut Quail-thrush						x				x	
	<i>Cinclosoma marginatum</i>	Western Quail-thrush						x					
	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush			x	x							
Ptilonorhynchidae	<i>Ptilonorhynchus maculatus guttatus</i>	Western Bowerbird										x	
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail			x	x		x			x	x	x
Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	S5					x				
	<i>Calidris ferruginea</i>	Curlew Sandpiper	Cr; Mi	S3; S5					x				
	<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	S5					x				
	<i>Calidris ruficollis</i>	Red-necked Stint	Mi	S5			x						
	<i>Tringa hypoleucos</i>	Common Sandpiper	Mi	S5					x				
	<i>Tringa nebularia</i>	Common Greenshank	Mi	S5			x						
Strigidae	<i>Ninox boobook boobook</i>	Southern Boobook									x		
Turnicidae	<i>Turnix velox</i>	Little Button-quail											x
<b>Mammals</b>													
Bovidae	<i>Bos taurus</i>	*European Cattle			x							x	x
Camelidae	<i>Camelus dromedarius</i>	*Camel							x		x		x
Canidae	<i>Canis familiaris</i>	*Dog			x			x	x				
	<i>Vulpes vulpes</i>	*Red Fox						x	x			x	x
Dasyuridae	<i>Dasyercus blythi</i>	Brush-tailed Mulgara		P4				x					x
	<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Vu	P4						x			
	<i>Dasykaluta rosamondae</i>	Little Red Kaluta											x
	<i>Dasyurus hallucatus</i>	Northern Quoll	En	S2					x				
	<i>Ningauai ridei</i>	Wongai Ningauai											x
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart											x
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart											x
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat											x



Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	
Equidae	<i>Equus asinus</i>	*Donkey							x			x	x	
	<i>Equus caballus</i>	*Horse							x					
Felidae	<i>Felis catus</i>	*Cat			x				x		x	x	x	
Leporidae	<i>Oryctolagus cuniculus</i>	*Rabbit							x		x	x	x	
Macropodidae	<i>Osphranter robustus erubescens</i>											x		
	<i>Osphranter rufus</i>	Red Kangaroo			x						x	x	x	
Megadermatidae	<i>Macroderma gigas</i>	Ghost Bat	Vu	S3					x					
Molossidae	<i>Austronomus australis</i>	White-striped Freetail-bat									x		x	
	<i>Chaerephon jobensis</i>	Greater Northern Freetail-bat											x	
	<i>Ozimops lumsdenae</i>	Northern Free-tailed Bat											x	
Muridae	<i>Mus musculus</i>	*House Mouse									x		x	
	<i>Notomys alexis</i>	Spinifex Hopping-mouse											x	
	<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse		P4			x	x				x		
	<i>Pseudomys desertor</i>	Desert Mouse											x	
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse											x	
	<i>Zyomys argurus</i>	Common Rock-rat										x		
Notoryctidae	<i>Notoryctes caurinus</i>	Northern Marsupial Mole		P4									x	
Rhinonycteridae	<i>Rhinonictis aurantius Pilbara form'</i>	Pilbara Leaf-nosed Bat	Vu	S3			x		x					
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna									x		x	
Thylacomyidae	<i>Macrotis lagotis</i>	Bilby	Vu	S3			x	x		x			x	
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat						x			x		x	
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat											x	
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat											x	
	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat											x	
<b>Reptiles</b>														
Agamidae	<i>Ctenophorus caudicinctus caudicinctus</i>						x							
	<i>Ctenophorus caudicinctus mensarum</i>				x		x							
	<i>Ctenophorus isolepis gularis</i>												x	
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon										x	x	
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon						x						
	<i>Ctenophorus scutulatus</i>											x	x	
	<i>Ctenophorus yinnietharra</i>	Yinnietharra Rock Dragon	Vu	S3						x				
	<i>Diporiphora paraconvergens</i>	Grey-striped Western Desert Dragon												x
	<i>Diporiphora valens</i>	Southern Pilbara Tree Dragon												x
	<i>Gowidon longirostris</i>	Long-nosed Dragon							x					x
	<i>Moloch horridus</i>	Thorny Devil									x			
	<i>Pogona minor minor</i>	Western Bearded Dragon												x
Carphodactylidae	<i>Nephrurus laevis</i>												x	
	<i>Nephrurus levis</i>												x	
Cheluidae	<i>Chelodina steindachneri</i>	Flat-shelled Turtle						x						
Diplodactylidae	<i>Diplodactylus conspicillatus</i>	Variable Fat-tailed Gecko											x	
	<i>Diplodactylus laevis</i>	Desert Fat-tailed Gecko											x	
	<i>Lucasium stenodactylum</i>										x		x	
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko											x	

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Strophurus ciliaris aberrans</i>												x
	<i>Strophurus elderi</i>							x					x
Elapidae	<i>Pseudechis australis</i>	Mulga Snake									x		x
	<i>Pseudonaja mengdeni</i>	Western Brown Snake											x
	<i>Simoselaps anomalus</i>	Desert Banded Snake											x
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake									x		
	<i>Suta fasciata</i>	Rosen's Snake						x					
Gekkonidae	<i>Gehyra punctata</i>							x					
	<i>Gehyra variegata</i>				x						x		x
	<i>Heteronotia binoei</i>	Bynoe's Gecko						x					x
Pygopodidae	<i>Delma nasuta</i>							x					
	<i>Lialis burtonis</i>							x					x
Pythonidae	<i>Aspidites melanocephalus</i>	Black-headed Python									x		
	<i>Liasis olivaceus barroni</i>	Pilbara Olive Python	Vu	S3					x				
Scincidae	<i>Ctenotus brooksi</i>												x
	<i>Ctenotus calurus</i>												x
	<i>Ctenotus grandis grandis</i>												x
	<i>Ctenotus hanloni</i>												x
	<i>Ctenotus inornatus</i>												x
	<i>Ctenotus leae</i>												x
	<i>Ctenotus leonhardii</i>												x
	<i>Ctenotus pantherinus ocellifer</i>										x		x
	<i>Ctenotus quattuordecimlineatus</i>												x
	<i>Ctenotus schomburgkii</i>										x		x
	<i>Cyclodomorphus melanops</i>	Slender Blue-tongue						x					
	<i>Cyclodomorphus melanops melanops</i>												x
	<i>Egernia depressa</i>	Southern Pygmy Spiny-tailed Skink											x
	<i>Eremiascincus musivus</i>	Mosaic Desert Skink											x
	<i>Eremiascincus pallidus</i>	Western Narrow-banded Skink											x
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer											x
	<i>Lerista bipes</i>												x
	<i>Lerista ips</i>												x
	<i>Lerista macropisthopus remota</i>			P2									x
	<i>Lerista muelleri</i>											x	
<i>Lerista neander</i>							x						
<i>Lerista timida</i>							x						
<i>Morethia ruficauda exquisita</i>							x						
<i>Tiliqua multifasciata</i>	Central Blue-tongue												x
Typhlopidae	<i>Anilius endoterus</i>												x
Varanidae	<i>Varanus eremius</i>	Pygmy Desert Monitor											x
	<i>Varanus giganteus</i>	Perentie									x		
	<i>Varanus gouldii</i>	Sand Monitor									x	x	
	<i>Varanus panoptes</i>	Yellow-spotted Monitor											x
	<i>Varanus tristis tristis</i>	Racehorse Monitor									x		

**Perth**

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# ABRA AIRSTRIP: FLORA, VEGETATION AND FAUNA SURVEYS

PREPARED FOR **GALENA MINERALS LTD**

25 March 2019

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# Executive Summary

Galena Mining Limited proposes to develop a lead mining operation in the Gascoyne Region of Western Australia, entitled the Abra Base Metals Project. The Project is located approximately 220 kilometres north of Meekatharra and 180 kilometres southwest of Newman. Stantec Australia Pty Ltd has previously completed a Detailed flora and vegetation survey and Level 1 fauna survey of the Project area and has been appointed to undertake a Reconnaissance flora and vegetation survey and Level 1 fauna survey of a proposed air strip (the Study Area), located east of the Project. The Study Area covers 278 hectares and is located on Exploration Lease E52/1455, overlapping partially with the Project.

The desktop assessment identified 22 flora and 26 fauna species of conservation significance with potential to occur in the Study Area. No Threatened or Priority Ecological Communities were identified within the Study Area, and the nearest Priority Ecological Community is the Diorite Land System (Priority 3) located 16 km to the southwest.

The field survey took place between the 2<sup>nd</sup> and 5<sup>th</sup> of October 2018 and the Study Area was sampled by way of opportunistic collections, vegetation and fauna mapping and data collected from 16 relevés and two mapping notes. There were 55 vascular flora taxa recorded from the Study Area, representing 19 families and 26 genera, with no introduced flora recorded. The most represented plant families were Fabaceae (legumes), Poaceae (grasses) and Malvaceae (malvas) and the most represented genera were *Acacia* and *Eremophila*. No Threatened or Priority flora taxa were recorded during the field survey and none are considered 'likely' to occur.

Five vegetation types were identified, including two that overlapped with the adjacent Project. None of these vegetation types are analogous to any Threatened or Priority Ecological Communities. Vegetation condition was 'excellent' throughout the Study Area, with disturbances restricted to clearing for tracks and impacts from non-native fauna. No introduced flora species were recorded during the survey. The vegetation types recorded represent what would be expected from similar landforms in the broader Augustus subregion in which the Study Area occurs.

Three broad fauna habitats were identified within the Study Area; open shrubland on sandy plain, open shrubland on stony plain and drainage. All are considered widespread and of limited significance for potential conservation significant vertebrate fauna.

No fauna species of conservation significance were recorded during the current survey. One species of conservation significance, the Peregrine Falcon (S7), was considered 'possible' to occur based on species range and previous records. Although the Study Area does not contain suitable nesting habitat for the species, it may forage over the Study Area from time to time without being dependent on any particular habitat. The remaining species of conservation significance were assessed as 'unlikely' to occur in the Study Area.

# Galena Minerals Ltd

## Abra Airstrip: Flora, Vegetation and Fauna Surveys

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# 1. Introduction

## 1.1 Project Background and Location

Galena Mining Limited (Galena) propose to develop a lead mining operation entitled; the Abra Base Metals Project, located within the Gascoyne Region of Western Australia (WA), 220 kilometres (km) north of Meekatharra and 180 km southwest of Newman (**Figure 1-1**) (the Project). Stantec Australia Pty Ltd (Stantec) previously completed a Detailed flora and vegetation survey and Level 1 fauna survey of the Project area, covering 1,357 hectares (ha)(Stantec 2018). Subsequently, Galena has appointed Stantec to complete a Reconnaissance flora and vegetation survey and Level 1 fauna survey of a proposed air strip (the Study Area), located east of the Project, to inform an application for a Miscellaneous Licence. The Study Area is located on Exploration Lease E52/1455 and covers an area of 278 ha (**Figure 1-2**).

## 1.2 Report Scope and Objectives

The principal objectives of the Reconnaissance flora and vegetation survey and Level 1 fauna survey were to investigate and define the environmental values of the Study Area and to describe their conservation significance in relation to the Project. To achieve these objectives, the specific scope is detailed below:

- complete a desktop review (database searches and literature review), to develop a list of flora and fauna species and vegetation communities that have been previously recorded within, or in the vicinity of, the Project, including species and communities with the potential to be of conservation significance;
- conduct a Reconnaissance -level field survey to identify, describe and map vegetation types, vegetation condition and fauna habitats within the Study Area;
- conduct targeted searches for flora, vegetation communities and fauna of conservation significance, including species and communities of local and regional significance;
- develop a list of flora and fauna species recorded as occurring within the Project, including introduced flora and fauna species and
- assess the survey findings in a local and regional context by comparing them with available data from other localities within the bioregion.

The objectives and methods adopted for these surveys are aligned with the following relevant regulatory guidelines:

- Environmental Protection Authority (EPA) Environmental Factor Guideline: Flora and Vegetation (EPA 2016d);
- EPA Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016f);
- EPA Environmental Factor Guideline: Terrestrial Fauna (EPA 2016e);
- EPA Technical Guidance – Terrestrial Fauna Surveys (EPA 2016c);
- EPA Factor Guideline: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016b);
- Department of Environment Regulation (DER), A guide to the assessment of applications to clear native vegetation (DER 2014); and
- Department of the Environment (DoE), Matters of National Environmental Significance - Significant Impact Guidelines 1.1 EPBC Act (DoE 2013).

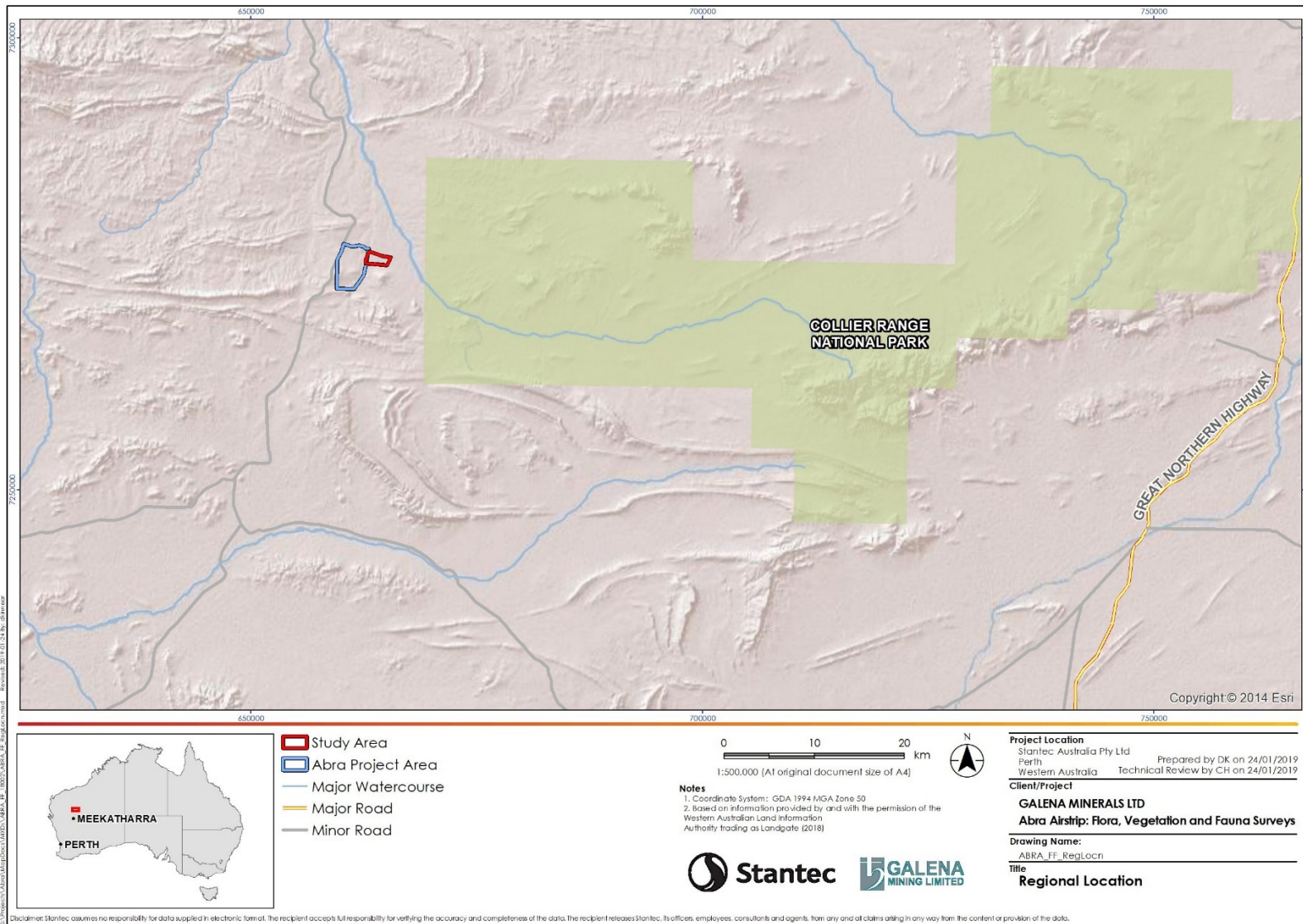


Figure 1-1: Regional locality of the Study Area

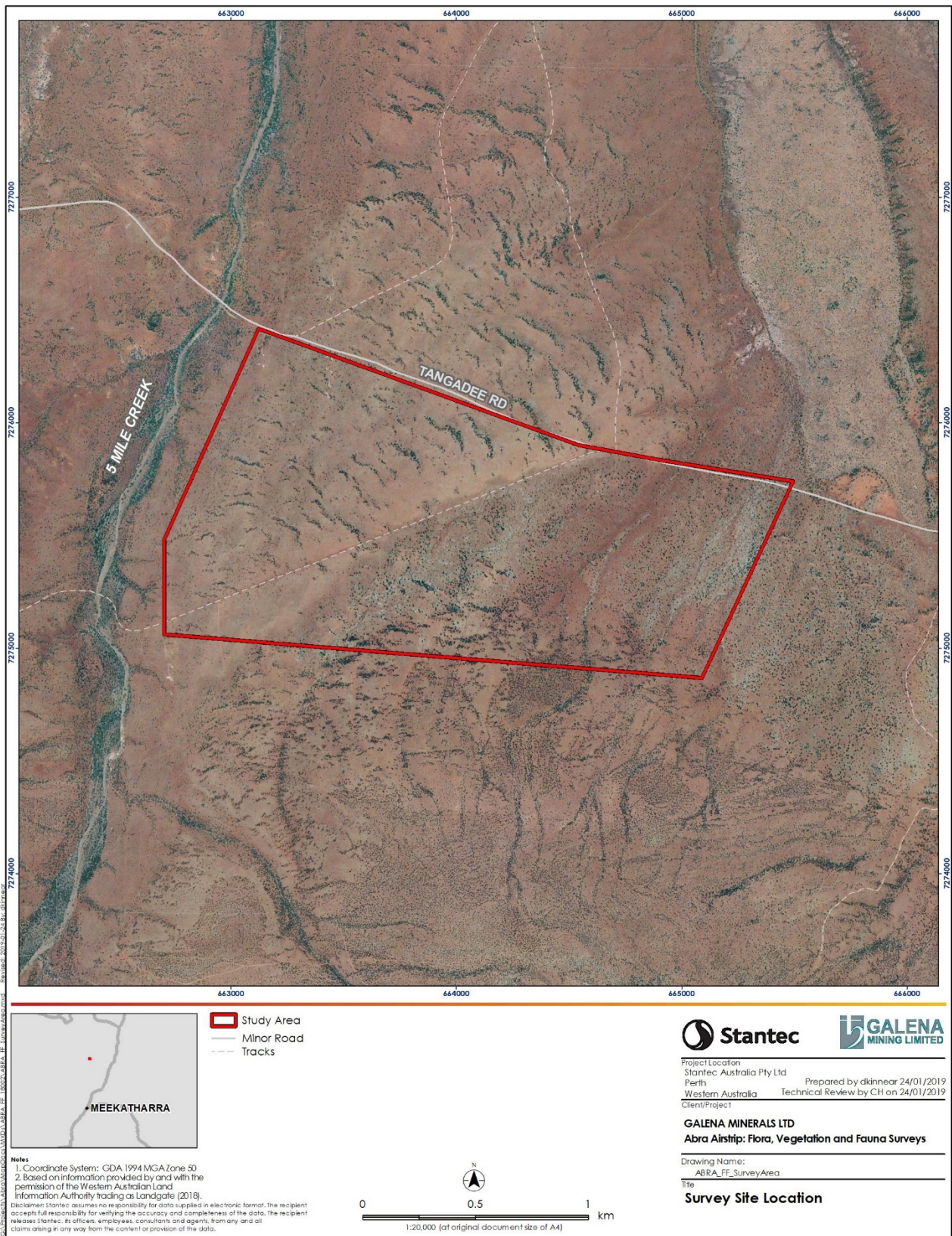


Figure 1-2: The Study Area

## 2. Existing Environment

### 2.1 Climate

The Study Area is located 178 km southwest of Newman within the Gascoyne region of Western Australia. The Gascoyne region typically receives low amounts of variable rainfall influenced by northern cyclonic events (GDC 2015).

Long-term rainfall data was collated from Neds Creek (007103) weather station for the period 1947 to 2018, approximately 139 km southeast of the Study Area and long-term temperature records have been collated from Newman Aerodrome (007176) weather station for the period 1966 to 2018 and Meekatharra Airport (007045) for the period 1950 to 2018, approximately 178 km northeast and 219 km south of the Study Area respectively (BoM 2018). The mean annual rainfall recorded at the Neds Creek weather station is 239 mm, with the majority received between January and March each year (**Figure 2-1**). Newman Aero has an annual average maximum temperature of 32.1°C and an annual average minimum temperature of 16.4°C (**Figure 2-1**). Meekatharra Airport has an annual average maximum temperature of 29.0°C and an annual average minimum temperature of 15.9°C (**Figure 2-2**).

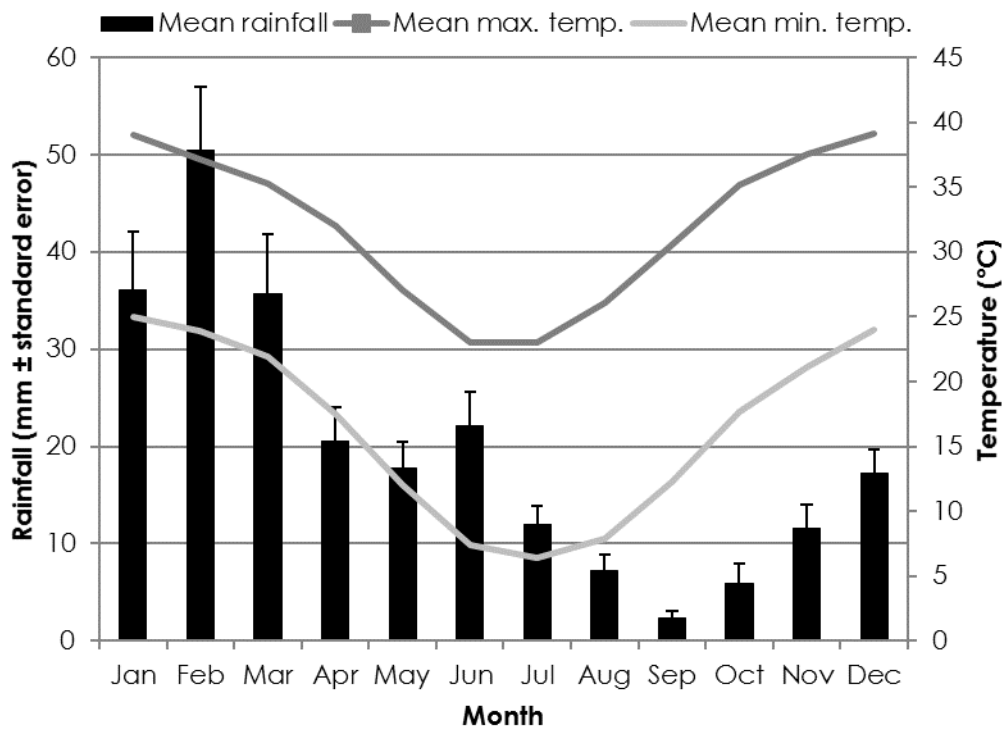


Figure 2-1: Long-term mean rainfall (mm) recorded at Neds Creek station (007103) and long-term maximum and minimum temperatures recorded at Newman Aero station (007176) (BoM 2018)

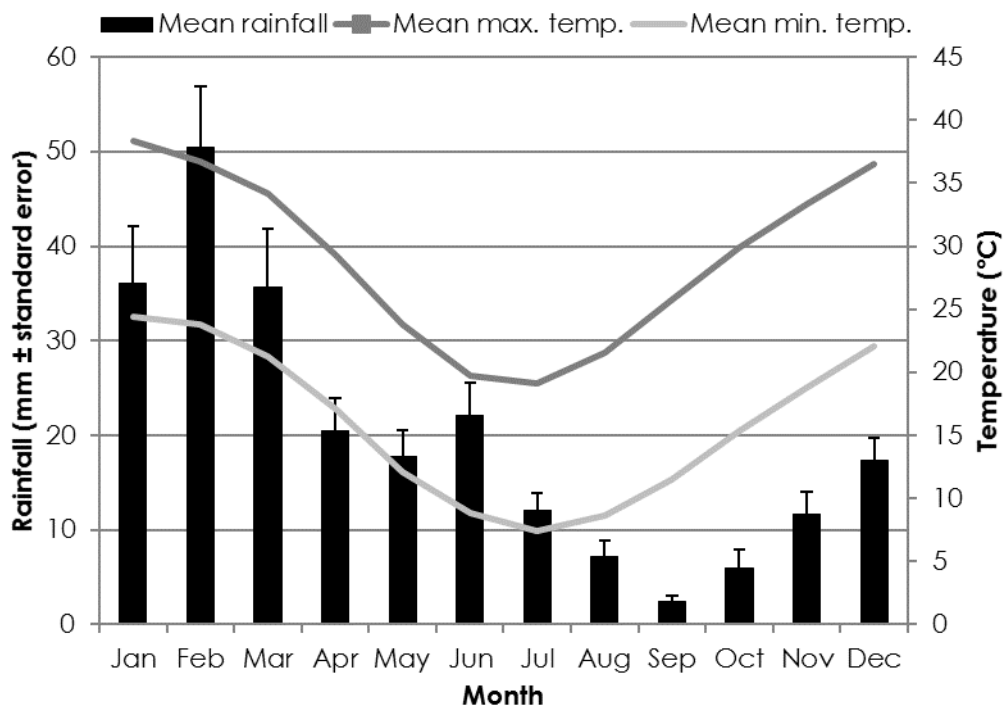


Figure 2-2: Mean rainfall (mm) recorded at Neds Creek station (007103) and long-term maximum and minimum temperatures recorded at Meekatharra Airport station (007045) (BoM 2018).

## 2.2 Landforms, Geology and Soils

The Study Area is located within the Mesoproterozoic Bangemall Basin and is the youngest of a series of sedimentary basins that unconformably lie over the Capricorn Orogen, a metamorphic terrain that represents amalgamation of the Yilgarn and Pilbara Cratons during the Paleoproterozoic (Payne *et al.* 1988). The Study Area lies within the south-eastern boundary of the Bangemall Geomorphic Province, as described by Payne *et al.* (1988). This province is 18,590 km<sup>2</sup> in size and forms the watershed between the Ashburton and Gascoyne Rivers. It consists predominantly of rugged mountains and hill and ridge country of Bangemall series Middle Proterozoic sedimentary rocks (Payne *et al.*, 1988).

The more weather-resistant rocks of the area, such as sandstone, form massive parallel ridges and ranges, predominantly trending northwest. The lower slopes, restricted valley plains and floors associated with the hills are covered with a dense surface strew of rock fragments of variable lithology. The sediments are frequently intruded by dolerite dykes and sills which are now exposed to form rounded hills and ridges. Soils include red shallow loams (often with hardpans), red loamy earths, stony soils and red deep sands with some red shallow sands (Tille 2006).

## 2.3 Land Systems

Land systems across the Gascoyne have been mapped by the Natural Resources Assessment Group of the former Department of Agriculture (now Department of Primary Industries and Regional Development, DPIRD) and provide a comprehensive description of biophysical resources within the area (Payne *et al.* 1988). The Study Area falls primarily within the Jamindie and Three Rivers Systems, with a small proportion occurring in the Collier System (Table 2-1; Figure 2-3).

Table 2-1: Land systems and their extent within the Study Area

Land System	Description	Extent within Study Area	
		Hectare (ha)	Percentage (%)
Jamindie System	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	123.73	44.5
Three Rivers System	Hardpan plains and minor sandy banks supporting sparse mulga shrublands.	146.22	52.6
Collier System	Undulating stony uplands, low hills, ridges, stony plains and drainage floors supporting mulga shrublands and some spinifex.	8.22	3
<b>Total</b>	-	<b>278.17</b>	<b>100</b>

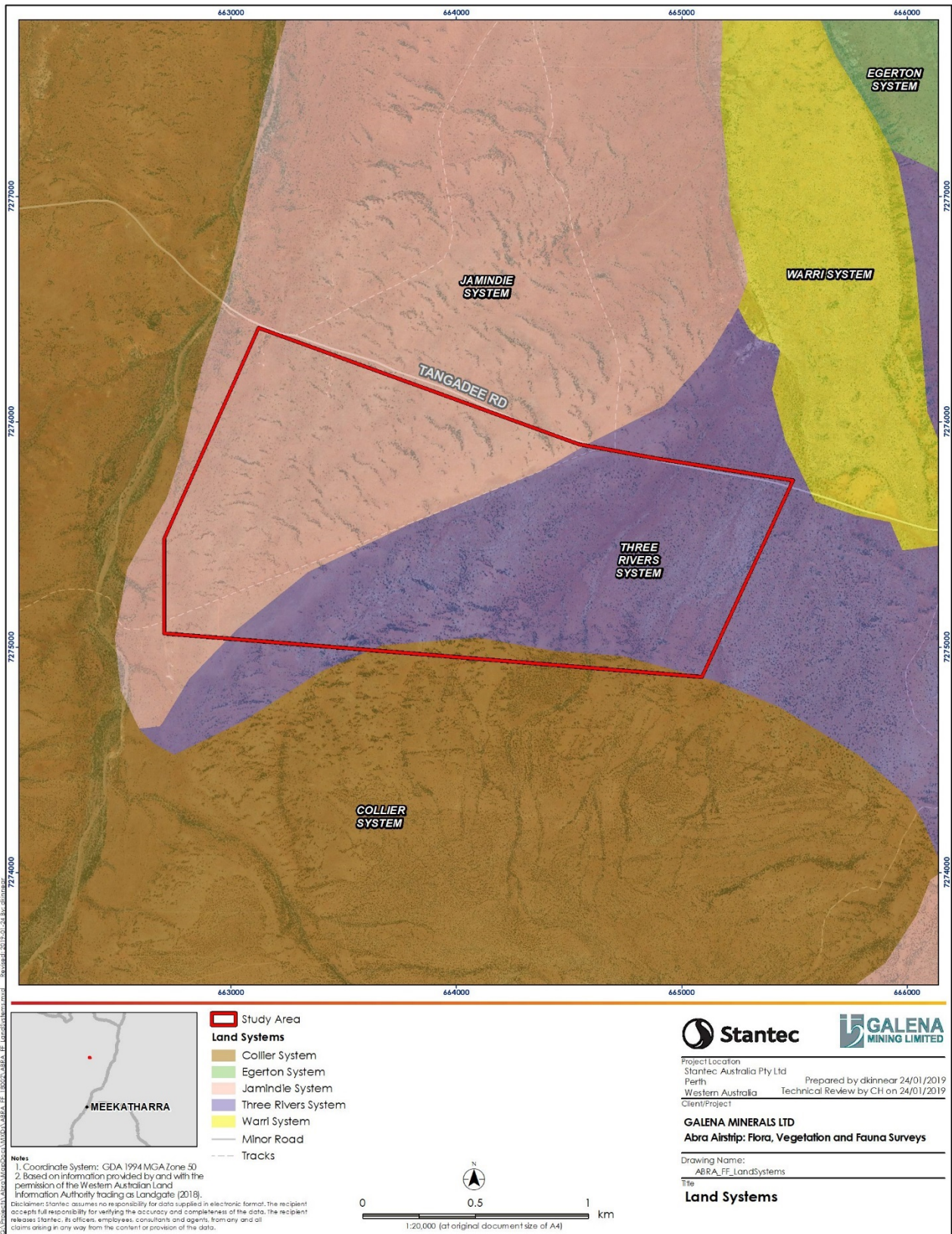


Figure 2-3: Land systems within and surrounding the Study Area

## 2.4 Surface Water and Hydrology

The main source of drainage within the Augustus subregion is the Gascoyne River system, however drainage is also provided by the Ashburton and Fortescue River headwaters (Desmond *et al.* 2001). The Gascoyne River reaches 760 km, flowing westward to drain into the Indian Ocean.

The Ashburton River and Ethel Creek, located immediately north and east of the survey area respectively, are seasonal watercourses with several permanent pools. A small tributary of the Ethel River, 5 Mile Creek, runs south to north to the west of the Study Area, coinciding with the Abra Project Area.

The drilling at the Project has some generalisations that can be made regarding the slope of the water table and the variable permeability of the lithologies. The relative elevation of the water table is estimated to slope gently from south to north from a range of <5 m to <15 m (Whitford *et al.* 1994). There appears to be some consistent spatial variation in the depth of the water table. It is relatively high in the southwest and appears to drop to the north and northeast. The mean groundwater flow should follow this slope, although on more local scales the anisotropic permeability of the rocks will probably result in a more complex pattern of groundwater movement (Whitford *et al.* 1994).

## 2.5 Biogeographic Region

The Interim Biogeographic Regionalisation for Australia (IBRA) is a bioregional framework that divides Australia into 89 biogeographic regions and 419 subregions on the basis of climate, geology, landforms, vegetation and fauna (Thackway and Cresswell 1995). It was developed through collaboration between state and territory conservation agencies with coordination by the Commonwealth Department of the Environment, Water, Heritage and the Arts (now the Commonwealth Department of the Environment and Energy, DoEE).

The Study Area is located in the Augustus subregion (GAS3) within the Gascoyne bioregion. The Augustus subregion makes up 10,687,739 ha and is classified as a Desert and Xeric Shrubland ecoregion, characterised by ranges separated by wide flat valleys (Desmond *et al.* 2001, DoEE 2013). Vegetation mainly consists of Mulga woodland over *Triodia* species on shallow stony loams and rises, and Mulga on shallow earthy loams over hardpan on plains (Hughes and Jones 2010).

## 2.6 Flora and Vegetation

The Study Area lies within the Ashburton Botanical District, as classified by Beard (1990). This district is almost entirely mulga (*Acacia aneura*) shrublands, sometimes with snakewood (*Acacia xiphophylla*) and other *Acacia* species as scrub on the hills, and as low woodland on the plains. Areas of dwarf scrub of *Eremophila* and *Senna* species also occur (Beard 1990).

### 2.6.1 Pre-European Vegetation

Vegetation mapping of Western Australia was completed on a broad scale (1:1,000,000 and 1:250,000) by Beard (1975a), who classified vegetation into broad vegetation associations. These vegetation associations were re-assessed by Shepherd *et al.* (2002) to account for clearing in the intensive land use zone, and to divide some larger vegetation units into smaller units. Additionally, Shepherd *et al.* (2002) developed a series of systems to assist in the removal of mosaics; however, some mosaics still occur. The Study Area has been mapped as 'low woodland; mulga (*Acacia aneura*), of the Gascoyne Ranges (Beard 1975a, Shepherd *et al.* 2002) (Table 2-2; Figure 2-4) (vegetation system associations described by Shepherd *et al.* (2002) correspond with that of Beard (1975a)). The current extent of this vegetation system association suggests that minimal land clearing has occurred across four scales of assessment (State, bioregion, subregion and Local Government Area (LGA) (Shire of Meekatharra) (Table 2-3).



Table 2-2: Vegetation system associations and their extent within the Study Area

System	System Code	Extent	Description
Gascoyne Ranges	18.5	278.17	Low woodland; mulga ( <i>Acacia aneura</i> )

Table 2-3: Vegetation system association extent remaining across four scales (State, Bioregion, Subregion and Local Government Area)

System	Scale	Pre-European Extent	Current Extent	% Remaining	Current extent within IUCN Class I-IV Reserves (ha)	% of current extent protected within IUCN Class I-IV Reserves
Gascoyne Ranges 18	State-wide	1,812,659.31	1,811,127.15	99.92	16,344.03	0.9
	Bioregion	1,794,574.24	1,793,131.87	99.92	16,344.03	0.9
	Sub-region	1,777,829.40	1,776,387.03	99.92	16,344.03	0.9
	LGA	918,276.87	916,753.77	99.83	16,214.53	1.77

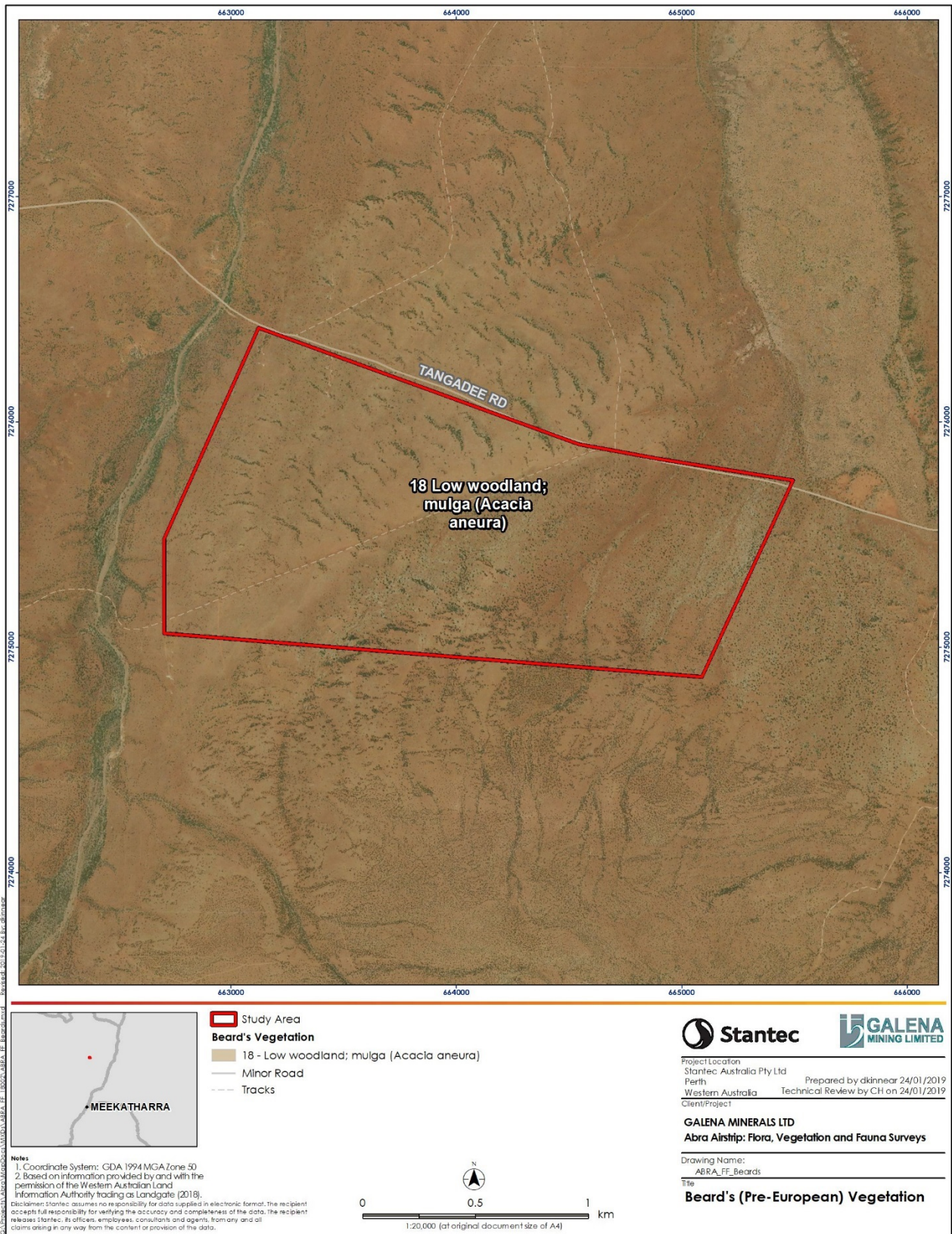


Figure 2-4: Pre-European vegetation associations of the Study Area

## 2.7 Land Use and Tenure

### 2.7.1 Land Use

The majority of land within the Gascoyne is used for pastoral purposes, with leases covering 84% of the area (GDC 2015) and only smaller areas serving horticultural or mining purposes (GDC 2015). The Study Area lies within the Mulgul Pastoral Lease with cattle grazing occurring across Galena's leases. The Project was previously known as the Mulgul which was acquired by Galena from Abra Mining Limited.

### 2.7.2 Conservation Reserves and Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the *Environmental Protection Act 1986* (EP Act) to prevent incremental degradation of important environmental values such as declared rare flora, threatened ecological communities (TECs) or significant wetlands.

The Study Area lies approximately 3.8 km west of Collier Range National Park, which is managed by the Department of Biodiversity, Conservation and Attractions (DBCA). The reserve was established due to the potential value of hills and freshwater pools serving as refuge from fire and harsh arid conditions (Desmond *et al.* 2001). Collier Range National Park receives annual baiting for wild dogs and is visited by staff, however there is limited information available regarding the biodiversity of the area (Desmond *et al.* 2001). Significant damage has been recorded from feral donkeys and cattle and there is no current fire regime (Desmond *et al.* 2001).

## 3. Methodology

### 3.1 Desktop Assessment

A desktop assessment, comprising a review of database searches and a literature review, was undertaken prior to the field surveys to gather contextual information on the Study Area. The purpose of the desktop assessment was to identify flora, vegetation and terrestrial fauna potentially occurring in the Study Area, in particular species of conservation significance.

#### 3.1.1 Database Searches

Database searches, conducted in January 2018 for the Project (Stantec 2018), were utilised to generate a list of vascular flora, vegetation communities and vertebrate fauna previously recorded within, and in the vicinity of the Study Area.

Eight database searches were conducted from a central coordinate (50J, 660525 m E, 7273300 m S) (**Table 3-1**). Appropriate search buffers were selected based on the technical capabilities of each of the databases and the ecological features of the area.

Conservation significance and conservation rankings used under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act 2016* (BC Act), as well as by the DBCA, are defined in **Appendix A**.

**Table 3-1: Database searches conducted for the desktop assessment**

Custodian	Database	Ecological Group	Reference	Buffer (km)
DoEE	Protected Matters Search Tool (PMST)	Matters of National Environmental Significance (MNES) flora and fauna	DoEE (2018a)	100
DBCA	NatureMap	Flora and fauna	(DBCA 2018b)	40
DBCA	Threatened and Priority Ecological Communities	Vegetation communities	(DBCA 2018a)	50
DBCA	Threatened and Priority Flora Database	Flora	(DBCA 2018d)	50
DBCA	Threatened and Priority Species List (TP List)	Flora	(DBCA 2018a)	50
DBCA	Western Australian herbarium Flora	Flora	(DBCA 2018e)	50
DBCA	Threatened and Priority Fauna Database	Fauna	(DBCA 2018a)	100
Birdlife Australia	Birdlife Bird data	Fauna	(Birdlife Australia 2018)	50

#### 3.1.2 Literature Review

Background information on the Study Area and surrounds was compiled to provide broad, contextual knowledge of the vegetation and habitats likely to be encountered in the Study Area. Historic vegetation mapping conducted by Beard (1975b, 1990), Shepherd *et al.* (2002), soil and landform mapping (Payne *et al.* 1988), IBRA classification system information (Desmond *et al.* 2001) and previous flora and fauna surveys conducted in the area. Previous survey reports were only considered if they were publicly available and undertaken in close proximity to the Study Area. As available relevant and recent literature for the locality was relatively limited, studies that preceded more recent work were reviewed to supplement the literature review.

#### 3.1.3 Likelihood of Occurrence of Flora and Fauna

Prior to undertaking the field survey, the conservation significant species identified from the database searches and literature review were assessed for likelihood of occurrence within the Study Area, based on interpretation of habitat types from aerial imagery and the nearest known location of each species. Each species of conservation significant flora and vertebrate fauna in the Study Area was assessed and ranked for occurrence in the Study Area according to the following definitions:

**Confirmed** – the presence of the species in the Study Area has been recorded unambiguously during the last ten years (i.e. during recent surveys of the Study Area or from reliable records obtained via database searches);

**Very Likely** – the Study Area lies within the known distribution of the species and is likely to contain suitable habitat(s), the species generally occurs in suitable habitat and has been recorded nearby within the last 20 years;

**Likely** – the Study Area lies within the known distribution of the species and the species has been recorded nearby within the last 20 years; however, either:

- the Study Area is likely to contain only a small area of suitable habitat, or habitat that is only marginally suitable; or
- the species is generally rare and patchily distributed in suitable habitat;

**Possible** – there is an outside chance of occurrence, because:

- the Study Area is just outside the known distribution of the species, but is likely to contain suitable and sufficient habitat (the species may be common, rare, or patchily distributed); or
- the Study Area lies within the known distribution of the species, but the species is very rare and/or patchily distributed; or
- the Study Area lies on the edge of, or within, the known distribution and is likely to contain suitable habitat, but the species has not been recorded in the area for over 20 years;

**Unlikely** – the Study Area lies outside the known distribution of the species, the Study Area is unlikely to contain suitable habitat, and the species has not been recorded in the area for over 20 years.

Following the field survey, the conservation significant flora species identified from the database searches and literature review were re-assessed to determine the likelihood of occurrence within the Study Area.

## 3.2 Survey Methodology

### 3.2.1 Survey Timing

The EPA (EPA 2016f) recommends that flora and vegetation surveys be undertaken following the season of highest rainfall to optimise the likelihood of encountering flowering and fruiting taxa and capturing ephemeral species. The recommended survey timing for the Eremaean botanical province, within which the Study Area lies, is six to eight weeks following the wet season (March to June). The field survey was undertaken between the 2<sup>nd</sup> and 5<sup>th</sup> of October 2018, which falls outside of the recommended survey season for the region. Annual rainfall in the 12 months preceding the field survey was 51.2 mm below the average annual rainfall of 187.8 mm (1947 to 2018) (**Figure 3-1**).

It is possible that some of the annual and ephemeral flora taxa that could potentially occur in the Study Area may not have been recorded during the field survey, as they may have senesced or lacked flowering and fruiting parts needed for identification. However, there were no flora of conservation significance that were considered as 'likely' to occur, based on the desktop assessment, that could not be identified from vegetative material owing to their perennial life form.

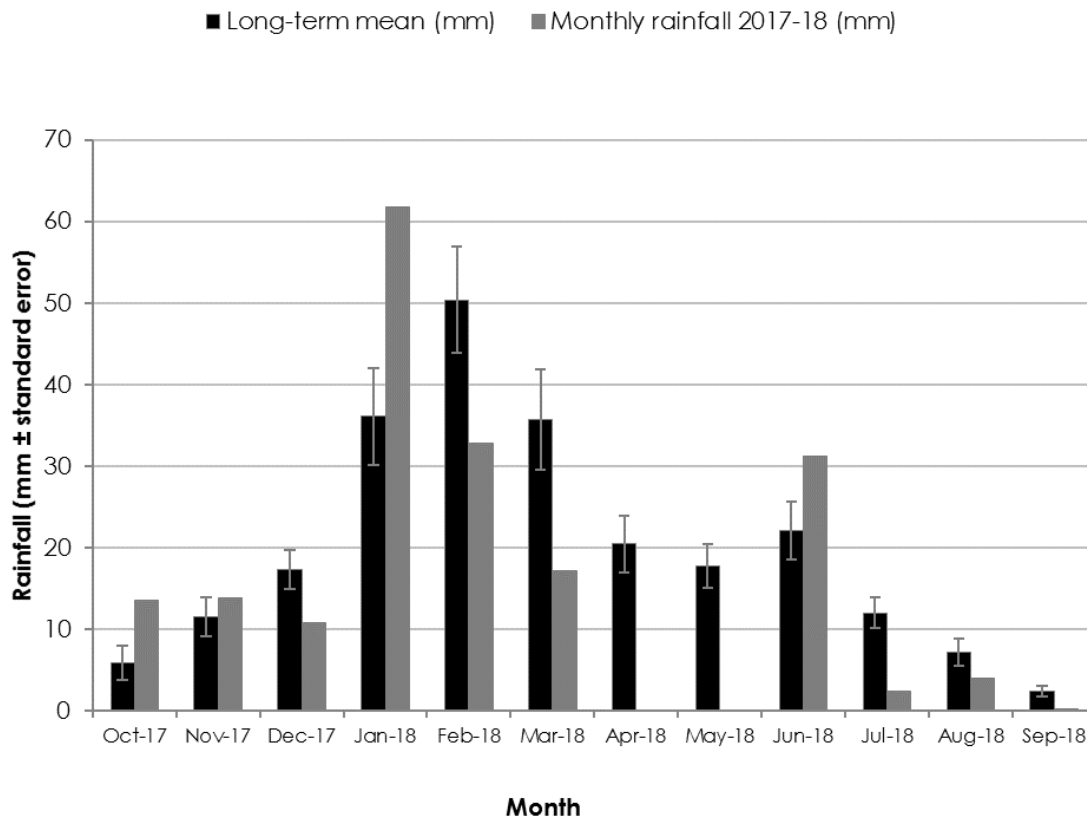


Figure 3-1: Long-term mean monthly rainfall (1947 to 2018) and actual rainfall received at Neds Creek weather station (007103) in the six months preceding the field survey (October)

### 3.2.2 Survey Team and Licensing

The field survey was led by Alice Bott (senior botanist) with support from Shane Chalwell (senior botanist). Alice is an experienced arid-zone botanist, with extensive experience spanning over nine years conducting vegetation and flora surveys in WA and was the technical lead for the field survey. All plant collections were taken under flora collecting permit SL012377 pursuant to the Biodiversity Conservation Act 2016. In addition, Alice holds a permit to collect Declared Rare Flora (license no. 145A-1718) for herbarium identification purposes.

### 3.2.3 Flora and Vegetation Assessment

Prior to the field survey, broad vegetation types were mapped on aerial imagery based on vegetation signatures and landscape features. Proposed sampling locations were identified prior to the field survey and according to the estimated number of vegetation types within the Study Area. These habitats were assessed in the field and a reconnaissance-level flora and vegetation survey, consistent with EPA (2016a), was employed to sample the flora and vegetation within the Study Area.

Sixteen relevés (unbounded sampling sites) and two mapping notes were sampled to compile a representative species list and to characterise the vegetation types identified. Where possible, vegetation types were reconciled to the vegetation types previously identified in (Stantec 2018) for the Abra Project. The remainder of the Study Area was traversed on foot and via vehicle to map vegetation types and to sample flora opportunistically. **Table 3-2** presents the information that was recorded at each relevé.

