Appendix B. Ecology Reports

ABRA FLORA, FAUNA AND VEGETATION SURVEY

PREPARED FOR **GALENA MINING LTD**

29 June 2018

Stantec

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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 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 28th May and 1st 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 considered to be low, with only two introduced flora species recorded within the Study Area. Both of these species, **Bidens bipinna* and **Malvastrum amercanum*, 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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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^2) surrounded by a single granted Exploration Licence, E52/1455, of approximately 180 km^2. 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 assesment 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.

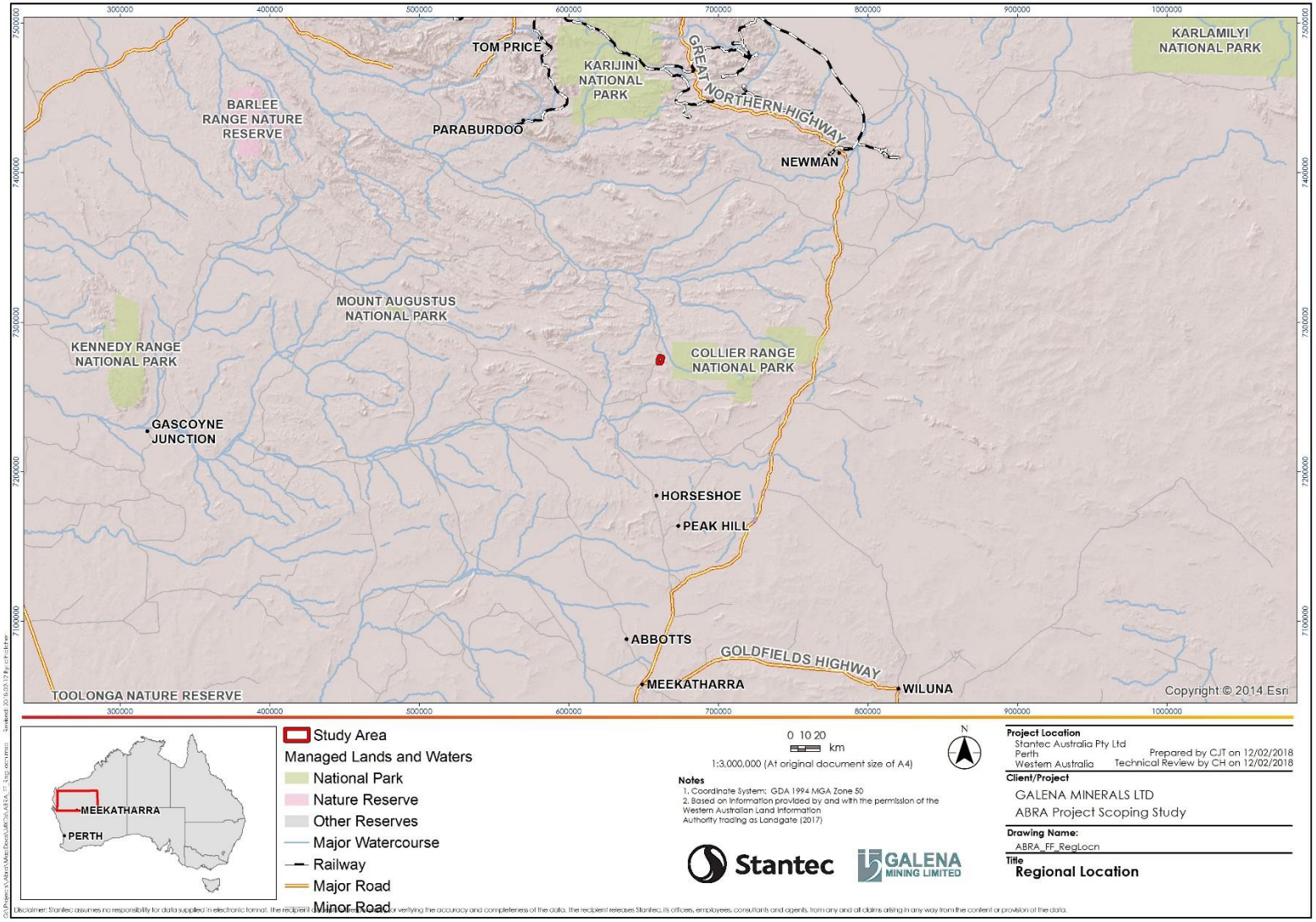


Figure 1-1: Regional locality of the Study Area

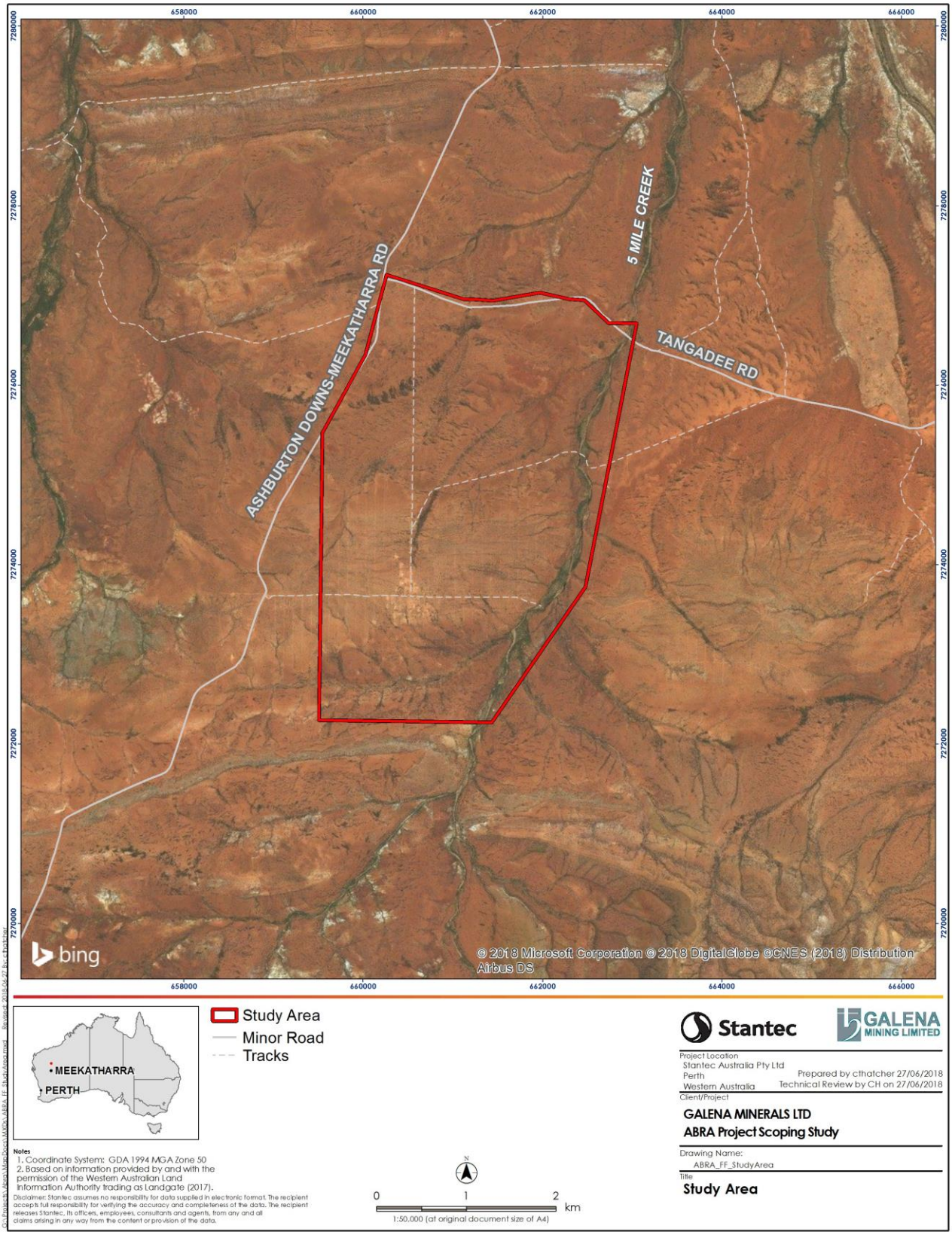


Figure 1-2: The Study Area

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**).

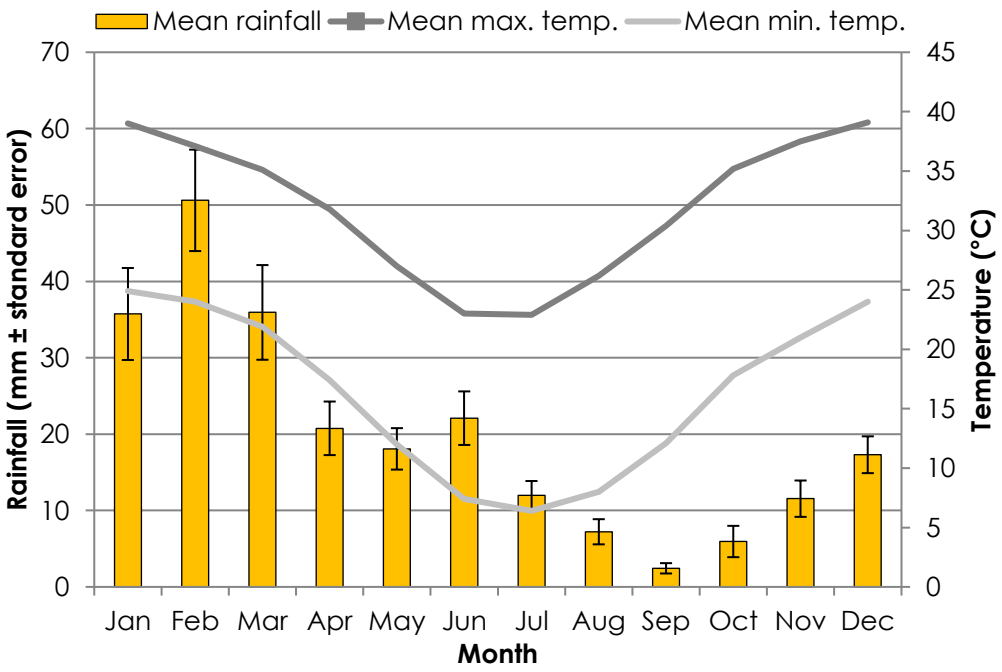


Figure 2-1: Mean maximum and minimum temperatures recorded at Newman Aero (007176) and mean rainfall recorded at Neds Creek (007103) (BoM 2018).

