



# IMPACT ASSESSMENT

## SECTION 4.3 TERRESTRIAL FAUNA

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## Jervois Base Metal Project

### VOLUME 2 Impact Assessment

#### SECTION 4.3 | TERRESTRIAL FAUNA

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### 4.3 Terrestrial Fauna

#### 4.3.1. Introduction

The Jervois Base Metal Project Environmental Impact Statement (EIS) Terms of Reference has identified terrestrial fauna as a preliminary environmental factor that may be impacted by the Project. As such, the EIS is to provide sufficient information regarding the existing environment, the potential impacts and risks arising from the Project and the proposed management and mitigation measures to be implemented to meet the Northern Territory Environment Protection Authority (NT EPA) objectives. The NT EPA's objective related to terrestrial fauna is to:

*“maintain the conservation status, diversity, ecological integrity and geographic distribution of terrestrial fauna values through the avoidance or management of adverse impacts”.*

The NT EPA has *Guidelines for Assessment of Impacts on Terrestrial Biodiversity* (NT EPA, 2013) that provide guidance as to the level of detail required for terrestrial fauna within the EIS document. As recommended by the guideline, this Section of the EIS has aimed to include detail on the following:

- the threatened fauna (as listed under the TPWCA and/or EPBC Act) of proposed development sites and immediately adjacent areas
- congregations, large populations or important sites for listed migratory fauna (EPBC Act) found on the proposed development site
- important fauna sites (e.g. major breeding areas, fauna congregations, isolated permanent water sources, geological features such as caves, large boulder piles or escarpments) in the proposed development area
- the local and regional conservation status of threatened fauna, listed migratory fauna, or important fauna congregations or sites present in development sites
- the potential impacts of projects on threatened fauna, listed migratory fauna, or important fauna congregations or sites in, adjacent to, and downstream from development sites; and
- the conservation significance of a development's impacts on threatened fauna, listed migratory fauna, important fauna congregations or sites at local and regional levels.

In order to satisfy the above listed requirements of the terrestrial fauna assessment, a number of ecological investigations were undertaken by Low Ecological Services P/L between 1985 and 2018. The reports from these ecological investigations appear in Appendix C-7.

#### **Relevant legislation**

There are a number of pieces of legislation written by the Commonwealth and Northern Territory governments that may be relevant to the terrestrial fauna potentially impacted by the Project, including:

- *Environment Protection and Biodiversity Conservation Act, 1999* (Commonwealth)
- *Environmental Assessment Act 1994* (Northern Territory)
- *Environmental Protection Act 2012* (Northern Territory)
- *Biological Control Act 2011* (Northern Territory)
- *Territory Parks and Wildlife Conservation Act 2014* (Northern Territory); and
- *Weeds Management Act 2001* (Northern Territory).

Where relevant, the EIS has addressed the requirements of the legislation within the document. It is noted that the Project was referred to the Commonwealth Department of Environment and Energy (DEE) in November 2013 and was deemed a non-controlled action.

### 4.3.2. Relevant activities

The Project is described as the re-opening of a mine. The Project area has been the subject of historic exploration and mining by various operators since 1929. Existing infrastructure at the site includes open pits, access roads, ruins from an old village and several mines and processing sites, waste rock dumps, tails storage facilities, evaporation dams, and drains and sumps. The Project involves mining copper and other base metals from at least five deposits. Ore will be processed onsite using a crushing, grinding and flotation plant, producing copper and lead/zinc concentrate.

The proposed Project infrastructure includes a processing plant, workshops, laydown areas, an explosive magazine, offices, warehouses, a laboratory, haul roads, sewage treatment systems, 12 MW diesel and/or gas fired power station, powerlines, water storages and an accommodation camp. The workforce is estimated to peak at approximately 300 staff during full production of underground and open cut operations, and will operate on a drive-in drive-out and fly-in fly-out basis. The Project was deemed “not a controlled action” under the EPBC Act.

The proposed activities that may have a significant impact on and/or pose a direct or indirect risk to terrestrial fauna, are described as follows:

- Construction of associated infrastructure (i.e. topsoil stockpiles, workshops, laydown areas, explosives magazine, offices, warehouse, laboratory, haul roads, sewage treatment systems, pipelines, power station (diesel or gas), powerlines, water storages and accommodation camp)
- Construction of open pits to access ore
- Construction of underground mines to access ore
- Stockpiling of ore
- Stockpiling of waste on purpose built waste landforms adjacent to open pits
- Transport of ore to ROM processing pad (traffic movements)
- Concentration of ore using standard flotation processes to produce concentrate containing copper sulphide and subordinate silver and other metals
- Discharge of thickened tailings to a purpose built above ground tailings storage facility (TSF) near the processing plant; and
- Transport of concentrate in enclosed truck containers off-site via the Plenty and Stuart highways to Alice Springs where it will be loaded onto trains for transport to Darwin and/or Adelaide.

Potential impacts and risks associated with these activities include:

- Removal of habitat for pits and infrastructure
- Change in habitat quality

- Impacts to threatened fauna
- Impacts to migratory fauna
- Introduction of exotic fauna
- Fauna mortality; and
- Hazardous material.

These impacts and risks are discussed in detail in Section 4.3.5.



### 4.3.3. Existing Environment

#### Climate

Climate statistics have been recorded at Jervois Station Homestead (Australian Bureau of Meteorology Station 015602) 35 km south of the mine site since 1966. The climate of the Jervois area is semi-arid, with predominantly summer rainfall occurring between November and April. The warmest months are October to March, with mean daily maximum temperatures over 33°C (Australian Government Bureau of Meteorology, 2017). The maximum average monthly temperature is 38.4°C in January (Australian Government Bureau of Meteorology, 2017). The coolest months are June to September with mean minimum temperatures under 8°C. The minimum average monthly temperature is 5.4 °C occurring in July (Australian Government Bureau of Meteorology, 2017). Relative humidity averages at 27.8% in the summer months and 38.5% during the winter months (Australian Government Bureau of Meteorology, 2017). The predominant wind direction is east and south-east although during storms and rainfall periods, the winds are predominantly from the west (Australian Government Bureau of Meteorology, 2017).

Rainfall records measured at Jervois Station since 1966 show a mean annual rainfall of 295.4 mm. Annual rainfall varies widely, with a range of 95.8 mm (2013) to 933.4 mm (2010) (Australian Government Bureau of Meteorology, 2017). Long-term rainfall trends show a pattern characteristic of the northern Australian arid zone, whereby long dry periods (rainfall around or below the annual average) are interrupted by short, large magnitude rainfall events lasting approximately 12 to 15 months. This rainfall variation is linked to the El-Nino Southern Oscillation phenomenon, whereby the El-Nino phase is often linked to drought and the La-Nina phase is often linked to high rainfall. Most rainfall occurs between November and April, when flooding can occur following storm events.



### Biogeographic region

The Interim Biogeographic Regionalisation of Australia (IBRA Version 7) provides a broad division of Australia into 89 geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information (DSEWPC, 2012). The Project area lies at the south edge of the Channel Country bioregion (Thackway, 1995). Further refinement of these regions into 419 sub-regions does not affect The Channel Country bioregion which is located on the Queensland (QLD), New South Wales (NSW), South Australia (SA) and NT borders, with 8% of the bioregion in the NT (Bastin, 2008). The Channel Country bioregion is characterised by braided, flood and alluvial plains, which are surrounded by gravel or gibber plains, dunefields and low ranges (Bastin, 2008). The predominant vegetation is Mitchell grass, gidgee and spinifex (Bastin, 2008). The predominant land use in the Channel Country bioregion is grazing (91% of total area (Bastin, 2008)). There are no reserves or protected areas in the Channel Country bioregion (Baker, 2005).

### Geology

The Project is within the Huckitta 1:250,000 map sheet (Black, 1984). The north western part of the Project area is made up of sedimentary sandstone, limestone and dolostone of the Jervois Range (P103), while the majority of the area overlies felsic and mafic intrusive such as schist and granites (A5) with limestone and doleritic remnants and intrusives. Soils are variable across the Project area but are classified as rudosols, young soils with negligible pedologic development. At a local level, soils vary from deep clayey loam to extensive calcareous loams and shallow skeletal montain earthy sands. The Australian Soil Classification (ASC) (Isbell, 2016) describes rudosols as follows:

*Soil with negligible (rudimentary) pedologic organisation apart from:*

- i. Minimal development of an A1 horizon; or*
- ii. The presence of less than 10% of B horizon material (including pedogenic carbonate) in fissures in the parent rock or saprolite. The soils are apedal or only weakly structured in the A1 horizon and show no pedological colour changes apart from the darkening of an A1 horizon. There is little or no texture or colour change with depth unless stratified or buried soils are present.*

### Hydrology

The Jervois Project area is in the upper catchment of the Hay River Basin, which ultimately feeds into Lake Eyre in the north of South Australia. The drainage lines that intersect the Project area feed into the Marshall River to the south and Arthur Creek to the north, which in turn converge into the Hay River, approximately 60 km south-east of the Project area. Surface water in the Project area and surrounding region is ephemeral and the creeks hold water during and after rainfall events. Drainage lines originating in the Jervois Range, include Unca Creek. Unca Creek and its tributaries drain to the east through the Project area and north-east towards Arthur Creek, but flood out through the broad drainage plain to the south-east. Other watercourses in the surrounding area include: Daylight Creek 4 km south-west, Midnight Creek 7 km south and Bonya Creek 11 km south-west.