Table 3-2: Summary of data recorded at each relevé

Parameter	Description
Relevé ID	The unique name that was assigned to the site that was sampled
Recorder and Date	The recorder(s) involved in sampling the relevé and date
Coordinates	Measured using a handheld GPS device in GDA94 format
Site photograph	At least one landscape photograph taken of the site
Soil description	A description of the soil colour and types based on the guide in the Australian Soil and Land Survey Field Handbook
Geology type	A description of the outcropping geology (if present) and course fragments
Habitat type	A description of the landform type and aspect
Vegetation Condition	Assessed according to the Trudgen vegetation condition scale ( <b>Appendix B</b> ).
Vascular flora species	A record of each flora species present
Height	The average height of each species in meters
Percent Foliar Cover (PFC)	An estimate of the PFC for each species will be recorded
Reconciled vegetation type	Where applicable, the vegetation will be assigned to a vegetation code from previous surveys undertaken adjacent to the Study Area
Vegetation structure	A description of the vegetation in accordance with the National Vegetation Information System (NVIS), Level 5 – Association (NVISTWG 2017) based on height and foliar cover of strata ( <b>Appendix C</b> ).
Disturbances	A list of any disturbances in the relevé area, if present.
Time since fire	An estimation of the time since the vegetation was last burnt.

### 3.2.3.1 Targeted Survey

Targeted searches were conducted for conservation significant flora identified from the desktop assessment (**Section 3**). Field personnel familiarised themselves with photographs, reference samples and descriptions of these taxa before the survey and actively searched for them in and around relevés and while traversing the Study Area. Where flora of conservation significance was identified, a record was collected. The following information was collected for each population of conservation significant flora identified in the field:

Table 3-3: Summary of data collected for conservation significant flora species encountered

Parameter	Description
Coordinates	Measured using a handheld GPS device in GDA94 format
Recorder and Date	The recorder(s) involved in sampling the site and date.
ID of individual or pop	The unique name that was assigned to the individual or population that was sampled
Species	Species name
Specimen ID	A unique identifier code will be assigned to any species that cannot be identified in the field.
Abundance	A count of the species in a 50 m x 50 m area or; Estimate of density (PFC) within a mapped polygon (for large populations)
Reproductive characteristics	Whether the species is fruiting, flowering or vegetative.
Photograph	A photograph of the species showing reproductive characteristics (if present) and habitat/form

### 3.2.3.2 Vegetation Type and Condition Mapping

The broad vegetation type mapping that was completed during the desktop assessment was refined on maps in the field, where necessary, as a result of ground-truthing. Vegetation types were delineated and described from aerial imagery utilising the quadrat and mapping note data. The vegetation types have been described to Level V (Vegetation Association) in the NVIS hierarchical structure (ESCAVI 2003) (**Appendix C**). Vegetation condition was assigned based on the six categories described by (Trudgen 1988) (**Appendix B**).

### 3.2.4 Terrestrial Fauna Assessment

Broad fauna habitat assessments were undertaken at the flora sampling locations. **Table 3-4** presents the following key habitat parameters that were recorded at each fauna habitat assessment site.

Table 3-4: Summary of data collected at fauna habitat assessment sites

Parameter	Description
Habitat ID	The unique name that was assigned to the site that was sampled
Recorder and Date	The recorder(s) involved in sampling the relevé and date
Coordinates	Measured using a handheld GPS device in GDA94 format
Site photograph	At least one landscape photograph taken of the site
Fauna habitat features	An estimation of the amount of woody debris, leaf litter, peeling bark, burrowing suitability, tree hollows and SRE potential

The Study Area was traversed on foot with searches undertaken for fauna taxa of conservation significance.



## 4. Results and Discussion

### 4.1 Desktop Results

The results of the literature review are summarised in **Table 4-1** and **Table 4-2** for flora and fauna respectively. The literature review includes a summary of methods, size of the area surveyed, proximity to the current Study Area and year of the survey, along with key findings that may be relevant to the current study.

Table 4-1: Key findings of flora studies conducted within the vicinity of the Study Area

Reference	Study details	Proximity to Study Area	Vegetation Units	Flora Recorded	Vegetation Condition	Species and communities of conservation significance
Stantec (2018)	<u>Location:</u> the Project <u>Study Type:</u> Detailed flora and vegetation survey <u>Survey date:</u> May 2018 <u>Size of survey area:</u> 1, 357 ha	Immediately west of Study Area	Seven vegetation types comprised of: <ul style="list-style-type: none"> <li>• <i>Grevillea berryana</i> open low woodland over <i>Acacia ?ramulosa</i> var. <i>ramulosa</i> and <i>Acacia incurvaneura</i> tall shrubland to open scrub over <i>Eremophila forrestii</i> subsp. <i>?forrestii</i> open low shrubland.</li> <li>• <i>Acacia pruinocarpa</i> open tall shrubland to open low woodland over <i>Ptilotus obovatus</i> open low shrubland.</li> <li>• <i>Eucalyptus victrix</i> and <i>Acacia citrinoviridis</i> woodland to open tall woodland over <i>Tephrosia rosea</i> var. <i>clementii</i> low shrubland over <i>Cymbopogon ambiguus</i> and <i>Eulalia aurea</i> very open tussock grassland.</li> <li>• <i>Acacia citrinoviridis</i> open tall shrubland to open low woodland over <i>Acacia pyrifolia</i> open shrubland over <i>Tephrosia rosea</i> var. <i>clementii</i>, <i>Corchorus crozophorifolius</i> and <i>Senna artemisioides</i> subsp. <i>helmsii</i> low shrubland.</li> <li>• <i>Acacia citrinoviridis</i> and <i>Corymbia ?ferriticola</i> open low woodland over <i>Eriachne benthamii</i>, <i>Eriachne mucronata</i> and <i>Themeda triandra</i> very open tussock grassland.</li> <li>• Vegetation mosaic of mulga groves (<i>Acacia aneura</i> complex) and plains</li> <li>• <i>Grevillea berryana</i> open low woodland over <i>Acacia ?ramulosa</i> hybrid open shrubland to tall open shrubland over <i>Eremophila exillifolia</i> and <i>Eremophila jucunda</i> subsp. <i>jucunda</i> low shrubland over <i>Eriachne mucronata</i> very open tussock grassland to open tussock grassland.</li> </ul>	Taxa: 101 Families: 25 Genera: 58	'Degraded' to 'Excellent'	None
G & G Environmental Pty Ltd (2011)	<u>Location:</u> North-east of Newman – includes a rail corridor <u>Study Type:</u> Level 2 survey <u>Survey date:</u> October 2010 and March 2011 <u>Size of survey area:</u> 79 km (linear)	Approximately 200 km north-east of the Study Area	Forty-one vegetation formations were identified, comprised broadly of: <ul style="list-style-type: none"> <li>• Hummock Grasslands</li> <li>• Acacia forests and woodlands</li> <li>• Acacia open woodlands</li> <li>• Acacia shrublands</li> <li>• Other shrublands</li> <li>• Eucalypt woodlands</li> <li>• Tussock grasslands</li> <li>• Grasslands.</li> </ul>	Taxa: 340 Families: 46 Genera: 147	Very Good to Pristine (96% of vegetation was considered as Excellent to Pristine)	None
Outback Ecology (2006)	<u>Location:</u> Mining tenement M52/766; exploration tenement E52/1455. <u>Study Type:</u> Level 2 survey for M52/766 and level 1 reconnaissance survey for E52/1455. <u>Survey Date:</u> 26-30 June 2006 <u>Survey area size:</u> 1, 000 ha	Immediately west of Study Area	Twenty-one vegetation associations grouped according to the following landforms: major creekline, minor creeklines, stony plain and stony hills/ridgeline.	Taxa: 133 Families: 38 Genera: 81	Excellent to Degraded	None

Reference	Study details	Proximity to Study Area	Vegetation Units	Flora Recorded	Vegetation Condition	Species and communities of conservation significance
Desmond et al. (2001)	<p><u>Location:</u> Augustus subregion</p> <p><u>Study Type:</u> Government report (overview of priority flora in Augustus subregion)</p> <p><u>Survey Date:</u> Published 2001</p>	Regional assessment	N/A	N/A	N/A	<ul style="list-style-type: none"> <li>• <i>Acacia wilcoxii</i> (P1);</li> <li>• <i>Eremophila arguta</i> (P1);</li> <li>• <i>Eremophila flaccida</i> subsp. <i>attenuata</i>;</li> <li>• <i>Eremophila gracillima</i> (P3);</li> <li>• <i>Eremophila lanata</i> (P3);</li> <li>• <i>Eremophila prolata</i> (P1);</li> <li>• <i>Eremophila rigida</i> (P3);</li> <li>• <i>Goodenia berringbinensis</i> (P4);</li> <li>• <i>Hemigenia pachyphylla</i> (P1);</li> <li>• <i>Homalocalyx chapmanii</i> (P2);</li> <li>• <i>Pityrodia augustensis</i> (VU);</li> <li>• <i>Ptilotus luteolus</i> (P3);</li> <li>• <i>Ptilotus lazaridis</i> (P3);</li> <li>• <i>Ptilotus trichocephalus</i> (P4);</li> <li>• <i>Rhodanthe frenchii</i> (P2) and</li> <li>• <i>Stylidium weeliwolli</i> (P3).</li> </ul>
Dames and Moore (1988)	<p><u>Location:</u> Fortnum Project, 40km northwest of Peak Hill</p> <p><u>Study Type:</u> Level 1 survey</p> <p><u>Survey Date:</u> 28-30 September 1988</p> <p><u>Size of survey area:</u> 1, 200 ha</p>	80 km south of Study Area	N/A	Taxa: 59	N/A	None

Table 4-2: Key findings of fauna studies conducted within the vicinity of the Study Area

Reference	Study Details	Proximity to Study Area	Fauna Habitats	Fauna Assemblages Recorded	Species of Conservation Significance
Stantec (2018)	<u>Location</u> : the Project <u>Study Type</u> : Level 1 fauna survey <u>Survey date</u> : May 2018 <u>Size of survey area</u> : 1, 357 ha	Immediately west of Study Area	Five fauna habitats were identified: <ul style="list-style-type: none"> <li>• Banded mulga on plain;</li> <li>• Riparian;</li> <li>• Open shrubland on stony plain;</li> <li>• Drainage; and</li> <li>• Gully.</li> </ul>	27 taxa including: <ul style="list-style-type: none"> <li>• 22 families</li> <li>• 26 genera</li> </ul>	None
Phoenix (2017)	<u>Location</u> : Beyondie Potash Project <u>Study Type</u> : Level 2 survey including systematic trapping, motion cameras, bat recording units, and targeted searches <u>Survey Date</u> : 13-23 April 2015 <u>Size of survey area</u> : 19, 588.5 ha	170 km east of Study Area	Ten fauna habitats were identified: <ul style="list-style-type: none"> <li>• Shrubland and Grassland on Sandplain;</li> <li>• Woodland on Stony Plain;</li> <li>• Salt Lake;</li> <li>• Rocky Hill;</li> <li>• Shrubland and Grassland Mosaic on Sandplain and Dune;</li> <li>• Shrubland and Grassland on Dune;</li> <li>• Freshwater Lake;</li> <li>• Creek and Drainage Line;</li> <li>• Shrubland and Grassland on Calcrete; and</li> <li>• Woodland on Dune.</li> </ul>	128 taxa including: <ul style="list-style-type: none"> <li>• 55 families</li> <li>• 98 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Brush-tailed Mulgara (P4)</li> <li>• Bilby (Vu, S3)</li> <li>• Northern Marsupial Mole (P4)</li> <li>• <i>Lerista macropisthopus remota</i> (P2)</li> </ul>
Outback Ecology (2006)	<u>Location</u> : Mining tenement M52/776. <u>Study Type</u> : Level 1 survey. <u>Survey Date</u> : 26-30 June 2006 <u>Survey area size</u> : 1, 000 ha	Immediately west of Study Area	Four fauna habitats were identified: <ul style="list-style-type: none"> <li>• Hills and Ridges;</li> <li>• Stony Uplands;</li> <li>• Stony Plains and</li> <li>• Drainage lines.</li> </ul>	41 taxa including: <ul style="list-style-type: none"> <li>• 31 families</li> <li>• 37 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pebble-mound Mouse (P4, disused mounds recorded)</li> </ul>
Desmond et al. (2001)	<u>Location</u> : Augustus subregion <u>Study Type</u> : Government report (overview of priority fauna in Augustus subregion) <u>Survey Date</u> : Published 2001	Overview of Augustus subregion	Habitats associated with priority fauna include: <ul style="list-style-type: none"> <li>• Low Mulga Woodland;</li> <li>• Open Mulga Woodland;</li> <li>• Sparse, low Mulga Woodland;</li> <li>• Mulga Scrublands;</li> <li>• Hummock Grassland (Mulga and <i>Eucalyptus</i> over <i>Triodia</i>)</li> </ul>	6 taxa including: <ul style="list-style-type: none"> <li>• 6 families</li> <li>• 6 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Crest-tailed Mulgara (Vu, P4)</li> <li>• Bilby (Vu, S3)</li> <li>• Peregrine Falcon (S7)</li> <li>• Princess Parrot (Vu, P4)</li> <li>• Yinnietharra Rock Dragon (Vu, S3)</li> </ul>
Dames and Moore (1988)	<u>Location</u> : Fortnum Project, 40km northwest of Peak Hill <u>Study Type</u> : Level 1 survey <u>Survey Date</u> : 28-30 September 1988 <u>Size of survey area</u> : 1, 200 ha	78.9 km south of Study Area	Two fauna habitats were identified: <ul style="list-style-type: none"> <li>• Low Mulga Woodland on Hills; and</li> <li>• Sparse Mulga Woodland on Plains.</li> </ul>	53 taxa including: <ul style="list-style-type: none"> <li>• 38 families</li> <li>• 47 genera</li> </ul>	<ul style="list-style-type: none"> <li>• Western Pebble-mound Mouse (P4, disused mounds recorded)</li> </ul>

### 4.1.1 Flora

A total of 22 flora taxa of conservation significance were recorded from the desktop assessment (**Appendix D**). One taxon, *Pityrodia augustensis*, is listed as Vulnerable under the BC Act, seven taxa were listed as Priority 1, three were listed as Priority 2, nine were listed as Priority 3 and two were listed as Priority 4. The likelihood of occurrence of these taxa within the Study Area was assessed based on the criteria detailed in **Section 3.1.3**. Two taxa were considered 'likely' to occur (*Eremophila gracillima* [P3] and *Eremophila humilis* [P31]), four taxa were considered as 'possible' to occur (two P1 taxa and two P3 taxa) and the remaining 16 taxa of conservation significance were considered 'unlikely' to occur within the Study Area.

The threatened species, *Pityrodia augustensis*, was detected via the PMST, which listed the species or species habitat as 'likely to occur within the area' (DoEE 2018a). A review of the recorded specimens of this taxa held by the WA Herb indicates that the closest record of this species is over approximately 150 km west of the Study Area (WAH 2018). The species was not recorded during previous surveys within the vicinity of the Study Area, however, was included in the subregion overview, which provides context rather than data specific to the Study Area (**Section 3.1.2**).

The species *Acacia tuberculata*, *Eremophila appressa*, *Eremophila coacta*, *Owenia acidula*, *Ptilotus actinocladius* T.Hammer & R.W.Davis and *Thysanotus* sp. Desert East of Newman (R.P. Hart 964) were listed on the DBCA TP List, which is searched according to place names rather than coordinates. A review of the recorded specimens held by the WA Herb indicates that all of the above taxa records within the last 20 years do not occur in close proximity to the Study Area; the closest of these occurs greater than 90 km from the Study Area, with some occurring over 200 km from the Study Area (WAH 2018). Further to this, these species have not been recorded during any previous surveys within the vicinity of the Project or Study Area (**section 3.1.2**)

### 4.1.2 Vegetation

No TECs or PECs were identified from the Threatened and Priority Ecological Community database (DBCA 2018a) or the DoEE PMST (DoEE 2018a) as occurring within the Project or Study Area. One PEC occurs in close proximity to the Study Area, the Diorite Land System (P3), which is located just under 16 km to the southwest (Figure 1-1). The Diorite Land System consists of low bald or sparse *Acacia* shrublands on basaltic domes and low rough hills. Desmond *et al.* (2001) lists 19 ecosystems that are at risk within the Augustus subregion. Several of the ecosystems include invertebrate assemblages of river pools and springs that are restricted and do not occur in the Study Area (Desmond *et al.* 2001). The remaining ecosystems include terrestrial vegetation, however they are restricted to landforms or habitat that do not occur within the Study Area (e.g. plant assemblages of Robinson Range) (Desmond *et al.* 2001).

### 4.1.3 Fauna

The desktop study identified 219 species of vertebrate fauna which have been recorded and/or have the potential to occur within the Study Area (**Appendix E**). This total comprises 27 native mammal, nine introduced mammal, 112 native bird, 63 native reptile, and eight amphibian species. Many of these species are unlikely to occur in the Study Area because, as is leading practice, these records have been collected from a large area encompassing a wide range of habitats, many of which do not occur within the Study Area. Furthermore, some small, common, ground-dwelling reptile and mammal species tend to be patchily distributed even where appropriate habitats are present, and many species of bird can occur as regular migrants, occasional visitors or vagrants.

Of the 219 species of vertebrate fauna identified during the desktop, 26 species are listed as being of conservation significance, comprising eight mammals, 15 birds and three reptiles (**Table 4-3**).

Table 4-3: Fauna of conservation significance identified during the desktop assessment

Species Name	Common Name	EPBC <sup>1</sup>	WA <sup>1</sup>
Birds			
<i>Anas querquedula</i>	Garganey	Mi	S5
<i>Apus pacificus</i>	Fork-tailed Swift	Mi	S5
<i>Charadrius veredus</i>	Oriental Plover	Mi	S5
<i>Falco peregrinus</i>	Peregrine Falcon		S7
<i>Hirundo rustica</i>	Barn Swallow	Mi	S5
<i>Motacilla cinerea</i>	Grey Wagtail	Mi	S5
<i>Motacilla flava</i>	Yellow Wagtail	Mi	S5
<i>Pezoporus occidentalis</i>	Night Parrot	En	S1
<i>Polytelis alexandrae</i>	Princess Parrot	Vu	P4
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	S5
<i>Calidris ferruginea</i>	Curlew Sandpiper	Cr; Mi	S3; S5
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	S5
<i>Calidris ruficollis</i>	Red-necked Stint	Mi	S5
<i>Tringa hypoleucos</i>	Common Sandpiper	Mi	S5
<i>Tringa nebularia</i>	Common Greenshank	Mi	S5
Mammals			
<i>Dasyercus blythi</i>	Brush-tailed Mulgara		P4
<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Vu	P4
<i>Dasyurus hallucatus</i>	Northern Quoll	En	S2
<i>Macroderma gigas</i>	Ghost Bat	Vu	S3
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse		P4
<i>Notoryctes caurinus</i>	Northern Marsupial Mole		P4
<i>Rhinonicteris aurantius Pilbara form'</i>	Pilbara Leaf-nosed Bat	Vu	S3
<i>Macrotis lagotis</i>	Bilby	Vu	S3
Reptiles			
<i>Ctenophorus ynnietharra</i>	Ynnietharra Rock Dragon	Vu	S3

Species Name	Common Name	EPBC <sup>1</sup>	WA <sup>1</sup>
<i>Liasis olivaceus barroni</i>	Pilbara Olive Python	Vu	S3
<i>Lerista macropisthopus remota</i>			P2

1= Conservation codes and descriptions are detailed within **Appendix A**.

## 4.2 Field Survey Results

### 4.2.1 Flora Composition

A total of 55 flora taxa (including subspecies, varieties and forms) were recorded from the Study Area, representing 19 families and 26 genera (**Appendix F**). Of these, five could not be identified confidently beyond family level and two could not be identified confidently to genus level, due to insufficient material for identification. The most represented families were Fabaceae (legumes), Poaceae (grasses) and Malvaceae (malvas) and the most represented genera were *Acacia* (wattles) with ten individuals, *Eremophila* (poverty bush) with eight individuals and *Dodonaea*, *Eriachne*, *Senna* and *Ptilotus* with three individuals (**Table 4-4**). Three of the *Acacia* species recorded within the Study Area belong to the Western Australian Mulga Flora Group (*Acacia aneura* F.Muell. ex Benth. and its close relatives) (Maslin and Reid 2012).

Table 4-4: Families and genera most represented in the Study Area

Family	Total taxa
Fabaceae	13
Poaceae	10
Malvaceae	8
Genus	Total taxa
<i>Acacia</i>	10
<i>Eremophila</i>	8
<i>Dodonaea</i> , <i>Eriachne</i> , <i>Senna</i> and <i>Ptilotus</i>	3

### 4.2.2 Flora of Conservation Significance

Despite extensive sampling and targeted searching, no state or Commonwealth listed Threatened flora or DBCA listed Priority flora were recorded within the Study Area.

#### 4.2.2.1 Post-survey Likelihood of Occurrence of Conservation Significant Flora

Following the field survey, with a greater understanding of the habitat types that occur within the Study Area, all Threatened and Priority flora species recorded from the desktop assessment are considered as 'unlikely' to occur. Species that were considered as 'likely' or 'possible' to occur in the desktop assessment have a perennial lifeform and it is unlikely that, if present, they would have gone unnoticed at the time of the survey. In addition, none of these species would be restricted to the Study Area as indicated by the vouchered records listed by the WAH (WAH 2018).

#### 4.2.2.2 Flora of Other Significance

The EPA advises that flora species, subspecies, varieties, hybrids and ecotypes may be considered significant for reasons other than listing as a Threatened or Priority Flora taxa, and may include the following:

- a keystone role in a particular habitat for Threatened taxa, or supporting large populations representing a significant proportion of the local regional population of a species;
- relic status;
- anomalous features that indicate a potential new discovery;
- being representative of the range of a species (particularly at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- the presence of restricted subspecies, varieties, or naturally occurring hybrids;
- local endemism/a restricted distribution; and/or
- being poorly reserved.

Based on these parameters, none of the native vascular flora taxa recorded from the Study Area during the field survey are of 'other' significance. The native vascular flora taxa recorded from the Study Area are all represented in the local and regional area and no unique taxa were recorded.

#### 4.2.2.1 Introduced Flora

Introduced flora species were compared to the Western Australian Organisms List (WAOL) (Department of Agriculture and Food WA (DAFWA)) to determine if any have been listed as declared pest and the Weeds of National Significance (WoNS) list. No introduced flora taxa were recorded from the Study Area.

### 4.2.3 Vegetation

A total of five vegetation types were identified in the Study Area (**Table 4-5; Figure 4-1**). In general, the vegetation of the Study Area consisted of mixed *Acacia* open shrublands over a mid-layer of predominantly *Eremophila* spp. over a very open tussock grass layer on stony to sandy plains. The most extensive vegetation type was a mosaic of two vegetation types also recorded in the Abra Project Area: GbArrAiEf/GbArrExEjjEm and occupied just under 50% of the Study Area.



Minor branches of the Five Mile Creek, a small tributary of the Ethel River, occurs in the north-western border of the Study Area, representing the AcAcPISpSchs vegetation type also recorded in the Abra Project Area. The AiAcEspp occurs in ephemeral drainage that runs through the eastern section of the Study Area.



#### 4.2.3.1 Vegetation Condition


With the exception of a previously cleared access track (3%), vegetation condition of the Study Area was assessed as 'excellent' (**Figure 4-2**). Minor disturbances were identified in the form of feral scats, trampling and grazing, however, vegetation structure remained intact and no weed species were recorded.



Table 4-5: Summary of Vegetation Types recorded in the Survey Area

Vegetation type code	Vegetation Type Description	Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
AcAcPISpSchs	<p><i>Acacia citrinoviridis</i> (<i>Grevillea berryana</i>) low woodland over <i>Acacia citrinoviridis</i> and <i>Psydrax latifolia</i> (<i>Acacia aneura</i> and <i>Acacia ?ramulosa</i> var. <i>ramulosa</i>) tall shrubland over <i>Sida ?sp.</i> spiciform panicles (E. Leyland 14/08/90), <i>Senna cuthbertsonii</i> and <i>Hibiscus sturtii</i> var. <i>forrestii</i> open shrubland to shrubland</p> <p><u>Associated species:</u>  <i>Acacia incurvaneura</i>, <i>Acacia kempeana</i>, <i>Aristida contorta</i>, <i>Cheilanthes sieberi</i>, <i>Eremophila forrestii</i> subsp. <i>?forrestii</i>, <i>Eriachne benthamii</i>, <i>Eriachne pulchella</i> subsp. <i>pulchella</i>, <i>Fimbristylis dichotoma</i>, <i>Hibiscus coatesii</i>, and <i>Solanum lasiophyllum</i>.</p>	AAr02 AAr03 AAr04	1.53	0.6	
AiAcEspp	<p><i>Acacia incurvaneura</i> and <i>Acacia citrinoviridis</i> tall open shrubland over <i>Eremophila</i> spp. open shrubland.</p> <p><u>Associated species:</u>  <i>Acacia ramulosa</i> var. <i>ramulosa</i>, <i>Acacia rhodophloia</i>, <i>Acacia tetragonophylla</i>, <i>Eragrostis eriopoda</i>, <i>Grevillea berryana</i>, <i>Psydrax latifolia</i>, <i>Ptilotus schwartzii</i> and <i>Senna</i> sp. Meekatharra (E. Bailey 1-26).</p>	AAr12 AAr13 AAr14 AAmn02	7.35	2.6	

Vegetation type code	Vegetation Type Description	Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
GbArrAiEf/GbArrExEjEm	<p>Mosaic of:</p> <p><b>A-</b> <i>Grevillea berryana</i> open low woodland over <i>Acacia ?ramulosa</i> var. <i>ramulosa</i> and <i>Acacia incurvaneura</i> tall shrubland to open scrub over <i>Eremophila forrestii</i> subsp. <i>?forrestii</i> open low shrubland and;</p> <p><b>B-</b> <i>Grevillea berryana</i> open low woodland over <i>Acacia ?ramulosa</i> hybrid open shrubland to tall open shrubland over <i>Eremophila exilifolia</i> and <i>Eremophila jucunda</i> subsp. <i>jucunda</i> low shrubland over <i>Eriachne mucronata</i> very open tussock grassland to open tussock grassland.</p> <p><u>Associated species:</u>  <i>Acacia citrinoviridis</i>, <i>Acacia kempeana</i>, <i>Acacia ramulosa</i> var. <i>linophylla</i>, <i>Acacia rhodophloia</i>, <i>Aristida contorta</i>, , <i>Eriachne pulchella</i> subsp. <i>pulchella</i> and <i>Ptilotus schwartzii</i></p>	AAr01 AAr05 AAr06	131.44	47.3	
AiArrEfEe	<p><i>Acacia incurvaneura</i> and <i>Acacia ramulosa</i> var. <i>ramulosa</i> tall open shrubland over <i>Eremophila forrestii</i> open shrubland over <i>Eragrostis eriopoda</i> very open tussock grassland.</p> <p><u>Associated species:</u>  <i>Acacia citrinoviridis</i>, <i>Acacia kempeana</i>, <i>Acacia pruinocarpa</i>, <i>Acacia pteraneura</i>, <i>Acacia ramulosa</i> var. <i>linophylla</i>, <i>Acacia rhodophloia</i>, <i>Aristida contorta</i>, <i>Eremophila ?granitica</i>, <i>Eremophila citrina</i>, <i>Eremophila fraseri</i>, <i>Eremophila spectabilis</i>, <i>Eriachne mucronata</i>, <i>Eriachne pulchella</i> subsp. <i>pulchella</i>, <i>Grevillea berryana</i>, <i>Marsdenia australis</i>, <i>Psyrax latifolia</i>, <i>Ptilotus obovatus</i>, <i>Ptilotus schwartzii</i>, <i>Senna</i> sp. <i>Meekatharra</i> (E. Bailey 1-26), <i>Sida</i> sp. <i>Golden calyces</i> and <i>Solanum lasiophyllum</i>.</p>	AAr07 AAr08 AAr09 AAr15	74.94	26.9	

Vegetation type code	Vegetation Type Description	Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
ArlApEsppEe	<p><i>Acacia ramulosa</i> var. <i>linophylla</i> and <i>Acacia pteraneura</i> tall shrubland over <i>Eremophila</i> spp. low shrubland over <i>Eragrostis eriopoda</i> open tussock grassland.</p> <p><u>Associated species:</u>  <i>Acacia incurvaneura</i>, <i>Acacia ramulosa</i> var. <i>ramulosa</i>, <i>Acacia rhodophloia</i>, <i>Aristida contorta</i>, <i>Grevillea berryana</i>, <i>Senna artemisioides</i> subsp. <i>helmsii</i>, <i>Senna</i> sp. Meekatharra (E. Bailey 1-26) and <i>Triodia basedowii</i>.</p>	AAr10 AAr11 AAr16	62.91	22.6	
			<b>278.17</b>	<b>100</b>	

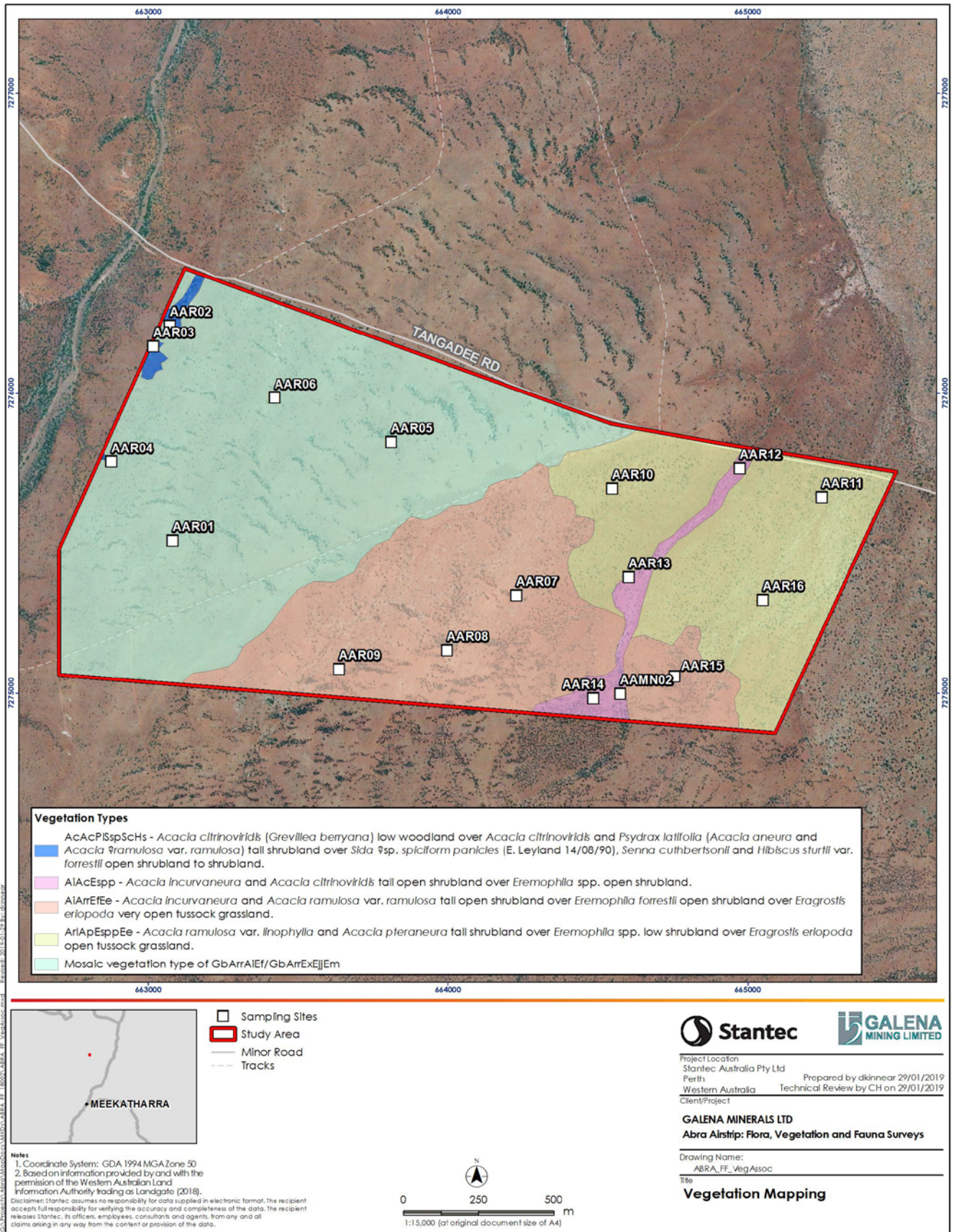


Figure 4-1: Vegetation types identified in the Study Area

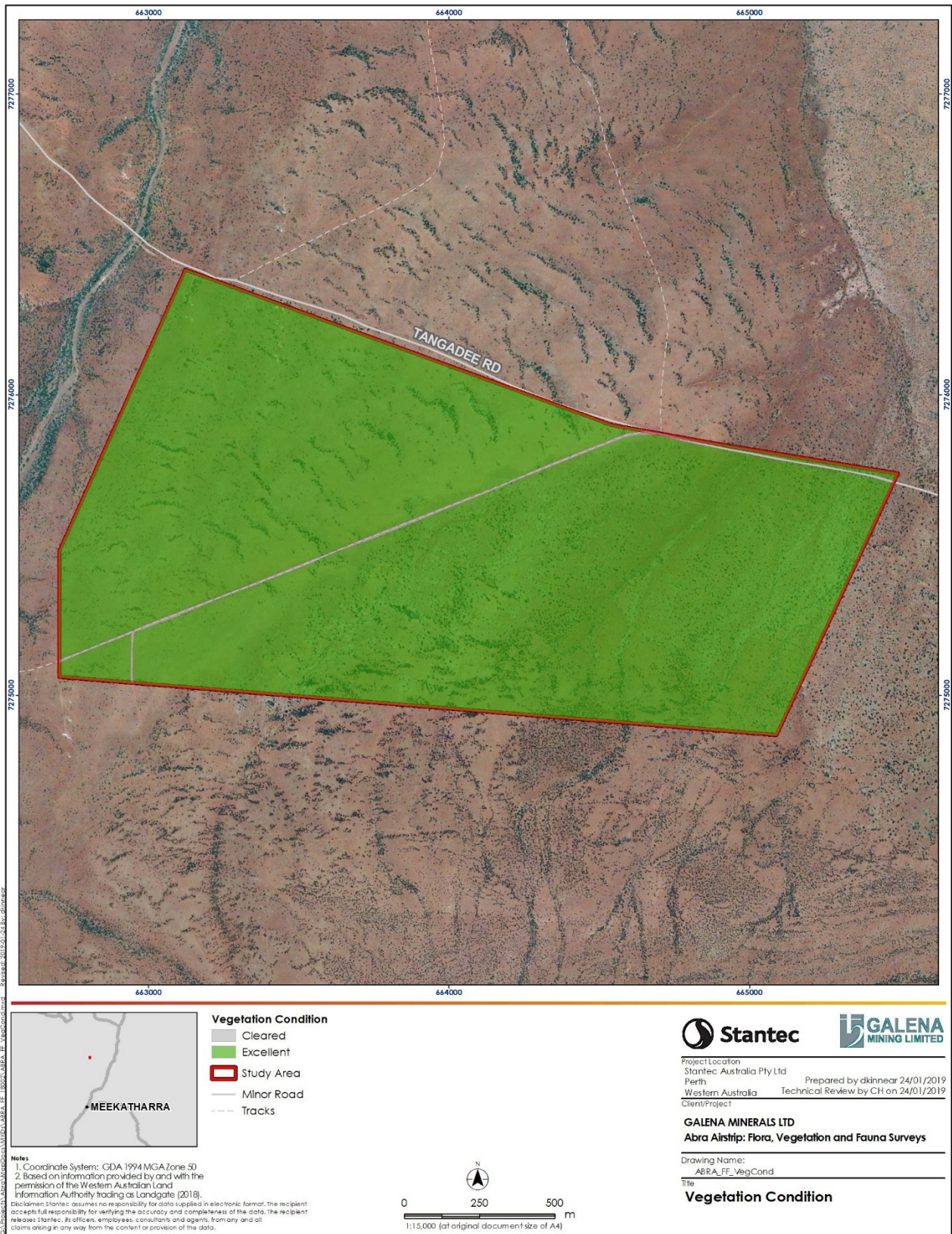


Figure 4-2: Vegetation condition of the Study Area

## 4.2.4 Terrestrial Fauna

### 4.2.4.1 Fauna Habitat



Three broad fauna habitats were identified and delineated from fauna habitat assessments conducted across the Study Area (**Table 4-6**). These comprised;


- Drainage;
- Open shrubland on sandy plain; and
- Open shrubland on stony plain.

These habitats differed primarily in the composition of their vegetation and substrate, particularly presence of rocky fragments, alcoves and the likelihood of seasonal water inundation. Most habitats contained rocky substrates. The habitat types in the Study Area were assessed on their extents and levels of significance according to the following criteria:

- **Distribution:** those habitats widespread and common within the surrounding regions were categorised as widespread; otherwise they were categorised as being of limited extent. All fauna habitats were considered widespread.
- **Significance:** those habitats considered important to species of conservation significance or distinct fauna assemblages are deemed significant; otherwise they were categorised as being of limited significance. No habitats were classified as significant.

Table 4-6: Broad fauna habitats identified within the Study Area

Habitat Type	Proportion of Study Area		Associated Vegetation Types	Condition	Value to Fauna	Reference Photograph
	Ha	%				
Drainage • Widespread • Limited Significance	8.8	3.2	AiAcEsp AcAcPISpSchs	Excellent	<p>Drainage areas tended to have increased vegetation cover compared to other habitat types and were prone to flooding. This comprised of an upper <i>Acacia</i> sp. storey over <i>Dodonaea</i> sp., <i>Eremophila</i> sp. and tussock grasses. The increased vegetation cover provided woody debris, and on the rare occasion peeling bark. Some drainage areas comprised sandy substrates (left), while others comprised clay loams with rocky fragments and minor gullies (right). Drainage areas were affected by cattle trampling and grazing.</p> <p>Drainage areas would provide suitable habitat for a range of mammals, reptiles and birds owing to increased shelter availability (vegetation cover, woody debris). This is particularly prevalent in minor gully drainages, where erosion and rocky substrates provided crevices and alcoves. The upper storey may provide nesting and/ or roosting for bird species, and when inundated drainage habitats may support wetland birds and amphibians.</p>	
Open shrubland on sandy plain • Widespread • Limited Significance	62.91	22.6	ArlApEspEe	Excellent	<p>Comprised <i>Acacia</i> sp. shrubland over <i>Eremophila</i> sp. and open tussock grasses on sandy clay loam plains. These areas contained woody debris, termite mounds and occasionally peeling bark, and were affected by feral trampling and grazing.</p> <p>Tall vegetation within sandy shrublands may provide nesting and/ or roosting for bird species, and areas with woody debris would provide shelter for reptiles and mammals.</p>	

Habitat Type	Proportion of Study Area		Associated Vegetation Types	Condition	Value to Fauna	Reference Photograph
	Ha	%				
Open shrubland on stony plain <ul style="list-style-type: none"> <li>• Widespread</li> <li>• Limited Significance</li> </ul>	206.38	74.2	GbArrAIef/GbArrExEjEm AiArrEfEe	Excellent	<p>Varied from open stony plains with a sparse cover of low shrubs and tussock grasses (left) to areas comprising <i>Acacia</i> sp. and <i>Grevillea berryana</i> over <i>Eremophila</i> sp., <i>Ptilotus</i> sp. and tussock grasses (right). Vegetation occurred over stony substrates, and this habitat contained woody debris, minimal peeling bark and termite mounds. Areas were disturbed by cattle trampling and grazing.</p> <p>Areas with sparse vegetation are unlikely to serve as significant habitat for fauna owing to the lack of shelter. However, areas with tall vegetation may provide nesting and/ or roosting for bird species, and areas with woody debris would provide shelter for reptiles and mammals.</p>	



#### 4.2.4.2 Fauna of Conservation Significance

Of the 219 species of vertebrate fauna identified during the desktop study, 26 species are listed as being of conservation significance, comprising eight mammals, 15 birds and three reptiles (**Table 4-3**). Of the 26-vertebrate species in the desktop study:

- Ten are listed as Threatened under the EPBC Act and/or BC Act;
- Six are recognised by DBCA as Priority fauna. DBCA recognises several species that are not listed under the BC Act or the EPBC Act but for which there is some conservation concern, and has produced a supplementary list of Priority fauna;
- One species is listed as recognised by state (BC Act) to be in need of special protection; and
- Twelve species are listed as Migratory under the EPBC Act and/or Schedule 5 under the BC Act.

Some of the species referred to above, listed as Threatened, Migratory and/or Priority fauna, may be included in multiple groups. The likelihood for species of conservation significance occurring in the Study Area was assessed and ranked (**Table 4-3**).

The rankings were assigned following definitions described in the desktop study methodology (**Section 3.1.3**) and conservation significance codes were determined using DBCA and EPBC Act guidelines (**Appendix A**). Of the conservation significant fauna, one species was considered 'possible' to occur; the Peregrine Falcon (S7), the remaining were assessed as 'unlikely' to occur.

Table 4-7: Conservation significant fauna identified during desktop assessment and likelihood of occurrence within the Study Area

Common name ( <i>Scientific name</i> )	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
<b>Mammals</b>				
Brush-tailed Mulgara ( <i>Dasyercus blythi</i> )		P4	Known to inhabit spinifex grasslands (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area occurs within the species range, however there are no nearby records of the species since 1993 (DBCA 2018b, van Dyck and Strahan 2008) The species was trapped in an area ~170km east of the Study Area, and numerous signs of activity were noted in suitable sandplain habitat (Phoenix 2017). However, the Study Area lacks spinifex sandplains, and therefore the species is considered unlikely to occur.
Crest-tailed Mulgara ( <i>Dasyercus cristicauda</i> )	Vu	P4	Known to inhabit open sand dunes with limited canegrass cover and near salt lakes with Nitre Bush (van Dyck and Strahan 2008).	<b>Unlikely</b> Although two species of Mulgara are known to occur in Australia, it is now recognised that only the Brush-tailed Mulgara ( <i>Dasyercus blythi</i> ) (Priority 4 DBCA) occurs within Western Australia (DoEE 2018, (DoEE 2018b, van Dyck and Strahan 2008). The Crest-tailed Mulgara ( <i>Dasyercus cristicauda</i> ) (Vulnerable EPBC Act) is restricted in its distribution to the eastern portion of the Northern Territory, South Australia and potentially Queensland (DoEE 2018b, van Dyck and Strahan 2008).
Northern Quoll ( <i>Dasyurus hallucatus</i> )	En	S2	Favour rocky habitats, also found in eucalyptus woodlands and forests and near settlements (van Dyck and Strahan 2008).	<b>Unlikely</b> While the species or species habitat was listed as 'likely to occur' (DoEE 2018a), the Study Area occurs well outside of the species current range and the species has not been recorded nearby (van Dyck and Strahan 2008).
Bilby ( <i>Macrotis lagotis</i> )	Vu	S3	Patchily distributed in the northern arid to semi-arid regions (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area lies outside of the species current range, and the species has not been recorded nearby since 1970 (DBCA 2018b, van Dyck and Strahan 2008). As such, the species is considered unlikely to occur.
Northern Marsupial Mole ( <i>Notoryctes caurinus</i> )		P4	Sand dune deserts, particularly the Great and Little Sandy Deserts (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area occurs well outside of the species current range, and the species has not been recorded nearby (van Dyck and Strahan 2008). The species was recorded ~170km east of the Study Area within suitable dune habitat, however as the Study Area does not contain dunes the species is considered unlikely to occur (Phoenix 2017).

Common name (Scientific name)	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
Western Pebble-mound Mouse ( <i>Pseudomys chapmanii</i> )		P4	Gentle rocky spinifex slopes (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area lies outside of the species current range, which is largely restricted to the central and southern Pilbara, Little Sandy Desert and an isolated population in the Gascoyne recorded in 1997 (van Dyck and Strahan 2008). The closest sighting of the species occurred in 1995 55km east of the Study Area (Strahan 2004). Only inactive mounds were recorded within the adjacent area in 2006 (Outback Ecology 2006). Furthermore, no mounds were detected during the 2018 Stantec survey of the same area (Stantec 2018). As such, the species is considered unlikely to occur.
Pilbara Leaf-nosed Bat ( <i>Rhinionictis aurantius</i> Pilbara form')	Vu	S3	Inhabit humid roosts, which occur in rocky gorges or abandoned mine shafts (van Dyck and Strahan 2008).	<b>Unlikely</b> The Study Area lies outside the species current range, which is restricted to the Pilbara, and lacks suitable gorge habitat (van Dyck and Strahan 2008). The closest record of the species lies 56km to the northwest and was recorded in 1999 (DBCA 2018c). As such, the species is considered unlikely to occur.
Ghost Bat ( <i>Macroderma gigas</i> )	Vu	S3	Inhabits a wide range of habitats, from arid areas of the Pilbara to northern rainforests (van Dyck and Strahan 2008).	<b>Unlikely</b> The species or species habitat was listed as 'likely to occur' (DoEE 2018a). However the Study Area lies outside of the species range, which occurs within the Pilbara and Kimberley in WA (van Dyck and Strahan 2008). The species has not been recorded nearby, and is considered unlikely to occur.
<b>Birds</b>				
Garganey ( <i>Anas querquedula</i> )	Mi	S5	Sewage ponds and well vegetated freshwater wetlands (Pizzey and Knight 2007).	<b>Unlikely</b> The species has not been recorded nearby since 1980, and the Study Area does not contain suitable habitat (DBCA 2018c, Pizzey and Knight 2007). The species is uncommon within Australia, migrating to Northern tropical areas in summer and remaining vagrant elsewhere (Pizzey and Knight 2007).
Fork-tailed Swift ( <i>Apus pacificus</i> )	Mi	S5	The species has an aerial habitat mainly over open areas ranging from coasts to semi-deserts, and may also occur over forests and urban areas (Pizzey and Knight 2007).	<b>Unlikely</b> The species or species habitat was listed as 'likely to occur', and the Study Area lies within the known species range (Pizzey and Knight 2007). However the species has not been recorded in the area.

Common name ( <i>Scientific name</i> )	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
Oriental Plover ( <i>Charadrius veredus</i> )	Mi	S5	Large open areas including plains, muddy and sandy wastes near swamps and mudflats, ploughed land, claypans and open turf e.g. airfields (Pizzey and Knight 2007).	<b>Unlikely</b> The species or species habitat was listed as 'may occur', however the Study Area does not contain suitable habitat (DoEE 2018a, Pizzey and Knight 2007). The species has not been recorded nearby, and the Study Area lies outside of the species range (Pizzey and Knight 2007).
Peregrine Falcon ( <i>Falco peregrinus</i> )		S7	The species occurs along cliffs, gorges, wooded rivers, wetlands, plains and open woodlands, as well as in association with pylons and buildings (Pizzey and Knight 2007). Nests on cliffs, in crevices, large tree hollows, in nests of other large birds or on building ledges (Pizzey and Knight 2007).	<b>Possible</b> The Study Area occurs within the species range and the species has been recorded between 90 and 95km from the Study Area, most recently in 2012 (DBCA 2017, Pizzey and Knight 2007). However three of the four records occur along the Great Northern Highway, where the species is likely to rest on pylons (DBCA 2017, Pizzey and Knight 2007). While the Study Area does not contain trees large enough to serve as suitable nesting habitat, the species may still forage over the area from time to time. As such the species is considered as 'possible' to occur but would not be dependent on any of the habitats in the Study Area.
Barn Swallow ( <i>Hirundo rustica</i> )	Mi	S5	Open areas, particularly near water, such as agricultural land, also in urban areas and rail yards (Pizzey and Knight 2007).	<b>Unlikely</b> Species or species habitat was listed as may occur, however the Study Area occurs outside of the species range, does not contain suitable habitat and the species has not been recorded nearby (DoEE 2018a, Pizzey and Knight 2007).
Yellow Wagtail ( <i>Motacilla flava</i> ) and Grey Wagtail ( <i>Motacilla cinerea</i> )	Mi	S5	Both species inhabit sewage ponds and lawn fields, however the Grey Wagtail also occurs along streams in escarpments, rainforests and unused quarries while the Yellow Wagtail occurs in swamp edges, short grass, bare ground and saltmarshes (Pizzey and Knight 2007).	<b>Unlikely</b> The species or species habitat was listed as 'may occur', however the species are summer vagrants that inhabit areas well outside the Study Area (closest range occurs along the northern coast) (Pizzey and Knight 2007). The species have not been recorded nearby and are considered unlikely to occur.
Night Parrot ( <i>Pezoporus occidentalis</i> )	En	S1	Known to inhabit treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed with chenopods (Pyke and Ehrlich 2014).	<b>Unlikely</b> The Study Area does not contain suitable habitat and the species is rare and has not been recorded nearby since 1912 (DBCA 2017, Strahan 2004). As such, the species is considered unlikely to occur.

