



# Hemi Gold Project

Detailed Vertebrate Fauna Survey 2021 – 2022



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## Executive Summary

### Introduction

De Grey Mining Limited proposes to develop the Hemi Gold Project, located in the Pilbara region of Western Australia, approximately 85 km south of Port Hedland, within the Town of Port Hedland Local Government Area. Western Wildlife was commissioned to carry out a two-phase detailed fauna survey of the Hemi study area, and a basic survey of the proposed infrastructure corridors. The purpose of the fauna survey was to gather baseline fauna data to inform environmental impact assessment as part of Project approvals. This report includes the findings of the two-phase baseline vertebrate fauna survey, conducted in September 2021 and March 2022, with some supporting data collected in August 2022.

### Methods

The fauna survey was undertaken in accordance with the Technical Guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020) and relevant State and Federal Guidelines on surveying conservation significant fauna. The fauna survey comprised three fieldtrips, 19 – 30 September 2021, 14 – 25 March 2022 and 9 – 12 August 2022, with methods including:

- trapping at six sites for seven nights, each with ten pitfall traps, ten funnel traps, ten Elliott traps and two cage traps
- bird surveys at each trapping site and opportunistically
- bat surveys with ultrasonic detectors
- Night Parrot survey with passive acoustic detectors at 13 sites in March 2022
- camera trap survey, particularly targeting Northern Quoll (*Dasyurus hallucatus*)
- nocturnal transects and searches
- diurnal transects and searches, particularly targeting the Bilby (*Macrotis lagotis*)
- keeping opportunistic records of fauna.

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

## **Results and Discussion**

Six fauna habitats were identified in the study area:

- Spinifex Sandplain
- Sandplain Drainage
- Sand Dune
- Major River
- Stony Hills
- Rocky Outcrops

Of these habitats, the Rocky Outcrops and Sand Dune are limited in extent in the study area and the wider region. The Major River is an ecological linkage and an area of higher productivity due to the presence of waterholes.

The predicted faunal assemblage includes up to ten frogs, 115 reptiles, 165 birds, 36 native mammals and eight introduced mammals. The observed assemblage thus far includes six frogs, 56 reptiles, 83 birds, 22 native mammals and six introduced mammals.

Thirty-one conservation significant fauna have either been recorded or may occur in the study area, seven Threatened, 14 Migratory, one Specially Protected, eight Priority and one Locally Significant.

The seven **Threatened** species are:

- Northern Quoll (*Dasyurus hallucatus*) – EBPC Act (Endangered), BC Act (Endangered)
- Pilbara Olive Python (*Liasis olivaceous barroni*) – EBPC Act (Vulnerable), BC Act (Vulnerable)
- Grey Falcon (*Falco hypoleucos*) – EBPC Act (Vulnerable), BC Act (Vulnerable)
- Night Parrot (*Pezoporus occidentalis*) – EBPC Act (Endangered), BC Act (Critically Endangered)
- Bilby (*Macrotis lagotis*) – EBPC Act (Vulnerable), BC Act (Vulnerable)
- Pilbara Leaf-nosed Bat (*Rhinionictoris aurantia*) – EBPC Act (Vulnerable), BC Act (Vulnerable)
- Ghost Bat (*Macroderma gigas*) – EBPC Act (Vulnerable), BC Act (Vulnerable)

The Northern Quoll was recorded and the study area provides Rocky Outcrop and Major River habitat critical to the survival of the species. These habitats are also likely to support the Pilbara Olive Python and the Grey Falcon may breed along the Major River. A Night Parrot survey in March 2022 failed to detect the species. There are some patches of mature spinifex that are potential Night Parrot breeding and roosting habitat, but this extremely rare species has only been recorded at a few sites in Western Australia. Secondary signs of the Bilby were recorded in the Sand Dune and Spinifex Sandplain habitats, and this species is likely to be widespread in the region. Pilbara Leaf-nosed Bat was recorded on this survey and the study area provides foraging habitat for both this species and the Ghost Bat, but diurnal roosting habitat is absent.

The 14 **Migratory** species are:

- Fork-tailed Swift (*Apus pacificus*)
- Oriental Plover (*Charadrius veredus*)
- Sharp-tailed Sandpiper (*Calidris acuminata*)
- Pectoral Sandpiper (*Calidris melanotos*)
- Red-necked Stint (*Calidris ruficollis*)
- Wood Sandpiper (*Tringa glareola*)
- Common Greenshank (*Tringa nebularia*)
- Marsh Sandpiper (*Tringa stagnatilis*)
- Common Sandpiper (*Actitis hypoleucos*)
- Eastern Osprey (*Pandion cristatus*)
- Oriental Pratincole (*Glareola maldivarum*)
- Gull-billed Tern (*Gelochelidon nilotica*)
- Caspian Tern (*Hydroprogne caspia*)
- Glossy Ibis (*Plegadis falcinellus*)

Of the Migratory species predicted to occur, only the Fork-tailed Swift was recorded. Most of the remaining species are likely to be non-breeding summer visitors to the study area, many being shorebirds that may use waterholes in the Major Rivers and possibly claypans in the Spinifex Drainage habitat. In general, the study area is unlikely to provide important habitat to Migratory fauna.

The one **Specially Protected** species is:

- Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon potentially occurs in the study area but its favoured breeding habitat is absent.

The eight **Priority** species are:

- Pin-striped Finesnout Ctenotus (*Ctenotus nigrilineatus*) – Priority 1
- Gane's Blind Snake (*Anilius ganei*) – Priority 1
- Northern Coastal Free-tailed Bat (*Ozimops cobourgianus*) – Priority 1
- Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4
- Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus*) – Priority 4
- Lakeland Downs Mouse (*Leggadina lakedownensis*) – Priority 4
- Western Pebble-mound Mouse (*Pseudomys chapmani*) - Priority 4

The Pin-striped Finesnout Ctenotus and Gane’s Blind Snake are poorly known, but possibly occur in the study area. The Northern Coastal Free-tailed Bat was recorded in the study area, foraging over Spinifex Sandplain and Sandplain Drainage habitats. The Long-tailed Dunnart is known from the region and potentially occurs in the Stony Hills and Rocky Outcrops. The Brush-tailed Mulgara was recorded in the Spinifex Sandplain and Sandplain Drainage habitats on this survey and is widely recorded on sandplains in the region. The Spectacled Hare-wallaby is likely to occur in the Spinifex Sandplain and Spinifex Drainage habitats where there is mature spinifex to provide shelter. The Lakeland Downs Mouse potentially occurs, possibly favouring the Spinifex Drainage habitat. Active mounds of the Western Pebble-mound Mouse were recorded in the Stony Hills habitat.

The one **Locally Significant** species is:

- Rufous-crowned Emu-wren (*Stipiturus rufus*)

This species is only likely to occur where there is mature spinifex and is likely to be locally extinct in areas that experience frequent fires. It was not recorded on this fauna survey.

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## 1. Introduction

De Grey Mining Limited proposes to develop the Hemi Gold Project, located in the Pilbara region of Western Australia, approximately 85 km south of Port Hedland, within the Town of Port Hedland Local Government Area.

An application for Mining Lease is 47/1628 is currently pending for the Hemi deposit and processing facilities. Several applications for Miscellaneous Licenses covering associated project infrastructure include L45/600, L45/604, L45/635, L47/962, L47/963, L47/964, L47/965, L47/966, L47/967, L47/975, L47/1047, L47/1048 and L47/1049.

Project components are likely to comprise:

- Open cut mining of gold bearing ore from the Hemi deposits.
- The construction and subsequent operation of a 10 Mtpa processing facility located adjacent to the Hemi deposit, capable of achieving 90% to 94% gold recovery from free milling and semi refractory ores.
- Disposal of process tailings to a surface Tailings Storage Facility (TSF) with a capacity for 130 Mt of processed ore.
- Water supply from the local groundwater aquifer with accompanying groundwater and surface water management infrastructure to facilitate mine dewatering.
- Stockpiling of waste rock to form permanent landforms.
- A village with messing and accommodation capacity for approximately 600 personnel.
- A power supply from the 220 kilo Volt (“kV”) network grid approximately 40 to 60 kilometres (“km”) north of the processing facility.
- A 9 km sealed access road from the Great Northern Highway.
- An airstrip with capacity for 100 seat jet aircraft.
- Other supporting infrastructure (offices, workshops, waste facilities, laydowns).

Western Wildlife was commissioned to carry out a two-phase detailed fauna survey of the Hemi study area, and a basic survey of the proposed infrastructure corridors. The purpose of the fauna survey was to gather baseline fauna data to inform environmental impact assessment as part of Project approvals. The key objectives of the fauna survey were to:

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

This report includes the interim findings of the two-phase baseline vertebrate fauna survey and targeted surveys conducted in September 2021, March 2022 and August 2022.

## 1.1 Regional Context

### 1.1.1 IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia into 89 Bioregions and 419 subregions, each defined by a set of environmental influences that impact the occurrence of flora and fauna and their interaction with the physical environment (DCCEEW 2020).

The Project is situated in the Chichester subregion of the Pilbara Bioregion (DEWHA 2004), which is comprised of undulating plains of Achaean granite and basalt, with basalt ranges (Kendrick and McKenzie 2001). The plains support open shrublands of *Acacia* over spinifex hummock grasslands, and the ranges support an open tree-steppe of *Eucalyptus leucophloia* over spinifex hummock grasslands.

The climate is semi-desert tropical, receiving about 300mm of rain per year (Kendrick and McKenzie 2001). The dominant land-uses are grazing on native pastures, Aboriginal lands and reserves, Unallocated Crown Land and Crown Reserves, Conservation and Mining (Kendrick and McKenzie 2001).

### 1.1.2 Botanical Province

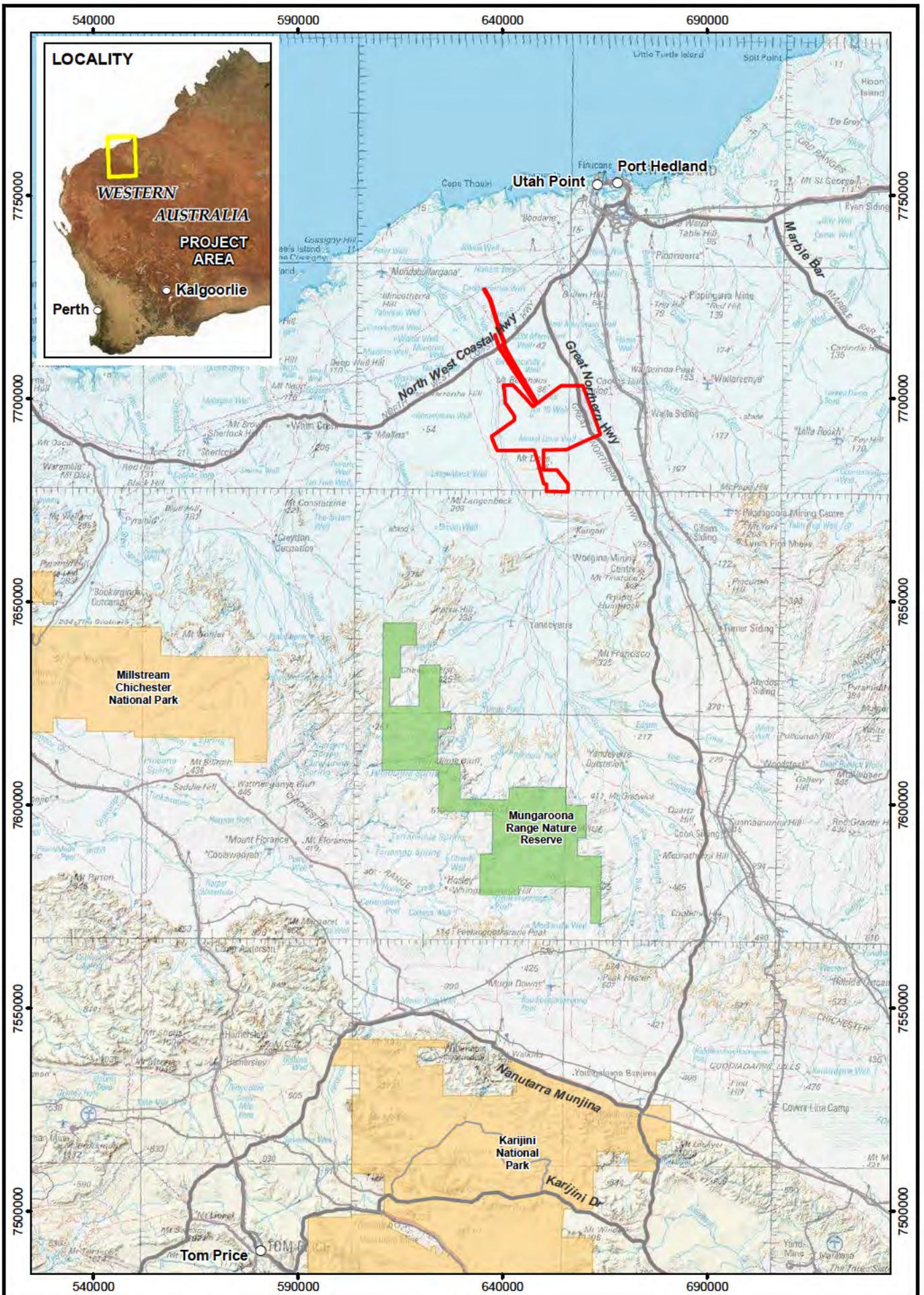
The Botanical Provinces are determined by vegetation mapping (Beard 1980) and broadly correspond to climactic regions; the Southwest (Bassian) Province experiencing warm dry summers and cool wet winters, the Northern Province experiencing warm wet summers and cool dry winters and the Eremaean Province experiencing low, irregular rainfall. The study area is in Eremaean Province.

### 1.1.3 Parks and Reserves

There are no reserves in or directly adjacent to the study area. The nearest reserves are Mungaroona Nature Reserve (45km south) and Millstream-Chichester National Park (50km south) (Figure 1).

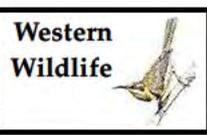
### 1.1.4 Threatened or Priority Ecological Communities

The study area includes the Priority 3 Ecological Community *Gregory Land System*. This ecological community is defined primarily by its vegetation so its significance is not further discussed in this report, except in terms of its habitat value to fauna.



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 Author: J. Wilcox



**Hemi Gold Project  
 Location**

Figure: **1**

### 1.1.5 Land Systems

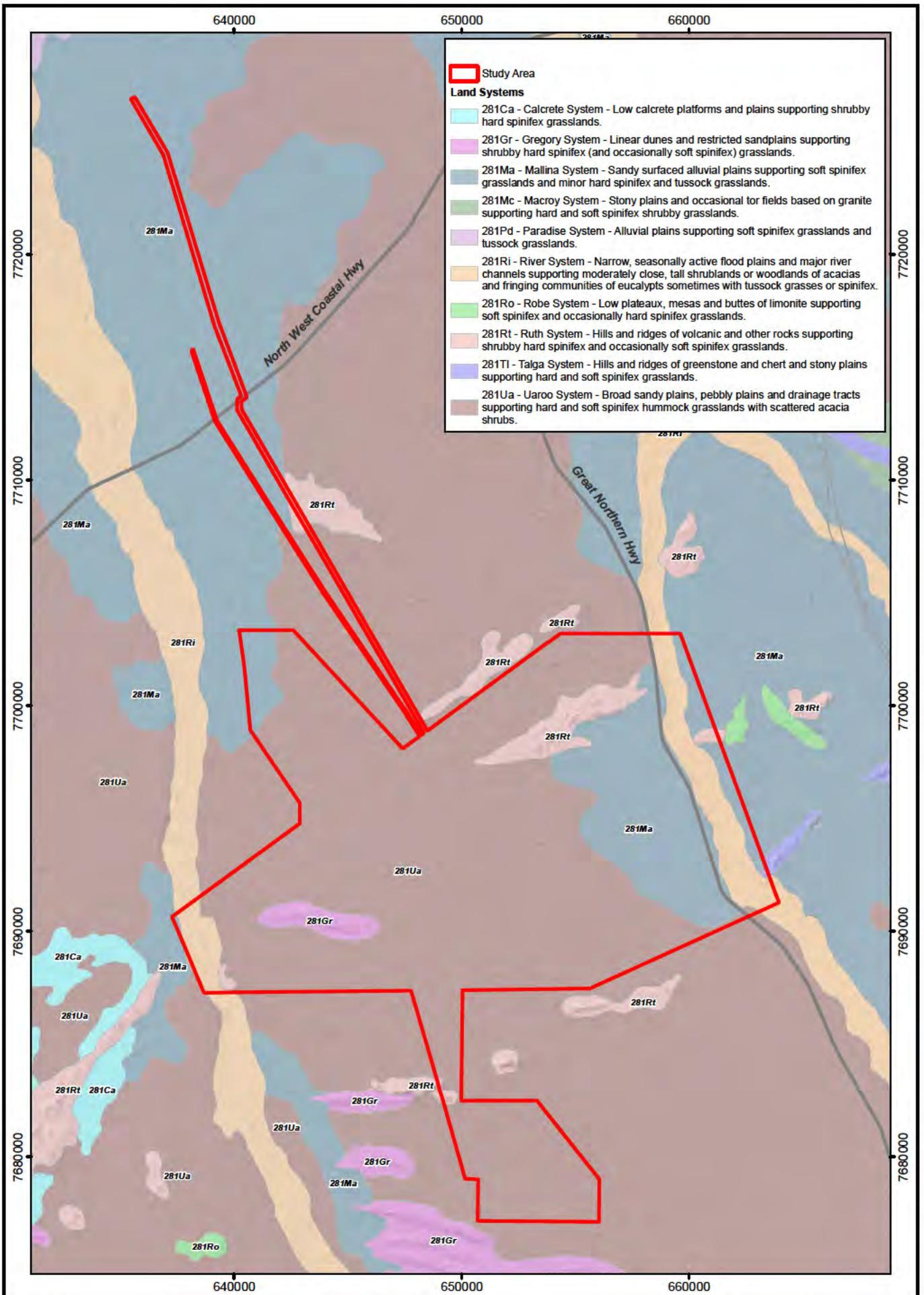
Land systems are broad descriptions of landform, geology and soils. The study area intersects six land systems (Figure 2), which are characterised as follows:

- **Uaroo System:** Broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered acacia shrubs.
- **Mallina System:** Sandy surfaced alluvial plains supporting soft spinifex grasslands and minor hard spinifex and tussock grasslands.
- **Ruth System:** Hills and ridges of volcanic and other rocks supporting shrubby hard spinifex and occasionally soft spinifex grasslands.
- **River System:** Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.
- **Gregory System:** Linear dunes and restricted sandplains supporting shrubby hard spinifex (and occasionally soft spinifex) grasslands.
- **Talga System:** Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.

## 1.2 Study Area

The study area is 34,687 ha and is shown in Figure 3. It includes two proposed infrastructure corridors extending from the edge of the study area 20 – 30 km to the north.

The majority of the study area is located on Indee Station. Except for roads and tracks, the entire area is under native vegetation over which the dominant land use is cattle grazing. There are several wells with cattle troughs, some with open water in small turkey's nests. The study area includes a portion of both the Yule and Turner Rivers.



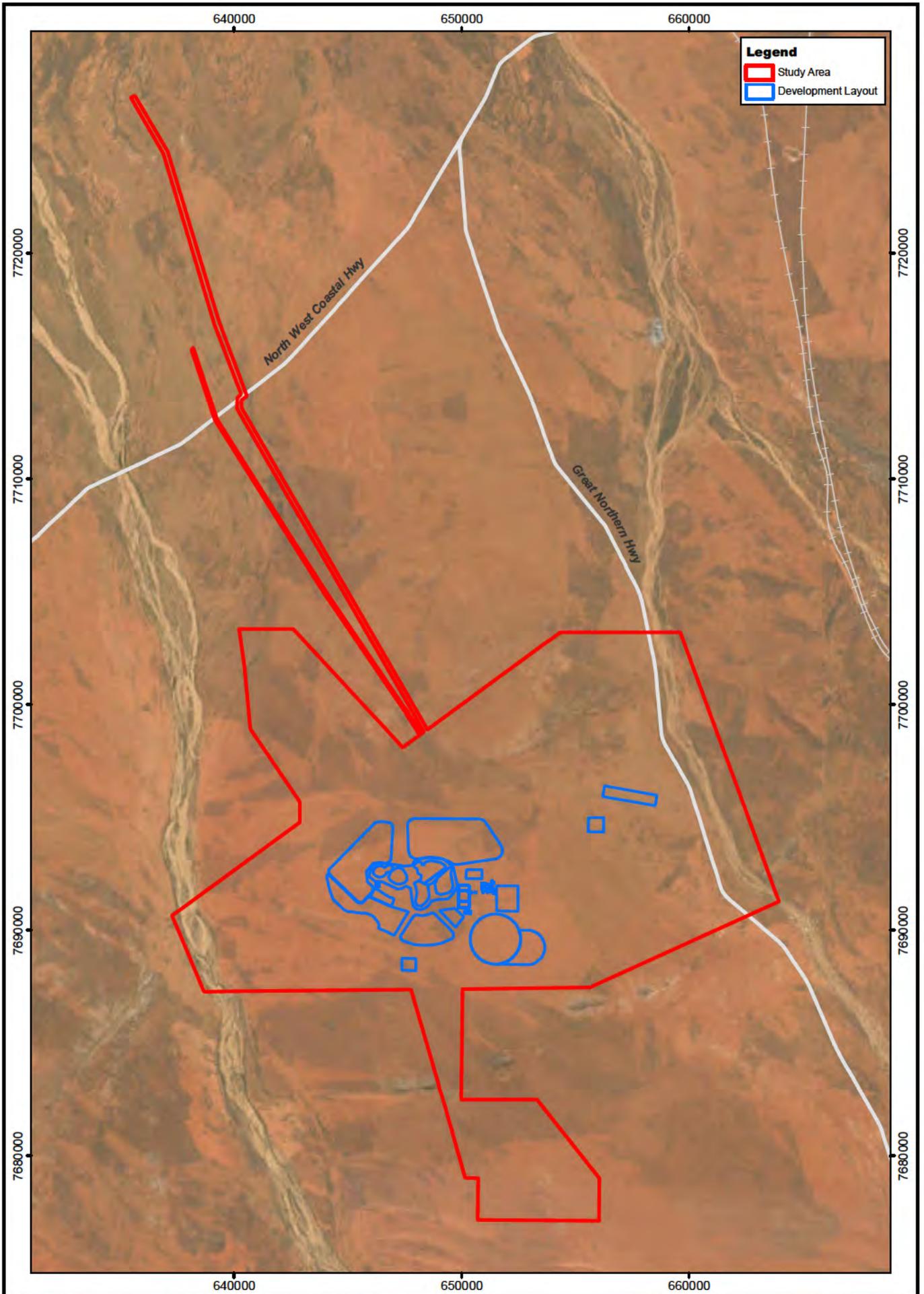
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**Hemi Gold Project  
 Land Systems**

Figure:  
**2**



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 Author: J. Wilcox

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### Hemi Gold Project Study Area

Figure:  
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### 1.3 Climate and Weather

The nearest weather station is Port Hedland Airport (site number 004032), about 80km north of the study area. The mean monthly maximum and minimum temperatures and rainfall for this weather station are presented in Figure 4. The data indicate that the highest rainfall and temperatures occur in the summer months.

The long-term average annual rainfall for Port Hedland is 317.0mm, based on data between 1942 and 2022 (Bureau of Meteorology 2022). The annual rainfall was about average in 2020 (310.6mm), but lower than average in 2021 (204.0mm). Weather during both phases of the survey was characterised by warm nights, hot days and high humidity. The daily temperatures and rainfall prior to and during the field surveys (as recorded at Port Hedland), are presented in Appendix 1.

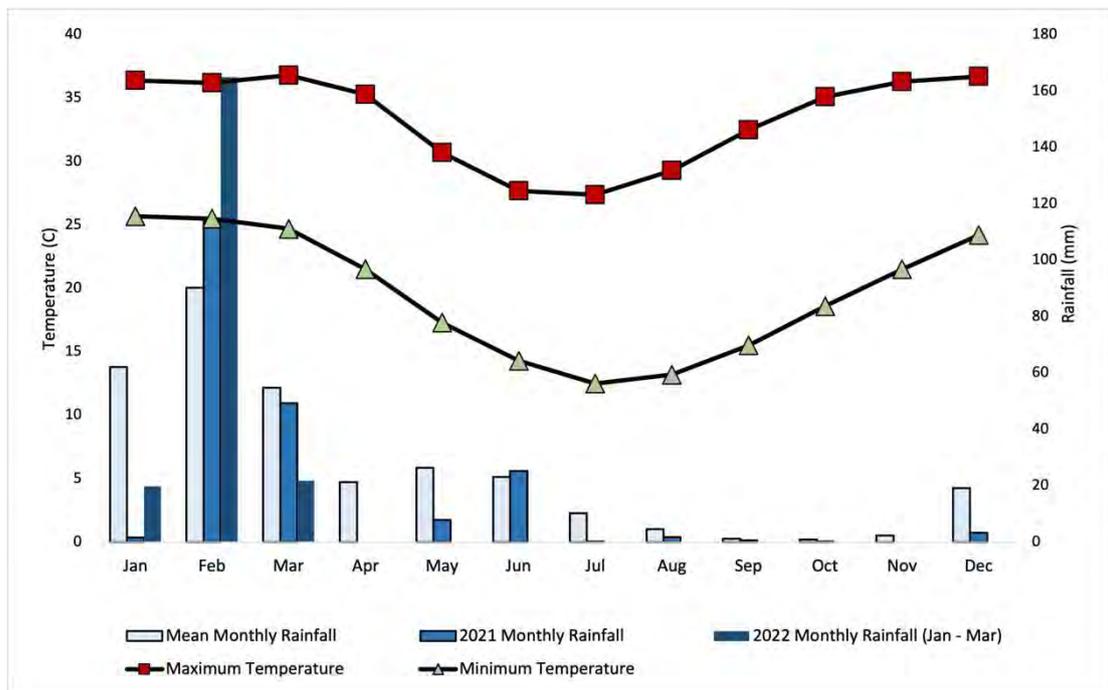


Figure 4. Monthly Climate Statistics for Port Hedland Airport.