Jervois Dam is an artificial water reservoir at the north-west corner of the Project area, which holds a substantial volume of water for several years following rainfall. It was constructed for previous mining operations and is the largest and most permanent surface water body in the Jervois Region. Faulty construction resulted in a pervious layer in the dam wall which allows seepage which provides long

term irrigation for the area immediately east of the dam. It is planned to repair this leak to enable a larger quantity of water to be available for the mining process.

Groundwater availability on Jervois Station has always been a problem (Low Ecological Services P/L, 1985). Water from Palaeozoic sediments is frequently salty (Black, 1984) but fault and fracture lines in metamorphic and igneous rock may provide fresh water. Deep Quaternary beds through which major water courses flow can yield good supplies of fresh water. Unca Bore on the project area is high in salt content at 3380 TDS.

### **Fire history**

Information on the fire history of the region is provided by the North Australia Fire Information (NAFI) website (North Australia and Rangelands Fire Information, 2017). Fire histories have been mapped to the nearest 1 km for years 1997 – 2010 and to the nearest 250 m for years 2004 onwards. Since 1997, the Project area has only been burnt once, in 2002 following the very wet years from 1999 to 2001. Widespread fires that burnt much of Central Australia in 2011 and the beginning of 2012 did not affect the Project area. However, a small isolated fire occurred by the Jervois Dam in 2011. The northern half of the project area has not experienced any fires since 1997.

### **4.3.4. Terrestrial Fauna Characteristics of the Project Area**

A number of ecological investigations were undertaken by Low Ecological Services P/L between 1985 and 2017. The studies included desktop assessment (i.e. interrogation of spatial databases and reviews of relevant literature) and field work involving on-ground fauna surveys in 1999, 2012, 2013, 2017 and 2018.

#### **Desktop assessment**

The database review and GIS mapping of several data sources provided an ecological context of the landscape, vegetation, habitats and climate of the lease areas. The sources include:

- Climate data online (Australian Government Bureau of Meteorology, 2017)
- Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway, 1995)
- Digital Atlas of Australian Soils (Northcote, 1968)
- Vegetation Survey of the Northern Territory Australia: Notes to accompany 1: 1,000, 000 Map Sheets (Wilson, 1990)
- Land Systems of the Alice Springs Area, Northern Territory, Australia (Perry, 1962)
- Fire history (North Australia and Rangelands Fire Information, 2017)
- Aerial photographs and satellite imagery
- EPBC Protected Matters Search Tool (PMST) (Department of Environment & Energy (DEE), 2017)
- NT Species Atlas (Department of Environment and Natural Resources (DENR), 2017)
- Jervois Base Metal Project Surface Water Impact Assessment (WRM Water & Environment P/L, 2018); and
- Jervois Base Metal Project Groundwater Impact Assessment (CloudGMS, 2018).

#### **Fauna surveys**

Field surveys were conducted by LES in the late dry (1999 and 2017) and in the post wet (2012, 2013 and 2018), including a total of 25 sites encompassing all land units in the Project area. General fauna

survey methodology follows the NT EPA “*Guidelines for Assessment of Impacts on Terrestrial Biodiversity*” (NT EPA, 2013). Fauna surveys for small mammals and reptiles were conducted at five to six trapping sites each survey (J01 – J07). Each site was trapped for three nights. At each site there was a transect of 25 Elliott traps spaced approximately 10 m apart, two pitfall traps and four funnel traps. Pitfall traps were placed adjacent to Elliott trap transects and had a 10 m drift fence centered over each pit to guide animals into the trap. One funnel trap was placed at either end of each 10 m drift fence. Pitfall traps were not used at all sites due to the difficulty of digging in the rocky substrate. Where this occurred, funnel traps were deployed, sometimes along a 10 m drift fence.

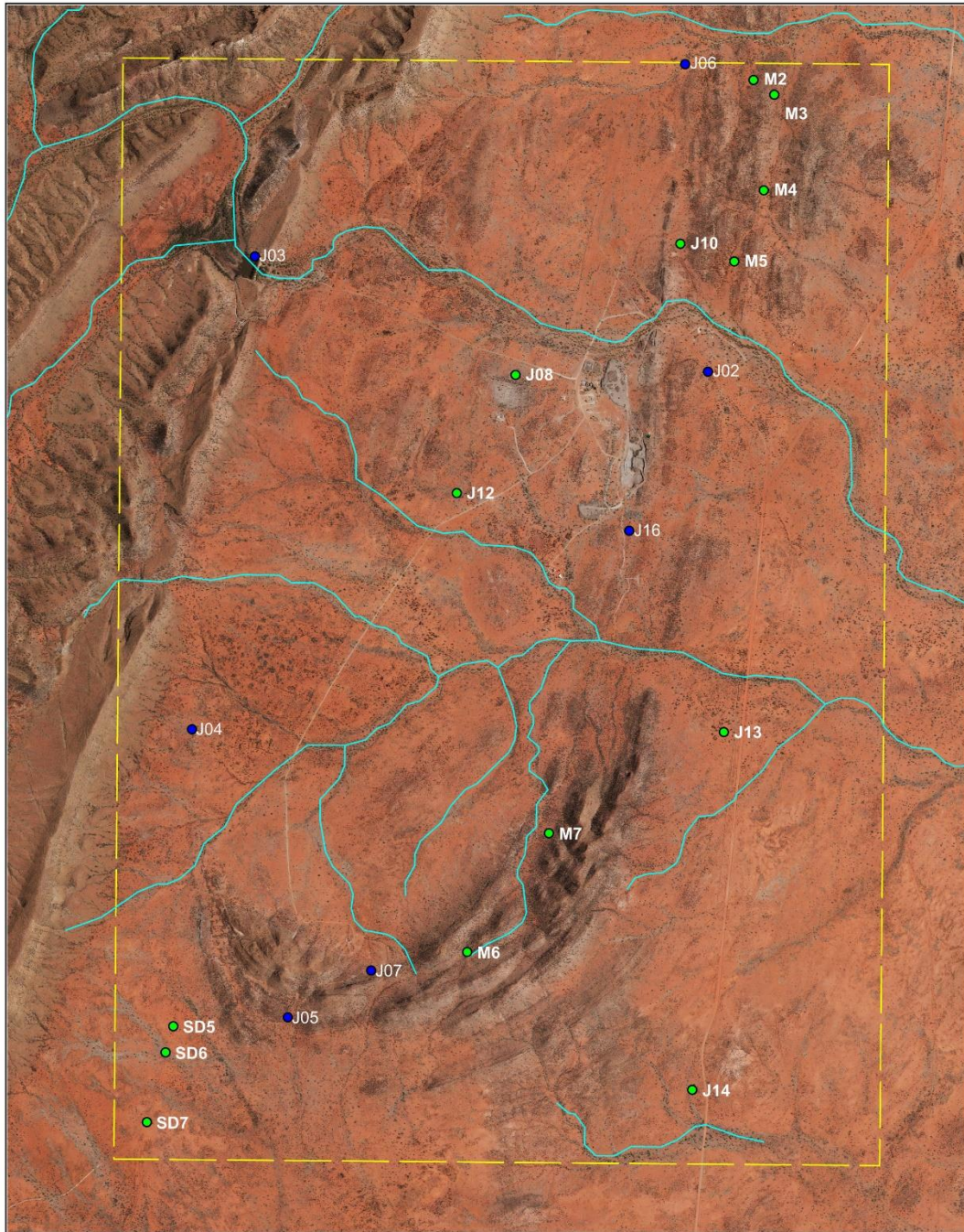
Elliott traps were baited with a mixture of peanut butter and oats. Traps were checked each morning and animals processed (i.e. noting sex, reproductive status, body length, tail length, snout-vent length etc.) and released at the point of capture. Elliott traps were closed during the day and then opened in late afternoon when pitfall and funnel traps were also checked. Cage trapping as recommended by the *Standard terrestrial vertebrate survey methods used by the DLRM* (NT EPA, 2013) was not conducted, as there are no species likely to be present in the appropriate size range for cage trapping. Medium to large sized mammal (e.g. cats, foxes, dingoes and rabbit) presence and abundance was determined through remote cameras, spotlighting and secondary sign searches. Trapping sites established in 2012 were continued in 2013 and 2017, with the addition of one other site in 2012, another in 2017 and one more in 2018.


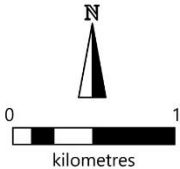
Additional targeted searches were conducted for EPBC listed threatened species that may occur within Project area as identified by the PMST and NT Flora and Fauna Atlas, comprising:

- Australian painted snipe (*Rostratula australis*) – Endangered (EPBC Act) and Vulnerable (TPWC Act)
- Curlew sandpiper (*Calidris ferruginea*) – Critically Endangered (EPBC Act) and Vulnerable (TPWC Act)
- Night parrot (*Pezoporus accidentalis*) - Endangered (EPBC Act) and Critically Endangered (TPWC Act)
- Plains wanderer (*Pedionomus torquatus*) – Critically Endangered (EPBC Act) and Data Deficient (TPWC Act)
- Red goshawk (*Erythrotriorchis radiatus*) – Vulnerable (EPBC Act and TPWC Act)
- Black-footed rock wallaby (*Petrogale lateralis*) - Vulnerable (EPBC Act) and Near Threatened (TPWC Act); and
- Common brushtail possum (Central Australian population) (*Trichosurus vulpecula*) – Endangered (TPWC Act).

Survey methods used to determine the presence of threatened species were based on the *Survey Guidelines for Australia’s Threatened Mammals* (Department of Sustainability, Environment, Water, Population and Communities (DSEWPC), 2011) and *Survey Guidelines for Australia’s Threatened Birds* (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2010).