Common name ( <i>Scientific name</i> )	Conservation status		Broad habitat type	Likelihood of occurrence Reason for likelihood
	EPBC	WA		
Princess Parrot ( <i>Polytelis alexandrae</i> )	Vu	P4	Areas with spinifex or near succulents around salt lakes, usually far from freshwater (Pizzey and Knight 2007).	<b>Unlikely</b> The Study Area occurs within the species irregular range, does not contain suitable habitat and the species has not been recorded nearby since 1919 (DBCA 2017, Pizzey and Knight 2007). As such, the species is considered unlikely to occur.
Sandpipers, stints and greenshanks from the family <i>Scolopacidae</i> .	Mi	S5	Habitats associated with water including wetland and lake margins, floodwaters, mudflats, saltmarshes and salt fields, swamps, intertidal flats and estuaries (Pizzey and Knight 2007).	<b>Unlikely</b> Six species were listed within this family. However, these species favour shallow aquatic habitats not present within the Study Area, and the species have not been recorded recently nearby (DBCA 2017, Pizzey and Knight 2007). Due to this, they are considered unlikely to occur.
<b>Reptiles</b>				
Yinnietharra Rock Dragon ( <i>Ctenophorus yinnietharra</i> )	Vu	S3	Low weathered granite outcrops; basks on low rocks and shrubs (Wilson and Swan 2013).	<b>Unlikely</b> The species is limited to granite outcrops near Yinnietharra Station (outside of the Study Area), and has not been recorded nearby (Wilson and Swan 2013).
Unpatterned robust slider (subsp.) <i>Lerista macropisthopus remota</i>		P2	Acacia shrublands and woodlands in semi-arid and arid areas (Wilson and Swan 2013).	<b>Unlikely</b> The Study Area may contain suitable habitat, however the subspecies is restricted to a small range to the east of the Study Area (Wilson and Swan 2013). The species has also not been recorded nearby, and is therefore considered unlikely to occur.
Pilbara Olive Python ( <i>Liasis olivaceus barroni</i> )	Vu	S3	Gorges and escarpments, often associated with water (Wilson and Swan 2013).	<b>Unlikely</b> The subspecies is restricted to the Pilbara, the Study Area contains unsuitable habitat and the subspecies has not been recorded nearby (Wilson and Swan 2013).

## 4.3 Survey Limitations and Constraints

There are a number of possible limitations and constraints that can impinge on the adequacy of vegetation, flora and fauna survey (DPaW 2016a, EPA 2016). These are summarised in **Table 4-8**, with respect to the survey of the Study Area.

**Table 4-8: Potential limitations and constraints of the field survey**

Factor	Constraint	Comments
Competency and experience of consultants	No	The field personnel, Alice Bott and Shane Chalwell have appropriate qualifications and experience to undertake the relevant components of the flora, vegetation and fauna survey. The specimen identifications were undertaken by Alice Bott and Crystal Heydenrych, who have extensive experience in WA.
Scope	No	The scope was well-defined and the flora, vegetation, fauna and their habitats were surveyed using standardised and well-established techniques. The desktop study was undertaken prior to the surveys to inform surveyors of the potential occurrence of factors of environmental significance.
Proportion of species identified	No	<p>Given the relatively small extent of the Study Area (217 ha) and the uniformity of the landscapes within the Study Area, the flora taxa inventory is comparable to counts obtained during previous surveys of a similar scope in the vicinity of the Study Area (<b>Section 4.1</b>).</p> <p>Survey sampling, timing, and intensity was considered adequate for the identification of most perennial species. Of the flora taxa recorded from the Study Area, five could not be identified confidently beyond family level and two could not be identified confidently to genus level. None of taxa that could not be identified resembled any of the potential flora of conservation concern that occur in the area.</p> <p>All vertebrate fauna encountered were identified and habitats were assessed for their importance to vertebrate fauna and fauna of conservation significance.</p>
Information sources (e.g. historic or recent)	Partial	<p>There is a paucity of information in the immediate vicinity of the Study Area, aside from the surveys undertaken by Outback Ecology in 2006 and Stantec in 2018 of the Abra Project Area. The literature review considered surveys that had been undertaken within a wide radius of the Study Area to account for this. Information was additionally supplemented by from database searches, which considered large search areas i.e. 40 to 100 km.</p> <p>Regional contextual information was also obtained from historic vegetation mapping conducted by Beard (1975b, 1990), Shepherd <i>et al.</i> (2002), soil and landform mapping (Payne <i>et al.</i> 1988), IBRA classification system information (Desmond <i>et al.</i> 2001) and previous flora and fauna surveys conducted in the wider region.</p>
Completeness and intensity	No	A total of 16 relevés and fauna habitat assessments and two mapping notes were sampled across the Study Area. This was sufficient to adequately sample all broad vegetation types, fauna habitats and flora within the Study Area.

Factor	Constraint	Comments
Timing / weather / season / cycle	No	The survey took place outside of the recommended season for flora and vegetation surveys within the Gscoyne bioregion EPA (2016a) and seasonal conditions were sub-optimal, with below average rainfall received in the 12 months preceding the survey. Most flora taxa, however, could be identified from vegetative material and this was not regarded as a significant limitation.
Disturbances	No	Vegetation condition is presented within <b>Section 4.2.3.1</b> and shows that the Study Area was in 'excellent' condition. Minimal disturbance had been noted as a result of clearing for access tracks and impacts from feral fauna, however, none of these disturbances limited the outcomes of this report.
Resources	No	Resources were adequate to carry out the survey and the survey participants were competent in identification of species present. WAH herbarium specimens, taxonomic guides, DBCA database searches and the FloraBase database were all used to prepare for the survey and used for the confirmation of any flora or fauna species where identification was uncertain.
Remoteness / access problems	No	All survey sites were easily accessible by vehicle and on foot.

## 5. Summary

The field survey was undertaken outside of the recommended timeframe for the bioregion, following below average rainfall preceding the field survey. Despite dry seasonal conditions, the Study Area was adequately surveyed through a combination of relevés, mapping notes and fauna habitat assessments to compile a representative species list of the Study Area and to characterise the vegetation types and habitat types present.

It is possible that some of the annual and ephemeral flora taxa that occur in the Study Area may not have been recorded during the field survey, however, it is unlikely that any Threatened or Priority flora species would have gone unnoticed. Three Priority flora species were assessed as 'possible' to occur within the Study Area, based on the post-survey assessment of likelihood of occurrence; all three of these species are perennial and are easily recognisable.

Five vegetation types were mapped within the Study Area, including two vegetation types that were reconciled to previous mapping undertaken for the adjacent Abra Project. The vegetation types recorded represent what would be expected from similar landforms in the broader Augustus subregion and none are analogous to any Commonwealth or State listed TECs or PECs. Due to minimal disturbance of vegetation present, the vegetation condition was 'excellent' throughout the Study Area.

Three broad fauna habitats were identified within the Study Area; open shrubland on sandy plain, open shrubland on stony plain and drainage. All were considered widespread and of limited significance for potential conservation significant vertebrate fauna.

No species of conservation significance were recorded during the current survey. One species of conservation significance was considered 'possible' to occur based on species range and previous records; the Peregrine Falcon (*S7*). The Study Area does not contain suitable nesting habitat for the species, however it may forage over the Study Area from time to time without being dependent on any particular habitat. The remaining species of conservation significance were assessed as 'unlikely' to occur in the Study Area.

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A close-up photograph of a hand reaching out from the left side of the frame. The hand is silhouetted against a bright, golden sunset sky. The sun is visible as a bright, glowing orb on the right side, creating a lens flare effect. The background is filled with the soft, out-of-focus outlines of tall grass or reeds, suggesting a field or meadow. The overall mood is serene and contemplative.

# Appendices

# Appendix A Codes and Terms Used to Describe Species of Conservation Significance

Flora and fauna may be accorded legislative protection by being listed under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act) and/or the Biodiversity Conservation Act 2016 (WA) (BC Act), or by being listed on the WA Department of Environment and Conservation's Priority Species List. This Appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories, such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are not presented here, as the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Definitions of codes and terms used to describe flora and fauna of conservation significance.

Categories used under the EPBC Act		
Status	Code	Description
<b>Critically Endangered</b>	<b>Cr</b>	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
<b>Endangered</b>	<b>En</b>	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
<b>Vulnerable</b>	<b>Vu</b>	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
<b>Migratory</b>	<b>Mi</b>	Species that migrate to, over and within Australia and its external territories

Schedules used under the BC Act			Description
Status	Code	Schedule	
<b>Critically Endangered</b>	<b>Cr</b>	<b>S1</b>	Taxa that is rare or likely to become extinct, as critically endangered taxa
<b>Endangered</b>	<b>En</b>	<b>S2</b>	Taxa that is rare or likely to become extinct, as endangered taxa
<b>Vulnerable</b>	<b>Vu</b>	<b>S3</b>	Taxa that is rare or likely to become extinct, as vulnerable taxa
<b>Presumed Extinct</b>	<b>Ex</b>	<b>S4</b>	Taxa that is presumed to be extinct
<b>Migratory</b>	<b>Mi</b>	<b>S5</b>	Birds that are subject to international agreements relating to the protection of migratory birds
<b>Conservation Dependent</b>	<b>CD</b>	<b>S6</b>	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
<b>Special Protection</b>	<b>SP</b>	<b>S7</b>	Taxa that is in need of special protection

# Appendix B    **Vegetation Condition Scale: Eremaean Province**

Code	Description
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires, or aggressive weeds.
Degraded	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	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

# Appendix C    **Vegetation Structure Scale**



NVIS Vegetation Structural Classifications							
Cover Characteristics							
Foliage cover *	70-100	30-70	10-30	<10	≈0	0-5	unknown
Crown cover **	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
% Crown cover ***	>80	50-80	20-50	0.25-20	<0.25	0-5	unknown
Cover code	d	c	i	r	bi	bc	unknown

Growth Form	Height ranges (m)	Structural Formation Classes						
tree, palm	>30 Tall	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
	10-30 Mid							
	<10 Low							
tree mallee	10-30 Tall	closed mallee forest	open mallee forest	mallee woodland	open mallee woodland	isolated mallee trees	isolated clumps of mallee trees	mallee trees
	<10 Mid							
	<3 Low							
shrub, cycad, grass-tree, fern	>2 Tall	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
	1-2 Mid							
	<1 Low							
mallee shrub	10-30 Tall							mallee shrubs

Growth Form	Height ranges (m)	Structural Formation Classes						
	<10 Mid	closed mallee shrubland	mallee shrubland	open mallee shrubland	sparse mallee shrubland	isolated mallee shrubs	isolated clumps of mallee shrubs	
	<3 Low							

Growth Form	Height ranges (m)	Structural Formation Classes						
heath shrub	>2 Tall	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
	1-2 Mid							
	<1 Low							
chenopod shrub	>2 Tall	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
	1-2 Mid							
	<1 Low							
samphire shrub	>0.5 Mid	closed samphire shrubland	samphire shrubland	open samphire shrubland	sparse samphire shrubland	isolated samphire shrubs	isolated clumps of samphire shrubs	samphire shrubs
	<0.5 Low							
hummock grass	>2 Tall	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
	<2 Low							
tussock grass	>0.5 Mid	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
	<0.5 Low							
other grass	>0.5 Mid	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
	<0.5 Low							
sedge	>0.5 Mid	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
	<0.5 Low							
rush	>0.5 Mid	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
	<0.5 Low							

Growth Form	Height ranges (m)	Structural Formation Classes						
forb	>0.5 Mid	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
	<0.5 Low							
fern	>2 Tall	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
	1-2 Mid							
	<1 Low							
bryophyte	<0.5	closed bryophyte land	bryophyte land	open bryophyte land	sparse bryophyte land	isolated bryophytes	isolated clumps of bryophytes	bryophytes
lichen	<0.5	closed lichenland	lichenland	open lichenland	sparse lichenland	isolated lichens	isolated clumps of lichens	lichens
vine	>30 Tall	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
	10-30 Mid							
	<10 Low							
aquatic	<1 Tall	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
	0-0.5 Low							
seagrass	<1 Tall	closed seagrass bed	Seagrass bed	open seagrass bed	sparse seagrass bed	isolated seagrasses	isolated clumps of seagrasses	seagrasses

# Appendix D Likelihood of Occurrence of Conservation Significant Flora in the Study Area

Species	Conservation Code			Habitat	Life Form	Nearest known locality (km)	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence	Source
	EPBC Act	BC Act	DBCA						
<i>Pityrodia augustensis</i>	VU	VU	VU	Amongst rocks on slopes or in drainage lines.	Perennial	112	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Desmond <i>et al.</i> (2001)
<i>Acacia wilcoxii</i>			1	Granitic soils. Along creeks & adjacent stony plains & granite outcrops.	Perennial	44	<b>Unlikely:</b> No granite outcrops are known to occur in the study area.	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species.	TPFL, TP List; WAHerb
<i>Eremophila appressa</i>			1	Ironstone gravel. Ridge slopes.	Perennial	116	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species and does not contain suitable habitat.	TP List
<i>Eremophila arguta</i>			1	The edge of floodplains, in dry creek beds and on road verges.	Perennial	98	<b>Possible:</b> The Study Area lies outside of the known distribution but may contain suitable habitat	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species and does not contain suitable habitat.	Desmond <i>et al.</i> (2001)
<i>Eremophila humilis</i>			1	Stony clay, loam. Rocky ridges.	Perennial	1.6	<b>Likely:</b> The Study Area contains suitable habitat for this species and known records are located within proximity.	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species. If present, this species could have been identified from vegetative material, however, despite extensive searches, it was not recorded.	TP List; WAHerb
<i>Eremophila prolata</i>			1	Red stony clay. Flats & rises.	Perennial	82	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Desmond <i>et al.</i> (2001)
<i>Hemigenia pachyphylla</i>			1	Watercourses, minor creeks, red sandy soils with rocks.	Perennial	270	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species.	Desmond <i>et al.</i> (2001)
<i>Ptilotus actinocladus</i> <i>T.Hammer &amp; R.W.Davis</i>			1	Bare areas, flat, seasonally inundated areas.	Annual	130	<b>Possible:</b> There is limited information available regarding the distribution and habitat requirements for this species.	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species. If present, this species could have been identified from vegetative material, however, despite extensive searches, it was not recorded.	TP List
<i>Acacia tuberculata</i>			2	Granite outcrops	Perennial	530	<b>Unlikely:</b> The Study Area lies outside of the known distribution range for this species and there are no granite outcrops known to occur in the Study Area.	<b>Unlikely:</b> The Study Area is located well outside of the known distribution range of this species and does not contain granite outcrops.	TP List
<i>Rhodanthe frenchii</i>			2	Stony hills, rocky river banks & outcrops.	Annual	285	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species.	Desmond <i>et al.</i> (2001)
<i>Thysanotus sp. Desert East of Newman</i> <i>(R.P. Hart 964)</i>			2	Red-brown loamy sand or red sand, sometimes silty. Sand plain, pisolitic buckshot plain.	Perennial	445	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species.	TP List
<i>Eremophila coacta</i>			3	Laterite, shale soils. Ironstone hills, creeklines.	Perennial	155	<b>Possible:</b> The Study Area lies outside of the known distribution for this species but may contain suitable habitat.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species and does not contain suitable habitat.	TP List
<i>Eremophila flaccida subsp. attenuata</i>			3	Stony clay over quartzite. Hillslopes, ridges.	Perennial	270	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species and does not contain suitable habitat.	TP List
<i>Eremophila gracillima</i>			3	Stony flats	Perennial	3	<b>Likely:</b> The Study Area contains suitable habitat for this species and known records are located within proximity.	<b>Unlikely:</b> If present, this species could have been identified from vegetative material, however, despite extensive searches, it was not recorded.	Desmond <i>et al.</i> (2001)
<i>Eremophila lanata</i>			3	Stony red clayey sand.	Perennial	117	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	TPFL, TP List; WAHerb

Species	Conservation Code			Habitat	Life Form	Nearest known locality (km)	Pre-survey likelihood of occurrence	Post-survey likelihood of occurrence	Source
	EPBC Act	BC Act	DBCA						
<i>Eremophila rigida</i>			3	Red sand alluvium. Hardpan plains, stony clay depressions.	Perennial	29	<b>Possible:</b> The Study Area lies just outside of the known distribution of this species but may contain suitable habitat	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species. If present, this species could have been identified from vegetative material, however, despite extensive searches, it was not recorded.	Desmond <i>et al.</i> (2001)
<i>Owenia acidula</i>			3	Clay plains.	Perennial	371	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species and does not contain suitable habitat.	TPFL; TP List; WAHerb
<i>Ptilotus lazaridis</i>			3	Clay loam. Floodplains.	Perennial	230	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species.	<b>Unlikely:</b> The Study Area lies well outside of the known distribution for this species and does not contain suitable habitat.	TP List
<i>Ptilotus luteolus</i>			3	Rocky slopes, screes and ridges.	Perennial	132	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species and does not contain suitable habitat.	Desmond <i>et al.</i> (2001)
<i>Stylidium weeliwoilli</i>			3	Gritty sand soil, sandy clay. Edge of watercourses.	Annual	180	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Desmond <i>et al.</i> (2001)
<i>Ptilotus trichocephalus</i>			4	Sandy soils. Colluvial plains.	Perennial	51	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area does not contain suitable habitat for this species. If present, this species could have been identified from vegetative material, however, despite extensive searches, it was not recorded.	WAHerb
<i>Goodenia berringbinensis</i>			4	Red sandy loam. Along watercourses.	Annual	135	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	<b>Unlikely:</b> The Study Area lies outside of the known distribution for this species.	Desmond <i>et al.</i> (2001)

# Appendix E Vertebrate Fauna Identified in the Desktop Assessment

## Legend:

### Desktop Searches:

- A Galena Minerals Ltd: Abra Flora, Fauna and Vegetation Survey (Stantec 2018)
- B Birdata: Custom Atlas Bird List (Birdlife Australia 2017)
- C Threatened and Priority Fauna Database (DBCA 2017)
- D NatureMap Database (DBCA 2018b)
- E Protected Matters Search Tool (DoEE 2018a)

### Literature Review

- F Gascoyne 3 (GAS3 - Augustus subregion) (Desmond *et al.* 2001)
- G Flora and Fauna Survey: Fortnum Project for Homestake Australia Limited (Dames and Moore 1988)
- H Desktop Vertebrate Fauna Assessment and Reconnaissance Survey of the Mulgul Project (Outback Ecology 2006)
- I Terrestrial fauna survey for the Beyondie Potash Project, Prepared for Kalium Lakes Ltd, Draft Report (Phoenix 2017)



Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
<b>Amphibians</b>													
Hylidae	<i>Cyclorana maini</i>	Sheep Frog			x								x
	<i>Cyclorana platycephala</i>	Western Water-holding Frog						x					x
	<i>Litoria rubella</i>	Little Red Tree Frog			x			x					x
Limnodynastidae	<i>Neobatrachus aquilonius</i>	Northern Burrowing Frog											x
	<i>Neobatrachus sudellae</i>	Desert Trilling Frog											x
	<i>Neobatrachus sutor</i>	Shoemaker Frog											x
	<i>Notaden nichollsi</i>	Desert Spadefoot											x
Myobatrachidae	<i>Uperoleia micromeles</i>	Tanami Toadlet											x
<b>Birds</b>													
Acanthizidae	<i>Acanthiza apicalis</i>	Inland Thornbill			x	x		x				x	
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				x		x					
	<i>Acanthiza iredalei iredalei</i>									x			
	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill				x		x					x
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill				x		x			x		x
	<i>Aphelocephala leucopsis</i>	Southern Whiteface				x		x					
	<i>Gerygone fusca</i>	Western Gerygone			x			x					x
	<i>Pyrrholaemus brunneus</i>	Redthroat				x		x					x
	<i>Smicrornis brevirostris</i>	Weebill				x		x			x	x	x
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				x		x					
	<i>Accipiter fasciatus</i>	Brown Goshawk											x
	<i>Aquila audax</i>	Wedge-tailed Eagle				x		x			x		x
	<i>Elanus caeruleus</i>	Black-shouldered Kite											x
	<i>Haliastur sphenurus</i>	Whistling Kite				x		x					x
	<i>Hamirostra isura</i>	Square-tailed Kite									x		
	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard				x		x					x
	<i>Hieraaetus morphnoides</i>	Little Eagle											x
Alaudidae	<i>Mirafra javanica</i>	Horsfield's Bushlark											x
Alcedinidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher									x		
Anatidae	<i>Anas gracilis</i>	Grey Teal											x
	<i>Anas querquedula</i>	Garganey	Mi	S5			x						
	<i>Anas superciliosa</i>	Pacific Black Duck									x		
	<i>Cygnus atratus</i>	Black Swan											x
Apodidae	<i>Apus pacificus</i>	Fork-tailed Swift	Mi	S5					x				
Ardeidae	<i>Ardea modesta</i>	Eastern Great Egret					x		x				
	<i>Ardea novaehollandiae</i>	White-faced Heron									x		
	<i>Ardea pacifica</i>	White-necked Heron				x		x					x
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow			x	x		x				x	x
	<i>Artamus minor</i>	Little Woodswallow				x		x					
	<i>Artamus personatus</i>	Masked Woodswallow											x
Cacatuidae	<i>Cacatua roseicapilla</i>	Galah				x		x				x	x
	<i>Cacatua sanguinea</i>	Little Corella											x
	<i>Nymphicus hollandicus</i>	Cockatiel				x		x					
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike				x		x					x

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Coracina novaehollandiae subpallida</i>							x					
	<i>Lalage tricolor</i>	White-winged Triller				x						x	
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar			x	x		x					
Charadriidae	<i>Charadrius melanops</i>	Black-fronted Dotterel						x					
	<i>Charadrius veredus</i>	Oriental Plover	Mi	S5					x				
	<i>Vanellus tricolor</i>	Banded Lapwing											x
Columbidae	<i>Geopelia cuneata</i>	Diamond Dove						x			x	x	
	<i>Geopelia striata</i>	Peaceful Dove				x		x					
	<i>Ocyphaps lophotes</i>	Crested Pigeon			x	x		x			x	x	x
	<i>Phaps chalcoptera</i>	Common Bronzewing			x	x		x					
Corvidae	<i>Corvus bennetti</i>	Little Crow									x	x	
	<i>Corvus orru</i>	Torresian Crow			x						x		
Cracticidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird			x	x		x				x	x
	<i>Cracticus tibicen</i>	Australian Magpie			x	x		x			x		
	<i>Cracticus torquatus</i>	Grey Butcherbird				x		x			x		
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo									x		
	<i>Chrysococcyx basalis</i>	Horsfield's Bronze Cuckoo									x		
Dromaiidae	<i>Dromaius novaehollandiae</i>	Emu				x		x			x		x
Estrildidae	<i>Taeniopygia guttata</i>	Zebra Finch			x	x		x			x	x	x
Falconidae	<i>Falco berigora</i>	Brown Falcon				x		x				x	
	<i>Falco cenchroides</i>	Australian Kestrel			x	x		x			x	x	x
	<i>Falco peregrinus</i>	Peregrine Falcon		S7			x			x			
Hirundinidae	<i>Hirundo rustica</i>	Barn Swallow	Mi	S5					x				
	<i>Petrochelidon nigricans</i>	Tree Martin				x		x					
Locustellidae	<i>Megalurus cruralis</i>	Brown Songlark				x							
	<i>Megalurus mathewsi</i>	Rufous Songlark											x
Maluridae	<i>Malurus lamberti</i>	Variiegated Fairy-wren											x
	<i>Malurus leucopterus</i>	White-winged Fairy-wren											x
	<i>Malurus splendens</i>	Splendid Fairy-wren				x		x				x	
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				x		x			x	x	x
	<i>Certhionyx variegatus</i>	Pied Honeyeater				x		x				x	x
	<i>Epthianura tricolor</i>	Crimson Chat				x		x					
	<i>Gavicalis virescens</i>	Singing Honeyeater			x	x		x					x
	<i>Lacustroica whitei</i>	Grey Honeyeater						x					
	<i>Lichmera indistincta</i>	Brown Honeyeater									x		
	<i>Manorina flavigula</i>	Yellow-throated Miner				x		x					x
	<i>Melithreptus gularis</i>	Black-chinned Honeyeater											x
	<i>Ptilotula keartlandi</i>	Grey-headed Honeyeater											x
	<i>Ptilotula penicillatus</i>	White-plumed Honeyeater				x							x
	<i>Purnella albifrons</i>	White-fronted Honeyeater				x		x			x		x
	<i>Sugomel niger</i>	Black Honeyeater				x							x
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater					x		x		x		x
Monarchidae	<i>Grallina cyanoleuca</i>	Magpie-lark				x		x			x	x	x
Motacillidae	<i>Anthus australis</i>	Australian Pipit				x					x	x	x

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Motacilla cinerea</i>	Grey Wagtail	Mi	S5					x				
	<i>Motacilla flava</i>	Yellow Wagtail	Mi	S5					x				
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella										x	
Oreoicidae	<i>Oreoica gutturalis</i>	Crested Bellbird			x	x		x			x	x	x
Otididae	<i>Ardeotis australis</i>	Australian Bustard						x			x		x
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrike-thrush			x	x		x				x	
	<i>Pachycephala rufiventris</i>	Rufous Whistler				x		x			x	x	x
Petroicidae	<i>Melanodryas cucullata</i>	Hooded Robin			x	x		x					x
	<i>Microeca fascinans</i>	Jacky Winter											x
	<i>Petroica goodenovii</i>	Red-capped Robin				x		x				x	
Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant				x		x					
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail				x		x					
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler				x		x			x	x	
	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler				x		x					x
Psittacidae	<i>Melopsittacus undulatus</i>	Budgerigar				x		x				x	x
	<i>Neophema bourkii</i>	Bourke's Parrot									x		
	<i>Pezoporus occidentalis</i>	Night Parrot	En	S1			x	x	x				
	<i>Platycercus varius</i>	Mulga Parrot			x	x					x	x	
	<i>Platycercus zonarius</i>	Australian Ringneck			x	x		x			x	x	
	<i>Polytelis alexandrae</i>	Princess Parrot	Vu	P4			x		x	x			
Psophodidae	<i>Cinclosoma clarum</i>	Western Chestnut Quail-thrush						x				x	
	<i>Cinclosoma marginatum</i>	Western Quail-thrush						x					
	<i>Cinclosoma castaneothorax</i>	Chestnut-breasted Quail-thrush			x	x							
Ptilonorhynchidae	<i>Ptilonorhynchus maculatus guttatus</i>	Western Bowerbird										x	
Rhipiduridae	<i>Rhipidura leucophrys</i>	Willie Wagtail			x	x		x			x	x	x
Scolopacidae	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	S5					x				
	<i>Calidris ferruginea</i>	Curlew Sandpiper	Cr; Mi	S3; S5					x				
	<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	S5					x				
	<i>Calidris ruficollis</i>	Red-necked Stint	Mi	S5			x						
	<i>Tringa hypoleucos</i>	Common Sandpiper	Mi	S5					x				
	<i>Tringa nebularia</i>	Common Greenshank	Mi	S5			x						
Strigidae	<i>Ninox boobook boobook</i>	Southern Boobook									x		
Turnicidae	<i>Turnix velox</i>	Little Button-quail											x
<b>Mammals</b>													
Bovidae	<i>Bos taurus</i>	*European Cattle			x							x	x
Camelidae	<i>Camelus dromedarius</i>	*Camel							x		x		x
Canidae	<i>Canis familiaris</i>	*Dog			x			x	x				
	<i>Vulpes vulpes</i>	*Red Fox						x	x			x	x
Dasyuridae	<i>Dasyercus blythi</i>	Brush-tailed Mulgara		P4				x					x
	<i>Dasyercus cristicauda</i>	Crest-tailed Mulgara	Vu	P4						x			
	<i>Dasykaluta rosamondae</i>	Little Red Kaluta											x
	<i>Dasyurus hallucatus</i>	Northern Quoll	En	S2					x				
	<i>Ningai ridei</i>	Wongai Ningai											x
	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart											x

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I	
	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart											x	
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat											x	
Equidae	<i>Equus asinus</i>	*Donkey							x			x	x	
	<i>Equus caballus</i>	*Horse							x					
Felidae	<i>Felis catus</i>	*Cat			x				x		x	x	x	
Leporidae	<i>Oryctolagus cuniculus</i>	*Rabbit							x		x	x	x	
Macropodidae	<i>Osphranter robustus erubescens</i>											x		
	<i>Osphranter rufus</i>	Red Kangaroo			x						x	x	x	
Megadermatidae	<i>Macroderma gigas</i>	Ghost Bat	Vu	S3					x					
Molossidae	<i>Austronomus australis</i>	White-striped Freetail-bat									x		x	
	<i>Chaerephon jobensis</i>	Greater Northern Freetail-bat											x	
	<i>Ozimops lumsdenae</i>	Northern Free-tailed Bat											x	
Muridae	<i>Mus musculus</i>	*House Mouse									x		x	
	<i>Notomys alexis</i>	Spinifex Hopping-mouse											x	
	<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse		P4			x	x				x		
	<i>Pseudomys desertor</i>	Desert Mouse											x	
	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse											x	
	<i>Zyomys argurus</i>	Common Rock-rat										x		
Notoryctidae	<i>Notoryctes caurinus</i>	Northern Marsupial Mole		P4									x	
Rhinonycteridae	<i>Rhinonycteris aurantius Pilbara form'</i>	Pilbara Leaf-nosed Bat	Vu	S3			x		x					
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna									x		x	
Thylacomyidae	<i>Macrotis lagotis</i>	Bilby	Vu	S3			x	x		x			x	
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat						x			x		x	
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat											x	
	<i>Scotorepens greyii</i>	Little Broad-nosed Bat											x	
	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat											x	
<b>Reptiles</b>														
Agamidae	<i>Ctenophorus caudicinctus caudicinctus</i>						x							
	<i>Ctenophorus caudicinctus mensarum</i>				x		x							
	<i>Ctenophorus isolepis gularis</i>												x	
	<i>Ctenophorus nuchalis</i>	Central Netted Dragon										x	x	
	<i>Ctenophorus reticulatus</i>	Western Netted Dragon						x						
	<i>Ctenophorus scutulatus</i>											x	x	
	<i>Ctenophorus yinnietharra</i>	Yinnietharra Rock Dragon	Vu	S3						x				
	<i>Diporiphora paraconvergens</i>	Grey-striped Western Desert Dragon												x
	<i>Diporiphora valens</i>	Southern Pilbara Tree Dragon												x
	<i>Gowidon longirostris</i>	Long-nosed Dragon							x					x
	<i>Moloch horridus</i>	Thorny Devil										x		
	<i>Pogona minor minor</i>	Western Bearded Dragon												x
Carphodactylidae	<i>Nephrurus laevis</i>												x	
	<i>Nephrurus levis</i>												x	
Cheluidae	<i>Chelodina steindachneri</i>	Flat-shelled Turtle						x						
Diplodactylidae	<i>Diplodactylus conspicillatus</i>	Variable Fat-tailed Gecko											x	

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Diplodactylus laevis</i>	Desert Fat-tailed Gecko											X
	<i>Lucasium stenodactylum</i>										X		X
	<i>Rhynchoedura ornata</i>	Western Beaked Gecko											X
	<i>Strophurus ciliaris aberrans</i>												X
	<i>Strophurus elderi</i>							X					X
Elapidae	<i>Pseudechis australis</i>	Mulga Snake									X		X
	<i>Pseudonaja mengdeni</i>	Western Brown Snake											X
	<i>Simoselaps anomalus</i>	Desert Banded Snake											X
	<i>Simoselaps bertholdi</i>	Jan's Banded Snake									X		
	<i>Suta fasciata</i>	Rosen's Snake						X					
Gekkonidae	<i>Gehyra punctata</i>							X					
	<i>Gehyra variegata</i>				X						X		X
	<i>Heteronotia binoei</i>	Bynoe's Gecko						X					X
Pygopodidae	<i>Delma nasuta</i>							X					
	<i>Lialis burtonis</i>							X					X
Pythonidae	<i>Aspidites melanocephalus</i>	Black-headed Python									X		
	<i>Liasis olivaceus barroni</i>	Pilbara Olive Python	Vu	S3					X				
Scincidae	<i>Ctenotus brooksi</i>												X
	<i>Ctenotus calurus</i>												X
	<i>Ctenotus grandis grandis</i>												X
	<i>Ctenotus hanloni</i>												X
	<i>Ctenotus inornatus</i>												X
	<i>Ctenotus leae</i>												X
	<i>Ctenotus leonhardii</i>												X
	<i>Ctenotus pantherinus ocellifer</i>										X		X
	<i>Ctenotus quattuordecimlineatus</i>												X
	<i>Ctenotus schomburgkii</i>										X		X
	<i>Cyclodomorphus melanops</i>	Slender Blue-tongue						X					
	<i>Cyclodomorphus melanops melanops</i>												X
	<i>Egernia depressa</i>	Southern Pygmy Spiny-tailed Skink											X
	<i>Eremiascincus musivus</i>	Mosaic Desert Skink											X
	<i>Eremiascincus pallidus</i>	Western Narrow-banded Skink											X
	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer											X
	<i>Lerista bipes</i>												X
	<i>Lerista ips</i>												X
	<i>Lerista macropisthopus remota</i>				P2								X
	<i>Lerista muelleri</i>											X	
<i>Lerista neander</i>							X						
<i>Lerista timida</i>							X						
<i>Morethia ruficauda exquisita</i>							X						
<i>Tiliqua multifasciata</i>	Central Blue-tongue											X	
Typhlopidae	<i>Anilius endoterus</i>												X
Varanidae	<i>Varanus eremius</i>	Pygmy Desert Monitor											X
	<i>Varanus giganteus</i>	Perentie									X		

Family	Species Name	Common Name	EPBC	WA	A	B	C	D	E	F	G	H	I
	<i>Varanus gouldii</i>	Sand Monitor									x	x	
	<i>Varanus panoptes</i>	Yellow-spotted Monitor											x
	<i>Varanus tristis tristis</i>	Racehorse Monitor									x		

# Appendix F    Inventory of Vascular Flora Recorded

Family	Species
	<i>Ptilotus aervoides</i>
	<i>Ptilotus obovatus</i>
Amaranthaceae	<i>Ptilotus schwartzii</i>
Apocynaceae	<i>Marsdenia australis</i>
Caryophyllaceae	<i>Polycarpaea corymbosa</i>
Chenopodiaceae	<i>Rhagodia eremaea</i>
Cyperaceae	<i>Fimbristylis dichotoma</i>
Euphorbiaceae	<i>Euphorbia boophthona/ tannensis</i>
	<i>Acacia ?macraneura</i>
	<i>Acacia citrinoviridis</i>
	<i>Acacia incurvaneura</i>
	<i>Acacia kempeana</i>
	<i>Acacia pruinocarpa</i>
	<i>Acacia pteraneura</i>
	<i>Acacia ramulosa</i> var. <i>linophylla</i>
	<i>Acacia ramulosa</i> var. <i>ramulosa</i>
	<i>Acacia rhodophloia</i>
	<i>Acacia tetragonophylla</i>
	<i>Senna artemisioides</i> subsp. <i>helmsii</i>
	<i>Senna cuthbertsonii</i>
Fabaceae	<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)
Goodeniaceae	<i>Goodenia ? tenuiloba</i>
	<i>Hibiscus burtonii</i>
	<i>Hibiscus coatesii</i>
	<i>Sida</i> sp. Golden calyces
Malvaceae	<i>Sida</i> sp.
	Myrtaceae sp.
Myrtaceae	<i>Calytrix desolata</i>
Nyctaginaceae	<i>Boerhavia coccinea</i>
	<i>Aristida contorta</i>
	<i>Cymbopogon ambiguus</i>
	<i>Enneapogon robustissimus</i>
	<i>Eragrostis eriopoda</i>
	<i>Eriachne benthamii</i>
	<i>Eriachne mucronata</i>
	<i>Eriachne pulchella</i> subsp. <i>pulchella</i>
	Poaceae sp.
Poaceae	<i>Triodia basedowii</i>
Proteaceae	<i>Grevillea berryana</i>
Pteridaceae	<i>Cheilanthes sieberi</i>
	<i>Psydrax latifolia</i>
Rubiaceae	<i>Psydrax suaveolens</i>
Santalaceae	<i>Santalum spicatum</i>
	<i>Dodonaea pachyneura</i>
Sapindaceae	<i>Dodonaea petiolaris</i>



	<i>Dodonaea sp.</i>
	<i>Eremophila ?granitica</i>
	<i>Eremophila citrina</i>
	<i>Eremophila exillifolia</i>
	<i>Eremophila forrestii</i> subsp. ? <i>forestii</i>
	<i>Eremophila fraseri</i> subsp. <i>fraseri</i>
	<i>Eremophila jucunda</i> subsp. <i>jucunda</i>
	<i>Eremophila margarethae</i>
Scrophulariaceae	<i>Eremophila spectabilis</i>
Solanaceae	<i>Solanum lasiophyllum</i>

# Appendix G Floristic Data - Flora Sampling Sites

# Abra Airstrip – AAr01

## Site Details:

Described by: AB  
Date: 2/10/2018  
Type: Relevé  
MGA Zone: 50J 663084mE  
 7275507mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Tracks, Grazing  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia incurvaneura*, *Grevillea berryana* and *Acacia ramulosa* var. *ramulosa* open tall shrubland, over *Senna* sp. Meekatharra open shrubland, over *Solanum lasiophyllum*, *Ptilotus schwartzii*, *Eremophila fraseri* subsp. *fraseri* open low shrubland.

Veg Condition: Excellent  
Fire Age: 5 to 15 years  
Weeds: None  
Fire Notes: N/A

**Table A: Species list**

Species	Height	Cover
<i>Acacia incurvaneura</i>	4	1
<i>Acacia kempeana</i>	1.5	0.5
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	2	4
<i>Acacia rhodophloia</i>	2	1
<i>Aristida contorta</i>	0.2	0.1
<i>Eremophila ?granitica</i>	0.25	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	0.8	0.5
<i>Eremophila margarethae</i>	2	0.5
<i>Eriachne mucronata</i>	0.3	0.5
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.1	0.5
<i>Grevillea berryana</i>	3.5	1
<i>Ptilotus schwartzii</i>	0.4	0.5
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.6	0.5
<i>Solanum lasiophyllum</i>	0.7	0.5



# Abra Airstrip – AAr02

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 663073mE  
 7276224mN

## Environmental Variables:

Landform: Minor gully  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: Laterite

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: N/A  
Introduced species: N/A

## FLORA AND VEGETATION DATA

Description: *Acacia rhodophloia* tall open shrubland over *Eremophila citrina* and *Senna* sp. Meekatharra open shrubland over *Eriachne benthamii*, *Eriachne mucronata* and *Aristida contorta* very open tussock grassland.

Veg Condition: Excellent

Fire Age: 5 to 15 years

Weeds: None

Fire Notes: N/A

**Table B: Species list**

Species	Height	Cover
<i>Acacia rhodophloia</i>	4	8
<i>Psyrax latifolia</i>	2.1	1
<i>Eriachne mucronata</i>	0.4	1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.15	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.8	0.1
<i>Fimbristylis dichotoma</i>	0.05	0.1
<i>Hibiscus coatesii</i>	0.4	0.1
<i>Eremophila citrina</i>	2.2	1
<i>Rhagodia eremaea</i>	0.4	0.1
<i>Cheilanthes sieberi</i>	0.15	0
<i>Dodonaea</i> sp.	2.1	1
<i>Aristida contorta</i>	0.2	0.1
<i>Eriachne benthamii</i>	0.4	0.1
<i>Grevillea berryana</i>	3	1
<i>Boerhavia coccinea</i>	0.45	0.1
<i>Solanum lasiophyllum</i>	0.4	0.1
<i>Hibiscus burtonii</i>	0.5	0.1
<i>Sida</i> sp. Golden calyces	0.4	0.1

Species	Height	Cover
<i>Enneapogon robustissimus</i>	0.45	0.1
<i>Eremophila ?granitica</i>	1.2	0.1
<i>Polycarpaea corymbosa</i>	0.1	0.1
<i>Eremophila ?granitica</i>	0.35	0.1



# Abra Airstrip – AAr03

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 663018mE  
 7276155mN

## Environmental Variables:

Landform: Minor gully  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: Laterite

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: Grazing  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia citrinoviridis*, *Acacia rhodophloia* open tall shrubland over *Dodonaea* sp., *Eremophila citrina*, *Eremophila ?granitica* open shrubland over *Eriachne benthamii*, *Poaceae* sp., *Enneapogon robustissimus* very open tussock grassland.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table C: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	3.5	4
<i>Acacia incurvaneura</i>	2.4	1
<i>Acacia rhodophloia</i>	3	3
<i>Acacia tetragonophylla</i>	2.2	0.1
<i>Aristida contorta</i>	0.2	0.1
<i>Cheilanthes sieberi</i>	0.2	0.1
<i>Cymbopogon ambiguus</i>	0.7	0.1
<i>Dodonaea</i> sp.	1.6	0.1
<i>Enneapogon robustissimus</i>	0.4	0.5
<i>Eragrostis ?eriopoda</i>	0.5	1
<i>Eremophila ?granitica</i>	1.2	0.1
<i>Eremophila ?granitica</i>	0.3	0.1
<i>Eremophila citrina</i>	1.8	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	1.2	0.5
<i>Eremophila jucunda</i> subsp. <i>jucunda</i>	0.5	0.1
<i>Eremophila spectabilis</i>	3	0.1
<i>Eriachne benthamii</i>	0.5	1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.15	0.1
<i>Fimbristylis dichotoma</i>	0.2	0.1
<i>Hibiscus coatesii</i>	0.2	0.1

Species	Height	Cover
<i>Psydrax latifolia</i>	1.8	0.1
<i>Santalum spicatum</i>	2.2	0.1
<i>Solanum lasiophyllum</i>	0.45	0.1





## Abra Airstrip – AAr04

### Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 662879mE  
 7275770mN

### Environmental Variables:

Landform: Minor gully  
Slope: Level (0-3°)

### Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: Laterite

### Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: N/A  
Introduced species: N/A

### FLORA AND VEGETATION DATA

Description: *Acacia citrinoviridis*, *Acacia incurvaneura* tall open shrubland over *Acacia rhodophloia*, *Dodonaea* sp., *Dodonaea pachyneura* open shrubland over *Eriachne mucronata*, *Eriachne benthamii* very open tussock grassland.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table D: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	6	3
<i>Acacia incurvaneura</i>	4	1.5
<i>Acacia incurvaneura</i>	2.4	0.1
<i>Acacia rhodophloia</i>	2	0.5
<i>Acacia tetragonophylla</i>	0.9	0.1
<i>Aristida contorta</i>	0.2	0.1
<i>Dodonaea pachyneura</i>	1.2	0.5
<i>Dodonaea</i> sp.	1.6	1
<i>Eremophila ?granitica</i>	1.2	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	0.8	0.1
<i>Eriachne benthamii</i>	0.5	0.5
<i>Eriachne mucronata</i>	0.3	0.5
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.5	0.1
<i>Grevillea berryana</i>	0.1	0.1
<i>Hibiscus coatesii</i>	0.9	0.1
<i>Psyrax latifolia</i>	2.2	0.1
<i>Psyrax suaveolens</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.6	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.1	0.1



# Abra Airstrip – AAr05

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 663812mE  
 7275836mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Tracks, Feral scats  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia incurvaneura* and *Acacia kempeana* tall open shrubland over *Acacia rhodophloia* and *Psyrdrax suaveolens* open shrubland over *Ptilotus schwartzii* and *Ptilotus obovatus* scattered low shrubs

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table E: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	4	0.5
<i>Acacia incurvaneura</i>	2.2	0.1
<i>Acacia incurvaneura</i>	4	1
<i>Acacia kempeana</i>	3.5	2
<i>Acacia kempeana</i>	5	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	1.53	0.5
<i>Acacia rhodophloia</i>	1.8	0.5
<i>Aristida contorta</i>	0.08	0.1
<i>Eremophila ?granitica</i>	0.25	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	0.8	0.1
<i>Eremophila spectabilis</i>	0.8	0.1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.08	0.1
<i>Euphorbia boophthona/ tannensis</i>	0.2	0.1
<i>Goodenia ? tenuiloba</i>	0.08	0.1
<i>Grevillea berryana</i>	5	1
<i>Myrtaceae</i> sp.	0.9	0.1
<i>Poaceae</i> sp.	0.8	0.1
<i>Polycarpaea corymbosa</i>	0.05	0.1
<i>Psyrdrax latifolia</i>	2.2	0.5
<i>Psyrdrax suaveolens</i>	1.5	0.1
<i>Ptilotus obovatus</i>	1.1	0.1

Species	Height	Cover
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.9	0.1
<i>Sida</i> sp. Golden calyces	0.25	0.1
<i>Solanum lasiophyllum</i>	0.4	0.1



# Abra Airstrip – AAr06

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 663423mE  
 7275984mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Feral scats, Grazing, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia pruinocarpa*, *Acacia incurvaneura* and *Grevillea berryana* (*Psyrax latifolia*) tall open shrubland over *Eremophila spectabilis* and *Senna* sp. Meekatharra open shrubland over *Eremophila ?granitica* and *Ptilotus schwartzii* scattered low shrubs with scattered *Poaceae* sp. tussock grasses.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table F: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	2.8	0.1
<i>Acacia incurvaneura</i>	4	3
<i>Acacia pruinocarpa</i>	4	1
<i>Acacia ramulosa</i> var. <i>linophylla</i>	0.8	0.1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	2.5	0.5
<i>Acacia rhodophloia</i>	1.1	0.1
<i>Aristida contorta</i>	0.15	0.1
<i>Eragrostis eriopoda</i>	0.5	0.1
<i>Eremophila ?granitica</i>	0.3	0.1
<i>Eremophila citrina</i>	1.1	0.1
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	0.9	0.1
<i>Eremophila spectabilis</i>	1.1	0.1
<i>Eriachne mucronata</i>	0.25	0.1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.1	0.1
<i>Grevillea berryana</i>	3	1
<i>Poaceae</i> sp.	0.5	0.1
<i>Psyrax latifolia</i>	2.2	1
<i>Psyrax suaveolens</i>	0.8	0.1
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.6	0.1

Species	Height	Cover
<i>Solanum lasiophyllum</i>	0.4	0.1



## Abra Airstrip – AAr07

### Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 664228mE  
 7275325mN

### Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

### Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

### Impacts:

Waterlogging: No - Never  
Disturbance: Grazing, Feral trampling, Tracks  
Introduced species: Cattle

### FLORA AND VEGETATION DATA

Description: *Acacia pteraneura*, *Acacia incurvaneura* and *Acacia ramulosa* var. *ramulosa* tall open shrubland over *Senna artemisioides* subsp. *helmsii*, *Eremophila forrestii* and *Ptilotus obovatus* open shrubland over Poaceae sp. and *Eragrostis eriopoda* scattered tussock grasses.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table G: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	4	0.5
<i>Acacia incurvaneura</i>	4	2
<i>Acacia kempeana</i>	1.8	0.5
<i>Acacia pteraneura</i>	5	4
<i>Acacia ramulosa</i> var. <i>linophylla</i>	1.6	1
<i>Acacia rhodophloia</i>	5	1
<i>Aristida contorta</i>	0.15	0.1
<i>Cheilanthes sieberi</i>	0.1	0.1
<i>Eragrostis eriopoda</i>	0.5	1
<i>Eremophila ?granitica</i>	0.9	0.1
<i>Eremophila citrina</i>	1.4	0.1
<i>Eremophila forrestii</i>	0.9	1.5
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	1.1	0.1
<i>Eremophila spectabilis</i>	0.6	1
<i>Grevillea berryana</i>	4	1
<i>Hibiscus coatesii</i>	0.4	0.1
<i>Marsdenia australis</i>	0	0.1
<i>Psyrdrax latifolia</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.9	0.1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	1.4	0.1

Species	Height	Cover
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.2	1
<i>Sida</i> sp. Golden calyces	0.25	0.1
<i>Solanum lasiophyllum</i>	0.4	0.1
<i>Ptilotus obovatus</i>	0.9	0.1





# Abra Airstrip – AAr08

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 663996mE  
 7275142mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Grazing, Feral trampling, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia incurvaneura*, *Acacia kempeana* and *Acacia ramulosa* var. *linophylla* and *Psyrax latifolia* tall open shrubland over *Eremophila forrestii* open shrubland over Poaceae sp. and *Eragrostis eriopoda* open tussock grassland.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table H: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	8	0.5
<i>Acacia incurvaneura</i>	5	6.5
<i>Acacia kempeana</i>	7	2
<i>Acacia pruinocarpa</i>	0.4	0.1
<i>Acacia ramulosa</i> var. <i>linophylla</i>	1.5	1.5
<i>Dodonaea petiolaris</i>	1.7	0.1
<i>Eragrostis eriopoda</i>	0.5	1
<i>Eremophila forrestii</i>	1.2	0.5
<i>Eremophila spectabilis</i>	0.4	0.1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.15	0.1
<i>Grevillea berryana</i>	6	0.5
<i>Marsdenia australis</i>	0	0.1
Poaceae sp.	0.5	1
<i>Psyrax latifolia</i>	4	0.5
<i>Ptilotus obovatus</i>	0.8	0.1
<i>Ptilotus schwartzii</i>	0.4	0.1
<i>Senna cuthbertsonii</i>	1.6	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	0.5	0.5
<i>Sida</i> sp. Golden calyces	0.2	0.1
<i>Solanum lasiophyllum</i>	0.5	0.1



# Abra Airstrip – AAr09

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 663639mE  
 7275079mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Grazing, Feral trampling, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia pteraneura*, *Acacia kempeana* and *Acacia ramulosa* var. *linophylla* (*Grevillea berryana* and *Psydrax latifolia*) over *Eremophila forrestii* open shrubland over *Poaceae* sp. (*Eragrostis eriopoda*) very open tussock grassland

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table I: Species list**

Species	Height	Cover
<i>Acacia kempeana</i>	4	3
<i>Acacia pruinocarpa</i>	5	0.5
<i>Acacia pteraneura</i>	5	3
<i>Acacia ramulosa</i> var. <i>linophylla</i>	2.1	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	4	0.5
<i>Acacia rhodophloia</i>	2.6	0.1
<i>Aristida contorta</i>	0.2	0.1
<i>Eragrostis eriopoda</i>	0.4	0.5
<i>Eremophila forrestii</i>	1.2	1.5
<i>Eriachne mucronata</i>	0.25	0.1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.1	0.1
<i>Grevillea berryana</i>	3.5	0.5
<i>Poaceae</i> sp.	0.5	1
<i>Psydrax latifolia</i>	3	1
<i>Ptilotus obovatus</i>	0.5	0.5
<i>Ptilotus schwartzii</i>	0.3	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.2	0.1
<i>Solanum lasiophyllum</i>	0.4	0.1



# Abra Airstrip – AAr10

## Site Details:

Described by: AB  
Date: 3/10/2018  
Type: Relevé  
MGA Zone: 50J 664548mE  
 7275681mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Feral trampling, Feral scats, Grazing, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia ramulosa* var. *linophylla*, *Acacia incurvaneura* and *Acacia pteraneura* tall shrubland over *Eremophila forrestii* and *Eremophila spectabilis* shrubland over *Poaceae* sp. and *Eragrostis eriopoda* very scattered tussock grasses.