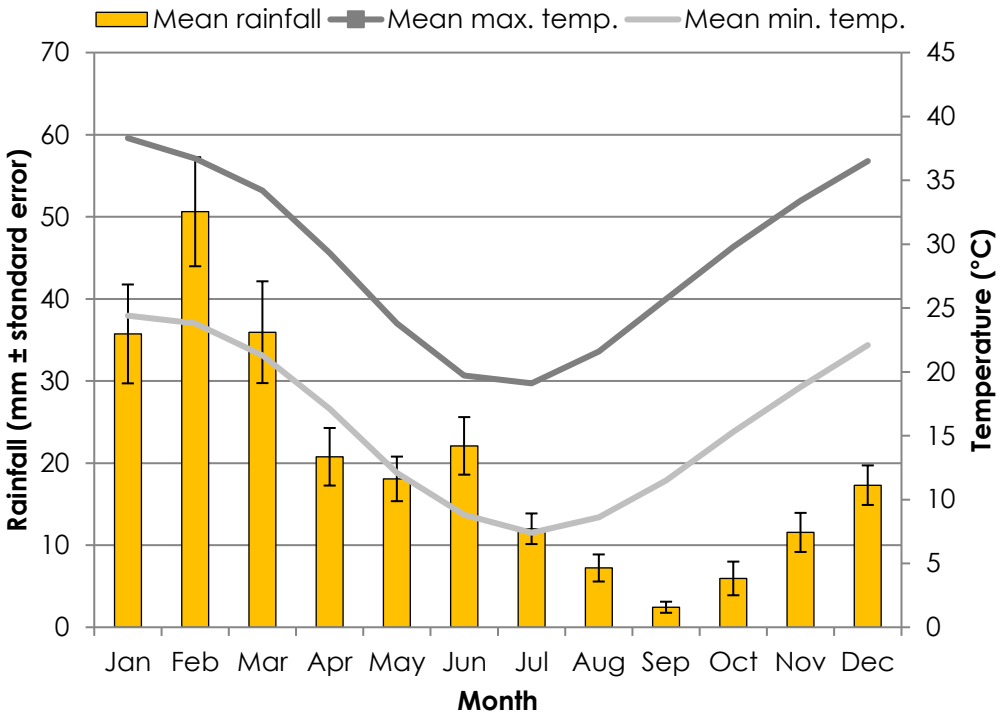


Figure 2-2: Mean maximum and minimum temperatures recorded at Meekatharra Airport (007045) and mean rainfall recorded at Neds Creek (007103) (BoM 2018).

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 Mulgul 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^2 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
Total		**1357**	**100**

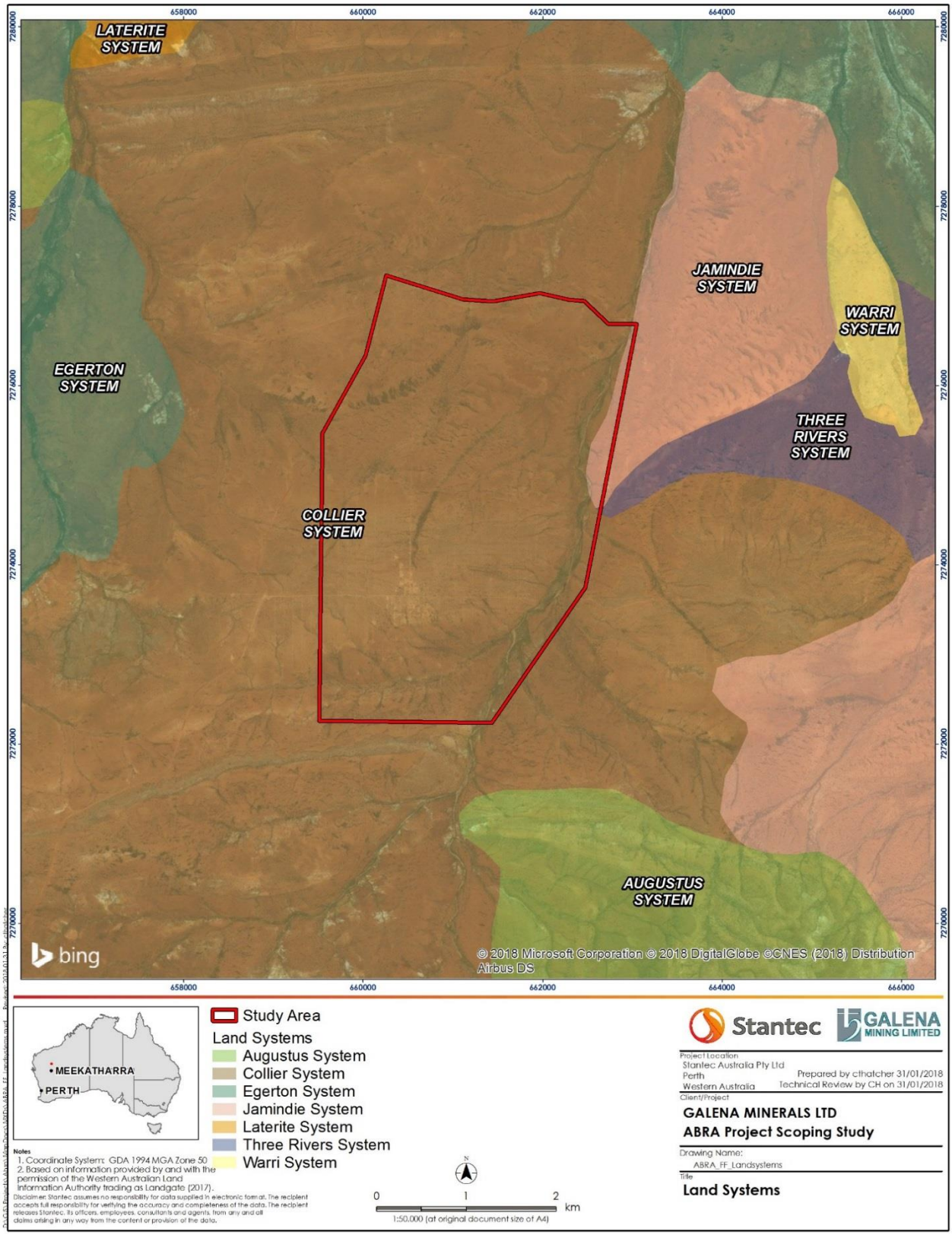


Figure 2-3: Land systems within and surrounding the Study Area

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 (*Acacia aneura*)
	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	-	-

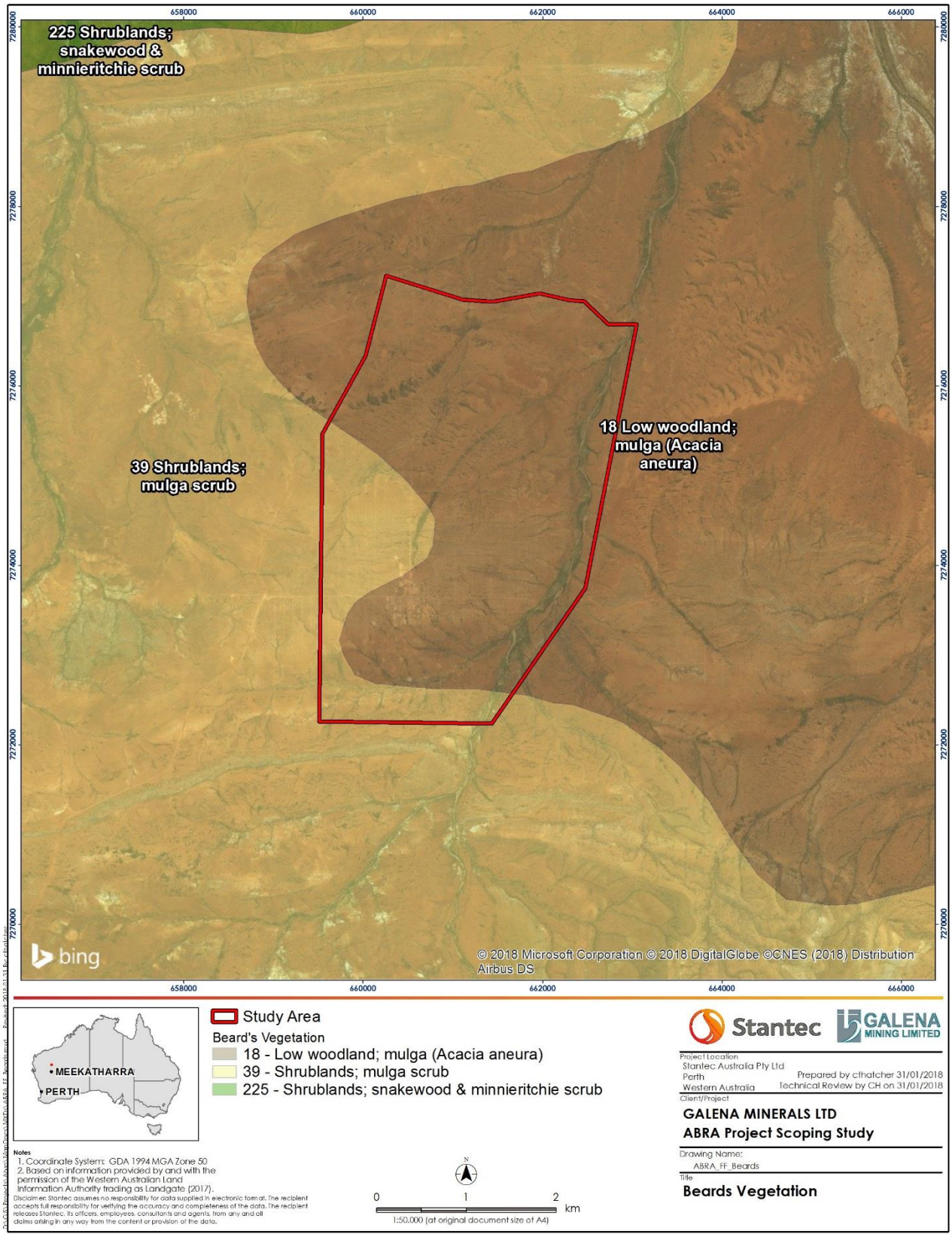


Figure 2-4: Pre-European vegetation associations of the Project Area

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)	Location: Fortnum Project, 40km northwest of Peak Hill Study Type: Level 1 survey Survey Date: 28-30 September 1988	78.9km south of Study Area	N/A	Taxa: 59 Families:- Genera:-	N/A	None.
(Outback Ecology 2007)	Location: Mining tenement M52/766; exploration tenement E52/1455. Study Type: Level 2 survey for M52/766 and level 1 reconnaissance survey for E52/1455. Survey Date: 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)	Location: North-east of Newman – includes a rail corridor Study Type: Level 2 survey Survey date: October 2010 and March 2011	Approximately 205 km north-east of the Study Area	Forty one (41) vegetation formations were identified, comprised broadly of: • Hummock Grasslands • Acacia forests and woodlands • Acacia open woodlands • Acacia shrublands • Other shrublands • Eucalypt woodlands • Tussock grasslands • Grasslands.	Taxa: 340 Families: 46 Genera: 147	Very Good to Pristine (96% of vegetation was considered as Excellent to Pristine)	None.
Desmond *et al.* (2001)	Location: Augustus subregion Study Type: Government report (overview of priority flora in Augustus subregion) Survey Date: Published 2001	Regional assessment	• N/A	N/A	N/A	• *Acacia wilcoxii* (P1); • *Eremophila arguta* (P1); • *Eremophila flaccida* subsp. *attenuata*; • *Eremophila gracillima* (P3); • *Eremophila lanata* (P3); • *Eremophila prolata* (P1); • *Eremophila rigida* (P3); • *Goodenia berringbinensis* (P4); • *Hemigenia pachyphylla* (P1); • *Homalocalyx chapmanii* (P2); • *Pityrodia augustensis* (VU); • *Ptilotus luteolus* (P3); • *Ptilotus lazaridis* (P3); • *Ptilotus trichocephalus* (P4); • *Rhodanthe frenchii* (P2) and • *Stylidium weeliwolli* (P3).