## 2. Methods

### 2.1 Overview

A two-phase detailed vertebrate fauna survey was conducted across the study area in September 2021 and March 2022, with some additional targeted surveys in August 2022. Surveys targeting conservation significant fauna, including the Northern Quoll (*Dasyurus hallucatus*), Bilby (*Macropus lagotis*) and the Night Parrot (*Pezoporus occidentalis*), were undertaken where there was habitat that potentially supported each species.

The methods are further described in the sections below.

### 2.2 Guidance Documents

The fauna survey was conducted with reference to the following documents:

- Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020)
- Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia (DPAW 2017)
- EPBC Act Referral Guideline for the Endangered Northern Quoll (DoE 2016)
- Guidelines for Surveys to Detect the Presence of Bilbies and to Assess the Importance of Habitat in Western Australia (DBCA 2017)
- Survey Guidelines for Australia’s Threatened Mammals (DSEWPaC 2011a)
- Survey Guidelines for Australia’s Threatened Bats (DEWHA 2010a)
- Survey Guidelines for Australia’s Threatened Birds (DEWHA 2010b)
- Survey Guidelines for Australia’s Threatened Reptiles (DSEWPaC 2011b)

### 2.3 Personnel

Four to six zoologists undertook each phase of the fieldwork, with bat call analysis provided by Specialised Zoological (2022). Details of the survey team and their experience are shown in Table 1. This report was prepared by Ms Jenny Wilcox.

**Table 1. Fauna survey personnel.**

Name	Role	Qualification	Experience	Survey
Jenny Wilcox	Supervising Vertebrate Zoologist (plan and lead fieldwork, analyse data, prepare report)	BSc.Biol/Env.Sci., Hons.	>20 years	Sept, Mar, Aug
Mike Brown	Vertebrate zoologist (fieldwork)	BSc.Env.Sci.	15 years	Sept, Mar
Samantha Lostrom	Vertebrate zoologist (fieldwork)	BSc.Biol., Hons.	>10 years	Sept, Mar
Brenden Metcalf	Vertebrate zoologist (fieldwork)	BSc.Biol., Hons.	>20 years	Mar
Wes Bancroft	Vertebrate zoologist (fieldwork)	PhD. Zool.	>20 years	Sept
Judy Dunlop	Vertebrate zoologist (fieldwork)	PhD. Zool.	>10 years	Sept, Mar
Joanna Riley	Vertebrate zoologist (fieldwork)	PhD. Zool.	>5 years	Mar
Louis Maserei	Vertebrate zoologist (fieldwork)	BSc.	>10 years	Aug
Kyle Armstrong	Bat call analysis	PhD. Zool.	>20 years	Sept, Mar

## 2.4 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report follow the Western Australian Museum checklists. In the text, common names are used where appropriate, and all scientific names are given in species lists. Where a species lacks a common name, they are referred to by their scientific name.

## 2.5 Literature Review

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

The databases in Table 2 were searched for fauna records in and around the study area. In all cases the extent of the database search was larger than the extent of the study area in order to pick up records of species in the wider area that may also occur in the study area.

Some species may occur on database results that are not likely to be present in the study area, usually due either to lack of suitable habitat or the study area being outside the known range of the species (i.e., erroneous records or records of vagrants). Some records may be historical, with the species known to be locally or regionally extinct. These species are generally not included in lists of expected fauna unless some discussion is thought to be necessary.

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

Database	Type of records held	Area searched
DBCA's Threatened and Priority Fauna Database (DBCA 2021)	Information and records on Threatened and Priority species in Western Australia. Includes records collated from Birds Australia, the Fauna Survey Returns Database and the Western Australian Museum Database.	Mallina Gold Project tenements with a 20km buffer
Dandjoo (DBCA 2023)	Records of fauna, excluding Threatened and Priority Fauna from several sources including industry and research.	Study area with a 100km buffer
Atlas of Living Australia (ALA) Database (ALA 2022)	<ul style="list-style-type: none"> <li>• Birds Australia Atlas Database - records of bird observations in Australia, 1998-2009.</li> <li>• Birdata - records of bird observations in Australia, 2010-current.</li> <li>• WA Museum Specimen Databases for reptiles frogs, birds and mammals - records of specimens held in the Western Australian Museum. Includes historical records.</li> </ul>	Study area with a 40km buffer
Index of Biological Surveys for Assessment (IBSA) Database	Reports and spatial data from fauna surveys undertaken for environmental impact assessment in Western Australia.	Surveys in the Pilbara Bioregion, within 50km of the study area.
EPBC Act Protected Matters Search Tool	Information and modelled distributions for matters protected under the EPBC Act, including threatened species and ecological communities, migratory species and marine species.	Study area with a 5km buffer

In addition, the results of the following fauna survey reports from Projects within 50km of the study area were used to compile the fauna lists:

- 360 Environmental. (2018a). *Flora, Vegetation and Fauna Assessment Wodgina Mine and Proposed Airstrip*. Unpublished report prepared for Mineral Resources Limited.
- 360 Environmental. (2018b). *Wodgina Mine and Additional Gas Pipeline: Flora, Vegetation, Fauna and Northern Quoll Assessment*. Unpublished report prepared for Mineral Resources Limited.
- Biologic (2018a). *Wodgina DSO Project: Northern Quoll Monitoring Survey*. Unpublished report to Atlas Iron Limited.
- Biologic (2018b). *Wodgina DSO Project: Pilbara Leaf-nosed Bat and Ghost Bat Monitoring Survey*. Unpublished report to Atlas Iron Limited.
- Biota (2002a) *An Assessment of the Distribution of the Mulgara Dasycercus cristicauda and Bilby Macrotis lagotis Along and Adjacent to the Proposed Hope Downs to Port Hedland Rail Corridor*. Unpublished report to Hope Downs Management Services.
- Biota (2002b) *Proposed Hope Downs Rail Corridor from Weeli Wolli Siding to Port Hedland – Vertebrate Fauna Survey*. Unpublished report to Hope Downs Management Services.
- Biota (2004) *Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor*. Unpublished report to Fortescue Metals Group.
- Outback Ecology (2009). *Wodgina DSO Project: Terrestrial Vertebrate Fauna Assessment*. Unpublished report prepared for Atlas Iron Limited.

- Outback Ecology (2011). *Mt Dove DSO Project: Vertebrate Fauna Assessment*. Unpublished report to Atlas Iron Limited.
- Outback Ecology (2012). *Hercules Project: Terrestrial Vertebrate Fauna Baseline Survey*. Unpublished report prepared for Atlas Iron Limited.
- Stantec (2017). *Northern Quoll Monitoring Survey 2017*. Unpublished report prepared for Atlas Iron Limited.
- Stantec (2018a). *Results of the Wodgina Supplementary Bat Survey*. Unpublished memo to Mineral Resources Limited, November 2018.
- Stantec (2018b). *Wodgina Project: Level 1 fauna Survey, targeted conservation significant fauna survey and desktop assessment*. Unpublished report prepared for Mineral Resources Limited, September 2018.

## 2.6 Field Survey

### 2.6.1 Licensing

The fauna survey was carried out under Regulation 27 Fauna Taking (Biological Assessment) License BA27000508 issued by the Department of Biodiversity, Conservation and Attractions (DBCA) and Section 40 Authorisation to Take or Disturb Threatened Species TFA 2021-0107.

### 2.6.2 Timing

The fieldwork was undertaken on the following dates:

- 19 – 30 September 2021
- 14 - 25 March 2022
- 9 – 12 August 2022

The detailed survey was undertaken in September and March. This is during the recommended September – April survey period for reptiles in the Eremaean region. The March survey was timed to follow summer rainfall, targeting birds and mammals (EPA 2020), however, limited rainfall fell in the region during the 2021-2022 summer period. The August survey involved methods such as diurnal transects, for which timing was not critical.

### 2.6.3 Trapping for Terrestrial Fauna

Trapping for terrestrial fauna (frogs, reptiles and small mammals) was undertaken using a combination of pitfall traps, Elliot traps, funnel traps and cage traps.

Six trapping sites were installed in 2021, each trapping site consisting of ten pitfall traps, ten funnel traps, 10 Elliott traps and two cage traps open for seven nights (Figure 5, Table 3). The number and types of traps were chosen to sample the likely faunal assemblage while allowing for timely checking of traps to preserve animal welfare in hot conditions. Recently burnt areas were avoided due to the lack of cover for trapped animals and the likelihood that faunal populations were still recovering after fire. The Rocky Outcrop habitat was not trapped, but this limited habitat was targeted with camera traps and nocturnal searches.

Each pitfall trap consisted of a 40cm deep, white 20L bucket. Each pair of pitfall traps was placed on a 15m flywire drift fence. A piece of egg carton and a small amount on native soil was used as shelter for any fauna in the trap. Two funnel traps were set with each pair of pitfall traps with the drift-fence bisecting the funnel entrances. Funnel traps were shaded with a reflective 'aircell' insulation cover and spinifex (Plate 1).



**Plate 1. Examples of trap line set-up.**

Elliott traps were placed in a separate transect with the cage traps at either end. All cage and Elliott traps were placed under vegetation to shade any captured animals and cage traps were covered with a hessian sack. All Elliott and cage traps were baited with a mixture of rolled oats, sardines, peanut butter and vanilla essence. Hot conditions during the March survey necessitated the shutting of all traps in the morning and re-opening in the late afternoon to avoid mortalities due to excessive heat.

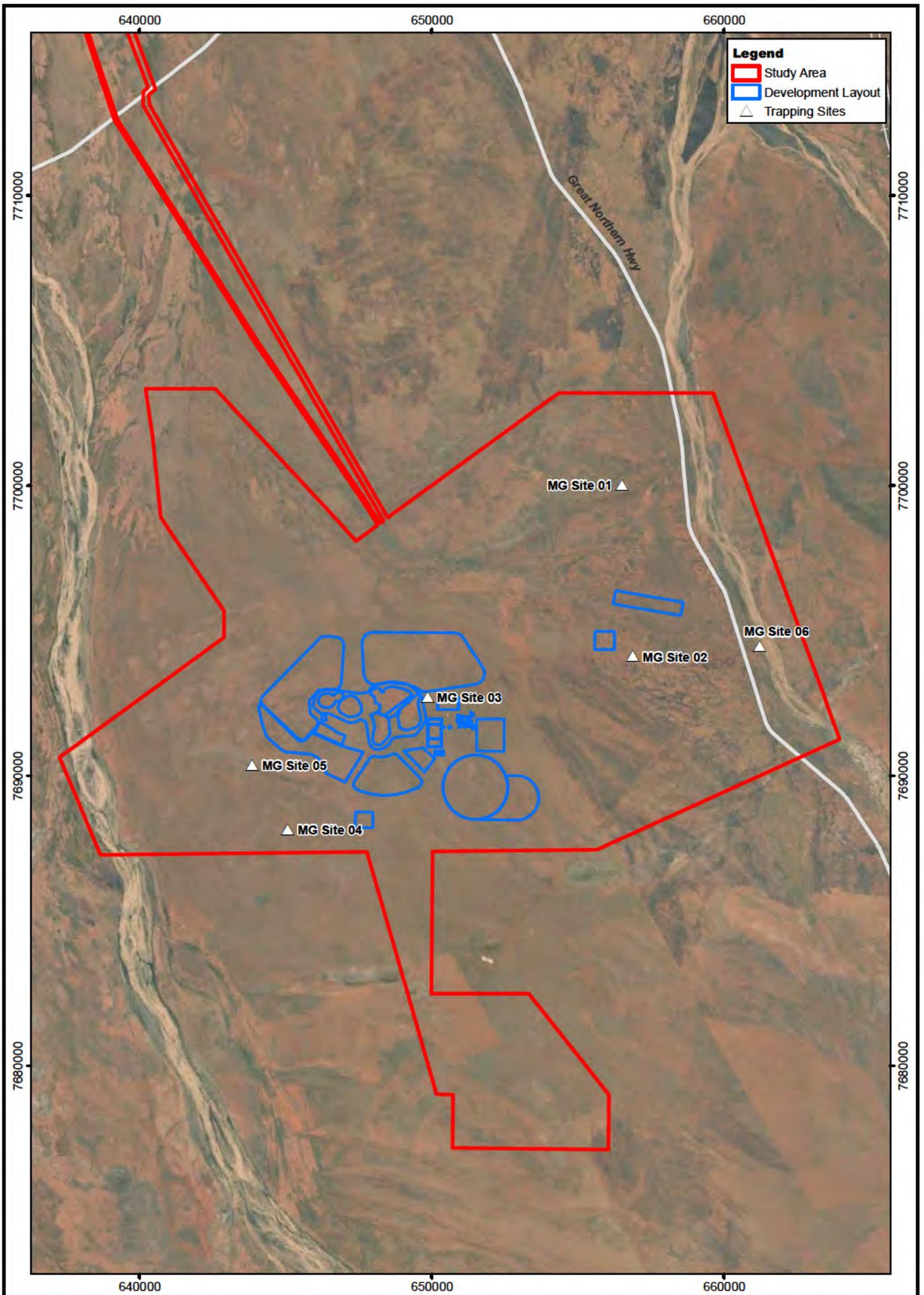
The number of trap-nights for each trap type in each survey phase was 420 (pitfalls), 420 (funnel traps), 420 (Elliott traps) and 84 (cage traps), giving a total of 2,688 trap-nights in total. All animals caught were identified and recorded, and generally released immediately at the site of capture.

**Table 3. Trapping site locations.**

Site	Dates open	Zone	Easting	Northing	Habitat
MG Site 01	<ul style="list-style-type: none"> <li>• 19 – 26/9/21</li> <li>• 16 – 23/3/22</li> </ul>	50	656498	7700031	<b>Stony hills.</b> Occasional tall <i>Acacia</i> shrubs over open spinifex hummock grassland on stony slopes. Dense <i>Acacia</i> shrubland in minor drainage. Plate 2
MG Site 02	<ul style="list-style-type: none"> <li>• 20 – 27/9/21</li> <li>• 17 – 24/3/22</li> </ul>	50	656877	7694113	<b>Sandplain drainage.</b> Patchy tall <i>Acacia</i> shrubs over spinifex hummock grassland on consolidated red sands and clayey flats. Plate 3.
MG Site 03	<ul style="list-style-type: none"> <li>• 20 – 27/9/21</li> <li>• 18 – 25/3/22</li> </ul>	50	649850	7692702	<b>Spinifex sandplain.</b> Occasional <i>Acacia</i> and <i>Melaleuca</i> shrubs over spinifex hummock grassland on consolidated red sands. Plate 4.
MG Site 04	<ul style="list-style-type: none"> <li>• 20 – 27/9/21</li> <li>• 17 – 24/3/22</li> </ul>	50	645070	7688150	<b>Spinifex sandplain.</b> Patchy tall <i>Acacia</i> shrubland over spinifex hummock grassland on consolidated red sands. Plate 5.
MG Site 05	<ul style="list-style-type: none"> <li>• 21 – 28/9/21</li> <li>• 17 – 24/3/22</li> </ul>	50	643859	7690367	<b>Sand dune.</b> Open <i>Acacia</i> shrubland over open low shrubs, spinifex and grasses on the slopes of a low sand dune. Plate 6
MG Site 06	<ul style="list-style-type: none"> <li>• 21 – 28/9/21</li> <li>• 16 – 23/3/22</li> </ul>	50	661221	7694476	<b>Major river.</b> <i>Eucalypt</i> and <i>Melaleuca</i> woodland over tall <i>Acacia</i> shrubland over patchy Spinifex hummock grassland on sandy rises and open sandy riverbed on the edge of the Turner River. Plate 7



**Plate 2. MG Site 01.**



**Legend**

- ▭ Study Area
- ▭ Development Layout
- ▲ Trapping Sites

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## Hemi Gold Project Fauna Trapping Sites

Figure:  
5



**Plate 3. MG Site 02.**



**Plate 4. MG Site 03.**



**Plate 5. MG Site 04.**



**Plate 6. MG Site 05.**



**Plate 7. MG Site 06.**

## **2.6.4 Bird Surveys**

Bird surveys were undertaken at each trapping site to give a total of six 20-minute surveys at each site on each of the September and March surveys, resulting in 72 surveys or 24 hours of survey across the two phases of survey. Surveys were within 300m of the trapping site and were undertaken concurrently with morning trap checks, between sunrise and approximately 9am. Birds were recorded if seen or heard. Birds were recorded as present only, and a frequency of occurrence calculated for each site. Birds were also recorded opportunistically throughout the study area.

## **2.6.5 Bat Survey**

Bat calls were recorded using Anabat Swift call detectors set to record between dusk and dawn. Detectors were deployed one or two nights at each trap site and then for one to three nights at selected sites around the study area, to give a total of 16 nights of recordings in September 2021 and 16 nights of recording in March 2022 (Appendix 2, Figure 6). The calls were then analysed by Specialised Zoological (2022a, 2022b), and the bat calls identified to species level where possible (Appendix 10).

### 2.6.6 Night Parrot Survey

In March 2022, timed to occur after summer rainfall, Songmeter 4 (SM4) passive acoustic detectors were deployed in potentially suitable habitat across the survey area (Figure 6, Appendix 2). Each SM4 was secured to a stake to hold it about 0.5m off the ground and set to record between dusk and dawn each night for six nights, giving a total of at least six recording nights across 13 sites. The data collected during this survey were analysed by Adaptive NRM (2022) for the presence of Night Parrot calls (Appendix 11).

### 2.6.7 Camera Trap Survey

Camera traps were deployed at 36 sites in September 2021 for a total of 180 trap-nights, 31 sites in March 2022 for a total of 221 trap-nights and five sites in August 2022 for a total of 40 trap-nights (Appendix 2, Figure 6). Cameras were primarily deployed to target rocky or riverine habitats that may support the Northern Quoll (*Dasyurus hallucatus*) and sandplains that may support the Spectacled Hare-wallaby (*Lagorchestes conspicillatus*), Bilby (*Macrotis lagotis*) or Brush-tailed Mulgara (*Dasyercus blythi*). Cameras were baited with a mixture of rolled oats, peanut butter and sardines and each individual camera was set for between 5 and 8 nights.

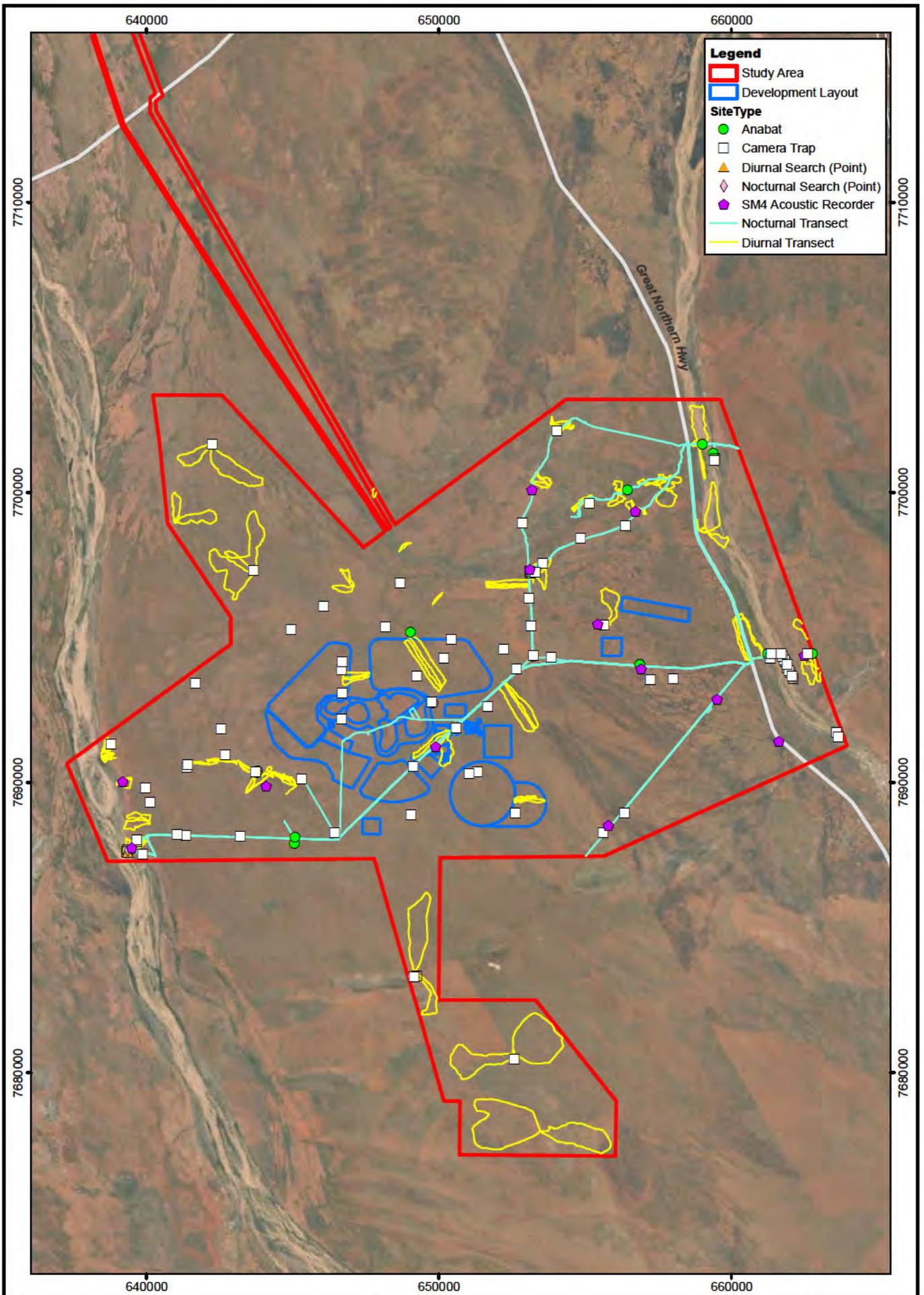
### 2.6.8 Nocturnal Searches

Spotlighting was carried out on the 27<sup>th</sup> and 28<sup>th</sup> September 2021, from 6:00pm – 9:00pm, and the 22<sup>nd</sup> and 23<sup>rd</sup> March 2022, from 6:00pm to 9:30pm. Three teams, each of two personnel, undertook a combination of road-spotting using vehicle headlights with targeted hand-searching using head-torches. The routes followed are shown in Figure 6.

### 2.6.9 Diurnal Searches

Transects and point searches for fauna were undertaken across the study area (Figure 6). Although all vertebrate fauna were recorded, the diurnal searches were particularly focused on detecting conservation significant species. Searches were undertaken for:

- Burrows, diggings, tracks or scats of the Bilby (*Macrotis lagotis*) in sandplain habitats.
- Scats of the Northern Quoll (*Dasyurus hallucatus*) in rocky habitats and tracks in sandy habitats such as riverbeds.
- Burrows, diggings, tracks or scats of the Brush-tailed Mulgara (*Dasyercus blythi*) in sandplain habitats.
- The presence of the Peregrine Falcon (*Falco peregrinus*), Grey Falcon (*Falco hypoleucos*) and Fork-tailed Swift (*Apus pacificus*) using general vigilance.
- Presence of Migratory shorebirds such as the Common Sandpiper (*Actitis hypoleucos*) and other conservation significant waterbirds at waterholes.
- Pebble-mounds of the Western Pebble-mound Mouse (*Pseudomys chapmani*) in stony habitats.



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## Hemi Gold Project Other Sampling Sites

Figure:  
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### 2.6.10 Opportunistic Records

At all times, observations of fauna were noted when they contributed to the accumulation of information on the fauna of the site. These included casual observations of reptiles, mammals and birds seen while travelling between sites or while undertaking other activities. Opportunistic observations were recorded to a general location for common species, and conservation significant species were recorded with a GPS location.