Veg Condition: Excellent  
Fire Age: 3 to 5 years  
Weeds: None  
Fire Notes: N/A

**Table J: Species list**

Species	Height	Cover
<i>Acacia ?macraneura</i>	1.7	0.1
<i>Acacia incurvaneura</i>	5	2
<i>Acacia kempeana</i>	2.5	0.1
<i>Acacia pteraneura</i>	4	2
<i>Acacia ramulosa</i> var. <i>linophylla</i>	2.5	12
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	1.1	0.1
<i>Acacia rhodophloia</i>	2.2	0.5
<i>Eragrostis eriopoda</i>	0.5	0.5
<i>Eremophila forrestii</i>	1.2	7
<i>Eremophila spectabilis</i>	1.2	5
<i>Grevillea berryana</i>	3	0.1
<i>Poaceae</i> sp.	0.5	1
<i>Psyrax latifolia</i>	0.25	0.1
<i>Ptilotus obovatus</i>	1.1	0.1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	1.6	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	2.1	0.5



# Abra Airstrip – AAr11

## Site Details:

Described by: AB  
Date: 4/10/2018  
Type: Relevé  
MGA Zone: 50J 665247mE  
 7275652mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Never  
Disturbance: Feral trampling, Feral scats  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia ramulosa* var. *linophylla*, *Acacia pteraneura* (*Grevillea berryana*) tall shrubland over *Eremophila forrestii* shrubland over *Eremophila spectabilis* low shrubs with scattered Poaceae sp. and *Eragrostis eriopoda* tussock grasses

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table K: Species list**

Species	Height	Cover
<i>Acacia incurvaneura</i>	4	0.5
<i>Acacia pteraneura</i>	4	4
<i>Acacia ramulosa</i> var. <i>linophylla</i>	2.4	4
<i>Acacia rhodophloia</i>	2	0.1
<i>Aristida contorta</i>	0.15	0.1
<i>Eragrostis eriopoda</i>	0.4	0.5
<i>Eremophila forrestii</i>	1.6	15
<i>Eremophila fraseri</i> subsp. <i>fraseri</i>	1.6	0.1
<i>Eremophila spectabilis</i>	0.6	1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.1	0.1
<i>Grevillea berryana</i>	3	0.5
Poaceae sp.	0.4	1
<i>Psyrax suaveolens</i>	3	0.1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	1.1	0.5
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	2.2	0.1
<i>Triodia basedowii</i>	0.4	0.1





# Abra Airstrip – AAr12

## Site Details:

Described by: AB  
Date: 4/10/2018  
Type: Relevé  
MGA Zone: 50J 664973mE  
 7275749mN

## Environmental Variables:

Landform: Minor flowline, not incised  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sand  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: Feral trampling, Grazing, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia incurvaneura*, *Acacia citrinoviridis* and *Acacia rhodophloia* tall open shrubland over *Calytrix desolata* scattered shrubs over *Eremophila citrina* scattered low shrubs and very scattered tussock grasses.

Veg Condition: Excellent  
Fire Age: 3 to 5 years  
Weeds: None  
Fire Notes: N/A

**Table L: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	5	1.5
<i>Acacia incurvaneura</i>	3.5	3
<i>Acacia kempeana</i>	1.1	0.1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	1.3	0.1
<i>Acacia rhodophloia</i>	3.5	1
<i>Aristida contorta</i>	0.15	0.1
<i>Calytrix desolata</i>	1.3	0.5
<i>Eragrostis eriopoda</i>	0.35	0.1
<i>Eremophila citrina</i>	0.7	1.5
<i>Eremophila exilifolia</i>	0.6	0.1
<i>Eriachne pulchella</i> subsp. <i>pulchella</i>	0.08	0.1
Poaceae sp.	0.4	0.1
<i>Psyrax latifolia</i>	2.2	0.1
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.2	0.1



# Abra Airstrip – AAr13

## Site Details:

Described by: AB  
Date: 4/10/2018  
Type: Relevé  
MGA Zone: 50J 664604mE  
 7275385mN

## Environmental Variables:

Landform: Minor flowline, not incised  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sand  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: Feral scats, Feral trampling, Grazing  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia citrinoviridis*, *Acacia incurvaneura* and *Psyrax latifolia* tall open shrubland over *Eremophila citrina* and *Eremophila spectabilis* open shrubland over very scattered tussock grasses.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table M: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	5	4
<i>Acacia incurvaneura</i>	4	4
<i>Acacia rhodophloia</i>	3.5	1
<i>Acacia tetragonophylla</i>	0.4	0.1
<i>Eragrostis eriopoda</i>	0.4	0.1
<i>Eremophila ?granitica</i>	1.1	0.1
<i>Eremophila citrina</i>	0.5	0.5
<i>Eremophila spectabilis</i>	1.1	0.5
<i>Eriachne mucronata</i>	0.2	0.1
<i>Euphorbia boophthona/ tannensis</i>	0.3	0.1
<i>Grevillea berryana</i>	1.5	0.1
<i>Hibiscus coatesii</i>	0.4	0.1
Poaceae sp.	0.5	0.1
<i>Psyrax latifolia</i>	2.5	1.5
<i>Sida</i> sp.	0.9	0.1



# Abra Airstrip – AAr14

## Site Details:

Described by: AB  
Date: 4/10/2018  
Type: Relevé  
MGA Zone: 50J 664484mE  
 7274981mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: Grazing, Feral scats, Feral trampling, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia ramulosa* var. *ramulosa*, *Grevillea berryana* (*Acacia citrinoviridis*) tall shrubland over *Eremophila citrina*, *Solanum lasiophyllum* and *Senna* sp. Meekatharra open shrubland.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A

**Table N: Species list**

Species	Height	Cover
<i>Acacia citrinoviridis</i>	7	0.5
<i>Acacia incurvaneura</i>	2.2	0.1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	2.4	12
<i>Acacia tetragonophylla</i>	3	0.1
<i>Eremophila citrina</i>	1.8	1
<i>Eremophila jucunda</i> subsp. <i>jucunda</i>	0.4	0.1
<i>Grevillea berryana</i>	2.1	0.1
<i>Psyrax latifolia</i>	3.2	1
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	1.1	0.1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.4	0.5
<i>Sida</i> sp. Golden calyces	0.25	0.1
<i>Solanum lasiophyllum</i>	1.1	1



# Abra Airstrip – AAr15

## Site Details:

Described by: AB  
Date: 4/10/2018  
Type: Relevé  
MGA Zone: 50J 664756mE  
 7275054mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: Grazing, Feral scats, Feral trampling, Tracks  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia ramulosa* var. *ramulosa*, *Acacia incurvaneura* and *Grevillea berryana* tall shrubland over *Eremophila citrina* and *Eremophila spectabilis* low shrubland over very scattered tussock grasses.

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: -

Fire Notes: N/A

**Table O: Species list**

Species	Height	Cover
<i>Acacia incurvaneura</i>	2.5	1
<i>Acacia pruinocarpa</i>	4.5	0.1
<i>Acacia ramulosa</i> var. <i>linophylla</i>	1.8	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	2.8	15
<i>Acacia rhodophloia</i>	3	0.5
<i>Eragrostis eriopoda</i>	0.25	0.1
<i>Eremophila citrina</i>	0.8	1
<i>Eremophila forrestii</i>	1.2	0.1
<i>Eremophila spectabilis</i>	0.8	1
<i>Eriachne mucronata</i>	0.2	0.1
<i>Grevillea berryana</i>	5	1
<i>Ptilotus schwartzii</i>	0.25	0.1
<i>Sida</i> sp. Golden calyces	0.25	0.1
<i>Solanum lasiophyllum</i>	1.1	0.1
<i>Triodia basedowii</i>	0.25	0.1





# Abra Airstrip – AAr16

## Site Details:

Described by: AB  
Date: 4/10/2018  
Type: Relevé  
MGA Zone: 50J 665050mE  
 7275309mN

## Environmental Variables:

Landform: Plain  
Slope: Level (0-3°)

## Soils:

Soil Texture: Sandy clay loam  
Soil Colour: Reddish brown  
Rock Type: N/A

## Impacts:

Waterlogging: No - Prone to Flooding  
Disturbance: Grazing, Feral scats, Feral trampling  
Introduced species: Cattle

## FLORA AND VEGETATION DATA

Description: *Acacia ramulosa* var. *ramulosa*, *Grevillea berryana* and *Acacia rhodophloia* tall open shrubland over *Eremophila spectabilis*, *Eremophila forrestii* and *Senna artemisioides* subsp. *helmsii* low shrubland over *Eriachne eriopoda* open tussock grassland.

Veg Condition: Excellent  
Fire Age: 3 to 5 years  
Weeds: None  
Fire Notes: N/A

Table P: Species list

Species	Height	Cover
<i>Acacia incurvaneura</i>	4	1
<i>Acacia ramulosa</i> var. <i>linophylla</i>	2.1	1
<i>Acacia ramulosa</i> var. <i>ramulosa</i>	1.2	0.1
<i>Acacia rhodophloia</i>	4	2
<i>Aristida contorta</i>	0.15	0.1
<i>Eragrostis eriopoda</i>	0.4	2.5
<i>Eremophila forrestii</i>	1.1	5
<i>Eremophila spectabilis</i>	1.2	7
<i>Grevillea berryana</i>	4	1
<i>Senna artemisioides</i> subsp. <i>helmsii</i>	1.8	1
<i>Senna</i> sp. Meekatharra (E. Bailey 1-26)	1.8	0.1
<i>Triodia basedowii</i>	0.25	0.1



## Abra Airstrip – AAmn02

### Site Details:

Described by: AB

Date: 4/10/2018

Type: Mapping note

MGA Zone: 50J 664576mE  
7274997mN

### Environmental Variables:

Landform: Minor flowline

Slope: Level (0-3°)

### FLORA AND VEGETATION DATA

Description: *Acacia incurvaneura*, *Acacia citrinoviridis* and *Acacia rhodophloia* tall open shrubland over *Calytrix desolata* scattered shrubs over *Eremophila citrina* scattered low shrubs and very scattered tussock grasses

Veg Condition: Excellent

Fire Age: 3 to 5 years

Weeds: None

Fire Notes: N/A



**Perth**

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**APPENDIX 2:**  
**EMS**



# Environmental Management System

Abra Mining Pty Limited

**Revision 5**

23 August 2022

## Document history and status

Revision	Date	Description	By
A	21/6/2018	Preliminary EMS	P Rokich
B	16/7/2018	First draft to client for review	P Rokich
1	25/10/2018	Issue to client	E. Maller
2	13/3/2019	Update to procedures	P Rokich
3	3/6/2019	Change company to AMPL and add Fauna Management Procedure	P Rokich
4	3/8/2020	Annual review. Update procedures	P Rokich
5	23/8/2022	Annual review. Update procedures	P Rokich

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**Appendix K. Hot work permit**



# 1. Introduction

Galena Mining Limited acquired exploration tenements in the Peak Hill mineral field in the Gascoyne region of Western Australia in 2017. These tenements contained the Abra Base Metals deposit. Exploration drilling has further defined the mineral resource to the point that AMPL is undertaking a Pre-Feasibility Study to develop the deposit into an operational mine. The mine will initially produce a lead – silver (Pb-Ag) concentrate, with the deposit transitioning to a polymetallic lead – silver – copper – gold (Pb-Ag-Cu-Au) product at depth. The project is now 100% owned by Abra Mining Pty Limited (AMPL).

The project, known as the Abra Base Metals mine, will involve underground mining, base metals concentrate production via floatation processing and road transport of the concentrate to the Port of Geraldton for export.

The Abra project has been described in detail in other documents, principally the Mining Proposal. The Mining Proposal document covers elements such as project description and existing environment and is not repeated in this document.

## 1.1 Purpose and Scope

This Environmental Management System (EMS) documents how AMPL will manage environment impact of its activities.

The EMS has been structured to be relevant for the construction and operational phases of the mine life cycle. Mine closure has a unique set of activities and potential environmental impacts to which the current EMS does not address. For mine closure, a future revision of the EMS will address specific closure issues identified in the Mine Closure Plan risk assessment and prepare specific Project Operating Procedures as required.

## 1.2 Location

The Abra project is located in the eastern Gascoyne region, approximately 250 kilometres north of Meekatharra. The proposed mine is shown in **Figure 1**.

## 1.3 Requirement for an EMS

The Abra Base Metals deposit is located in a wider land precinct containing existing conservation reserves and pastoral leases. To minimise potential environmental impacts from the project, AMPL wish to develop documented processes to mitigate potential impacts to acceptable levels.

The (then) Department of Mines and Petroleum (DMP) (now Department of Industry Regulation and Safety – DMIRS) published *Guidelines for Mining Proposals in Western Australia* in April 2016. The guidelines require proponents to demonstrate an upfront assessment and identification of risk management measures in any Mining Proposal submitted to them. Due to the long term nature of mining activities and the potential for new risks to arise during operation, ongoing risk identification and monitoring of the success of the proposed management measures is required. Following approval of a Mining Proposal, DMIRS requires the risk management process to be maintained and managed throughout the life of the project via an appropriate EMS. While DMIRS does not require certification of the system under the AS/NZS ISO 1400:2016 Environmental Management System Standard (Standards Australia 2016), should proponents choose not to certify their system or implement an alternative EMS, an outline of this system must be explained in the Mining Proposal.

This EMS is consistent with AS/NZS ISO 14001:2016.

## 1.4 EMS Evolution

The EMS is to be implemented on commencement of activities at the site and continue throughout the operating life of mine. The EMS is adaptive and will be reviewed on an annual basis to maintain currency and addresses operational changes.

At this early stage of the Abra project, many systems, including this EMS, are also in development. As more information on how the Abra project is developed comes to hand, the EMS will be updated.

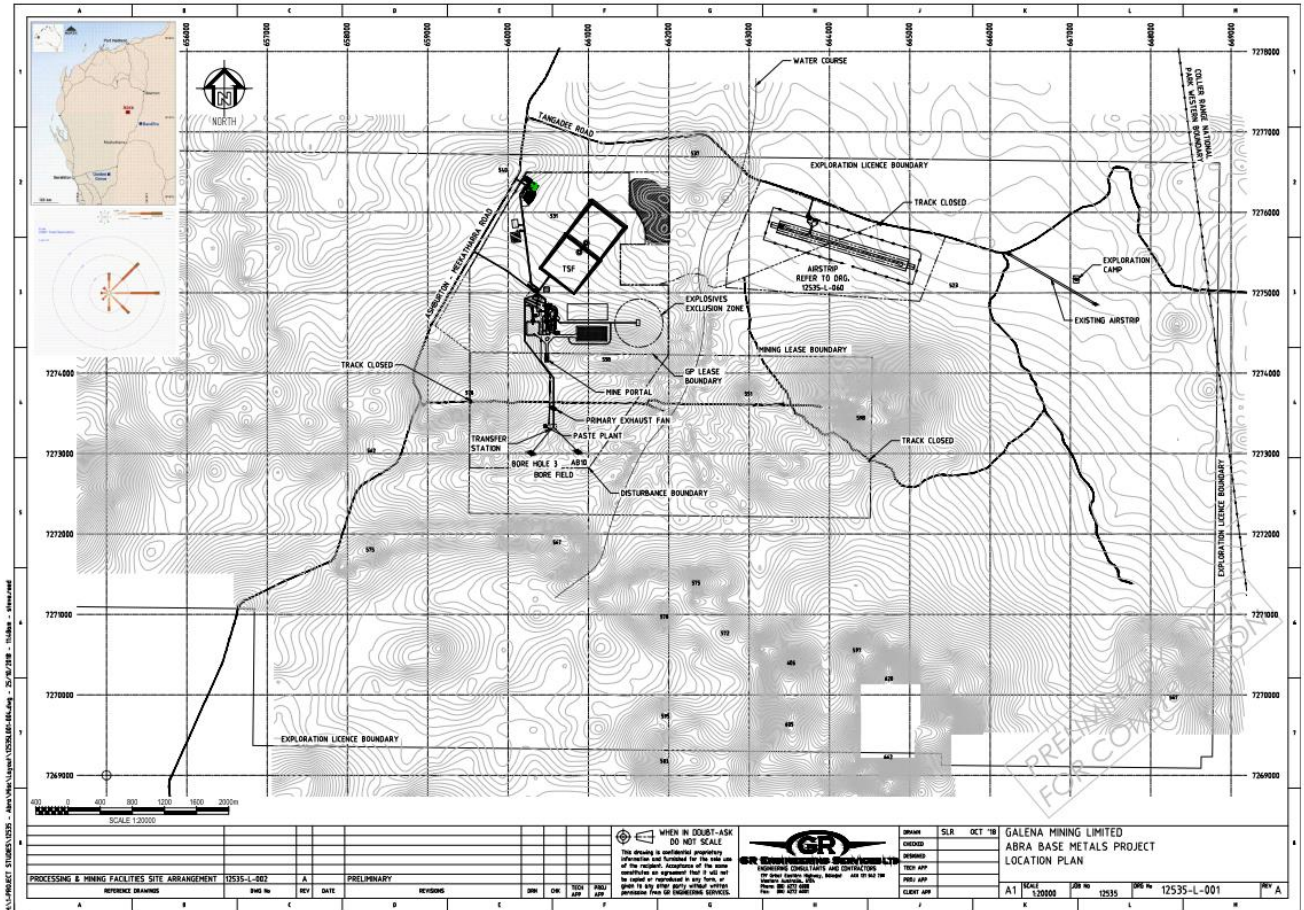


Figure 1: Location

## 2. Document Structure

AMPL has developed this EMS consistent with the principles of AS/NZS ISO 14001:2016. The sequent sections of this document describe the EMS. While the EMS uses the AS/NZS ISO 14001:2016 framework, AMPL does not intend to seek AS/NZS ISO 14001:2016 accreditation. **Table 2-1** demonstrates where AS/NZS ISO 14001:2016 content and also DMP (2016) example structure is reflected in the EMS document.

AMPL has developed the EMS to manage environmental impacts associated with its mining operations. The EMS includes management procedures, checklists and forms to manage specific activities on the project site.

**Table 2-1: Document Structure**

<b>DMP (2016) Model Structure</b>	<b>Sub Headings and Description</b>	<b>Section of this Document</b>
<b>Policy</b>	<p><b>Environmental Policy</b></p> <p>AMPL's Environmental Policy provides objectives for the conduct of all operations, employees and contractors. The policy details AMPL's commitment to continuous improvement in environmental performance, pollution prevention, and compliance with environmental legislation.</p>	<b>3</b>
<b>Planning</b>	<p><b>Legal obligations and other commitments</b></p> <p>Statutory requirements set the minimum standard for compliance. A Compliance Register detailing applicable legal requirements, as well as voluntary commitments made by AMPL has been developed to assist in monitoring compliance with these requirements and commitments.</p>	<b>4.1</b>
	<p><b>Management commitment</b></p> <p>AMPL management recognise the importance of leading by example. Senior management have committed to active involvement in implementation of this system.</p> <p>The senior mine management team will review the EMS annually, to ensure that it remains effective and appropriate. The review takes into account results of environmental audits, the extent to which environmental objectives and targets have been met, its continued relevance to changing conditions and issues raised by stakeholders.</p>	<b>4.2</b>
	<p><b>Environmental Aspects (Risk Management)</b></p> <p>Environmental aspects (issues) and risks associated with the company's activities are identified, evaluated and managed. Operational control documents have been developed to reduce environmental risks during construction, normal operations and emergency situations as low as reasonably practicable (ALARP).</p>	<b>4.3</b>

<b>DMP (2016) Model Structure</b>	<b>Sub Headings and Description</b>	<b>Section of this Document</b>
<b>Implementation</b>	<b>Responsibilities and Reporting Structure</b> Environmental management is a line accountability, but every employee and contractor is also responsible for conducting activities in an environmentally acceptable manner. Successful implementation of the EMS depends on commitment of all employees and contractors. Individual responsibilities and authorities have been defined in relevant documents and communicated to personnel through inductions and meetings.	<b>5.1</b>
	<b>Induction and Training</b> All staff and contractors working on site will be inducted and will need to have the appropriate training and/or experience for their roles.	<b>5.2</b>
	<b>Communication</b> AMPL commits to ongoing consultation with both internal and external stakeholders. This includes reports to government agencies, meetings and written correspondence.	<b>5.3</b>
<b>Implementation</b>	<b>Operational Control</b> AMPL will ensure that plans, procedures, permits, forms and checklists are implemented to reduce environmental impact of activities. Environmental monitoring will provide ongoing feedback on the effectiveness of control strategies.	<b>5.4</b>
<b>Performance and Reporting</b>	<b>Environmental Performance</b> Monitoring provides data on the site's performance against targets, compliance with regulatory requirements, voluntary commitments and with the EMS.	<b>6.1</b>
	<b>Reporting</b> Systems have been established for internal and external reporting and communication of hazard /incident reports; operational reports; environmental monitoring results.	<b>6.2</b>
	<b>Contractor Management</b> AMPL will implement an inspection program to ensure contractor's performance is consistent with requirements of the EMS.	<b>6.3</b>
<b>Review</b>	<b>Environmental Audits and Inspections</b> Audits, inspections and reviews allow the operation to identify opportunities for improvement to enable the operation to continually improve its performance. <u>Inspections</u> focus on the practical implementation of company procedures. <u>Audits</u> are conducted to ensure specific components of the EMS are being complied with. <u>Reviews</u> are conducted to ensure requirements of the EMS are practicable and assist the operation in meeting its regulatory and voluntary environmental commitments.	<b>7</b>

### 3. Environmental Policy

Appendix C provides AMPL's company policy on environmental matters.

## 4. Planning

### 4.1 Legal Compliance

Statutory requirements are the minimum compliance standard. A Compliance Register for the site shall be maintained that contains a list of approval conditions, tenement conditions, voluntary commitments and current copies of relevant licences and permits. The compliance register records:

1. Statutory conditions that include:
  - a. Tenement conditions
  - b. Department of Water and Environmental Regulation (DWER) Environmental Protection (EP) Act Part V licence conditions
  - c. Water licence conditions
  - d. Clearing permit conditions
  - e. Mining Proposal commitments
2. Date of commencement and expiry of all licences and permits.
3. Status of the condition.

### 4.2 Management Commitment

AMPL management recognise the importance of leading by example. Senior management have committed to active involvement in implementing the EMS.

**Table 4-1** details roles and responsibilities that include annual review the EMS, to ensure that it remains effective and appropriate. The review takes into account results of environmental audits, the extent to which environmental objectives and targets have been met, its continued relevance to changing conditions and issues raised by stakeholders.

### 4.3 Risk Management

The Australian and New Zealand Standard on Risk Management (AS/NZS 4360) defines risk as the product of the likelihood of an event occurring and the consequence of that event. AMPL has developed a risk matrix based on AS/NZS 4360:2004 to assess the risk of activities undertaken in its operation.

A risk assessment has been undertaken for key functions for the Abra project. It is included in the Mining Proposal document. To maximise the benefit in pro-active management of environmental issues, it is important that manpower and other resources are allocated on a priority basis to issues. It is normally accepted that the highest risk issues receive the highest priority.

AMPL has established a set of routine controls that comprise procedures, internal permits, forms and inspection checklists, which provide control measures to reduce environmental impacts of activities at their mining operation. These are detailed in **Section 5.4: Operational Control**.

Table 4-1: Roles and Responsibilities

Personnel	Responsibilities
<b>Mine Manager (MM)</b>	<ul style="list-style-type: none"> <li>• Ensure the EMS is effectively implemented.</li> <li>• Review performance of the EMS on an annual basis.</li> <li>• Review any environmental non-conformances and remediation actions;</li> <li>• Allocate resources to manage environmental issues; and</li> <li>• Ensure contractors comply with environmental requirements.</li> </ul>
<b>Departmental Managers (DM)</b>	<ul style="list-style-type: none"> <li>• Implement the EMS on site.</li> <li>• Liaise with the Environmental Staff on environmental issues and non-conformances.</li> <li>• Ensure that site personnel are aware of their environmental obligations.</li> <li>• Take corrective action to resolve non-conformances.</li> </ul>
<b>Environmental Staff (ES)</b>	<ul style="list-style-type: none"> <li>• Assigned responsibility for the EMS's compliance.</li> <li>• Implement an appropriate environmental induction programme and assist site personnel to implement the programme.</li> <li>• Prepare Annual Environmental Report (AER), with Environmental Office, for external reporting.</li> <li>• Liaise with relevant local authorities to maintain effective communication.</li> <li>• Liaise with the general public and key stakeholders, as required.</li> <li>• Review and update the EMS and associated documentation.</li> <li>• Ensure the EMS is implemented and required records are maintained.</li> <li>• Prepare monthly Environmental Report (MER) for internal report purposes.</li> <li>• Prepare Annual Environmental Report (AER) for external reporting.</li> <li>• Ensure prestart/ toolbox meetings address environmental issues as required and these are documented in meeting minutes.</li> <li>• Ensure that appropriate communications are in place between AMPL and the contractors.</li> <li>• Confirm all personnel have been inducted prior to commencing work.</li> <li>• Implement environmental monitoring and audit programmes.</li> <li>• Ensure that environmental records and files are maintained.</li> </ul>
<b>Employees</b>	<ul style="list-style-type: none"> <li>• Employees are expected to conduct all activities in an environmentally responsible manner during the course of their employment.</li> <li>• Supervisors shall make all employees aware of their responsibilities for environmental management.</li> <li>• Employees will comply with any environmental instruction relating to work practices.</li> <li>• Employees will report and rectify unacceptable environmental conditions and practices when they are identified.</li> <li>• Employees are encouraged to take ownership of environmental issues through participation in decision-making and accountability in all areas of their workplace.</li> </ul>
<b>Contractors</b>	<ul style="list-style-type: none"> <li>• Contractors are required to uphold AMPL' environmental standards and commitments referred to in the EMS.</li> <li>• Relevant Departmental Managers shall ensure that all contractors in their area of responsibility are informed of their environmental responsibilities and that their performance is monitored.</li> </ul>

## 5. Implementation

### 5.1 Responsibilities

The Registered Mine Manager has ultimate statutory responsibility for activities undertaken on the mine.

Departmental Managers are responsible for their respective areas' compliance with regulatory requirements and internal company standards. The Environmental Staff will actively assist Departmental Managers in fulfilling these responsibilities. Key site responsibilities are outlined in **Table 4-1**.

### 5.2 Induction and Training

The site induction ensures that employees, contractors and third parties are made aware of their roles and responsibilities in relation to the environment, safety and health. The environmental induction component of this site wide process specifically addresses:

- AMPL's Corporate Environmental Policy.
- The Environmental Management System.
- Internal environmental work permit systems.
- Emergency Response Procedures (environmental emergencies).
- Areas of environmental sensitivity at the project site.

Training requirements will be identified and documented in relevant environmental procedures. Where identified in a procedure, training will be provided if employees have specific tasks that have or may have a significant environmental impact and where their activities have the potential to influence the performance measurement of the site. Environmental training may include, but is not limited to such things as:

- Spill response (Emergency Response Team members).
- Dangerous goods storage and handling (Supply personnel).
- Water sample collection and sample dispatch (environmental staff).
- Waste management (environmental staff).

Environmental training shall be conducted by appropriately qualified and experienced internal personnel or external bodies. All environmental training undertaken by employees shall be recorded on their individual personnel file. Training records will be held by the Administration Manager and will be managed to ensure confidentiality is maintained.

### 5.3 Communication

AMPL recognises the importance of communicating the performance of the EMS with employees, contractors and stakeholders.

Employees and contractors are to be encouraged to report deficiencies, non-conformances and environmental issues at toolbox meetings.

The Registered Manager is responsible for ensuring that a monthly report is prepared and submitted to the Board. This report specifically includes details of:

- Environmental incidents recorded.
- Communications with regulatory authorities.
- New approvals obtained or amendments to existing approvals.
- Non-compliances identified in audits and actions taken to address these.



- Anomalous environmental monitoring results.

The Registered Manager is responsible for communicating the performance of the EMS to employees, contractors and, where applicable, other stakeholders:

Requests and directives from regulatory authorities shall be dealt with in a timely manner. All formal environmental related correspondence with regulatory bodies shall be issued under the Registered Manager's signature.

## **5.4 Operational Control**

**Table 5-1** details operational controls aimed at providing measures to reduce environmental impacts from site activities. These include procedures, internal permits, forms and inspection checklists. These are appended to this EMS (**Appendix A**).

**Table 5-1: Operational Controls**

<b>Document</b>	<b>Control function</b>	<b>Application</b>
Vegetation management procedure	Documents the process for vegetation clearing, topsoil management and weed control. Includes the internal clearing permit form and clearing register.	When undertaking clearing activities
Fauna management procedure	Documents the process for fauna management. Includes the internal fauna death or injury form.	Ongoing through the life of mine
Airstrip fauna management procedure	Documents monitoring for fauna that may impact approaching aircraft, prior to the plane's arrival on site	Prior to aircraft arrival
Hydrocarbon and chemical procedure	Documents the process for hydrocarbon and chemical management. Includes the Hazardous Materials Register and the Spill Procedure	Ongoing through the life of mine
Aboriginal heritage procedure	Documents the process to identify and protect Aboriginal heritage sites.	Prior to commencement of site works
Waste management procedure	Documents the process for waste management. Includes the spill procedure	Ongoing through the life of mine
Accident/Incident Form	Form to report accidents and incidents	As required
Accident Incident Investigation Form	Form to investigation Significant or High risk incidents	As required
Hot work permit	Documents the process to undertake hot work activities on site	As required
Environmental constraints map	Records environmental / heritage sites and buffer areas.	Ongoing through the life of mine
Water monitoring procedure	Documents the process for water monitoring.	As required by licences and permits.
Monthly inspection of contractors area	Records inspection of contractor areas and routine reporting requirements (e.g. NPI data; clearing reconciliation).	Monthly
Monthly inspection of mine area	Records inspection of site facilities and mine features for compliance with environmental requirements.	Monthly

## 6. Performance and Reporting

### 6.1 Environmental Performance

Monitoring programs are to be established for a range of site activities that may have a significant impact on the environment. Data collected from monitoring activities is to be assessed and compared against relevant approval conditions and performance measures. A summary of monitoring results shall be included in the site's internal quarterly report and external reports (**Section 6.2**). **Table 6-1** lists the routine monitoring requirements for the site. Additional requirements will be added as approval and licence conditions are known.

### 6.2 Reporting

Systems have been established for internal and external reporting and communication of hazard /incident reports; operational reports; environmental monitoring results.

An internal Monthly Environmental Report (MER) is required to be compiled from environmental staff to the Mine Manager, summarising:

- Environmental monitoring data and identifying trends.
- Anomalous monitoring records and actions resulting.
- Environmental incidents and outcomes.
- Environmental commitments and conditions relevant for the period and actions taken.

An Annual Environmental Report (AER) is required by regulatory agencies as an audit tool against compliance with their approval conditions. The AER is likely to include a summary of monitoring data collected during the reporting period, identify trends, identify reasons for any anomalous results recorded and describe any changes proposed to environmental monitoring programs. Monitoring data from the MER's will be collated and included in the AER.

### 6.3 Contractor Management

AMPL will implement an inspection program to ensure contractor's performance is consistent with requirements of the EMS.

**Table 6-1: Monitoring Schedule**

<b>What</b>	<b>How</b>	<b>Who</b>	<b>Report in ...</b>
<b>As required.</b>			
Seed collection	Record weight of seed and species collected from cleared areas	ES	AER
Constraints Map	Update with new information on constraints and location of stockpiles	ES	AER
<b>Monthly</b>			
Bore flow meter readings	Record meter readings of bores and water network on site.	ES	MER
Potable water sampling	Take samples from potable water locations	ES	MER
Contractor checklist	Inspection of work areas to record general housekeeping and compliance with AMPL requirements	Contractors and AMPL ES	MER
Site checklist	Inspect each mine feature against approval conditions and performance measures	ES	MER
<b>Quarterly</b>			
Vegetation clearing	Maintain clearing Register. Collate clearing permit forms.	ES	MER
Environmental incidents	Collate all environmental incident reports	ES	MER
Induction records	Collate induction records	Admin officer	MER
Water monitoring	Collate monitoring records and compare against licence conditions	ES	MER
<b>Annually</b>			
Vegetation procedure	Review of procedure and update EMS	ES	AER
Water monitoring procedure	Review of procedure and update EMS	ES	AER
Hydrocarbon and chemical procedure	Review of procedure and update EMS	ES	AER
Waste Management Procedure	Review of procedure and update EMS	ES	AER

## 7. Review

Regular inspections, audits and reviews are an essential component of the EMS. The audit and review program is summarised in **Table 7-1**.

The environmental staff shall audit the site on an annual basis. Results of the audit are to be submitted to the Registered Manager as part of the annual system review.

Departmental Managers, in conjunction with environmental staff, shall develop an action plan to address identified non-compliances within their areas. Responsibilities and timeframes for completion of tasks shall be allocated and documented in the action plan.

**Table 7-1: Review Schedule**

<b>Activity</b>	<b>Document</b>	<b>Frequency</b>	<b>Auditor/Reviewer</b>
Inspection	Scheduled inspections of site	Monthly	Environmental staff (ES)
Audit	Compliance Register	Annually	Environmental staff
Audit	EMS compliance	Annually	Environmental staff
Review	Procedures, permits and guidelines	Annually	Document custodians.
Review	Position Responsibilities	Annually	Employee's line manager
Review	Environmental Policy	Biennially	AMPL CEO

## 8. References

Department of Mines and Petroleum 2016, *Guideline for Mining Proposals in Western Australia*, Government of Western Australia. Available from <http://www.dmp.wa.gov.au/>. [16 July 2018].

Standards Australia 2016, *Environmental Management Systems – Requirements with guidance and use*, AS/NZS 14001:2016. Available from Australian Standards. [16 July 2018].

# Appendix A. Control Documents

List of control documents

<b>Procedure</b>
Appendix B- Aboriginal Heritage Procedure
Appendix C - Environmental Policy
Appendix D - Monthly Contractor Inspection Checklist
Appendix E - Hazard / Incident Forms
Appendix F - Hydrocarbon and Chemicals Procedure and Hazardous Materials Register
Appendix G- Vegetation Management Procedure
Appendix H- Waste Management Procedure
Appendix I - Water Monitoring Procedure
Appendix J - Fauna Management Procedures
Appendix K - Hot work permit

# Appendix B. Aboriginal Heritage Procedure



**Aboriginal Heritage Procedure****Purpose**

This standard procedure details action required to comply with the *Aboriginal Heritage Act 1972* and protect places and objects of Aboriginal heritage value in the project area.

**Background**

All staff and contractors will be made aware of cultural heritage issues in the site induction.

**Risks**

The key risk is inadvertent damage to Aboriginal heritage sites located in or adjacent to active areas.

**Procedure*****Prior to ground disturbance activities***

Conduct heritage surveys over project areas, to identify locations to be avoided and exclusion zones.

Record all exclusion zones on the environmental constraints map.

Use signposts, flagging or fencing to protect identified heritage sites in the project area.

Where disturbance of known cultural heritage sites cannot be avoided, obtain Ministerial consent under Section 18 (Aboriginal Heritage Act, 1972).

***During site activities***

Immediately stop work if any new cultural heritage site is identified / uncovered and report the find to the site environmental officer. The environmental officer is to inform the Mine Manager, who is to inform the Department of Indigenous Affairs. An investigation and action plan will follow.

***Monitoring***

The environmental officer is to annually inspect all control measures in place to protect cultural heritage sites, to ensure no inadvertent disturbance has occurred.

**Reporting**

Any non-compliance with this procedure will be reported immediately as an environmental incident.

# Appendix C. Environmental Policy



## Environmental Policy

Abra Mining Pty Limited (AMPL) recognises that we cannot operate or be successful without fully integrating environmental considerations into our daily processes.

To achieve this, AMPL will aim to:

- Comply with and, where appropriate, exceed the requirements of applicable legislation, regulations and other standards to which we subscribe.
- Promote environmental awareness among our personnel and contractors to increase understanding of their roles and responsibilities in environmental management.
- Develop our people and provide resources to meet our environmental objectives.
- Ensure that environmental issues are integrated into the decision-making process of our exploration and project development.
- Identify and assess the potential environmental effects of our activities and manage environmental risk.
- At all times maintain an open and honest relationship with stakeholders.
- Continually improve and regularly monitor our environmental performance.
- Promote our environmental progress and performance to our stakeholders.

Anthony (Tony) James  
Managing Director & CEO

July 2022

# Appendix D. Inspection Checklists

## Monthly Inspection of Mine Areas

### Procedure.

Item	Action	Who
1	AMPL environmental staff (ES) to inspect each mine area on housekeeping matters and to ensure installed infrastructure to in good working order.	ES
3	ES to enter inspection date in the Compliance Register, and file completed checklist.	ES
4	ES to follow up with Area Managers to ensure close out of all items raised.	ES

### Mine Area Inspection Checklist

Inspected by (Print Name):			
Contractor area:			
Date/Time:			
Area	Specific Criteria	Status Yes/No	Comments
Stores, Offices & laydown yards	Any weeds growing that require eradication?		
	All products correctly stored and labelled.		
	Rubbish removed		
Hydrocarbon facilities	All bunds intact.		
	Leaks and spills cleaned up.		
	All products correctly stored and labelled.		
	Hoses located inside bunds		
Water pipelines	Leaks identified and reported for		
Parking areas	Any weeds growing that require eradication?		
	Minor leaks and spills cleaned up.		
ROM	Drainage off ROM contained		
Process plant area	Drains and sumps clear.		
	Dust management effective		
	Minor leaks and spills cleaned up.		
	Spill absorbent material available		
TSF	Water recovery systems operating		
	No tailings dust blowing off the TSF		
WRD	Drainage off the WRD contained		

Power station	Drains and sumps clear.		
	Dust management effective		
	Minor leaks and spills cleaned up.		
	Spill absorbent material available		
Concentrate loadout facility	Drains and sumps clear.		
Explosives magazines	Minor leaks and spills cleaned up.		
Accommodation village	All products correctly stored and labelled.		
Airstrip	All products correctly stored and labelled.		
Roads	Dust generation that requires suppression (use of water cart)		

## Monthly Inspection of Contractors Areas

### Procedure.

Item	Action	Who
1	AMPL to supply all contractors on site with this procedure and instruct them to undertake monthly inspections of their areas.	Mine Manager
2	Contractors to complete the checklist below and return completed form to AMPL Environmental Staff (ES).	Contractors
3	ES to enter inspection date in the Compliance Register, and file completed checklist.	ES
4	ES to follow up with contractors to ensure close out of all items raised.	ES

### Contractor Area Inspection Checklist

Inspected by (Print Name):			
Contractor area:			
Date/Time:			
General item	Specific Criteria	Status Yes/No	Comments
Stores, Offices & laydown yards	Any weeds growing that require eradication?		
	All products correctly stored and labelled.		
	Rubbish removed		
Hydrocarbon facilities	All bunds intact.		
	Leaks and spills cleaned up.		
	All products correctly stored and labelled.		
	Hoses located inside bunds		
Water pipelines	Leaks identified and reported for		
Parking areas	Any weeds growing that require eradication?		
	Minor leaks and spills cleaned up.		
Incidences	All environmental incidences reported.		
Plant area	Drains and sumps clear.		
	Dust management effective		
	Minor leaks and spills cleaned up.		
	Spill absorbent material available		
Vehicle washdown	Has all equipment entering the site been washed?		
	Form completed and submitted		
Personnel	Have all new employees been inducted?		
NPI reporting	Diesel use (litres)		
	Drilling (metres)		
	Heavy vehicle use (engine Kw & hrs)		
	Generators/lighting plants (engine Kw & hrs)		
Dust control	Is all dust control equipment operational		

## **Appendix E. Hazard / Incident Forms**

Incident and hazard report forms are now done online through the INX software.



## Appendix F. Hydrocarbon and Chemical Procedure



HYDROCARBON AND CHEMICAL PROCEDURE

MAY 2019

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Appendix 2: Spill procedure

# 1. INTRODUCTION

This procedure provides information for the storage and handling of hydrocarbons and bulk chemicals, including diesel fuel, oils, grease, chemicals and explosives. This procedure outlines the manner in which bulk and small containers of substances should be stored and handled on-site. These include bulk tanks, 1,000 litre bulk 'pods', down to small containers of 20 L drums.

Implementing good hydrocarbon and chemical management practices will minimise environmental impacts from spills and accidents.

## 1.1 ENVIRONMENTAL OBJECTIVES

The objectives of hydrocarbon and chemical management are:

- To ensure no release of hydrocarbons to the environment as a result of storage or handling incidents.
- To ensure storage and handling of fuels and chemicals at the site does not pose a threat to the environment.
- To ensure that any spill or incident associated with fuels and chemicals is promptly cleaned up.
- To monitor the effectiveness of this hydrocarbon and chemical management procedure.

## 1.2 LEGISLATION AND STANDARDS

Table 1 lists relevant legislation and standards.

**Table 1: Legislation and Standards**

Reference
Dangerous Good Safety Act 2004
Dangerous Goods Safety (Storage and Handling of Non-Explosives) Regulations 2007
Dangerous Goods Safety (Road and Rail Transport of Non-Explosives) Regulations 2007
Dangerous Goods Safety (Explosives) Regulations 2007
Dangerous Goods Safety (General) Regulations 2007
AS 1940 - The Storage and Handling of Flammable and Combustible Liquids.
AS 3780 - The Storage and Handling of Corrosive Substances.
AS 4452 - The Storage and Handling of Toxic Substances.
AS 4681 - The Storage and Handling of Class 9 (miscellaneous) Dangerous Goods and Articles.

## 1.3 OTHER RELEVANT INFORMATION

The following list of other documents is also applicable to hydrocarbon and chemical management.

- Hazardous materials register

Appendix 1

- Spill procedure
- Emergency Response Plan
- Monthly contractor inspection checklist

## 2. POTENTIAL IMPACTS

It is anticipated that, due to the relatively localised nature of site activities, impacts from hydrocarbons and chemicals will also be localised. Potential impact from hydrocarbons and chemicals is the contamination of soil and water from spills and leaks.

## 3. MANAGEMENT ACTIONS

Actions to be undertaken to manage hydrocarbons and chemicals are outlined in **Table 2**.

**Table 2: Management actions**

Action	Who	When
<b>Induction and training</b>		
All personnel will be inducted on the appropriate precautions to minimise risk of chemical spillage and misuse. All employees are to be aware of the spill response procedure.	All personnel	Commencement on site
<b>Product inventories</b>		
Maintain a hazardous materials register which includes an inventory of all receivables and dispatches of hydrocarbon and chemical products. The register is to also include details of supplier, quantities, storage location and MSDS.	Supply department	Ongoing
Maintain an inventory of explosives and associated products used on site.	Mining department	Ongoing
<b>Storage</b>		
Storage facilities will be appropriate to the type of chemical and will, as a minimum, meet the relevant Australian Standards.	Project engineer	Ongoing
All storage facilities on site are to be recorded in the hazardous materials register (Appendix 1).	Supply department	Ongoing
Regular monitoring of facilities will be carried out on a monthly basis. Records of all inspections are to be maintained.	Environmental officer	monthly
Auditing will be carried out on an annual basis. Records of all audits are maintained in the register.	Environmental officer	annually
All hydrocarbon containers will be stored in bunded areas compliant with licence conditions, Regulations, and relevant Standards.	Area managers	Ongoing
All 200 L drums will be stored in either: <ul style="list-style-type: none"> <li>• A compacted earthen floor and plastic lined bund with a spillage capacity of at least 20% of the total hydrocarbons stored in the bund,</li> <li>• A concrete floor and bund with a spill holding capacity of 20% of the total hydrocarbons stored in the bund.</li> <li>• On self contained spill pallets</li> </ul>	Area managers	Ongoing
All 200 L drums stored vertically will be held individually or by groups on self contained spill pallets.	Area managers	Ongoing
All 200 L drums stored horizontally will be located on suitable holding tables over a steel or plastic drip tray under each row of outlet (supply) valves, with a capacity of 220 L.	Area managers	Ongoing
<b>Handling</b>		
Wherever possible, hydrocarbons and chemicals will be purchased in re-useable or returnable bulk containers.	Supply department	Ongoing

Action	Who	When
Wherever possible, all oils and greases used in plant maintenance and servicing at workshops will have drip trays located under outlets.	Maintenance supervisor	Ongoing
Transfer points to or from bulk containers or permanent refuelling stations will be provided with a bunded concrete apron with collection of drainage discharging to a triple oil interceptor tank.	Project engineer	Ongoing
If a spill of hydrocarbons occurs, the spill response procedure is to be followed (Appendix 2). The incident is to be reported as required in the procedure.	All personnel	Ongoing
When waste oils are collected from servicing of equipment or machinery, they should be transferred immediately to a waste oil collection system in the relevant area.	Mechanic	Ongoing
Filters should be placed on a rack to drain before disposing	Mechanic	Ongoing
Conduct regular housekeeping inspections to determine when container drip trays require emptying and to ensure area is kept clean and tidy with no fire hazards.	Area managers	Ongoing

## 4. OUTCOMES AND PERFORMANCE

**Table 3** provides targets and performance criteria to be used to track progress in achieving hydrocarbon and chemical management objectives.

**Table 3: Performance Criteria**

Objectives	Outcome	Performance Measure
To ensure no significant release of hydrocarbons and chemicals to the environment as a result of storage or handling incidents.	Integrity of hydrocarbon and chemical storage bunds and containment measures is maintained.	Any hydrocarbon spills remediated so that there is no residual impact from the spill.
To ensure storage and handling of fuels and chemicals at the site does not pose a threat to the environment.	Compliance with licence conditions, Regulations and Standards	Number of environmental incidents arising from non-compliance with statutory requirements
To ensure that any spill or incident associated with fuels and chemicals will be cleaned up quickly and effectively.	All hydrocarbon and chemical spills identified and remediated to the agreed standard in the Contaminated Sites Act 2003	Any hydrocarbon or chemical spill is categorised as per the spill procedure (in the EMS) and actioned accordingly within 24 hours
To monitor the effectiveness of this hydrocarbon and chemical management procedure.	Annual review of this procedure	Audit / review record on the effectiveness of this procedure.

## 5. MONITORING AND AUDITING

Contractors will conduct monthly inspections of their work areas, which includes hydrocarbon facilities. Results of inspections are supplied to the site environmental officer.

The site environmental officer will conduct quarterly audits of the site to assess compliance with this procedure. The audit will record:

- Number of spill incidents reported.

- Number of workplace inspections undertaken.

## **6. CORRECTIVE ACTIONS**

In the event that non compliance with elements of this procedure is identified, corrective actions will be developed based on the extent and severity of the exceedance. The process used on site to record, track and resolve non compliances is the Hazard/Incident form.

The annual environmental report (AER) will include a summary of all environmental incidents recorded for the period and documented remedial actions. This includes incidents associated with hydrocarbons and chemicals.

## **7. RECORDS AND REPORTING**

Reporting to regulatory agencies on compliance with this plan is undertaken through the Annual Environmental Report (AER) process.

## **APPENDICES**



**APPENDIX 1:  
HAZARDOUS MATERIALS REGISTER**

# Hazardous Materials Register



Date	Product	Hazchem class	Location	Location Map Ref	Storage Volume	Storage Method	Disposal Method

## **APPENDIX 2: SPILL PROCEDURE**

## Spill Procedure



### Purpose

This procedure details steps to be taken to contain and clean up spills of hydrocarbons and other liquid and solid hazardous chemicals on site.

### Safety

- All products and hazardous substances used and stored on site are to have their Material Safety Data Sheets (MSDS) included in the site's Hazardous Materials Register.
- Spill clean up actions are to follow relevant MSDS requirements for PPE and other safety precautions.

### Action sequence

Spills of hazardous substances are to be treated using the following action sequence:

1. Isolate the spill area.
2. Identify the spilt substance.
3. Identify hazards and PPE requirements.
4. If safe to do so, the source of the spill should be restricted or stopped (eg; if a valve is open, close it).
5. Contain spill – to reduce the area of impact and prevent flow to other areas.
6. Collect spilt material (if possible).
7. Dispose of collected material in the appropriate manner.
8. Report the spill – either through the Incident report form.
9. Remediate residual contamination in spilt area.

### Actions

- **Small hydrocarbon spills** to soil in uncontained (unbunded) areas (< 20 litres or < 2m<sup>2</sup> in area) are to be remediated in situ by scarifying the surface soil, applying bioremediation additives and lightly watering.
- **Large hydrocarbon spills** to soil in uncontained (unbunded) areas (> 20 litres or > 2m<sup>2</sup> in area) are to be excavated and contaminated material taken to the site's bioremediation facility for treatment.
- **Large spills that cannot be excavated for some reason** (eg; buried pipelines/powerlines) are to be recorded on the site's environmental constraints map as a contaminated site, to be investigated and remediated during mine closure works.
- Spills of solid hazardous substances are to be immediately collected using spades / brooms. Collected material that is uncontaminated can be repackaged for use.
- Dispose of contaminated material in the appropriate manner – as described in the MSDS or hazardous materials register.
- Remediate any residual contaminated area in the appropriate manner – as described in the MSDS or hazardous materials register.

### Techniques to collect spilled hydrocarbons

- On advice of the environmental officer or the safety coordinator, pump remaining liquids into a container for transfer to the waste oil tank for recycling.
- Use absorbent materials to soak up residual hydrocarbons.
- Use earthmoving equipment to excavate contaminated soil for treatment as directed by the environmental officer.
- Hydrocarbons contained in concrete bunds are to be transferred to the waste oil tank for recycling.
- If the spill has contaminated a water body, use mini booms to contain the spread of hydrocarbon on the surface of the water. Use a skimmer to collect contained hydrocarbon and pump to a waste oil tank or other safe container
- Hydrocarbon absorbents are to be collected and disposed of as advised by the environmental officer.