 <p><b>Legend</b></p> <ul style="list-style-type: none"> <li><span style="color: green;">●</span> Site Description</li> <li><span style="color: blue;">●</span> Trapping sites</li> <li><span style="border: 1px dashed yellow; display: inline-block; width: 15px; height: 10px; margin-right: 5px;"></span> Project area</li> </ul>	 <p>0 1 kilometres</p>	<p><b>Jervois Base Metal Project</b> ENVIRONMENTAL IMPACT STATEMENT</p> <p><b>Field Survey Sites</b></p>
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Created by Nitro Solutions Pty Ltd with data supplied by the Client, technical specialists and GSA. Maps may be based on or contain data provided by the respective State Government 2018

**Figure 4.3-1 Field survey sites**

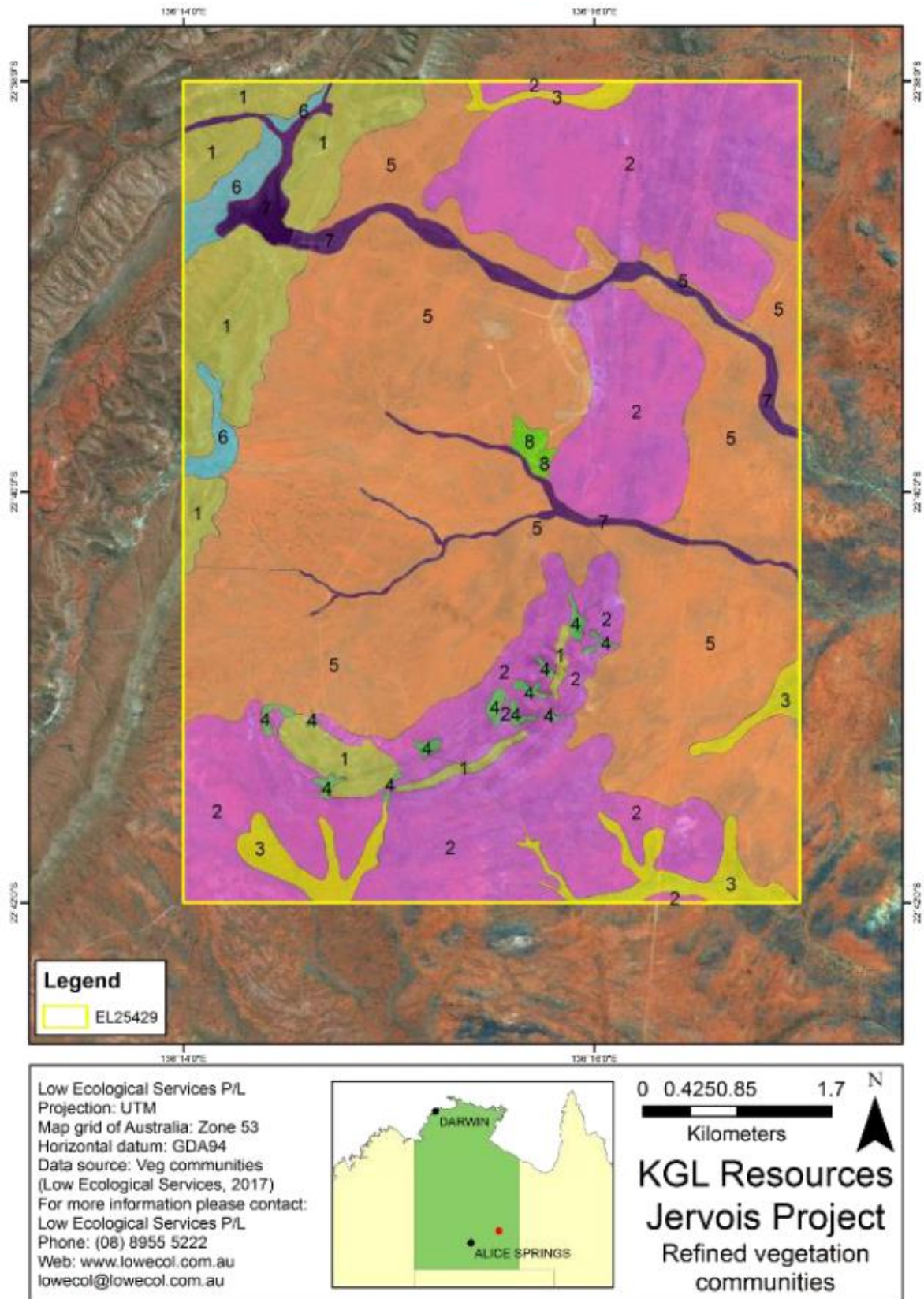
#### 4.3.4.1. Habitat types

The Project area, which is estimated at 3,800 ha, contains areas of remnant vegetation as well as some areas of historic disturbance (i.e. for previous mining activities). Based on survey results, eight refined vegetation communities have been mapped over the entire Project area (refer to Section 4.1 Terrestrial Flora and Vegetation). Fauna distribution and abundance is influenced by species specific responses to broad habitat types, rather than to refined vegetation communities. For the purposes of this report, the eight refined vegetation communities have been grouped into six broad habitat types based on geology, vegetation structure and complexity, and characteristic species, which translate into differences in the nature and availability of resources relevant to fauna. The six broad habitat types have been extracted from Figure 4.3-2 and are outlined in Table 4.3-1.

**Table 4.3-1 Broad Habitat Types in the Project area**

Broad Habitat Type	Vegetation Community	Refined Vegetation Communities	Amount in Project area (ha)
Hummock grassland	1	Hummock ( <i>Triodia basedowii</i> , <i>Triodia pungens</i> ) grassland with sparse shrubs and low trees (VC1).	345.7
Low <i>Acacia</i> sp. shrubland	2, 6, 8	Sparse, low <i>Acacia siberica</i> shrubland over short grasses and forbs (VC2).  Sparse low <i>Acacia</i> woodland over hummock grasses (VC6).  <i>Acacia georginae</i> (Gidgee) dominated woodland. Sparse grass and forb understorey (VC8).	1,322.6
Tall <i>Acacia</i> sp. woodland	3, 4	<i>Acacia estrophiolata</i> tall, open woodland over short grasses with sparse shrubs (VC3).  Tall <i>Acacia aneura</i> woodland over short grasses in fire protected valleys and upper reaches of drainage lines (VC4).	151.3
Tall <i>Corymbia</i> sp. and <i>Acacia</i> sp. woodland	5	Tall, open woodland with <i>Corymbia</i> and <i>Acacia siberica</i> over short grasses and forbs; on floodplains and at the base of ranges (VC5).	1,843
Tall <i>Eucalyptus</i> sp. woodland on drainage lines	7	<i>Eucalyptus camaldulensis</i> tall woodland over sparse grasses in drainage channels and rocky creek beds (VC7).	116.5
Jervois Dam	7	Large artificial lake on Unca Creek, created by the presence of a dam.	6.7





**Figure 4.3-2 Refined Vegetation Communities**

Source: Low Ecological Services, 2018

#### 4.3.4.2. Important Congregations of or Sites for Fauna

Important congregations of fauna or sites for fauna include locations with:

- Seasonal feeding/roosting congregations of migrant species
- Colonies of roosting species
- Breeding colonies
- Caves
- Breeding areas for species with known highly specific breeding area requirements e.g. Gouldian finches; and
- Isolated and possibly spatially rare habitat resources important to fauna or of importance to fauna at a particular time of year or the life cycle e.g. isolated sources of permanent water, large boulder piles, escarpments.

Jervois Dam is an isolated source of permanent water that is a potentially significant resource for fauna species in the regional area.



#### 4.3.4.3. Fauna species

A total of 118 fauna species have been recorded during the 1999, 2012, 2013, 2017 and 2018 surveys; 79 birds, 22 mammals, 14 reptiles and three amphibians (Low Ecological Services P/L, 2018). Invertebrates including wolf spiders, huntsman spiders, scorpions, centipedes, snails and cockroaches were not recorded in a systematic way during the surveys and have not been included in the report.

##### **Birds**

There were 79 species of native birds recorded during the surveys. Numbers of bird species recorded during the surveys varied (October 1999 n=35, July 2012 n=48, March 2013 n=29, September 2017 n=43 and May 2018 n=30) and was particularly low in the March 2013 survey (n= 29). This may have been due low rainfall leading up the survey resulting in dry conditions as plant stress was visible, and



hot conditions during the survey. There was one species of conservation significance recorded in the Project area, emu (*Dromaius novaehollandiae*) which is listed as Near Threatened under the TPWC Act.

### **Mammals**

There were 22 species of mammals recorded during the surveys, including four exotic species (i.e. cow, cat, house mouse and rabbit). This also includes six species of bat recorded with bat detectors. The number of mammals caught was relatively consistent throughout the surveys (October 1999 n=7, July 2012 n=8, March 2013 n=6, September 2017 n=8 and May 2018 n=2). There was one species of conservation significance recorded in the Project area, long-haired rat (*Rattus villosissimus*) which is listed as Near Threatened under the TPWC Act.

### **Reptiles**

Fourteen species of reptile were recorded from the Project area during surveys, including three species of snake. Fewer reptiles were recorded during surveys in cooler months (October 1999 n=6, July 2012 n=4, March 2013 n= 5, September 2017 n=3 and May 2018 n=1). There were no exotic or conservation significant reptiles detected.

### **Amphibians**

Three amphibian species were recorded from the Project area during surveys; including two near the Jervois Dam during the October 1999 (*Limnodynastes spenceri* (Spencer's burrowing frog) and *Litoria rubella* (desert tree frog)) and another one *Cyclorana cultripes* (burrowing frog) in May 2018. There was good rain leading up to the October 1999 survey and the frogs were active due to rain overnight during the survey. *Litoria rubella* was observed at the camp during the September 2017 field survey. There were no exotic or conservation significant amphibians detected.