## 2.7 Habitat Assessment

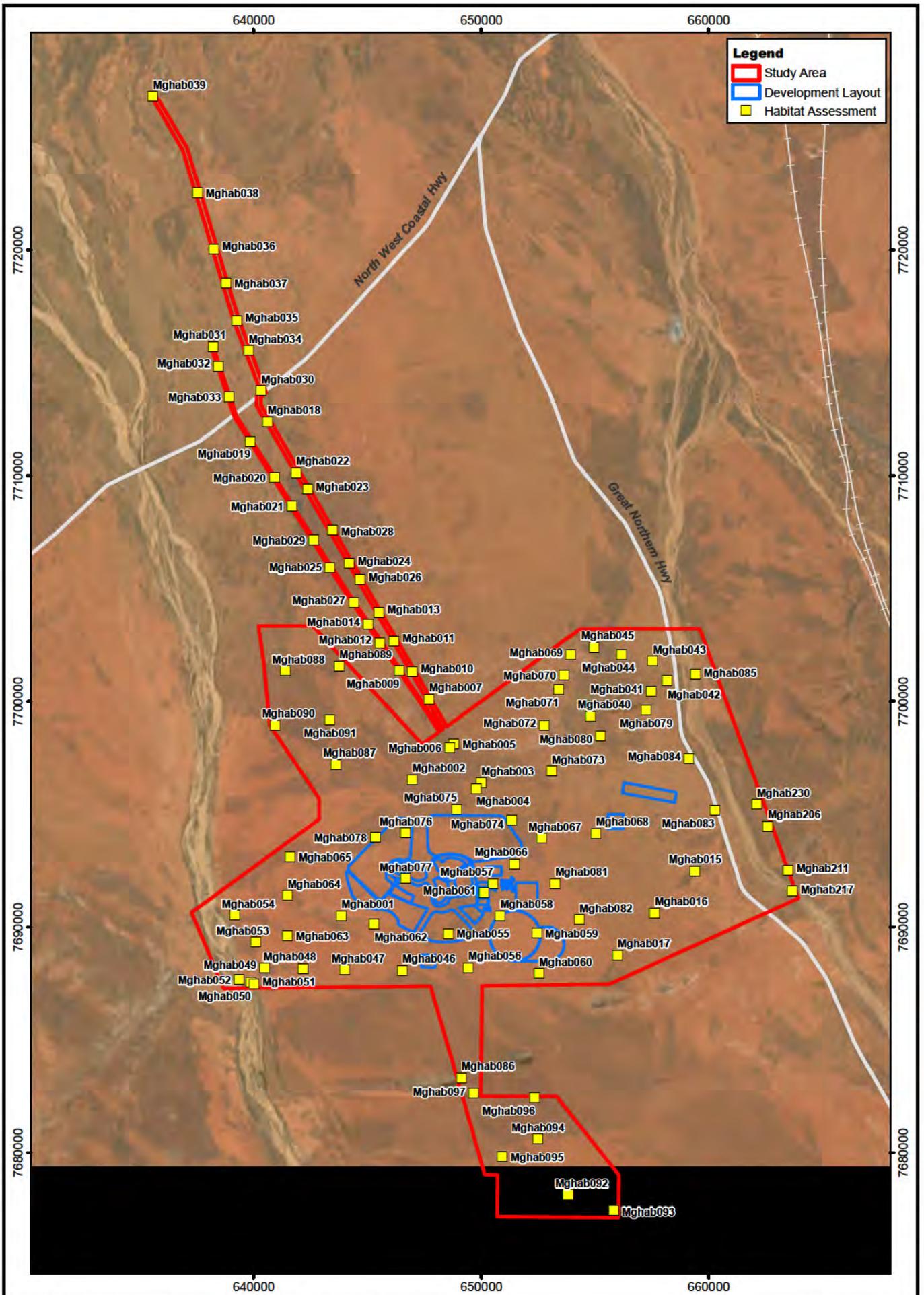
### 2.7.1 Habitat Assessment Sites

Habitat assessments were undertaken at 85 points across the study area (shown on Figure 7, Appendix 3). At each habitat assessment point the following were recorded:

- GPS co-ordinates
- Representative photographs
- Habitat name
- Landform
- Vegetation (brief description of structure and dominant species, if known)
- Evidence of fire
- Disturbance (e.g., weeds, grazing, firewood collection)
- Soil colour and type
- Rock type and presence of any outcropping
- Important habitat elements, including, but not limited to the presence of:
  - Leaf litter accumulations
  - Woody debris and logs
  - Tree hollows or crevices
  - Soils suitable for burrowing
  - Long-unburnt vegetation
  - Water
  - Caves or rock crevices
  - Dense shelter vegetation
  - Important plant species for conservation significant fauna
- Presence of wetlands
- Any fauna

### 2.7.2 Habitat Mapping

The fauna habitats were identified and mapped using the habitat assessments (Appendix 3) and observations made in the field during the fauna survey, interpretation of vegetation mapping (Umwelt Australia 2022), aerial photography and land system mapping.



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 Author: J. Wilcox

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## Hemi Gold Project Habitat Assessment Sites

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## 2.8 Species Accumulation Curves

A species accumulation curve at its most simple is a graph of the number of detected species against sampling effort. However, the curve is usually derived through sub-sampling the dataset to find a mean curve, otherwise known as a sample-based rarefaction curve.

Species accumulation curves were calculated for reptiles, mammals and birds for all habitats combined. For frogs, reptiles and mammals, an individuals-based approach was used. This means that the species richness was graphed against the number of individuals caught, rather than per each sample. The sampling unit for birds was all species observed in a 20 minute bird survey at a trapping site.

The statistical package EstimateS (Colwell 2013) was used to find a non-parametric estimator of species richness; either Chao1, ICE (Incidence-based Coverage Estimator) or Chao2. Chao1 uses abundance data to provide an estimation of the lower bound of species richness and is a good estimator of the actual species richness when the sample size is large or the rare species in the sample have similar detection probabilities (Chao and Chiu 2016). ICE or Chao2 are similar, but uses incidence (presence only, no abundance) data only.

EstimateS (Colwell 2013) uses a bias-corrected form of Chao1 and Chao2 as a default, though these become imprecise when the co-efficient of variation or incidence distribution  $>0.5$ . In these cases, the classic Chao1 and Chao2 were used, and the larger estimate of Chao1(classic) and ACE (Abundance-based Coverage Estimator) or Chao2(classic) and ICE (Incidence-based Coverage Estimator) is used as the estimate of species richness. For large sample sizes, if Chao 1 or Chao 2 are equal to the observed number of species, then the accumulation of species is assumed to have reached an asymptote (Colwell 2013).

Jackknife estimators of species richness are not used, as they typically underestimate the true species richness when the sample is small, (as is often the case in detailed surveys) and overestimate when the sample is large. Thus, there is only a small window when the Jackknife estimators are close to the true species richness (Chao and Chiu 2016).

## 2.9 Assessment of Conservation Significance

### 2.9.1 Legislative Protection for Fauna

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

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

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

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

Reports on the conservation status of most vertebrate fauna species have been produced by the federal Department of Environment and Energy (DoEE) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger *et al.* 1993), birds (Garnett and Barker 2020) and mammals (Woinarski *et al.* 2014). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

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

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

Threatened Species:

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

Specially Protected Species:

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

- **Other specially protected species (OS):** fauna in need of special protection to ensure their conservation.

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

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

### 2.9.2 Levels of Conservation Significance in this report

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

- **Threatened (T):** Taxa listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the EPBC Act and/or BC Act. These species are grouped as they are all species considered to be at risk of extinction, are often rare and are likely to be subject to on-going threatening processes.
- **Migratory (Mi):** Taxa listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened. These species are grouped as they are not necessarily rare, but may be dependent on specific habitats for a portion of their life-cycle. For these species, loss of important foraging, breeding or stop-over sites may have a disproportionately large impact on populations.
- **Specially Protected (SP):** Taxa listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act. These species are not necessarily rare, but may be dependent on on-going conservation to ensure their protection.
- **Priority (P):** Taxa listed as Priority by DBCA. These species are grouped as they are either conservation dependent or data deficient and in need of further survey.
- **Locally Significant (LS):** Locally significant taxa are not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by DBCA, but are considered by the author to potentially be of local significance because they are at the limit of their distribution in the area, they have a very restricted range or restricted habitat requirements, or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative recognition and is based on interpretation of information on the species patterns of distribution. For example, the Government of Western Australia (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity.

## 2.10 Likelihood of Occurrence

Fauna of conservation significance were assessed and ranked for their likelihood of occurrence in the study area, according to the criteria in Table 4.

**Table 4. Criteria for assessing likelihood of occurrence.**

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

### 3. Survey Limitations

Various factors can limit the effectiveness of a fauna survey. Pursuant to EPA Technical Guidance (EPA 2020), these factors have been identified and their potential to impact on the effectiveness of the surveys has been assessed in Table 5. All fauna surveys have limitations, and not all fauna species present on the site are likely to be sampled during a survey. Fauna may not be recorded because they are rare, they are difficult to trap or observe, or because they are only present on the site for part of the year.

**Table 5. Fauna survey limitations.**

Potential Limitation	Extent of limitation for the fauna survey
Availability of data and information	<b>Not Limiting.</b> The Pilbara is a relatively well-studied region due to the prevalence of mining activities. The Pilbara Biological Survey also gives context to fauna studies in this region. There are numerous records in the vicinity of the study area on databases and other fauna surveys have been undertaken nearby.
Competency/experience of the survey team, including experience in the bioregion surveyed	<b>Not Limiting.</b> Key personnel have over 20 years' experience with fauna surveys in Western Australia and are experienced with targeted surveys for Northern Quoll, Night Parrot, Bilby and conservation significant bats. All personnel have undertaken previous surveys, including detailed fauna surveys, in the Pilbara Bioregion.
Scope of survey (e.g., faunal groups excluded from the survey)	<b>Not Limiting.</b> The detailed survey covered all vertebrate faunal groups. Conservation significant species were targeted with a variety of methods including camera traps and searches for secondary signs.
Timing, weather and season	<b>Minor Limitation.</b> The timing of the survey was consistent with that recommended in the Technical Guidelines (EPA 2020). The weather during the survey was warm to hot and suitable for trapping and spot-lighting, however, the summer rainfall was lower than average resulting in drier post-wet conditions than in an average year. Hot conditions during the March survey necessitated the shutting of all traps in the morning and re-opening in the late afternoon to avoid mortalities due to excessive heat, thus limiting the time spent on other sampling methods.
Disturbance that may have affected the results	<b>Minor Limitation.</b> Parts of the study area were recently burnt and therefore temporarily unlikely to support key species such as the Bilby. Much of the study area is burnt on a regular basis (for pastoralism) which is likely to have resulted in a smaller extent of mature spinifex.
The proportion of fauna identified, recorded or collected	<b>Not Limiting.</b> Over half of the potentially occurring species were recorded during the survey. The field component of the survey was supported with a literature review.
The adequacy of the survey intensity and proportion of survey achieved (e.g., extent to which the area was surveyed)	<b>Not Limiting.</b> The intensity and coverage of the fauna survey was adequate and appropriate for the level of survey. A representative portion of all habitats were visited during the survey. Trapping was undertaken in all habitats except the Rocky Outcrop habitat, which was limited in extent in the study area and sampled with other methods.
Access problems	<b>Not Limiting.</b> All habitats were readily accessible by vehicle and/or on foot and a representative portion of each habitat was able to be surveyed.
Problems with data and analysis, including sampling biases	<b>Not Limiting.</b> No complex analyses were undertaken, and no problems were noted.

## 4. Fauna Habitat

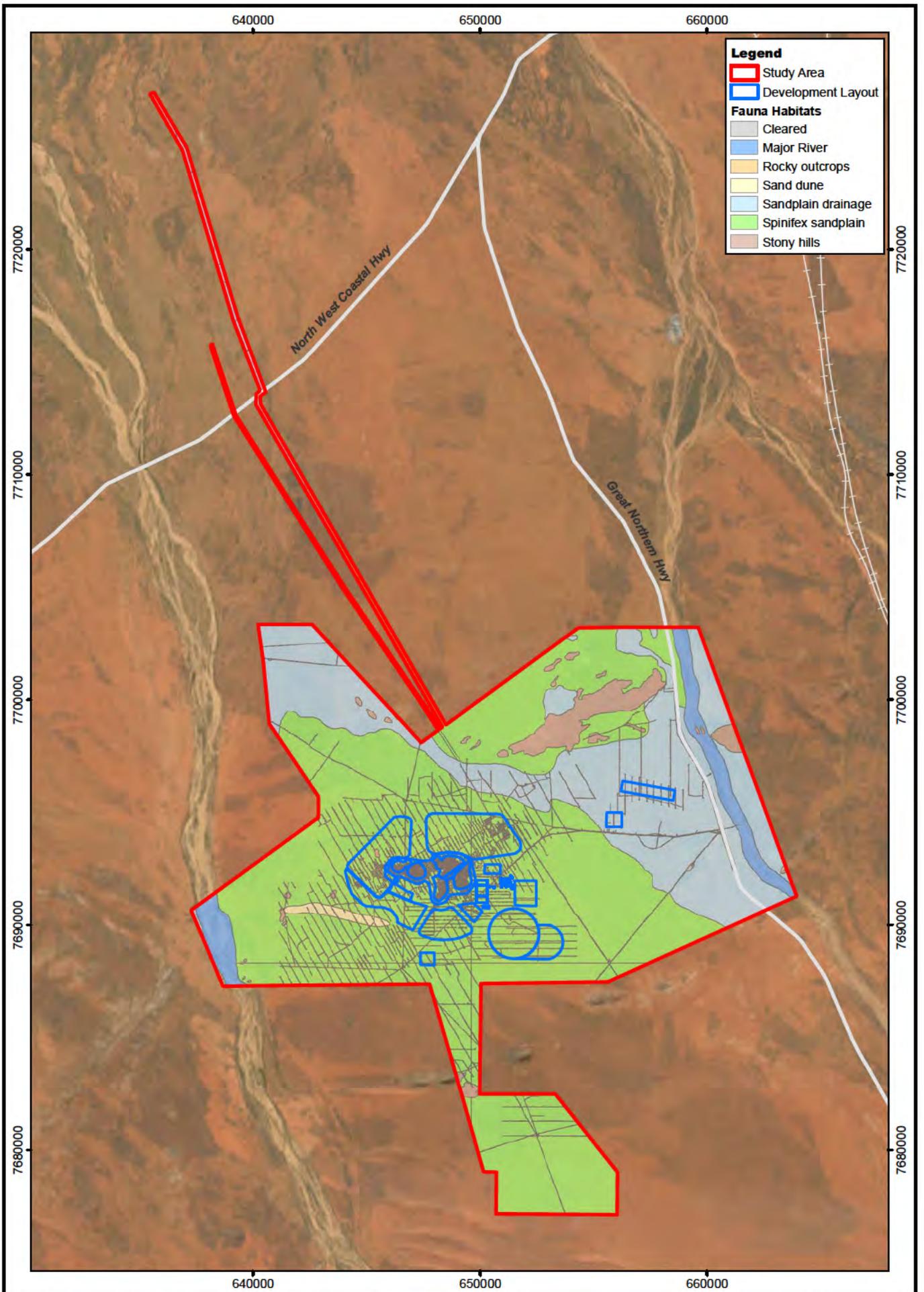
### 4.1 Habitats of the Hemi Gold Project

Six fauna habitats were identified in the study area (Table 6, Figure 8). They are described in the following sections, with the vegetation descriptions drawn from Umwelt Australia (2022). Of these habitats, Spinifex Sandplain, Sandplain Drainage and Stony Hills are widespread in the region. The sand dune habitat is uncommon in the region, roughly corresponding to the Gregory Land System (a Priority 3 Ecological Community). Rocky Outcrops are very uncommon in the study area but are more common, although still limited in extent, in surrounding areas.

**Table 6. Fauna habitats in the study area.**

Habitat	Key Habitat Elements	Area (ha)
Spinifex sandplain	<ul style="list-style-type: none"> <li>Consolidated sands suitable for burrowing reptiles and mammals.</li> </ul>	22,162
Sandplain drainage	<ul style="list-style-type: none"> <li>Consolidated sands suitable for burrowing reptiles and mammals.</li> <li>Claypans of various sizes that hold water and may be breeding habitat for frogs.</li> <li>Mature spinifex in some areas, where encouraged by water runoff and/or protection from fire.</li> </ul>	9247
Sand dune	<ul style="list-style-type: none"> <li>Loose flowing sands provide habitat for fossorial reptiles.</li> </ul>	188
Stony hills	<ul style="list-style-type: none"> <li>Minor drainages lines (not mapped separately) provide dense habitat for birds.</li> <li>Small stones suitable for Western Pebble-mound Mouse.</li> <li>Minor rocky outcrops provide shelter for saxicoline reptiles.</li> </ul>	1,189
Major river	<ul style="list-style-type: none"> <li>Likely to function as a corridor for fauna movement.</li> <li>Waterholes provide habitat for bathing and drinking, as well as breeding habitat for frogs.</li> <li>Tree hollows for arboreal reptiles, bats and hollow-nesting birds.</li> <li>Leaf litter accumulations and woody debris in the creek bed provides habitat for reptiles.</li> </ul>	1,232
Rocky outcrops	<ul style="list-style-type: none"> <li>Outcropping rocky areas, boulders, overhangs and rock crevices provide shelter for reptiles and mammals (no large caves present).</li> </ul>	2
Cleared	<ul style="list-style-type: none"> <li>None noted.</li> </ul>	667
<b>Total:</b>		<b>34,687</b>

The main disturbance noted was from mining exploration activities (e.g., drilling access tracks, drill pads, service areas) and pastoral activities (e.g., station tracks, bores, livestock). Areas around rivers, wells and stands of trees showed trampling by livestock cattle. Parts of the study area were recently burnt in 2021, mainly across the Spinifex Sandplain and Sandplain Drainage habitats.



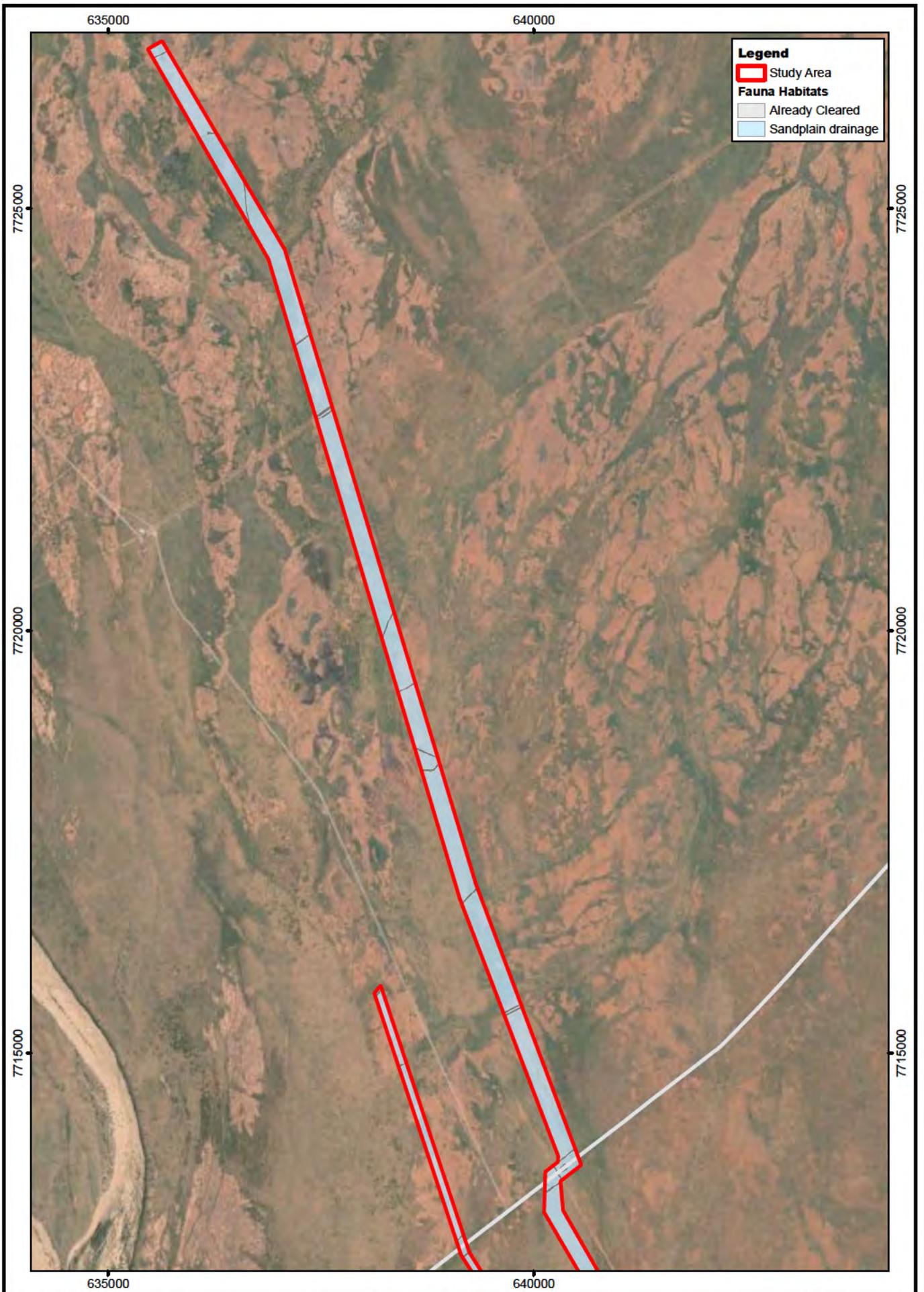
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 CAD Ref: a2882Fa010\_07 A4  
 Date: January 2023 Rev: A

N 0 1.5 3 km  
 Scale: 1:225,000  
 MGA94 (Zone 50)  
 Author: J. Wilcox

Western  
 Wildl

# Hemi Gold Project Fauna Habitats

Figure:  
**8**



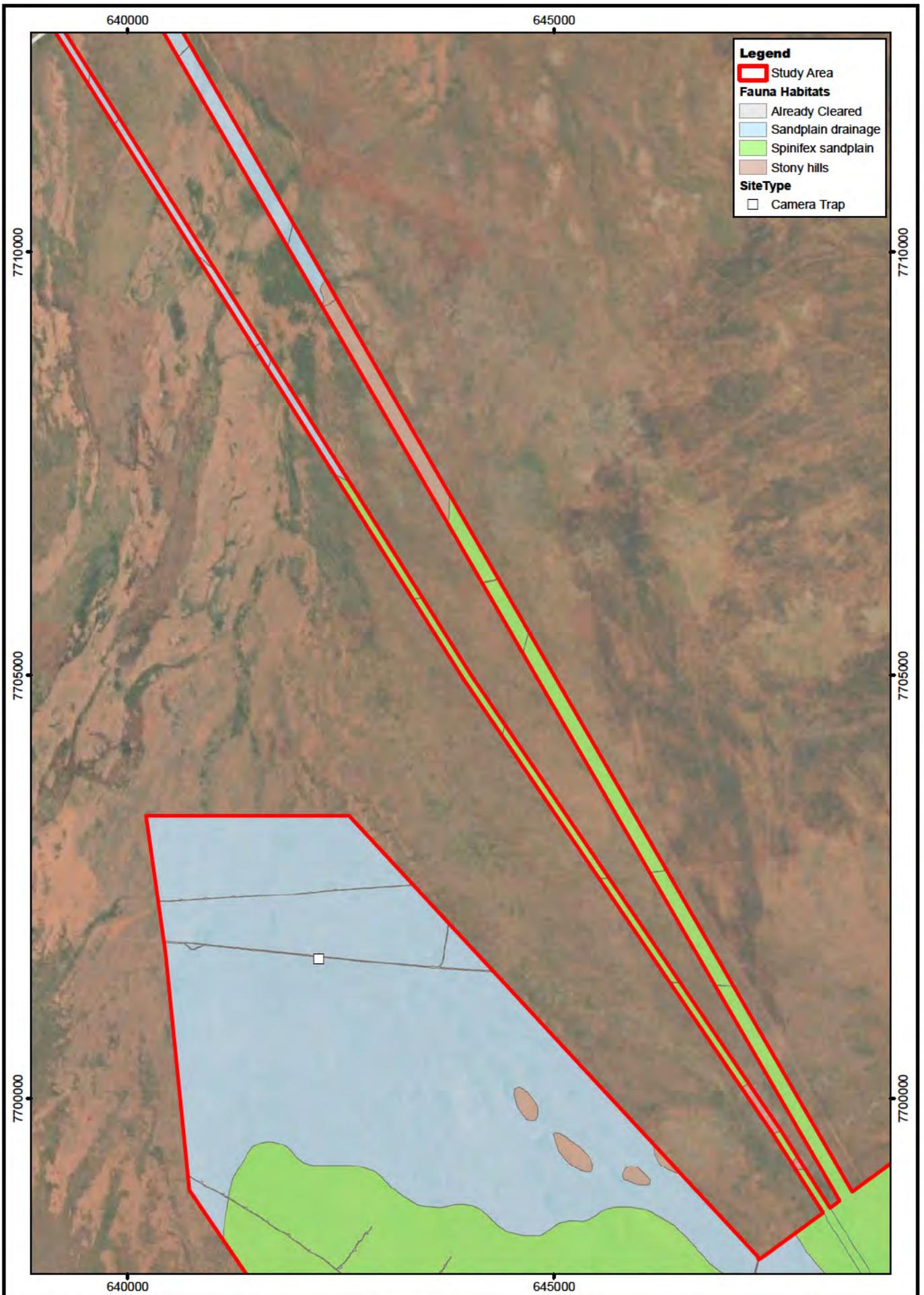
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 MGA94 (Zone 50)