### Technique to treat hydrocarbon contaminated soil

The most common technique for bioremediation is to thinly spread the contaminated soil and broadcast a nitrogenous fertiliser (urea or ammonium nitrate) over the soil at a rate not exceeding 100 kg/ha. The surface is scarified to mix in the fertiliser and regularly watered with potable quality water. Additional fertiliser and tilling applications may be required. Bioremediated soil is sampled to test for residual hydrocarbons. Once levels fall below specified threshold levels, the soil can be reused or disposed.

### Reporting

- Large hydrocarbon spills are to be reported as an environmental incident using the Hazard/Incident form.
- Any non-compliance with this procedure is to be reported to the AMPL Supervisor within 24-hours of the incident occurring.

# Appendix G. Vegetation Management Procedure



## VEGETATION PROCEDURE

JUNE 2020

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Appendix 1: Clearing procedure

Appendix 2: Internal clearing permit

Appendix 3: Vehicle inspection checklist

Appendix 4: Weed Checklist

# 1. INTRODUCTION

This vegetation procedure has been prepared to reduce potential impacts to vegetation and flora in operational areas of the Abra base metals project. It is a requirement that the actions contained in this procedure are complied with at all times by site personnel.

Clearing controls are important for the following reasons:

1. **Reduce vegetation clearing** to as small as necessary to undertake site activities. This minimises disturbance to surrounding vegetation and also reduces the area subsequently requiring rehabilitation.
2. **Manage topsoil** removal, stockpiling and return operations. Topsoil is a critical factor in achieving successful rehabilitation of disturbed areas, as it contains the majority of seeds, soil micro-organisms, organic matter and nutrients.
3. **Support rehabilitation** programmes over completed areas.

## 1.1 OBJECTIVES

The objectives of clearing are:

1. Minimise vegetation clearing and disturbance in the project area.
2. Protect vegetation and flora of conservation significance.
3. Maximise benefit and use from cleared areas.
4. Conserve available topsoil for use in rehabilitation.

### Procedures:

- Vegetation clearing                      Appendix 1

### Forms and checklists:

- AMPL clearing permit                      Appendix 2
- Vehicle inspection                          Appendix 3

# 2. POTENTIAL IMPACTS

It is acknowledged that some flora and vegetation will be disturbed as a result of mining operations. Potential impacts to vegetation can include:

- Direct loss or degradation of conservation significant flora and vegetation;
- Indirect impacts on adjacent vegetation from dust.
- Soil erosion off cleared areas;
- Disruption of natural water courses and flow paths

AMPL is committed to minimising areas of vegetation disturbance through:

- Staged approach to activities, therefore only clearing areas as necessary.
- Internal clearing permits are required prior to vegetation disturbance.
- Clearing activity will maximise salvage and retention of topsoil and cleared vegetation.



- Restrict personnel and vehicles outside designated areas.
- Use existing tracks and disturbed areas where possible.

### 3. MANAGEMENT ACTIONS

Actions to be undertaken to manage vegetation and flora are outlined in **Table 1**.

**Table 1: Management actions**

Action	Who	When
<b>Induction and training</b>		
All personnel will be inducted on the significance of vegetation and flora in the project area and management actions established to reduce impacts.	All personnel	Commencement on site
<b>Clearing activities</b>		
Submit an internal clearing permit (Appendix 2) prior to conducting clearing.	All personnel	Prior to clearing
Comply with the clearing procedure (Appendix 1) and any permit conditions.	All personnel	During clearing
Clearing permits are to conform to approved clearing areas, in CPS clearing permits.	Environmental officer	Ongoing
<b>Communications</b>		
An environmental constraints map will be located on notice boards through the site. The map will show environmentally sensitive areas, with associated buffers if required, which are to be avoided.	Environmental officer	Ongoing
<b>Monitoring</b>		
Undertake vegetation monitoring contained in respective management plans and procedures	Environmental officer	Ongoing

### 4. OUTCOMES AND PERFORMANCE MEASURES

**Table 2** provides targets and performance measures to be used to track progress in achieving the flora management objectives.

**Table 2: Outcomes and Performance Measures**

Objectives	Outcomes	Performance Measure
Minimise vegetation clearing and disturbance in the project area.	All site activities are undertaken within approved project disturbance boundaries.	Extent of site clearing is within approved limit and boundaries and recorded within 3 months of clearing
Conserve available topsoil for use in rehabilitation.	Topsoil salvaged and stored for use in rehabilitation	Survey quantity (m <sup>3</sup> ) of stockpiled topsoil within 3 months of construction
Monitor the effectiveness of commitments, procedures and controls.	No environmental incidents of unplanned clearing	Number of incidents of unplanned clearing recorded
Review outcomes to ensure management measures remain relevant to the operation.	Annual review of plans, procedures, forms, incidents.	Review confirms listed objectives are being met.

## 5. MONITORING AND AUDITING

The site environmental officer will conduct quarterly audits of the site to assess compliance with this plan. This will involve:

- Reconciliation that areas approved for clearing conform to surveyed boundaries of cleared areas.
- Inspection and photograph that topsoil and vegetation stockpiles conform to approved locations and design.
- Inspect and photograph that pre-clearing drainage paths are maintained or re-instated.

## 6. CORRECTIVE ACTIONS

In the event that non compliance with elements of this procedure is identified, corrective actions will be developed based on the extent and severity of the exceedance. The process used on site to record, track and resolve non compliances is the Hazard / Incident form. **Table 3** details corrective actions that will be implemented for identified non compliances.

**Table 3: Corrective actions**

Subject	Issue	Actions
Vegetation clearing / disturbance and Priority Flora.	Clearing native vegetation outside designated area.	Fill out the environmental incident report form. Report the unplanned area of disturbance to DMIRS. Reinstate fencing, barriers or flagging to delineate clearing boundaries. Place removed vegetation in over-cleared area to provide erosion control and seed stock. Include area in annual rehabilitation program.
Clearing	Fire	Follow fire management procedures. Fill out the environmental incident report form. Report the fire to DMIRS as soon as practically possible.
Altered drainage patterns.	High sediment runoff, erosion and decline in the health of vegetation in affected area	Implement corrective drainage measures. Include area of disturbance into annual rehabilitation program. Report area of impact as per vegetation disturbance.

## 7. RECORDS AND REPORTING

Reporting to regulatory agencies on compliance with this plan, including components such as areas cleared and environmental incidents is undertaken through the Annual Environmental Report (AER) process.

## **APPENDICES**

**APPENDIX 1:  
CLEARING PROCEDURE**

## Vegetation Clearing Procedure



### Purpose

This procedure provides generic information to be implemented during clearing activities. For other information relating to vegetation clearing, refer to the clearing procedure and clearing permit conditions.

### Risks

The key risks for unplanned disturbance of native vegetation are:

- Insufficient planning to avoid environmentally significant areas.
- Failure to identify and communicate access tracks, gridlines, work area and exclusion zones.
- Insufficient planning to avoid indirect impacts by such things as changing drainage patterns.

### Procedure

To ensure vegetation clearing is conducted in a responsible manner and to avoid unacceptable environmental impacts, the following procedure must be followed both during the planning of clearing and during clearing activities. This is outlined below.

#### **Prior to Clearing**

- Prior to undertaking clearing activities the AMPL clearing permit form **must be completed**.
- All personnel are to be inducted on the importance of minimising clearing and disturbance.
- Persons undertaking clearing activity and the AMPL supervisor will walk the area to verify the area to be cleared and any exclusion zones to be avoided.
- Exclusion areas are to be flagged in the field prior to any clearing.
- Salvage of seed, timber etc is to be scheduled. These activities are to be confined to the clearing area.
- No clearing is to commence until personnel implementing the clearing have been provided with a map (drawings) that indicate:
  - Designated locations to be avoided, which may include;
    - Declared Rare Flora or Priority species and any associated buffer.
    - Significant fauna habitats and any associated buffer.
    - The location of heritage sites.
    - Any other identified feature.
  - The location of access tracks.
  - The extent of the clearing area.

#### **During Clearing**

- All clearing will be supervised by the relevant site supervisor.
- Cleared vegetation is to be stockpiled adjacent to the area it was cleared from for use during rehabilitation.
- Topsoil removal (where required), will be removed to a depth of approximately 100 mm and stored immediately adjacent to the area where it was cleared and separate to any subsoil or vegetation stockpiles.
- All vegetation and topsoils stockpiles will be positioned away from any watercourses and drainage paths. Stockpiles are to be no higher than 2 m.
- Vehicles and machinery will only use designated roads, tracks and gridlines. Off-road traversing into bush areas is prohibited.
- No burning of cleared vegetation is permitted.

#### **Rehabilitation**

- Rehabilitation is to follow procedures outlined in the rehabilitation plan.

### Monitoring

The AMPL Representative / supervisor will monitor the clearing activities to ensure compliance with requirements.

### Reporting

- If unauthorised clearing occurs, the incident must be reported to the AMPL Environmental Officer within 24-hours of the incident occurring using the Hazard / Incident report form.

**APPENDIX 2:  
INTERNAL CLEARING PERMIT**



# PERMIT - TO CLEAR / DISTURB

PERMIT  
No

<b>WORK / PERMIT REQUEST</b>	REQUESTED BY		COMPANY		SUPERVISOR	
	LOCATION OF WORK					
	WORK DESCRIPTION					
	DURATION	START DATE / TIME	FINISH DATE / TIME	DATE		
	EQUIPMENT	<input type="checkbox"/> DOZER <input type="checkbox"/> LOADER <input type="checkbox"/> EXCAVATOR <input type="checkbox"/> GRADER			AREA (HA) PROPOSED	
	COMMENTS:					<input type="checkbox"/> YES COMPLETED
<b>SURVEY CHECKS</b>	CLEARING LOCATION PLAN	<input type="checkbox"/> YES <input type="checkbox"/> NO	DETAILS:			
	DRAINAGE CONSIDERED	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A	DETAILS			
	EXCAVATE PERMIT REQ'D	<input type="checkbox"/> YES <input type="checkbox"/> NO	DETAILS:			
	TOPSOIL DEPTH & SP LOCATION (PLAN)	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A	DETAILS			
	TOPSOIL SP HEIGHT (<2.5m)	<input type="checkbox"/> YES <input type="checkbox"/> NO	DETAILS			
	HERITAGE AREA (>100m) <b>IF NO, SPOTTER REQ'D</b>	<input type="checkbox"/> YES <input type="checkbox"/> NO	DETAILS			
	<b>Survey MUST FLAG &amp;/OR PEG Extents Clearly in-field prior to commencement of Clearing:</b> <b>FLAGGING COLOUR:</b>					<input type="checkbox"/> YES COMPLETED
SURVEY CHECKS WERE CONDUCTED Scaled Survey Drawing of Clearing Area must be attached to this Permit			SIGN  AUTHORISED PERSON (AMPL SURVEY)		SURVEY CLEARING <input type="checkbox"/> N/A <input type="checkbox"/> YES	

- **NOTIFY – All affected Work Groups and Barricade off Access as deemed necessary during CLEARING ACTIVITIES.**

<b>SAFETY</b>	ROAD ACCESS NOTIFY & TRAFFIC BARRICADES / SIGNS	<input type="checkbox"/> YES <input type="checkbox"/> N/A	DETAILS
	PEDESTRIAN BARRICADES, SIGNS, BUNTING	<input type="checkbox"/> YES <input type="checkbox"/> N/A	DETAILS
	SPOTTER AND/OR RADIO COMMUNICATIONS	<input type="checkbox"/> YES <input type="checkbox"/> N/A	DETAILS
	SUPERVISION REQUIRED	<input type="checkbox"/> YES <input type="checkbox"/> NO	DETAILS

<b>OPERATOR</b>	<b>Original PERMIT to be with person performing excavation at all times.</b>		
	I UNDERSTAND THE JOB, Area requiring clearing and will not clear outside allocated area as marked by Survey.		
	PRINT & SIGN _____	DATE _____	PERMIT EXPIRY DATE
	PERSON DOING THE CLEARING		

**PERSON - requesting the Permit is responsible for ensuring ALL Additional INFORMATION is supplied**

<b>APPROVAL</b>	COMMENTS _____		
	I HEREBY APPROVE THAT THE CLEARING MAY PROCEED AS IN ACCORDANCE WITH THE PERMIT AND ITS CONDITIONS.		
	PRINT & SIGN _____	DATE _____	
	AUTHORISED PERSON (AMPL SUPERVISOR)		
	PRINT & SIGN _____	DATE _____	
AUTHORISED PERSON (AMPL ENVIRONMENTAL DEPT.)			
ACCEPTANCE _____	DATE _____		
PERSON REQUESTING PERMIT			

- SKETCHING AREA BELOW, CLEARLY IDENTIFY LOCATION –

<b>SURVEY</b>	COMMENTS _____ _____ ALL NEW CLEARINGS HAVE BEEN SURVEYED IN ACCORDANCE WITH THIS PERMIT AT COMPLETION.		
	<b>PRINT &amp; SIGN:</b>		<b>DATE:</b>
<b>CLOSED</b>	COMMENTS _____ _____ ALL ACTIONS HAVE BEEN COMPLETED IN ACCORDANCE WITH THIS PERMIT TO CLEARING AND THE PERMIT IS NOW CLOSED.		
	<b>PRINT &amp; SIGN:</b>		<b>DATE:</b>



**APPENDIX 3:  
VEHICLE INSPECTION CHECKLIST**



# VEHICLE INSPECTION CHECKLIST

It is important that earthmoving machinery is in an acceptable condition before it enters site working areas in relation to safety, weeds, hydrocarbons, emissions and noise.

This certificate must be completed in the presence of the machine Supervisor.

Date of arrival/inspection:	
Name of machinery Supervisor:	
Name of person conducting inspection:	
What kind of machine is it?	
Where was the last site the machine worked	
Please list any problem weeds at the last site.	
Was the machine cleaned before it left the last site?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are buckets, tracks, blades etc free of soil and vegetation?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Are the tyres free of seeds?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Is machine free of fuel and oil leaks?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Is the exhaust/muffler in good working order?	Yes <input type="checkbox"/> No <input type="checkbox"/>
Work required/comments:	

**If you have answered NO to any of these questions, please carry put the required cleaning and/or maintenance before the machine enters the site. This form must be signed by the machine Supervisor and Site Supervisor when all cleaning and/or maintenance is completed.**

**Print name**

**Signature**

Machine Supervisor			Date	
Site Supervisor			Date	

### Vehicle Wash down Procedure

- Wash down machine in designated wash down bay.
- Remove all soil and vegetation including seeds.
- Ensure runoff, soil and any seeds are contained on the hardstand or directed to the sediment basin.
- Carry out final inspection with site personnel before moving into site

**APPENDIX 4:  
WEED CHECKLIST**

## SITE WEED INSPECTION CHECKLIST

Name of Inspector (Print): \_\_\_\_\_ Date: \_\_\_\_\_

Weather Conditions Prior to Inspection: \_\_\_\_\_

Weed Inspection Areas	Weds Present (Yes/No)	Actions Taken
Village		
Village recreation areas		
Sewage irrigation area		
Mine workshop		
Production bore surrounds		
Storage areas		
Workshop area		
Landfill area		
Wash down bay		
Lay down areas		
Office buildings		
Haul roads and access tracks		
ROM stockpile areas		
WRD		
Other		

Eradication	Record
Weed Species	
Probable cause of occurrence	
Area (m2)	
Location	
Photo or sample of weed attached	
Eradication method	
<b>Name (print)</b> <b>Signature</b> <b>Date</b>	
Post Eradication	Follow up Actions
Weed Species	
New weed population (y/n)	
New growth (y/n)	
Follow up of eradication	
Evidence of weed death (photo)	
<b>Name (print)</b> <b>Signature</b> <b>Date</b>	

# Appendix H. Waste Management Procedure



## WASTE MANAGEMENT PROCEDURE

MAY 2019

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# 1. INTRODUCTION

This waste management procedure has been prepared to reduce potential contamination of soil, water and areas surrounding the Abra base metals project. It is a requirement that the actions contained in this procedure are complied with at all times by site personnel. Waste management is important for the following reasons:

1. **Mine waste rock and rubbish** has potential to adversely affect the environment of the project area and its surrounds
2. **Liquid waste** has the potential to contaminate surrounding soil and water.
3. **Hazardous waste** includes hydrocarbon waste and other chemicals which have potential to contaminate surrounding soil and water.
4. **Prompt spill cleanup** limits the area immediately contaminated and the possibility of extended impact from contaminant transport off site.
5. **Recycling** reduces the amount of waste needed to be disposed on site and provides energy and material savings from the products reuse.

## 1.1 ENVIRONMENTAL OBJECTIVES

The overall waste management objective is to minimise waste where practicable, using the sequence of avoid, reuse, reduce, recycle, treat, dispose. More specific objectives include:

- Dispose of waste in an acceptable manner.
- Reuse / recycle materials where practicable
- Minimise the risk of spillage of hazardous materials.

## 1.2 LEGISLATION

Regulatory requirements applicable to the project site include but are not limited to the following:

- Australian Standard (AS) 1940:2017 The Storage and Handling of Flammable and Combustible Liquids.
- Contaminated Sites Act 2003.
- Dangerous Good Safety Act 2004
- Dangerous Goods Safety (Explosives) Regulations 2007
- Dangerous Goods Safety (General) Regulations 2007
- Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007
- Department of Water and Environmental Regulation – Assessment and Management of Contaminated Sites (2014)
- Environmental Protection Act 1986.
- Environmental Protection (Controlled Wastes) Regulations 2004.
- Environmental Protection (Rural Landfill) Regulations 2002;
- Health (Miscellaneous Provisions) Act 1911
- Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste Regulations) 1974;
- Water Quality Protection Note 10 – Containment spills emergency response.
- Water Quality Protection Note 65 – Toxic and hazardous substances (storage and use).

## 2. POTENTIAL IMPACTS

The key potential impact from inappropriate disposal or accidental release of hazardous materials is contamination of surrounding soil and water.

## 3. MANAGEMENT ACTIONS

Actions to be undertaken to manage fauna are outlined in **Table 1**.

**Table 1: Management actions**

Action	Who	When
<b>Induction and training</b>		
All personnel will be inducted on the significance of appropriate waste management in the project area. The induction to include information on: <ul style="list-style-type: none"> <li>• Procedures for handling and storing fuels and chemicals.</li> <li>• Refuelling vehicles and machinery.</li> <li>• Waste disposal.</li> <li>• Spill clean-up procedure.</li> <li>• Location of the hazardous materials register.</li> </ul>	All personnel	Commencement on site
<b>Mine waste</b>		
Mine waste is stored managed so minimise impact to the surrounding environment	Mine manager	Ongoing
<b>Waste collection and disposal</b>		
Obtain appropriate licenses and permits for on-site waste disposal.	Environmental officer	Commencement on site
Provide appropriate waste collection, treatment and disposal facilities (e.g. bins, waste oil tank, sewage treatment plant, landfill, recycling facility).	Environmental officer, project engineer	Ongoing
Collect and empty waste disposal facilities regularly.	Camp coordinator, Project engineer	Ongoing
Putrescible and industrial waste will be collected and disposed to an onsite landfill. The landfill will be managed in accordance with the <i>Environmental Protection (Rural Landfill) Regulations 2002</i> .	Environmental officer	Ongoing
The landfill site is to be designed as follows: <ul style="list-style-type: none"> <li>• Landfill trench created in the landfill site</li> <li>• Tipping face no greater than 30 m.</li> <li>• Tipping face covered on a weekly basis.</li> <li>• Safe access to the tipping face maintained.</li> </ul>	Environmental officer, project engineer	Ongoing
Provide a recycling area for storage of recyclable materials, for collection and transport to a recycling facility off site. Recyclable materials include: <ul style="list-style-type: none"> <li>• Heavy grade metal- located in a stockpile.</li> <li>• Batteries- on pallets in a banded area;</li> <li>• Waste oil- in a bulk storage tank</li> </ul>	Environmental officer	Ongoing
<b>Wastewater</b>		
Sewage and grey water from the accommodation village will be treated in a package treatment plant. Treated wastewater will be pumped to an irrigated field or evaporation lagoons. Sewage from the mine offices and workshops will be treated in Biocycle units / septic tanks-leach drains or similar	Project engineer	Commencement on site
<b>Hazardous materials</b>		
Hazardous materials will be clearly labelled and will be handled, stored and disposed in accordance with the Material	Purchasing officer, safety manager	Ongoing

<b>Action</b>	<b>Who</b>	<b>When</b>
Safety Data Sheet (MSDS). MSDS sheets will be stored on site and available to all personnel.		
<b>Wash down bay waste</b>		
Soil not contaminated with hydrocarbons above levels which require bioremediation are to be disposed in the site landfill	Area manager	Ongoing
Contaminated soil will be disposed to a licensed facility off site, or bio remediated on site.	Area manager & environmental officer	Ongoing
Waste oil from the plate separator will be added to the waste oil tank for collection by a licensed contractor.	Area manager	Ongoing
<b>Spills and contamination</b>		
Spills of hydrocarbons, other liquid wastes and hazardous chemicals are to be cleaned up according to the spill procedure (Appendix 1).	All personnel	Ongoing
Spill kits and shovels will be available for spillages. Spent spill kits will be handled as hazardous waste.	All personnel	Ongoing
The incident report form will be used to record any spills of hydrocarbons or chemicals > 20 litres.	All personnel	Ongoing
<b>Hydrocarbons</b>		
Flammable and combustible liquids will be stored to requirements of Australian Standard AS 1940 – 2004.	Project engineer	Commencement on site
Equipment will be refuelled on bunded pads in designated locations. Tracked vehicles and stationary plant (gensets etc) will be refuelled in the field by field service vehicles.	mine supervisor	Ongoing
<b>Design</b>		
Design workshop and washdown bay to be internally draining and routed through oil-water separators.	Construction manager	Prior to construction
Use self-bunded storage vessels and pallets where possible	Project engineer	Ongoing
Water collected in bunded facilities to be treated through an oil-water separator.	Project engineer	Ongoing

## 4. OUTCOMES AND PERFORMANCE

**Table 2** provides targets and performance criteria to be used to track progress in achieving waste management objectives.

**Table 2: Performance Criteria**

Objectives	Outcomes	Performance Measure
Reuse / recycle materials where practicable.	Maximise quantity of material reused/recycled.	Register of reused / recycled materials recording quantities of materials
Dispose of waste in an acceptable manner.	All waste disposed in an acceptable manner	Annual report on landfill management including the number of waste management incidents.
	No off-site pollution from mine landforms	Surface soil Pb levels within 500 metres of the tenement boundary below NEPM <sup>1</sup> added contaminant limits (ACL) for commercial/ industrial use.
	Landform stability is appropriate for the stage of mine life.	No impacts to vegetation outside the mine disturbance boundary from unstable mine landforms.
Minimise risk of spillage of hazardous materials.	All spills are categorised as per the spill procedure and actioned accordingly within 24 hours	Number of incident reports.

1. NEPM (1999). Schedule B1 – Table 1(B)4

## 5. MONITORING AND AUDITING

The site environmental officer will conduct an annual waste audit of the site, to assess compliance with this plan. The audit will record:

- Quantity of material reused or recycled.
- Report on landfill management.
- Report on bioremediation facility management (if active)
- Number of waste incidents from the Hazard/Incident form.

## 6. CORRECTIVE ACTIONS

In the event that non compliance with elements of this procedure is identified, corrective actions will be developed based on the extent and severity of the exceedance. The process used on site to record, track and resolve non compliances is the Hazard/Incident form.

The annual environmental report (AER) will include a summary of all environmental incidents recorded for the period and documented remedial actions. This includes incidents associated with fauna.

## 7. RECORDS AND REPORTING

The following records will be maintained on site:

- A hazardous materials register which details all hazardous goods brought to site, usage and remaining inventories. The relevant MSDS will be available for all hazardous goods.
- Where applicable, the collection of hazardous waste will comply with the *Environmental Protection (Controlled Wastes) Regulations 2004*. Where controlled waste tracking forms are required, the customer's copy is to be retained onsite.

Reporting to regulatory agencies on compliance with this plan is undertaken through the Annual Environmental Report (AER) process.

## **APPENDICES**

**APPENDIX 1:  
SPILL CLEAN-UP PROCEDURE**

## Spill Procedure



### Purpose

This procedure details steps to be taken to contain and clean up spills of hydrocarbons and other liquid and solid hazardous chemicals on site.

### Safety

- All products and hazardous substances used and stored on site are to have their Material Safety Data Sheets (MSDS) included in the site's Hazardous Materials Register.
- Spill clean up actions are to follow relevant MSDS requirements for PPE and other safety precautions.

### Action sequence

Spills of hazardous substances are to be treated using the following action sequence:

1. Isolate the spill area.
2. Identify the spilt substance.
3. Identify hazards and PPE requirements.
4. If safe to do so, the source of the spill should be restricted or stopped (eg; if a valve is open, close it).
5. Contain spill – to reduce the area of impact and prevent flow to other areas.
6. Collect spilt material (if possible).
7. Dispose of collected material in the appropriate manner.
8. Report the spill – either through the Incident report form.
9. Remediate residual contamination in spilt area.

### Actions

- Small hydrocarbon spills to soil in uncontained (unbunded) areas (< 20 litres or < 2m<sup>2</sup> in area) are to be remediated in situ by scarifying the surface soil, applying bioremediation additives and lightly watering.
- Large hydrocarbon spills to soil in uncontained (unbunded) areas (> 20 litres or > 2m<sup>2</sup> in area) are to be excavated and contaminated material taken to the site's bioremediation facility for treatment.
- Large spill areas that cannot be excavated for some reason (eg; buried pipelines/powerlines) are to be recorded on the site's environmental constraints map as a contaminated site, to be investigated and remediated during mine closure works.
- Spills of solid hazardous substances are to be immediately collected using spades / brooms. Collected material that is uncontaminated can be repackaged for use.
- Dispose of contaminated material in the appropriate manner – as described in the MSDS or hazardous materials register.
- Remediate any residual contaminated area in the appropriate manner – as described in the MSDS or hazardous materials register.

### Techniques to collect spilled hydrocarbons

- On advice of the environmental officer or the safety coordinator, pump remaining liquids into a container for transfer to the waste oil tank for recycling.
- Use absorbent materials to soak up residual hydrocarbons.
- Use earthmoving equipment to excavate contaminated soil for treatment as directed by the environmental officer.
- Hydrocarbons contained in concrete bunds are to be transferred to the waste oil tank for recycling.
- If the spill has contaminated a water body, use mini booms to contain the spread of hydrocarbon on the surface of the water. Use a skimmer to collect contained hydrocarbon and pump to a waste oil tank or other safe container
- Hydrocarbon absorbents are to be collected and disposed of as advised by the environmental officer.

### Technique to treat hydrocarbon contaminated soil

The most common technique for bioremediation is to thinly spread the contaminated soil and broadcast ammonium nitrate fertiliser over the soil at a rate not exceeding 100 kg/ha. The surface is scarified to mix in the fertiliser and regularly watered with potable quality water. Additional fertiliser and tilling applications may be required. Bioremediated soil is sampled to test for residual hydrocarbons. Once levels fall below specified threshold levels, the soil can be reused.

### Reporting

- Hydrocarbon spills to soil in uncontained (unbunded) areas > 20 litres or > 2m<sup>2</sup> in area are to be reported as an environmental incident using the Hazard/Incident form.
- Any non-compliance with this procedure is to be reported to the AMPL Supervisor within 24-hours of the incident occurring.



# Appendix I. Water Monitoring Procedure



## WATER MONITORING PROCEDURE

MAY 2019

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## APPENDICES

Appendix 1: Water monitoring locations

# 1. INTRODUCTION

A series of groundwater monitoring bores and surface water monitoring locations are situated around the Abra base metals project site. Regular monitoring of water levels and quality is conducted to determine the impacts of mining on the local ground and surface water systems.

Monitoring of surface water is conducted opportunistically, as local drainage lines only flow for short periods after rainfall.

## 1.1 OBJECTIVES

The objectives for water monitoring are:

- Assess environmental effects of activities by regular monitoring and review of performance.
- Comply with licence conditions.

## 1.2 LEGISLATION AND STANDARDS

Table 1 lists relevant legislation and standards relevant to water monitoring.

Table 1: Legislation and standards

Reference	Relevance	Regulatory Authority
AS NZS:5667.1.1998.	Water quality – Sampling Guidance on sampling of groundwaters. Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.	-
<i>Rights in Water and Irrigation Act 1914.</i>	Licensing of groundwater abstraction	DWER
Water Quality Protection Guidelines No 11.	Mining and Mineral Processing: Mine dewatering. Guidelines on mine dewatering	DWER
Water Quality Protection Notes.	Guidelines on protection of ground and surface waters.	DWER

# 2. POTENTIAL IMPACTS

It is anticipated that, due to the relatively localised nature of site activities, impacts to water will also be localised.

Potential impacts to water include:

- Groundwater level drawdown beyond modelled extent.
- Vegetation loss through groundwater level drawdown.
- Contamination of groundwater or surface water.

# 3. MANAGEMENT ACTIONS

Monitoring is to be undertaken according to DWER licence conditions. There must be no disturbance to the monitor bore (such as bailing or pumping) one week prior to water level measurement. Actions to be undertaken for water monitoring are outlined in Table 2.

Table 2: Management actions

Action	Who	When
<b>Meter readings</b>		
Reading of water meters is required to determine water production and usage on site.	Environmental officer	monthly

Action	Who	When
Site plan showing location of bores and of meter locations is attached as Appendix 1	Environmental officer	
Meter readings taken in the field are to be recorded in the water production spreadsheet.	Environmental officer	monthly
<b>Water levels</b>		
Check that the water level probe is operational.	Environmental officer	monthly
Lower the probe into the bore until contact with the water is confirmed by both the audible beep and/or visual red light.	Environmental officer	
Read the depth level to the top of casing (TOC) to within the nearest centimetre. Use of previous monitoring data will help to estimate the point of contact.	Environmental officer	
Ensure the 'stick-up' distance – the height of the TOC above ground level, is recorded for the bore. This allows measured results to be calibrated to ground levels.	Environmental officer	
Note should be made if the bore is dry.	Environmental officer	
<b>Groundwater (bore) samples</b>		
Purge bores according to AS/NZS:5667.1.1998.	Environmental officer	quarterly
Take sample with bailer. Rinse bailer with RO water between samples	Environmental officer	
Place sample in plastic container and record Electrical Conductivity and pH.	Environmental officer	
Ensure that the bore cap is replaced.	Environmental officer	
Send samples to external laboratory for analysis.	Environmental officer	
On receipt of data from laboratory, enter data into the water production spreadsheet.	Environmental officer	
<b>Surface water monitoring</b>		
Opportunistic monitoring is required to be carried out at the established surface water monitoring sites whenever surface water flows occur (to a maximum of 2 per quarter).	Environmental officer	Surface water flow
Sampling is to be undertaken in accordance with AS/NZS:5667.1.1998.	Environmental officer	
Electrical conductivity and pH is to be monitored according to the steps set out under the bore water monitoring section.	Environmental officer	
Laboratory analysis to be conducted the same as groundwater samples.	Environmental officer	
On receipt of data from laboratory, enter data into the water production spreadsheet.	Environmental officer	
<b>Potable water monitoring</b>		
Take samples from a range of potable supply outlets (taps) and analyse for microbial content	Environmental officer	monthly

## 4. OUTCOMES AND PERFORMANCE

**Table 3** provides targets and performance measures to be used to track progress in achieving water monitoring objectives.

**Table 3: Performance Criteria**

Objectives	Outcome	Performance Measure
Comply with all licence conditions.	Comply with all licence / permit water monitoring requirements.	All licence requirements met.
Assess environmental effects of activities by regular monitoring and review of performance.	Groundwater level and quality beyond the tenement boundary is maintained within the range of background levels	Groundwater level change less than 2 metres (accounting for natural variance) five years after mine closure when measured at monitoring bores established within 500 metres downstream from the tenement boundary

## **5. REVIEW**

The site environmental officer will conduct quarterly reviews, to assess compliance with this plan. This will involve recording:

- Water abstraction against licence limit.
- Water quality parameters against licence limits.
- Commentary on important findings and notes.

## **6. CORRECTIVE ACTIONS**

In the event that non compliance with elements of this procedure is identified, corrective actions will be developed based on the extent and severity of the exceedance. The process used on site to record, track and resolve non-compliance is the Hazard/Incident form.

The annual environmental report (AER) will include a summary of all environmental incidents recorded for the period and documented remedial actions. This includes incidents associated with water monitoring.

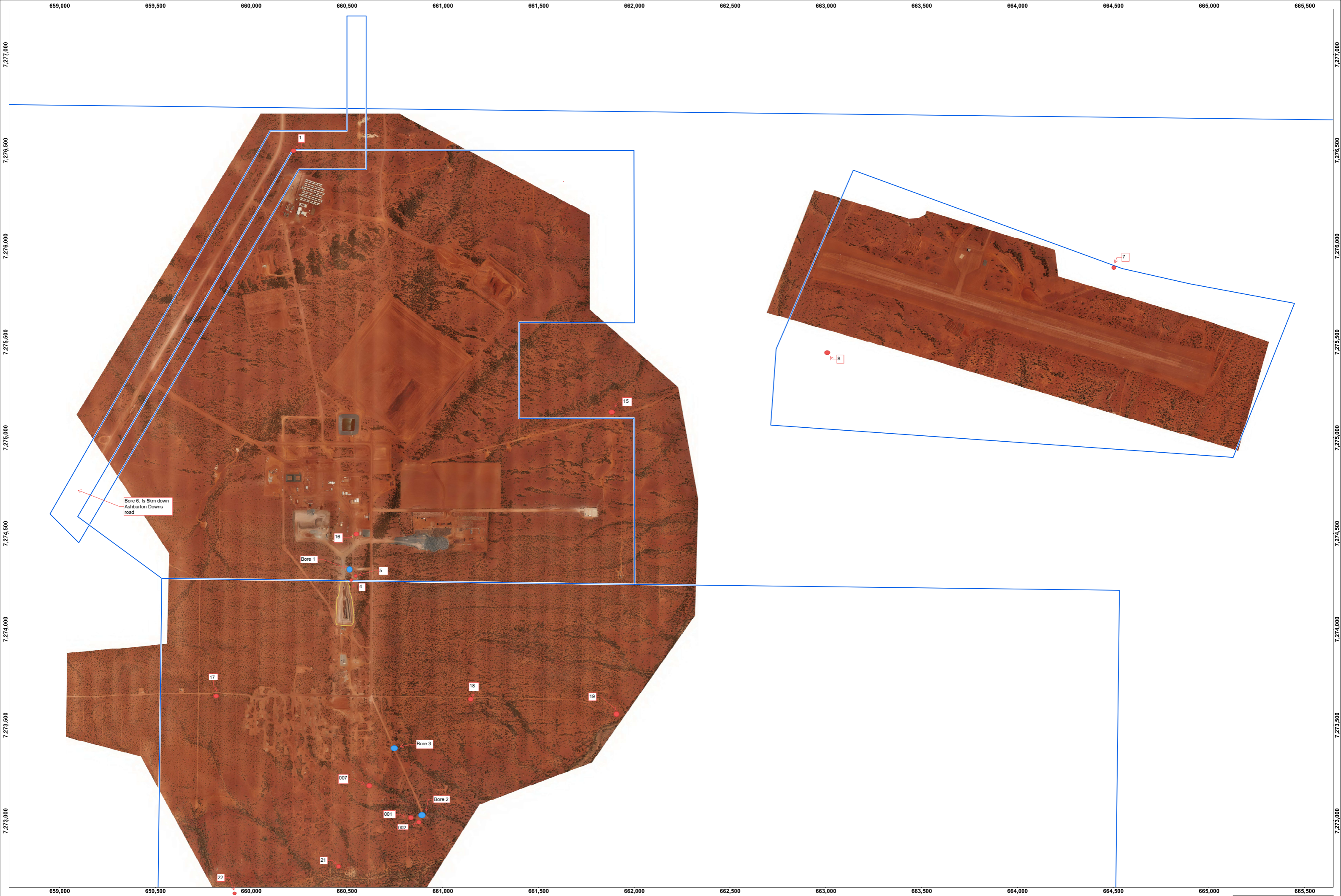
## **7. RECORDS AND REPORTING**

Reporting to regulatory agencies on compliance with this plan is undertaken through the Annual Environmental Report (AER) and annual aquifer review process.

## **APPENDICES**

**APPENDIX 1:  
WATER MONITORING LOCATIONS**





Bore 6. Is 5km down Ashburton Downs road

Bore 1

Bore 3

Bore 2

LEGEND  
AMPL tenements



Abra Project  
Aerial photography of mine site  
accommodation processing plant area  
box cut and aerodrome  
Project: ABMP Scale: 1:4,000  
Drafted by: AS Date: 14/02/2022

# Appendix J. Fauna Management Procedures



## FAUNA MANAGEMENT PROCEDURE

MAY 2019

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## APPENDICES

Appendix 1: Off road driving procedure

Appendix 2: Fauna Mortality Register

# 1. INTRODUCTION

This fauna management procedure has been prepared to reduce potential impacts to fauna in operational areas of the Abra base metals project. It is a requirement that the actions contained in this procedure are complied with at all times by site personnel.

Fauna management is important for the following reasons:

1. **Minimise direct impact** by removing habitat (via vegetation clearing) and collisions with vehicles.
2. **Reduce indirect impact** by minimising barriers to movement, and control of feral predators.

## 1.1 ENVIRONMENTAL OBJECTIVES AND STANDARDS

The objectives for fauna management are:

- Minimise potential impacts of site activities on fauna species.
- Minimise potential impacts to species of conservation significance (including terrestrial and subterranean fauna).

## 1.2 LEGISLATION

Fauna protection is subject to legislation at both the state and federal level. Table 1 lists relevant legislation, its relevance and regulatory authority.

**Table 1: Legislation**

<b>Legislation</b>	<b>Relevance</b>	<b>Regulatory Authority</b>
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)	Protection on environmental matters of national significance	Department of Environment, Heritage, Water and the Arts (DEHWA)
<i>Conservation and Land Management Act 1984</i> (WA)	Protection and management of nature reserves, state forest, marine parks etc.	DBCA
<i>Environmental Protection Act 1986</i> (WA)	Prevention, control and abatement of pollution and conservation protection and enhancement of environment	DBCA
<i>Wildlife Conservation Act 1950</i> (WA)	Provides for the conservation and protection of wildlife (flora and fauna). Special provisions and schedules cover protection and management of gazetted rare flora and fauna.	DBCA

### 1.3 OTHER RELEVANT INFORMATION

The following list of other documents is also applicable to fauna management.

- Off road driving procedure                      Appendix 1
- Fauna Mortality Register                      Appendix 2

## 2. POTENTIAL IMPACTS

It is acknowledged that some fauna will be disturbed as a result of site activities. It is anticipated that, due to the relatively localised nature of site activities, impacts to fauna will also be localised. Potential impacts to fauna include:

- Habitat loss through clearing, mining (excavation) and vegetation degradation
- Direct impact on fauna.
- Indirect impacts such as barriers to movement, groundwater changes, and feral predators.

## 3. MANAGEMENT ACTIONS

Actions to be undertaken to manage fauna are outlined in Table 2.

**Table 2: Management actions**

Action	Who	When
<b>Induction and training</b>		
All personnel will be inducted on the significance of fauna in the project area and management actions established to reduce impacts.	All personnel	Commencement on site
Obtain appropriate training and licenses for fauna handling.	Environmental officer (EO)	Ongoing
<b>Project actions</b>		
Ensure barriers to native fauna movement are kept to a minimum.	EO, project engineer	Ongoing
Minimise time trenches are left open. If necessary for a trench to remain open for longer than 24 hours, install escape ramps at regular intervals along the trench;	Project engineer	At construction
For trenches open for longer than 24 hours, check them within 2 hours of sunrise and remove trapped fauna. Record number and type of relocated fauna (Appendix 2).	EO	Ongoing
Comply with speed limits on site (Appendix 1).	All personnel	Ongoing
Install fauna egress matting in lined dams/ponds	EO	At onstruction
Fence aerodrome to exclude stock	EPC contractor	At construction
Spotter vehicle to drive the airstrip prior to plane landing	EO	As required
Do not feed fauna.	All personnel	Ongoing
<b>Communications</b>		
A site environmental map will be located on notice boards through the site. The map will show environmentally sensitive areas, with associated buffers if required, which are to be avoided.	EO	Ongoing

## 4. TARGETS AND PERFORMANCE

Table 3 provides targets and performance criteria to be used to track progress in achieving fauna management objectives.

**Table 3: Performance Criteria**

<b>Objectives</b>	<b>Target</b>	<b>Performance</b>
Minimise potential impacts of site activities on native fauna species.	No significant barriers for native fauna.	Number of fauna trapped in trenches.
	Minimise injury or mortality to fauna.	Number of fauna injured or killed

## 5. MONITORING AND AUDITING

The site environmental officer will conduct 6 monthly audits of the site to assess compliance with this plan. This will involve providing a brief report to the Environmental Manager summarizing data on:

- Record of fauna trapped in trenches.
- Record of injured or killed fauna.

## 6. CORRECTIVE ACTIONS

In the event that non compliance with elements of this procedure is identified, corrective actions will be developed based on the extent and severity of the exceedence. The process used on site to record, track and resolve non compliances is the Accident/Incident form.

The annual environmental report (AER) will include a summary of all environmental incidents recorded for the period and documented remedial actions. This includes incidents associated with fauna.

## 7. RECORDS AND REPORTING

Reporting to regulatory agencies on compliance with this plan is undertaken through the Annual Environmental Report (AER) process.

## **APPENDICES**



**APPENDIX 1:**  
**OFF ROAD DRIVING PROCEDURE**

## **Off-road driving procedure**

### **Purpose**

This procedure details the actions required for responsible off road driving by all personnel on site.

### **Background**

The project's environmental constraints map details exclusion zones to be avoided by vehicles during site activities.

### **Risks**

Key risks to the project from inappropriate use of vehicles includes:

- Damage to vegetation, fauna habitat and drainage lines outside approved areas of disturbance.
- Damage to Aboriginal heritage sites.
- Introduction or spread of weeds.
- Increased likelihood of collision with fauna.

### **Procedure**

The following procedure is required to be implemented by all project personnel:

#### ***Prior to driving on site***

- All employees and contractors are required to participate in the site induction, which includes information on required driving practices.
- All employees and contractors are to complete a site driving competency test with their Supervisor before driving in active areas of the site.
- All vehicles must have effective communication (2 way radio and/or satellite phone) and operating instructions for their use.
- Undertake a pre-start vehicle check, complete the appropriate form and submit to the site supervisor.

#### ***During site activities***

- Vehicles must not exceed designated speed limits on site.
- Vehicles must not leave designated project areas or access tracks without approval from the Abra Supervisor.
- Any native animal injury or death is to be reported immediately to the Abra Environmental Officer
- Any road kills are to be removed from the road, to avoid further mortality of scavenger species.
- Reduce speed during adverse road conditions, such as flooding and thick bush, to a speed suitable for the driving conditions.

### **Reporting**

- Any non-compliance with this procedure is to be reported to the Abra Supervisor within 24-hours of the incident occurring using the Incident report form.
- Any native animal injury/death is to be reported immediately as an environmental incident to the Abra environmental officer.

**APPENDIX 2:**  
**FAUNA MORTALITY REGISTER**







## AIRSTRIP FAUNA MANAGEMENT PROCEDURE

NOVEMBER 2021

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Appendix 1: CASA Advisory Circular

Appendix 2: Fauna Monitoring Checklist

Appendix 3: Fauna Monitoring Register

# 1. BACKGROUND

1. Abra Mining Pty Limited (AMPL) is required to prepare and implement an **Aerodrome Manual** in order to obtain certification of the airstrip by the Civil Aviation Safety Authority (CASA).
2. The Aerodrome Manual addresses safety and operational requirements contained in CASA's Manual of Standards (MOS).
3. This procedure has been prepared to comply with requirements in MOS Chapter 17 – Wildlife Hazard Management.

## 1.1 KEY MOS REQUIREMENTS

This procedure addresses key aspect of MOS Chapter 17 that relate to AMPL's Abra mine airstrip. These are:

1. As part of the aerodrome serviceability inspection, the aerodrome operator must monitor and record the presence and behaviour of wildlife on the aerodrome and wildlife activity that is visible in the vicinity of the aerodrome.
2. Any detected wildlife hazard must be assessed for its potential risk to aircraft operations.
3. The aerodrome operator must implement controls to mitigate wildlife hazard risks within the boundary of the aerodrome.
4. Wildlife hazard monitoring personnel must be trained to:
  - (a) conduct wildlife observations and identify high-risk species;
  - (b) record information;
  - (c) collect any remains of a wildlife strike on the aerodrome;
  - (d) report the outcomes of observation, monitoring and strike collection activities.
5. The aerodrome operator must create training records for its monitoring personnel and records must be kept in safe custody for a period of at least 3 years.

CASA has prepared *Advisory Circular (AC) 139-26(0) (2011) – Wildlife Management at Aerodromes* to provide general information to assist in the management of wildlife hazards at aerodromes. This document is attached to this procedure in **Appendix 1**.

## 1.2 OTHER RELEVANT INFORMATION

The following list of other documents is also applicable to fauna management.

- Appendix 1                      CASA Advisory Circular
- Appendix 2                      Fauna Monitoring Checklist

# 2. TERMINOLOGY

Terminology used in this procedure and the fauna monitoring checklist is shown below.



Building	Are they around buildings and infrastructure
Drain	Are they in drainage lines
Flocking	Birds. Do they occur as individuals, pairs or flocks (more than a single pair)
Foraging	Are they actively feeding
Grass	Are they on the ground, in grass
Herding	Ground animals. Do they occur as individuals, a family (mother and calf) or a larger group (herd)
In flight	Birds. Are they flying or circling overhead
Loafing	Are they sitting (perching) quietly and 'just resting'
Perching	Are they just sitting in a tree or in a sheltered location
Pooled water	Are they in or near pools of water
Roosting	Sleeping
Tree / bush	Are they in trees or bushes

### 3. FAUNA MONITORING

The fauna monitoring checklist is included as **Appendix 2**. The checklist must be completed within 2 hours prior to the first plane arrival.

Any fauna sightings, and actions taken, must be recorded in the fauna monitoring register included as **Appendix 3**.

### 4. WILDLIFE STRIKE REPORTING

Any bird or animal strike must be reported to the Air Transport Safety Board (ATSB) using the Aviation Accident or Incident Notification Form: <https://www.atsb.gov.au/mandatory/asair-form/>

A link to this form is also in the Aerodrome Manual section 1.5

If the wildlife strike results in the death or injury of a person and/or serious damage to the aircraft, reports must be made immediately to the ATSB via telephone on 1800 011 034

Other reports must be lodged as soon as possible but in any event within 72 hours of an incident.

Details on the information required in the wildlife strike report is provided in the Advisory Circular – Section 11 , included as **Appendix 1**.

#### 4.1 TERMINOLOGY WHEN RECORDING A WILDLIFE STRIKE

Terminology used when recording a wildlife strike is provided below:

Confirmed	physical evidence, carcass, impact damage
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Incident	An event where it is likely that a strike could have resulted from a wildlife hazard. A <u>near miss</u> event involving wildlife and aircraft should be considered a form of wildlife incident.
on-aerodrome	occurs within aerodrome boundary
suspected	no physical evidence found, no damage located
remote from aerodrome	en-route incident
vicinity of aerodrome	areas identified as contributing to risk at the aerodrome
Single strike / multiple strike	numbers of animals involved

## 4.2 WILDLIFE STRIKE RESPONSE ACTIONS

Any wildlife strike incident at the airport must also follow AMPL's safety procedures for any accident or incident.

- Ensure the incident area is declared safe prior to approaching the plane.
- Photograph remains of any animal/bird(s) and damage to the plane.
- If possible from animal remains, make positive species identification and number and record in the wildlife monitoring register
- If no positive identification can be made, use appropriate PPE (disposable surgical gloves and mask), collect tissue samples and feathers and place in zip lock bags. Date samples and freeze

## 5. DOCUMENT REVISION

Date	Description	Reviewer
30/11/2021	Draft A	P Rokich

## **APPENDICES**

**APPENDIX 1:**  
**CASA ADVISORY CIRCULAR**



# Advisory Circular

AC 139-26(0)

JULY 2011

## WILDLIFE HAZARD MANAGEMENT AT AERODROMES

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### 1. REFERENCES

- This Advisory Circular (AC) should be read in conjunction with:
- Civil Aviation Safety Regulations 1998 Part 139 – Aerodromes.
  - Manual of Standards (MOS) Part 139 – Aerodromes.
  - Transport Safety Investigation Regulations 2003 (TSIR).

### 2. PURPOSE

The purpose of this AC is to provide general information and advice for the management of wildlife hazards at aerodromes.

### 3. STATUS OF THIS ADVISORY CIRCULAR

This is the first AC on the subject of wildlife hazard management at aerodromes.

*Advisory Circulars are intended to provide advice and guidance to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material.*

*Where an AC is referred to in a 'Note' below the regulation, the AC remains as guidance material.*

*ACs should always be read in conjunction with the referenced regulations.*

*This AC has been approved for release by the Executive Manager Standards Development and Future Technology Division.*

## 4. ACRONYMS

4.1 The following are acronyms used throughout this AC:

<b>AC</b>	Advisory Circular
<b>ATSB</b>	Australian Transport Safety Bureau
<b>ERSA</b>	En-Route Supplement Australia
<b>ICAO</b>	International Civil Aviation Organization
<b>MOS</b>	Manual of Standards
<b>NOTAM</b>	Notice to Airmen
<b>SMS</b>	Safety Management System
<b>TSIR</b>	Transport Safety Investigation Regulations 2003
<b>WHMP</b>	Wildlife Hazard Management Plan

## 5. DEFINITIONS

5.1 The following definitions explain various terms used throughout this AC:

**Wildlife** - includes all birds, bats and terrestrial animals as a practical definition.

**Wildlife strike** - when wildlife and a moving aircraft collide.

**Confirmed wildlife strike** - A wildlife strike is confirmed in the following cases:

- When physical evidence of a wildlife strike is found on the runway or runway strip used by the aircraft involved (unless another reason for the death of the wildlife can be found);
- When physical evidence of the strike is found on the aircraft involved following an inspection; and
- In any other instance where it can be reasonably proved from evidence that wildlife was struck as a direct result of a moving aircraft. For example, when aircrew report they definitely saw, heard or smelt a wildlife strike.