#### 4.3.4.4. Conservation significant fauna species

A database search of the EPBC PMST and the NT Fauna Atlas identified nine threatened fauna species listed under the EPBC Act as occurring or potentially occurring within 20 km of the Project area. The NT Fauna Atlas database (2015) identified an additional 9 species of conservation significance occurring within 20 km of the project area. Fauna species listed under the EPBC Act or TPWC Act and identified in the desktop survey as potentially occurring in the Project area are discussed in Table 4.3-2.

Surveys recorded two species of conservation significance; *Dromaius novaehollandiae* (emu) and *Rattus villosissimus* (long-haired rat). Another two of these species, *Macrotis lagotis* (greater bilby) and *Isodon auratus* (golden bandicoot), are considered regionally extinct.

**Table 4.3-1 Threatened and conservation significant fauna species identified as occurring or potentially occurring within a 20 km radius of the Project area**

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
<b>Birds</b>						
Australian bustard <i>Ardeotis australis</i>		NT	Widely distributed across inland Australia, where it is still common away from settlement. Inhabits grasslands, spinifex, open scrublands, grassy woodlands, sandhills, pastoral lands, burned ground, and occasionally crops and airfields (Pizzey & Knight, 2012).	<b>Likely:</b> Appropriate habitat in the Project area, associated with all habitat types present. Records within 20km.		X
Curlew sandpiper <i>Calidris ferruginea</i>	CE	VU	Inhabits coastal and brackish lagoons, intertidal mud and sand flats, estuaries, saltmarshes and occasionally inland freshwater wetlands (Ward, 2012). The closest record of this species to the Project area is 265 km south-west of the Project area at the Alice Springs wastewater treatment plant.	<b>Potential:</b> Suitable habitat exists at the Jervois Dam, but there are no nearby records.	X	
Red-tailed black cockatoo (Central Australian populations) <i>Calyptorhynchus banksii samueli</i>		NT	Inhabits tall open forests, woodlands, grasslands, scrublands, floodplains, river margins, <i>E. camaldulensis</i> along watercourses and wetlands (Pizzey & Knight, 2012).	<b>Likely:</b> Appropriate habitat in the Project area, associated with "Tall <i>Corymbia</i> sp. and <i>Acacia</i> sp. woodland" and "Tall <i>Eucalyptus</i> sp. woodland on drainage lines". Records within 20km.		X



Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
Grey honeyeater <i>Conopophila whitei</i>		DD	Sparsely distributed across inland Australia from north east SA west through the Pilbara in WA and north to Frewena and Wave Hill, NT. Inhabits mature mulga woodland, open mulga with spinifex, tall open acacia scrubland and sandhills with red mulga, canegrass, beefwood and desert bloodwood (Pizzey & Knight, 2012).	<b>Likely:</b> Appropriate habitat in the Project area, associated with "Tall Acacia sp. woodland" and "Tall <i>Corymbia</i> sp. and <i>Acacia</i> sp. woodland". Records within 12 km in similar land system.		X
Emu <i>Dromaius novaehollandiae</i>		NT	Was widely distributed across the Australian mainland although sparsely in the NT, but is now mostly absent from closely settled areas. Inhabits plains, scrublands, open woodlands, coastal heaths, alpine pastures, semi-deserts, margins of lakes, and pastoral and cereal growing areas (Pizzey & Knight, 2012).	<b>Known:</b> Emu tracks were identified near the old tailings dam in 2017 and the species is likely to use all habitat types.		X
Red Goshawk <i>Erythrotriorchis radiatus</i>	VU	VU	The species is generally confined to tall wooded areas in the narrow coastal and sub-coastal strip in northern Australia from Kimberly (WA) across NT and QLD to northern NSW, though sparse throughout its range (Department of the Environment (DotE), 2018). However, there are some recent, isolated records in Central Australia	<b>Unlikely:</b> Previous surveys found potential but low quality habitat for the species in the Jervis Dam seepage area. There are no nearby records.	X	

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
			(Debus, 2012). The preferred habitat is tall open eucalypt forest and riparian areas (Woinarski, 2006).			
Square-tailed kite <i>Lophoictinia isura</i>		NT	Inhabits heathlands, woodlands, forests, tropical and subtropical rainforests, timbered watercourses, and hills and gorges across much of Australia except the central and inland south (Pizzey & Knight, 2012).	<b>Potential:</b> Appropriate habitat in the Project area, associated with "Tall Corymbia sp. and Acacia sp. woodland" and "Tall Eucalyptus sp. woodland on drainage lines". The species has been recorded previously within the Project area in the Bond Springs land system.		X
Plains wanderer <i>Pedionomus torquatus</i>	CE	DD	Known from south-eastern Australia, particularly in the Riverina, with some isolated records in SA and inland QLD. The preferred habitat is sparse low grasslands, typically with 50% bare ground and most vegetation under 5 cm in height (Woinarski & Ward, 2016) †.	<b>Unlikely:</b> The Project area is out of the typical range and there is no potential habitat.	X	
Night parrot <i>Pezoporus occidentalis</i>	EN	CE	Restricted to arid and semi-arid Australia. Records of <i>P. occidentalis</i> in western QLD, northern WA and southern NT are from spinifex ( <i>Triodia</i> sp.) hummock grasslands in stony or sandy areas (Pavey, 2006).	<b>Unlikely:</b> The Project area is out of the typical range and there is no potential habitat.	X	

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
Australian Painted Snipe <i>Rostratula australis</i>	EN	VU	In the NT, <i>R. australis</i> has been recorded on the Barkly Tablelands, at Lake Woods and Sturt Plateau, but may occur also in the northern NT on any shallow ephemeral wetlands in central or southern NT (Taylor, Chatto, & Woinarski, 2013).	<b>Likely:</b> A single female <i>R. australis</i> has been recorded in March 2012 (not part of this survey) at the Jervois Dam.	X	X
Freckled duck <i>Stictonetta naevosa</i>		NT	Mainly distributed across south east and south west of Australia, but occurs as a vagrant elsewhere in Australia. The species generally inhabits permanent freshwater swamps and creeks, and generally rests in dense cover such as bullrushes, lignum or tea-tree (Pizzey & Knight, 2012).	<b>Potential:</b> The Jervois Dam represents potential habitat and there are records within 5km.		X
<b>Mammals</b>						
Crest-tailed mulgara <i>Dasyercus cristicauda</i>	VU	VU	In the southern NT, <i>D. cristicauda</i> inhabits the slopes and crests of sandridges with a high cover of <i>Triodia basedowii</i> and a relatively high abundance of ephemeral plant species with large seed crops (Pavey, 2011).	<b>Unlikely:</b> The Project area is out of the typical range and there is no potential habitat.	X	
Black-footed rock wallaby <i>Petrogale lateralis</i> MacDonnell Ranges race	VU	NT	The distribution spans from the Davenport and Murchison Ranges in the north, east to the Jervois Range, west to the WA border	<b>Potential:</b> There is a small area of potentially suitable habitat in the Jervois Range in the far north-western corner of	X	

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
			and south to the SA border. Geological features favoured are steep slopes, cuestas, deep gorges and boulder scree slopes, which are common in quartzite ranges (Gibson, 2000).	the lease. The nearest record is 45km east.		
Golden bandicoot <i>Isoodon auratus</i>	VU	EN	Now known from only one location, in the NT, Marchinbar Island in the Wessel chain, north-eastern Arnhem Land (Fisher & Woinarski, 1994).	<b>Locally extinct</b>	X	X
Long-haired rat <i>Rattus villosissimus</i>		NT	Occurs in central and northern Australia in core cracking clay areas during dry periods, but across a much larger area during irruptions following high rainfall (Woinarski & Aplin, 2017).	<b>Known:</b> An abandoned nest was located in the Project area and may have been used during population irruptions. The species has a wide habitat association during period of irruption and could potentially use any of the habitat types in the Project area.		X
Greater bilby <i>Macrotis lagotis</i>	VU	VU	The species occurs in a wide variety of habitats that can be classified into three major groups; sparse grassland/forbland on uplands and hills with a low fire frequency, mulga scrub/ woodlands on ridges and rises with an infrequent year) fire interval and hummock grassland/	<b>Locally extinct</b>	X	X

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
			mixed shrub or woodland steppe on plains and alluvial areas with a high (4-10 year) fire frequency (Southgate, 1990).			
Common brushtail possum (Central Australian population) <i>Trichosurus vulpecula vulpecula</i>		EN	This species occurs in isolated populations in southern NT. It is restricted to riverine habitat, close to rocky outcrops and moist gullies within ranges or rocky slopes (Pavey & Ward, 2012).	<b>Unlikely:</b> The Project area is out of the typical range and there is no potential habitat.		X
Spectacled hare wallaby <i>Lagorchestes conspicillatus</i>		NT	Patchily distributed in northern WA and central-northern NT, and widespread in areas northern Queensland from Cape York to Rockhampton. Inhabits open forests, open woodland, tall shrublands, and tussock and hummock grasslands, and regularly feeds in areas regenerating after fire (Winter, Woinarski, & Burbidge, 2016).	<b>Unlikely:</b> The Project area is out of the typical range and there is no potential habitat.		X

#### 4.3.4.5. Migratory species

The EPBC PMST and NT Fauna Atlas identified 12 species listed as migratory as occurring or potentially occurring within 20 km of the Project area (Table 4.3-3). The Jervois Dam provides habitat for migratory aquatic or wading species during the migration period, when there is water in the dam. No listed migratory species were recorded during surveys. However, the following species were considered as likely or potentially occurring when conditions are suitable:

- Fork-tailed swift (*Apus pacificus*)
- Sharp-tailed sandpiper (*Calidris acuminata*)
- Caspian tern (*Hydroprogne caspia*)
- Glossy ibis (*Plegadis falcinellus*)
- Common sandpiper (*Tringa hypoleucus*); and
- Common greenshank (*Tringa nebularia*).