Western  
 Wildl

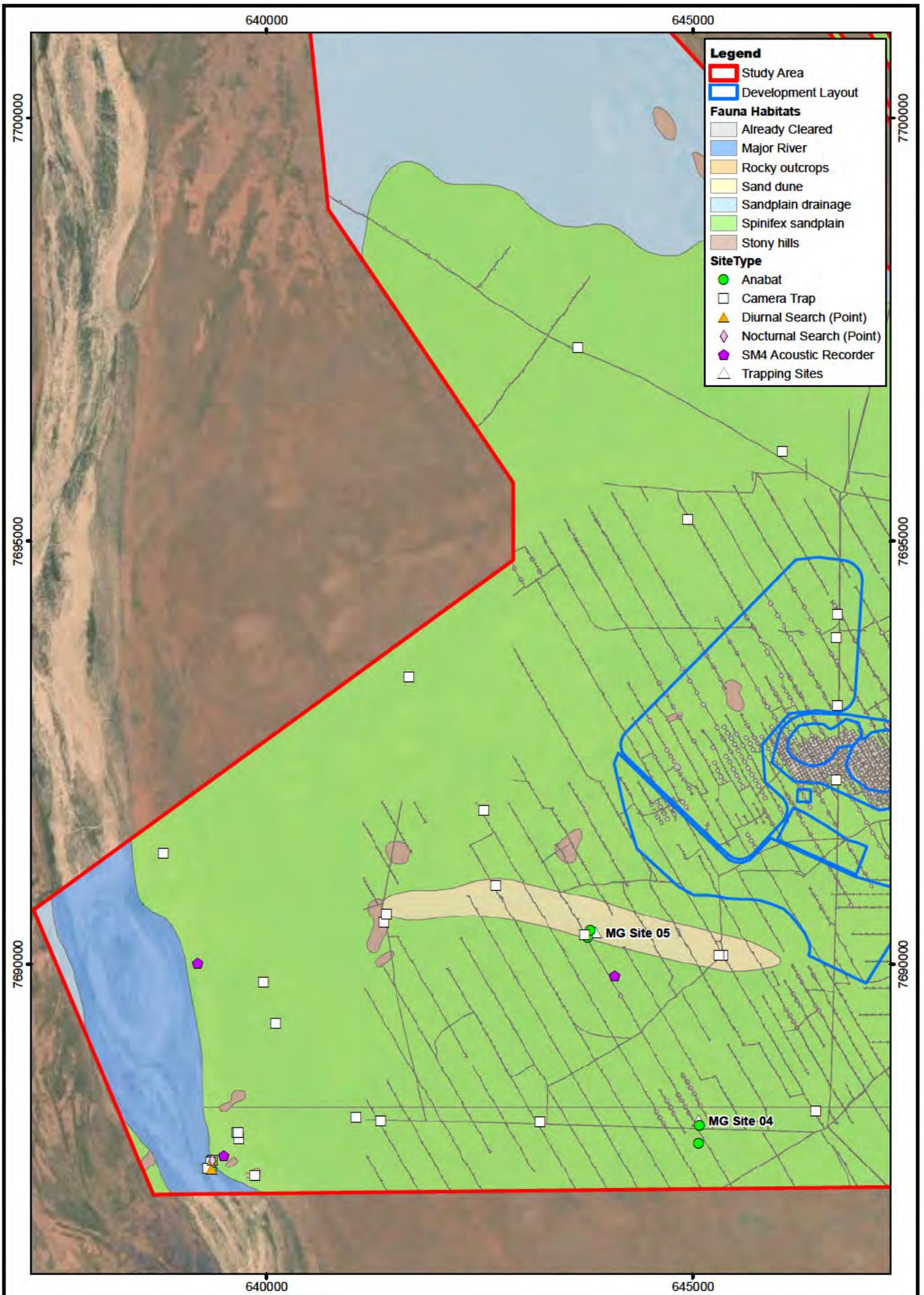
**Hemi Gold Project  
 Fauna Habitats  
 Sheet 1 of 6**

Figure:  
**8.1**



**Legend**

- Study Area
- Fauna Habitats**
- Sandplain drainage
- Spinifex sandplain
- Stony hills
- SiteType**
- Camera Trap



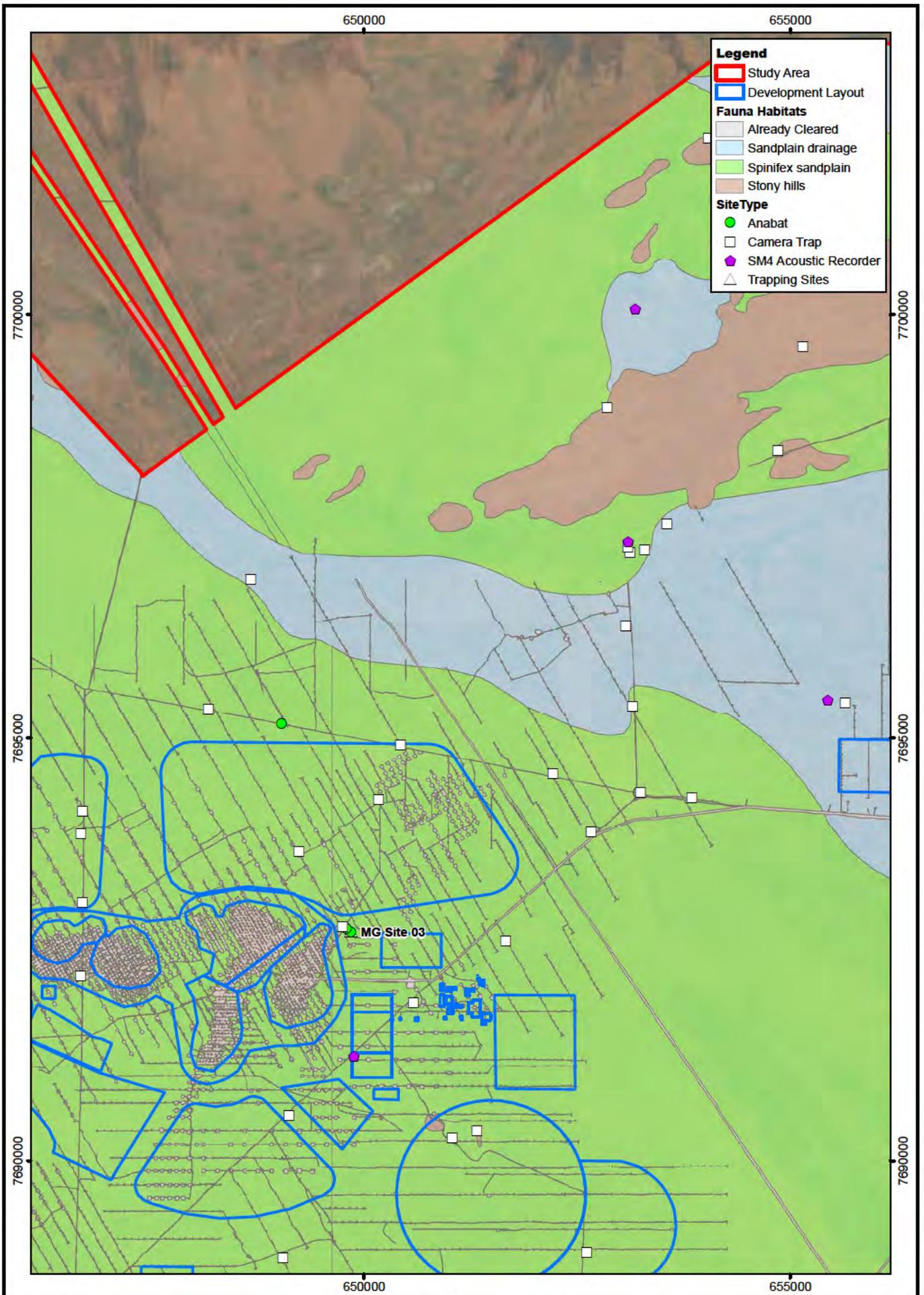
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Date: January 2023 | Rev: A | Author: J. Wilcox

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MGA94 (Zone 50)

Western  
Wildlife

Hemi Gold Project  
Fauna Habitats  
Sheet 3 of 6

Figure:  
**8.3**



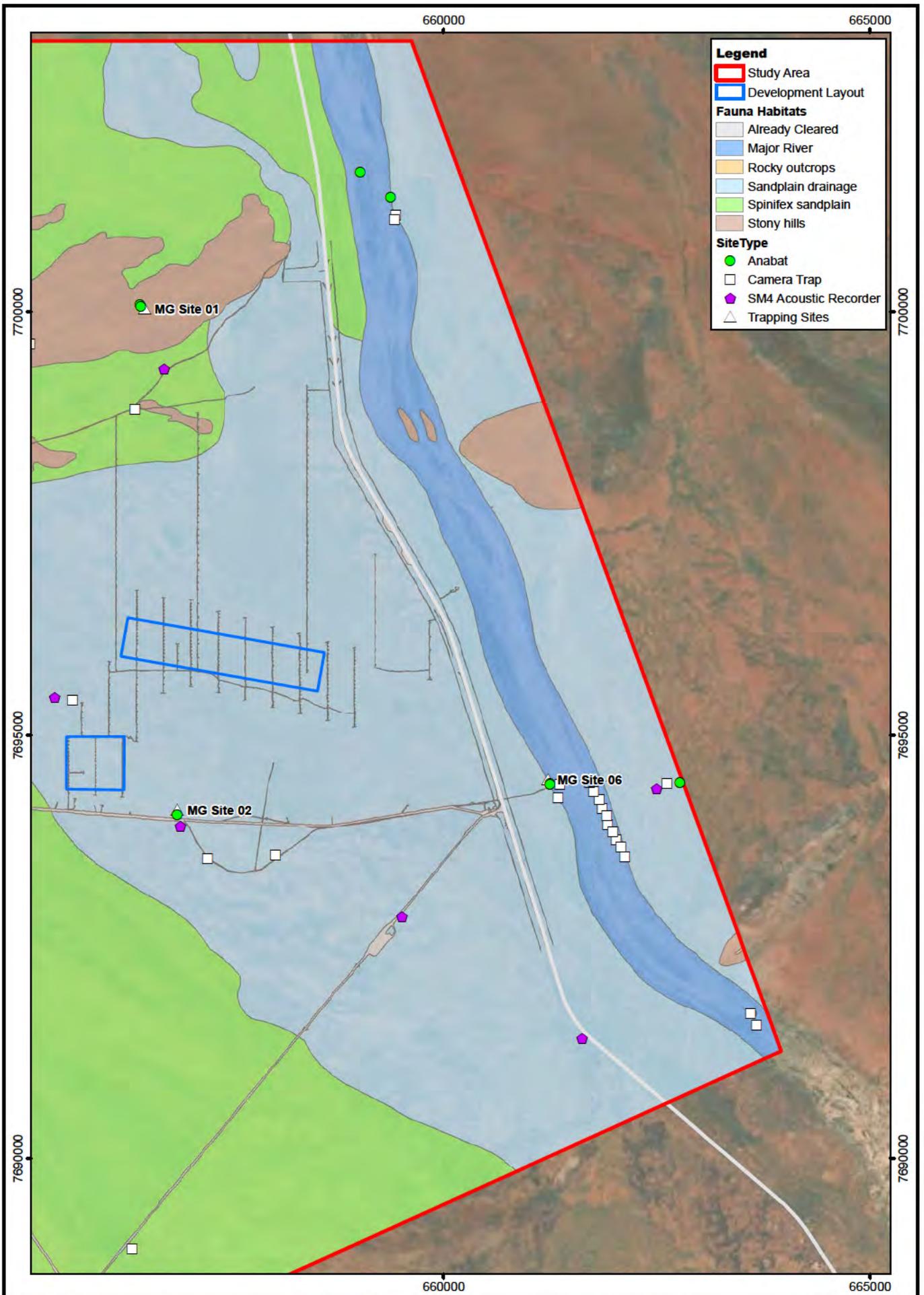
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 CAD Ref: a2882Fa010\_07\_01 A4  
 Date: January 2023

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 Scale: 1:60,000  
 MGA94 (Zone 50)  
 Rev: A Author: J. Wilcox

Western  
 Wildlife

Hemi Gold Project  
 Fauna Habitats  
 Sheet 4 of 6

Figure:  
**8.4**



**Legend**

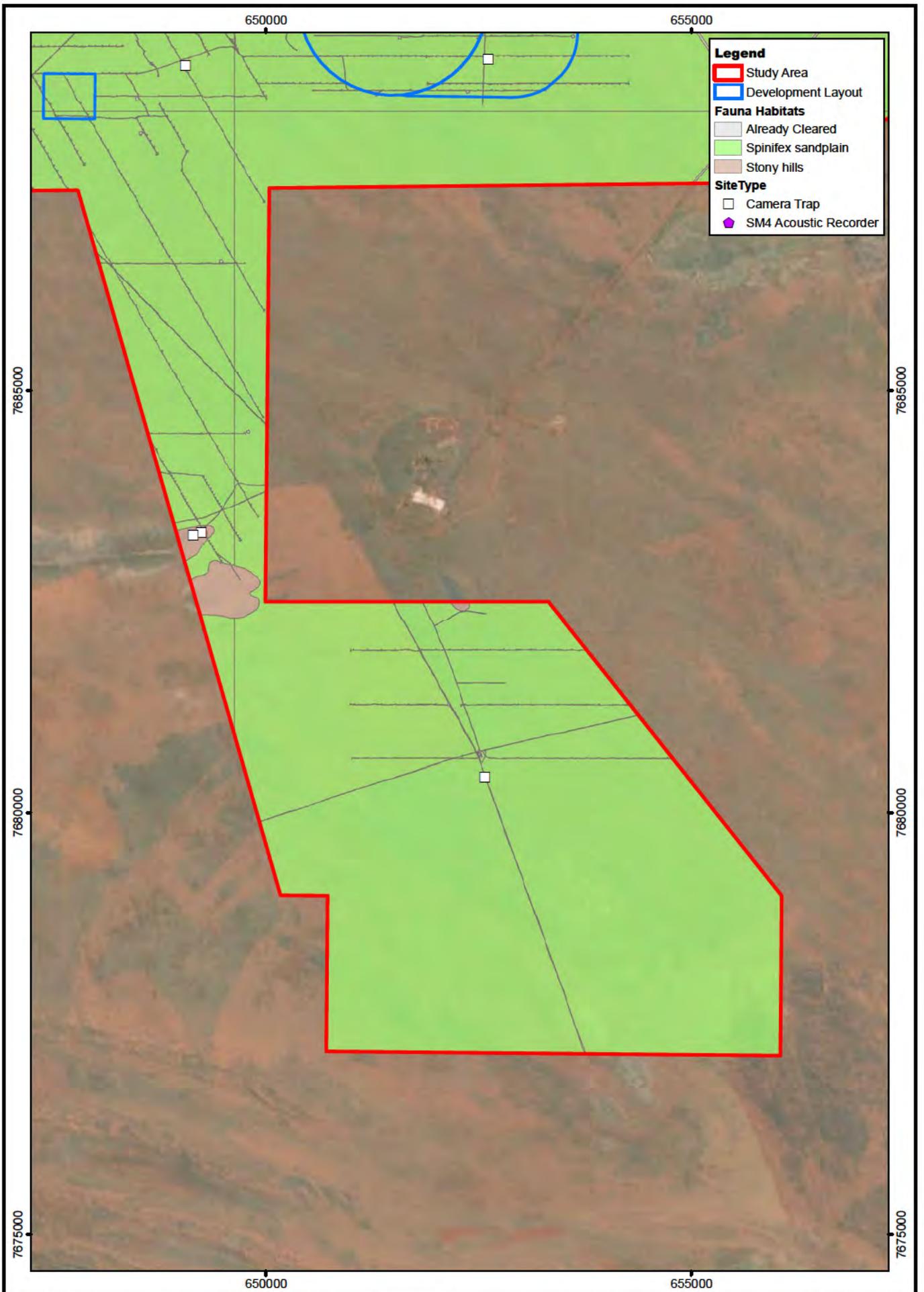
- Study Area
- Development Layout

**Fauna Habitats**

- Already Cleared
- Major River
- Rocky outcrops
- Sandplain drainage
- Spinifex sandplain
- Stony hills

**SiteType**

- Anabat
- Camera Trap
- ◆ SM4 Acoustic Recorder
- △ Trapping Sites



Drawn: CAD Resources  
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 Tel: (08) 9246 3242  
 CAD Ref: a2882Fa010\_07\_01 | A4  
 Date: January 2023 | Rev: A | Author: J. Wilcox

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Western  
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Hemi Gold Project  
 Fauna Habitats  
 Sheet 6 of 6

Figure:  
**8.6**

### 4.1.1 Spinifex Sandplain

Red consolidated sands support a patchy *Acacia* shrubland (*Acacia ancistrocarpa*, *Acacia inaequilatra* and *Acacia acradenia*) over spinifex (*Triodia lanigera* and *Triodia schinzii*) hummock grassland mixed with a low shrubland of Poverty Bush (*Acacia stellaticeps*). There are occasional other trees (*Corymbia zygomphylla* and *Corymbia hamersleyana*) or shrubs (*Grevillea wickhamii*, *Hakea lorea* or *Melaleuca lasiandra*) (Plates 8 – 11). Although somewhat variable in vegetation structure, the defining feature of this habitat is the red sandplain.



**Plate 8. Spinifex Sandplain.**



**Plate 9. Spinifex Sandplain.**

This habitat roughly corresponds to the Uaroo Land System. Conservation Significant fauna that may be associated with this habitat are the Bilby (*Macrotis lagotis*: Vulnerable), Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardtii*: Priority 4) and Brush-tailed Mulgara (*Dasymercus blythi*: Priority 4).



**Plate 10. Spinifex Sandplain (burnt).**



**Plate 11. Spinifex Sandplain (recently burnt).**

### 4.1.2 Sandplain Drainage

Low-lying areas with heavy clay soils support an open spinifex hummock grassland, and sandy rises support a tall *Acacia* shrubland (*Acacia ancistrocarpa*, *Acacia inaequilatra* and *Acacia coleii*) over spinifex (*Triodia epactica* and *Triodia schinzii*) hummock grassland mixed with a low shrubland of Poverty Bush (*Acacia stellaticeps*) (Plates 12 – 13). Low-lying areas are seasonally wet and include areas of open claypan (Plates 14 – 15). The sandy rises are similar to the Spinifex Sandplain habitat and it is likely to support a similar faunal assemblage. This habitat roughly corresponds to the Mallina Land System.



Plate 12. Sandplain Drainage.



Plate 13. Sandplain Drainage.

Conservation Significant fauna that may be associated with this habitat are the Bilby (*Macrotis lagotis*: Vulnerable), Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardtii*: Priority 4) and Brush-tailed Mulgara (*Dasyercus blythi*: Priority 4).



**Plate 14. Sandplain Drainage – claypan.**



**Plate 15. Sandplain Drainage – claypan.**

### 4.1.3 Sand Dune

A single low sand dune, about 4.6km long, occurs in the study area. The red flowing sands support an open shrubland of *Acacia sabulosa* and *Sida arenicola* over an open grassland of Spinifex (*Triodia schinzii* and *Triodia lanigera*) and *Corchorus incanus* (Plates 16 – 17). This habitat roughly corresponds to the Gregory Land System. A Conservation Significant fauna species that may be associated with this habitat is the Bilby (*Macrotis lagotis*: Vulnerable).



Plate 16. Sand Dune.



Plate 17. Sand Dune.

#### 4.1.4 Stony Hills

Low stony hills and gently sloping stony flats occur mainly in the north-eastern part of the study area, with isolated low stony rises patchily occurring elsewhere. Minor rocky outcrops occur, but there are no cave-bearing formations present. The hills support a mixed low grassland and shrubland of Spinifex (*Triodia wiseana* and *Triodia epactica*) and Poverty Bush (*Acacia stellaticeps*) with scattered tall shrubs (*Acacia inaequilatra*, *A. ancistrocarpa* and *A. acradenia*) (Plates 18 – 19). This habitat roughly corresponds to the Ruth Land System. A Conservation Significant fauna species that may be associated with this habitat is the Western Pebble-mound Mouse (*Pseudomys chapmani*: Priority 4).



**Plate 18. Stony Hills.**



**Plate 19. Stony Hills.**

### 4.1.5 Major River

The Turner and Yule Rivers both traverse the study area. The rivers support an open woodland of River Red Gum (*Eucalyptus camaldulensis*), Little Ghost Gum (*Eucalyptus victrix*) and Silver Cadjuput (*Melaleuca argentea*) over Acacia shrubland (*Acacia trachycarpa* and *Acacia pyrifolia*) over grasses and Spinifex (Plates 20 – 21). There are also considerable expanses of open stony or sandy riverbed and a series of permanent and semi-permanent waterholes (Plates 22 – 23).



**Plate 20. Major River – Turner River.**



**Plate 21. Major River – Turner River.**

This habitat roughly corresponds to the River Land System. Conservation Significant fauna that may be associated with this habitat are the Northern Quoll (*Dasyurus hallucatus*: Endangered), Pilbara Olive Python (*Liasis olivaceous barroni*: Vulnerable), Pilbara Leaf-nosed Bat (*Rhinonictis aurantia*: Vulnerable), Common Sandpiper (*Actitis hypoleucos*: Migratory) and other birds listed as Migratory.



**Plate 22. Major River – permanent pool on the Yule River.**



**Plate 23. Major River – open pool on the Yule River.**

#### 4.1.6 Rocky Outcrops

Very small rocky outcrops occur in the study area (Plates 24 – 25). No caves are present, but boulders and rocky crevices provide fauna habitat. This habitat roughly corresponds to parts of the Ruth and Talga Land Systems. Conservation Significant fauna that may be associated with this habitat are the Northern Quoll (*Dasyurus hallucatus*: Endangered) and Pilbara Olive Python (*Liasis olivaceous barroni*: Vulnerable).



**Plate 24. Rocky Outcrop – edge of a ridge that just extends into the eastern edge of the study area.**



**Plate 25. Rocky Outcrop – very small, isolated outcrop near the Yule River.**

## 5. Faunal Assemblage of the Study Area

### 5.1 Vertebrate Fauna Assemblage

The results of the literature review and field survey were combined to create a list of all the vertebrate fauna potentially occurring at in the study area (Appendices 4 - 7). Indicated in the fauna lists are all the species observed in the study area during the fauna survey and those recorded in the region as part of the literature review.

The potentially occurring faunal assemblage is summarised in Table 7. The overall vertebrate faunal assemblage is likely to be largely intact, with the exception of species that are extinct or greatly reduced in their distribution in the Bioregion. The faunal assemblage and conservation significant species likely to occur are further discussed in the sections below.

**Table 7. Summary of vertebrate fauna predicted to occur in the study area.**

Taxon	Total Species Predicted	Total Species Recorded	Conservation significant species				
			Threatened (T)	Migratory (Mi)	Specially Protected (SP)	DBCA Priority (P)	Locally significant (LS)
Amphibians	10	6	-	-	-	-	-
Reptiles	115	56	1	-	-	2	-
Birds	165	83	2	12	1	-	1
Native Mammals	36	22	4	-	-	6	-
Int. Mammals	8	6	-	-	-	-	-
<b>Totals:</b>	<b>334</b>	<b>173</b>	<b>7</b>	<b>12</b>	<b>1</b>	<b>8</b>	<b>1</b>

#### 5.1.1 Amphibians

Ten species of frog potentially occur, of which six were recorded in the study area on this survey (Table 8, Appendix 5). The majority of species were recorded at MG Site O6 on the Turner River (Table 8). The frog species potentially occurring in the study area are common and widely distributed in the semi-arid zone.

The Desert Tree Frog (*Litoria rubella*) is likely to be common, occurring in Major Rivers, but also using artificial water sources such as wells and cattle troughs (Plate 26). Burrowing species aestivate underground when conditions are dry, so are difficult to sample except immediately after wet conditions. The Desert Spadefoot (*Notaden nichollsi*) is a burrowing species recorded in both the Major River and Sand Dune habitats and is also likely to occur in the Sandplain Drainage habitat (Plate 26). This species burrows in sandy soil, breeding in temporary pools formed after cyclonic summer rain. The tadpole develop into frogs very quickly. Adult frogs of this and other burrowing species also forage in adjacent terrestrial habitats when conditions are suitable.

**Table 8. Amphibians recorded in the study area.**

Species	Number trapped at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Other methods only
<b>Water-holding Frogs</b>							
<i>Cyclorana maini</i>						-/12	
<i>Litoria rubella</i>						-/1	
<b>Ground Frogs</b>							
<i>Notaden nichollsi</i>					-/14	-/2	
<i>Platyplectrum spenceri</i>						-/4	
<i>Uperoleia glandulosa</i>						-/16	
<i>Uperoleia saxatilis</i>						-/2	
<b>Total species:</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>6</b>	<b>0</b>



**Plate 26. Desert Tree Frogs (*Litoria rubella*) and Desert Spadefoot (*Notaden nichollsi*).**

### 5.1.2 Reptiles

There are 115 species of reptile that have the potential to occur, of which 56 were recorded in the study area (Table 9, Appendix 5). The reptile assemblage of the Pilbara Bioregion is very diverse, including a suite of endemic species associated with rocky surfaces (Doughty *et al.* 2011). As the reptile assemblage is generally informed by the ground surface (e.g. sandy, clayey or rocky surfaces) the study area is likely to support several distinct assemblages. Despite this, many reptile species are likely to occur across all habitats, although they may be more common in one.

Of the 55 species were recorded during this survey, 46 were captured in trapping sites and nine were recorded through other methods, mainly nocturnal searches (Table 9). The highest species richness was recorded in the Sand Dune habitat at MG Site 05. Some species, including the Northern Spiny-tailed gecko (*Strophurus ciliaris*), Fourteen-lined Ctenotus (*Ctenotus quattuordecimlineatus*), Rufous Finesnout Ctenotus (*Ctenotus rufescens*) and Pindan Dragon (*Diporiphora pindan*) were only recorded in this habitat, although at least some of these are also likely to occur on the Spinifex Sandplain and Sandplain Drainage habitats as there is likely to be considerable overlap in the reptile assemblage across these sandy-surfaced habitats. Many species, including the Desert Banded Snake (*Simoselaps anomalus*), Grand Ctenotus (*Ctenotus grandis*) and Military Dragon (*Ctenophorus isolepis*) were recorded in more than one sandy habitat (Table 9, Plate 27). Species such as the Bearded Dragon (*Pogona minor*) and Sand Goanna (*Varanus gouldii*) require sandy soil for burrowing and egg-laying, but are also likely to use other habitats (Plate 28).