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)	Location: Mining tenement M52/776. Study Type: Level 1 survey. Survey Date: 26-30 June 2006	• Within Study Area	Four fauna habitats were identified: • Hills and Ridges; • Stony Uplands; • Stony Plains and • Drainage lines.	41 taxa including: • 31 families • 37 genera	• Western Pebble-mound Mouse (P4, disused mounds recorded)
Dames and Moore (1988)	Location: Fortnum Project, 40km northwest of Peak Hill Study Type: Level 1 survey Survey Date: 28-30 September 1988	• 78.9km south of Study Area	Two fauna habitats were identified: • Low Mulga Woodland on Hills; and • Sparse Mulga Woodland on Plains.	53 taxa including: • 38 families • 47 genera	• Western Pebble-mound Mouse (P4, disused mounds recorded)
Desmond *et al.* (2001)	Location: Augustus subregion Study Type: Government report (overview of priority fauna in Augustus subregion) Survey Date: Published 2001	• Overview of Augustus subregion	Habitats associated with priority fauna include: • Low Mulga Woodland; • Open Mulga Woodland; • Sparse, low Mulga Woodland; • Mulga Scrublands; • Hummock Grassland (Mulga and *Eucalyptus* over *Triodia*)	6 taxa including: • 6 families • 6 genera	• Crest-tailed Mulgara (Vu, P4) • Bilby (Vu, S3) • Peregrine Falcon (S7) • Princess Parrot (Vu, P4) • Yinnietharra Rock Dragon (Vu, S3)
Phoenix (2017)	Location: Beyondie Potash Project Study Type: Level 2 survey including systematic trapping, motion cameras, bat recording units, and targeted searches Survey Date: 13-23 April 2015	• 170km east of Study Area	Ten fauna habitats were identified: • Shrubland and Grassland on Sandplain; • Woodland on Stony Plain; • Salt Lake; • Rocky Hill; • Shrubland and Grassland Mosaic on Sandplain and Dune; • Shrubland and Grassland on Dune; • Freshwater Lake; • Creek and Drainage Line; • Shrubland and Grassland on Calcrete; and • Woodland on Dune.	128 taxa including: • 55 families • 98 genera	• Brush-tailed Mulgara (P4) • Bilby (Vu, S3) • Northern Marsupial Mole (P4) • *Lerista macropisthopus remota* (P2)

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 28th May and 1st 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**).

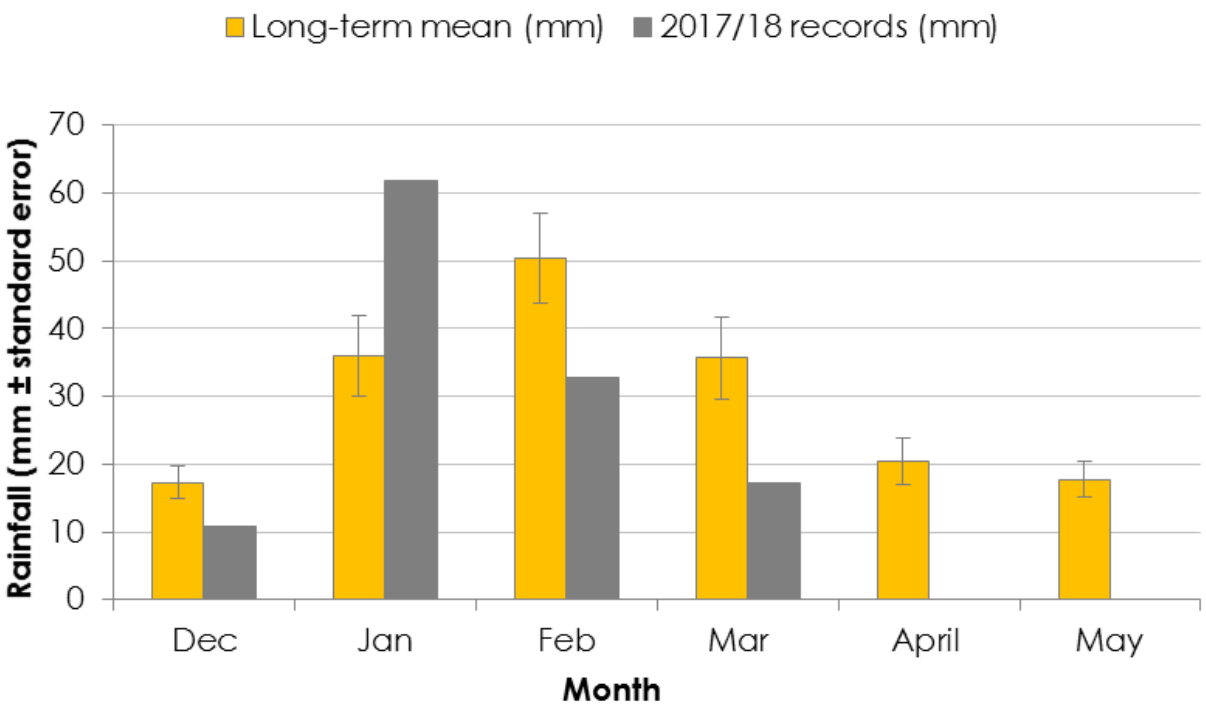


Figure 4-1: Long-term mean monthly rainfall (1947 to 2018) at Ned Creek weather station (007103), commencing five months preceding the flora, fauna and vegetation survey (April) and 6 months preceding the additional fauna survey (May).

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 m². 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 a 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.

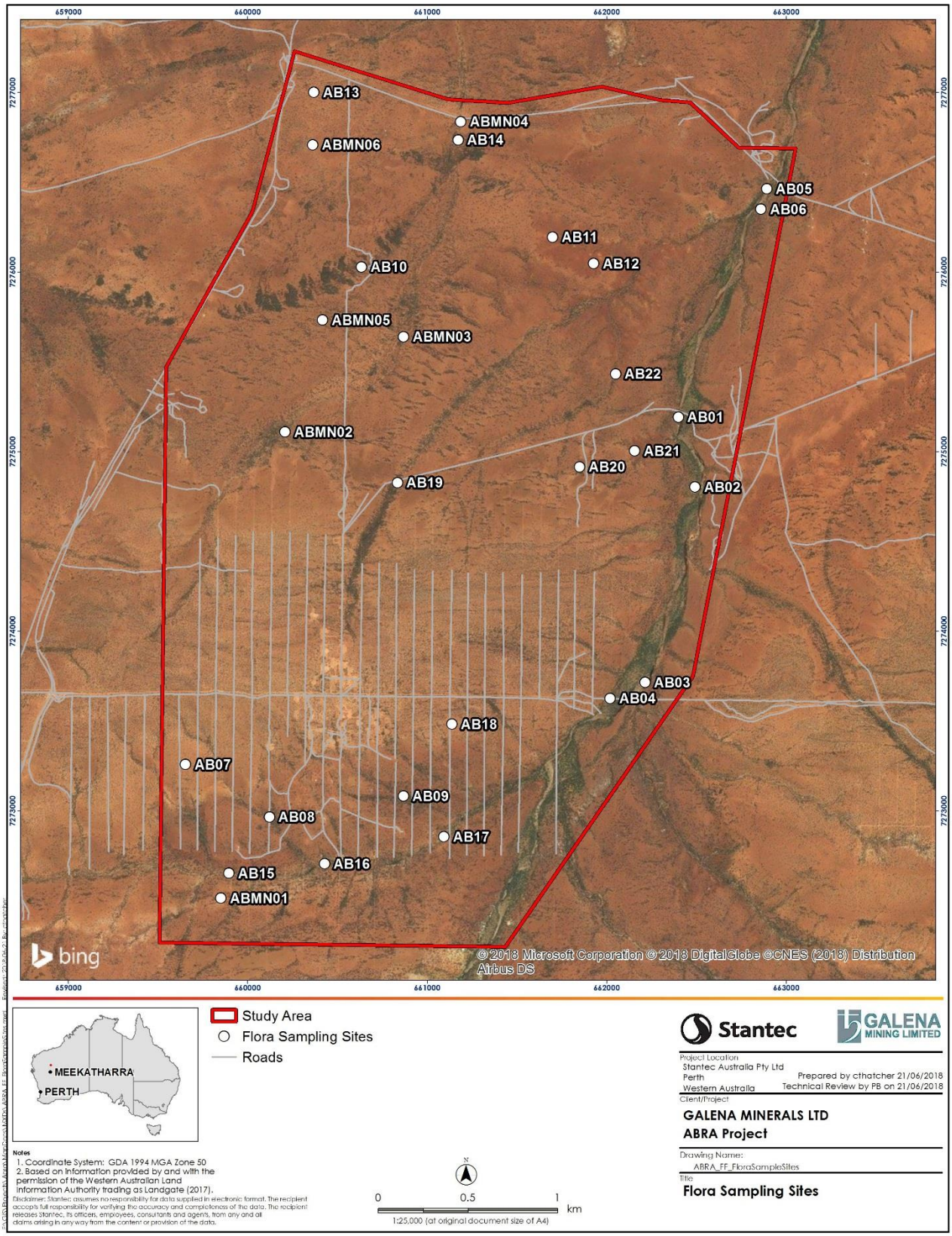


Figure 4-2: Location of flora sampling sites

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 also 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

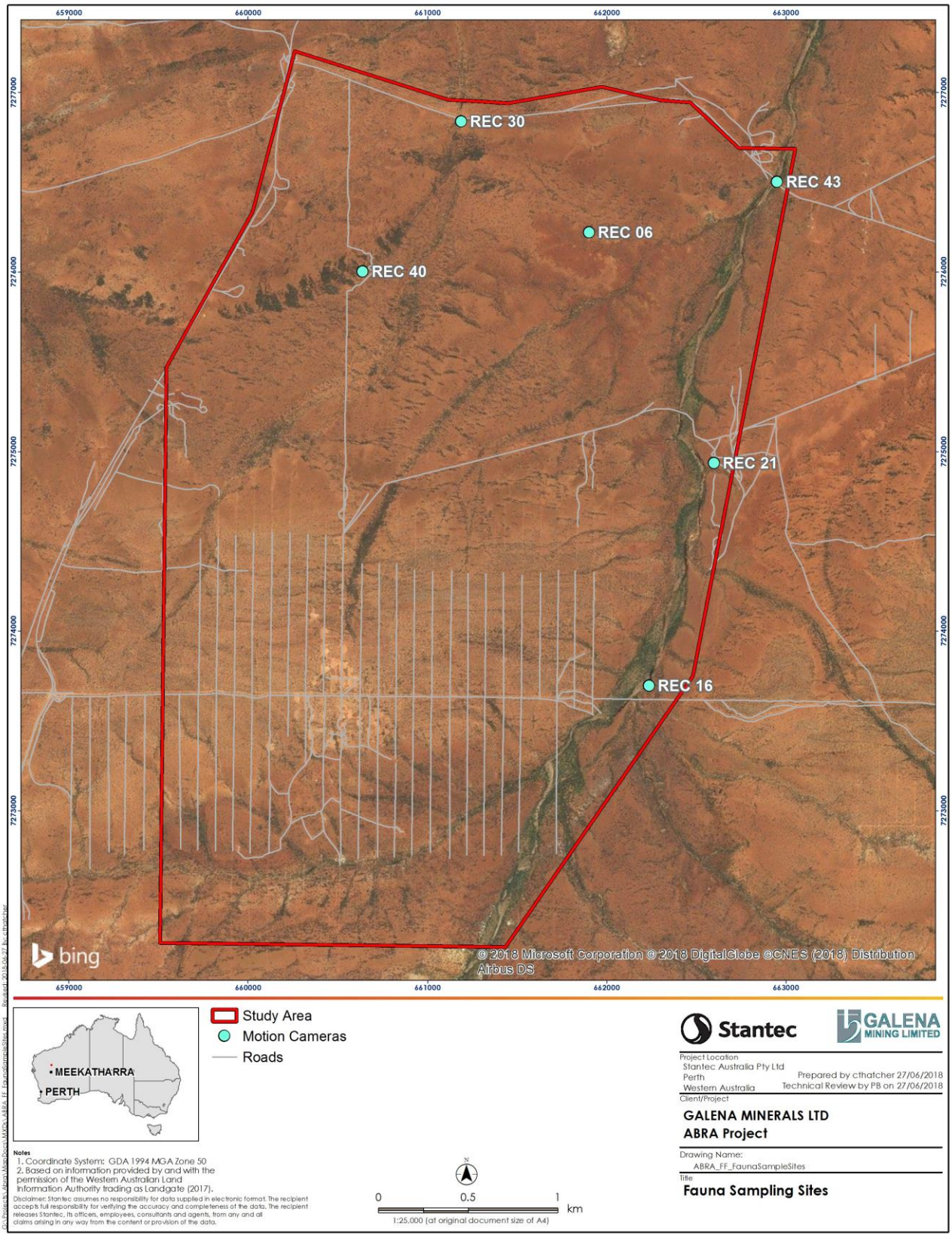


Figure 4-3: Location of motion cameras within the Study Area

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 approximately150 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 3.2**).