**Table 4.3-3 Migratory species identified as occurring or potentially occurring within a 20 km radius of the Project area**

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
Fork-tailed swift <i>Apus pacificus</i>	Mi	-	Low to very high airspace over varied habitat, rainforest to semi-desert, most active just ahead of summer storm fronts (Morcombe, 2003).	<b>Potential:</b> habitat is arid and sub-optimal for the species, but there are nearby records.	X	X
Sharp-tailed sandpiper <i>Calidris acuminata</i>	Mi	-	In Queensland, they are recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions (Department of the Environment (DotE), 2018).	<b>Potential:</b> habitat is arid and sub-optimal for the species, but there are nearby records.	X	X
Curlew sandpiper <i>Calidris ferruginea</i>	Mi	V	Occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters (Department of the Environment (DotE), 2018).	<b>Unlikely:</b> habitat is arid and sub-optimal for the species, and there are no nearby records.	X	

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
Oriental plover <i>Charadrius veredus</i>	Mi	-	It appears that the entire global population spends the non-breeding season in northern Australia, in both coastal and inland areas. Thereafter they usually inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps (Department of the Environment (DotE), 2018).	<b>Unlikely:</b> habitat is arid and sub-optimal for the species, and there are no nearby records.	X	
Oriental pratincole <i>Glareola maldivarum</i>	Mi	-	Non-breeding migrant to Australia. Within Australia the Oriental Pratincole is widespread in northern areas. It is also widespread but scattered inland, mostly north of 20° S. Usually inhabits open plains, floodplains or short grassland (including farmland or airstrips), often with extensive bare areas and near terrestrial wetlands (Department of the Environment (DotE), 2018).	<b>Unlikely:</b> habitat is arid and sub-optimal for the species, and there are no nearby records.	X	
Caspian tern <i>Hydroprogne caspia</i>	Mi	-	Mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal	<b>Potential:</b> habitat is arid and sub-optimal for the species, but there are nearby records.		X

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
			or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks (Department of the Environment (DotE), 2018).			
Barn swallow <i>Hirundo rustica</i>	Mi	-	In Australia, the Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires, and also in or over freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland (Department of the Environment (DotE), 2018).	<b>Unlikely:</b> habitat is arid and not suitable for the species, and there are no nearby records.	X	
Grey wagtail <i>Motacilla cinerea</i>	Mi	-	Non-breeding summer visitor to northern Australia. Prefers running water in disused quarries, sandy or rocky escarpments, rainforests, sewage ponds, ploughed fields and airfields (Morcombe, 2003).	<b>Unlikely:</b> habitat is arid and not suitable for the species, and there are no nearby records.	X	
Yellow wagtail <i>Motacilla flava</i>	MI	-	Open habitats, often near water; it is usually coastal (Morcombe, 2003).	<b>Unlikely:</b> habitat is arid and not suitable for the species, and there are no nearby records.	X	

Scientific name	Status		Preferred habitat	Likelihood of occurrence in Project area	Source	
	EPBC Act	TPWA			PMST	NT Flora Atlas
Glossy ibis <i>Plegadis falcinellus</i>	Mi	-	Fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons (Morcombe, 2003).	<b>Potential:</b> habitat is arid and sub-optimal for the species, but there are nearby records.		X
Common sandpiper <i>Tringa hypoleucus</i>	Mi	-	Non-breeding migrant found along all coastlines of Australia and in many areas inland. The population when in Australia is concentrated in northern and western Australia in a range of coastal wetlands (Department of the Environment (DotE), 2018).	<b>Potential:</b> habitat is arid and sub-optimal for the species, but there are nearby records.	X	X
Common greenshank <i>Tringa nebularia</i>	Mi	-	Diverse inland and coastal areas; away from the coast uses both permanent and temporary wetlands – billabongs, swamps, lakes, floodplains, flooded irrigated crops, sewage farms and saltworks ponds; prefers wet and flooded mud and clay rather than sand (Morcombe, 2003).	<b>Potential:</b> habitat is arid and sub-optimal for the species, but there are nearby records.		X

#### 4.3.4.6. Introduced fauna

Ten introduced fauna species were identified by the EPBC PMST as occurring or potentially occurring within 20 km of the Project area Table 4.3-4. There are no records of introduced fauna within a 20 km radius of the Project area in the NT Fauna Atlas database. This is likely due to the lack of fauna records in the region.

Four introduced fauna species were recorded during the on-ground surveys. These are *Bos taurus* (domestic cattle), *Mus musculus* (house mouse), *Oryctolagus cuniculus* (rabbit) and *Felis catus* (feral cat). Domestic cattle are widespread across the Project area as the land use is pastoral. House mice were also widespread across the Project area. House mice were caught in Elliott traps in all surveys and observed in the camp kitchen. Two rabbits were observed during spotlighting in the September 2017 survey. Camel, donkeys and horses are known to be in the area (R Lennartz, pers comm, 2017).

**Table 4.3-4 Introduced fauna species occurring or potentially occurring in the Project area**

Scientific name	Common name	PMST	On-ground
<i>Bos taurus</i>	Cow	X	X
<i>Canis lupis familiaris</i>	Dog	X	
<i>Camelus dromedaries</i>	Camel	X	
<i>Equus asinus</i>	Donkey	X	
<i>Equus caballus</i>	Horse	X	
<i>Felis catus</i>	Cat	X	X
<i>Mus musculus</i>	House mouse	X	X
<i>Oryctolagus cuniculus</i>	Rabbit	X	X
<i>Sus scrofa</i>	Pig	X	
<i>Vulpes vulpes</i>	Fox	X	

#### 4.3.5. Potential Impacts and Risks

The construction and operation of the mine is associated with a number of potential impacts to the terrestrial fauna values of the Project area, including:

- Removal of habitat for pits and infrastructure
- Change in habitat quality
- Impacts to threatened fauna
- Impacts to migratory fauna
- Introduction of exotic fauna
- Fauna mortality; and
- Hazardous material.

A risk assessment process has been undertaken to predict the level of risk associated with each impact (Appendix C-11). The process follows the procedures described in AS/NZS 4360 (1999) and ISO 31000 (2009) and has been undertaken for each impact before the application of any mitigation measures. The application of mitigation measures will ameliorate the level of risk to an acceptable level for the Project.

#### 4.3.5.1. Removal of habitat for pits and infrastructure

The new infrastructure will have an impact area of approximately 389 hectares (ha) of which approximately 32.5 ha of new infrastructure will be located over existing disturbance areas. In accordance with the Vegetation Survey of the Northern Territory (Wilson, 1990) the entire impact area is within the Acacia woodland broad vegetation classification. At a finer scale the impact area affects two fine vegetation classes Class 71 (*Acacia aneura* (Mulga) tall sparse-shrubland with grassland understorey) and Class 74 (*A. stowardii* (Bastard Mulga), *Cassia*, *Eremophila* (Fuchsia) sparse-shrubland). Both of these fine vegetation classes have <1% of their extents protected within reserves in the Northern Territory (Baker, 2005). The areas impacted by the Project represent <0.1% of the Acacia woodland broad vegetation in the Northern Territory.

The habitat type most affected by the Project would be habitat type 4 – Tall *Corymbia sp.* and *Acacia sp.* woodland, closely followed by habitat type 2 – Low *Acacia sp.* shrubland. This is a reflection of the distribution of these habitat types over the Project area.

Table 4.3-5 contains details of the impact of the Project on each of the habitat types located within the Project area.

**RISK ASSESSMENT RATING: medium (before mitigation)**

**Table 4.3-5 Habitat types impacted by the Project**

Description	Impact (ha)	Amount in Project area (ha)
Hummock grassland.	14.2	345.7
Low <i>Acacia sp.</i> shrubland.	107	1,332.6
Tall <i>Acacia sp.</i> woodland.	2.6	151.3
Tall <i>Corymbia sp.</i> and <i>Acacia sp.</i> woodland	69.9	1,843
Tall <i>Eucalyptus sp.</i> woodland on drainage lines	3.35	116.5
Jervois Dam	0	6.7

#### 4.3.5.2. Change in habitat quality

##### **Dust**

Dust deposition from passing haul trucks may impact on natural ecosystems adjacent to the Project area if reasonable quantities of dust are sustained over extended periods of time. Excessive dust deposition on foliage can reduce photosynthetic processes, respiration, transpiration and subsequent growth rate of the plant (Farmer, 1993) (Thompson, Mueller, Fluckiger, & Rutter, 1984). Lower growth rates and subsequently slower recovery from grazing may have a negative impact on habitat quality for native fauna, particularly grazing species (e.g. macropods).

Dust deposition issues are most likely to occur along haul roads and adjacent to open pits and has been identified as a medium risk. This is discussed further in Section 4.1 Terrestrial Flora and Vegetation.

##### **Erosion and sedimentation**

Erosion is the transport by wind, water and ice of soil, sediment and rock fragments produced by the weathering of geological features (Department of Water and Environmental Regulation (DWER), 2018). Sedimentation occurs when eroded material that is being transported by water, settles out of the



water column onto the surface, as the water flow slows (Department of Water and Environmental Regulation (DWER), 2018).