**Plate 27. *Simoselaps anomalus* and *Ctenotus grandis*.**

The Stony Hills habitat (MG Site 01) supports a small suite of species that favour stony-surfaced habitats, including the Large Pilbara Rock Gehyra (*Gehyra macra*), Medium Pilbara Rock Gehyra (*Gehyra media*), Ring-tailed Dragon (*Ctenophorus caudicinctus*) and Rock Ctenotus (*Ctenotus saxatilis*). These species are likely to be largely restricted to the Stony Hills and Rocky Outcrop habitats.

Table 9. Reptiles recorded in the study area.

Species	Number trapped at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Other methods only
<b>Geckoes</b>							
<i>Diplodactylus laevis</i>	4/2	1/9	-/10	1/4			
<i>Gehyra macra</i>	-/1						
<i>Gehyra media</i>	-/11						
<i>Gehyra micra</i>	3/-						
<i>Gehyra montium</i>	1/2	1/-	1/1	9/5	56/28		
<i>Heteronotia binoei</i>	1/-				1/-	2/4	
<i>Lucasium stenodactylum</i>				3/-	-/2		
<i>Nephrurus levis</i>		3/1			1/2		
<i>Rhynchoedura ornata</i>							N
<i>Strophurus ciliaris</i>					1/		
<b>Legless Lizards</b>							
<i>Delma butleri</i>				-/2			
<i>Delma pax</i>	-/1	1/-				-/1	
<i>Lialis burtonis</i>			1/-				
<i>Pygopus nigriceps</i>							N
<b>Dragons</b>							
<i>Ctenophorus caudicinctus</i>	1/4						
<i>Ctenophorus isolepis</i>		5/-	6/2	21/3	8/2	1/-	
<i>Ctenophorus nuchalis</i>							O
<i>Diporiphora pindan</i>					2/2		
<i>Gowidon longirostris</i>						-/1	
<i>Pogona minor</i>			1/-	-/1	-/3		
<b>Skink Lizards</b>							
<i>Carlia munda</i>						1/-	
<i>Carlia triacantha</i>	-/1	4/-					
<i>Ctenotus grandis</i>		1/5	-/4	-/2	1/-	2/7	
<i>Ctenotus hanloni</i>				-/1			
<i>Ctenotus helenae</i>		1/9	-/5	3/7	-/1	-/1	
<i>Ctenotus pallasotus</i>	-/1	2/-	5/-		2/-		
<i>Ctenotus pantherinus</i>		2/1	2/-	6/5	4/-		
<i>Ctenotus quattuordecimlineatus</i>					9/14		
<i>Ctenotus rufescens</i>					1/1		
<i>Ctenotus saxatilis</i>	3/18	1/1			1/-	1/11	
<i>Ctenotus schomburgkii</i>	-/1						
<i>Egernia eppisulus</i>							C
<i>Eremiascincus pallidus</i>		1/-			16/9		

Table 9. (cont.)

Species	Number trapped at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Other methods only
<i>Lerista bipes</i>		2/5	13/19	16/42	38/45	1/14	
<i>Lerista clara</i>			1/-			3/-	
<i>Menetia greyii</i>			1/-		-/1		
<i>Morethia ruficauda</i>	1/-	1/-			3/-	1/-	
<i>Tiliqua multifasciata</i>	-/1			-/1			
<b>Goannas / Monitors</b>							
<i>Varanus acanthurus</i>	1/-		1/-			1/-	
<i>Varanus brevicauda</i>	1/1	3/-	2/-				
<i>Varanus bushi</i>							D
<i>Varanus eremius</i>	1/-	1/1		1/-		1/-	
<i>Varanus giganteus</i>							D
<i>Varanus gouldii</i>	-/1				1/1	1/-	
<i>Varanus panoptes</i>							C
<i>Varanus tristis</i>						1/-	
<b>Blind Snakes</b>							
<i>Anilius ammodytes</i>		-/1	-/3			-/1	
<i>Anilius hamatus</i>			-/1				
<b>Pythons</b>							
<i>Aspidites ramsayi</i>							N
<b>Elapid Snakes</b>							
<i>Demansia psammophis</i>		2/-					
<i>Demansia rufescens</i>				-/1	4/-		
<i>Furina ornata</i>							N
<i>Pseudechis australis</i>							N
<i>Pseudonaja mengdeni</i>					-/1		
<i>Pseudonaja modesta</i>		1/-	2/1	-/1			
<i>Simoselaps anomalus</i>		1/-		1/-	8/2		
<b>Total species:</b>	<b>18</b>	<b>20</b>	<b>17</b>	<b>16</b>	<b>23</b>	<b>16</b>	<b>10</b>

\*C = camera trap, N = night sighting, D = day sighting.

The Major River habitat is likely to support species that favour both sandy and stony surfaces, as it includes both substrates. This habitat also has tree hollows, providing habitat for the Black-tailed Monitor (*Varanus tristis*) and other arboreal species. Other species commonly associated with Major Rivers are the Long-nosed Dragon (*Gowidon longirostris*) and Flat-shelled Turtle (*Chelodina steindachneri*).



**Plate 28. *Pogona minor* and *Varanus gouldii*.**

### 5.1.3 Birds

There are 165 species of bird that potentially occur in the study area, of which 83 species were recorded on this survey (Table 10, Appendix 6). The terrestrial bird fauna of the Pilbara region is thought to be generally uniform, with a higher species richness where there is riparian vegetation such as tall *Eucalyptus* or *Melaleuca* trees (Burbidge *et al.* 2010). Most of the potentially occurring bird species have wide distributions through the Pilbara Bioregion, many occurring in a variety of habitats.

Of the 83 species recorded, more than 40% were recorded opportunistically. The most species rich sites were in the Major River (MG Site 06) and Sand Dune (MG Site 05) habitats, each with 28 species (Table 10). This is likely to be due to the more complex vegetation structure at these sites, providing habitat for a greater range of species.

The Major River habitat is likely to support a large group of species that are absent or very uncommon in other habitats. Several wetland dependent bird species, such as ducks, herons, cormorants, grebes and shorebirds, were recorded during the current survey, mostly in association with waterholes on the Yule River. The Star Finch (*Neochmia ruficauda*) is also likely to be restricted to the Major River habitat (Plate 29). These species are likely to be present whenever water is present in the Turner and Yule Rivers, some species occurring in small numbers year-round on permanent waterholes. Waterholes also provide habitat for terrestrial birds to drink and bathe (Plate 29).



**Plate 29. Little Corella bathing in a waterhole and Star Finch on the Yule River.**

Sites in the Sandplain Drainage (MG Site 02) and Spinifex Sandplain (MG Site 03 and MG Site 04) habitats were less species rich. The vegetation in the Spinifex Sandplain habitat is relatively low and open, supporting fewer bird species. The Sandplain Drainage habitat varies, with patches of open spinifex grassland and claypans, with denser shrublands on sandy rises. Although the species richness at MG Site 02 was relatively low, it is likely that some parts of this habitat support more species.

The bird assemblage is likely to include a suite of species that are resident in the study area, a second group that makes regular or nomadic movements into and through the study area. Resident species include many of the small insectivores such as fairywrens, whistlers and robins. Resident species are present all year, though their populations may fluctuate in response to rainfall and fire.

Birds that make regular seasonal movements include the Rainbow Bee-eater (*Merops ornatus*), cuckoos and some birds of prey. Honeyeaters are also likely to make seasonal or nomadic movements to take advantage of flowering events (Plate 30). Although not present all year, these species are likely to use the study area for foraging, breeding or shelter on a seasonal basis or when conditions are suitable.



**Plate 30. Honeyeaters in the study area.**

**Table 10. Birds recorded in the study area.**

Species*	Frequency of occurrence (n=6) at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Opportunistic
Australasian Darter							+
Australasian Pipit							+
Australasian Reed Warbler							+
Australian Bustard				1/1	6/1		
Australian Hobby							+
Australian Kestrel	-/1						
Australian Owllet-nightjar							+
Australian Pelican							+
Australian Magpie	2/-						
Australian Ringneck					1/-	-/1	
Bar-shouldered Dove					-/1		
Black Kite							+
Black-eared Cuckoo							+
Black-faced Cuckoo-shrike			2/-	1/-	6/1	1/-	
Black-faced Woodswallow		1/2	1/-	-/1	2/3	-/1	
Black-fronted Dotterel							+
Black-necked Stork							+
Blue-winged Kookaburra						1/-	
Brown Falcon				-/1	2/2		
Brown Goshawk							+
Brown Honeyeater	1/-				1/-		
Brown Quail							+
Budgerigar	-/2		1/1	1/1	3/5	1/2	
Bush Stone-curlew							+
Cockatiel			-/1			1/1	
Collared Sparrowhawk							+
Common Bronzewing	2/-	1/-				-/2	
Crested Bellbird	1/-				2/-	2/2	
Crested Pigeon		1/-		2/-	4/2	1/1	
Crimson Chat	-/1						
Diamond Dove	1/-	1/-	1/-		3/3	-/2	
Eastern Great Egret							+
Emu							+
Fairy Martin							+
Fork-tailed Swift (Mi)	-/1						
Galah		2/-				1/2	
Great Cormorant							+

\*see Appendix 6 for scientific names

**Table 10. (cont.)**

Species	Frequency of occurrence (n=6) at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Opportunistic
Grey Teal							+
Grey-crowned Babbler						1/1	
Grey-headed Honeyeater	4/2	1/-		-/1			
Grey Shrike-thrush					-/1		
Horsfield's Bronze-cuckoo		2/-	-/1	1/2	4/4	-/1	
Horsfield's Bush Lark			-/1		1/4		
Little Black Cormorant							+
Little Button-quail				-/1			
Little Corella							+
Little Eagle					-/1		
Little Pied Cormorant							+
Magpie-lark	1/-	1/-				3/3	
Masked Woodswallow							+
Pacific Black Duck							+
Painted Finch	-/3		-/2	-/2			
Pallid Cuckoo							+
Peaceful Dove					-/1	1/2	
Pied Butcherbird	5/-						
Purple-backed Fairy-wren	-/1	1/1		-/1	4/5		
Rainbow Bee-eater		1/1			6/6	4/6	
Red-backed Kingfisher							+
Red-browed Pardalote						1/-	
Rufous Songlark							+
Rufous Whistler					2/-	1/-	
Sacred Kingfisher						-/6	
Singing Honeyeater	4/6	6/2	5/5	5/2	6/4	-/1	
Southern Boobook							+
Spinifex Pigeon	2/-			1/-		-/1	
Spinifexbird	1/-						
Spotted Harrier				1/-	1/-	1/-	
Spotted Nightjar							+
Straw-necked Ibis							+
Star Finch							+
Torresian Crow	1/1		2/1	4/1	2/1	-/2	
Tree Martin						-/1	
Wedge-tailed Eagle							+
Western Bowerbird							+
Whistling Kite							+

Table 10. (cont.)

Species	Frequency of occurrence (n=6) at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Opportunistic
White-browed Babbler							+
White-faced Heron							+
White-plumed Honeyeater			-/1		5/2	6/6	
White-winged Fairy-wren		2/1	2/6	4/5	4/1		
White-winged Triller					1/-		
Willie Wagtail					3/-		
Yellow-throated Miner	6/3	4/-		-/1	2/1	1/1	
Zebra Finch	-/6	4/4	-/5	4/4	6/6	-/1	
<b>Total species:</b>	<b>20</b>	<b>14</b>	<b>13</b>	<b>18</b>	<b>28</b>	<b>28</b>	<b>34</b>

### 5.1.4 Mammals

There are 44 species of mammal that have the potential to occur in the study area, of which 36 are native and eight introduced (Appendix 7). A total of 28 species were recorded on this survey, of which 22 were native and six introduced (Table 11). The mammal assemblage is likely to be relatively intact, with the exception of species that are extinct in the Pilbara Bioregion. Australia has a history of mammal extinctions since European settlement, most likely due to changed fire regimes and the impacts of feral Cats and Foxes (Woinarski *et al.* 2015). Of the mammals known from the Pilbara Bioregion, 15% are now extinct (McKenzie *et al.* 2009).

Between one and six species were recorded in trapping grids, but most species were recorded by other methods including, camera trapping, bat call records and opportunistic observation (Table 11). MG Site 03 on the Spinifex Sandplain was the most species rich, but all of the species trapped were also recorded at other sites.

The Spinifex Sandplain and Sandplain Drainage habitats are likely to support a similar range of sandplain species, including the Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*), Spinifex Hopping Mouse (*Notomys alexis*) and Desert Mouse (*Pseudomys desertor*) (Plate 31). The Pilbara Ningau (Ningau *timealeyi*) is widespread but likely to favour productive low-lying habitats such as the Major River and Sandplain Drainage (Plate 31).



**Plate 31. Desert Mouse (*Pseudomys desertor*) and Pilbara Ningai (*Ningai timealeyi*).**

A small suite of species favour rocky habitats, including Woolley's False Antechinus (*Pseudantechinus woolleyae*), Long-tailed Dunnart (*Sminthopsis longicaudata*), Common Rock-rat (*Zyzomys argurus*), Rothschild's Rock-wallaby (*Petrogale rothschildi*), Northern Quoll (*Dasyurus hallucatus*) and some bat species. The Rocky Outcrop habitat is likely to provide important habitat for these species, however, this habitat is extremely limited in the study area.

Although the mammal fauna of the Pilbara is relatively well-studied, there are still taxonomic issues to be resolved, for example there are several undescribed species of *Planigale* present in the Pilbara (Westerman *et al.* 2016). Although this example does not impact the outcomes of this survey, it provides an indication that despite the many surveys that are undertaken in the region, there are still knowledge gaps.

Six introduced mammal species were recorded in the study area (Table 11, Appendix 7). Cats (*Felis catus*) and Foxes (*Vulpes vulpes*) were both recorded on camera traps (Plate 32). The Cat (*Felis catus*), Fox (*Vulpes vulpes*) and Wild Dog (*Canis familiaris dingo*) are feral predators known to prey on native fauna species. 'Predation by Feral Cats' and 'Predation by the European Red Fox' are listed as a key threatening processes under the EPBC Act. Foxes prey on 'critical weight range' mammals (i.e. those between 35g and 5.5kg) and ground-nesting birds (Commonwealth of Australia 2018). Feral Cats have contributed to the extinction of many small to medium sized native mammals and ground-nesting birds in the arid zone (Commonwealth of Australia 2015). Though mammals tend to be the dominant prey (Commonwealth of Australia 2015), each Feral Cat in natural environments kills on average 225 reptiles per year, with cats in arid areas taking even more, equating to the predation of about 1.8 million reptiles per day (Woinarski *et al.* 2018).

Table 11. Mammals recorded in the study area.

Species	Number trapped at each site (Sept/Mar)						
	1 – Stony Hills	2 – Sandplain Drainage	3 – Spinifex Sandplain	4 – Spinifex Sandplain	5 – Sand Dune	6 – Major River	Other methods only*
<b>Echidna</b>							
<i>Tachyglossus aculeatus</i>							S
<b>Dasyurid marsupials</b>							
<i>Dasyercus blythi</i> (P4)							C
<i>Dasyurus hallucatus</i> (En)							C,S
<i>Dasykaluta rosamondae</i>	1/6	12/9	1/1	2/-		5/2	
<i>Ningauai timealeyi</i>		1/-				3/3	
<i>Planigale sp. 1</i>	7/-		1/-				
<i>Sminthopsis youngsoni</i>		1/1	4/-	5/1			
<b>Bilbies</b>							
<i>Macrotis lagotis</i> (Vu)							S
<b>Kangaroos</b>							
<i>Osphranter robustus</i>							D
<i>Osphranter rufus</i>							D
<b>Bats</b>							
<i>Chaerephon jobensis</i>							A
<i>Chalinolobus gouldii</i>							A
<i>Ozimops cobourgiana</i> (P1)							A
<i>Rhinonictoris aurantia</i> (Vu)							A
<i>Saccolaimus flaviventris</i>							A
<i>Scotorepens greyii</i>							A
<i>Taphozous georgianus</i>							A
<i>Vespadelus findlaysoni</i>							A
<b>Rodents</b>							
<i>Notomys alexis</i>				1/-			
<i>Pseudomys chapmani</i> (P4)							S
<i>Pseudomys desertor</i>		1/-	1/-				
<i>Pseudomys hermannsburgensis</i>	3/-	7/-	7/2	-/1		1/1	
<b>Introduced species</b>							
<i>Mus musculus</i>			-/1		1/-		
<i>Felis catus</i>							C
<i>Vulpes vulpes</i>							C
<i>Camelus dromedarius</i>							S
<i>Canis familiaris dingo</i>							C
<i>Bos taurus</i>							S
<b>Total species:</b>	<b>3</b>	<b>5</b>	<b>6</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>19</b>

\*A = Anabat call recording, S = secondary signs, C = camera trap, N = night sighting, D = day sighting.



**Plate 32. Fox (*Vulpes vulpes*) and Cat (*Felis catus*).**

## 5.2 Vertebrate Fauna of Conservation Significance

There are 31 vertebrate fauna of conservation significance that potentially occur in the study area: seven Threatened, 14 Migratory, one Specially Protected, eight Priority and one Locally Significant species (Table 12). Each species is summarised in Table 12 and discussed in the sections below. The results of the DBCA Threatened and Priority Fauna Database extract is shown on Figure 9 and the conservation significant fauna recorded on this survey are shown in Figure 10. The results EPBC Protected Matters Search Tool extract is shown in Appendix 8.

Several conservation significant species listed on database searches in the area have been omitted from the list of potential fauna in Appendices 4 – 7 and the discussion below. These species are listed in Appendix 9 and includes Migratory shorebirds that primarily occur in coastal habitats, seabirds, marine turtles and species only likely to occur as vagrants. The study area does not provide habitat likely to regularly support these species.

**Table 12. Summary of conservation significant fauna.**

Key to status: Cr = Critically Endangered, En = Endangered, Vu = Vulnerable, Mi = Migratory, OS = Other Specially Protected, P1 – P4 = Priority 1 – 4, LS = Locally Significant.

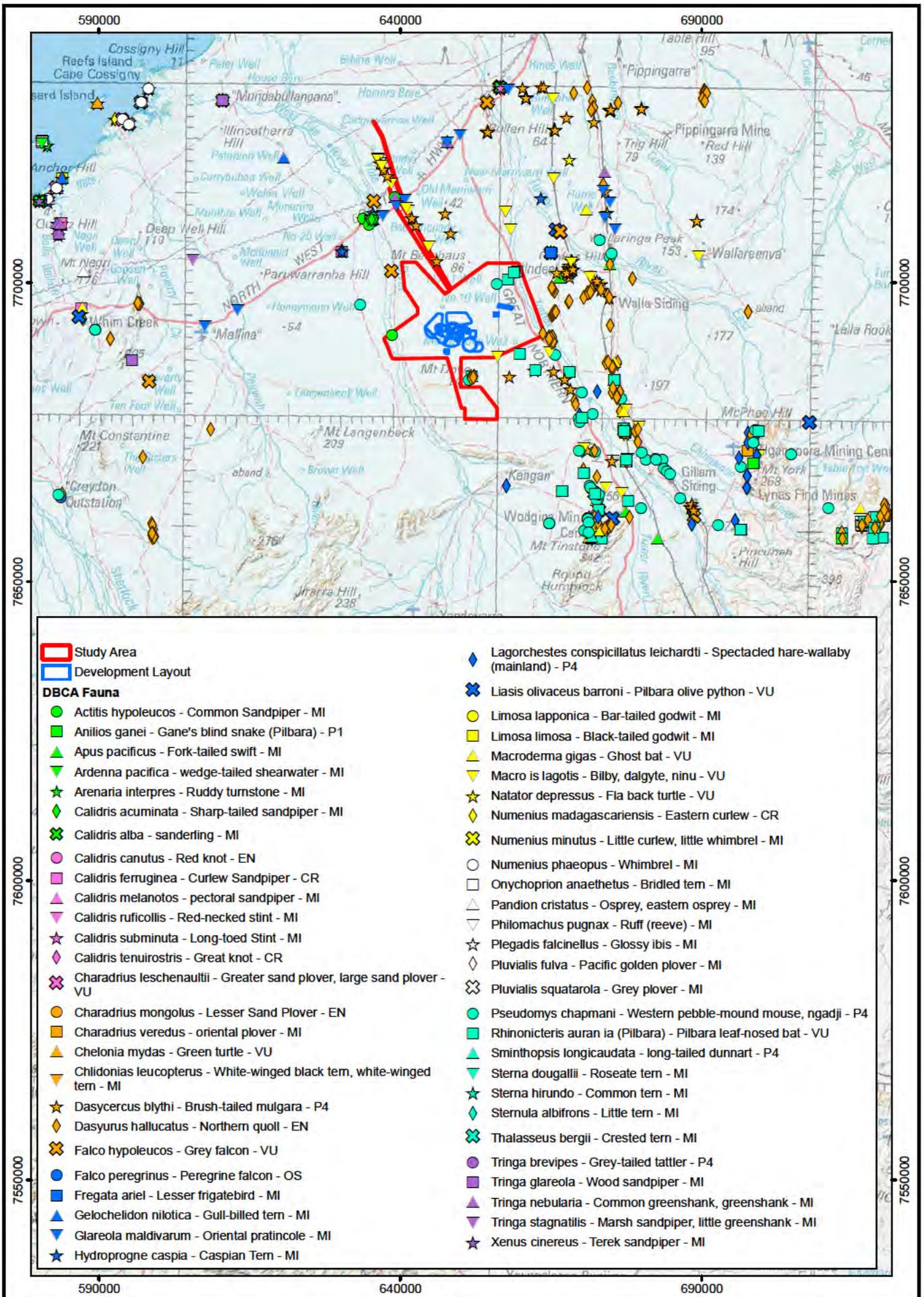
Species	Conservation Status				Likelihood of Occurrence	Notes
	EPBC Act	BC Act	DBCA Priority	Locally significant		
<b>Threatened Species</b>						
<i>Pezoporus occidentalis</i> <b>Night Parrot</b>	En	Cr			Possible	This species is known from very few records anywhere, but habitats in the study area may be suitable (patches of mature spinifex).
<i>Dasyurus hallucatus</i> <b>Northern Quoll</b>	En	En			Known to occur	<b>Recorded in the study area in September 2021, March and August 2022.</b> Likely to be a resident of the Rocky Outcrops and Major River habitats, dispersing and foraging in adjacent habitats.
<i>Macrotis lagotis</i> <b>Bilby</b>	Vu	Vu			Known to occur	<b>Secondary signs recorded in the study area in September 2021 and March 2022.</b> Likely to be an uncommon resident to the Spinifex Sandplain, Sandplain Drainage and Sand Dune habitats.
<i>Rhinionictes aurantia</i> <b>Pilbara Leaf-nosed Bat</b>	Vu	Vu			Known to occur	<b>Recorded in the study area in September 2021 and March 2022.</b> Likely to be a regular foraging visitor to all habitats, particularly of the Rocky Outcrops and Major River habitats. No diurnal roosting habitat present.
<i>Macroderma gigas</i> <b>Ghost Bat</b>	Vu	Vu			Likely	Likely to be a regular foraging visitor to all habitats. No diurnal roosting habitat present.
<i>Liasis olivaceus barroni</i> <b>Pilbara Olive Python</b>	Vu	Vu			Likely	Known to occur nearby (Figure 9), this species is likely to be a foraging visitor and possible breeding resident of the Major River and Rocky Outcrop habitats.
<i>Falco hypoleucos</i> <b>Grey Falcon</b>	Vu	Vu			Likely	Known to occur nearby (Figure 9), this species is likely to be a foraging visitor to open habitats and possible breeding resident of the Major River habitat.
<b>Migratory Species</b>						
<i>Charadrius veredus</i> <b>Oriental Plover</b>	Mi	Mi			Possible	May be a non-breeding summer visitor to open plains and recently burnt areas, but there are very few records of this species in the region.

Table 12. (cont.)

Species	Conservation Status				Likelihood of Occurrence	Notes
	EPBC Act	BC Act	DBCA Priority	Locally significant		
<i>Actitis hypoleucos</i> <b>Common Sandpiper</b>	Mi	Mi			Likely	Non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Calidris acuminata</i> <b>Sharp-tailed Sandpiper</b>	Mi	Mi			Potential	Non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Calidris melanotos</i> <b>Pectoral Sandpiper</b>	Mi	Mi			Possible	May be a non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Calidris ruficollis</i> <b>Red-necked Stint</b>	Mi	Mi			Potential	Non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Tringa glareola</i> <b>Wood Sandpiper</b>	Mi	Mi			Likely	Non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Tringa nebularia</i> <b>Common Greenshank</b>	Mi	Mi			Likely	Non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Tringa stagnatilis</i> <b>Marsh Sandpiper</b>	Mi	Mi			Potential	Non-breeding summer visitor to waterholes on Major Rivers, possibly also to claypans in the Sandplain Drainage habitat.
<i>Pandion cristatus</i> <b>Eastern Osprey</b>	Mi	Mi			Potential	Foraging visitor to waterholes on Major Rivers. No breeding habitat present.
<i>Apus pacificus</i> <b>Fork-tailed Swift</b>	Mi	Mi			Known to occur	<b>Recorded in the study area in March 2022.</b> Although likely to occur on occasion, this species is largely aerial in Australia so the terrestrial habitats in the study area are unlikely to be of particular importance to the species.
<i>Glareola maldivarum</i> <b>Oriental Pratincole</b>	Mi	Mi			Potential	Non-breeding summer visitor to open plains or claypans in the Sandplain Drainage habitat.
<i>Gelochelidon nilotica</i> <b>Gull-billed Tern</b>	Mi	Mi			Potential	Foraging visitor to waterholes on Major Rivers. No breeding habitat present.
<i>Hydroprogne caspia</i> <b>Caspian Tern</b>	Mi	Mi			Likely	Foraging visitor to waterholes on Major Rivers. No breeding habitat present.