The 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) 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 3.2**)

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 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 5-1**).

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

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

1= 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 genus (**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**
Acacia	16
Senna	7
Eremophila	7

5.2.1.2 Flora of Conservation Significance

Despite extensive sampling and targeted searching no state or Commonwealth listed Threated 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 ectinocladus* (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 considered to be 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).

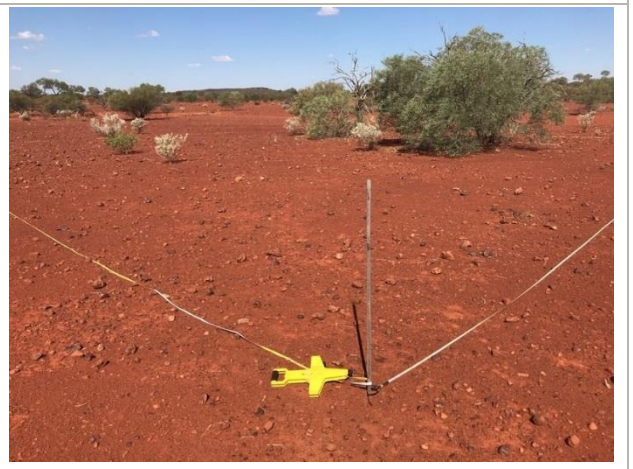
Plate 5-2: **Bidens bipinnata* and **Malvastrum americanum*

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 *Acacai* 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 recroded in the Survey Area

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

Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
EvAcTrcCaEa	Vegetation Description: *Eucalyptus victrix* and *Acacia citrinoviridus* woodland to open tall woodland over *Tephrosia rosea* var. *clementii* low shrubland over *Cymbopogon ambiguus* and *Eulalia aurea* very open tussock grassland Associated Species: *Abutilon cryptopetalum*, *Acacia tetragonophylla*, **Bidens bipinnata*, *Cleome viscosa*, *Dipteracanthus australasicus* subsp. *australasicus*, *Duperraya commixta*, *Evolvulus alsinoides* var. *villosicalyx*, *Glycine canescens*, **Malvastrum americanum*, *Rhynchosia minima*, *Sida* sp. spiciform panicles (E. Leyland 14/08/90), *Solanum sturtianum*, *Sporobolus australasicus*, *Stemodia viscosa* and *Themeda triandra*.	AB01 AB03 AB05	25.8	2	

Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
AcApTrcCc Sah	Vegetation Description: *Acacia citrinoviridis* open tall shrubland to open low woodland over *Acacia pyrifolia* open shrubland over *Tephrosia rosea* var. *clementii, Corchorus crozophorifolius* and *Senna artemisiodes* subsp. *helmsii* low shrubland Associated Species: *Acacia sclerosperma* subsp. *sclerosperma*, *Acacia tetragonophylla*, *Androcalva loxophylla*, *Aristida contorta*, *Cleome viscosa*, *Cymbopogon ambiguus*, *Dipteracanthus australasicus* subsp. *australasicus*, *Duperreya commixta*, *Eremophila fraseri* subsp. *fraseri*, *Eriachne benthamii*, *Indigofera monophylla*, *Paraneurachne muelleri*, *Pterocaulon ?sphaeranthoides*, *Ptilotus obovatus*, *Senna artemisioides* subsp. *filifolia*, *Senna artemisioides* subsp. *helmsii*, *Setaria dielsii*, *Sida* sp. spiciform panicles (E. Leyland 14/08/90) and *Solanum lasiophyllum*.	AB02 AB04 AB06	66.2	5	

Vegetation type code	Vegetation Type Description	Quadrats, Relevés & Mapping Notes	Extent		Representative Photograph
			Hectares	Proportion of Survey Area (%)	
AcAcPlSspScHs	Vegetation Description: *Acacia citrinoviridis* (*Grevillea berryana*) low woodland over *Acacia citrinoviridis* and *Psydrax latifolia* (*Acacia aneura* and *Acacia ?ramulosa* var. *ramulosa*) tall shrubland over *Sida* ?sp. spiciform panicles (E. Leyland 14/08/90), *Senna cuthbertsonii* and *Hibiscus sturtii* var. *forrestii*) open shrubland to shrubland *Associated Species:* *Acacia incurvaneura, Acacia kempeana, Eremophila forrestii* subsp. *?forrestii, Eriachne benthamii, Indigofera chamaeclada, Sida ?ectogama* and *Sida* sp. Golden calyces glabrous (H.N. Foote 32).	AB22 AB08 AB09 AB19 ABMn02 ABMn03 ABMn04	134.58	10	
AcCfEbEmTt	Vegetation Description: *Acacia citrinoviridis* and *Corymbia ?ferriticola* open low woodland over *Eriachne benthamii, Eriachne mucronata* and *Themeda triandra* very open tussock grassland. Associated Species: *Acacia aneura*, *Eremophila exilifolia*, *Hibiscus sturtii* var. *forrestii*, *Mirbelia rhagadioides*, *Psydrax latifolia*, *Senna cuthbertsonii* and *Senna glaucifolia*.	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/ GbArrExEjjEm	Vegetation Description: Mosaic vegetation type of GbArrAiEf/GbArrExEjjEm This vegetation included a dense network of mulga groves (*Acacia aneura* complex) and plains that occurred on a scale too fine to capture on the mapping.	ABMn05	530.6	39	
GbArrExEjjEm	Vegetation Description: *Grevillea berryana* open low woodland over *Acacia ?ramulosa* hybrid *open* shrubland to tall open shrubland over Eremophila exilifolia and *Eremophila jucunda* subsp. *jucunda* low shrubanld over *Eriachne mucronata* very open tussock grassland to open tussock grassland. Associated Species: *Fimbristylis dichotoma*, *Neurachne minor*, *Ptilotus schwartzii*, *Sida* sp. Golden calyces glabrous (H.N. Foote 32) and *Solanum lasiophyllum*.	AB07 AB13 AB18 ABMn06 ABMn01	492.5	36	

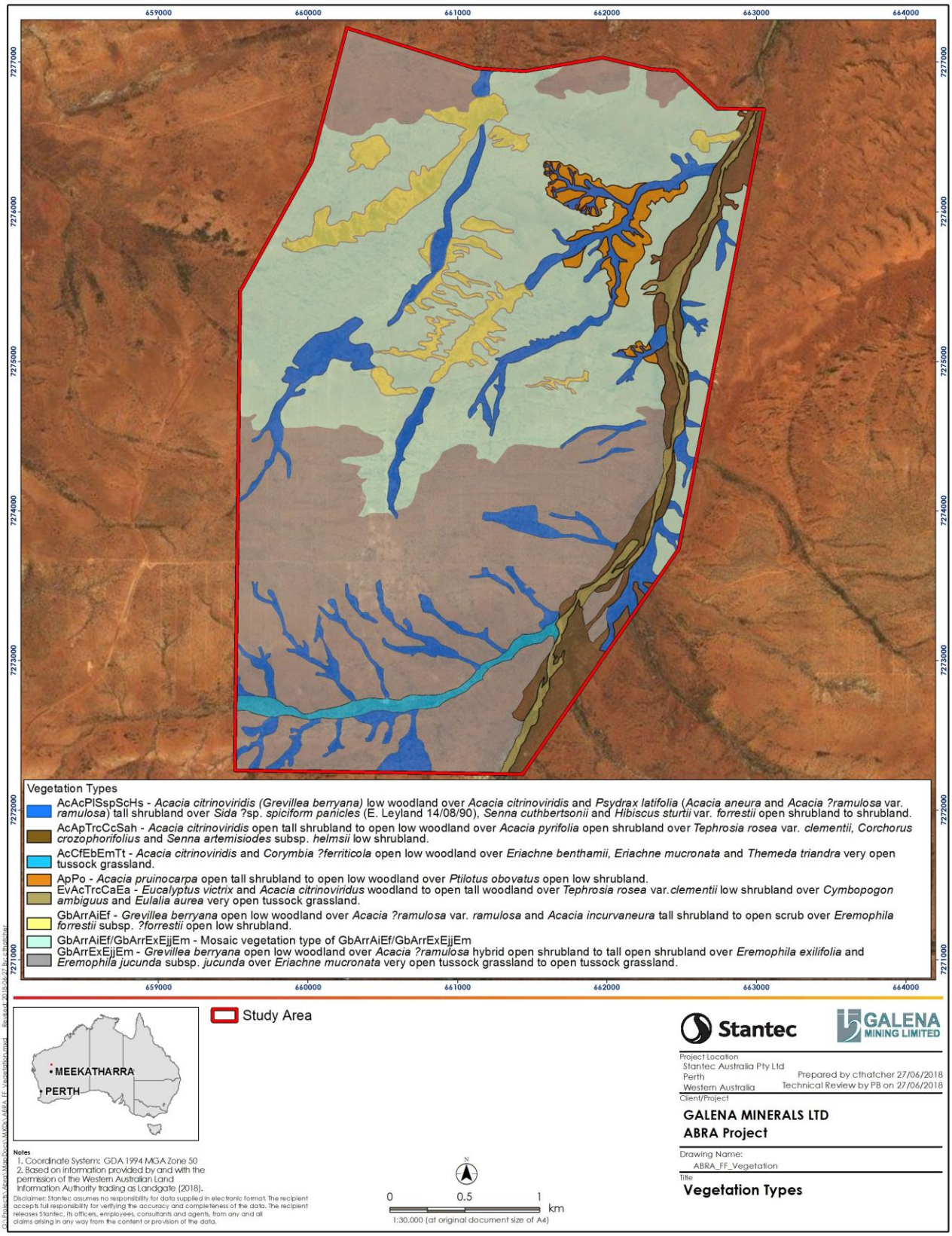


Figure 5-1: Vegetation types identified in the Study Area

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 considered to be 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 bipnnata* and **Malvastrum amercanum*, 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.