The proposed Jervois Dam upgrade will increase peak discharges, flood levels and velocities in Unca Creek downstream of the dam due to the increased spillway capacity. The predicted increases in flood levels and velocities are typically confined to the Unca Creek channel. The increased levels and velocities would be no greater than pre-dam levels and velocities, and therefore the impact is not predicted to change the morphological behaviour of Unca Creek (WRM Water & Environment P/L, 2018). The vegetation clearing and surface disturbance associated with the construction and operation of the Project can lead to increased run-off, erosion of exposed surfaces and sedimentation of the waterways; which ultimately affects habitat quality.

Erosion and sedimentation issues are most likely to occur drainage lines and waterways and have been identified as a high risk. This is discussed further in Section 4.1 Terrestrial Flora and Vegetation.

### **Noise**

The available published literature indicates that man-made noise sources, such as traffic and industry, may have impacts on fauna species. These impacts may relate to stress or avoidance, interference with communication, and masking the sounds of predators and prey. In the case of exposure to extreme levels of noise, temporary or permanent hearing damage may also be possible. Research has demonstrated that habituation to man-made noise may occur. Whilst an initial response to an unfamiliar sound may be a startle effect, subsequently familiarisation may occur and the sound may be ignored, as the sound is not biologically of significance to the species (Larkin, Pater, & Tazik, 1996).

In a literature review on the effects of noise and light from urban development on biodiversity, the distance at which various bird species were affected by man-made noise was restricted to less than 1 km from the noise source, except in one study where bird presence and breeding was identified as being reduced at a distance of up to 1.2 km from a major road (> 30,000 vehicles per day) (Newport, Shorthouse, & Manning, 2014).

The disturbance of fauna by noise is indicated as a very low to low risk. On the basis of the information above and due to the presence of some conservation significant fauna in the Project area, noise related emissions management measures may be investigated for prevention of impacts on any habitat areas. Further information regarding noise emissions from the Project is presented in Section 4.6 Air, Greenhouse Gas and Noise.

### **Hydrology**

The hydrological landscape of an area greatly influences the distribution and type of vegetation communities found there. Generally, the Project area is within an arid zone that is greatly influenced by the seasonal availability of water from rainfall within the catchment area. The most prominent hydrological feature within the Project area is Unca Creek, with its major tributaries and expansive floodplains. Some of the floodplain in surrounding areas is subject to grazing, with remnant vegetation concentrated in riparian areas. Some of these areas (habitat type 5) have been indicated as having a moderate potential to support Groundwater Dependent Ecosystems (GDE).

The impacts of hydrological change may include redirection or drainage of water away from a water dependent ecosystem, water extraction or flooding of normally dry areas. These changes are ultimately expressed by the vegetation communities, which may die-back or expand into new areas.

The *E. camaldulensis* community along Unca Creek (broad habitat type 5) in the Project area has been demonstrated to rely on surface water and shallow groundwater (up to 10m below ground) (Horner, 2009). In this case, it is likely there is a strong groundwater influence because Unca Creek flows (on average) only once in 4 years and has done so since about the 1980's when Jervois Dam was constructed (WRM Water & Environment P/L, 2018).

The groundwater levels in the Project area will be influenced by pit dewatering, particularly of Reward pit (which is located on Unca Creek). The Reward pit will intercept the water table. Groundwater drawdown is expected to occur at Reward pit and models predict that during operation the drawdown at Unca Creek (Obs 7) will be over 120 m and between 40 m and 80 m in areas about 200m from the creek line (including those areas where the creek diversion will run). Post-mining groundwater drawdown (at the point where Unca Creek meets the Reward pit) will recover very slowly and is not predicted to level out for about 180 years when it reaches levels that are still 18 - 23 m below existing levels (CloudGMS, 2018). From an ecological perspective this will likely result in a permanent 1 km severance of the Unca Creek riparian habitat and wildlife corridor and refuge habitat area. This has been discussed in more detail in Section 4.1 (Terrestrial Flora and Vegetation) and has been identified as a high risk.

### **Connectivity**

Habitat fragmentation is a reduction in the continuity of a habitat through disturbance or loss. It often results in the creation of many smaller habitat patches (with varying degrees of connectivity) in a previously large and continuous remnant habitat. The survival of species in a fragmented landscape depends, in part, on their ability to disperse. Discontinuity of habitat areas may present barriers that can impede or even prevent movement or dispersal between habitats. In an arid environment, the ecological value of aquatic systems is significant because they provide reliable sources of water during drought conditions and connectivity pathways during more favourable periods (Mancini, 2017). Many bird species use riparian vegetation for food, breeding and shelter (roosting) or regularly visit waters to drink while spending most time away from the rivers in adjacent habitats.

Similarly, many riparian bird species use the resources of adjacent landscapes on an occasional basis. There is a distinct possibility that these riparian corridors act as 'highways' for landbirds on the move, which means the rivers may play an important role in connecting bird populations across different regions in Australia (Mancini, 2017). In the Project area Unca Creek (and major tributary) and the associated floodplain vegetation connects areas of habitat in and around the Project area to Arthur Creek (north-east of the Project area).

The Project would retain the vast majority of the Unca Creek corridor, with additional haul-road crossings of minor drainage lines and two sediment dams (one on Unca Creek and one on the major tributary to the south). The expansion of the 'Reward' pit in the north of the Project area will result in the redirection of Unca Creek and the removal of 4.31 ha of riparian vegetation. In the short-term this will result in the severance of the wildlife corridor provided by Unca Creek. In the long-term (>20 years), the redirection of Unca Creek will be rehabilitated and the riparian vegetation will recover to provide a connectivity pathway in the landscape. This has not been identified as a risk in the risk assessment.

**Edge effects**

Edge effects occur when previously intact remnant vegetation is cleared in part, leaving a new boundary of vegetation that becomes exposed to some form of disturbance. Edge effects can include: the establishment of weeds (Section 4.1, Terrestrial Flora and Vegetation) (which is a medium risk), immigration of pest fauna species (which is a medium risk) and exclusion of more sensitive native species, dust deposition (Section 4.1, Terrestrial Flora and Vegetation) (which is a medium risk) and greater light intensity (which is a very low risk) and noise penetration (which is a low risk).

The construction and operation of the mine would cause ongoing and localised increases in noise, vibration and light disturbance in habitats directly adjacent to the Project. The extent of this impact would depend on the distance between the Project and the adjacent habitat, the level of noise and light emanating from the Project, the type of habitat (dense forest is more resilient) and the hours of operation. Nocturnal animals would be more susceptible to this disturbance, due to their sensitivity to light and noise. The mine is expected to operate 24 hours a day, seven days a week for 3 years (when open cut mining will cease).

Areas of remaining habitat potentially exposed to light and noise pollution are located adjacent to mine pits, haul roads and processing plant. These areas contain mostly low *Acacia sp.* shrubland and some *Corymbia* and *Acacia sp.* woodland habitats (sparse vegetation) that are easily penetrated by light and noise. It is anticipated that more sensitive, nocturnal fauna species inhabiting these woodland areas would be affected by light and noise issues, including native marsupials and rodents.

**RISK ASSESSMENT RATING: medium (before mitigation)****4.3.5.3. Impacts to threatened fauna**

Surveys recorded two species of conservation significance; *Dromaius novaehollandiae* (emu) and *Rattus villosissimus* (long-haired rat) within the Project area. Another four conservation significant fauna species were indicated as 'likely' to occur within the Project area:

- Australian bustard (*Ardeotis australis*) – Near threatened (TPWC Act)
- Red-tailed black cockatoo (*Calyptorhynchus banksii samueli*) – Near threatened (TPWC Act)
- Grey honeyeater (*Conopophila whitei*) – Data deficient (TPWC Act)
- Australian painted snipe (*Rostratula australis*) – Endangered (EPBC Act), Vulnerable (TPWC Act).

Three of these species have very broad habitat requirements and may utilise any of the mapped habitat types located in the Project area: emu, long-haired rat and Australian bustard. The removal of 197 ha of potential habitat in the Project area is not considered to have a significant impact on these species, which will be able to utilise areas of habitat that are not impacted by the operations in the Project area and surrounding environment.

The Red-tailed black cockatoo is associated with "Tall *Corymbia sp.* and *Acacia sp.* woodland" and "Tall *Eucalyptus sp.* woodland on drainage lines". Approximately 69.9 ha of potential habitat for the species would be removed by the Project, but this is not anticipated to have a significant impact on the species due to the amount of potential habitat within the Project area (1,843ha) and surrounds.

The Grey honeyeater is associated with "Tall *Acacia sp.* woodland" and "Tall *Corymbia sp.* and *Acacia sp.* woodland". Approximately 2.6 ha of potential habitat for the species would be removed by the Project, but this is not anticipated to have a significant impact on the species due to the amount of potential habitat within the Project area (151.3 ha) and surrounds.

The Australian painted snipe is associated with potential habitat at Jerois Dam, which will not be removed or altered during the lifetime of the Project. No significant impact is anticipated for this species.

**RISK ASSESSMENT RATING: low (before mitigation)**

#### 4.3.5.4. Impacts to migratory fauna

There were no listed migratory species recorded during surveys, however, the following species were considered as likely or potentially occurring when conditions are suitable:

- Fork-tailed swift (*Apus pacificus*)
- Sharp-tailed sandpiper (*Calidris acuminata*)
- Caspian tern (*Hydroprogne caspia*)
- Glossy ibis (*Plegadis falcinellus*)
- Common sandpiper (*Tringa hypoleucus*); and
- Common greenshank (*Tringa nebularia*).