Table 12. (cont.)

Species	Conservation Status				Likelihood of Occurrence	Notes
	EPBC Act	BC Act	DBCA Priority	Locally significant		
<i>Plegadis falcinellus</i> <b>Glossy Ibis</b>	Mi	Mi			Potential	Occasional foraging visitor to waterholes on Major Rivers. No breeding habitat present.
<b>Specially Protected</b>						
<i>Falco peregrinus</i> <b>Peregrine Falcon</b>		OS			Potential	This species potentially occurs as a foraging visitor but breeding habitat is limited in the study area.
<b>Priority Species</b>						
<i>Ctenopus nigrilineatus</i> <b>Pin-striped Finesnout Ctenopus</b>			P1		Possible	This species is known from very few records, but habitats in the study area may be suitable.
<i>Anilius ganei</i> <b>Gane's Blind Snake</b>			P1		Possible	This species is known from very few records, but habitats in the study area may be suitable.
<i>Ozimops cobourgiana</i> <b>Northern Coastal Free-tailed Bat</b>			P1		Known to occur	<b>Recorded in the study area in March 2022.</b> Likely to be a foraging visitor to most habitats, may roost in tree hollows in the Major River habitat.
<i>Dasyercus blythi</i> <b>Brush-tailed Mulgara</b>			P4		Known to occur	<b>Recorded in the study area in September 2021, March and August 2022.</b> Likely to be a common resident of the Spinifex Sandplain and Spinifex Drainage habitats.
<i>Lagorchestes conspicillatus</i> <b>Spectacled Hare-wallaby</b>			P4		Likely	This species is known to occur in the region and suitable habitat is present in the Spinifex Sandplain and Sandplain Drainage habitats.
<i>Sminthopsis longicaudata</i> <b>Long-tailed Dunnart</b>			P4		Potential	This species is known to occur in the region, and potentially suitable habitat is present in the Stony Hills and Rocky Outcrops.
<i>Leggadina lakedownensis</i> <b>Lakeland Downs Mouse</b>			P4		Potential	This species is known to occur in the region, and potentially suitable habitat is present in the Sandplain Drainage habitat.
<i>Pseudomys chapmani</i> <b>Western Pebble-mound Mouse</b>			P4		Known to occur	<b>Active mounds recorded in the study area in September 2021, March and August 2022.</b> Likely to be a common resident of the Stony Hills habitat.
<i>Stipiturus ruficeps</i> <b>Rufous-crowned Emu-wren</b>				LS	Likely	Likely to occur where mature spinifex is present. Recorded elsewhere on the Mallina Gold Project.





### 5.2.1 Threatened Fauna

There are seven Threatened species that potentially occur in the study area (Table 12).

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

#### Night Parrot – *Pezoporus occidentalis*

The Night Parrot is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act.

Historically, the Night Parrot was recorded across a large range in the arid and semi-arid interior of Australia (Garnett *et al.* 2011). In recent times however, there are very few verified records of the species. Western Australia records are from six sites including Lake Gregory, a site near Wiluna and near the Fortescue Marsh in the Pilbara (NPRT 2019, Davis and Metcalf 2008, Garnett and Baker 2021). Sampling with passive acoustic detectors over the last few years have failed to find any further birds, and the no more than 30 individual Night Parrots have been detected 2013 – 2020 (Garnett and Baker 2021).

The key habitats for the Night Parrot are thought to be chenopod shrublands and Spinifex grasslands, with the chenopod shrublands a refuge during dry conditions (Garnett *et al.* 2011). Nesting sites are in mature Spinifex, often large ring-forming clumps, usually in *Triodia longiceps* (DPAW 2017), but also in other species. Foraging habitats are likely to vary across Australia, but include herbs, grasses, grass-like plants, *Sclerolaena spp.* and other chenopods (DPAW 2017).

Key threats to the Night Parrot are thought to include habitat degradation due to large-scale grazing, habitat loss due to potash mining, fires that result in loss of mature spinifex, predation by cats (Garnett and Baker 2021).

Knowledge about the current distribution and habitat requirements of the Night Parrot in Western Australia is based on very few records. Therefore, there is considerable uncertainty when assessing the likelihood of occurrence of this species. The targeted survey in March 2022 deployed passive acoustic detectors at 13 sites across the study area, and no Night Parrots were detected (Adaptive NRM 2022, Appendix 11). Most habitats lack the large spinifex clumps required for breeding habitat, at least in part due to regular fires by the pastoralist. Small parts of the Spinifex Sandplain and Sandplain Drainage habitats support large spinifex clumps, usually where water runoff has promoted growth in depressions, or small areas have been protected from fire. For the most part the presence of mature spinifex is in very small patches, at a scale far finer than the habitat mapping. The Night Parrot possibly occurs as possible breeding and roosting habitat is present, however, it is considered unlikely that the study area comprises critical habitat for this species as contemporary Western Australian records of this species have been associated with salt lakes and marshes.

### Northern Quoll – *Dasyurus hallucatus*

The Northern Quoll is listed as Endangered under the EPBC Act and BC Act.

The Northern Quoll occurs across the northern parts of Australia including Western Australia, the Northern Territory, Queensland and some offshore islands (Van Dyck and Strahan 2008). The Northern Quoll has declined, now occurring as several disjunct populations, of which the Pilbara population is one (Braithwaite and Griffiths 1994). The reduction in population size is estimated at 50% over the last decade, with a further 25% reduction expected over the next decade (Woinarski *et al.* 2014). An ‘important population’ is one that is important to the long-term survival of the Northern Quoll. This may be a population that is high density, a population free of Cane Toads and where Cane Toads are unlikely to gain a foothold, or a population subject to on-going research.

The Northern Quoll is reproductively mature at 11 months, and breed in their first year (Van Dyck and Strahan 2008). Breeding occurs between July and September and is usually synchronised within a population. At about two months old the young are left in a den while the mother forages, and at six months about two or three young are weaned (Van Dyck and Strahan 2008). In general, all adults die after breeding, though some females have been recorded living up to three years in the wild (Van Dyck and Strahan 2008).

The Northern Quoll occurs in a variety of habitats across its range, but favours dissected rocky escarpments in the Pilbara (Hill and Ward 2010, Van Dyck and Strahan 2008). Where shelter habitat occurs within the Northern Quolls predicted range, it is considered ‘habitat critical to the survival of the species’ (DoE 2016). In the Pilbara, shelter and denning habitat consists of rocky habitats such as ranges, escarpments, mesas, gorges, breakaways and boulder fields (DoE 2016). Northern quoll habitat preferences have been modelled (Molloy *et al.*, 2017; Shaw, In press), with granite areas south of Port Hedland identified as a habitat stronghold.

Little is known about Northern Quoll foraging and dispersal habitats, however, the EPBC Act referral guidelines recognise that all native vegetation within 1km of shelter habitat or Northern Quoll records may be considered foraging and dispersal habitat (DoE 2016). Recent studies have shown that Northern Quolls in the Pilbara form two subpopulations (roughly east and west) with a great deal of mixing, indicating that individuals have a great capacity for dispersal (Shaw, In press). Females tend to stay close (about 2km) to their maternal dens, whereas males disperse further (4-10 km) (Shaw, In press). Higher dispersal capacity is linked to proximity to watercourses (Shaw, In press).

Cane Toads are considered the main threat to the Northern Quoll in the parts of its range that overlap the Cane Toad distribution (Hill and Ward 2010). As yet the Pilbara is free of Cane Toads, though it is uncertain whether this will be the case in the future. The Northern Quoll was already in decline in parts of its range prior to Cane Toad invasion, so other threatening processes are thought to be at play (Hill and Ward 2010).

Feral Predators, such as the Fox (*Vulpes vulpes*) and Cat (*Felis catus*), are likely to prey on Northern Quolls. Hernandez-Santin (2018) suggests that in the Pilbara Cats may exclude quolls from open spinifex plains, restricting them to rocky habitats. Inappropriate fire regimes, such as too-frequent fires, appear to impact Northern Quolls, possibly through decreased cover resulting in increased predation, changes to habitat structure or reduction in food availability. However, these mechanisms are not well understood (Hill and Ward 2010).

Habitat degradation caused by livestock is of concern in the northern savannah habitats, and together with inappropriate fire regimes, may be the cause of declines of this species in the Pilbara (Hill and Ward 2010). Habitat destruction occurs through developments such as mining, housing and agriculture, and though it occurs on a smaller scale than habitat degradation, it may still have a significant impact on critical habitat (Hill and Ward 2010).

The Northern Quoll population on Indee Station has been subject to long-term monitoring by DBCA since 2013 and has also been a study site for two PhD projects (Dunlop *et al.* 2019). The DBCA study site is located about 1km to the southeast of the study area at Red Rock, and is shown on Figure 11. This site has been a stronghold for Northern Quoll every year, compared to other sites that have fluctuated or had local extinctions and reinvasions. The only site that is comparable is Dolphin Island, off Karratha, which is a rocky island free of feral cats, foxes and other feral species. Trapping between 2014 and 2019 resulted in 410 captures of 125 individuals from several sites, including Red Rock on the Turner River (<1km from the southeast corner of the study area) and Wingina Ridge (adjacent to the eastern edge of the study area) (Dunlop *et al.* 2019). In 2018, seven individual females were captured on the west end of Wingina Ridge, each with eight pouch young. This is an unusually high density of denning females in such a small area. By comparison, denning females from Dolphin Island and around the Turner River were captured across a much broader area and tracked back to dens that were sparsely separated across the landscape (Chan 2017, Cowan 2019).

The Northern Quoll was recorded in the study area, on camera traps in the Yule and Turner Rivers as well as through secondary signs (scats and tracks) (Plate 33, Figure 10). The Northern Quolls in the study area are abundant and part of the population studied by DBCA and thus considered an 'important population'. Shelter habitat in the study area are primarily the Rocky Outcrop and Major River habitats (Figure 8, Figure 11). The Major River habitat is likely to be important for foraging and dispersal, as it contains shelter such as tree hollows and is likely to be a higher productivity foraging environment due the seasonal presence of water. Breeding is likely to be restricted to Rocky Outcrops. It is likely that both the Rocky Outcrop and Major River habitats are critical habitat for the Northern Quoll. Foraging and dispersal habitat within 1km of these habitats is also considered critical habitat (Figure 11).



**Plate 33. Northern Quoll on camera in the Turner River.**



### **Bilby – *Macrotis lagotis***

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

The Bilby currently occurs patchily across the Pilbara and inland northern Australia with the total population estimated at less than 10,000 individuals and in decline (Woinarski *et al.* 2014). The Bilby inhabits spinifex on plains and alluvial areas, Mulga on ridges and rises and tussock grasslands on uplands and hills (Pavey 2006). Key threats to the Bilby are introduced predators (foxes and cats) and too-frequent fires, with lesser threats including predation by Dingo/Dogs and habitat degradation due to Rabbits and livestock (Woinarski *et al.* 2014).

Secondary signs of the Bilby were recorded on this survey, mostly of old burrows (inactive, but active in the past year) (Figure 12, Plate 34). The records were in the Sand Dune and Spinifex Sandplain habitats, particularly in the vicinity of the Yule River. There are several records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). As the Bilby can move its home range in response to the changing availability of food (Van Dyck and Strahan 2008), they may not always be present despite suitable habitat being available.

Critical habitat for this species is not well understood (Pavey 2006), but is likely to include the Sand Dune, Spinifex Sandplain and Sandplain Drainage habitats. Unlike critical habitat for other species, Bilby habitat is often widespread, and in this case constitutes most of the study area.



**Plate 34. Dis-used Bilby burrows in the Sand Dune habitat.**



### **Pilbara Leaf-nosed Bat – *Rhinonictoris aurantia***

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the EPBC Act and BC Act.

The Pilbara Leaf-nosed Bat requires warm, humid diurnal (daytime) roost sites and forages in gorges, along watercourses and over low Spinifex-covered hills (TSSC 2016d). The local distribution of the Pilbara Leaf-nosed Bat is mostly strongly influenced by the suitability of roost caves (hot and with a high humidity level) rather than habitat type. The species is heavily reliant on warm (28 - 32°C), humid (85 - 100%) sites for roosting, which enables individuals to reduce water loss and energy expenditure (Baudinette *et al.* 2000). Core roost sites are thought to be restricted to caves where at least semi-permanent water is nearby (Armstrong 2001, Churchill 2008), although significant roosts have also become established in man-made structures such as abandoned mines in the Pilbara region (Churchill 1991).

For the Pilbara Leaf-nosed Bat, 'habitat critical to the survival of the species' is defined by TSSC (2016d) as underground diurnal roosts with warm temperatures and high humidity, listed in order of priority for conservation, they are:

- **Permanent Diurnal Roost:**

*“occupied year-round and likely the focus for some part of the 9-month breeding cycle; considered as critical habitat that is essential for the daily survival of the Pilbara leaf-nosed bat.”*

- **Non-Permanent Diurnal Roost:**

*“evidence of usage during some part of the 9-month breeding cycle (July–March), but not occupied year-round; considered as critical habitat that is essential for both the daily and long-term survival of the Pilbara leaf-nosed bat.”*

- **Transitory Diurnal Roost:**

*“occupied for part of the year only, outside the breeding season (April–June), and which could facilitate long distance dispersal in the region; considered as critical habitat that is essential for both the daily and long-term survival of the Pilbara leaf-nosed bat.”*

Habitat important for the persistence of the local population, although not considered to be critical habitat, is:

- **Nocturnal Refuge:**

*“occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Excludes overhangs. Not considered critical habitat but are important for persistence in a local area.”*

It is difficult to define critical foraging habitat (TSSC 2016d). Foraging habitat appears to be diverse and not a restricting factor, however, suitable foraging habitat located within vicinity of a diurnal roost in order of priority for conservation includes gorges with pools (Priority 1), gullies (Priority 2), rocky outcrops (Priority 3), major watercourses (Priority 4) and open grasslands and woodlands (Priority 5).

The TSSC (2016d) lists nine threats to the conservation status of the Pilbara Leaf-nosed Bat:

- heat and water loss: the species is known for its poor ability to maintain body temperature and water
- mine collapse: resulting in direct mortality
- flooding: resulting in destruction of roost sites and possibly direct mortality
- natural predators
- mine development: may result in the destruction of roost sites
- blasting in adjacent workings: resulting in abandoning of roost sites by bats
- human entry of roosts: resulting in animals abandoning the site
- road kills: direct mortality resulting from increased vehicle activity
- site rehabilitation.

There are several records of the Pilbara Leaf-nosed Bat in the surrounding area on DBCA's Threatened and Priority Fauna Database (Figure 9). The records are relatively recent, ranging from 2010 to 2019 (DBCA 2021).

The Pilbara Leaf-nosed Bat was recorded in this survey, with its calls detected at several sites across the study area (Figure 10). These records are of foraging bats, and the Pilbara Leaf-nosed Bat is likely to forage throughout the study area, particularly in Rocky Outcrops habitat (Priority 3 foraging habitat) and the Major River habitat (Priority 4 foraging habitat). The remainder of the study area can be considered Priority 5 foraging habitat.

No diurnal roosts were recorded or considered likely to occur in the study area, due to the lack of suitable cave-bearing rocky formations. Permanent diurnal roosts known in the region are at Abydos (64km southeast), Yule River (17km south) and East Turner River (40km southeast). Transitory diurnal roosts are known from Wodgina (35km south) (Stantec 2018b). It is possible that the bats recorded in the study area are from the Yule River Roost, as bats are thought to forage 20km or sometimes up to 30km from a roost (Bat Call WA 2021). There may also be other diurnal and transitory diurnal roosts in the region.

### **Ghost Bat – *Macroderma gigas***

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

The Ghost Bats of the Pilbara region are disjunct and genetically distinct to those that occur in the Kimberley, Northern Territory and Queensland. The Pilbara population is divided between those in the Hamersley Ranges and those in the Chichester Ranges, though the genetic differentiation is low, suggesting bats move between these populations (Ottewell *et al.* 2017). Ghost Bats in the study area would fall within the Chichester Range subpopulation, which is estimated to be about 1,500 individuals (TSSC 2016a).

In the Chichester region, Ghost Bats are often found in large maternal roosts and these congregations are important for the survival of the species. However, smaller roosts are also likely to be important, allowing bats to occupy and forage through more of the landscape, resulting in dispersal and gene-flow between larger roosts. As the overall Chichester population is so small, all populations are likely to be important.



Ghost Bats utilise several diurnal and nocturnal roost caves within an area for feeding, resting, breeding and maternity. In the Pilbara, a number of natural formations are used by the Ghost Bat intermittently as short-term transient roosts and for feeding activity for single or small numbers of individuals, whilst others are used by maternity colonies (Armstrong and Anstee, 2000).

The structure of a roost site is largely indicative of its use. Transient day roosts or feeding sites for Ghost Bats are often shallower with microclimates similar to ambient conditions (Armstrong and Anstee, 2000). Breeding activity for Ghost Bats is associated with roost sites that have a relative humidity of above 80% (Armstrong and Anstee, 2000). Restricted to gorges and escarpments in the Pilbara where access to surface water, particularly where permanent or semi-permanent rock pools are present, is reasonably accessible. Individuals and small groups may shelter in deep rock crevices and abandoned mine pits.

Although the foraging ecology of the Pilbara populations has not been studied, a recent Queensland study found that male Ghost Bats forage up to 11.8km from the roost, while lactating females forage within 3km (Augusteyn *et al.* 2018). A study in the Northern Territory found that bats foraged on average 1.9km from their diurnal roost (Tidemann *et al.* 1985). Ghost Bats have large wings and are capable of flying considerable distances to forage, but there is uncertainty around the relative importance of close foraging habitats. If bats are forced to fly further to forage, this may impact on breeding success and cause population decline (Augusteyn *et al.* 2018). Therefore, any foraging habitat within 3km of a diurnal roost or potential maternity roost may be considered important foraging habitat.

Threats to the conservation status of the Ghost Bat include:

- direct heat and water loss: the species is known for its poor ability to maintain body temperature and water
- wide fluctuations in cave temperature and humidity due to extrinsic disturbances, especially maternity caves, leading to direct mortality and cave abandonment
- mine/cave collapse: resulting in direct mortality
- flooding: resulting in destruction of roost sites and possibly direct mortality
- mine development: may result in the destruction of roost sites
- blasting in adjacent workings: resulting in abandoning of roost sites by bats
- human entry of roosts: resulting in animals abandoning the site.

There are several records of the Ghost Bat in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). The Ghost Bat was not recorded on this survey, but it has been recorded nearby, including at Wingina Ridge in March 2022 (Western Wildlife 2022). The Ghost Bat is likely to occur as a foraging visitor to the study area. While foraging habitat is important, it is also widespread and unlikely to be habitat critical to the survival of the species. No diurnal roosting habitat is present, although diurnal roosts are present at Wodgina (35km south).

### **Pilbara Olive Python – *Liasis olivaceous barroni***

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and BC Act.

An iconic species of the Pilbara region, the Pilbara Olive Python is large and mostly nocturnal. Adults are usually around 2.5m long, with individuals reliably measured up to 4.5m long (Pearson 2003). Due to its cryptic habits, there are no reliable estimates of population size (DEWHA 2008), however, it was thought to be uncommon with the initial description of the subspecies in 1981 performed on a mere eight specimens collected over 65 years (Pearson 2003).

Within its range, the Pilbara Olive Python has been found to be widely distributed with many sizable populations (Pearson 2003). It is generally associated with large river systems, such as the Coongan, Shaw, Yule, Harding, Fortescue, Ashburton and Robe Rivers (DSEWPaC 2011). The favoured habitat of the Pilbara Olive Python is generally considered to be deep gorges with waterholes, however, it also occurs in riverine habitats (DSEWPaC 2011) and on the Burrup Peninsula it inhabits large rock piles in spinifex grasslands (Tutt *et al.* 2004). Radio-tracking studies on the Robe and Fortescue Rivers have found that in summer pythons range along rivers, visiting permanent pools, and in winter they shelter in rocky areas away from water, including caves in flat-topped hills (Pearson 2003, DEWHA 2008). Artificial waters, such as sewage ponds and recreational lakes, are also used (Pearson 2003).

Breeding occurs in winter, with males travelling up to three or four kilometres in search of females (Tutt *et al.*, 2004, Pearson 2003). Females only breed every 3 – 4 years (DPAW 2013). Nest sites have been observed under large slabs of rock at a considerable distance from water (DPAW 2013, Pearson 2003). In January the eggs hatch, and the young disperse (Pearson 2003). Although only preliminary results are available, on the Burrup Peninsula the Pilbara Olive Python has been found to occupy a large and distinct home-range (Tutt *et al.* 2004). Females have been found to have a highly localised home-range of 89.76 – 365.33 ha (based on three individuals) and males wander widely in search of females and have a home range of 449.26 ha (based on a single individual) (Tutt *et al.* 2004, DPAW 2013).

Threats to the Pilbara Olive Python are listed in the Conservation Advice for the species (DEWHA 2008):

- Direct predation by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*), particularly of juveniles.
- Loss of prey species, such as Northern Quolls (*Dasyurus hallucatus*) and rock-wallabies (*Petrogale spp.*) to predation by foxes.
- Loss of habitat to gas and mining developments, including changes to hydrology and downstream impacts such as sedimentation or pollution.
- Deliberate road-kills.
- Killed due to being mis-identified as a venomous snake species.

There is still a lack of information on the basic ecology of the Pilbara Olive Python. Although radio-tracking studies have been completed in several Pilbara locations, these datasets remain largely unpublished. The cryptic habits of this species make it difficult to systematically survey, as even a large-scale survey may fail to record any individuals.

There are six records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). The most recent record is from Indee Station in 2012, near Turner River East (DBCA 2021). There is also a recent anecdotal record of this species from 'Red Rock', a site on the Turner River 1.5km south of the study area.

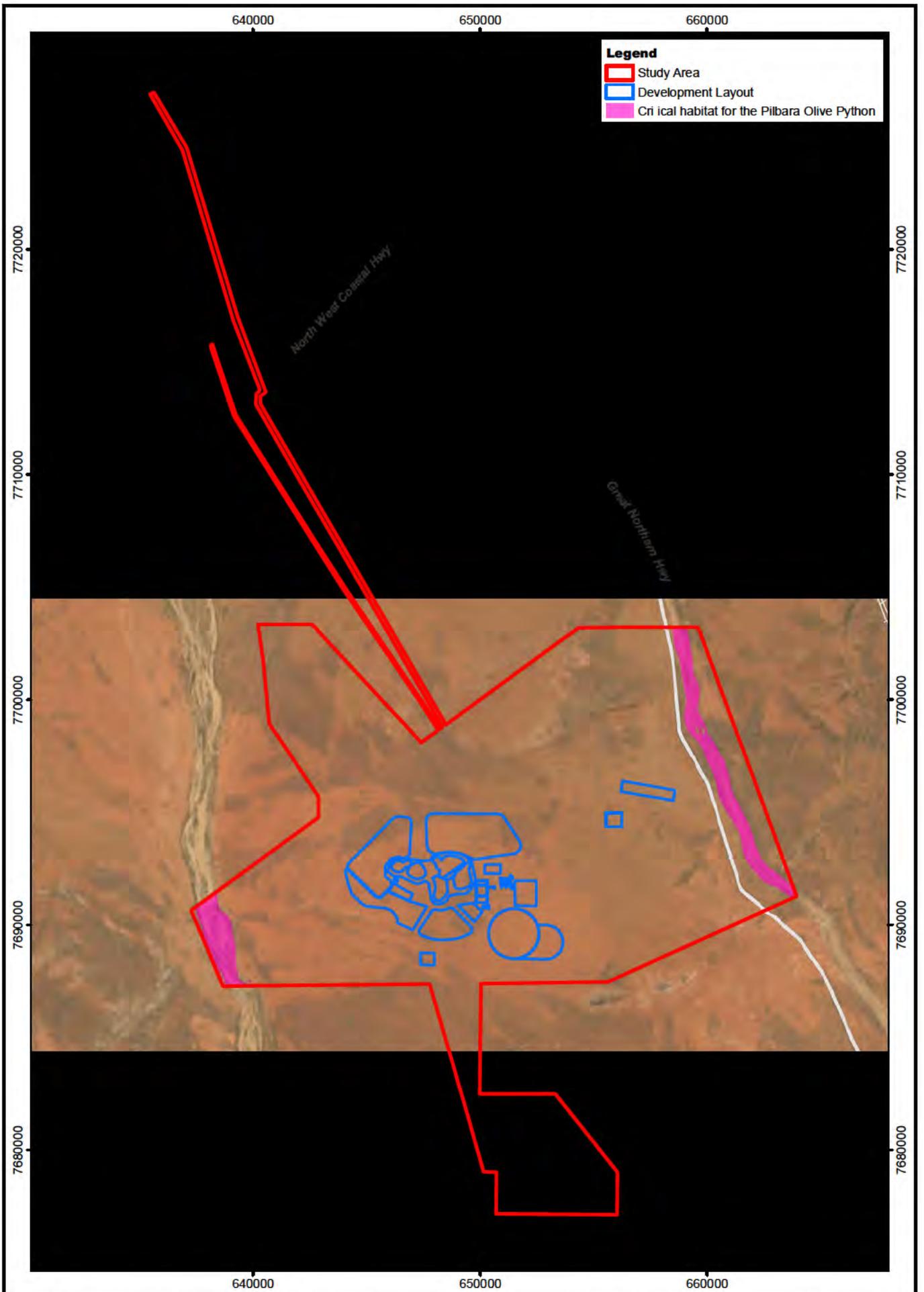
The Pilbara Olive Python is likely to occur in the study area. This species potentially occurs in a variety of habitats when dispersing and looking for mates, however, habitats in the study area likely to be habitat critical for survival are the Major River and Rocky Outcrop habitats (Figure 14).