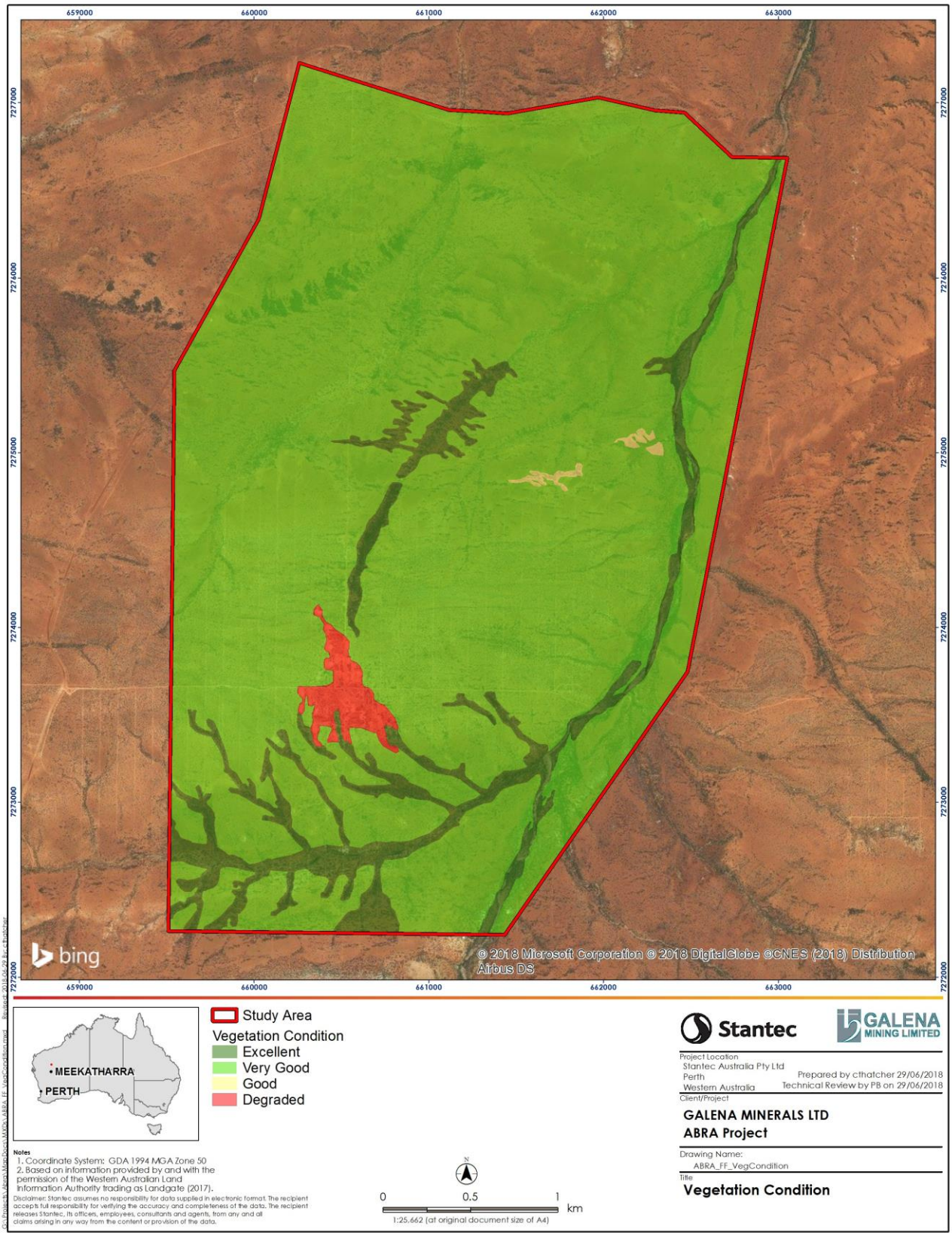


Figure 5-2: Vegetation condition within the Study Area

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 • Widespread • Limited significance	65.0	5	GbArrAiEf	Good – Excellent	Comprised a relatively dense *Acacia* sp. shrubland including *Acacia ?ramulosa* var. *ramulosa* and *Acacia incurvaneura*, under *Grevillea berryana* woodland, over an open layer of *Eremophila forrestii* 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. 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.	
Open shrubland on stony plain • Widespread • Limited significance	1023.2	75	GbArrExEjjEm GbArrAiEf/ GbArrExEjjEm	Degraded – Very Good	Varied from open stony plains with a sparse cover of low shrubs and tussock grasses to areas comprising open *Grevillea berryana* and *Acacia ?ramulosa* hybrid over open *Eremophila exilifolia, Eremophila jucunda* subsp. *jucunda* and sparse tussock grasses. Some areas of this habitat contained dense networks of mulga groves (*Acacia aneura* 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. 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.	
Riparian • Widespread • Significant	25.8	2	EvAcTrcCaEa	Excellent	The Riparian habitat included a major drainage along the East boundary of the Study Area. This contained an upper storey of tall *Eucalyptus victrix* and *Acacia citrinoviridis* over *Tephrosia rosea* var. *clementii* and tussock grasses including *Cymbopogon ambiguous* and *Eulalia aurea*. The Riparian habitat contained elatively 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 *Eucalyptus victrix* trees. 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	

Habitat type	Proportion of Study Area		Veg. units	Condition	Value to fauna	Reference Photographs
	ha	%				
					species. Tall Eucalyptus 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 courses and is assessed as possibly occurring within the Study Area (**section 5.2.3.3**). .	
Drainage • Widespread • Limited significance	219.2	16.2	AcAcPlSspScHs AcApTrcCcSah AcCfEbEmTt	Very Good – Excellent	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 *Acacia citrinoviridis, Acacia aneura, Psydrax latifolia* and *Acacia pyrifolia*, over tussock grasses and low vegetation such as Senna sp., *Hibiscus sturtii* var. *forrestii*, Sid sp. and Tephrosia sp.. Drainage areas tended to contain leaf litter and woody debris, and in some areas clay boundaries formed small crevices. 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.	 
Gully • Widespread • Limited significance	23.4	2	ApPo	Good – Very Good	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 *Acacia pruinocarpa* over low shrubs such as *Ptilotus obovatus*. 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. 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.	  

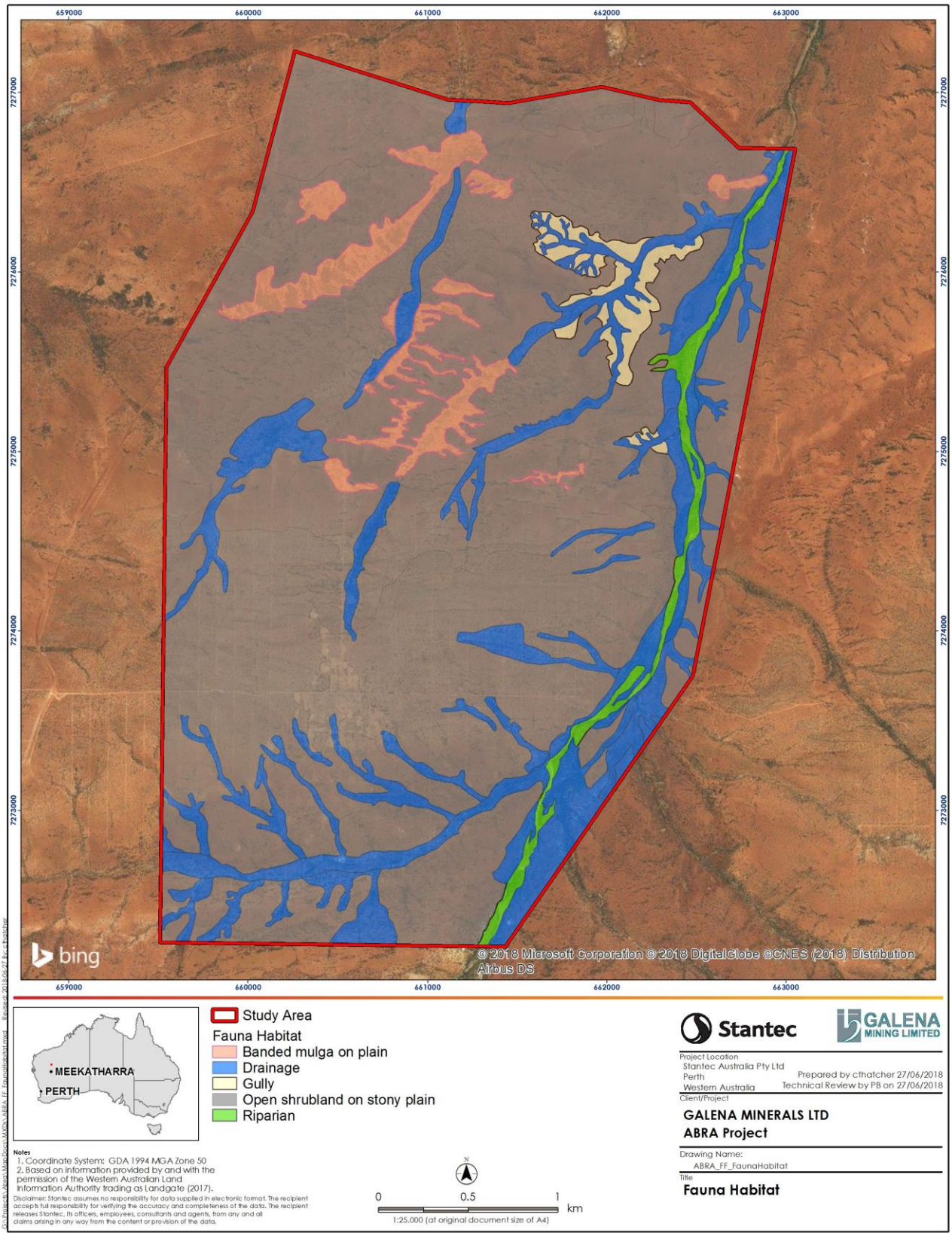


Figure 5-3: Broad fauna habitats identified within the Study Area

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 were 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
Bos taurus	*European Cattle		
Canis familiaris	*Dog		
Felis catus	*Cat		
Osphranter rufus	Red Kangaroo		
Acanthiza apicalis	Inland Thornbill		
Gerygone fusca	Western Gerygone		
Artamus cinereus	Black-faced Woodswallow		
Eurostopodus argus	Spotted Nightjar		
Ocyphaps lophotes	Crested Pigeon		
Phaps chalcoptera	Common Bronzewing		
Corvus orru	Torresian Crow		
Cracticus nigrogularis	Pied Butcherbird		
Cracticus tibicen	Australian Magpie		
Taeniopygia guttata	Zebra Finch		
Falco cenchroides	Australian Kestrel		
Gavicalis virescens	Singing Honeyeater		
Oreoica gutturalis	Crested Bellbird		
Melanodryas cucullata	Hooded Robin		
Colluricincla harmonica	Grey Shrike-thrush		
Platycercus varius	Mulga Parrot		
Platycercus zonarius	Australian Ringneck		
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush		
Rhipidura leucophrys	Willie Wagtail		
Gehyra variegata			
Ctenophorus caudicinctus mensarum			
Litoria rubella	Little Red Tree Frog		
Cyclorana maini	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 (*Scientific name*)	Conservation status		Broad habitat type	**Likelihood of occurrence** Reason for likelihood
	EPBC	WA		
Mammals				
Brush-tailed Mulgara (*Dasycercus blythi*)		P4	Known to inhabit spinifex grasslands (van Dyck and Strahan 2008).	**Unlikely** 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 (*Dasycercus cristicauda*)	Vu	P4	Known to inhabit open sand dunes with limited canegrass cover and near salt lakes with Nitre Bush (van Dyck and Strahan 2008).	**Unlikely** Although two species of Mulgara are known to occur in Australia, it is now recognised that only the Brush-tailed Mulgara (*Dasycercus blythi*) (Priority 4 DBCA) occurs within Western Australia (DoEE 2018, (DoEE 2018b, van Dyck and Strahan 2008). The Crest-tailed Mulgara (*Dasycercus cristicauda*) (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 (*Dasyurus hallucatus*)	En	S2	Favour rocky habitats, also found in eucalyptus woodlands and forests and near settlements (van Dyck and Strahan 2008).	**Unlikely** 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 (*Macrotis lagotis*)	Vu	S3	Patchily distributed in the northern arid to semi-arid regions (van Dyck and Strahan 2008).	**Unlikely** 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 (*Notoryctes caurinus*)		P4	Sand dune deserts, particularly the Great and Little Sandy Deserts (van Dyck and Strahan 2008).	**Unlikely** 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 (*Pseudomys chapmanii*)		P4	Gentle rocky spinifex slopes (van Dyck and Strahan 2008).	**Unlikely** 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 (*Rhinonicteris aurantius* Pilbara form')	Vu	S3	Inhabit humid roosts, which occur in rocky gorges or abandoned mine shafts (van Dyck and Strahan 2008).	**Unlikely** 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 (*Macroderma gigas*)	Vu	S3	Inhabits a wide range of habitats, from arid areas of the Pilbara to northern rainforests (van Dyck and Strahan 2008).	**Unlikely** 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.
Birds				
Garganey (*Anas querquedula*)	Mi	S5	Sewage ponds and well vegetated freshwater wetlands (Pizzey and Knight 2007).	**Unlikely** 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 (*Apus pacificus*)	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).	**Unlikely** 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 (*Scientific name*)	Conservation status		Broad habitat type	**Likelihood of occurrence** Reason for likelihood
	EPBC	WA		
Oriental Plover (*Charadrius veredus*)	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).	**Unlikely** 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 (*Falco peregrinus*)		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).	**Possible** 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 (*Hirundo rustica*)	Mi	S5	Open areas, particularly near water, such as agricultural land, also in urban areas and rail yards (Pizzey and Knight 2007).	**Unlikely** 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 (*Motacilla flava*) and Grey Wagtail (*Motacilla cinerea*)	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).	**Unlikely** 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.