**Suspected wildlife strike** - An event where a wildlife strike has been suspected by aircrew or ground personnel but upon inspection:

- no carcass from the wildlife is found; and
- there is no physical evidence on the aircraft of the strike having occurred.

**Wildlife incident** - An event where it is likely that a strike could have resulted from a wildlife hazard. A near miss event involving both wildlife and aircraft should be considered a form of wildlife incident.

**Wildlife Hazard Management Plan** - A plan which identifies the wildlife hazard risk and details the measures used to treat that risk. This is also referred to in the MOS as a “bird or animal hazard management plan”.

**Hazard** - describes the source of potential harm to an aircraft caused by wildlife.

**Risk** - describes the likelihood of a wildlife strike occurring and the resultant consequence to the aircraft.

**Risk treatment** - describes the measures taken to reduce the likelihood of a wildlife strike occurring and/or the resultant consequence.

**Substantial damage** - means damage or structural failure incurred by an aircraft by a wildlife strike that adversely affects the structural strength, performance or flight characteristics of the aircraft and that would normally require major repair or replacement of the affected component.

**Aerodrome vicinity** - includes any facility, site or area which is identified as contributing to the risk at the aerodrome.

## 6. GENERAL

**6.1** Aviation safety statistics have demonstrated that wildlife can pose a significant hazard to the safe conduct of aircraft operations. According to recent worldwide data, the vast majority of wildlife strikes occur either on or within the immediate vicinity of an aerodrome.

**6.2** In many wildlife strike events, damage is sustained to the aircraft involved and/or the aircraft is delayed to allow for an inspection of possible damage. In more serious cases, the damage from a strike could result in the aircraft being unable to maintain safe operations.

**6.3** It is important that all reasonable action is taken by aerodrome operators to manage the wildlife hazard at their aerodrome. The recommended approach is to:

- identify and monitor the wildlife hazard;
- assess the hazard and rank wildlife species in their order of risk;
- identify suitable risk treatment options;
- develop a Wildlife Hazard Management Plan (WHMP) that is appropriate to address the hazard;
- implement the WHMP and monitor its effectiveness; and
- review and update the WHMP regularly.

**6.4** Operators of Certified Aerodromes are required to monitor and record the presence of wildlife on or in the vicinity of the aerodrome. Where this monitoring confirms the existence of a wildlife hazard, the aerodrome operator must develop a WHMP.

**6.5** Operators of Registered Aerodromes are required to monitor wildlife activity during their serviceability inspections. It is recommended that the operators of these aerodromes also consider the development of a WHMP, in the form of written procedures, where a wildlife hazard is found to exist.

**6.6** At certain other aerodromes, it is recommended that the wildlife hazard is assessed and that appropriate action is taken to manage the risk.

**6.7** The scope of the WHMP and the actions taken to manage the hazard should be commensurate with the responsibilities of the aerodrome operator.

**6.8** When assessing the wildlife hazard, individual species should be identified and prioritised in order of risk. The mass of the wildlife species and its behavioural characteristics (i.e. herding, flocking etc.) should be considered as this will affect the likelihood of a strike occurring and the resultant consequence.

**6.9** When assessing the wildlife hazard, the aerodrome operator should consider the number of confirmed and suspected strikes as well as any wildlife incidents that have occurred at the aerodrome. The practice of recording wildlife incidents is hence recommended as such events can indicate a situation with the potential to cause an actual wildlife strike.

**6.10** Where required, advice should be sought from a suitably qualified person when assessing and mitigating the wildlife risk.

**6.11** For wildlife hazards in the aerodrome vicinity which contribute to the risk but are outside the control of the aerodrome operator (i.e. on land located outside the aerodrome boundary), it is expected that the aerodrome operator will:

- advise the relevant land owner(s) or controlling authority of both the nature of the wildlife hazard and the resultant impact on the aerodrome; and
- work with the relevant land owner(s) or controlling authority to manage the wildlife hazard.

**6.12** Wildlife strikes must be reported to the Australian Transport Safety Bureau (ATSB). More information on reporting requirements can be found in section 11.2 of this AC.

**6.13** Aerodrome operators are encouraged to actively engage with their aircraft operators and other relevant stakeholders including the sharing of wildlife hazard and strike information.

## **7. WILDLIFE HAZARD MANAGEMENT AT CERTIFIED AERODROMES**

**7.1** The following section details the requirements, guidelines and recommendations for the operators of Certified Aerodromes with regard to wildlife hazard management.

### **7.2 Aerodrome serviceability inspections**

**7.2.1** Aerodrome serviceability inspections are visual checks used to assess the safety of the aerodrome at a particular point in time. Wildlife hazard identification forms an important part of these inspections and as a minimum, a check must be made of the following:

- the condition of aerodrome fencing (particularly in critical areas);
- climatic or seasonal considerations, such as the presence of:
  - wildlife at certain times of the year; and
  - the depth of water in drainage ponding areas etc.;
- possible shelter provided by aerodrome infrastructure (such as buildings, equipment and gable markers);
- wildlife hazard management procedures (as incorporated in the environmental management procedures for the aerodrome);
- off-airport attraction sources (such as animal sale centres, picnic areas, aeration facilities, waste disposal and landfill areas etc.); and
- the use of harassment procedures where appropriate.

**7.2.2** The aerodrome serviceability inspection should support wildlife monitoring at the aerodrome.



### **7.3 Wildlife Monitoring**

**7.3.1** Operators of Certified Aerodromes are required to monitor and record on a regular basis the presence of wildlife on the aerodrome. This requirement also extends to the aerodrome vicinity where wildlife hazards outside the aerodrome boundary are found to impact on the safe operation of the aerodrome. The recommended practice for monitoring wildlife hazards can be found in section 9 of this AC.

**7.3.2** Monitoring personnel should be suitably trained to be able to:

- perform an initial identification of the wildlife species;
- assess populations and describe their behaviour; and
- demonstrate an understanding of the recording and reporting process.

**7.3.3** To perform their roles properly, it is recommended that monitoring personnel have access to wildlife identification materials and equipment such as a field guide, identification books, binoculars etc.

**7.3.4** Records of the results from wildlife monitoring must be maintained.

### **7.4 Wildlife Hazard Management Plan**

**7.4.1** Where monitoring confirms the existence of a wildlife hazard to aircraft operations, the operator of a Certified Aerodrome must produce a WHMP.

**7.4.2** The WHMP must be prepared by a suitably qualified person such as an ornithologist, biologist or someone with demonstrated expertise in the management of the wildlife hazard.

**7.4.3** The scope and complexity of the WHMP should be commensurate with the wildlife hazard at the aerodrome. The content of the plan must address the following as a minimum:

- hazard assessment (including monitoring action and analysis);
- pilot notification (reporting);
- liaison and working relationships with land use planning authorities;
- on-airport sources of wildlife attraction (i.e. food, water, shelter etc.);
- suitable harassment methods; and
- an ongoing strategy for wildlife hazard reduction (i.e. the provision of appropriate fencing).

**7.4.4** For more information on hazard assessments, please refer to sections 6.8, 6.9 and 6.10 of this AC for more information.

**7.4.5** The responsibilities for wildlife hazard management and the roles of key personnel should be clearly defined in the WHMP.

**7.4.6** Once produced, the WHMP should be subject to continuous review and improvement to ensure it remains commensurate with the wildlife hazard at the aerodrome.

**7.4.7** The following events should trigger an immediate and urgent review of the WHMP:

- when an aircraft experiences multiple wildlife strikes;
- when an aircraft experiences substantial damage following a wildlife strike;
- when an aircraft experiences an engine ingestion of wildlife; and

- when wildlife are observed on the aerodrome in size or in numbers that are capable of causing the events described above.

**7.4.8** For aerodromes with a significant wildlife hazard, a Wildlife Hazard Management Committee can be formed to coordinate the efforts of the aerodrome operator, qualified persons and any key stakeholders.

## **7.5 Integration with the Aerodrome Safety Management System**

**7.5.1** To ensure a consistent approach to hazard identification and risk management is undertaken, the WHMP should be integrated with the Aerodrome Safety Management System (SMS).

**7.5.2** Both confirmed and suspected wildlife strikes as well as any wildlife incidents should all be considered when assessing the wildlife strike risk through the SMS.

**7.5.3** Any investigations into a wildlife strike, wildlife incident etc. should follow the relevant investigation procedures in the SMS.

**7.5.4** The WHMP should also be subject to the review and audit functions of the SMS.

## **8. WILDLIFE HAZARD MANAGEMENT AT REGISTERED AERODROMES**

**8.1** The following section details the requirements and recommendations for the operators of Registered Aerodromes with regard to wildlife hazard management.

**8.2** The serviceability inspection checklist used at a Registered Aerodrome must include a check for wildlife activity both on and in the vicinity of the aerodrome.

**8.3** If this assessment shows the existence of a wildlife hazard, operators of a Registered Aerodrome should be able to demonstrate that they are discharging their duty of care in providing a safe facility for aircraft operations. Registered Aerodromes should develop a simplified WHMP, in the form of written procedures, where a wildlife hazard is found to exist.

**8.4** If appropriate for managing the wildlife hazard, it is recommended that these procedures cover the monitoring, assessment and treatment of wildlife hazards. Refer to sections 6, 7, 9 and 10 of this AC for more information.

**8.5** Operators of a Registered Aerodrome are further required to issue Notice To Airmen (NOTAM) to the same standard as required for Certified Aerodromes. More information on reporting requirements can be found in section 11 of this AC.

## **9. WILDLIFE HAZARD MONITORING**

**9.1** Before the wildlife hazard can be effectively treated, it must first be identified through a monitoring process. The personnel selected to conduct monitoring should be suitably trained. Refer to section 7.3.2 of this AC for more information.

**9.2** Wildlife monitoring must involve:

- wildlife presence and behaviour on the aerodrome; and
- wildlife activity in the vicinity of the aerodrome.

### **9.3 Wildlife monitoring on the aerodrome**

**9.3.1** The following is a suggested practice for monitoring wildlife on the aerodrome:

- The aerodrome environment should be divided into separate monitoring zones. It is reasonable to expect that the aerodrome operator will select these zones based on:
  - Geographical size;
  - Specific environmental factors within the zone such as terrain, soil type, flora, land use etc.; and
  - The operational use of the zone by aircraft such as takeoff, approach etc.
- A trained person should monitor and record wildlife populations and behaviour within each zone; and
- Any wildlife that transit across the zone, either by ground or by air, should be included.

**9.3.2** Wildlife monitoring should be conducted regularly and the frequency should correlate to the severity of the wildlife hazard. In other words, the greater the wildlife hazard, the more frequently monitoring should be conducted.

**9.3.3** The timing of wildlife monitoring should be such that it provides a complete coverage of wildlife activity, day or night, as appropriate to the aerodrome.

### **9.4 Wildlife monitoring in the vicinity of the aerodrome**

**9.4.1** The monitoring of wildlife in the vicinity of the aerodrome should cover any obvious concentrations of wildlife and/or sources of wildlife attraction (i.e. habitat, migratory routes, feeding and breeding areas etc.) which contribute to the risk at the aerodrome.

**9.4.2** Monitoring in the vicinity of the aerodrome could include but is not limited to:

- areas used for waste, recycling, offal or sewage;
- wetlands, marshes, areas of water discharge and open waterways;
- areas containing significant food sources for high risk species; and
- national parks, wildlife reserves and other significant wildlife corridors.

**9.4.3** The identification of these areas could be achieved by:

- the observation of wildlife transiting across the aerodrome between separate sources of attraction;
- the physical observation of land uses in the aerodrome environment; and
- any wildlife hazard reports received from pilots, authorities and/or the general public.

**9.4.4** The outcome of the wildlife monitoring must be recorded. These records should be maintained in order to provide a detailed history of wildlife populations and behaviour over time.

**9.4.5** Once monitoring has identified a wildlife hazard, it should then be assessed. Please refer to sections 6.8, 6.9 and 6.10 of this AC for more information.

## **10. WILDLIFE HAZARD TREATMENT**

**10.1** Once the wildlife hazard has been identified, monitored and assessed, the aerodrome operator should implement appropriate controls to manage the risk. Given the wide variety of wildlife species, it is likely that more than one control measure will be required.

**10.2** In order to determine what are appropriate and effective treatments, it is recommended that the aerodrome operator seek guidance from one or more of the following sources:

- rangers, ornithologists, zoologists, other wildlife experts; and/or
- other aerodrome operators with experience in treating a similar wildlife hazard.

**10.3** Priority should be given to addressing those wildlife species that were identified as being the highest risk. The treatment options themselves generally fall into two categories being Pre-emptive and Active.

**10.4 Pre-emptive treatments.** These are generally applied to the aerodrome environment and can include but are not limited to:

- provision of appropriate fencing around the aerodrome boundary;
- removal of food and habitat sources;
- covering of open water sources, drains etc.;
- use of spikes, wire, nets and/or mesh to prevent roosting;
- selection of plant species with reduced attraction qualities;
- maintenance of grasses at set lengths above the ground;
- removal or covering of exposed sources of waste, sewage, offal etc.; and
- the use of appropriate landscaping techniques.

**10.5 Active treatments.** These are generally applied to the actual wildlife hazard and could include but are not limited to:

- the use of scare tactics such as horns, sirens, loud hailers, gas cannons, pyrotechnics, arm waving and chasing;
- the simulation of threats to wildlife such as lures, dogs, distress call generators etc.; and
- the use of capture or culling practices.

**10.6** Appropriate approval should be obtained from the relevant authorities before treatment commences. Personnel should be properly trained and qualified in the use of the treatment.

**10.7** When using active treatments, care should be taken to ensure that the wildlife responding to the treatment will not be directed towards an aircraft.

**10.8** The recommended practice for addressing wildlife hazards in the aerodrome vicinity can be found in section 6.11 of this AC.

## 11. REPORTING REQUIREMENTS FOR CERTIFIED AND REGISTERED AERODROMES

**11.1** The following section details the requirements, guidelines and recommendations for the operators of Certified and Registered aerodromes in the reporting of wildlife strikes and wildlife hazards.

### 11.2 Wildlife strike reports to the Australian Transport Safety Bureau (ATSB)

**11.2.1** The ATSB is a key recipient of wildlife strike information and conducts periodic analysis of the information that it receives. Detailed reports on wildlife strikes are then released to the aviation industry on a routine basis.

**11.2.2** Under TSIR, the operators of Certified and Registered aerodromes are required to report to the ATSB within 72 hours a wildlife strike occurring at their aerodrome. For all aircraft operations, the TSIR defines a wildlife strike as being '*a collision with an animal, including a bird*'.

**11.2.3** Reports to the ATSB can be made via post, fax or email using the official form sourced from the ATSB website: <http://www.atsb.gov.au/mandatory/asair.aspx>

**11.2.4** If the wildlife strike results in the death or injury of a person and/or serious damage to the aircraft, reports must be made immediately to the ATSB via telephone on **1800 011 034** or via fax on **(02) 6274 6434**.

**11.2.5** Reports to the ATSB must include the following information as known by the person making the report:

- The name and contact details of the reporter;
- The date and time (local) of the strike;
- Aircraft part(s) damaged (if any);
- The location of the strike (i.e. at aerodrome, greater than 5 kilometres away, etc)

**11.2.6** Reports to the ATSB should also include the following details as known by the person making the report:

- **For bird strikes:**
  - The runway number used by the aircraft operation;
  - The number of birds sighted;
  - The number of birds struck;
  - The species involved (or bird type if the actual species is not known);
  - The size (large, medium, small etc.) of the actual bird(s) involved (not what is the normal size for the particular species);
  - The details of any engine ingestion (including the number of engines experiencing ingestion).
- **For animal strikes:**
  - Specific location (runway, taxiway, etc.);
  - The size (large, medium, small etc.) of the animal(s) involved (not what is the normal size for the particular species);
  - The species involved (or type of animal if species is not known);

**11.2.7** As the process for identifying the wildlife species can take time, an initial report with the known information must be submitted to the ATSB within 72 hours. If a subsequent investigation uncovers additional details of the strike (such as the species involved), the ATSB should then be contacted with the new information. The original report can then be updated accordingly.

**11.2.8** Should the aerodrome operator be unable to identify the wildlife species involved in the strike, forensic identification methods such as DNA sampling of the remains may assist. More information is available from the ATSB report titled “Forensic Identification of Aviation Bird Strikes in Australia”:

[http://www.atsb.gov.au/media/32727/grant\\_20050117.pdf](http://www.atsb.gov.au/media/32727/grant_20050117.pdf)

**11.2.9** Under the TSIR, aircraft operators are also required to report a wildlife strike involving their aircraft to the ATSB.

### **11.3 Wildlife hazard reports through Notice To Airmen (NOTAM)**

**11.3.1** Certified and Registered aerodromes are required to report to the Australian NOTAM office any significant increases or concentrations in wildlife both on and in the vicinity of the aerodrome. This practice ensures that pilots and aircraft operators can continuously assess the wildlife hazard at the aerodrome.

**11.3.2** At aerodromes where a standing caution is included in En-Route Supplement Australia (ERSA) for a bird or animal hazard, NOTAM action must only be initiated where there is a significant increase in the wildlife hazard. Any such NOTAMs must include the following specific information:

- the wildlife species;
- the periods of wildlife activity; and
- their likely location and flight path.

### **11.4 Wildlife hazard information in Enroute Supplement of Australia (ERSA)**

**11.4.1** Where a standing caution for wildlife hazards at an aerodrome is published in ERSA, it is recommended that the following information is also included:

- the high risk species commonly found at the aerodrome;
- the location of any significant sources of attraction (both on the aerodrome and in the vicinity) as applicable to the high risk species;
- any periods, seasons and/or times of increased wildlife activity; and
- other relevant information that describes the wildlife hazard that is normally present at the aerodrome.

## **12. FURTHER INFORMATION**

**12.1** The Australian Aviation Wildlife Hazard Group is a combined industry and government discussion panel for aviation wildlife hazard management. More information is available through their website at: <http://www.aawhg.org>

**12.2** The International Civil Aviation Organization (ICAO) has produced information on bird control and reduction in ICAO Doc 9137: Airport Services Manual - Part 3. Copies are available for purchase through their website at:

[http://www.icao.int/icao/en/m\\_publications.html](http://www.icao.int/icao/en/m_publications.html)

**12.3** The ATSB has a number of wildlife strike publications available and aims to publish an ‘Australian Aviation Wildlife Strike Statistics’ report every two years. More information is available through their website: <http://www.atsb.gov.au/research.aspx>

**12.4** Further information on wildlife hazard management can also be obtained from the following websites:

- The International Bird Strike Committee: <http://www.int-birdstrike.org>
- Federal Aviation Administration – Wildlife Strike Database: <http://wildlife-mitigation.tc.faa.gov/wildlife/database.aspx>
- Civil Aviation Authority (United Kingdom) – Birdstrikes: <http://www.caa.co.uk/default.aspx?catid=375&pagetype=90&pageid=3404>
- Transport Canada – Wildlife Control: <http://www.tc.gc.ca/eng/civilaviation/standards/aerodromeairnav-standards-wildlifecontrol-menu-931.htm>

*Note: The Civil Aviation Safety Authority makes no representation regarding the currency and accuracy of the information available from these resources.*

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Executive Manager  
Standards Development and Future Technology

July 2011

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**APPENDIX 2:**  
**FAUNA MONITORING CHECKLIST**

Date: \_\_\_\_\_ Start Time: \_\_\_\_\_ End Time \_\_\_\_\_

Wildlife Monitor (Print Name): \_\_\_\_\_ (Sign): \_\_\_\_\_

### Fauna Monitoring Checklist

#	Task	Y/N	Comment
<b>Safety communication</b>			
1	<p><u>Prior to entering the fenced runway area</u>, radio broadcast is required to be made to alert any aircraft in the vicinity.</p> <p>ARO is to announce intention by radio on CTAF 126.7MHz. For example “<i>Abra traffic, light vehicle entering runway area for runway inspection</i>”</p> <p>After making the broadcast, pause for a possible response and visual scan for aircraft in the circuit area. If no response enter the area to conduct inspection.</p>		<p>Record time of radio call below:</p> <p>_____</p>
<b>Wildlife monitoring AT the airstrip</b>			
2	Drive the perimeter fence of the airstrip. Are fences intact and gates secure?		If Yes – go to #4
3	<p>If No - Enter a maintenance item in the Aerodrome Maintenance Logbook located in hard copy in the ARO room at the Abra Mine Aerodrome Terminal building.</p> <p>Radio the Aerodrome Manager to inform them of the maintenance issue.</p>		
4	Are there any seasonal or environmental conditions present which may act as wildlife attractants (eg; pools from recent rainfall, flowering vegetation etc)		
5	Check likely fauna attractant locations within airstrip fenced area - water ponds, rubbish bins, grass areas, shade / shelter from buildings and trees		
6	Is any large ground fauna [kangaroos, cattle, ferals (camel, donkey)] within the airstrip fenced area		If No – go to #10
7	If Yes - Radio Aerodrome Manager. Alert them of the situation and request assistance to help remove the animals from the fenced area.		
8	Open gates and then use vehicles to herd animals towards the gates. Once all large ground fauna have been confirmed as outside the airstrip fenced area, close gates.		
9	Record species, number, time of sighting, in the fauna monitoring register		Appendix 3
10	Check for evidence of wildlife inhabiting the aerodrome confines, for example, bird droppings under building eaves, lizard burrow under buildings or nests in trees		
11	Use binoculars to identify any bird or birds that are (i) within the airstrip fenced area or (ii) within visual distance of the airstrip.		
12	For any birds inside the airstrip fenced area use vehicle car horn / starters gun / siren to frighten birds and chase them out of the fenced airstrip area. Observe the direction of their flight from the airstrip and approximate distance of their last sighting.		

#	Task	Y/N	Comment
13	Use binoculars to check for wildlife attraction sources within visual distance from the aerodrome such as deceased wildlife or roadkill		
14	Record species, number, time of sighting, distance and direction of last sighting in the fauna monitoring register		Appendix 3
Wildlife monitoring beyond visible distance (vicinity) of the Airstrip			
	<p><i>NOTE - The TSF, process plant water dams, other site water storage dams, site landfills and natural creeklines are attractants to wildlife in the vicinity of the airstrip. Both ground fauna and birds are known to be attracted to these locations.</i></p> <p><i>The <u>birds</u> could be in flight and present a strike risk to aircraft during approach or departure from the airstrip</i></p>		
15	ARO to contact respective duty managers or supervisors at the process plant and mine, for them to confirm if any bird species are on or visible around any of the above locations.		
16	Observe any bird species at creeklines and natural pools when travelling to the airstrip from the mine site.		
17	Record species, number and location of birds observed in the vicinity of the aerodrome on the fauna monitoring register		Appendix 3
Communication with plane prior to landing			
18	<p>When plane is heard or is visible from the airstrip, the ARO must radio the pilot and inform them of aerodrome conditions, including a wildlife report, stating either:</p> <p>All clear – no hazards or wildlife sightings on or in visible distance of the airstrip; or</p> <p>Birds sighted - in the vicinity of the airstrip, species (if known), number and direction of last sighting</p>		
19	The ARO is to ensure that the pilot positively acknowledges there is no known wildlife strike risk or, if birds are present in the vicinity of the airstrip; type, number and where they were last sighted		Record time of radio call below: _____
Record keeping			
	<p><b>Completed wildlife checklist and register forms</b> must be filed in hard copy in <u>File 9</u> in the ARO Room, which is located in the Aerodrome Terminal Building behind the check-in desk</p> <p>Wildlife strike reports and NOTAMs must be filed in <u>File 5</u> in the ARO Room</p>		

**APPENDIX 3:  
FAUNA MONITORING REGISTER**



# Appendix K. Hot work permit

# HOT WORK PERMIT

<b>BEFORE INITIATING HOT WORK, CAN THIS JOB BE AVOIDED? IS THERE A SAFER WAY?</b>
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This Hot Work Permit is required for any temporary operation involving open flames or sparks. This includes, but is not limited to: brazing, cutting, grinding, soldering, thawing pipes, torch-applied roofing, and welding.

Date:	Permit Checklist
Building:	
Location:	
Description of hot work:	
Name of Hot Work Operator:	
Is a Fire Watch required? <input type="checkbox"/> Yes <input type="checkbox"/> No	
A Fire Watch should be posted if	
<ul style="list-style-type: none"><li>• combustible materials within a 35-foot radius of hot work cannot be removed</li><li>• wall or floor openings within a 35-foot radius of hot work expose combustible materials in adjacent areas, including concealed spaces in walls or floors</li><li>• combustible materials are adjacent to the opposite side of partitions, walls, ceilings or roofs and are likely to be ignited</li><li>• it is deemed necessary by the Permit Authorizing Individual</li></ul>	<ul style="list-style-type: none"><li><input type="checkbox"/> Flammable and combustible materials within a 35-foot radius of hot work have been removed or covered with fire retardant tarps or metal shields.</li><li><input type="checkbox"/> All floors and surfaces within a 35-foot radius of the hot work area have been swept free of combustible dust or debris.</li><li><input type="checkbox"/> Any openings or cracks in the walls, floors, or ducts that are potential travel passages for sparks, heat and flames have been covered.</li><li><input type="checkbox"/> An operable fire extinguisher is nearby and accessible.</li><li><input type="checkbox"/> Sprinkler heads that could be activated by hot work have been covered with a wet rag.</li><li><input type="checkbox"/> Smoke detectors in the area of hot work have been covered to prevent false alarms.</li><li><input type="checkbox"/> A Fire Watch has been posted, if it is required, during hot work operations and for 30 minutes after work has been completed.</li></ul>

AUTHORIZATION: The information on this permit has been evaluated, the site has been examined and all safety measures are in place.

Signed: \_\_\_\_\_  
Permit Authorizing Individual

Reviewed 2015

# WARNING!

**HOT WORK IN PROGRESS  
WATCH FOR FIRE!**

The permit valid until: \_\_\_\_\_

If you have questions about these hot work activities:

CALL: \_\_\_\_\_

AT: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# WARNING!



**APPENDIX 3:  
CONFIDENTIAL INFORMATION**



**TERRA ROSA**  
CONSULTING

**Report on an Archaeological and Ethnographic  
Site Avoidance survey of E52/1455 with  
Nharnuwangga Wajarri and Ngarlawangga  
Traditional Owners, and prepared for Galena  
Mining Ltd**

**July 2018**

**Author: Sarah Keiller and Tom Lally**

**TRCo Ref: JJ1806**

Version	Date	Change log	Author(s)
0.1	6/07/18	Draft document created	S. Keiller
0.2	24/07/18	Results and recommendations drafted	T. Lally
0.3	25/07/2018	Report edit	D. Lafrentz
0.3	26/07/2018	Draft released to JJAC and CCNTS	C. Blight
1.0	08/08/2018	CCNTS feedback incorporated and document released to Galena	C. Blight
1.1	15/08/2018	Galena feedback incorporated and document released to Galena	S. Keiller

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## Disclaimer

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The information, opinion, ideas and recommendations presented in this document is partly based on the experience of the authors, research, and recognised procedures, which are believed to be accurate, but not infallible. The advice contained herein is given in good faith and follows acceptable professional standards and procedures, but is not meant to encourage any activity, practice or exercise, which may have ceased, changed or have been superseded for any reason without the knowledge of the authors. The authors assume no responsibility or liability for any loss or damage caused directly or indirectly by the information presented in this document.

## Coordinate capture

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The authors advise that all coordinates quoted in this document were initially obtained with a Garmin hand held GPS using the GDA datum. All grid references are projected in MGA Zone 50, unless otherwise stated. Dependent on external conditions, these units afford an optimal spatial accuracy of  $\pm 5$  m.

## Heritage project participants and contacts

The contact details of the heritage project stakeholders are provided below. The authors would like to thank everyone that participated in the heritage survey and assisted in organising the fieldwork.

The heritage survey was conducted between 17 and 20 July, 2018 (exclusive of travel days).

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<b>Report authors</b>	Sarah Keiller and Tom Lally
<b>Editor</b>	Damien Lafrentz
<b>Executive sign-off</b>	Scott Chisholm

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<b>Field work participants</b>	Garry 'Cowboy' Robinson Snr Rose Robinson Stewart Robinson Glexis Robinson Bobbie Robinson Jack McPhee Joseph Walsh

### Proponent **Galena Mining Ltd**

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<b>Contact</b>	Ed Turner
<b>Field work participants</b>	Angelo Scopel

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## Acronyms and definitions

The following terms and acronyms are utilised throughout the report. Definitions are provided below for reference.

Term / Abbreviation	Definition
<b>ACMC</b>	Aboriginal Cultural Materials Committee
<b>AHIS</b>	Aboriginal Heritage Inquiry System
<b>CCNTS</b>	Cross Country Native Title Services
<b>DPLH</b>	Department of Planning, Lands and Heritage
<b>Galena</b>	Galena Mining Ltd
<b>GIS</b>	Geographic information system
<b>GPS</b>	Global positioning system
<b>Heritage object</b>	An object to which the Act applies under section 6
<b>HISF</b>	Heritage Information Submission Form
<b>Isolated artefacts</b>	Cultural material with insufficient density to constitute a site.
<b>JJAC</b>	Jidi Jidi Aboriginal Corporation
<b>MGA</b>	Map grid of Australia
<b>NNTT</b>	National Native Title Tribunal
<b>Other Heritage Place</b>	Other heritage places are heritage places catalogued by the DPLH but not included on the Register of Aboriginal Sites for one of the following reasons: <ol style="list-style-type: none"> <li>1. Information about the OHP has been lodged with the DPLH but is pending assessment by the ACMC (status L – lodged; also see definition for ‘potential site’, below); or</li> <li>2. The ACMC assessed the OHP and considered it not to meet the evaluation criteria for inclusion on the Register of Sites (i.e. not a registered Aboriginal site) (status S – stored / not a site).</li> </ol>
<b>Registered Aboriginal site</b>	A heritage place which has been determined as meeting criteria under section 5 of the <i>Aboriginal Heritage Act 1972 (WA)</i> , and has been registered by the Registrar of Aboriginal Sites (DPLH status R - registered).
<b>Site</b>	Any place which may meet the criteria of an Aboriginal site under s5 of the <i>Aboriginal Heritage Act 1972 (WA)</i> .
<b>Terra Rosa</b>	Terra Rosa Consulting
<b>Traditional Owners</b>	Nharnuwangga Wajarri and Ngarlawangga native title claimants (NNTT no WCD 2000/01) and invited participants
<b>The Act</b>	<i>Aboriginal Heritage Act 1972 (WA)</i>

## 1 Heritage project overview

---

Galena Metals Ltd (Galena) plans to use land within the Nharnuwangga Wajarri and Ngarlawangga native title determination area (WCD 2000/001) for the purpose of mining. The project area is contained within the exploration tenement E52/1455 (see Map 1).

Cross Country Native Title Services Pty Ltd (CCNTS) on behalf of Jidi Jidi Aboriginal Corporation (JJAC), as the representative of the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, engaged Terra Rosa Consulting (Terra Rosa) to conduct an archaeological and ethnographic site avoidance heritage survey of the area in consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.

The survey was conducted between 17 and 22 July, 2018, by 6 Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, two Terra Rosa consultants and a representative of Galena.

The aim of the site avoidance survey was to identify and record all Aboriginal heritage values within the survey area. This level of recording will allow Galena to make informed decisions for the management of these locations. Site avoidance recording is insufficient to allow a full significance assessment to be made under s39 of the Act.

*Plate 1: The heritage team*





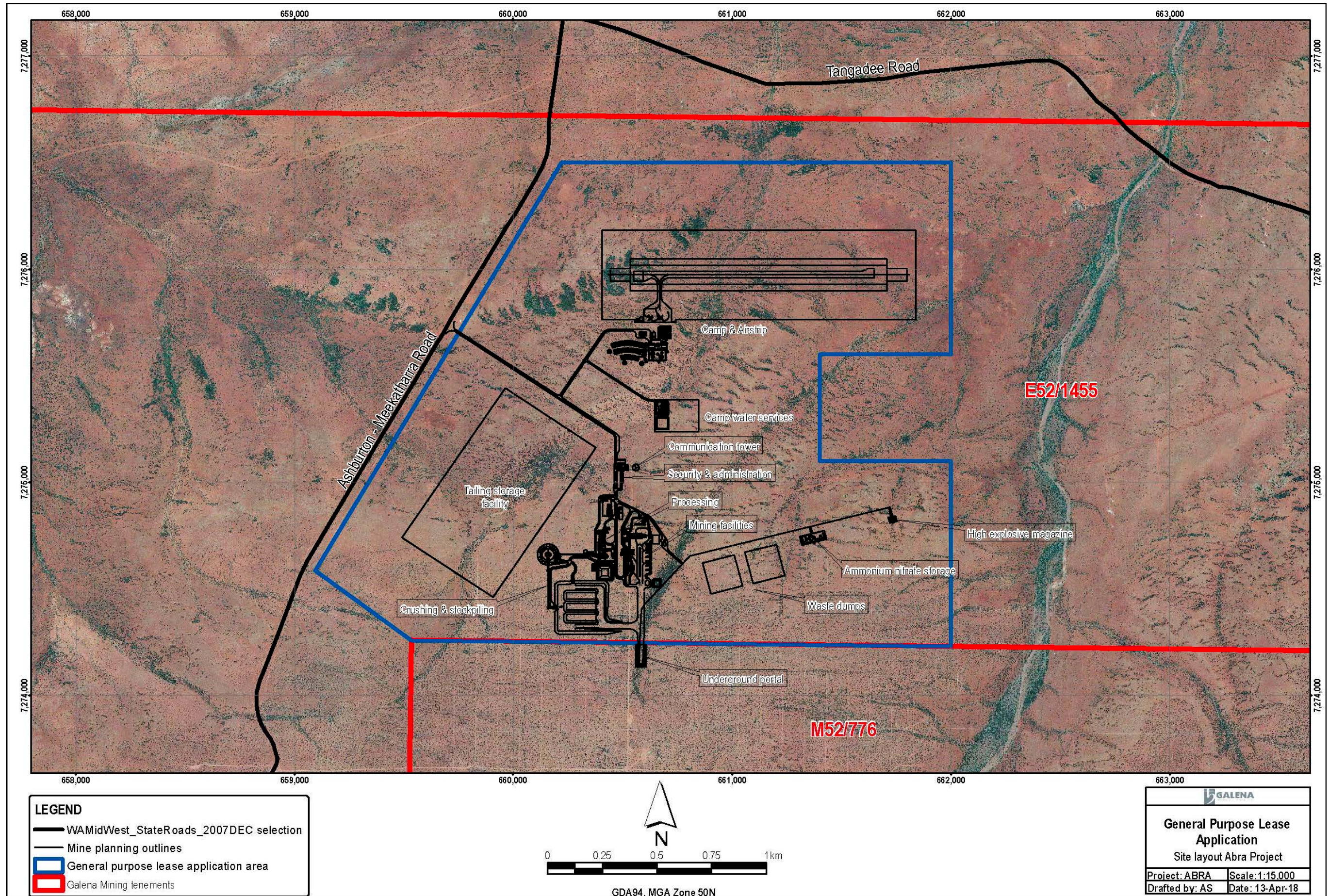
*Plate 2: The G 5200292 survey area*



*Table 1: Heritage survey overview*

Survey area	Total area (ha)	Assessment type
General Purpose Lease application area within E52/1455 (see Map 1) Additional survey area (see Map 2)	Two polygons totalling 574 ha	Archaeological and ethnographic site avoidance survey

Map 1: Proposed E52/1455 Project heritage survey area



## 2 Heritage assessment method

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The heritage survey was conducted to a site avoidance standard. The objective of site avoidance heritage surveys is to identify, and record brief details of Aboriginal sites as defined under s5 of the Act, to negotiate deviations around such places where possible, and to provide Galena Mining with heritage management considerations for heritage values that would otherwise be impacted by the proposed development. As such, a site avoidance method is designed to document Aboriginal heritage values to a standard sufficient to provide a preliminary understanding of a site's characteristics, and to allow the proponent to proceed with works that will not impact those places.

This includes accurate delineation of the spatial extent of sites using handheld global positioning systems (GPSs), justification of the recorded boundaries, and brief description of the heritage values of the places sufficient to convey the potential importance and significance of the place. However, site avoidance recording is insufficient to allow a full significance assessment to be made under s39 of the Act for consideration by the Aboriginal Cultural Materials Committee (ACMC).

Overviews of the procedures used during desktop and field-based research are provided below.

### 2.1 Legislative requirements

---

Under section 17 (s17) of the Act, it is an offence to disturb an Aboriginal site without prior written Ministerial consent to do so under s16 or s18 of the Act. This applies regardless of whether an Aboriginal site is registered. Heritage assessments of proposed development areas are conducted to identify the location and extent of sites so that they can be appropriately managed in accordance with the legislative requirements of the Act. Outlines of the sections of the Act referenced in this report are provided in appendix 1.

### 2.2 Desktop assessment procedure

---

A preliminary desktop assessment was completed prior to field work to provide an overview of the heritage research undertaken to date within the area. This focused on the identification of any registered Aboriginal sites and surveys within the area, which need to be considered in the heritage approval process for the project.

Desktop research for heritage values relies largely on the Register of Sites maintained by the Department of Planning, Lands and Heritage (DPLH), which provides an indication as to the presence and nature of any heritage values previously recorded and registered within the area. The AHIS search is also utilised to determine whether any heritage assessments have previously been conducted within the application area and if any heritage reports containing information relevant to the application area have been registered with the DPLH.

Prior to field work, the survey area boundaries were entered into the DPLH's Aboriginal Heritage Inquiry System (AHIS) to learn whether any registered Aboriginal sites or other heritage places (OHPs) have been recorded within the area. Registered Aboriginal sites are those areas that have been assessed by the ACMC as constituting sites under the Act. OHPs include places for which data has been lodged with the DPLH but is pending

assessment by the ACMC, and places that have been assessed by the ACMC as not constituting registered Aboriginal sites (listed as stored data / not a site).

Following the AHIS search, relevant registered Aboriginal site files, OHP files and heritage reports held by the DPLH were accessed and studied. Any relevant to the survey areas were summarised in order to provide the field team with an understanding of the heritage survey and assessment works to date.

### 2.3 Field assessment procedure

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A briefing was conducted by the heritage consultants to provide the Traditional Owners with information about the purpose, scope, and method of the heritage survey. Any places of interest known to or recognised by the Traditional Owners, including registered Aboriginal sites and OHPs, were discussed, along with accessibility to and possible vantage points within the assessment area. The heritage consultants sought confirmation from the Traditional Owners that they consented to participate in the heritage assessment and whether additional Traditional Owners, who may hold further knowledge of the area, needed to be consulted. The method utilised during field work was approved and endorsed by the Traditional Owners who participated in the field assessment.

Pedestrian transects were used to assess the remainder of the survey area for cultural heritage values. Any sites identified were recorded to a site avoidance standard. Detailed methods used to record different heritage values are provided in appendix 2.

Upon conclusion of the field trip a debrief was conducted to offer the Traditional Owners the opportunity to discuss and comment upon the field method and the sites identified, including mitigation strategies and recommendations for heritage management within the area.

*Plate 3: Surveying G 5200292*



## 2.4 Review of findings

---

A draft report was reviewed by CCNTS and JJAC, prior to dissemination of results to Galena. The review process ensures that culturally sensitive information is appropriately indicated, and the recommendations discussed amongst the heritage team are appropriate and made in accordance with any existing Agreements. This process provides Terra Rosa with feedback which is taken into account during the final editing of the report.

### 3 Heritage assessment results

Table 2 presents a summary of the survey area assessment status at the end of the field trip.

Table 2: Heritage survey summary

Survey areas	Assessment Type	Assessment status
General Purpose Lease application area within E52/1455 and Additional survey area	Archaeological and ethnographic site avoidance survey	Complete

As a result of the heritage survey:

- No DPLH registered Aboriginal sites were identified;
- No lodged DPLH OHPs were identified;
- No stored DPLH OHPs were identified;
- **One** newly identified site (GAL18-01) was recorded to site avoidance standard.

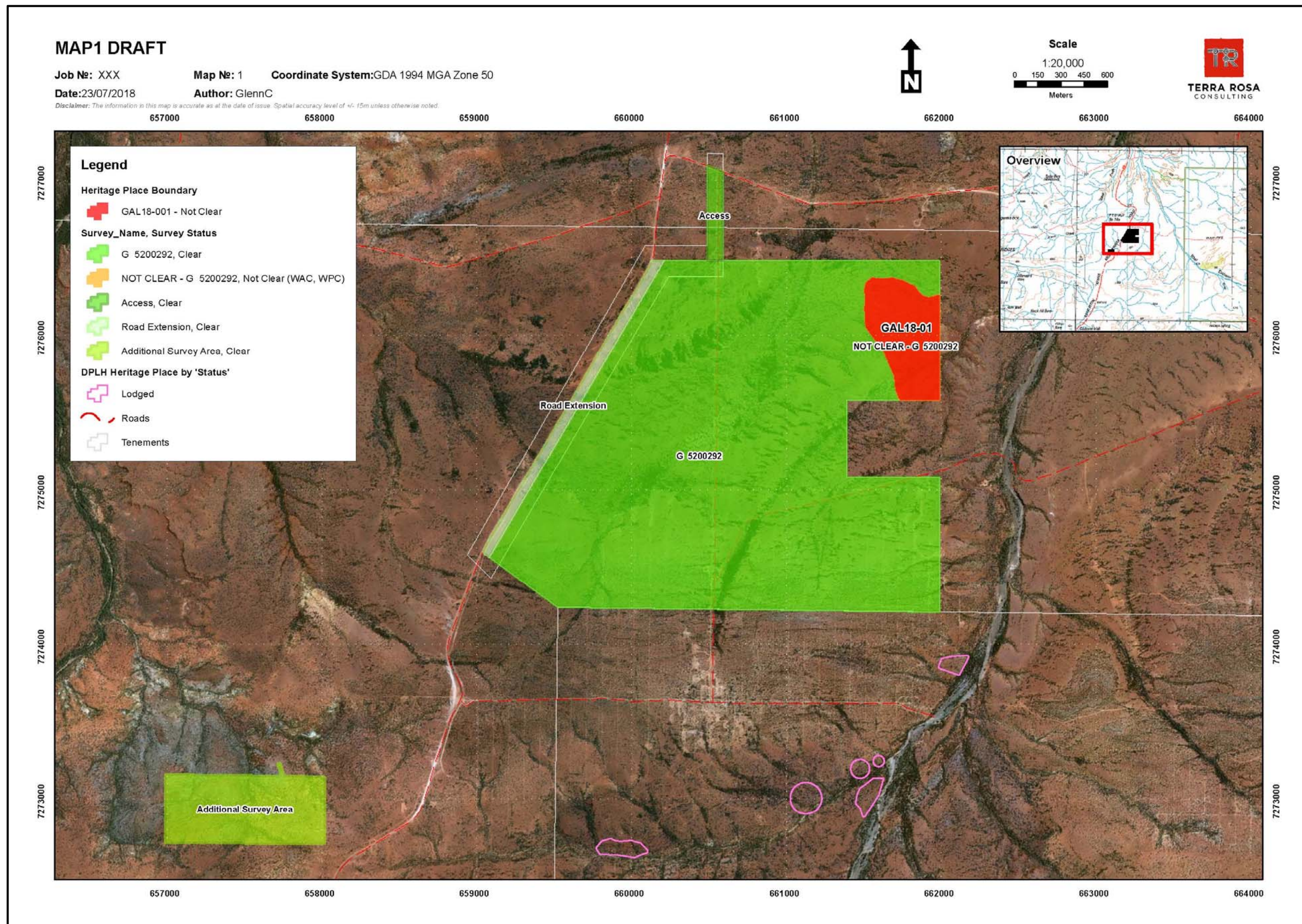
A total of 133 isolated artefacts were also recorded within the survey areas and relocated to the *Wagula* keeping place.

A detailed overview of these results is provided in Table 3, with site summaries presented in sections 3.1 to 3.3. The survey results are illustrated in map 2.

Table 3: Aboriginal sites and isolated artefacts identified within the assessment area

Classification of findings	Number identified	Survey Areas	Place ID	Place type	HISF receipt no.	Comments
<b>Registered Aboriginal sites</b> <i>see section 3.1</i>	0	GPL within E52/1455 & Additional survey area	n/a	n/a	n/a	AHIS search revealed no previously registered Aboriginal sites within the survey area.
<b>DPLH OHPs</b> <i>see section 3.2</i>	0	GPL within E52/1455 & Additional survey area	n/a	n/a	n/a	AHIS search revealed no lodged or stored OHPs within the survey area.
<b>Newly identified sites</b> <i>see section 3.3</i>	1	GPL within E52/1455 & Additional survey area	GAL18-01	Artefact Scatter	n/a	Artefacts scatter recorded to a site avoidance standard
<b>Isolated artefacts</b> <i>see appendix 5</i>	133	GPL within E52/1455 & Additional survey area	n/a	Isolated archaeological material	n/a	No HISF required. Relocated to the <i>Wagula</i> keeping place.

Map 2: Archaeological results within the E52/1455 project area





### 3.1 Summaries of registered Aboriginal sites

---

No registered Aboriginal sites were found to exist within the survey areas.

The absence of registered Aboriginal sites within the survey area does not necessarily indicate an absence of sites or artefacts within the area. Any previous heritage assessments undertaken within the area may have lacked the scope to record and register identified sites or artefacts. Alternatively, the lack of registered Aboriginal sites may be due to the area not having been surveyed.

### 3.2 Summaries of DPLH OHPs

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No lodged or stored DPLH OHPs were found to exist within the survey areas.

Please note the absence of lodged or stored DPLH OHPs within the survey area does not necessarily indicate an absence of sites or artefacts within the area. Previous heritage assessments undertaken within the area may have lacked the scope to record identified sites or artefacts and submit information for consideration by the ACMC. Alternatively, they may not have been previously subject to heritage assessment.

### 3.3 Summary of a newly identified site

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A summary of the newly identified site that was assessed under s5 of the Act is provided below.

#### 3.3.1 GAL18-01 (Artefacts / Scatter)

GAL18-01 has been assessed as a potential site with the following heritage value; artefacts scatter. GAL18-01 has been recorded to a site avoidance level only and Galena Mining must avoid impacts or disturbance to this site.

##### 3.3.1.1 *Boundary description and justification*

The boundary for GAL18-01 was captured by intensive pedestrian transects around an artefacts scatter. The eastern and southern boundaries of the site are defined by the survey boundary, although the site extends outside of this likely all the way to 5 Mile Creek, c.600 m to the east. The northern and western boundaries are defined by the extent of the material on the top of the breakaway. The breakaway is encompassed completely by the boundary.

The boundary is considered to be sufficient to capture all associated heritage values associated with the place. The boundary and the method used to define it was approved by the Nharnuwangga, Wajarri and Ngarlawangga Traditional Owners.

##### 3.3.1.2 *Place description*

GAL18-01 is a large artefact scatter that is located on a floodplain with a large area which is characterised as a breakaway. There are numerous small, eroded cavities and islands around the edges of the breakaway, with large drainage channels in the centre which funnel water east towards 5 Mile Creek. Initially Garry Robinson thought that all the cultural material had been washed into the area, however, after talking about how people would have used

the landscape with Stewart Robinson it was understood that the breakaway would have offered shelter or act as a windbreak to people and would have been used as a camping place.

Stewart Robinson also noted that as 5 Mile Creek is located c.600 m to the east, people would have used that to travel through country. On the east side of the creek line is also where the spinifex and Collier Ranges starts, which is an important hunting area for the Nharluwanga, Wajarri and Ngarluwanga Traditional Owners. GAL18-01 is also located c.500 m to the south of the Tangadee Road.

The vegetation surrounding the site consists of a middle storey of *Acacia* spp. and Mulga on top of the terrace but nothing down inside the breakaway area. There is no understorey of vegetation present in either locations. The ground surface is a silty, sandy sediment overlaid on top of the terrace with a BIF, ironstone and chert gibber.

The artefact scatter contained within GAL18-01 is predominantly made up of basalt material, while there are also artefacts of chert, chalcedony, dolerite, ironstone, quartz and quartzite present in the assemblage. A chert quarry to the north-east outside of the survey area was indicated by Angelo Scopel as a possible quarrying source for the material.

The typologies included flakes, flake fragments, retouch/utilised pieces, single platform cores, multiple platform cores and a single blade. A large number of retouch/utilised pieces and retouch and usewear was also present in the assemblage, along with various levels of weathering present, which indicates GAL18-01 was a site of multiple occupation periods. There is also evidence of knapping occurring with the presence of large cores, and the testing of different materials.

Three basal grindstone fragments of dolerite were also noted within GAL18-01, with ground surfaces on each side, medium polish and low invasiveness. While the use of grinding technology is believed to have intensified during the mid- to late-Holocene, grinding related artefacts have been identified in excavated contexts from c. 30,000 years (Gorecki et al. 2007; Smith 2009).

### **3.3.1.3** *Place condition*

GAL18-01 is affected by water movement, especially in the centre of the breakaway in the drainage channels. However, the materials on the terraces, islands and higher areas are unaffected by water and are intact.