### **Grey Falcon – *Falco hypoleucos***

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

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

The Grey Falcon has been recorded nearby on DBCA's Threatened and Priority Fauna Database (Figure 9) and is likely to occur in the study area, at least on occasion. There is potential breeding habitat on the Yule and Turner Rivers, and the Major River habitat is likely to be habitat critical to the survival of this species (Figure 15).



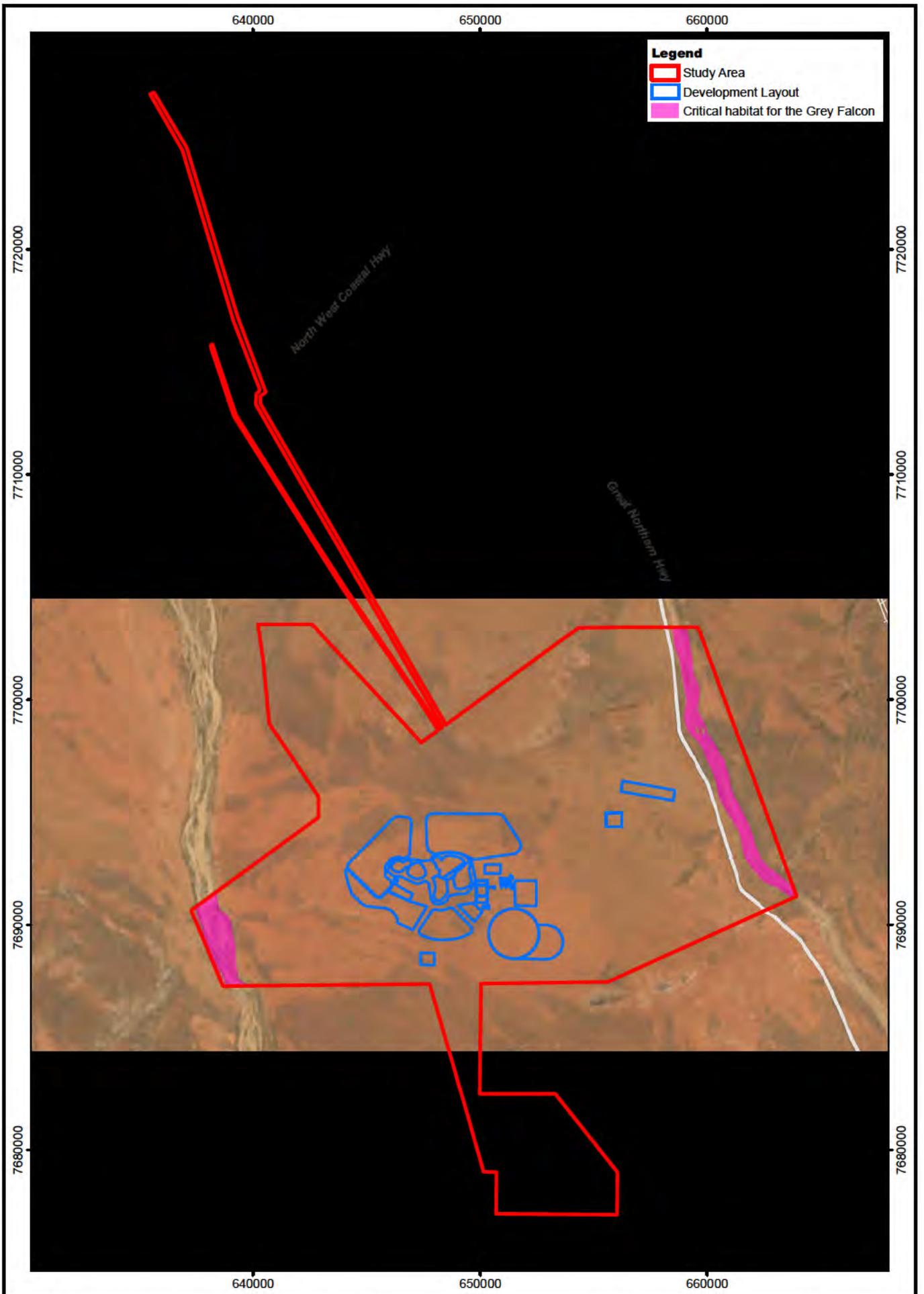
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Author: J. Wilcox

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**Hemi Gold Project  
 Pilbara Olive Python  
 critical habitat**

Figure:  
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 Author: J. Wilcox

Western  
 Wildlife

Hemi Gold Project  
 Grey Falcon critical habitat

Figure:  
**15**

## 5.2.2 Migratory Fauna

There are 14 Migratory species that potentially occur in the study area (Table 12). Other migratory shorebird species are present in the region but favour coastal habitats such as beaches and intertidal mudflats, habitats that are absent from the study area.

Migratory species are not always present at a site, but a particular site may have significance as a seasonal or ephemeral foraging, breeding or shelter area. Impacts to these sites may then impact the population both within the site and further afield. The study area is only likely to be an internationally significant site for Migratory shorebirds if it supports 20,000 birds or 1% or more of the flyway population of a species, or a nationally significant site if it supports 2,000 birds or 0.1% or more of the flyway population of a species (DoEE 2017, Hansen *et al.* 2016). The flyway population estimates, 1% and 0.1% criteria for selected shorebirds are given in Table 13.

**Table 13. Flyway population estimates for selected migratory shorebirds.**

Species	Flyway Population Estimate*	1% Flyway Population Criterion*	0.1% Flyway Population Criterion*
Oriental Plover	230,000	2,300	230
Common Sandpiper	190,000	1,900	190
Sharp-tailed Sandpiper	85,000	850	85
Pectoral Sandpiper	1,220,000 – 1,930,000	12,200	1,220
Red-necked Stint	475,000	4,750	475
Wood Sandpiper	130,000	1,300	130
Common Greenshank	110,000	1,100	110
Marsh Sandpiper	130,000	1,300	130
Oriental Pratincole	2,880,000	28,800	2,880

\*Data from Hansen *et al.* (2016).

### Oriental Plover – *Charadrius veredus*

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

The Oriental Plover favours dry grasslands and open plains, including recently burnt areas (Geering *et al.* 2007). This species is a non-breeding summer visitor to Australia, migrating from northern China and Mongolia through the East Asian-Australasian Flyway (Geering *et al.* 2007).

There is only a single record of the Oriental Plover in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). This record is from the Pilgangoora Project in 1999 (DBCA 2021), about 40km southeast of the study area. The Oriental Plover possibly occurs in small numbers as a non-breeding visitor to the study area, however, an ecologically important proportion of the population is not likely to occur. If present, the Oriental Plover is likely to favour open habitats such as recently burnt areas and claypans.

### **Common Sandpiper – *Actitis hypoleucos***

The Common Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Common Sandpiper may be present at any time of the year, but more likely between September and March (Johnstone and Storr 1998). This species occurs in a range of salt and freshwater habitats, including coasts, river pools, drying swamps and floodwaters (Johnstone and Storr 1998), however, it is most common on the coast (Geering *et al.* 2007).

There are 16 records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). Many of these records are from the Yule River, including a record from Jelliabidina Pool in 2002, which is within the study area (DBCA 2021). Although not recorded on this survey, the Common Sandpiper is likely to occur on waterholes along the Yule and Turner Rivers and may also occur on flooded claypans in the Sandplain Drainage habitat. It is likely to be a regular visitor in small numbers, but the study area is not likely to support a nationally or internationally important proportion of the population.

### **Sharp-tailed Sandpiper – *Calidris acuminata***

The Sharp-tailed Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Sharp-tailed Sandpiper was listed as Vulnerable in the *Action Plan for Australian Birds 2020* due to a sharp population decline (Garnett and Baker 2021). This listing has not yet been updated in State or Federal legislation, but it is currently being assessed for inclusion under the EPBC Act. The Sharp-tailed Sandpiper favours non-tidal freshwater or brackish wetlands, though it also occurs in other habitats (Geering *et al.* 2007). Threats to this species within Australia are considered relatively minor compared to destruction of migratory stop-over sites outside Australia but may include habitat loss due to climate change induced drought (Garnett and Baker 2021).

There are nine records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). There is a record of the Sharp-tailed Sandpiper from the Yule River in 2007 (DBCA 2021). Although not recorded on this survey, this species is likely to be a non-breeding visitor to waterholes in the study area and may also occur on claypans in the Sandplain Drainage habitat. These habitats are not likely to regularly support more than a few individuals.

### **Red-necked Stint – *Calidris ruficollis***

The Red-necked Stint is listed as Migratory under the BC Act and EPBC Act.

The Red-necked Stint was listed as Near Threatened in the *Action Plan for Australian Birds 2020* as recent analyses have suggested that slow declines in this species have accelerated in the last decade (Garnett and Baker 2021). The Red-necked Stint occurs in a range of freshwater and saltwater habitats, both on the coast and inland (Geering *et al.* 2007). Threats to this species within Australia are considered relatively minor compared to destruction of migratory stop-over sites outside Australia (Garnett and Baker 2021).

There are eleven records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including on the Yule River in 2005 (DBCA 2021). Although not recorded on this survey, this species is likely to be a non-breeding visitor to waterholes in the study area and may also occur on claypans in the Sandplain Drainage habitat. These habitats are not likely to regularly support more than a few individuals.

### **Pectoral Sandpiper – *Calidris melanotos***

The Pectoral Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Pectoral Sandpiper favours freshwater wetlands, although it may also occur on brackish waters or samphire flats (Geering et al. 2007, Johnstone and Storr 1998). It is a non-breeding visitor to south-west Australia between December and March (Johnstone and Storr 1998).

There is a single record of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), from Forestier Bay in 2013 (DBCA 2021). Although not recorded on this survey, this species may possibly be a non-breeding visitor to waterholes in the study area and may also occur on claypans in the Sandplain Drainage habitat. These habitats are not likely to regularly support more than a few individuals.

### **Wood Sandpiper – *Tringa glareola***

The Wood Sandpiper is listed as Migratory under the BC Act and EPBC Act.

In northern Australia, the Wood Sandpiper inhabits inland freshwater wetlands (Geering *et al.* 2007).

There are six records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including from the Yule River in 2005 (DBCA 2021). Although not recorded on this survey, this species is likely to be a non-breeding visitor to waterholes in the study area and may also occur on claypans in the Sandplain Drainage habitat. These habitats are not likely to regularly support more than a few individuals.

### **Common Greenshank – *Tringa nebularia***

The Common Greenshank is listed as Migratory under the BC Act and EPBC Act.

The Common Greenshank was listed as Vulnerable in the *Action Plan for Australian Birds 2020* due to a sharp population decline (Garnett and Baker 2021). This listing has not yet been updated in State or Federal legislation, but it is currently being assessed for inclusion under the EPBC Act. The Common Greenshank breeds in the northern hemisphere and is a visitor to Australia generally between September and March (Johnstone and Storr 1998). It inhabits a range of fresh and salt waters both on the coast and inland (Geering *et al.* 2007, Johnstone and Storr 1998). Threats to this species within Australia are considered relatively minor compared to destruction of migratory stop-over sites outside Australia, but may include habitat loss due to climate change, water extraction and human disturbance (Garnett and Baker 2021).

There are 21 records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). This includes records from the Yule River in 2005, as well as coastal sites (DBCA 2021). Although not recorded on this survey, this species is likely to be a non-breeding visitor to waterholes in the study area and may also occur on claypans in the Sandplain Drainage habitat. These habitats are not likely to regularly support more than a few individuals.

### **Marsh Sandpiper – *Tringa stagnatilis***

The Marsh Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Marsh Sandpiper occurs on coastal and inland freshwater and saltwater wetlands, generally avoiding intertidal mudflats (Geering *et al.* 2007).

There are five records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including on the Yule River in 2005 and 2007 (DBCA 2021). Although not recorded on this survey, this species is likely to be a non-breeding visitor to waterholes in the study area and may also occur on claypans in the Sandplain Drainage habitat. These habitats are not likely to regularly support more than a few individuals.

### **Oriental Pratincole – *Glareola maldivarum***

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

The Oriental Pratincole inhabits open plains, and wetland margins, occurring in flocks of a few birds up to very large flocks, including the notable record of 2.88 million birds on Eighty Mile Beach in 2004 (Geering *et al.* 2007).

There are 12 records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including a flock of 100 birds at Indee in 2012 (DBCA 2021). Although not recorded on this survey, this species may be a non-breeding visitor to plains and claypans in the study area. It is unlikely that a nationally or internationally significant proportion of the population would ever be present (Table 13), and its movements in Australia are unpredictable, possibly based on patterns of rainfall (Geering *et al.* 2007).

### **Gull-billed Tern – *Gelochelidon nilotica***

The Gull-billed Tern is listed as Migratory under the BC Act and EPBC Act.

This species occurs on sheltered seas and estuaries as well as on inundated inland claypans and salt lakes (Johnstone and Storr 1998). Globally, this species has a very large range and although thought to be decreasing, its population size is very large (Birdlife International 2022).

There are 16 records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including a record from the Yule River in 2004 (DBCA 2021). This species potentially forages over waterholes on the Major Rivers, but the habitats in the study area are unlikely to be important for the Gull-billed Tern.

### **Caspian Tern – *Hydroprogne caspia***

The Caspian Tern is listed as Migratory under the BC Act and EPBC Act.

Globally, the Caspian Tern has an extremely large range, a large population and the population trend is increasing (BirdLife International 2022). It usually inhabits sheltered seas, estuaries and tidal creeks, but also occurs on near-coastal salt lakes and the lower reaches of rivers (Johnstone and Storr 1998).

There are 32 records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including a records from the Yule River in 1999, 2004 and 2007 (DBCA 2021). Although not recorded on this survey, this species potentially occurs as a non-breeding visitor to waterholes on the Turner and Yule River on occasion.

### **Eastern Osprey – *Pandion cristatus***

The Eastern Osprey is listed as Migratory under the BC Act and EPBC Act.

Globally, the Eastern Osprey has an extremely large range, a large population and the population trend is increasing (BirdLife International 2022). The Eastern Osprey inhabits mainly nests on offshore islands, foraging in sheltered seas and in the lower reaches of rivers (Johnstone and Storr 1998).

There are 12 records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), including a records from the Yule River in 1999, and 2000 (DBCA 2021). Although not recorded on this survey, this species potentially visits waterholes on the Turner and Yule River. The study area lacks breeding habitat and river pools are not likely to be important foraging habitat for this species.

### **Fork-tailed Swift – *Apus pacificus***

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

The Fork-tailed Swift is a non-breeding visitor to Australia between September and April (Boehm 1962, Johnstone and Storr 1998). The bird is primarily observed foraging for insects in proximity to cyclonic weather (Boehm 1962). Although a migratory species, the Fork-tailed Swift has a large range and a large population that appears to be stable (BirdLife International 2022).

This species was recorded in the study area in March 2022 (Table 10, Figure 10). There are also eleven records from the surrounding area on DBCA's Threatened and Priority Fauna Database (Figure 9). The Fork-tailed Swift is likely to be a regular summer visitor in small numbers, but as it is a largely aerial species in Australia it is unlikely to be affected by changes to the study area.

### **Glossy Ibis – *Plegadis falcinellus***

The Glossy Ibis is listed as Migratory under the BC Act and EPBC Act.

The Glossy Ibis has an extremely large global range and although its population size is thought to be decreasing, it is not at a rate sufficient to justify listing the species as Vulnerable (Birdlife International 2022). In Western Australia, the Glossy Ibis occurs mainly on well-watered flats in the Kimberley region, favouring freshwater wetlands, and is a vagrant in drier and hillier regions (Johnstone and Storr 1998).

There is a single record of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), from the Yule River in 2004 (DBCA 2021). Although not recorded during this survey, it potentially occurs on waterholes on the Yule and Turner Rivers. It is only likely to occur as an occasional foraging visitor and is unlikely to breed in the study area.

### **5.2.3 Specially Protected Fauna**

There is one specially protected vertebrate species that potentially occurs in the study area (Table 12). The populations of Specially Protected species are large enough that they are not considered to be Threatened. However, they require on-going conservation intervention (i.e., Conservation Dependent) or be specially protected in order to prevent them from becoming Threatened.

### **Peregrine Falcon – *Falco peregrinus***

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

The Peregrine Falcon is a widespread bird of prey that globally has a very large range and a very large population that appears to be stable (BirdLife International 2022). In Western Australia the population is secure, though this species may experience reductions at a local level due to human disturbance at nesting sites (Debus 1998). The Peregrine Falcon nests mainly on ledges on cliffs or rocky outcrops, and it may also use tall trees (Johnstone and Storr 1998). This species often takes advantage of man-made structures such as abandoned open pits or quarries.

There are three records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). The Peregrine Falcon potentially occurs as a non-breeding visitor to the study area.

## 5.2.4 Priority Fauna

There are eight Priority fauna species that potentially occur in the study area (Table 12).

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

### **Pin-striped Finesnout Ctenotus – *Ctenotus nigrilineatus***

This species is listed as Priority 1 by DBCA.

The Pin-striped Finesnout Ctenotus is a small lizard that is confined to a small area of the Pilbara interior. It is only known from a few records near Woodstock, Meentheena and Nullagine, and its distribution is thought to be patchy (Chapple *et al.* 2019). Little is known of the species, but those trapped have been from Spinifex plains on granitic soils near watercourses. It is possible that its rarity is natural and there are no known threats to the species (Chapple *et al.* 2019).

There are no records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). The study area is currently just outside the known range of this species, but as it is rarely recorded and its distribution is patchy, it possibly occurs. If present, it may occur on the Spinifex Sandplains, Spinifex Drainage or Major River habitats.

### **Gane's Blind Snake – *Anilios ganei***

Gane's Blind Snake is listed as Priority 1 by DBCA.

The habitat requirements for Gane's Blind Snake are poorly known, as this species is known from relatively few records and was only formally described in 1998. It is endemic to the Pilbara, occurring between Newman and Pannawonica. This species is tentatively associated with moist gorges and gullies, though some of the early specimens are from the Newman townsite and Mt Whaleback waste dump (Aplin 1998).

There are three records of Gane's Blind Snake in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). It is unknown but possible that the habitats of the study area are suitable for Gane's Blind Snake, and it is likely that the study area falls within the range of this species. Therefore, this species possibly occurs in the study area.

### **Northern Coastal Free-tailed Bat – *Ozimops cobourgiana***

This bat is listed as Priority 1 by DBCA.

This bat occurs within 100km of the coast in the Pilbara and Kimberley, as well as in the Northern Territory (Woinarski *et al.* 2014). Although generally associated with mangroves, it has also been recorded in other habitats including *Melaleuca* forests, rainforest, eucalypt forest, woodlands, open floodplains and coastal flats (Woinarski *et al.* 2014). This bat usually roosts in tree hollows. Although considered data deficient by DBCA, this species is listed as 'Least Concern' in the *Action Plan for Australian Mammals 2012*, as it has a large range, its population size is likely to be more than 10,000 and there is no evidence of a decline (Woinarski *et al.* 2014). Threats to the species are habitat loss on a local level around coastal developments and the future risk of sea-level rises due to climate change.

There are no records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9), however, it was recorded at several sites across the study area in the March field survey (Figure 10). It is likely that this species forages across all habitats, potentially roosting in tree hollows in the Major River habitat. It is possible that this species uses the Major River habitat to disperse into the region from coastal mangrove habitats, however, the movements of this species are poorly known.

### **Brush-tailed Mulgara – *Dasyercus blythi***

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

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

The Brush-tailed Mulgara was recorded mainly in the Spinifex Sandplain and Sandplain Drainage habitats on this survey (Figure 10). Secondary signs such as burrows and diggings were recorded, as well as records on camera traps (Plate 35). There are also numerous records in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). This species is likely to be a relatively common resident, although its population will fluctuate from year to year depending on prevailing environmental conditions.



**Plate 35. Brush-tailed Mulgara burrow.**

#### **Long-tailed Dunnart – *Sminthopsis longicaudata***

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

The Long-tailed Dunnart occurs in the Pilbara, Mid-West and the central deserts of Western Australian and Northern Territory. It is associated with breakaways and scree slopes, but also occurs on gravel or stony plains (Van Dyck and Strahan 2008). There is a single record in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). This record is from the Wodgina Project in 2009 (DBCA 2021, Outback Ecology 2009). Although not recorded in this survey, the Long-tailed Dunnart possibly occurs in the study area, in the Stony Hills or Rocky Outcrops.

#### **Spectacled Hare-wallaby – *Lagorchestes conspicillatus leichardti***

The mainland population of the Spectacled Hare-wallaby is listed as Priority 4 by DBCA.

On the mainland, the Spectacled Hare-wallaby is sparsely distributed and generally uncommon (Woinarski *et al.* 2014). It occurs in a range of tropical grassland habitats, sheltering in large spinifex hummocks when in spinifex grasslands (Van Dyck and Strahan 2008). It is listed as 'Near Threatened' in the Action Plan for Australian Mammals, due to past and continuing declines in its population (Woinarski *et al.* 2014). In Western Australia it currently occurs in isolated populations in the Pilbara, Kimberley and north-eastern Great Sandy Desert. Threats to the species include predation by foxes and feral cats and inappropriate fire regimes (Woinarski *et al.* 2014). The Pilbara population has declined significantly, possibly due to frequent fires preventing large Spinifex clumps from forming, as well as predation by foxes (Van Dyck and Strahan 2008).

There are several DBCA Threatened and Priority Fauna Database records of this species in the vicinity of the study area (Figure 9). The nearest are records from Indee Station in 2019, about 14km south of the study area (DBCA 2021). A dead individual was also recorded at the Wodgina Project in 2018 (Biologic 2018a), about 32km south. This species is likely to occur in low densities in the Spinifex Sandplain and Spinifex Drainage habitats, particularly where there are large, long-unburnt spinifex hummocks in which to shelter.

#### **Lakeland Downs Mouse – *Leggadina lakedownensis***

The Lakeland Downs Mouse is listed as Priority 4 by DBCA.

The Lakeland Downs Mouse (also known as the Short-tailed Mouse) favours cracking and gilgaied clays (Gibson and McKenzie 2009), but it also occurs in a range of other habitats, including spinifex grasslands and stony ranges (Van Dyck and Strahan 2008). Populations of this species can fluctuate dramatically (Van Dyck and Strahan 2008), so it may be common in one year and virtually absent in another.

There are no records in the vicinity on DBCA's Threatened and Priority Fauna Database (Figure 9), however, the study area is within the known range of the species. The Lakeland Downs Mouse potentially occurs in the study area, possibly favouring the Sandplain Drainage habitat.

#### **Western Pebble-mound Mouse – *Pseudomys chapmani***

The Western Pebble-Mound Mouse is listed as Priority 4 by DBCA.

The Western Pebble-Mound Mouse occurs in the ranges of the central and southern Pilbara, and the smaller ranges of the Little Sandy Desert. It inhabits gentle stony slopes where it constructs its pebble mounds, often situating them near *Acacia*-lined minor drainages (Van Dyck and Strahan 2008). This species has disappeared from parts of its range along the Pilbara coast, Murchison and Gascoyne, possibly due to the fox and introduced herbivores (Van Dyck and Strahan 2008). Despite this, mining is not considered to be a threatening process for this species, as its habitat is relatively widespread (Woinarski *et al.* 2014).

There are many records of this species in the vicinity of the study area on DBCA's Threatened and Priority Fauna Database (Figure 9). Active, inactive and historic mounds of this species were found on the stony hills in the study area (Figure 10, Plate 36). The Western Pebble-mound Mouse is likely to occur throughout the Stony Hills habitat of the study area and in the wider region.



**Plate 36. Active Western Pebble-mound Mouse (*Pseudomys chapmani*) mounds.**

### 5.2.5 Locally Significant Fauna

A single locally significant species was identified: the Rufous-crowned Emu-wren (*Stipiturus ruficeps*). Although widespread across arid Australia, this species relies on mature spinifex for habitat, usually in association with low shrubs. In areas where fires are frequent, this species may become locally extinct as it is likely to be a poor disperser. The Rufous-crowned Emu-wren was not recorded on this survey but has been recorded in close proximity (Western Wildlife 2022). It may inhabit long-unburnt areas within the Spinifex Sandplain and Sandplain Drainage habitats.

## 6. Survey Adequacy

### 6.1 Species Accumulation Curves

Species accumulation curves were calculated for frogs, reptiles, mammals and birds for all habitats combined (Figures 16 - 19). Estimates of species richness for reptiles and mammals are given in Table 14, using the Chao1 estimator for abundance-based trapping data and the Chao-2 estimator for incidence-based bird survey data. These are good indicators of the lower bound of the total species richness with small sample sizes. There are several singletons (unique records) in the reptile and bird samples, indicating that the sample size may be low, and the accuracy of these estimates is likely to be poor. This is a common feature of all detailed fauna surveys, with many species represented by a single capture or observation and is ameliorated by using other survey techniques to increase the number of species recorded across the overall study area.