The Jerois Dam provides potential habitat for migratory aquatic or wading species during the migration period, when there is water in the dam. No listed migratory species were recorded in the Project area in significant numbers to indicate any important feeding or breeding habitat. The Project does not propose to remove or reduce the Jerois Dam, which will remain functional as habitat for the life of the Project. No significant impact on Migratory species is expected to occur as a result of the Project and the proposed action will not be inconsistent with Australia's obligations under:

- (i) The Bonn Convention
- (ii) CAMBA
- (iii) JAMBA; or
- (iv) An international agreement approved under subsection 209(4) of the EPBC Act.

**RISK ASSESSMENT RATING: low (before mitigation)**

#### 4.3.5.5. Introduction of exotic fauna

The field surveys have recorded the presence of a variety of exotic fauna, namely:

- *Bos taurus* (domestic cattle)
- *Mus musculus* (house mouse)
- *Oryctolagus cuniculus* (rabbit); and
- *Felis catus* (feral cat).

The EPBC Act lists rabbits and feral cats as 'key threatening processes' to biodiversity due to their impact on wildlife and the landscape (TSSC 2009).

Most feral species are assumed to have resident populations in in the Project area and surrounds, though their abundance is likely to vary with the seasons. Feral animals threaten populations of native wildlife in two main ways: direct predation (for example by foxes, cats and dogs); or competition for limited resources (rabbits, rodents and pigs). As most of the Project area contains patchy remnant vegetation surrounded by agricultural uses, feral and pest animals already have access to (and have been recorded within) most habitat areas.

Activities associated with the Project may provide increased refuge and scavenging resources (e.g. discarded food scraps) for introduced fauna species. Feral animals would be discouraged within the

Project area by maintaining a clean, rubbish-free environment, and appropriately qualified persons would be engaged to undertake pest animal monitoring within the Project area. Feral animal control strategies (e.g. baiting, trapping) would be implemented in accordance with relevant standards to maintain low abundance of declared animals.

**RISK ASSESSMENT RATING: medium (before mitigation)**

4.3.5.6. Fauna mortality

**Clearance Activities**

Fauna present in the areas proposed to be cleared would be at risk of injury or fatality during clearance activities. The removal of habitat would also result in displacement of mobile species (such as birds and mammals) to similar habitats in the surrounding area. This was not identified as a risk in the risk assessment process. All of the fauna habitats mapped in the Project area occur more extensively within the surrounding landscape.

A staged and controlled land clearance practices will be adopted for the Project. Land clearance will occur progressively over the life of the mine and only in areas required for mining activities within the following year. The habitat to be cleared will be subject to targeted pre-clearance surveys for native fauna and breeding places. Fauna or breeding places identified during the pre-clearance surveys would be managed to minimise injury to resident fauna during clearance activities.

**Vehicle Strike**

Vehicle movements and road haulage has the potential to result in fauna mortality through vehicle strike and has been identified as a medium risk. Road mortality has been implicated in the decline of wildlife populations, including species of conservation significance (Rowden, Steinhardt, & Sheehan, 2008) (Taylor & Goldingay, 2004).

The main access road for the Project will make use of an existing road (Lucy Creek Access Road) and is located through sparsely wooded areas where visibility on the adjoining road shoulders is good. This will help to minimise the risk of vehicle strike to native fauna. There is one location, however, where the main access road would cross the Unca Creek major tributary and associated riparian woodlands, which serves as a movement corridor and refuge habitat for native fauna. It is possible that a higher occurrence of vehicle strike may affect this area. Vehicle movements within the Project area (e.g. from mine pits to the processing plant) will be subject to lower speed limits, which will assist to minimise the risk of fauna vehicle strike in these areas.

**Other incidental deaths**

There are other activities within the Project area that have the potential to result in a fauna mortality, for example:

- Entrapment of fauna within mine pits
- Entrapment of fauna within drill holes
- Falling down unstable slopes
- Electrocutation in transmission lines; and
- Drowning in dams.

These incidents have been identified as a low risk.

**RISK ASSESSMENT RATING: medium (before mitigation)**

#### 4.3.5.7. Hazardous material

Wildlife ingestion or exposure to hazardous material at the Project site is primarily a risk at tailings dams (which has been identified as a high risk) and through the escape of contaminated water into creeks and water supplies (which has been identified as a medium risk). Effects can be immediate or cumulative. Consumption of contaminated water by fauna can cause:

- Death or harm
- Disruption to breeding success; and
- Local increase in predators/scavengers to ill/dead fauna.

The potential release of contaminants into the environment is discussed in Section 4.1 (Terrestrial Flora and Vegetation). Exposure of fauna to hazardous material at the tailings dams is a potential impact primarily to birds that are attracted to large bodies of water. At the Project site, the tailings dams are located next to the processing plant and are surrounded by roads and other noisy infrastructure that will assist in deterring birds from utilising tailings dams. The design of the tailings dams will also follow best practice for the Northern Territory to be less attractive to birds. The Jervois Dam in the north-west of the will provide a more appropriate habitat for birds and act to entice them away from the tailings dams.

**RISK ASSESSMENT RATING: medium (before mitigation)**

#### 4.3.6. Mitigation measures

The mitigation strategy for the Project has focused on a hierarchy of:

1. Avoidance;
2. Minimisation;
3. Mitigation; then
4. Offset residual impacts.

The avoidance or minimisation of adverse impacts is most relevant to the design phase of the Project, where information collected through desktop analysis and field surveys can be incorporated into the planning and preliminary engineering work. Mitigation of impacts (including the implementation of monitoring and management plans) is most relevant to the construction and operational phases of the Project. Table 4.3-6 provides a summary of the mitigation strategies for the Project, with a brief description of potential impacts and measures that can be implemented at each stage in the life of the Project.

Residual impacts, after the implementation of the mitigation strategy, may be required to be offset in accordance with Commonwealth and State approval conditions. Offsets proposed for the Project are discussed in Section 4.1.

#### **Measures to avoid and minimise impacts**

The Project area covers approximately 3,800 ha. The total disturbance footprint for the Project will be approximately 970 ha, of which approximately 163 ha has been previously disturbed by historic mining activities. The Project will make use of existing infrastructure as far as possible, to reduce the development footprint. The majority of new infrastructure to be located on the existing infrastructure footprint may include:

- Mine pits
- Roads and access tracks



- Jervois Dam and spillway
- Processing plant & infrastructure
- Tailings Storage Facility (TSF)
- Waste rock dumps
- ROMs; and
- Mining village / camp.

**Impact mitigation**

Impact mitigation associated with the Project has been detailed in Table 4.3-6 **Error! Reference source not found.** Due to the length of time that the mine is expected to operate and the ongoing need for management of terrestrial flora during the operation of the mine, operational mitigation measures are best presented in 'Monitoring and Management Plans'.

**Table 4.3-6 Impact mitigation**

Potential Impact	Mitigation measures	
	Construction & Operation	Relevant Management Plans
1. Removal of habitat for pits and infrastructure	<ul style="list-style-type: none"> <li>• Land clearing will be undertaken in accordance with site Clearing Procedures to ensure clearing is minimised and is conducted within defined boundaries</li> <li>• Ensure there is an appropriately qualified Environmental Officer on-site.</li> <li>• Vegetation clearing / excavation to be subject to internal permitting system.</li> <li>• Staging of the works to manage habitat loss.</li> <li>• Demarcate exclusion zones to protect areas of vegetation to be retained prior to clearing.</li> <li>• Measures to retain mature trees or habitat trees where possible.</li> <li>• Collection of native seed from the Project area for use in rehabilitation program.</li> <li>• Progressive rehabilitation of Project area.</li> <li>• Ongoing implementation and monitoring of offsets.</li> </ul>	<p>Biodiversity Management Plan (Section 5)            Mine Rehabilitation and Closure Plan (Section 5)            Voluntary Offset Strategy (Section 4.1)</p>
2. Change in habitat quality	<p><b>Dust</b></p> <ul style="list-style-type: none"> <li>• Implement mitigation measures as outlined in Section 4.1 Terrestrial Flora and Vegetation.</li> <li>• Implement any mitigation measures recommended within the Environmental Management Plan.</li> </ul> <p><b>Erosion and sedimentation</b></p>	<p>Biodiversity Management Plan            Mine Rehabilitation and Closure Plan            Environmental Management Plan            Erosion and Sediment Control Plan</p>

Potential Impact	Mitigation measures	
	Construction & Operation	Relevant Management Plans
	<ul style="list-style-type: none"> <li>• Implement mitigation measures as outlined in Section 4.1 Terrestrial Flora and Vegetation.</li> <li>• Implement any mitigation measures recommended within the Erosion and Sediment Control Plan.</li> </ul> <p><b>Noise</b></p> <ul style="list-style-type: none"> <li>• Implement mitigation measures as outlined in Section 4.6 Air, Greenhous Gas and Noise.</li> </ul> <p><b>Hydrology</b></p> <ul style="list-style-type: none"> <li>• Implement any mitigation measures recommended within the Surface Water and Groundwater Management Plans.</li> <li>• Follow hierarchy of water supply:                             <ul style="list-style-type: none"> <li>○ Use of mine water and non-potable raw water;</li> <li>○ Jervois dam</li> <li>○ External groundwater borefield.</li> </ul> </li> <li>• Monitor the use of water and implement water restrictions, where possible.</li> <li>• Use of water is within the limits defined by any development approvals or conditions.</li> </ul> <p><b>Connectivity</b></p> <ul style="list-style-type: none"> <li>• Observe established buffer areas and no-go zones to avoid construction and mine activity within sensitive areas.</li> <li>• Ensure redirected portion of Unca Creek is rehabilitated to represent the riparian community and provide connectivity along Unca Creek to areas to the east.</li> </ul>	