### **3.3.1.4** *Importance and significance*

GAL18-01 is of importance and significance to the Nharluwanga, Wajarri and Ngarluwanga Traditional Owners as it demonstrates how past Aboriginal people stopped at this very large place to undertake tool production and camp, which has been used over a long period of time. The presence of the breakaway down below the floodplain, provides an ideal camping place away from the elements. The presence of food production material indicates the grinding of seeds as part of a subsistence strategy, usually attributed to the mid- to late-Holocene (Smith 2010).

GAL18-01 is also located in close proximity to an important creekline, 5 Mile Creek, and hunting area for the Aboriginal people of the area. It is also located 20 km to the north-east

of an important site in the Dreamtime story of the Nharnuwangga, Wajarri and Ngarlawangga Traditional Owners.

It is likely part of a larger culturally significant landscape which has been exploited for a long time by the Nharnuwangga, Wajarri and Ngarlawangga Traditional Owners.

*Plate 4: Context photo of GAL18-01*



*Plate 5: Section of 'breakaway' within GAL18-01*



*Plate 6: Dolerite basal grindstone fragment (scale = 10 cm)*



*Plate 7: Weathered chert flake (scale = 10 cm)*



*Plate 8: Weathered basalt single-platform core (scale = 10 cm)*



## 4 Cultural heritage management recommendations

The following recommendations have been provided based on consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners and the archaeological and ethnographic assessment of the General Purpose Lease application area within tenement E52/1455.

### 1 Galena Mining is advised that beyond the site boundaries, the areas that have been surveyed are clear for the proposed works to proceed.

As a result of the site avoidance heritage survey:

- No DPLH registered Aboriginal sites were identified;
- No lodged DPLH OHPs were identified;
- No stored DPLH OHPs were identified; and
- **One** newly identified site (**GAL18-01**) was recorded to site avoidance standard.

A total of 133 isolated artefacts were also recorded within the survey areas and relocated to the *Wagula* keeping place.

### 2 All Galena Mining employees and contractors working within the project area must be made aware of and instructed to avoid GAL18-01. The location and boundaries of this not clear area must be clearly demarcated and access restrictions put in place. Galena must restrict project access and works to areas that have been surveyed and found to be clear of heritage values.

Galena Mining must avoid impact to GAL18-01. This artefact scatter site has been deemed as a **not clear** area during the heritage survey. Galena must restrict their proposed works to the areas that have been surveyed and assessed as **clear** for works to proceed.

It is an offence to disturb an Aboriginal heritage place without prior written permission to do so under s16 or s18 of the Act. Financial penalties may be applied against individuals or corporations who disturb a heritage place. S18 of the Act details the statutory provisions for applications to be made to the Minister to utilise areas in which Aboriginal heritage places may exist and is subject to evaluation by the ACMC and the conditions of the Act.

### 3 The Nharnuwangga, Wajarri and Ngarlawangga Traditional Owners require that two Traditional Owner monitors are present during ground clearance works for the area surrounding GAL18-001.

The Nharnuwangga Wajarri and Ngarlawangga Traditional Owners require that two monitors are engaged during ground clearing works in the area surrounding GAL18-001. These monitors will assist in the protection of heritage values and ensure that any other cultural material identified during ground clearing works in this area is appropriately managed. It was evident to the survey team that more cultural material is present in the area surrounding the GAL18-001 and the Traditional Owners need

to ensure that no inadvertent impacts are made to any undocumented heritage values in the area.

**4 If Galena Mining proposes to alter the type of works or expand the project, either in size or scale, beyond that assessed during the heritage survey, then Galena must undertake further consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.**

Galena Mining is advised that only areas subjected to a heritage assessment are clear for works to proceed. Should the program of works expand in size and scale, or should the proponent wish to conduct a different type of works, the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners must be engaged for a further heritage assessment.

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### Legislation

- Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth of Australia), viewed 4 July 2018, <<http://www.comlaw.gov.au/Details/C2010C00807>>
- Aboriginal Heritage Act 1972* (Western Australia), viewed 4 July 2018, <[http://www.austlii.edu.au/au/legis/wa/consol\\_act/aha1972164/](http://www.austlii.edu.au/au/legis/wa/consol_act/aha1972164/)>



## Appendix 1 – Relevant sections of the Act

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The below sections of the Act are referenced in the current report and included below for easy reference. A full copy of the Act is available online at [http://www.austlii.edu.au/au/legis/wa/consol\\_act/aha1972164/](http://www.austlii.edu.au/au/legis/wa/consol_act/aha1972164/).

### s5 Application to places

This Act applies to —

- a) any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;
- b) any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;
- c) any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State;
- d) any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.

### s6 Application to objects

- 1) Subject to subsection (2a), this Act applies to all objects, whether natural or artificial and irrespective of where found or situated in the State, which are or have been of sacred, ritual or ceremonial significance to persons of Aboriginal descent, or which are or were used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people past or present.
- 2) Subject to subsection (2a), this Act applies to objects so nearly resembling an object of sacred significance to persons of Aboriginal descent as to be likely to deceive or be capable of being mistaken for such an object.
  - a. This Act does not apply to a collection, held by the Museum under section 9 of the Museum Act 1969, which is under the management and control of the Trustees under that Act.
- 3) The provisions of Part VI do not apply to an object made for the purpose of sale and which —
  - a. is not an object that is or has been of sacred significance to persons of Aboriginal descent, or an object so nearly resembling such an object as to be likely to deceive or be capable of being mistaken for the same; or
  - b. is an object of the kind referred to in paragraph (a) that is disposed of or dealt with by or with the consent of the Minister.

### s15 Report of findings

Any person who has knowledge of the existence of any thing in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other

place or thing to which this Act applies or to which this Act might reasonably be suspected to apply shall report its existence to the Registrar, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question to be already known to the Registrar.

### **s17 Offences relating to Aboriginal sites**

A person who –

- a. excavates, destroys, conceals or in any way alters any Aboriginal site; or
- b. in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom or assumes the possession, custody or control of any object on or under an Aboriginal site,

commits an offence unless he is acting with the authorisation of the Registrar under section 16 or of the Minister under section 18.

### **s39 Functions of the Committee**

1. The functions of the Committee are —
  - a. to evaluate on behalf of the community the importance of places and objects alleged to be associated with Aboriginal persons;
  - b. where appropriate, to record and preserve the traditional Aboriginal lore related to such places and objects;
  - c. to recommend to the Minister places and objects which, in the opinion of the Committee, are, or have been, of special significance to persons of Aboriginal descent and should be preserved, acquired and managed by the Minister;
2. In evaluating the importance of places and objects the Committee shall have regard to —
  1. any existing use or significance attributed under relevant Aboriginal custom;
  2. any former or reputed use or significance which may be attributed upon the basis of tradition, historical association, or Aboriginal sentiment;
  3. any potential anthropological, archaeological or ethnographical interest; and
  4. aesthetic values.
3. Associated sacred beliefs, and ritual or ceremonial usage, in so far as such matters can be ascertained, shall be regarded as the primary considerations to be taken into account in the evaluation of any place or object for the purposes of this Act.

## Appendix 2 – Heritage place recording methods

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Detailed below are the methods used by Terra Rosa to record sites and values identified within the survey area. This includes how place boundaries are defined, which attributes are documented, and how an assessment of a place's importance and significance is made.

### Definition of archaeological sites

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Following thorough investigation, if a collection of objects were deemed to be of insufficient density or importance to constitute a heritage place under the meaning of the Act, artefacts were recorded as isolated artefacts.

For isolated artefacts, the location, artefact lithology, and typology were noted. Artefacts were then returned to their original location and orientation.

Artefacts were deemed to be isolated unless one or more of the following conditions existed:

- The heritage place displayed clear, purposive activity;
- The heritage place and its objects are considered to be relatively intact and in sufficient condition for an assessment of their importance and significance to be made;
- The material was identified in association with other heritage place elements; and
- The Traditional Owners requested that the material be recorded as a heritage place.

If the above conditions were met and the survey team assess the objects and/or features to constitute a heritage place under the meaning of s5 of the Act, the place and its constituent features were comprehensively photographed, and then recorded using the methods outlined below.

The methods employed during the heritage assessment within the survey areas were discussed with, and approved by, the attending Traditional Owner representatives.

### Designation of archaeological heritage place boundaries

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Archaeological heritage place boundaries were determined by a number of factors, including the extent and / or density of heritage features and objects, and / or natural features (e.g. creek banks or outcrop margins). All heritage place boundaries were checked with the Traditional Owners to ensure all important and significant cultural heritage values were sufficiently encompassed.

Boundaries were delineated in the field where possible, and recorded using a hand-held Garmin GPS unit / Panasonic FZ-A1 ToughPad / Apple iPad. Where field-based delineation of boundaries was not feasible, heritage place extents are calculated using GIS determinations during assessment of field data in the office.

### Assessing importance and significance

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Site avoidance level recording is insufficient to allow a significance assessment to be made under s39 of the Act for consideration by the ACMC.

### Artefact scatter recording method [delete section if not applicable]

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Areas containing a density of artefacts were investigated as potential artefact scatters.

For site avoidance level recording, once a boundary was established, a comprehensive description of the place and its associated heritage features and objects was produced. This included details and photos of environmental attributes along with any relevant and / or interesting archaeological features. The Traditional Owners were consulted, and their discussion regarding the cultural values of the place was recorded.

## Appendix 3 – Regional background

### Region and native title interests

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The Nharluwanga Wajarri and Ngarlawanga People hold native title over an area located within the Shires of Ashburton, Meekatharra and Upper Gascoyne (NNTT no. WCD 2000/001).

The Nharluwanga Wajarri and Ngarlawanga determination area broadly extends from Turee Creek and Prairie Downs pastoral leases in the north (southwest of Newman); south to Doolgunna pastoral lease; west-southwest towards Landor; and northeast to Pingandy and Miner pastoral leases. Their traditional lands include the Collier Range National Park (Reserve 35104).

Jidi Jidi Aboriginal Corporation is the registered Native Title Body Corporate for Nharluwanga Wajarri and Ngarlawanga.

### Biogeography and major landforms

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The Nharluwanga Wajarri and Ngarlawanga determination area is located within the Gascoyne (GAS) biogeographic region, as described in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell, 1995), more specifically within the Augustus subregion (GAS 3).

The Augustus subregional area is approximately 10,687,739ha (106,877 square kilometres). The bioregion has approximately 2.5% of its surface under some form of conservation tenure, 3.37% in Aboriginal reserves, and approximately 9.7% being other Crown reserves and Unallocated Crown Land (UCL). Pastoralism occupies nearly 85% of the region and mining also has considerable interests.

Broadly, Mulga (*Acacia* spp.) woodland with an understorey of *Triodia* spp. occurs on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland.

Much of the region is covered by a large sedimentary basin known as the Carnarvon Basin. The sedimentary Carnarvon Basin slopes gently towards the coast and is characterised by low relief, open drainage and large gently undulating sand plains. This contrasts strongly with the small area of Precambrian rocks in the north east of the Gascoyne, which has moderately high relief, a close dendritic drainage pattern and mature valley topography.

The north eastern part of the Gascoyne region is covered by Middle Proterozoic sandstone, shale and dolomite of the Bangemall Basin. These sediments of varying age, almost entirely marine in origin, have been subjected to low- grade metamorphism, folding and intrusion by numerous dolerite sills, which have a westerly regional dip.

The Augustus subregion (GAS 3) is summarised as consisting largely of rugged low Proterozoic sedimentary and granite ranges. There are extensive areas of alluvial valley-fill deposits, the Gascoyne River System provides the main drainage of this subregion, it is also the headwaters of the Ashburton and Fortescue Rivers.

The soils in the Gascoyne region have many features that are common to semi-arid soils elsewhere in Australia. Most obvious is the predominantly red colouration of the soil which is due to soil particles covered by oxides of iron.

The Department of Agriculture and Food (DAFWA) (2006), describe the Nharnuwangga Wajarri and Ngarlawangga Determination area as occurring within the Gascoyne Valley Zone (295), consisting of:

- Hardpan wash plains (with hills, stony plains and some calcrete plains and floodplains) on alluvial deposits over gneiss and volcanic rocks of the southern parts of the Gascoyne Complex and Edmund and Collier Basins.
- Red-brown hardpan shallow loams with red deep sands, red shallow sandy duplexes and red loamy earths and some red/brown non-cracking clays and stony soils.
- Mulga shrublands (with some Wanderrie grasses and Chenopods), located in the Upper Gascoyne between Landor Station and the Great Northern Highway.

## Cultural landscape

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The Nharnuwangga Wajarri and Ngarlawangga Native Title determination area is located in the boarder Midwest Region, which begins on the coast near Cervantes and ends just north of Exmouth, extending inland to Mt Magnet. The ethnographic record reflects a diversity of views regarding the traditional organisation of social and linguistic boundaries within the Midwest region, boundaries that have often been defined along the circumcision and subincision lines, which separated the Geraldton Coastal Region from Aboriginal groups further inland (Tindale 1974).

Embedded within these topographical features are Law, stories, Dreamtime pathways, ancestral spirits and traditional travel routes through country. Pathways travelled by the mythical beings who transformed the lands were called 'Dreaming tracks' and the maps people used to travel across the country were often depicted in songs. Thus, song-lines or stories tell the journeys of ancestral spirits that moulded the earth as they travelled across country, including mythical water snakes called *Bimara* (Green 2001; Shaw & Martin 2011).

## Water resources

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With Gascoyne climate being so arid, knowledge of reliable water sources was necessary for survival. Ethnographic and archaeological sites within the Nharnuwangga Wajarri and Ngarlawangga determination area are concentrated along major water sources such as the Gascoyne River, Murchison River and Ashburton River, including their various tributaries the Angelo River, Ethel River and Turee Creek. Nharnuwangga Wajarri and Ngarlawangga people traditionally utilised natural cavities forming in rocky outcrops, known as rock holes and gnamma holes. These were often covered over with a movable stone in order to protect the gathered water from evaporating and being contaminated. To this day, Yamatji people continue to maintain these water sources when encountered, often by cleaning them out and/or covering them up.

The Murchison River, Gascoyne River, and Ashburton River are highly culturally significant for a variety of groups throughout the Midwest and Gascoyne regions as they cover multiple native title boundaries. Multiple groups believe that the permanent water sources contain *Bimara*, or mythological water serpents that often bear the same name as the site it

associated with (Kingsford 1982). *Bimara* are inherently linked to the 'Dreamtime' responsible for creating the landscape and water sources (Shaw & Martin 2011). Permanent water sources continue to be of high cultural importance, indicating the health of country, which in turn reflects the health of culture (Barber & Jackson 2011).

## Natural resources

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A myriad of faunal and botanical resources were readily available within the NWN determination area. The knowledge and use of various plants and animals continues to be passed on generationally among Traditional Owners. Exploitable wildlife and vegetation available within the region includes various types of *Kangaroo* and rock kangaroo, porcupines (echidnas), bird species including ducks and emu, *bungarra* (Goanna) and lizards (Shaw & Martin 2011).

Vegetation traditionally served a variety of purposes for Nharnuwangga Wajarri and Ngarlawangga people including modification into tools, food, and association with spiritual and cultural beliefs. Traditionally seeds, fruits and tuber vegetables were commonly collected and consumed as part of the diet, including bush tomato and *quandong* berries were also commonplace bush foods found throughout the region (ibid.).

## Pastoral history

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Pastoral settlement began in the Geraldton region the 1850's with expansion into the central parts of the Murchison occurring in the 1860's (Kingsford 1982), following legislative Council inducements to pastoralists to take up leases for the grazing of sheep and cattle. Stock routes along which drovers took cattle from the Ashburton and Pilbara to railheads at Mullewa and Meekatharra pass through the region (GDC. c. 2000).

Pastoralism comprises an important part of recent history for many of the groups in the Midwest, including the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, with many elders holding living memories of the pastoral lifestyle.

Many Nharnuwangga Wajarri and Ngarlawangga Traditional Owners hold living memory of working on pastoral stations, often holding familial association with particular stations. Aboriginal people were engaged to undertake various tasks, often as station hands, stockmen and shearers, mostly in return for basic rations, stores and shelter. Women often served as domestic help. According to Biskup (1973), by 1910 all surviving full-Aboriginal people had all settled on stations or around towns, profoundly effecting traditional lifestyles and establishing strong connections with the pastoral industry.

Pastoral stations specifically associated with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners determination area include Bryah, Doolgunna, Kumarina, Landor, Milgun, Mingah Springs, Mount Clere, Mount Vernon, Mulgul, Tangadee, Three Rivers, Turee Creek, Woodlands, and Yarlalweelor.

## Appendix 4 – Artefact recording codes and assemblage data

**Artefact Type:** The following abbreviations for artefact types have been employed in this report.

<b>ADB</b>	<i>Burren adze</i>	<b>FF</b>	<i>Flake fragment</i>	<b>MUF</b>	<i>Muller fragment</i>
<b>ADT</b>	<i>Tula adze</i>	<b>GM</b>	<i>Geometric microlith</i>	<b>RUP</b>	<i>Re-touched/Utilised piece</i>
<b>AF</b>	<i>Angular fragment</i>	<b>HS</b>	<i>Hammer stone</i>	<b>SRF</b>	<i>Scraper fragment</i>
<b>BL</b>	<i>Blade</i>	<b>LBFL</b>	<i>Longitudinally broken flake – left</i>	<b>SPC</b>	<i>Single platform core</i>
<b>BGF</b>	<i>Basal grinding fragment</i>	<b>LBFM</b>	<i>Longitudinally broken flake – medial</i>	<b>SR</b>	<i>Scraper</i>
<b>BGS</b>	<i>Basal grindstone</i>	<b>LBFR</b>	<i>Longitudinally broken flake – right</i>	<b>TBFD</b>	<i>Transversely broken flake – distal</i>
<b>CF</b>	<i>Core fragment</i>	<b>LTBF</b>	<i>Longitudinally / transversely broken flake</i>	<b>TBFM</b>	<i>Transversely broken flake – medial</i>
<b>CT</b>	<i>Core tool</i>	<b>MPC</b>	<i>Multi-platform core</i>	<b>TBFP</b>	<i>Transversely broken flake – proximal</i>
<b>F</b>	<i>Complete flake</i>	<b>MU</b>	<i>Muller</i>	<b>NA</b>	<i>Not applicable/not present</i>

**Lithology:** This describes the material from which the artefact was manufactured. The following abbreviations have been employed in this report. [Add in lithology types as if necessary]

<b>B</b>	<i>Bone</i>	<b>DOL</b>	<i>Dolerite</i>	<b>MUD</b>	<i>Mudstone</i>
<b>BS</b>	<i>Basalt</i>	<b>GR</b>	<i>Granite</i>	<b>SIL</b>	<i>Silcrete</i>
<b>BIF</b>	<i>Banded ironstone formation</i>	<b>IS</b>	<i>Ironstone</i>	<b>SL</b>	<i>Siliceous limestone</i>
<b>CA</b>	<i>Canga</i>	<b>JS</b>	<i>Jasper</i>	<b>QI</b>	<i>Quartzite</i>
<b>CH</b>	<i>Chert</i>	<b>KAL</b>	<i>Kaolinite</i>	<b>QZ</b>	<i>Quartz</i>
<b>CQ</b>	<i>Crystal quartz</i>	<b>LM</b>	<i>Limestone</i>		
<b>CY</b>	<i>Chalcedony</i>	<b>LT</b>	<i>Laterite</i>		

**Retouch and Usewear:** This describes the visible signs used to identify tools and tool use, specifically the working of materials to form a tool or refine an existing tool and perforations and other wear resulting from tool use. The following abbreviations have been employed in this report.

<b>AM</b>	<i>All margins</i>	<b>DM</b>	<i>Distal margin</i>	<b>LLM</b>	<i>Left lateral margin</i>
<b>PM</b>	<i>Proximal margin</i>	<b>RLM</b>	<i>Right lateral margin</i>		

**Platform:** This describes the area on a stone core or flake that has been struck to prepare raw material for use in the process of toolmaking. The following abbreviations have been employed in this report to categorise platform types.

<b>COR</b>	<i>Cortical</i>	<b>FA</b>	<i>Faceted</i>	<b>FOC</b>	<i>Focalised</i>
<b>CR</b>	<i>Crushed</i>	<b>FL</b>	<i>Flat</i>		

**Termination:** This describes the cross-sectional shape of the distal end of a flake. The following abbreviations have been employed in this report to categorise various kinds of termination.

<b>A</b>	<i>Axial</i>	<b>H</b>	<i>Hinge</i>	<b>S</b>	<i>Step</i>
<b>F</b>	<i>Feather</i>	<b>P</b>	<i>Plunge</i>		

**All numerical measurements within the assemblage data are presented in millimetres. – not always**



## Appendix 5 – Isolated artefacts

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The 133 isolated objects identified in the project areas were relocated to the *Wagula* Keeping Place outside the survey area as directed by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners present on the survey.

*Plate 9: Traditional Owners Jack McPhee and Joseph Walsh and Terra Rosa consultant Tom Lally depositing artefacts at the Wagula keeping place.*





**TERRA ROSA**  
CONSULTING

**Report on an Archaeological and Ethnographic  
Work Area Clearance survey of a miscellaneous  
licence area for an airstrip (within E52/1455)  
with Nharnuwangga Wajarri and Ngarlawangga  
Traditional Owners, and prepared for Galena  
Mining Ltd**

**October 2018**

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## Coordinate capture

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The authors advise that all coordinates quoted in this document were initially obtained with a Garmin hand held GPS and an Apple iPad, using the GDA datum. All grid references are projected in MGA Zone 50, unless otherwise stated. Dependent on external conditions, these units afford an optimal spatial accuracy of  $\pm 5$  m.

## Heritage project participants and contacts

The contact details of the heritage project stakeholders are provided below. The authors would like to thank everyone that participated in the heritage survey and assisted in organising the fieldwork.

The heritage survey was conducted on the 3 and 4 October 2018.

<b>Heritage service provider</b>	<b>Terra Rosa Consulting</b>
<b>Address</b>	12/20 Sustainable Avenue, Bibra Lake, Western Australia 6163
<b>Field work participants</b>	Sarah Keiller Amy Butcher
<b>Report authors</b>	Sarah Keiller and Amy Butcher
<b>Editor</b>	Damien Lafrentz
<b>Executive sign-off</b>	Damien Lafrentz

<b>Traditional Owners</b>	<b>Nharnuwangga Wajarri and Ngarlawangga Traditional Owners</b>
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<b>Contact</b>	Ambrose Cummins
<b>Field work participants</b>	Garry 'Cowboy' Robinson Snr Garry Robinson Jnr Leonard Smith Snr Aaron Ryder Valdera Mippy Darren Mippy

<b>Proponent</b>	<b>Galena Mining Ltd / Abra Mining Pty Ltd</b>
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<b>Contact</b>	Ed Turner (General Manger Geology and Exploration)

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## Acronyms and definitions

The following terms and acronyms are utilised throughout the report. Definitions are provided below for reference.

Term / Abbreviation	Definition
<b>ACMC</b>	Aboriginal Cultural Materials Committee
<b>AHIS</b>	Aboriginal Heritage Inquiry System
<b>CCNTS</b>	Cross Country Native Title Services Pty Ltd
<b>DPLH</b>	Department of Planning, Lands and Heritage
<b>Galena</b>	Galena Mining Ltd / Abra Mining Pty Ltd
<b>GIS</b>	Geographic information system
<b>GPS</b>	Global positioning system
<b>Heritage object</b>	An object to which the Act applies under s6
<b>Isolated artefacts</b>	Isolated cultural material
<b>JJAC</b>	Jidi Jidi Aboriginal Corporation
<b>MGA</b>	Map grid of Australia
<b>NNTT</b>	National Native Title Tribunal
<b>Other Heritage Place</b>	Other heritage places are places catalogued by the DPLH but not included on the Register of Aboriginal Sites for one of the following reasons: <ol style="list-style-type: none"> <li>1. Information about the OHP has been lodged with the DPLH but is pending assessment by the ACMC (status L – lodged; also see definition for ‘potential site’, below); or</li> <li>2. The ACMC assessed the OHP and considered it not to meet the evaluation criteria for inclusion on the Register of Sites (i.e. not a registered Aboriginal site) (status S – stored / not a site).</li> </ol>
<b>Registered Aboriginal site</b>	A site which has been determined as meeting criteria under section 5 of the <i>Aboriginal Heritage Act 1972 (WA)</i> , and has been registered by the Registrar of Aboriginal Sites (DPLH status R - registered).
<b>Site</b>	Any place which may meet the criteria of an Aboriginal site under s5 of the <i>Aboriginal Heritage Act 1972 (WA)</i> .
<b>Terra Rosa</b>	Terra Rosa Consulting
<b>Traditional Owners</b>	Nharnuwangga Wajarri and Ngarlawangga native title holders (NNTT no WCD 2000/01)
<b>The Act</b>	<i>Aboriginal Heritage Act 1972 (WA)</i>

## 1 Heritage project overview

Galena Mining Ltd / Abra Mining Pty Ltd (Galena) plans to utilise land within the Nharnuwangga Wajarri and Ngarlawangga native title determination (WCD 2000/01) for the purpose of building an airstrip. Galena will need to will need to apply for an additional miscellaneous licence for the airstrip. The project area is contained within exploration tenement E52/1455 (see map 1). E52/1455 is a tenement held by Abra Mining Pty Ltd, which is a wholly owned subsidiary of Galena Mining Ltd.

Cross Country Native Title Services Pty Ltd (CCNTS) on behalf of the Jidi Jidi Aboriginal Corporation (JJAC), as the representative of the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, engaged Terra Rosa consulting (Terra Rosa) to conduct an archaeological and ethnographic work area clearance survey of the proposed airport, in accordance with a heritage survey request submitted by Galena.

The heritage survey was undertaken on the 3 and 4 of October 2018 by six Nharnuwangga Wajarri and Ngarlawangga Traditional Owners nominated by JJAC, two Terra Rosa heritage consultants and a representative from Galena.

*Table 1: Work area overview*

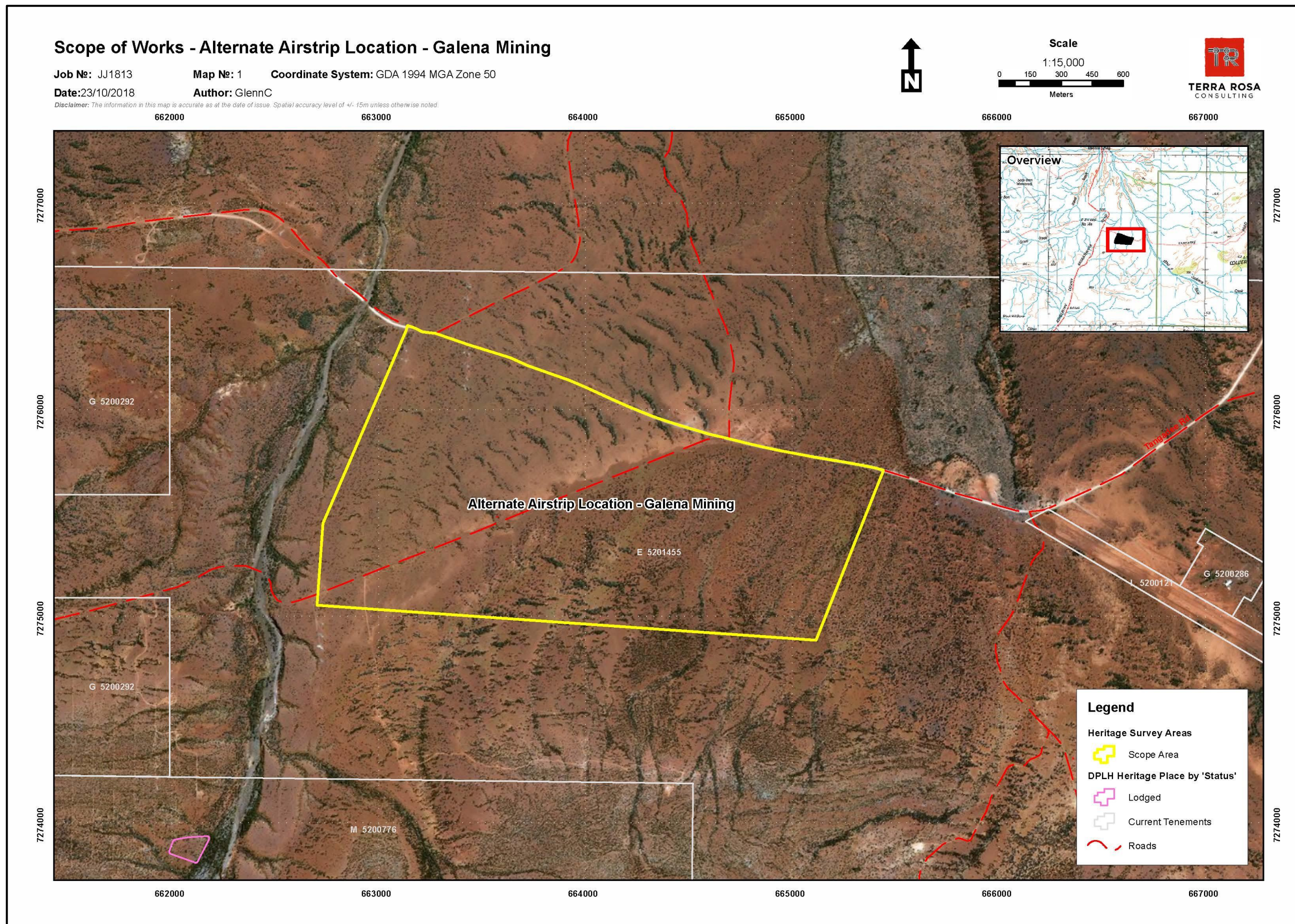
Survey area	Total area (ha)
E52/1455 airstrip (see map 1)	One polygon totalling 270 ha

*Plate 1: Heritage survey team photo*





Map 1: Galena airstrip location survey area



## 2 Heritage assessment method

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The archaeological and ethnographic heritage survey was conducted to a work area clearance standard. The objective of a work area clearance assessment is to establish the existence of any archaeological and ethnographic values within the project area, to establish avoidance boundaries around sites likely to be impacted by the proposed works, and to address any heritage concerns arising from discussions with the Traditional Owners present.

### 2.1 Desktop assessment procedure

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Prior to field work, a preliminary desktop assessment was undertaken to provide an overview of heritage research undertaken to date within the area. Desktop research focused on the identification of any registered Aboriginal sites, OHPs and surveys within the area, which need to be considered in the heritage approval process for the project.

Desktop research for heritage values relies largely on the Register of Sites maintained by the Department of Planning, Lands and Heritage (DPLH), which provides an indication as to the presence and nature of any heritage values previously recorded and registered within the area.

The Aboriginal Heritage Inquiry System (AHIS) search is also utilised to determine whether any heritage assessments have previously been conducted within the application area and if any heritage reports containing information relevant to the application area have been registered with the DPLH.

Prior to field work, the survey area boundaries were entered into the AHIS to learn whether any registered Aboriginal sites or other heritage places (OHPs) have been recorded within the area. Registered Aboriginal sites are those areas that have been assessed by the Aboriginal Cultural Materials Committee (ACMC) as constituting sites under the Act. OHPs include places for which data has been lodged with the DPLH but is pending assessment by the ACMC, and places that have been assessed by the ACMC as not constituting registered Aboriginal sites (listed as stored data / not a site).

### 2.2 Field assessment method

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The method outlined below was approved and endorsed by participating Traditional Owners.

In order to identify any archaeological and ethnographic heritage values within the survey area, a pedestrian transect method was utilised. This involved the Terra Rosa heritage consultants walking the two outer transects with a handheld Garmin GPS unit and an Apple iPad, with the remainder of the heritage team spaced evenly in between. This spacing ranged between 20 m and 30 m, depending on the terrain and vegetation coverage of each area.

When areas of archaeological or ethnographic heritage value were identified, an avoidance boundary was defined around the extent of the site. Such areas were deemed not heritage clear for inclusion in the proposed works.

During assessment of the work area, the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners were invited to give feedback regarding the project. Any relevant concerns raised were discussed amongst the heritage team and heritage management recommendations were recorded.

Upon conclusion of the field trip a debrief was conducted to offer the Traditional Owners an opportunity to discuss and comment upon the field method and the sites identified, including mitigation strategies and recommendations.

A draft report was reviewed by CCNTS, prior to dissemination of results to Galena. The review process ensures that culturally sensitive information is appropriately indicated, and the recommendations discussed amongst the heritage team are made in accordance with the Traditional Owners' suggestions. This process provides Terra Rosa with feedback which is taken into account during the final editing of the report.

*Plate 2: The heritage team surveying country*



### **3 Desktop research**

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Desktop research results, including a search of the DPLH's AHIS, and a review of any relevant, unpublished heritage reports, are presented below.

#### **3.1 AHIS research**

---

The boundaries of the survey area were searched on the Aboriginal Heritage Inquiry System (AHIS) to establish the presence or absence of registered Aboriginal sites and OHPs (status L or S) previously catalogued by the DPLH. The search revealed no registered Aboriginal sites and no OHPs within the survey area. Status abbreviations are defined in section 2.1.

The AHIS was also searched for reports detailing the results of previous heritage surveys within the survey area. Two heritage reports are catalogued as being relevant to the survey area. These are presented as references in section 6.

The absence of registered Aboriginal sites and OHPs within the survey area does not necessarily indicate an absence of heritage places or objects within the area. Any previous heritage assessments undertaken within the area may have lacked the scope to record and register identified heritage places or heritage objects. Alternatively, the lack of registered Aboriginal sites and OHPs may be resultant of the area having not been subjected to heritage assessment.

#### **3.2 Unpublished material**

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No unregistered heritage reports relevant to the survey area were provided to Terra Rosa by JJAC or Galena prior to the commencement of field work.

## 4 Fieldwork results

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The archaeological and ethnographic work area clearance heritage survey has been completed for a miscellaneous licence area for an airstrip; within E52/1455 (see map 2).

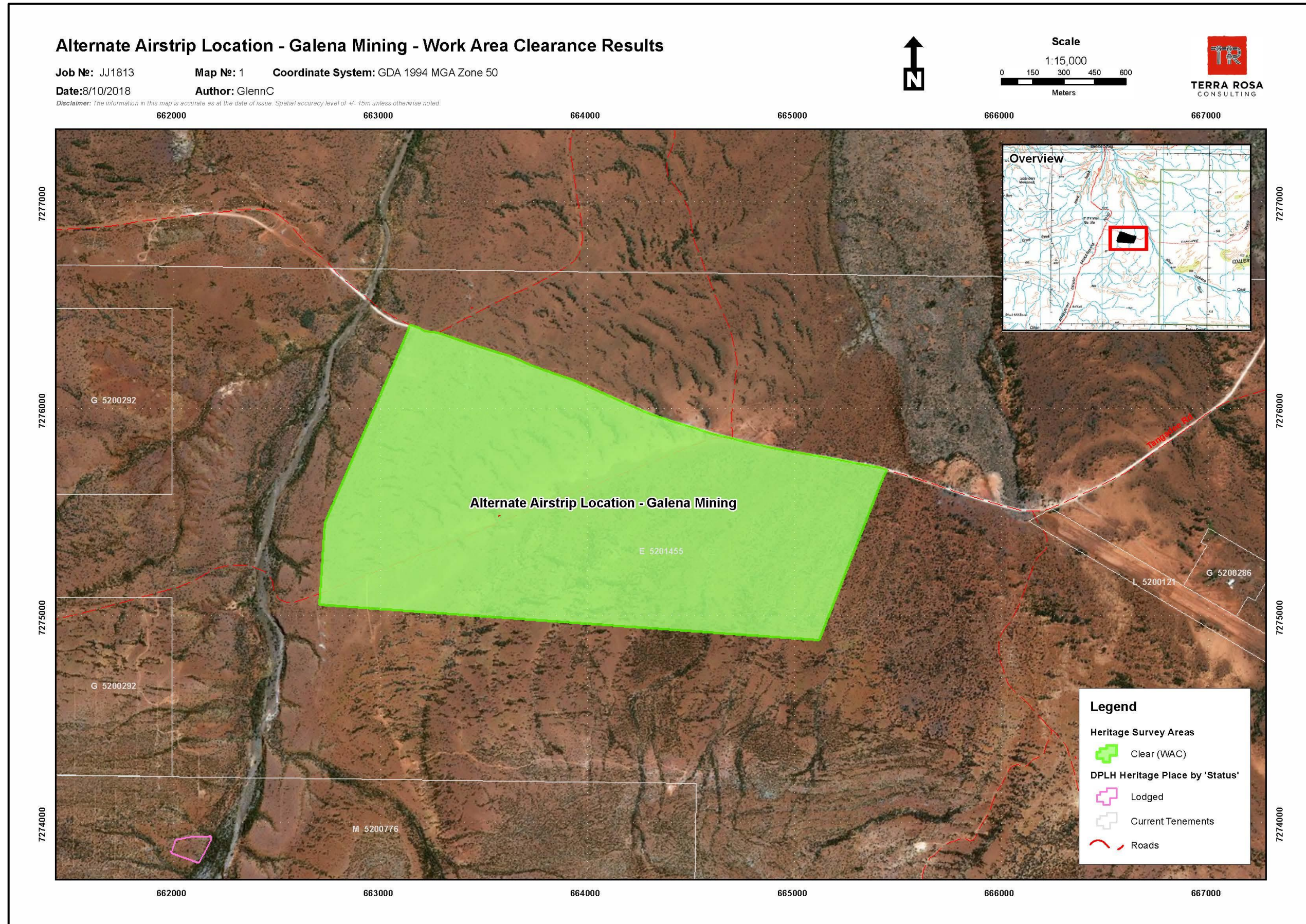
- The survey area is heritage clear for the airstrip works to proceed;
- The survey area as discussed and agreed to in the field by all participants was pushed between 20 - 50 m north to meet an existing access track;
- 86 isolated artefacts were identified and relocated to the Wagula Keeping Place (see appendix 2).

Map 2, below, further present the results outlined above. A spatial data package containing all results from this work area clearance assessment is appended to this report.

*Plate 3: Nharnuwangga Wajarri and Ngarlawangga Traditional Owners Valdera Mippy and Garry 'Cowboy' Robinson Snr with a basal grindstone fragment*



Map 2: Results of the work area clearance of the Galena airstrip project area



## 5 Recommendations and conclusions

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The following conclusions and recommendations have been approved by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owner representatives who were present during the fieldwork:

- 1 Galena Mining Ltd / Abra Mining Pty Ltd is advised that the archaeological and ethnographic work area clearance for a miscellaneous licence area for an airstrip; within E52/1455, is complete and has been heritage cleared by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.**

The surveyed area has been assessed as heritage clear by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owner representatives for the airstrip works to proceed.

- 2 If Galena Mining Ltd / Abra Mining Pty Ltd proposes to alter the type of works or expand the project, either in size or scale, beyond that assessed during the heritage survey, then Galena must undertake further consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.**

Galena is advised that should the program of works expand in size or scale, or should they wish to conduct a different type of works, the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners must be engaged for a further heritage assessment.

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## 6 Bibliography

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Australia ICOMOS 2013, *The Burra Charter: The Australia ICOMOS charter for places of cultural significance 2013*, viewed 25 September 2018, <<http://australia.icomos.org/wp-content/uploads/The-Burra-Charter-2013-Adopted-31.10.2013.pdf>>

Commonwealth of Australia 2002, *Australian Natural Heritage Charter 2002*, 2nd edn, viewed 25 September 2018, <<http://www.environment.gov.au/heritage/ahc/publications/commission/books/pubs/australian-natural-heritage-charter.pdf>>

Commonwealth of Australia 2016, *Claimant summary – Nharnuwangga*, viewed 25 September 2018, <[http://www.nntt.gov.au/searchRegApps/NativeTitleClaims/Pages/Determination\\_details.aspx?NNTT\\_Fileno=WCD2000/001](http://www.nntt.gov.au/searchRegApps/NativeTitleClaims/Pages/Determination_details.aspx?NNTT_Fileno=WCD2000/001)>

Department of Planning, Lands and Heritage 2016, *Aboriginal Heritage Inquiry System*, viewed 25 September 2018, <<http://maps.dia.wa.gov.au/AHIS2/>>

### Legislation

*Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Commonwealth of Australia), viewed 25 September 2018, <<http://www.comlaw.gov.au/Details/C2010C00807>>

*Aboriginal Heritage Act 1972* (Western Australia), viewed 25 September 2018, <[http://www.austlii.edu.au/au/legis/wa/consol\\_act/aha1972164/](http://www.austlii.edu.au/au/legis/wa/consol_act/aha1972164/)>

### DPLH heritage reports

Kimber, T and S Chisholm 2014, *Archaeological Work program Clearance Assessment of a Proposed Drilling Program in MMG Exploration's Abra JV Project Area*, prepared for Mount Magnet Gold Exploration, DPLH report ID 200305.

Kimber, T and Chisholm S 2015, *Report on an Archaeological Work Program Clearance Heritage Assessment of a Proposed Drilling Program in the Abra JV Project Area*, DPLH report ID 200306.



## Appendix 1 – Relevant sections of the Act

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The below sections of the Act are referenced in the current report and included below for easy reference. A full copy of the Act is available online at [http://www.austlii.edu.au/au/legis/wa/consol\\_act/aha1972164/](http://www.austlii.edu.au/au/legis/wa/consol_act/aha1972164/).

### s5 Application to places

This Act applies to —

- a) any place of importance and significance where persons of Aboriginal descent have, or appear to have, left any object, natural or artificial, used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people, past or present;
- b) any sacred, ritual or ceremonial site, which is of importance and special significance to persons of Aboriginal descent;
- c) any place which, in the opinion of the Committee, is or was associated with the Aboriginal people and which is of historical, anthropological, archaeological or ethnographical interest and should be preserved because of its importance and significance to the cultural heritage of the State;
- d) any place where objects to which this Act applies are traditionally stored, or to which, under the provisions of this Act, such objects have been taken or removed.

### s6 Application to objects

- 1) Subject to subsection (2a), this Act applies to all objects, whether natural or artificial and irrespective of where found or situated in the State, which are or have been of sacred, ritual or ceremonial significance to persons of Aboriginal descent, or which are or were used for, or made or adapted for use for, any purpose connected with the traditional cultural life of the Aboriginal people past or present.
- 2) Subject to subsection (2a), this Act applies to objects so nearly resembling an object of sacred significance to persons of Aboriginal descent as to be likely to deceive or be capable of being mistaken for such an object.
  - a. This Act does not apply to a collection, held by the Museum under section 9 of the Museum Act 1969, which is under the management and control of the Trustees under that Act.
- 3) The provisions of Part VI do not apply to an object made for the purpose of sale and which —
  - a. is not an object that is or has been of sacred significance to persons of Aboriginal descent, or an object so nearly resembling such an object as to be likely to deceive or be capable of being mistaken for the same; or
  - b. is an object of the kind referred to in paragraph (a) that is disposed of or dealt with by or with the consent of the Minister.

### s15 Report of findings

Any person who has knowledge of the existence of anything in the nature of Aboriginal burial grounds, symbols or objects of sacred, ritual or ceremonial significance, cave or rock paintings or engravings, stone structures or arranged stones, carved trees, or of any other

place or thing to which this Act applies or to which this Act might reasonably be suspected to apply shall report its existence to the Registrar, or to a police officer, unless he has reasonable cause to believe the existence of the thing or place in question to be already known to the Registrar.

### **s17 Offences relating to Aboriginal sites**

A person who –

- a. excavates, destroys, conceals or in any way alters any Aboriginal site; or
- b. in any way alters, damages, removes, destroys, conceals, or who deals with in a manner not sanctioned by relevant custom or assumes the possession, custody or control of any object on or under an Aboriginal site,

commits an offence unless he is acting with the authorisation of the Registrar under section 16 or of the Minister under section 18.

### **s39 Functions of the Committee**

1. The functions of the Committee are —
  - a. to evaluate on behalf of the community the importance of places and objects alleged to be associated with Aboriginal persons;
  - b. where appropriate, to record and preserve the traditional Aboriginal lore related to such places and objects;
  - c. to recommend to the Minister places and objects which, in the opinion of the Committee, are, or have been, of special significance to persons of Aboriginal descent and should be preserved, acquired and managed by the Minister;
2. In evaluating the importance of places and objects the Committee shall have regard to —
  1. any existing use or significance attributed under relevant Aboriginal custom;
  2. any former or reputed use or significance which may be attributed upon the basis of tradition, historical association, or Aboriginal sentiment;
  3. any potential anthropological, archaeological or ethnographical interest; and
  4. aesthetic values.
3. Associated sacred beliefs, and ritual or ceremonial usage, in so far as such matters can be ascertained, shall be regarded as the primary considerations to be taken into account in the evaluation of any place or object for the purposes of this Act.

## Appendix 2 – Isolated artefacts

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If cultural material was identified but not deemed to constitute a site, it was recorded as isolated artefacts to meet obligations under s6 of the Act.

The 86 isolated objects identified in the project area were relocated to the Wagula Keeping Place outside the survey area as directed by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners present. The total number of artefacts currently at the Wagula Keeping Place is 219.

*Plate 4: Nharnuwangga Wajarri and Ngarlawangga Traditional Owner Garry 'Cowboy' Robinson Snr depositing artefacts at the Wagula Keeping Place*





**TERRA ROSA**  
CONSULTING

An archaeological and  
ethnographic site avoidance  
heritage survey of the Bore Access  
Project East L2 and West L2  
survey areas, with the  
Nharnuwangga Wajarri and  
Ngarlawangga Traditional Owners  
for Abra Minerals Pty Ltd

**REPORT**

**April 2022**



## Acknowledgement of Country

Terra Rosa acknowledge the Nharnewangga Wajarri and Ngarlawangga people, who are the Traditional Custodians of the Country described in this document, and to the Whadjuk Noongar people, who are the Traditional Custodians of the Country in which Terra Rosa's office is situated.

We pay our respects to their Elders past, present, and emerging, and to their continuing cultural and spiritual connections to their lands.

<https://www.reconciliation.org.au>



TRCo ref  
JJ2201



### Site Avoidance

East L2

West L2

### Survey dates

24 February 2022

## EXECUTIVE SUMMARY

Abra Minerals Pty Ltd (Abra Minerals) commissioned Terra Rosa Consulting (Terra Rosa) to undertake an archaeological and ethnographic site avoidance heritage survey over the areas planned for development within the Nharnuwangga Wajarri and Ngarlawangga native title determination area (WCD 2000/001). The heritage survey was undertaken with the endorsement of Jidi Jidi Aboriginal Corporation (JJAC), who are the representatives for the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.

The survey was undertaken on 24 February 2022 by six Nharnuwangga Wajarri and Ngarlawangga representatives and two heritage consultants from Terra Rosa. One Abra Minerals representative was also present during this time to support the survey team.

The summarised survey results of the scope of works (SOW) are as follows:

### East L2 – Complete

- No Department of Planning, Lands and Heritage (DPLH) registered Aboriginal sites or other heritage places (OHPs) exist within the survey area;
- Three heritage places (GAL22-01, GAL22-02, and GAL22-03) were identified;
- GAL22-01 and GAL22-02 were recorded to a site avoidance standard. GAL22-03 was located outside the survey area, and so was not recorded during this heritage trip; and
- Sixty-four isolated artefacts were documented and relocated to Boogooda keeping place (DPLH ID 37827)

### West L2 – Not commenced

- No DPLH registered Aboriginal sites or OHPs exist within the survey area; and
- The heritage survey of West L2 was not commenced due to time constraints.

Based on the results of the survey and consultation with the Traditional Owners, the following recommendations are made:

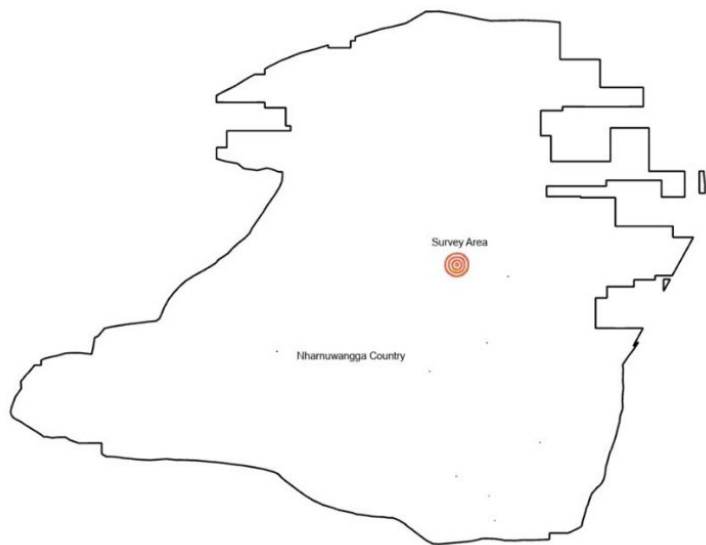
- 1** Abra Minerals must avoid the heritage sites identified within the East L2 Project Area.
- 2** If the three heritage places identified during the East L2 survey cannot be avoided, Abra Minerals must facilitate archaeological and ethnographic site identification level recording of these places.
- 3** Abra Minerals is advised to facilitate an archaeological and ethnographic survey over the West L2 survey area.
- 4** All employees and contractors working within the East L2 and West L2 Project Areas must be made aware of the location and boundaries of all heritage places identified and are clearly instructed to restrict access and works to areas that have been subject to heritage survey and assessment.
- 5** If Abra Minerals proposes to alter the type of works or to expand their program of works, either in size or scale, beyond what was subject to the heritage survey, it is advised that further consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners should be undertaken prior to the commencement of works.

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# PROJECT INTRODUCTION



Abra Minerals Pty Ltd (Abra Minerals) intend to use land within the Nhamuwangga Wajarri and Ngarlawangga native title determination area (WCD 2000/001) to connect water bores to a pre-existing mine area, and to construct service roads.

To minimise the likelihood of breaching the *Aboriginal Heritage Act 1972 (WA)* (the Act), Abra Minerals commissioned a site avoidance heritage survey over the areas planned for development. These are detailed in scope of works (SOW).