Common name (*Scientific name*)	Conservation status		Broad habitat type	**Likelihood of occurrence** Reason for likelihood
	EPBC	WA		
Night Parrot (*Pezoporus occidentalis*)	En	S1	Known to inhabit treeless or sparsely wooded long unburnt spinifex hummock plains often interspersed with chenopods (Pyke and Ehrlich 2014).	**Unlikely** 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 (*Polytelis alexandrae*)	Vu	P4	Areas with spinifex or near succulents around salt lakes, usually far from freshwater (Pizzey and Knight 2007).	**Unlikely** 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.
Sandpipers, stints and greenshanks from the family *Scolopacidae*.	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).	**Unlikely** 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.
Reptiles				
Yinnietharra Rock Dragon (*Ctenophorus yinnietharra*)	Vu	S3	Low weathered granite outcrops; basks on low rocks and shrubs (Wilson and Swan 2013).	**Unlikely** 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.) *Lerista macropisthopus remota*		P2	Acacia shrublands and woodlands in semi-arid and arid areas (Wilson and Swan 2013).	**Unlikely** 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 (*Liasis olivaceus barroni*)	Vu	S3	Gorges and escarpments, often associated with water (Wilson and Swan 2013).	**Unlikely** 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 a number of 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	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 (Section 3.2). 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. 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. All vertebrate fauna encountered were identified and habitats were assessed for their importance to vertebrate fauna and fauna of conservation significance.

Factor	Constraint	Comments
Information sources (e.g. historic or recent)	Partial	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 took into account 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 took into account large search areas i.e. up to 100 km. Regional contextual information was also obtained from 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 wider region.
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 28th May and 1st 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 **Section 5.2.2.1**.
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 considered to be 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
Critically Endangered	**Cr**	Taxa that is considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	**En**	Taxa that is considered to be facing a very high risk of extinction in the wild in the near future
Vulnerable	**Vu**	Taxa that is considered to be facing a high risk of extinction in the wild in the medium-term future
Migratory	**Mi**	Species that migrate to, over and within Australia and its external territories

Schedules used under the BC Act			Description
Status	Code	Schedule	
Critically Endangered	**Cr**	**S1**	Taxa that is rare or likely to become extinct, as critically endangered taxa
Endangered	**En**	**S2**	Taxa that is rare or likely to become extinct, as endangered taxa
Vulnerable	**Vu**	**S3**	Taxa that is rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	**Ex**	**S4**	Taxa that is presumed to be extinct
Migratory	**Mi**	**S5**	Birds that are subject to international agreements relating to the protection of migratory birds
Conservation Dependent	**CD**	**S6**	Taxa that are of special conservation need being species dependent on ongoing conservation intervention
Special Protection	**SP**	**S7**	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						
Pityrodia augustensis	VU	VU	T	Amongst rocks on slopes or in drainage lines.	Perennial	~111.8	**Unlikely:** The Study Area lies outside of the known distribution for this species.	-	DBCA (2017b) Desmond *et al.* (2001)
Acacia wilcoxii			1	Granitic soils. Along creeks & adjacent stony plains & granite outcrops.	Perennial	44	**Unlikely:** No granite outcrops are known to occur in the study area.	-	DBCA (2017b) Desmond *et al.* (2001)
Eremophila appressa			1	Ironstone gravel. Ridge slopes.	Perennial	~115.89	**Unlikely:** The Study Area lies outside of the known distribution for this species.	Apr. to Oct.	DBCA (2017b)
Eremophila arguta			1	The edge of floodplains, in dry creek beds and on road verges.	Perennial	~98	**Possible:** The Study Area lies outside of the known distribution but may contain suitable habitat	Sep.	Desmond *et al.* (2001)
Eremophila humilis			1	Stony clay, loam. Rocky ridges.	Perennial	1.7	**Likely:** The Study Area contains suitable habitat for this species and known records are located within close proximity.	Sep	DBCA (2017b) (DBCA 2018a)
Eremophila prolata			1	Red stony clay. Flats & rises.	Perennial	~90	**Unlikely:** The Study Area lies outside of the known distribution for this species.	Aug. to Sep.	Desmond *et al.* (2001)
Hemigenia pachyphylla			1	-	-	~295	**Unlikely:** The Study Area lies outside of the known distribution for this species.	-	Desmond *et al.* (2001)
Ptilotus actinocladus T.Hammer & R.W.Davis			1	-	-	~150	**Possible:** There is limited information available regarding the distribution and habitat requirements for this species.	-	DBCA (2017b)
Acacia tuberculata			2	Granite outcrops	Perennial	~530	**Unlikely:** 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)
Rhodanthe frenchii			2	Stony hills, rocky river banks & outcrops.	Annual	~180	**Unlikely:** The Study Area lies outside of the known distribution for this species.	Aug. to Oct.	Desmond *et al.* (2001)
Thysanotus 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	**Unlikely:** The Study Area lies outside of the known distribution for this species.	-	DBCA (2017b)
Eremophila coacta			3	Laterite, shale soils. Ironstone hills, creeklines.	Perennial	~96.5	**Possible:** The Study Area lies outside of the known distribution but may contain suitable habitat	-	DBCA (2017b) (DBCA 2018a)
Eremophila flaccida subsp. attenuata			3	Stony clay over quartzite. Hillslopes, ridges.	Perennial	~266	**Unlikely:** The Study Area lies outside of the known distribution for this species.	May	Desmond *et al.* (2001)
Eremophila gracillima			3	Stony flats	Perennial	0.85	**Likely:** The Study Area contains suitable habitat for this species and known records are located within close proximity.		DBCA (2017b) Desmond *et al.* (2001)
Eremophila lanata			3	Stony red clayey sand.	Perennial	~120	**Unlikely:** The Study Area lies outside of the known distribution for this species.	Aug.	Desmond *et al.* (2001)
Eremophila rigida			3	Red sand alluvium. Hardpan plains, stony clay depressions.	Perennial	29	**Possible:** The Study Area lies outside of the known distribution but may contain suitable habitat	Sep.	DBCA (2017b) DoEE (2018a) Desmond *et al.* (2001)
Owenia acidula			3	Clay plains.	Perennial	~470	**Unlikely:** The Study Area lies outside of the known distribution for this species.	Aug.	DBCA (2017b), (DBCA 2018a)
Ptilotus lazaridis			3	Clay loam. Floodplains.	Perennial	~62	**Unlikely:** The Study Area does not contain suitable habitat for this species.	Jul., Oct.	Desmond *et al.* (2001)

Species	Conservation Code			Habitat	Life form	Nearest known locality (km)	Reason of Likelihood	Flowering time	Source
	EPBC Act	BC Act	DBCA						
Ptilotus luteolus			3	Rocky slopes, screes and ridges.	-	~180	**Unlikely:** The Study Area lies outside of the known distribution for this species.	-	Desmond *et al.* (2001)
Stylidium weeliwolli			3	Gritty sand soil, sandy clay. Edge of watercourses.	Annual	~81	**Unlikely:** The Study Area lies outside of the known distribution for this species.	Aug. to Sep.	Desmond *et al.* (2001)
Ptilotus trichocephalus			4	Sandy soils. Colluvial plains.	Perennial	47	**Unlikely:** The Study Area lies outside of the known distribution for this species.	-	DBCA (2017b) Desmond *et al.* (2001)
Goodenia berringbinensis			4	Red sandy loam. Along watercourses.	Annual	~127	**Unlikely:** 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	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	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 1-2 Mid <1 Low	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
chenopod shrub	>2 Tall 1-2 Mid <1 Low	closed chenopod shrubland	chenopod shrubland	open chenopod shrubland	sparse chenopod shrubland	isolated chenopod shrubs	isolated clumps of chenopod shrubs	chenopod shrubs
samphire shrub	>0.5 Mid <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 <2 Low	closed hummock grassland	hummock grassland	open hummock grassland	sparse hummock grassland	isolated hummock grasses	isolated clumps of hummock grasses	hummock grasses
tussock grass	>0.5 Mid <0.5 Low	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	>0.5 Mid <0.5 Low	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	>0.5 Mid <0.5 Low	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	>0.5 Mid <0.5 Low	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	>0.5 Mid <0.5 Low	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	>2 Tall 1-2 Mid <1 Low	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumpsof ferns	ferns

Growth Form	Height ranges (m)	Structural Formation Classes						
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 10-30 Mid <10 Low	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines
aquatic	<1 Tall 0-0.5 Low	closed aquatic bed	aquatic bed	open aquatic bed	sparse aquatics	isolated aquatics	isolated clumps of aquatics	aquatics
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	*Dipteracanthus australasicus* subsp. *australasicus*
	Alternanthera nodiflora
Amaranthaceae	*Ptilotus obovatus*
	Ptilotus schwartzii
Asteraceae	**Bidens bipinnata*
	Centipeda minima subsp. *macrocephala*
	Pluchea dentex
	Pterocaulon sphaeranthoides
	Pterocaulon sp.
Caryophyllaceae	*Polycarpaea corymbosa*
	Polycarpaea longiflora
Chenopodiaceae	*Dysphania rhadinostachya* subsp. *inflata*
	Salsola australis
	Sclerolaena cornisheana
	Maireana sp.
Cleomaceae	*Cleome viscosa*
Convolvulaceae	*Duperreya commixta*
	Evolvulus alsinoides var. *villosicalyx*
Cyperaceae	*Cyperus rigidellus*
	Fimbristylis dichotoma
	Cyperaceae sp.
	Cyperus sp.
Euphorbiaceae	*Euphorbia biconvexa*
	Euphorbiaceae sp.
Fabaceae	*Acacia ?aptaneura*
	Acacia ?ramulosa hybrid
	Acacia ?ramulosa var. *ramulosa*
	Acacia acradenia
	Acacia aneura
	Acacia ayersiana
	Acacia citrinoviridis
	Acacia incurvaneura
	Acacia kempeana
	Acacia pruinocarpa
	Acacia pyrifolia
	Acacia ramulosa var. *linophylla*
	Acacia rhodophloia
	Acacia sclerosperma subsp. *sclerosperma*
	Acacia sibirica
	Acacia tetragonophylla