Potential Impact	Mitigation measures	
	Construction & Operation	Relevant Management Plans
	<ul style="list-style-type: none"> <li>• Monitor Unca Creek riparian habitat and rehabilitation area.</li> </ul> <p><b>Edge effects</b></p> <ul style="list-style-type: none"> <li>• Limit Project lighting.</li> <li>• Where lighting is required, use directional lighting to reduce the spill over into surrounding areas.</li> <li>• Blasting to be undertaken (if necessary) during the middle of the day when fauna movement is generally at its lowest.</li> <li>• To minimise noise from construction equipment, equipment to be where practicable the quietest available in existing stock, properly maintained, monitored to ensure noise emissions in accordance with manufacturer's specifications and Australian Standards, and fitted with noise suppression equipment consistent with the requirements of the activity.</li> <li>• Maintain machinery to ensure optimal operation and minimal unnecessary noise.</li> <li>• Use lighting in buildings only as required, i.e. sensor lighting or switch off during non-operational hours.</li> <li>• Implement weed management as recommended in Section 4.1 Terrestrial Flora and Vegetation.</li> </ul>	
3. Impacts to threatened fauna	<ul style="list-style-type: none"> <li>• Implement mitigation measures for habitat clearance and habitat quality as outlined above.</li> </ul>	Biodiversity Management Plan Voluntary Offset Strategy

Potential Impact	Mitigation measures	
	Construction & Operation	Relevant Management Plans
	<ul style="list-style-type: none"> <li>• Implement mitigation measures for fauna mortality as outlined below.</li> <li>• Provide offsets for the removal of areas of mature <i>Eucalyptus sp.</i> or <i>Corymbia sp.</i> that may provide nesting resources for large parrots (such as Red-tailed black cockatoo) and feeding resources for Grey honeyeater.</li> <li>• Ongoing monitoring of fauna species present in the Project area.</li> </ul>	
4. Exotic fauna	<ul style="list-style-type: none"> <li>• Ensure site waste management measures reduce the potential to attract vermin and other fauna.</li> <li>• Any waste storage facilities associated with the Project to be designed and located to restrict fauna access.</li> <li>• Management of feral animals, particularly rabbits and cats.</li> <li>• Fauna, including pest species, will not be fed.</li> <li>• Implement weed management protocol to prevent degradation of remaining habitat areas and spread of feral animals into degraded areas.</li> </ul>	Biodiversity Management Plan
5. Fauna mortality	<ul style="list-style-type: none"> <li>• Ensure there is an Environmental Officer on-site to address in a timely manner potential issues that may arise.</li> <li>• Staff, including contractors, to be inducted in relation to the risks of fauna injury and deaths and how to manage</li> </ul>	Biodiversity Management Plan

Potential Impact	Mitigation measures	
	Construction & Operation	Relevant Management Plans
	<p>animals that are injured or displaced, including threatened species.</p> <ul style="list-style-type: none"> <li>• Where practical, retain hollow-bearing trees and large stags as potential nesting and roosting habitat, especially near watercourses and wetland areas.</li> <li>• Stockpiling of cleared vegetation can provide habitat for native animals, particularly reptiles, echidnas and ground-dwelling mammals.</li> <li>• Appropriate signage in prominent positions to reduce vehicle speeds in the Project area, to promote awareness and to provide safety for fauna crossing or inhabiting the area.</li> <li>• Vehicular traffic generally to be restricted to access tracks and not to exceed speed restrictions.</li> <li>• Record incidences of fauna mortality to inform future management.</li> </ul>	
6. Hazardous material	<ul style="list-style-type: none"> <li>• Design of tailings dams to follow best practice guidelines currently recommended for the Northern Territory.</li> <li>• Reduce the attractiveness of the dam landscape for wildlife via design that includes, but is not limited to, the reduction of the dam surface area, removing dam bank vegetation, creating steep dam walls and avoiding the creation of islands in the dam</li> </ul>	Biodiversity Management Plan Waste Management Plan Mine Rehabilitation and Closure Plan

### **Operational management and monitoring plans**

The Jervois Mine will be required to have a Mining Management Plan (MMP) under the *Mining Management Act 2001*. The primary purpose of a Mining Management Plan (MMP) is to formalise the actions to be taken and strategies to be implemented, that combined, will manage impacts to the environment to acceptable and sustainable limits over both the short and long-term. The MMP has several components or sub-plans relating to the management of various issues. The Biodiversity Management Plan (BMP) has been developed to provide a clear and concise outline of the actions and methods required to mitigate likely impacts on biodiversity including:

- Procedures to be adopted during vegetation clearing, including wildlife rescue procedures;
- Weed and feral animal management; and
- Mitigation of potential impacts on rare, threatened species.

In addition to this BMP, the management of biodiversity is addressed in several other sub-plans including:

- Environmental Management Plan;
- Erosion and Sediment Control Plan;
- Water Management Plan;
- Waste Management Plan; and
- Bushfire Management Plan.

These sub-plans will consolidate information regarding the management of specific issues during the operation of the mine and provide for ongoing reference over the life of the mine. These management sub-plans will be kept on site for continual reference. The BMP forms part of the MMP for the Project and is considered to be a working document. It will be updated following formal assessment of the EIS by the NT EPA, and by Department of Mines and Energy through the mine authorisation process. The BMP is provided as part of this EIS in Section 5.

#### **4.3.7. Decommissioning of the mine**

At the end of the mine life, it is expected that the mine site will be rehabilitated to be fit for the nominated future land use. Currently the Project area is part of the Jervois Pastoral Lease and has been used historically for mining and a low level of cattle grazing. It is anticipated that the post-mining land form will remain suitable for cattle grazing, with a combination of grassland and wooded areas representing the vegetation communities currently extant in the Project area.

Rehabilitation will be performed in accordance with contemporary accepted industry best practice and conducted in accordance with an approved MMP. KGL has prepared a Mine Rehabilitation and Closure Plan. The MRCP will be a dynamic document that is reviewed regularly to ensure the plan remains relevant to the activities being undertaken and planned to be undertaken. The MRCP will include a post-closure monitoring and reporting program to evaluate rehabilitation success and progress toward achieving closure objectives and contingency measures to be implemented in the event that monitoring demonstrates that rehabilitation closure objectives are not being met.



### 4.3.8. Conclusions

The Jervois Base Metal Project Environmental Impact Statement (EIS) Terms of Reference has identified terrestrial fauna as a preliminary environmental factor that may be impacted by the Project. In order to better understand the terrestrial fauna values of the Project area, a number of ecological investigations were undertaken by Low Ecological Services P/L between 1985 and 2018. The studies included desktop assessment (i.e. interrogation of spatial databases and reviews of relevant literature) and field work involving on-ground fauna surveys in 1999, 2012, 2013, 2017 and 2018. General fauna survey methodology follows the NT EPA “Guidelines for Assessment of Impacts on Terrestrial Biodiversity” (NT EPA, 2013). Additional targeted surveys were conducted for fauna species of conservation significance listed under the TPWC Act that were identified in database searches as potentially occurring within the Project area.

Based on survey results, six habitat types have been mapped over the entire Project area (3,800 ha). The most common habitat type in the Project area is “Tall *Corymbia sp.* and *Acacia sp.* woodland” followed by “Low *Acacia sp.* shrubland”. Two fauna species listed as near threatened under the *Territory Parks and Wildlife Conservation Act* (TPWC Act), emu (*Dromaius novaehollandiae*) and long-haired rat (*Rattus villosissimus*), were recorded during on-ground surveys. There were no listed migratory species recorded during fauna surveys, although the Jervois Dam was identified as potential habitat for migratory species that may be in transit over the Project area. The Project area contained four exotic fauna species (cat, rabbit, house mouse and cattle) but was generally considered to be in good condition considering a long history (since 1929) of mining and the presence of some existing mining infrastructure.

The construction and operation of the mine is associated with a number of potential impacts to the floristic values of the Project area, including:

- Removal of habitat for pits and infrastructure
- Change in habitat quality
- Impacts to threatened fauna
- Impacts to migratory fauna
- Introduction of exotic fauna
- Fauna mortality; and
- Hazardous material.

A risk assessment process as described in AS/NZS 4360 (1999) and ISO 31000 (2009) has been undertaken for each impact before the application of any mitigation measures. Risk levels for impacts to fauna values of the Project area ranged from low to high. The application of mitigation measures will ameliorate the level of risk to an acceptable level for the Project.

The Jervois Mine will be required to have a Mining Management Plan (MMP) under the *Mining Management Act 2001*. The primary purpose of a Mining Management Plan (MMP) is to formalise the actions to be taken and strategies to be implemented, that combined, will manage impacts to the environment to acceptable and sustainable limits over both the short and long-term. The MMP has several components or sub-plans relating to the management of various issues. The Biodiversity Management Plan (BMP) has been developed to provide a clear and concise outline of the actions and methods required to mitigate likely impacts on biodiversity including:

- Procedures to be adopted during vegetation clearing, including wildlife rescue procedures;
- Weed and feral animal management; and

- Mitigation of potential impacts on rare, threatened species.

Other plans will also have components addressing biodiversity, such as the Environmental Management Plan, Erosion and Sediment Control Plan, Water Management Plan, Waste Management Plan, Bushfire Management Plan and Mine Closure and Rehabilitation Plan. The BMP forms part of the MMP for the Project and is considered to be a working document. It will be updated following formal assessment of the EIS by the NT EPA, and by Department of Mines and Energy through the mine authorisation process. Further, a voluntary offset strategy has been proposed for the removal of some ecological values considered to be of local significance in the ecological assessments completed for the Project.