*Overleaf: members of the heritage team (Gary Robinson Snr, David English, and Leonard Smith Snr) inspecting the new signage at Boogooda*

Abra Minerals' Project Area is located approximately 210 km north of Meekatharra in the Mid West region of Western Australia. The East L2 and West L2 survey areas are located on the eastern and western sides of the Ashburton Downs-Meekatharra Road respectively. The scoped survey areas are also contained within tenures E520/1455 and L520/194, (see maps below).

## Amendments to scope

To avoid impact to GAL22-01, a 50 m wide deviation corridor was surveyed outside the proposed area to allow adequate access for Abra's bore project. This deviation begins in the southeast corner of the eastern bore project area and follows the bend in the road back into the survey area.

This deviation was created in consultation with, and agreed upon, by Abra representative Angelo Scopel, and the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.

## Survey participants



The heritage survey was conducted on

24 February 2022

by six Nharnuwangga Wajarri and Ngarlawangga representatives, two Terra Rosa consultants, and one Abra Minerals representative.

As the representative for the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, Jidi Jidi Aboriginal Corporation (JJAC) engaged Terra Rosa Consulting (Terra Rosa) to conduct a site avoidance survey of the areas requested in the SOW.

The heritage survey was carried out by the following people on 24 February 2022 (excluding travel days):

### Nharnuwangga Wajarri and Ngarlawangga Traditional Owners

- Gary 'Cowboy' Robinson Snr
- Leonard Smith Snr
- Rowan Robinson
- Denis McPhee
- William Riley
- Phillip Robinson

### Terra Rosa Consulting

- Natalie Guetlich
- David English

### Abra Minerals Pty Ltd

- Angelo Scopel

The Nharnuwangga Wajarri and Ngarlawangga participants were selected by JJAC as the appropriate knowledge holders for the survey area and consented to participate in the heritage survey.

Contact details for the survey participants are provided in Appendix A of this report.

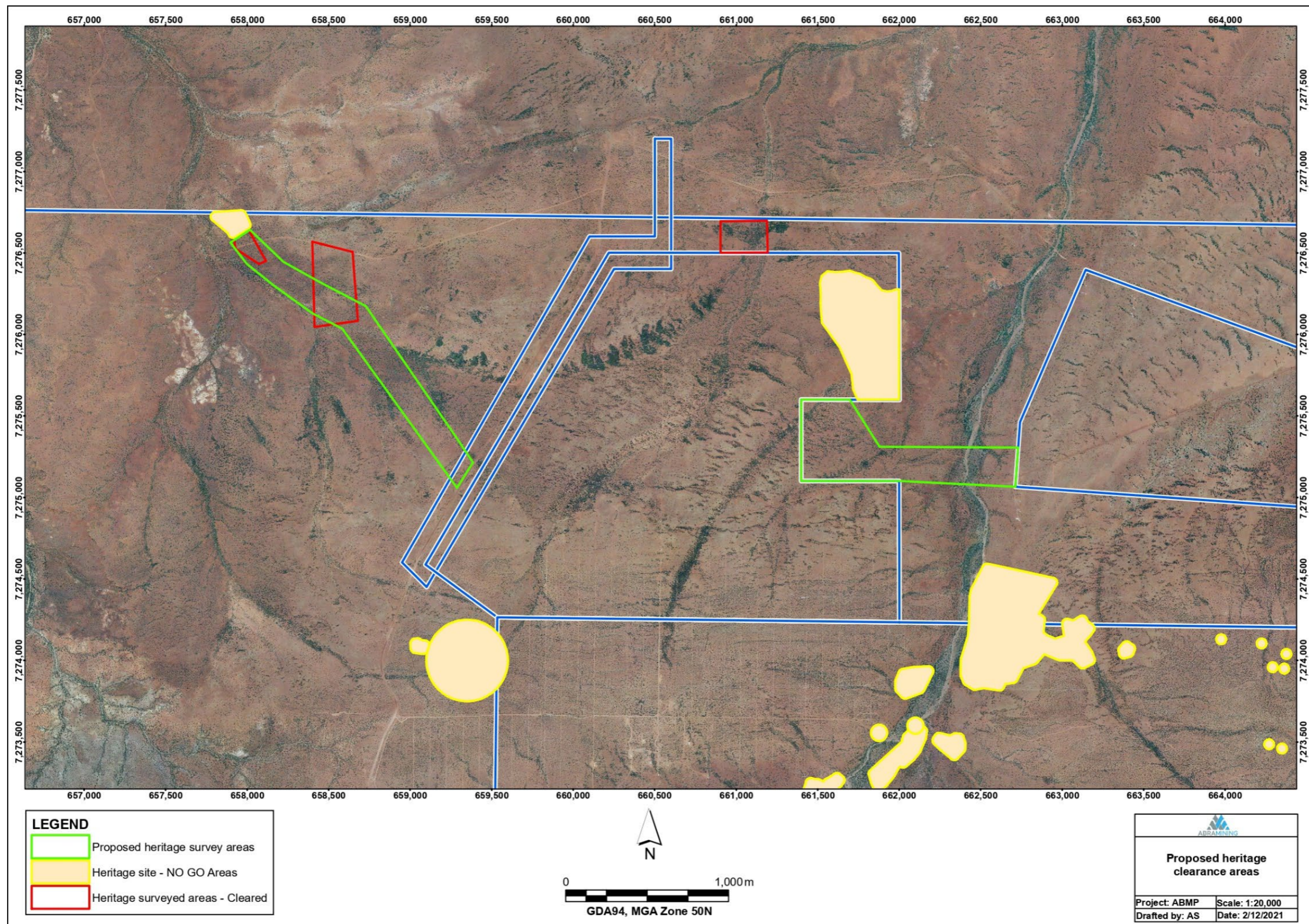
**Right:** Natalie Guetlich recording an artefact.

**Below:** The heritage survey team on 24 February 2022.

(L to R): Natalie Guetlich, Rowan Robinson, Phillip Robinson, Gary 'Cowboy' Robinson Snr, David English, Leonard Smith Snr, Denis McPhee, William Riley.



Heritage survey area map, provided by Abra Minerals Pty Ltd





**Nharnuwangga Wajarri  
and Ngarlawangga  
people**

WDC 2000/001

**Major towns**

Meekatharra

Landor

Peak Hill

# NHARNUWANGGA WAJARRI AND NGARLAWANGGA COUNTRY

The Nharnuwangga Wajarri and Ngarlawangga People hold native title over an area located within the Shires of Ashburton, Meekatharra, and Upper Gascoyne (NNTT no. WCD 2000/001). They were the first group in Western Australia to receive their native title.

The Nharnuwangga Wajarri and Ngarlawangga determination area broadly extends from Turee Creek and Prairie Downs pastoral leases in the north (southwest of Newman); south to Doolgunna pastoral lease; west-southwest towards Landor; and northeast to Pingandy and Mininer pastoral leases. Their traditional lands include the Collier Range National Park (Reserve 35104).

Jidi Jidi Aboriginal Corporation is the registered Native Title Body Corporate for the Nharnuwangga Wajarri and Ngarlawangga native title determination.





**Overleaf:** The landscape on the southern side of the Robinson Range

The Nharnuwangga Wajarri and Ngarlawangga determination area is located within the Gascoyne (GAS) biogeographic region, as described in the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell, 1995), more specifically within the Augustus subregion (GAS 3).

The Augustus subregional area is approximately 10,687,739ha (106,877 square kilometres). Broadly, Mulga (*Acacia* spp.) woodland with an understorey of *Triodia* spp. occurs on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland.

Much of the region is covered by a large sedimentary basin known as the Carnarvon Basin. The sedimentary Carnarvon Basin slopes gently towards the coast and is characterised by low relief, open drainage, and large gently undulating sand plains. This contrasts strongly with the small area of Precambrian rocks in the northeast of the Gascoyne, which has moderately high relief, a close dendritic drainage pattern and mature valley topography.

The northeastern part of the Gascoyne region is covered by Middle Proterozoic sandstone, shale, and dolomite of the Bangemall Basin. These sediments of varying age, almost entirely marine in origin, have been subjected to low-grade metamorphism, folding and intrusion by numerous dolerite sills, which have a westerly regional dip.

The Augustus subregion (GAS 3) is summarised as consisting largely of rugged low Proterozoic sedimentary and granite ranges. There are extensive areas of alluvial valley-fill deposits, and the Gascoyne River System provides the main drainage of this subregion. It is also the headwaters of the Ashburton and Fortescue Rivers.

The soils in the Gascoyne region have many features that are common to semi-arid soils elsewhere in Australia. Most obvious is the predominantly red colouration of the soil which is due to soil particles covered by oxides of iron.

The Department of Agriculture and Food (DAFWA) (2006), describe the Nharnuwangga Wajarri and Ngarlawangga Determination area as occurring within the Gascoyne Valley Zone (295), consisting of:



### The Robinson Range, Peak Hill

- Hardpan wash plains (with hills, stony plains and some calcrete plains and floodplains) on alluvial deposits over gneiss and volcanic rocks of the southern parts of the Gascoyne Complex and Edmund and Collier Basins.
- Red-brown hardpan shallow loams with red deep sands, red shallow sandy duplexes and red loamy earths and some red/brown non-cracking clays and stony soils.
- Mulga shrublands (with some Wanderrie grasses and Chenopods), located in the Upper Gascoyne between Landor Station and the Great Northern Highway

The Nharnuwangga Wajarri and Ngarlawangga Native Title determination area is located within the broader Midwest Region, which begins on the coast near Cervantes and ends just north of Exmouth, extending inland to Mt Magnet. The ethnographic record reflects a diversity of views regarding the traditional organisation of social and linguistic boundaries within the Midwest region, boundaries that have often been defined along the circumcision and subincision lines, which separated the Geraldton Coastal Region from Aboriginal groups further inland (Tindale 1974).



### Key waterways

Gascoyne River  
Murchison River  
Ashburton River  
Angelo River  
Ethel River  
Inabiddy Creek  
Turee Creek  
Divide Creek

### Common site types

Artefact scatter  
Quarry

Embedded within these topographical features are Law, stories, Dreamtime pathways, ancestral spirits, and traditional travel routes through country. Pathways travelled by the mythical beings who transformed the lands were called 'Dreaming tracks', and the maps people used to travel across the country were often depicted in songs. Thus, song-lines or stories tell the journeys of ancestral spirits that moulded the earth as they travelled across country, including mythical water snakes called *Bimara* (Green 2001; Shaw & Martin 2011).

With the Gascoyne climate being so arid, knowledge of reliable water sources was necessary for survival. Ethnographic and archaeological sites within the Nharnuwangga Wajarri and Ngarlawangga determination area are concentrated along major water sources such as the Gascoyne River, Murchison River, and Ashburton River, including their various tributaries such as the Angelo River, Ethel River, and Turee Creek. Nharnuwangga Wajarri and Ngarlawangga people traditionally utilised natural cavities forming in rocky outcrops, known as rock holes and gnamma holes. These were often covered over with a movable stone in order to protect the gathered water from evaporating and being



contaminated. To this day, Yamatji people continue to maintain these water sources when encountered, often by cleaning them out and/or covering them up.

The Murchison River, Gascoyne River, and Ashburton River are highly culturally significant for a variety of groups throughout the Midwest and Gascoyne regions as they cover multiple native title boundaries. Multiple groups believe that the permanent water sources contain *Bimara*, or mythological water serpents that often bear the same name as the site it associated with (Kingsford 1982). *Bimara* are inherently linked to the 'Dreamtime' responsible for creating the landscape and water sources (Shaw & Martin 2011). Permanent water sources continue to be of high cultural importance, indicating the health of country, which in turn reflects the health of culture (Barber & Jackson 2011).

A myriad of faunal and botanical resources is readily available within the Nharnuwangga Wajarri and Ngarlawangga determination area. The knowledge and use of various plants and animals continue to be passed on generationally among Traditional Owners. Exploitable wildlife and vegetation available within the region include various



types of Kangaroo and rock kangaroo, porcupines (echidnas), bird species including ducks and emu, *bungarra* (Goanna) and lizards (Shaw & Martin 2011).

Vegetation traditionally served a variety of purposes for Nharnuwangga Wajarri and Ngarlawangga people including modification into tools, food, and association with spiritual and cultural beliefs. Traditionally seeds, fruits, and tuber vegetables were commonly collected and consumed as part of the diet, including bush tomato and *quandong* berries, which were also commonplace bush foods found throughout the region (ibid.).

#### Pastoral Stations

Bryah

Doolgunna

Kumarina

Landor

Milgun

Mingah Springs

Mount Clere

Mount Vernon

Mulgul

Tangadee

Three Rivers

Turee Creek

Woodlands

Yarlarweelor

Nharnuwangga Wajarri and Ngarlawangga country contains a wide variety of archaeological and ethnographic sites. These include mythological sites, ceremonial sites, burials, artefact scatters, engravings, quarries, rockshelters, man-made structures, and water sources. These sites attest to the past use of country by the Nharnuwangga Wajarri and Ngarlawangga people, and its ongoing significance.

Their use of country is further attested by a wide variety of rock art sites. Engraving sites are the most common, often occurring in proximity to pastoral stations such as Turee Creek Station (DPLH ID 11220), Waldberg Station (10978), Woodlands Station (10979) and Mt Vernon Station (10985). An important engraving site at Broncho Pool (10988) contains hundreds of motifs, including anthropomorphs, animals, and tracks.

Paintings are also present on Nharnuwangga Wajarri and Ngarlawangga country, though in lesser numbers. Painting sites include Nichol Spring (10987), Upper Gascoyne River (10989), Bamboo Springs (10990) and Brumby Creek (11428). These rock art sites often have mythological and ceremonial significance and are therefore highly significant to the Nharnuwangga Wajarri and Ngarlawangga people.

The arrival of Europeans to the Midwest began with Pastoral settlement in the Geraldton region in the 1850's, with expansion into the central parts of the Murchison occurring in the 1860's (Kingsford 1982), following legislative Council inducements to pastoralists to take up leases for the grazing of sheep and cattle. Stock routes along which drovers took cattle from the Ashburton and Pilbara to

railheads at Mullewa and Meekatharra pass through the region (GDC. c. 2000).

A goldrush in the 1890's at Peak Hill brought a large number of people into Nharnuwangga Wajarri and Ngarlawangga country, further disrupting their use and access of the land.

Pastoralism comprises an important part of recent history for many of the groups in the Midwest, including the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, with many elders holding living memories of the pastoral lifestyle.

Ethnographic and archaeological sites associated with pastoral activity occur throughout Nharnuwangga Wajarri and Ngarlawangga country. Historical sites occur at WINDMILL, SPRING & CAMP (DPLH ID 17377) and at TUREE CREEK (DPLH ID 17381). The Turee Creek site was a camp for Aboriginal station workers and their families, who represented a wide variety of language groups, including the Ngarlawangga. The site has an ongoing sentimental



*A landscape view near  
Tunnel Creek*



connection to the group. Likewise, the Windmill site also has sentimental associations with the Ngarlawangga, who camped and lived there.

These sites and others reveal how Nharnuwangga Wajarri and Ngarlawangga people engaged with the pastoral lifestyle, and the trace these interactions have left in the archaeological record.

Many Nharnuwangga Wajarri and Ngarlawangga Traditional Owners hold living memory of working on these pastoral stations and have a familial association with them. Aboriginal people were engaged to undertake various tasks, often as station hands, stockmen, and shearers, mostly in return for basic rations, stores, and shelter. Women often served as domestic help. According to Biskup (1973), by 1910 all surviving full-Aboriginal people had all settled on stations or around towns, profoundly effecting traditional lifestyles and establishing strong connections with the pastoral industry.

## PROJECT METHOD

The archaeological heritage survey of Abra Minerals' Bore Access Project Areas was conducted to a site avoidance standard. The aims of a site avoidance heritage survey are to:

Site avoidance surveys aim to record any identified sites to a standard that allows Abra Minerals to avoid them.

1. identify and record Aboriginal sites (as defined under s5 of the Act) within the requested survey areas;
2. provide Abra Minerals with the location and a preliminary understanding of a site's characteristics so that Abra Minerals can proceed with works that will not impact those sites;
3. negotiate deviations around these sites where possible; and
4. provide Abra Minerals with relevant and informed heritage management recommendations for heritage values identified within the requested survey area.

Please note that site avoidance level recording is not comprehensive enough to thoroughly assess the site's importance and significance under s39 of the Act. As such, sites recorded to site avoidance level should not be submitted to the Aboriginal Cultural Materials Committee (ACMC) for consideration.

## Legislation



[Aboriginal Heritage Act 1972](#)

Under section 17 (s17) of the Act, it is an offence to disturb an Aboriginal site without prior written Ministerial consent to do so under s16 or s18 of the Act. This applies regardless of whether an Aboriginal site is registered. Heritage assessments of proposed development areas are conducted to identify the location and extent of sites so that they can be appropriately managed in accordance with the legislative requirements of the Act.

A full copy of the Act can be accessed online.

## Desktop method

**Registered Aboriginal sites** are heritage places that have been assessed by the ACMC as constituting **sites** under sections 5 and 39 of the Act.

**Other heritage places** include places for which data has been **lodged** with the DPLH but are pending assessment by the ACMC, and places that have already been assessed by the ACMC as not constituting an Aboriginal site under the meaning of the Act (listed as **stored data / not a site**).

A desktop assessment was completed before the start of the field survey to understand the extent of heritage research undertaken to date within the survey area. This research relies largely on the Register of Sites maintained by the DPLH, which is a catalogue of heritage places previously recorded within the area and submitted to the DPLH.

Before the start of the field work, the scoped survey areas were entered into the DPLH's Aboriginal Heritage Inquiry System (AHIS) to learn whether any heritage surveys have previously been conducted, and whether any registered Aboriginal sites or other heritage places (OHPs) exist in the area.

Any relevant unpublished material (heritage reports not registered with the DPLH) was also reviewed prior to field work and included in the heritage assessment results where relevant.

The results of the desktop research are provided in the 'Survey Outcomes' section, below.

## Survey method

Prior to the survey Terra Rosa's heritage consultants conducted a survey brief to provide the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners with information about the purpose, scope, and proposed method of the heritage survey. The results of the desktop survey were also discussed to provide the survey team with contextual information on what heritage values are known to exist within the survey areas. The proposed method was approved by the Traditional Owners present.

*Nharnuwangga Wajarri and Ngarlawangga Traditional Owners inspecting a rockhole*



Pedestrian transects were used to inspect the survey areas, with survey team members spaced up to 30 m apart (depending on the terrain). Any heritage places identified were recorded to site avoidance standard, as scoped.

*Heritage consultant Natalie Guetlich recording artefacts at GAL22-02*



At the end of the field trip a debrief was conducted to discuss the results of the heritage survey, and to offer the Traditional Owners an opportunity to provide additional comments on the heritage places identified, the effectiveness of the methods used, and their recommendations for the management of cultural heritage values in the area.



Refer to [Appendix C](#) for the methods used to record different site types within the survey area.

## Coordinate capture

All coordinates provided in this report and in the spatial data package accompanying it (Attachment 1) were obtained with a Garmin hand-held GPS and a Samsung Galaxy tablet, using the GDA datum. All grid references are projected in MGA Zone 50, unless otherwise stated. Dependent on external conditions, these units afford an optimal spatial accuracy of  $\pm 5$  m.



MGA Zone 50

## Report review

A draft version of this report was reviewed by JJAC before it was provided to Abra Minerals. This review ensures that culturally sensitive information is appropriately indicated, and that the recommendations provided are made in accordance with any existing agreements. This process also provides Terra Rosa with feedback which is considered during the final edit of the report.



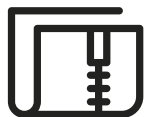
## SURVEY OUTCOMES

The table below presents the status of each scoped survey area at the end of the fieldtrip.

Survey area	Survey standard	Survey status
Bore Access Project - East	Site avoidance	Complete
Bore Access Project - West	Site avoidance	Not commenced

The complete results of the desktop and field survey for each of these survey areas are presented in the following table and are illustrated in the following map. These results are further discussed by survey area below.

### Data



The survey results presented below are also provided in the spatial data pack that accompanies this report.

Attachment 1:

JJ2201 Spatial Data

Summary of the desktop and heritage survey results

Survey area	Survey standard	Survey status	DPLH Registered Aboriginal sites	DPLH OHPs	Heritage sites	Isolated artefacts	Notes
Bore Access Project - East	Site avoidance	Complete	None	None	GAL22-01 GAL22-02 GAL22-03	64	The isolated artefacts were relocated to Boogooda keeping place (DPLH ID 37827). The recording of GAL22-03 was not completed due to time constraints and the location of the site outside the project area. As such, the site avoidance level assessment of this heritage place remains 'pending'.
Bore Access Project - West	Site avoidance	Not commenced	None	None	n/a	n/a	The heritage assessment of this survey area was not commenced due to time constraints.

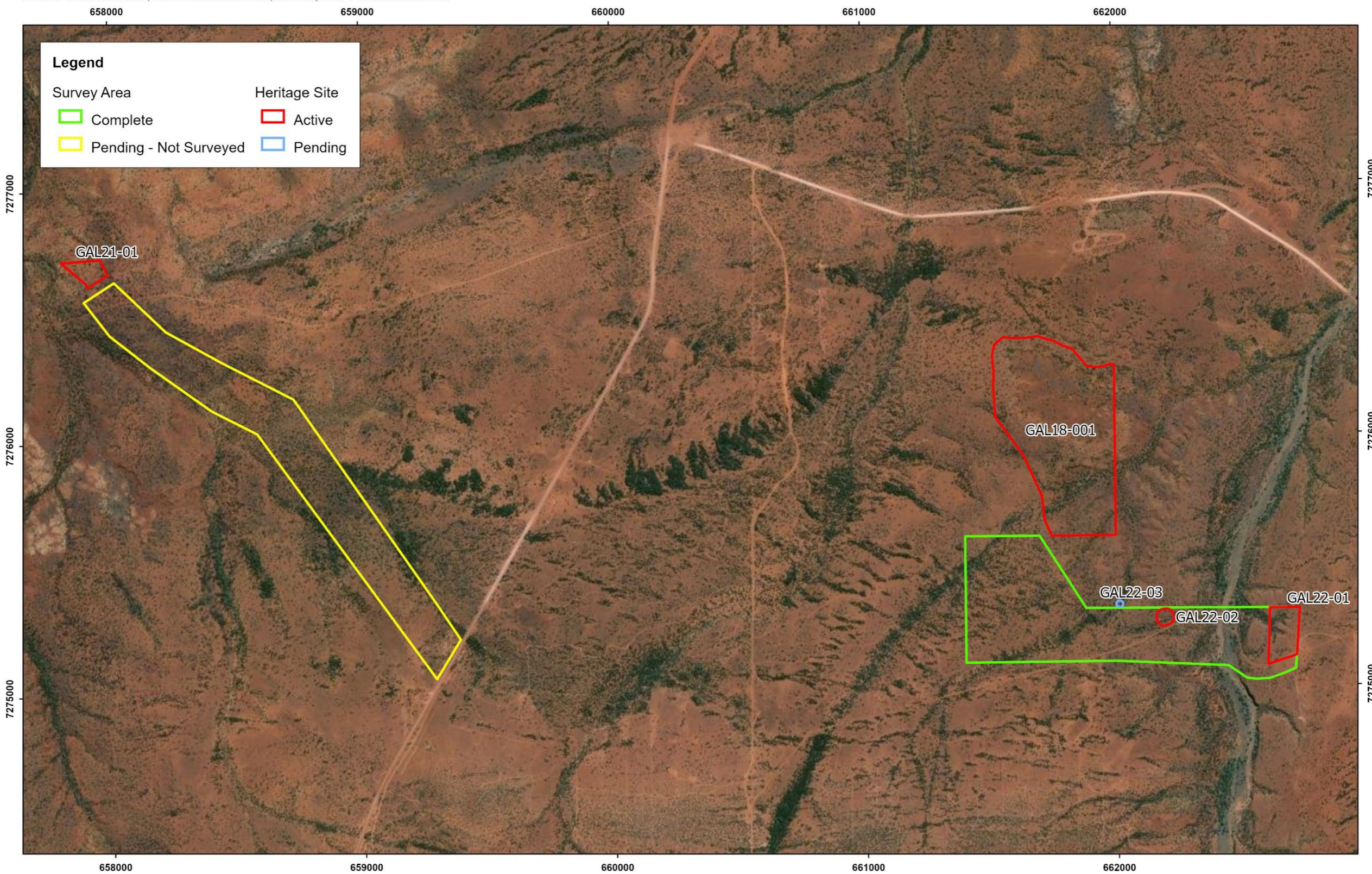
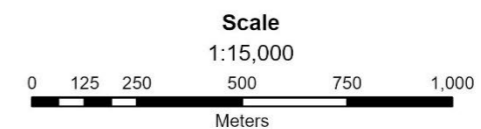
JJ2201 Results Overview Map

### Heritage Survey Results

Job No: JJ2201    Map No: 1    Coordinate System: GDA94 MGA Zone 50

Date: 4/04/2022    Author: Ariell

Disclaimer: The information in this map is accurate as at the date of issue. Spatial accuracy level of +/- 15m unless otherwise noted.





### Site Avoidance

#### East L2: Complete

Registered sites: none

DPLH OHPs: none

Heritage sites: 3

Isolated artefacts: 64

## Bore Access Project – East L2 and West L2 Results

The East L2 survey area was archaeologically and ethnographically assessed to site avoidance standard on 24 February 2022 by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners and Terra Rosa consultants.

The heritage assessment of West L2 was not commenced due to time limitations, and as such, this survey area is not clear for Abra Minerals proposed works to proceed.

### Previous heritage investigations

#### East L2: Not commenced

Registered sites: none

DPLH OHPs: none

The desktop survey undertaken prior to the commencement of fieldwork identified no DPLH registered Aboriginal Sites exist within either the East L2 and West L2 survey areas. Additionally, no lodged OHPs and no stored OHPs exist within the survey areas.

Several heritage sites are present in the landscape surrounding the survey areas. Those located within a three-kilometre radius include but are not limited to: GAL21-01 (quarry and artefact scatter), GAL18-001 (artefact scatter), Five Mile Creek 06 (DPLH OHP ID 19293), Ethel Creek Scatter 3 (DPLH OHP ID 18834), Ethel Creek Scatter 2 (DPLH





**Overleaf: Surveying the East  
L2 survey area**

OHP ID 18832), Five Mile Creek 04 (DPLH OHP ID 19301), Ethel Creek Scatter 1 (DPLH OHP ID 18829), and Five Mile Creek 05 (DPLH OHP ID 19294).

As such, it is evident that this section of Nharnuwangga Wajarri and Ngarlawangga Country is part of an important cultural landscape that was heavily utilised in past times.

### Landscape context

The landscape within which the survey areas are situated is undulating, and it is likely that the low points would be prone to flooding during the wet season, especially considering the proximity of Ethel Creek (main body located 5.1 km east). A tributary of Ethel Creek runs north-south through the eastern portion of East L2 and would have been used as a travel pathway in the past by ancestral Nharnuwangga Wajarri and Ngarlawangga People.

Vegetation is relatively sparse on the plains but grows more densely in proximity to Ethel Creek and the other ephemeral creeklines that criss-cross the landscape. This vegetation consists of various Acacia species, and in particular, a high number of Mulga trees and bushes. An upper storey is mostly absent, except in proximity to the creeklines where the trees grow to greater heights.

The survey areas were easily accessible via pre-existing access tracks. One track runs east-west through the southern portion of East L2, and the Ashburton Downs – Meekatharra Road runs past the southern end of West L2.

### Heritage survey results

As mentioned, the West L2 survey area was not commenced due to time constraints. As such, this survey area remains ‘pending’ following the heritage trip.

The East L2 survey area was completed, and three heritage sites were identified. These heritage sites were GAL22-01, GAL22-02, and GAL22-03. GAL22-01 and GAL22-02 were recorded to a site avoidance standard (see below). A deviation around the southern portion of GAL22-01 was created and is depicted in the results map below.

GAL22-03 was not recorded due to time constraints and its location outside of the project area. However, a boundary has been provided for this place in the spatial data to enable Abra Minerals to avoid it in future.



#### GAL22-01 – artefact scatter and water source

GAL22-01 is a large, moderate density artefact scatter containing cores, flakes, and blade fragments. It was recorded to site avoidance standard on 24 February 2022 by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners and Terra Rosa consultants.



#### GAL22-02 – artefact scatter

GAL22-02 is a small, moderate density artefact scatter containing cores, flakes, and blade precursors. It was recorded to site avoidance standard on 24 February 2022 by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners and Terra Rosa consultants.

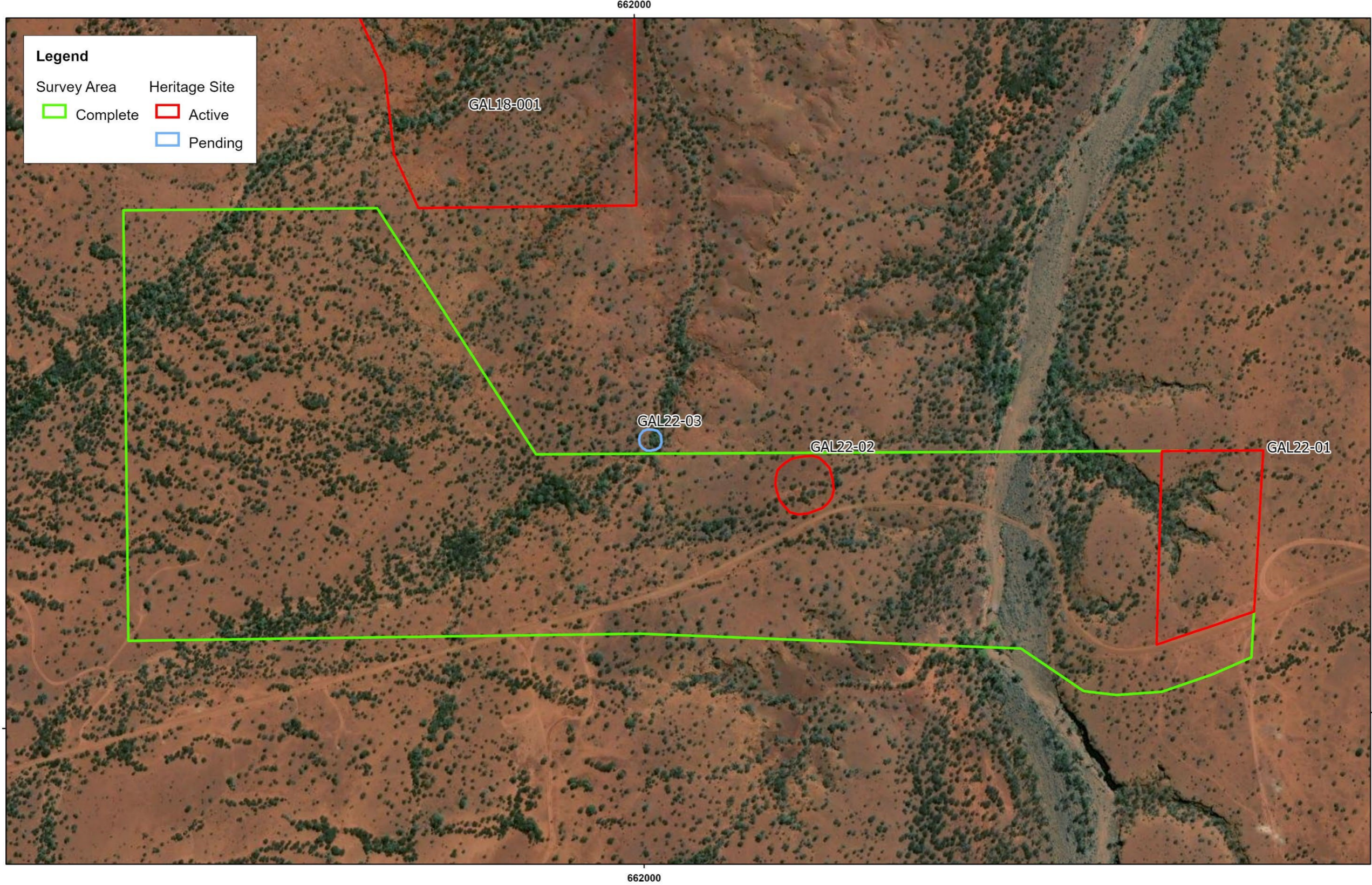
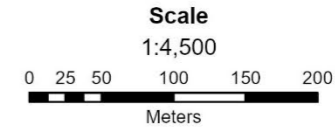
These results are illustrated in the map below.

# JJ2201 Results – East L2

Job No: JJ2201    Map No: 1    Coordinate System: GDA94 MGA Zone 50

Date: 4/04/2022    Author: Ariell

Disclaimer: The information in this map is accurate as at the date of issue. Spatial accuracy level of +/- 15m unless otherwise noted.



]



## GAL22-01

### Artefact scatter and water source

Site avoidance

#### Centroid:

662663 mE / 7275200 mN

Size: 23,858 m<sup>2</sup>

GAL22-01 is a large, moderate density artefact scatter containing cores, flakes, and blade fragments. It was recorded to site avoidance standard on 24 February 2022 by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners and Terra Rosa consultants.

### Location

GAL22-01 is located in the northeastern corner of Abra Minerals' East L2 survey area. This survey area itself is located approximately 1.9 km east of the Ashburton Downs – Meekatharra Road, and 1.6 km south of Tangadee Road in the Mid-West region of Western Australia.

Ridgelines are visible to the west of GAL22-01, and the Collier Ranges are visible to the northeast. The border of the Collier Range National Park is located approximately 6.6 km east of the site. GAL22-01 is also bordered by a tributary of Ethel Creek to the west, which would have







*Overleaf: view south from the centre of GAL22-01. The southern access track is also visible in the distance.*

been used as a source of semi-permanent water in past times. The main body of Ethel Creek is located approximately 5.3 km east of the site.

The northern, eastern, and southern boundaries of GAL22-01 were defined by the extent of the project area boundary. Due to time constraints, the full extent of cultural material present in the northern, eastern, and southern parts of the site were not included within the site boundary recorded during this assessment. The southern boundary is also defined by the pre-existing access track present within the survey area. The western boundary of GAL22-01 was defined by the extent of cultural material present up until a steep drop-off at Ethel Creek, and also encompasses part of this creek.

This boundary was designed to capture the extent of cultural material present within the project area boundary, as well as a small section of Ethel Creek along which the site is situated. The Nharnuwangga Wajarri and Ngarlawangga Traditional Owners were consulted during the delineation of this boundary and approved it upon completion.

#### Site description

GAL22-01 is a moderate density artefact scatter situated upon an elevated mudflat within a predominantly undulating landscape. As mentioned, a tributary of Ethel Creek borders the site to the west and would have provided a semi-permanent water source in past times. Nharnuwangga Wajarri and Ngarlawangga Elder Gary Robinson Snr said, “Two hundred years ago there would have been water in here, but now it’s all changing [with the changing climate]” (pers comm. 24 February 2022).

Other permanent and semi-permanent water sources within the landscape surrounding GAL22-01 include ephemeral creeklines and permanent springs, such as Nickel Spring. Regarding the water sources and area surrounding GAL22-01, Nharnuwangga Wajarri and Ngarlawangga Elder Leonard Smith Snr said:

“We used to come out this way to go to Nickel Spring (Bamboo Spring), when we stayed at the station (Milgan). Good hunting ground because there's always permanent water there – on the surface...[Would] come to areas like this, hunting and [collecting] seeds for grinding. Hunting Turkey, Bungarra's, Roo's... make tools... Boomerangs and Junna's...”

(pers comm. 24 February 2022)

As Leonard has stated, the landscape and ground surface surrounding GAL22-01 features dry mudflats that would hold semi-permanent water after rain, and a compact iron rich soil overlaid by a mixed, fine-grained gibber of banded ironstone formation (BIF), dolerite, and quartz. The vegetation present within the site and the surrounding landscape is predominantly comprised of scattered Acacia species, and in particular, Mulga trees and bushes which form the lower and middle storeys of the open woodland present.

The cultural material identified within the site is comprised predominately of dolerite and basalt, with some chert, quartz, and mudstone artefacts also represented. Some of these materials, such as the chert and basalt, are not readily available within this landscape, and as such were likely imported into the site for knapping purposes.

The predominant typologies present within the artefact scatter include cores, flakes, and blade fragments. Cores, both single-platform and multi-platform, were predominant, in addition to core fragments, blade fragments, and blade precursors. The presence of blade precursors and fragments within the site, in addition to the high levels of cores could indicate that GAL22-01 was used as a manufacturing area for tools associated with hunting. This interpretation is also in line with Leonard Smith Snr's comments above regarding the site.

Leonard Smith Snr also stated that his ancestors:

“Would have made tools here for hunting and cutting up meat... Even in the wet season, but always eventually go back to where permanent water is... follow the creeks.”

(pers comm. 24 February 2022)

As stated, it is likely the Nharnuwangga Wajarri and Ngarlawangga People were following the major creeklines in the area to access permanent and semi-permanent water, as well as the bush foods and game that would have been present in these hunting grounds in past times. As such, it is likely that GAL22-01 is the result of the periodic and opportunistic usage of raw material resources in this area to manufacture hunting tools to be used directly in the surrounding landscape.

It is also evident that GAL22-01 is of importance and significance to the Nharnuwangga Wajarri and Ngarlawangga People, as a place in which they can connect to and learn more about the experiences of their ancestors in past times. Of this, Leonard Smith Snr stated:

“[It's] good to see what the Old People been doing...had to be really good at it [toolmaking] because it's hard...”

(pers comm. 24 February 2022)

As such, GAL22-01 should be avoided and protected into the future for the benefit of the future generations of Nharnuwangga Wajarri and Ngarlawangga People.

#### Site condition

GAL22-01 is in very good condition. The site is mostly intact and undisturbed, and the cultural material present here remains in situ.

It is likely that the cultural material present within the site extended further south before the access road was built, however, the concentration of artefacts become sparse in the southern portions of the site, and the access road has not adversely impacted the cultural values or integrity that give GAL22-01 importance and significance to the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners.

#### Significance assessment

As site avoidance level recording is designed to enable Abra Minerals to effectively avoid the site in the course of their proposed works, a complex significance assessment in line with s39(2) of the Act has not been presented.

#### Key heritage considerations

- A 50 m deviation was created around the southern border of GAL22-01 to prevent man-made impacts to the site. Abra Minerals must use this deviation to access their work area during the full course of their proposed works.
- If GAL22-01 cannot be avoided, further consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners must take place, as well as the detailed recording of the site to a site identification level.

*View west from the centre of  
GAL22-01*



*View north from the centre of  
GAL22-01*



*View east from the centre of  
GAL22-01*





## GAL22-02

### Artefact Scatter

Site avoidance

#### Centroid:

662193 mE / 7277270 mN

**Size:** 3,666 m<sup>2</sup>

GAL22-02 is a small, moderate density artefact scatter containing cores, flakes, and blade precursors. It was recorded to site avoidance standard on 24 February 2022 by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners and Terra Rosa consultants.

### Location

GAL22-02 is located approximately 400 m west of GAL22-01 in the central-northern portion of Abra Minerals' East L2 survey area. This survey area itself is located approximately 1.9 km east of the Ashburton Downs – Meekatharra Road, and 1.6 km south of Tangadee Road in the Mid-West region of Western Australia.

GAL22-02 is bordered to the south by an access road, and a tributary of Ethel Creek is located approximately 170 m to the east. Ethel Creek is a large, semi-permanent water source, and would have been utilised





*Overleaf: Terra Rosa  
heritage consultant Natalie  
Guetlich recording artefacts at  
GAL22-02*

in past times as a travel pathway through Country. The main body of Ethel Creek is located 5.7 km east of the site.

The boundary of GAL22-02 was designed to capture the extent of cultural materials present in the area. The Nharnuwangga Wajarri and Ngarlawangga Traditional Owners flagged this boundary and were satisfied with it upon completion.

As an access track is present to the south, the southern boundary of the site is halted approximately 10 m north of this access road. It is likely cultural material would have been present south of this road prior to it having been built, but upon consultation, the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners were satisfied to exclude the access road from the site boundary.

#### Site description

GAL22-02 is very similar in composition and landscape context as GAL22-01. The site is situated on a mudflat between two north-south trending ephemeral creeklines. The landscape is undulating, with the Collier Ranges and Collier Range National Park visible to the northeast. The ground surface within this landscape is comprised of a compact, iron rich soil overlaid with a medium sized gibber of BIF, ironstone, and quartz, while the vegetation present in the area is comprised of various Acacia species, and in particular, Mulga bushes.

Nharnuwangga Wajarri and Ngarlawangga Elder Leonard Smith Snr stated that this part of Country was used in past times as a hunting ground, as it often contained water and plenty of bush tucker. Regarding this, Leonard said:

“We used to come out this way to go to Nickel Spring...Good hunting ground because there’s always permanent water there – on the surface.”

(Pers comm. 24 February 2022)

Like with GAL22-01, the cultural material identified within the site was comprised predominantly of dolerite and basalt. Several chert, quartz, and mudstone artefacts were also noted but were not as widely represented. The main artefact types present amongst the assemblage include cores (both single-platform and multi-platform), flakes, broken flakes, and blade precursors. Therefore, as with GAL22-01, it is likely that GAL22-02 may have been utilised as a convenient and opportunistic manufacturing area for tools associated with hunting as the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners travelled up and down the creeklines in past times.

Regarding this, Leonard Smith Snr stated:

“[They] would have made tools here for hunting and cutting up meat...Even in the wet season, but [would] always eventually go back to where permanent water is...follow the creeks.”

(Pers comm. 24 February 2022)

As such, it is likely that GAL22-02 was a small, opportunistic hunting camp utilised in the wet season to create stone tools associated with hunting, which would have been utilised on the hunting grounds as the Nharnuwangga Wajarri and Ngarlawangga people travelled through Country.

#### Site condition

GAL22-02 is in very good condition. No natural or man-made impacts to the site's cultural values were noted, though a light vehicle track abuts the southern end of the site.

#### Significance assessment

As site avoidance level recording is designed to enable Abra Minerals to effectively avoid the site in the course of their proposed works, a



complex significance assessment in line with s39(2) of the Act has not been presented.

#### Key heritage considerations

- GAL22-02 is of importance and significance to the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners. As such, Abra Minerals must avoid impact to the site during the course of all their proposed works in the area.
- If GAL22-02 cannot be avoided, further consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners must take place, as well as the detailed recording of the site to a site identification level.

*View north from GAL22-02*



*View west from GAL22-02*



*View east from GAL22-02*



*View south from GAL22-02*



# HERITAGE MANAGEMENT

## RECOMMENDATIONS

Based on the survey outcomes, Terra Rosa and the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners have developed the following recommendations to assist Abra Minerals with the management of the identified cultural heritage values in the area.

**1**

**Abra Minerals must avoid the heritage sites identified within the East L2 Project Area.**

Three heritage places were identified during the survey and consultation of the East L2 Project Area. These heritage places are GAL22-01, GAL22-02, and GAL22-03.

Of these sites identified, only GAL22-01 and GAL22-02 are located within the Project Area boundary.

These places are of great importance and significance to the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners, and as such, Abra Minerals must avoid these heritage places throughout the course of all their proposed works in the East L2 Project Area.

**2**

**If the three heritage places identified during the East L2 survey cannot be avoided, Abra Minerals must facilitate archaeological and ethnographic site identification level recording of these places.**

Under section 17 (s17) of the Act, it is an offence to disturb an Aboriginal site without prior written Ministerial consent to do so under s16 or s18 of the Act. This applies regardless of whether an Aboriginal site is registered.

Should heritage places GAL22-01, GAL22-02, and GAL22-03 not be able to be avoided, they must first be recorded to site identification level and submitted to the DPLH for review before a s16 or s18 application can be made to the Minister for Aboriginal Affairs.

**3**

**Abra Minerals is advised to facilitate an archaeological and ethnographic survey over the West L2 survey area.**

Due to time constraints, the heritage survey of West L2 was not commenced. As such, the proposed works cannot proceed within West L2 until such a time as an archaeological and ethnographic heritage survey over this area has been completed.

**4**

**All employees and contractors working within the East L2 and West L2 Project Areas must be made aware of the location and boundaries of all heritage places identified and are clearly instructed to restrict access and works to areas that have been subject to heritage survey and assessment.**

It is an offence to disturb an Aboriginal heritage place without prior written consent under s16 or s18 of the Act. Financial penalties may be applied against individuals or corporations who disturb a heritage place, regardless of whether that place is catalogued by the DPLH or not.

To avoid a breach of s17 of the Act, Abra Minerals must clearly instruct all employees and contractors working within the East L2 and West L2 Project Areas to restrict access and works to areas that have been subject to heritage survey, and to avoid impact to all heritage places in that area.

**5**

**If Abra Minerals proposes to alter the type of works or to expand their program of works, either in size or scale, beyond what was subject to the heritage survey, it is advised that further consultation with the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners should be undertaken prior to the commencement of works.**

Abra Minerals is advised that only the areas subjected to heritage assessment are clear for the proposed works to proceed. Should the program of works expand in size or scale or should Abra Minerals wish to conduct activities that differ to those discussed during field work, the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners will need to be engaged for further heritage assessment.

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# APPENDICES

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## Appendix A – Project contacts

The contact details of the heritage project stakeholders are provided below. Terra Rosa thanks everyone involved with the heritage survey and its organisation.

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### Abra Minerals Pty Ltd

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## Appendix B – Acronyms and definitions

The following terms and acronyms are used in this report. Definitions are provided below for reference.

Term / abbreviation	Definition
<b>Abra Minerals</b>	Abra Minerals Pty. Ltd.
<b>ACMC</b>	Aboriginal Cultural Materials Committee
<b>AHIS</b>	Aboriginal Heritage Inquiry System
<b>DPLH</b>	Department of Planning, Lands and Heritage
<b>GIS</b>	Geographic information system
<b>GPS</b>	Global positioning system
<b>Heritage object</b>	An object to which the Act applies under section 6
<b>Heritage site / Heritage place</b>	Any place which may meet the criteria of an Aboriginal site under s5 of the <i>Aboriginal Heritage Act 1972 (WA)</i> .
<b>HISF</b>	Heritage Information Submission Form
<b>Isolated artefacts</b>	Cultural material with insufficient density or context to constitute a site.
<b>JJAC</b>	Jidi Jidi Aboriginal Corporation
<b>MGA</b>	Map grid of Australia
<b>NNTT</b>	National Native Title Tribunal
<b>Other Heritage Place</b>	Other heritage places (OHPs) are heritage places classified by the DPLH as either: <ol style="list-style-type: none"> <li>1. A heritage place that has been reported to the DPLH but is pending assessment by the ACMC (status L – lodged); or</li> <li>2. A heritage place that has been submitted to the DPLH and evaluated by the ACMC to not meet the criteria for inclusion on the Register of Sites (i.e., not a registered Aboriginal site) (status S – stored / not a site).</li> </ol>
<b>Registered Aboriginal site</b>	A heritage place which has been determined as meeting criteria under section 5 of the <i>Aboriginal Heritage Act 1972 (WA)</i> and has been registered by the Registrar of Aboriginal Sites (DPLH status R - registered).
<b>SOW</b>	Scope of Works
<b>Terra Rosa</b>	Terra Rosa Consulting
<b>Traditional Owners</b>	Nharnuwangga Wajarri and Ngarlawangga native title claimants (NNTT no WCD 2000/001) and invited participants
<b>The Act</b>	<i>Aboriginal Heritage Act 1972 (WA)</i>

## Appendix C – Heritage place recording methods

Detailed below are the methods used by Terra Rosa to record sites and values identified within the survey area. This includes how place boundaries are defined, which attributes are documented, and how an assessment of a place's importance and significance is made.

### Definition of archaeological sites

Following thorough investigation, if a collection of objects were deemed to be of insufficient density or importance to constitute a heritage place under the meaning of the Act, artefacts were recorded as isolated artefacts.

For isolated artefacts, the location, artefact lithology, and typology were noted. Artefacts were then returned to their original location and orientation.

Artefacts were deemed to be isolated unless one or more of the following conditions existed:

- The heritage place displayed clear, purposive activity;
- The heritage place and its objects are relatively intact and in sufficient condition for an assessment of their importance and significance to be made;
- The material was identified in association with other heritage place elements; and
- The Traditional Owners requested that the material be recorded as a heritage place.

If the above conditions were met and the survey team assess the objects and/or features to constitute a heritage place under the meaning of s5 of the Act, the place and its constituent features were comprehensively photographed, and then recorded using the methods outlined below.

The methods employed during the heritage assessment within the survey areas were discussed with, and approved by, the attending Traditional Owner representatives.

### Designation of archaeological heritage place boundaries

Archaeological heritage place boundaries were determined by several factors, including the extent and / or density of heritage features and objects, and / or natural features (e.g., creek banks or outcrop margins). All heritage place boundaries were checked with the Traditional Owners to ensure all important and significant cultural heritage values were sufficiently encompassed.

Boundaries were delineated in the field where possible and recorded using a hand-held Garmin GPS unit and a Samsung Galaxy tablet. Where field-based delineation of boundaries was not feasible, heritage place extents are calculated using GIS determinations during assessment of field data in the office.

### Assessing importance and significance

Site avoidance level recording is insufficient to allow a significance assessment to be made under s39 of the Act for consideration by the ACMC.

### Artefact scatter recording method

Areas containing a density of artefacts were investigated as potential artefact scatters.

For site avoidance level recording, once a boundary was established, a comprehensive description of the place and its associated heritage features and objects was produced. This included details and photos of environmental attributes along with any relevant and / or interesting archaeological features. The Traditional Owners were consulted, and their discussion regarding the cultural values of the place was recorded.

## Appendix D – Isolated artefacts

If cultural material was identified but not deemed to constitute a site under the meaning of s5 of the Act, it was recorded as an isolated artefact to meet obligations under s6 of the Act.

Sixty-four isolated artefacts were identified within the East L2 survey area and were relocated to the Boogooda keeping place (DPLH ID 37827), as directed by the Nharnuwangga Wajarri and Ngarlawangga Traditional Owners present on the survey.

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