Family	Species
	Glycine canescens
	Indigofera chamaeclada
	Indigofera monophylla
	Mirbelia rhagadioides
	Rhynchosia minima
	Senna artemisioides subsp. *filifolia*
	Senna artemisioides subsp. *helmsii*
	Senna artemisioides subsp. *oligophylla*
	Senna cuthbertsonii
	Senna glaucifolia
	Senna glutinosa subsp. *pruinosa*
	Senna stricta
	Tephrosia rosea var. *clementii*
	Acacia sp.
	Senna sp.
Goodeniaceae	*Goodenia* sp.
Malvaceae	*Abutilon cryptopetalum*
	Androcalva loxophylla
	Corchorus crozophorifolius
	Hibiscus sturtii var. *forrestii*
	**Malvastrum americanum*
	Melhania oblongifolia
	Sida ?ectogama
	Sida ?sp. spiciform panicles (E. Leyland 14/08/90)
	Sida sp. Golden calyces glabrous (H.N. Foote 32)
	Abutilon sp.
	Hibiscus sp.
	Malvaceae sp.
Marsileaceae	*Marsilea hirsuta*
Myrtaceae	*Corymbia ?ferriticola*
	Corymbia candida subsp. *?dipsodes*
	Eucalyptus victrix
	Thryptomene decussata
Nyctaginaceae	*Boerhavia coccinea*
Plantaginaceae	*Stemodia viscosa*
Poaceae	*Aristida contorta*
	Cymbopogon ambiguus
	Enneapogon robustissimus
	Eragrostis ?elongata
	Eragrostis cumingii
	Eriachne benthamii
	Eriachne mucronata

Family	Species
	Eriachne pulchella
	Eulalia aurea
	Neurachne minor
	Paraneurachne muelleri
	Perotis rara
	Setaria dielsii
	Sporobolus australasicus
	Themeda triandra
	Trichodesma zeylanicum
	Triodia basedowii
	Triodia pungens
	Poaceae sp.
	Setaria sp.
Portulacaceae	*Portulaca oleracea*
Proteaceae	*Grevillea berryana*
	Grevillea stenobotrya
Pteridaceae	*Cheilanthes* sp.
Rubiaceae	*Psydrax latifolia*
	Psydrax suaveolens
Santalaceae	*Santalum ?lanceolatum*
Sapindaceae	*Dodonaea petiolaris*
	Dodonaea viscosa
Scrophulariaceae	*Eremophila exilifolia*
	Eremophila forrestii subsp. *?forrestii*
	Eremophila fraseri subsp. *fraseri*
	Eremophila gielsii subsp. *?variabilis*
	Eremophila jucunda subsp. *jucunda*
	Eremophila latrobei subsp. *?*
	Eremophila latrobei subsp. *latrobei*
	Eremophila sp.
Solanaceae	*Solanum lasiophyllum*
	Solanum sturtianum
Zygophyllaceae	*Tribulus suberosus*

Appendix F Floristic Data - Flora Sampling Sites

Galena Minerals – Abra – AB01

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

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

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

Erosion: -

Introduced species: N/A

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 crozophoifolius* open low heath.

Species List

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

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

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

Erosion: -

Introduced species: **Bidens bipinnata*

Human disturbance: Weeds

FLORA AND VEGETATION DATA

Description:

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

Species List

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

Cleome viscosa	0.4	0.1
Corchorus crozophorifolius	0.5	0.1
Mirbelia rhagadioides	0.1	0.1
Polycarpaea longiflora	0.15	0.1
Abutilon cryptopetalum	0.4	0.1
Abutilon cryptopetalum	0.35	0.1
Sida sp. *spiciform panicles* (E. Leyland 14/08/90)	0.8	0.1
**Bidens bipinnata*	0.15	0.1
Eremophila fraseri subsp. fraseri	0.5	0.1
Sida ? sp. spiciform panicles (E. Leyland 14/08/90)	0.5	0.1
Dipteracanthus australasicus subsp. *australasicus*	0.15	0.1
Eucalyptus victrix	18	15

Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
2	75	2	21

Veg Condition: Excellent

Weeds: **Bidens bipinnata*

Fire Age: 5 to 15 years

Fire Notes: N/A

SITE PHOTOGRAPH

Galena Minerals – Abra – AB04

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

Goodenia sp. *indeterminate*	0.15	0.1
Senna artemisioides subsp. helmsii	0.95	0.1
Acacia sclerosperma subsp. *sclerosperma*	0.8	0.1
Duperreya commixta	0	0.1
Aristida contorta	0.15	0.1
Cymbopogon ambiguus	0.9	0.1
Senna artemisioides subsp. *filifolia*	0.7	0.1
Acacia pyrifolia	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

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

Abutilon cryptopetalum	0.3	0.1
Ptilotus obovatus	0.25	0.1
Sporobolus australasicus	0.1	0.1
Tephrosia rosea var. *clementii*	0.25	0.1
Cleome viscosa	0.15	0.1
Cyperaceae sp indet	0.15	0.1
Evolvulus alsinoides var. *villosicalyx*	0.15	0.1
Rhynchosia minima	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

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 *helsmii* and *Tephrosia roses* subspecies *clementii* low shrubland.

Species List

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

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

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 exilifolia* and *Eremophila jucunda subsp. jucunda* low shrubland over *Eriachne mucronata* open tussock grassland.

Species List

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

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

Acacia incurvaneura	0.8	0.1
Sida sp. *Golden calyces glabrous* (H.N. Foote 32)	0.15	0.1
Acacia rhodophloia	6	0.1

Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
4	5	30	75

Veg Condition: Excellent

Weeds: None

Fire Age: 3 to 5 years

Fire Notes: No fire scar, mature mulga

SITE PHOTOGRAPH

Galena Minerals – Abra – AB09

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

Erosion: -

Introduced species: N/A

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

Hibiscus sturtii var. forrestii	0.9	0.1
Poaceae sp.	0.25	0.1
Euphorbiaceae sp indet	0.15	0.1
Acacia citrinoviridis	5	2
Acacia aneura	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
Acacia acradenia	2.2	0.1
Acacia sibirica	3	20
Grevillea berryana	5	4
Acacia ramulosa var. *linophylla*	3	4
Acacia incurvaneura	5	5
Eremophila forrestii subsp. *? forrestii*	1.2	6
Senna cuthbertsonii	1.1	1.5
Ptilotus obovatus	1.1	0.1
Hibiscus sturtii var. *forrestii*	1.2	0.1
Eremophila sp.	2.3	1
Acacia tetragonophylla	3	1
Acacia citrinoviridis	1.1	0.1
Acacia pruinocarpa	0.9	0.1
Duperreya commixta	0	0.1

Ptilotus schwartzii	0.25	0.1
Maireana sp. *indeterminate*	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
Acacia pruinocarpa	3.5	8
Ptilotus obovatus	0.65	2
Ptilotus schwartzii	0.4	0.1
Acacia kempeana	0.5	0.1
Maireana sp.	0.15	0.1
Senna artemisioides subsp. helmsii	0.4	0.1
Eremophila sp.	0.35	0.1
Hibiscus 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

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

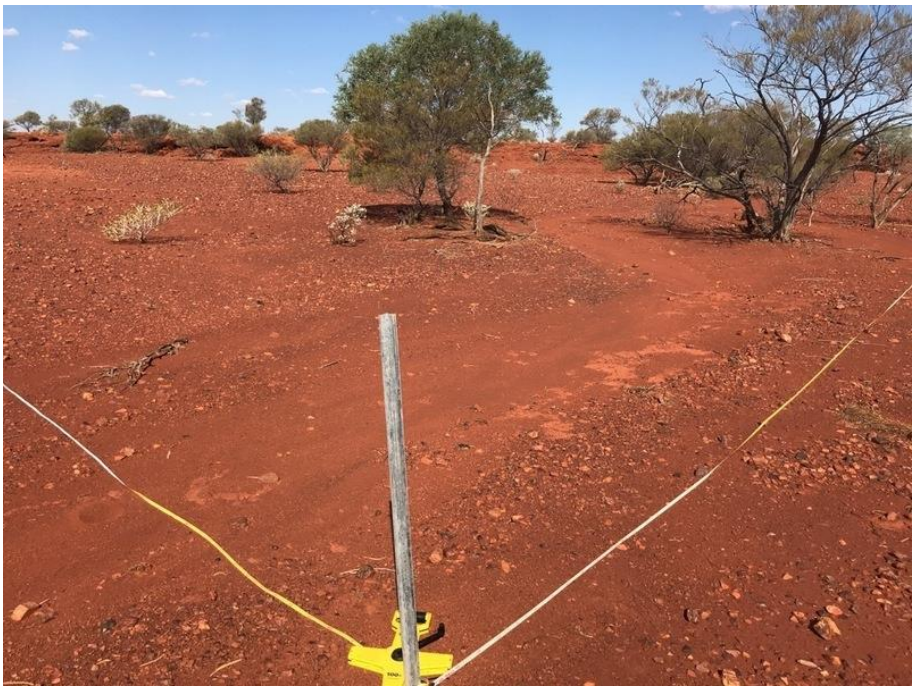
Species	Height	Cover
Acacia pruinocarpa	4	3
Tribulus suberosus	0.5	0.1
Ptilotus obovatus	0.5	0.1
Acacia sp.	4	6
Eremophila sp. indeterminate	0.4	0.1
Senna glutinosa subsp. *pruinosa*	0.8	0.1
Senna sp. indeterminate	1.2	0.1
Acacia kempeana	1.2	0.1

Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	50	0	12

Veg Condition:	Very Good	Fire Age:	3 to 5 years
Weeds:	None	Fire Notes:	No evidence, no scars

SITE PHOTOGRAPH



Galena Minerals – Abra – AB13

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

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

Erosion: -

Introduced species: N/A

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

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

Erosion: -

Introduced species: N/A

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

Acacia incurvaneura	0.7	0.1
Psydrax latifolia	0.8	0.1
Eremophila exilifolia	0.65	0.1
Eremophila sp.	0.65	0.1
Dodonaea petiolaris	0.65	0.1
Senna cuthbertsonii	0.65	0.1
Acacia ? ramulosa 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

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

Erosion: -

Introduced species: N/A

Human disturbance: Feral trampling, Grazing, Tracks

FLORA AND VEGETATION DATA

Description:

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

Species List

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

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

FLORA AND VEGETATION DATA

Description:

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

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

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

Erosion: -

Introduced species: N/A

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

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, *Psydrax 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
Acacia citrinoviridis	7	20
Psydrax latifolia	5	12
Senna cuthbertsonii	0.5	25
Grevillea berryana	8	0.1
Acacia ? ramulosa hybrid	2.5	15
Acacia ? aptaneura	5	6
Eremophila sp.	1.3	5
Triodia basedowii	0.5	5
Acacia kempeana	0.9	0.1
Duperreya commixta	0	0.1
Eremophila gielsii subsp. *? variabilis*	2.5	0.1
Eriachne benthamii	0.3	0.1
Psydrax suaveolens	0.45	0.1

Sida sp. *Golden calyces glabrous* (H.N. Foote 32)	0.5	0.1
Indigofera chamaeclada	0.2	0.1
Fimbristylis dichotoma	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

Erosion: -

Introduced species: N/A

Human disturbance: Feral scats, Feral trampling, Grazing, Tracks

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FLORA AND VEGETATION DATA

Description:

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

Species List

Species	Height	Cover
Acacia incurvaneura	4	8
Acacia ? ramulosa var. *ramulosa*	4	15
Acacia sp.	4	15
Poaceae sp. indeterminate	0.4	0.1
Acacia citrinoviridis	4	0.1

Ground Cover (percent)

Rock	Bare soil	Litter	Perennial ground cover
0	55	2	45

Veg Condition:	Good	Fire Age:	3 to 5 years
Weeds:	None	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
Acacia pruinocarpa	4.5	2
Psydrax latifolia	0.8	0.1
Acacia citrinoviridis	0.8	0.1
Eremophila 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

Introduced species: N/A

Erosion: -

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

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

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

Site Details:

Described by: Crystal Heydenrych

Date: 2018-04-29

Type: Quadrat (20m x 20m)

MGA Zone: 50J 660869mE 7275639mN

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

FLORA AND VEGETATION DATA

Description:

Mosaic.

Veg Condition: Very Good

SITE PHOTOGRAPH

Galena Minerals – Abra – Mn06

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

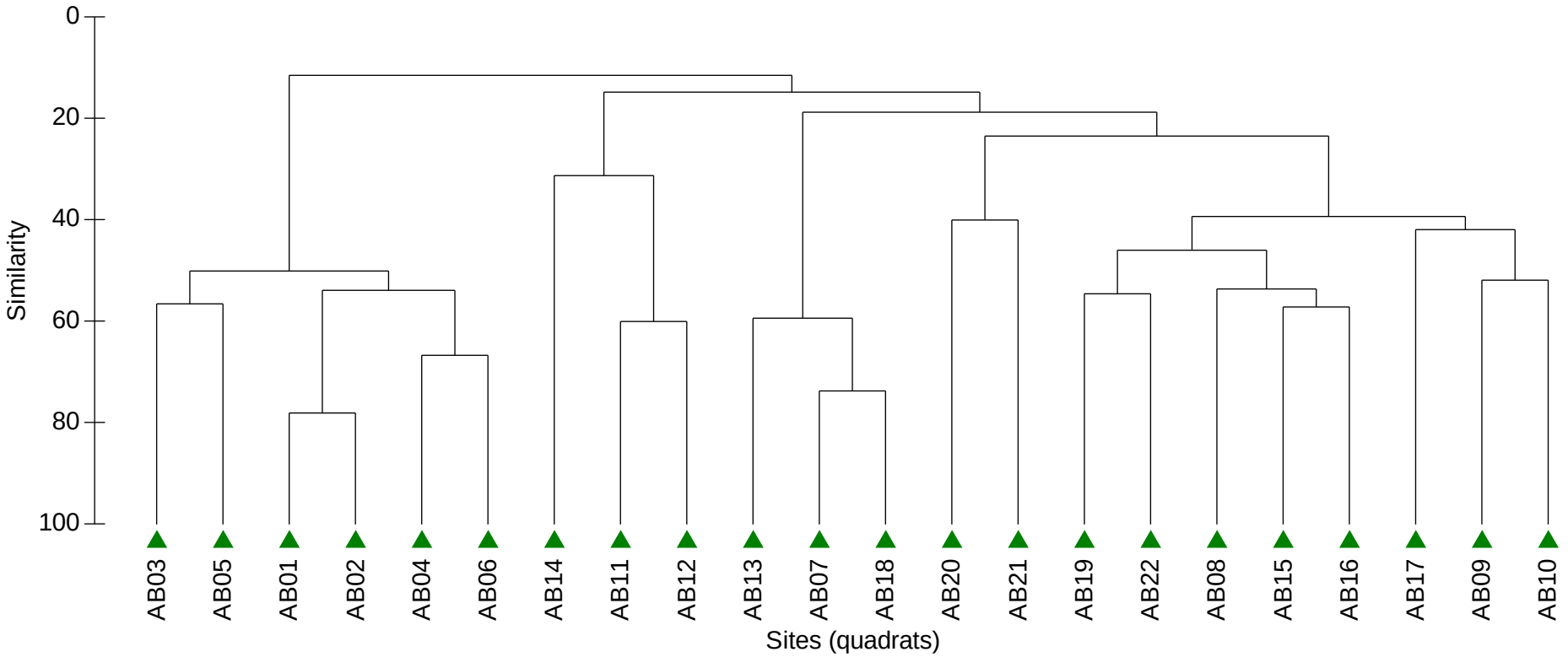
Fire Age: 5 to 15 years

Fire Notes: No evidence, mature shrubs, grasses present

SITE PHOTOGRAPH

Appendix G Floristic Community Structure

G.1 Dendogram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20
40
60
80
100
AB03
AB05
AB01
AB02
AB04
AB06
AB14
AB11
AB12
AB13
AB07
AB18
AB20
AB21
AB19
AB22
AB08
AB15
AB16
AB17
AB09
AB10
Sites (quadrats)

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
Abutilon cryptopetalum	0	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia acradenia	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Acacia aneura	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0
Acacia ayersiana	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia citrinoviridis	1	1	1	1	1	1	0	1	1	1	0	0	0	0	1	1	1	1	1	1	1	1
Acacia incurvaneura	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1	0	1
Acacia kempeana	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	1	0	0	1
Acacia pruinocarpa	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	1	0
Acacia pyrifolia	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia ramulosa var. *linophylla*	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Acacia rhodophloia	1	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Acacia sclerosperma subsp. *sclerosperma*	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acacia sibirica	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Acacia tetragonophylla	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Alternanthera nodiflora	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Androcalva loxophylla	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aristida contorta	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Bidens bipinnata	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boerhavia coccinea	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Centipeda minima subsp. *macrocephala*	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cleome viscosa	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corchorus crozophorifolius	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corymbia candida subsp. *? dipsodes*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Cymbopogon ambiguus	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Cyperus rigidellus	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dipteracanthus australasicus subsp. *australasicus*	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dodonaea petiolaris	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Dodonaea viscosa	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Duperreya commixta	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
Enneapogon robustissimus	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eragrostis cumingii	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila exilifolia	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0
Eremophila forrestii subsp. *? forrestii*	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0
Eremophila fraseri subsp. *fraseri*	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila gielsii subsp. *? variabilis*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Eremophila jucunda subsp. *jucunda*	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
Eremophila latrobei subsp. *?*	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremophila latrobei subsp. *latrobei*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Eriachne benthamii	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	1	0	0	1
Eriachne mucronata	1	1	0	0	0	0	1	1	0	0	0	0	1	0	1	1	0	1	0	0	0	0
Eriachne pulchella	1	1	0	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Eucalyptus victrix	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eulalia aurea	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Euphorbia biconvexa	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Evolvulus alsinoides var. *villosicalyx*	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
Fimbristylis dichotoma	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0
Glycine canescens	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grevillea berryana	0	0	0	0	0	0	1	0	1	1	0	0	1	0	1	0	0	1	1	0	0	0
Grevillea stenobotrya	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hibiscus sturtii var. *forrestii*	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	0	0	0	0	1
Indigofera chamaeclada	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Indigofera monophylla	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malvastrum americanum	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsilea hirsuta	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Melhania oblongifolia	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mirbelia rhagodioides	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Neurachne minor	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Paraneurachne muelleri	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perotis rara	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pluchea dentex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Polycarpaea corymbosa	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polycarpaea longiflora	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Psydrax latifolia	0	0	0	0	1	1	0	1	1	0	0	0	1	1	1	1	1	0	1	0	1	1
Psydrax suaveolens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Pterocaulon sphaeranthoides	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ptilotus obovatus	0	1	0	1	1	1	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0
Ptilotus schwartzii	0	1	0	0	0	0	1	0	0	1	1	0	1	1	0	0	0	1	0	0	0	0
Rhynchosia minima	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salsola australis	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sclerolaena cornisheana	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. *filifolia*	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna artemisioides subsp. *helmsii*	0	1	0	1	1	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
Senna artemisioides subsp. *oligophylla*	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senna cuthbertsonii	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1	1	0	1	0	0	1
Senna glaucifolia	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Senna glutinosa subsp. *pruinosa*	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Senna stricta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Setaria dielsii	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sida 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
Solanum lasiophyllum	0	1	0	0	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0	0	0	0
Solanum sturtianum	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sporobolus australasicus	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Stemodia viscosa	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tephrosia rosea var. *clementii*	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Themeda triandra	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
Tribulus suberosus	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
Trichodesma zeylanicum	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triodia basedowii	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
Amphibians													
Hylidae	*Cyclorana maini*	Sheep Frog			x								x
	Cyclorana platycephala	Western Water-holding Frog						x					x
	Litoria rubella	Little Red Tree Frog			x			x					x
Limnodynastidae	*Neobatrachus aquilonius*	Northern Burrowing Frog											x
	Neobatrachus sudellae	Desert Trilling Frog											x
	Neobatrachus sutor	Shoemaker Frog											x
	Notaden nichollsi	Desert Spadefoot											x
Myobatrachidae	*Uperoleia micromeles*	Tanami Toadlet											x
Birds													
Acanthizidae	*Acanthiza apicalis*	Inland Thornbill			x	x		x				x	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill				x		x					
	Acanthiza iredalei iredalei									x			
	Acanthiza robustirostris	Slaty-backed Thornbill				x		x					x
	Acanthiza uropygialis	Chestnut-rumped Thornbill				x		x			x		x
	Aphelocephala leucopsis	Southern Whiteface				x		x					
	Gerygone fusca	Western Gerygone			x			x					x
	Pyrrholaemus brunneus	Redthroat				x		x					x
	Smicrornis brevirostris	Weebill				x		x			x	x	x
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk				x		x					
	Accipiter fasciatus	Brown Goshawk											x
	Aquila audax	Wedge-tailed Eagle				x		x			x		x
	Elanus caeruleus	Black-shouldered Kite											x
	Haliastur sphenurus	Whistling Kite				x		x					x
	Hamirostra isura	Square-tailed Kite									x		
	Hamirostra melanosternon	Black-breasted Buzzard				x		x					x
	Hieraaetus morphnoides	Little Eagle											x
Alaudidae	*Mirafra javanica*	Horsfield's Bushlark											x
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher									x		
Anatidae	*Anas gracilis*	Grey Teal											x
	Anas querquedula	Garganey	Mi	S5			x						
	Anas superciliosa	Pacific Black Duck									x		
	Cygnus atratus	Black Swan											x
Apodidae	*Apus pacificus*	Fork-tailed Swift	Mi	S5					x				
Ardeidae	*Ardea modesta*	Eastern Great Egret					x		x				
	Ardea novaehollandiae	White-faced Heron									x		
	Ardea pacifica	White-necked Heron				x		x					x
Artamidae	*Artamus cinereus*	Black-faced Woodswallow			x	x		x				x	x
	Artamus minor	Little Woodswallow				x		x					
	Artamus personatus	Masked Woodswallow											x
Cacatuidae	*Cacatua roseicapilla*	Galah				x		x				x	x
	Cacatua sanguinea	Little Corella											x
	Nymphicus hollandicus	Cockatiel				x		x					
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike				x		x					x

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

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

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

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

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

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