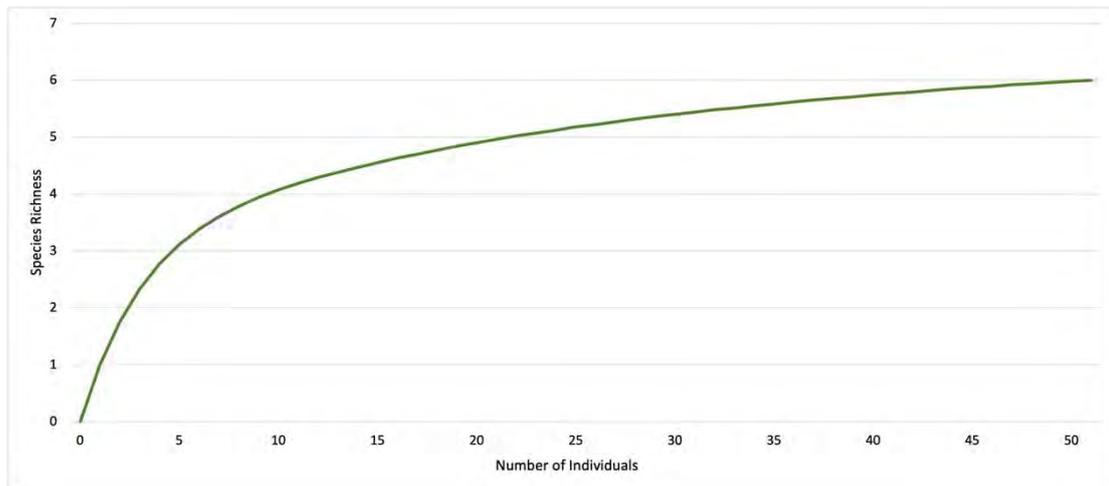


Figure 16. Species accumulation curve for frogs in all habitats.

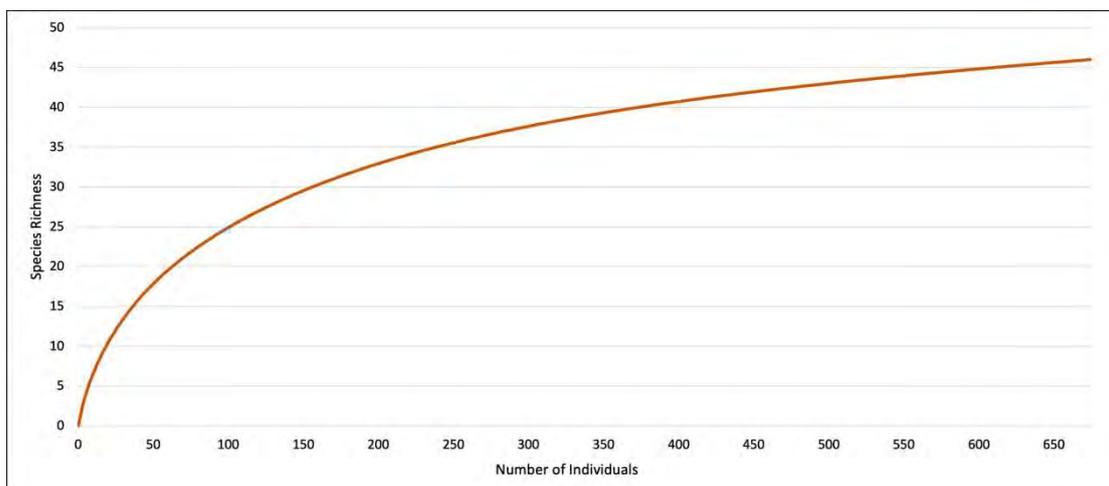
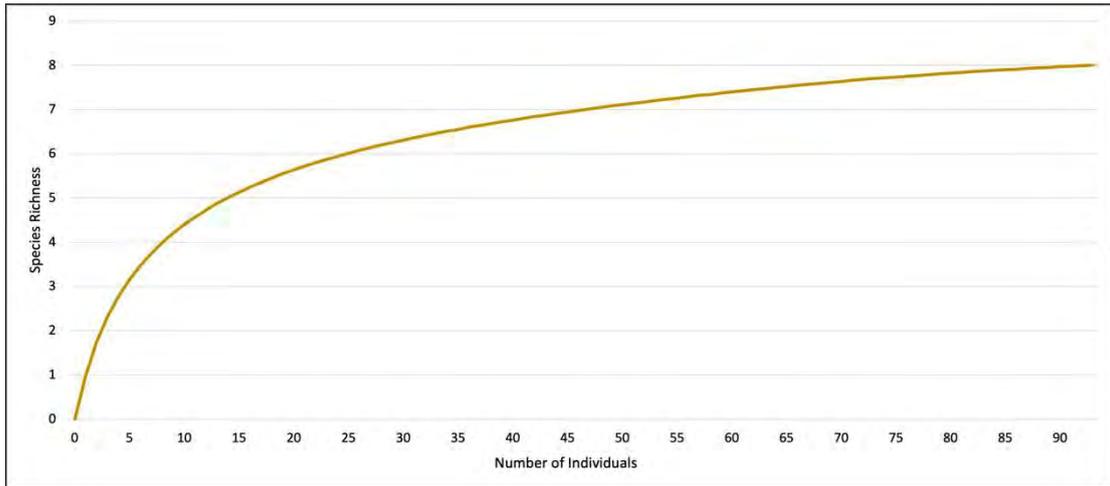
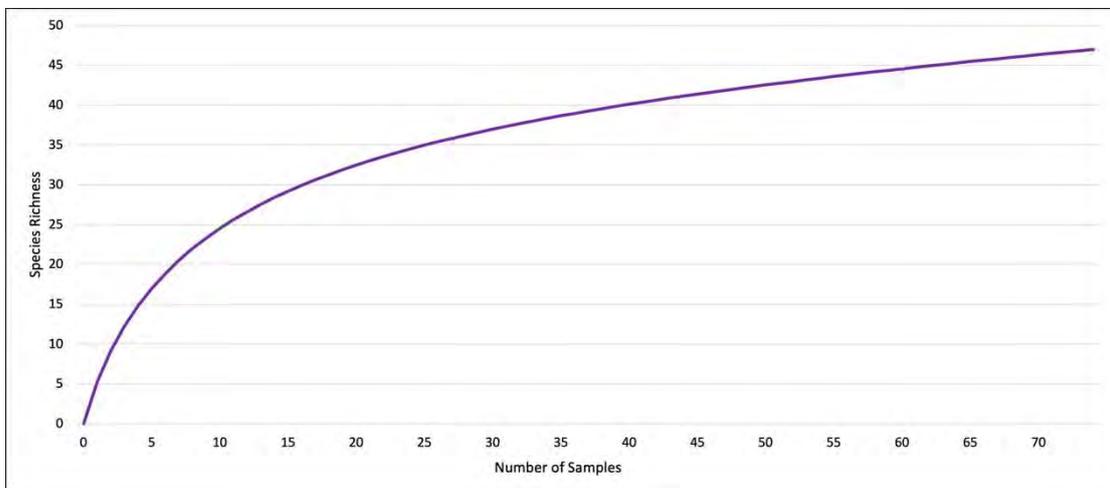


Figure 17. Species accumulation curve for reptiles in all habitats.



**Figure 18. Species accumulation curve for mammals in all habitats.**



**Figure 19. Species accumulation curve for birds in all habitats.**

When interpreting species accumulation curves and estimators of species richness in the context of a detailed fauna survey, it is vital to remember that the data collected is influenced by the sampling methods. All sampling methods have inherent biases that favour the detection of some species over others, i.e. some species will be readily trapped and others may be trapped rarely or not at all. Thus, the species accumulation curves and estimates of species richness are that of the ‘trappable’ component of the fauna only. Species may not be trappable if they are temporarily absent from the site (e.g. migratory, nomadic species or irruptive species), are too large to be targeted by standard trapping techniques (e.g. kangaroos) or are shy of entering traps. Fauna may also be patchy in their distribution within a habitat and may only be trapped if the trapping site intersects their home-range. The trappable component of the fauna is also likely to vary due to the prevailing conditions, e.g. burrowing frogs may be trappable after heavy rains, but virtually impossible to sample in dry conditions. Long-term drought conditions may reduce some species to undetectable levels, or cool conditions may result in reptiles being inactive.

**Table 14. Estimated species richness for each species group.**

Species Group	Observed species richness (systematic data only)	Sample Size (number of records)	Number of uniques in the sample	Chao1 Estimate of species richness ( $\pm$ SD)	Chao2 Estimate of species richness ( $\pm$ SD)
Frogs	6	51 (Individuals)	1	6.0 $\pm$ 0.25	-
Reptiles	46	674 (individuals)	10	53.49 $\pm$ 6.35	-
Mammals	8	93 (individuals)	1	8.0 $\pm$ 0.16	-
Birds	47	74 (samples)	12	-	60.02 $\pm$ 10.1

For frogs and mammals, the species accumulation curves were close to reaching asymptote, suggesting that almost all of the trappable fauna had been recorded and if trapping had continued, few, if any species would have been added to the list of observed species. For both of these groups the estimate of species richness was similar to the observed species richness, suggesting no species remained unrecorded.

For birds, and reptiles the species accumulation curve did not reach asymptote, although it should be noted that many species were observed outside of systematic surveys. The estimated species richness for birds was about 50 - 70 species (Table 14) and 83 species were recorded on the current survey (Table 10). The estimated species richness for reptiles was about 47 - 60 species (Table 14) and 55 species were recorded on the current survey (Table 9). This suggests that further sampling is likely to have resulted in up to five additional species being recorded.

Overall, it appears likely that a large proportion of the fauna able to be recorded through systematic methods, were recorded.

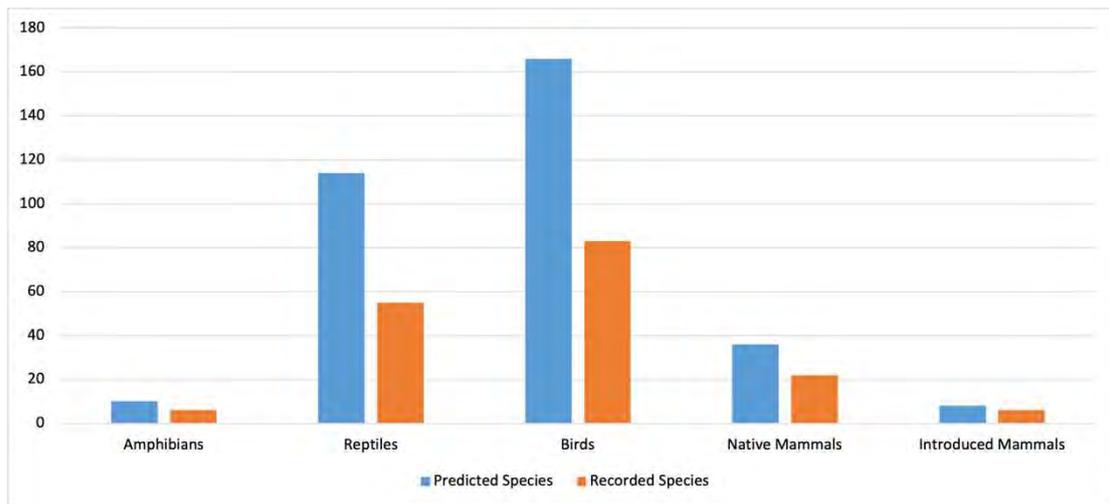
## 6.2 Proportion of the Fauna Identified

Species accumulation curves are not the complete picture, as they are based only on the systematically collected trapping and bird survey data. Many species are observed opportunistically or through targeted surveys, and these records often add considerably to the total species inventory of a particular site. The total number of species observed can be compared to the number of species potentially occurring on the site. A total of ten frogs, 115 reptiles, 166 birds, 36 native mammals and eight introduced mammals potentially occur, based on the literature review (Table 7, Appendices 4 - 7). Of these, 60.0% of frogs, 48.7% of reptiles, 50.3% of birds, 61.1% of native mammals and 75.0% of introduced mammals were recorded in the study area (Figure 20).

As the list of potentially occurring species in Appendices 4 - 7 is relatively conservative, it is quite likely that some of the unrecorded species, though known from the wider region, do not in fact occur in the study area. Some of the predicted species are on the edge of their known range in the study area and it is probable that for at least some of these species, their range does not extend into the study area.

Bird species that remain unrecorded include several waterbird species that may occur when river pools are flooded, irruptive species that may move into the area during flowering events or after a fire, and sparsely distributed species such as some birds of prey. Of the reptiles and mammals that remain unrecorded, several are species that inhabit rocky habitats that are largely absent from the study area, although they occur nearby.

It is likely that further work in the study area would result in more species being recorded. This is the case with all fauna surveys, as the short survey periods only provide a 'snapshot' of the fauna occurring in the study area. Despite these limitations, this fauna survey has resulted in a significant proportion of the predicted fauna being recorded.



**Figure 20. Proportion of the vertebrate fauna identified.**

## 7. Conclusions

### 7.1 Faunal Assemblage

The predicted faunal assemblage includes up to ten frogs, 115 reptiles, 165 birds, 36 native mammals and eight introduced mammals. The observed assemblage to date includes six frogs, 56 reptiles, 83 birds, 22 native mammals and six introduced mammals.

### 7.2 Important Habitats

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

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

None of the habitats in the study area supported a particularly unique faunal assemblage, as although relatively diverse, the fauna present are typical of the Pilbara Bioregion. The Rocky Outcrop and Sand Dune habitats are limited in their extent in both the study area and the region.

The Rocky Outcrop habitat provides small caves, cracks and crevices for shelter, offering breeding and roosting sites for a range of native fauna. Although there are no caves likely to support diurnal roosting by conservation significant bats, this habitat is likely to be habitat critical to the survival of the Northern Quoll (*Dasyurus hallucatus*: Endangered) and Pilbara Olive Python (*Liasis olivaceous barroni*: Vulnerable) both of which may shelter in this habitat.

The Sand Dune habitat is uncommon and patchily distributed in the region. It provides habitat for the Bilby (*Macrotis lagotis*: Vulnerable), as this species appeared to favour the Sand Dune for burrowing compared to the surrounding Spinifex Sandplain habitat.

The Major River habitat is likely to function as an ecological linkage, as well as providing habitat that is more productive than surrounding areas due to the presence of water. The higher productivity is likely to support a greater abundance and diversity of fauna, and there are many species that are only likely to occur in this habitat, such as waterbirds. Waterholes in the rivers provide water to fauna in an otherwise relatively dry landscape, permanent waterholes offering a refuge for fauna in dry conditions. The open riverbed may provide a refuge from fire and a natural firebreak.

The Major River habitat supports several conservation significant species. The Pilbara Leaf-nosed Bat (*Rhinoicteris aurantia*: Vulnerable) forages in this habitat. There are several shorebirds that may forage at waterholes in the summer, including the Common Sandpiper (*Actitis hypoleucos*: Migratory) and Sharp-tailed Sandpiper (*Calidris acuminata*: Migratory), however, the is habitat is unlikely to support nationally or internationally important numbers of shorebirds. The Major River habitat is likely to be habitat critical to the survival of the Northern Quoll (*Dasyurus hallucatus*: Endangered), Pilbara Olive Python (*Liasis olivaceous barroni*: Vulnerable) and Grey Falcon (*Falco hypoleucos*: Vulnerable). The Northern Quoll and Pilbara Olive Python are likely to forage and disperse through the area, with tree hollows providing shelter sites for the Northern Quoll. The larger trees potentially provide nesting habitat for the Grey Falcon.

Spinifex Sandplain and Sandplain Drainage habitats support conservation significant species, including the Bilby (*Macrotis lagotis*: Vulnerable) and Brush-tailed Mulgara (*Dasyercus blythi*: Priority 4). However, these habitats are relatively contiguous and widespread in the region, so their importance is comparatively lower than habitats that are limited in extent. Spinifex Sandplain and Sandplain Drainage may still be vulnerable to threats that operate on a widespread level, such as homogenising fires, grazing pressure and the presence of introduced predators supported by watering points.

The Stony Hills support the Western Pebble Mound Mouse (*Pseudomys chapmani*: Priority 4) and potentially the Long-tailed Dunnart (*Sminthopsis longicaudata*: Priority 4) but this habitat is comparatively common in the region.

## 8. References

- 360 Environmental. (2018a). Flora, Vegetation and Fauna Assessment Wodgina Mine and Proposed Airstrip. Unpublished report prepared for Mineral Resources Limited.
- 360 Environmental. (2018b). Wodgina Mine and Additional Gas Pipeline: Flora, Vegetation, Fauna and Northern Quoll Assessment. Unpublished report prepared for Mineral Resources Limited.
- Adaptive NRM (2022). Results of acoustic surveys conducted for the Night Parrot (*Pezoporus occidentalis*) at the Mallina Gold Project. Unpublished report to Western Wildlife.
- ALA (Atlas of Living Australia) Database (2022). Database extract study area +40km buffer 2022.
- Aplin, K.P. (1998). The new blindsnakes (Squamata:Typhlopidae) from northwestern Australia. *Records of the Western Australian Museum* 19: 1-12.
- Armstrong K.N. and Anstee S.D., (2000). The ghost bat in the Pilbara: 100 years on. *Australian Mammalogy* 22: 93-101.
- Armstrong, K. N. (2001). The distribution and roost habitat of the Orange Leaf -nosed Bat, *Rhinonictes aurantius*, in the Pilbara region of Western Australia. *Wildlife Research* 28: 95 -104.
- Augusteyn J., Hughes J., Armstrong G., Real K. and Pacioni C. (2018). Tracking and tracing central Queensland's Macroderma—determining the size of the Mount Etna ghost bat population and potential threats. *Australian Mammalogy*, 40(2), pp.243-253.
- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Victoria.
- Bat Call WA (2021). *A review of Pilbara leaf- nosed bat ecology, threats and survey requirements*, report prepared for the Department of Agriculture, Water and the Environment, Canberra, November.
- Baudinette, R.V., S.K. Churchill, K.A. Christian, J.E. Nelson & P.J. Hudson (2000). Energy, water balance and the roost microenvironment in three Australian cave-dwelling bats (Microchiroptera). *Journal of Comparative Physiology*. B 170:439-446.
- Biologic (2018a). *Wodgina DSO Project: Northern Quoll Monitoring Survey*. Unpublished report to Atlas Iron Limited.
- Biologic (2018b). *Wodgina DSO Project: Pilbara Leaf-nosed Bat and Ghost Bat Monitoring Survey*. Unpublished report to Atlas Iron Limited.
- Biota (2002a) *An Assessment of the Distribution of the Mulgara Dasyurus cristicauda and Bilby Macrotis lagotis Along and Adjacent to the Proposed Hope Downs to Port Hedland Rail Corridor*. Unpublished report to Hope Downs Management Services.
- Biota (2002b) *Proposed Hope Downs Rail Corridor From Weeli Wolli Siding to Port Hedland – Vertebrate Fauna Survey*. Unpublished report to Hope Downs Management Services.
- Biota (2004). Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor, Fortescue Metals Group Fauna Habitat and Fauna Assemblage Report. Unpublished report to Fortescue Metals Group
- BirdLife International (2022) IUCN Red List for birds. URL: <http://www.birdlife.org>
- Boehm, E.F. (1962). Some habits of the Fork-tailed Swift. *Emu* 61(4) 281-282.
- Braithwaite, R.W. and Griffiths, A.D. (1994). Demographic variation and range contraction in the Northern Quoll, *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Wildlife Research* 21: 203-217.
- Burbidge, A.H., Johnstone, R.E., Pearson, D.J. (2010). Birds in a vast arid upland:avian biogeographical patterns in the Pilbara Region of Western Australia. *Records of the Western Australian Museum* 78: 247-270.
- Bureau of Meteorology (2022). Monthly Climate Statistics for Port Hedland Airport. URL: <http://www.bom.gov.au/climate/>
- Carwardine, J., Nicol, S. Van Leeuwen, S., Walters, B., Firn, J., Reeson, A., Martin, T.G. and Chades, I (2014). *Priority Threat Management for Pilbara Species of Conservation Significance*. CSIRO Ecosystems Sciences, Brisbane.

- Chan, R. (2017) 'Investigating mate choice, sexual selection and multiple paternity based on parentage testing in island and mainland populations of the northern quoll (*Dasyurus hallucatus*)', p. 92.
- Chao, A. and Chiu, C. H. (2016). *Species richness: estimation and comparison*. Wiley StatsRef: Statistics Reference Online. 1-26.
- Churchill, S. K. (1991). Distribution, abundance and roost selection of the orange horseshoe bat *Rhinonicteris aurantius*, a Tropical Cave-dweller. *Wildlife Research* 18, 343-353.
- Churchill, S. (2008). *Australian Bats*. 2<sup>nd</sup> Edition. Reed New Holland, Sydney.
- Cogger, H.G., Cameron, E.E., Sadler, R.A. and Egger, P. (1993). *The Action Plan for Australian Reptiles*. Endangered Species Programme Project Number 124, Australian Nature Conservation Agency, Canberra.
- Colwell, R.K. (2013). *EstimateS: Statistical estimation of species richness and shared species from samples*. Version 9. URL: [purl.oclc.org/estimateS](http://purl.oclc.org/estimateS).
- Commonwealth of Australia (2018). Threat abatement plan for predation by the European Red Fox.
- Commonwealth of Australia (2015). Threat abatement plan for predation by feral cats.
- Cowan, M.A. (2019) 'Denning requirements of the northern quoll (*Dasyurus hallucatus*) and the implications for artificial den construction in the Pilbara, Western Australia', p. 123.
- Davis, R.A. and Metcalf, B.M. (2008). The Night Parrot (*Pezoporus occidentalis*) in northern Western Australia: a recent sighting from the Pilbara region. *Emu* 108(3) 233-236.
- Debus, S. (1998). *The Birds of Prey of Australia: A Field Guide*. Oxford University Press, Australia.
- DBC (Department of Biodiversity, Conservation and Attractions) (2017). *Guidelines for Surveys to Detect the Presence of Bilbies and to Assess the Importance of Habitat in Western Australia*. Version 1 – August 2017.
- DBC (2021). Threatened and Priority Fauna Database extract, 2021.
- DBC (2023). Dandjoo Search Accessed January 2023.
- DCCEEW (Department of Climate Change, Energy, the Environment and Water) (2020), Interim Biogeographic Regionalisation for Australia (Subregions) v. 7 (IBRA).
- DEWHA (Department of Environment, Water, Heritage and the Arts) (2008). *Approved Conservation Advice for Liasis olivaceus barroni (Olive Python - Pilbara subspecies)*. Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/66699-conservation-advice.pdf>.
- DEWHA (2010a). *Survey Guidelines for Australia's Threatened Bats*. Commonwealth of Australia 2010.
- DEWHA (2010b). *Survey Guidelines for Australia's Threatened Birds*. Commonwealth of Australia 2010.
- DPAW (Department of Parks and Wildlife) (2013). *Pilbara Olive Python Workshop TalkBook*. Workshop held at Kieran McNamara Conservation Science Centre DPAW, Dick Perry Avenue, Kensington, facilitated by Craig Salt.
- DPAW (2017). Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia.
- DoE (Department of Environment) (2015). Draft Referral Guideline for 14 birds listed as migratory under the EPBC Act. Australian Government, May 2015.
- DoE (2016). *EPBC Act referral guideline for the endangered northern quoll (Dasyurus hallucatus)*. EPBC Act Policy Statement. Commonwealth of Australia. January 2016.
- DoEE (Department of Environment and Energy) (2017). EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species. Commonwealth of Australia.
- Doughty, P., Rolfe, J.K., Burbidge, A.H., Pearson, D.J. and Kendrick, P.G. (2011). Herpetological assemblages of the Pilbara biogeographic region, Western Australia: ecological associations, biogeographic patterns and conservation. *Records of the Western Australian Museum* 78: 315-341.

- DSEWPaC (Department of Sustainability, Environment, Water, Population and Communities) (2011a). *Survey Guidelines for Australia's Threatened Mammals*. Commonwealth of Australia 2011.
- DSEWPaC (2011b). *Survey Guidelines for Australia's Threatened Reptiles*. Commonwealth of Australia 2011.
- Dunlop, D.J., Birch, N. and Moore, H. (2019) *Pilbara Northern Quoll Research Program*. Perth, Western Australia: DBCA.
- EPA (Environmental Protection Authority) (2020). *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. EPA, Western Australia.
- Garnett, S.T. and Barker, G.B. (2021). *The Action Plan for Australian Birds 2020*. CSIRO Publishing, Collingwood, Victoria.
- Garnett, S.T. Szabo, J.K. and Dutson, G. (2011). *The Action Plan For Australian Birds 2010*. CSIRO Publishing, Collingwood, Victoria.
- Geering, A., Agnew, L. and Harding, S. (2007). *Shorebirds of Australia*. CSIRO Publishing, Collingwood, Victoria.
- Gibson, L.A. and McKenzie, N.L. (2009). Environmental associations of small ground-dwelling mammals in the Pilbara region, Western Australia. *Records of the Western Australian Museum* 78: 91-122.
- Government of Western Australia (2000). *Bush Forever Volume 2*. Department of Environmental Protection, Perth.
- Hansen, B.D., Fuller, R.A., Watkins, D., Rogers, D.I., Clemens, R.S., Newman, M., Woehler, E.J. and Weller, D.R. (2016) *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species*. Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne.
- Hernandez-Santin, L., Fisher, D. and Goldizen, A. (2018). *Ecology and predator associations of the northern quoll in the Pilbara*. 2018. Report of the National Environmental Science Program Threatened Species Recovery Hub.
- Hill, B.M. and Ward, S.J. (2010). *National Recovery Plan for the Northern Quoll* *Dasyurus hallucatus*. Department of Natural Resources, Environment, The Arts and Sport, Darwin.
- IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-1. <<http://www.iucnredlist.org>>
- Johnstone, R.E. & Storr, G.M. (1998). *Handbook of Western Australian Birds. Volume 1: Nonpasserines (Emu to Dollarbird)*. Western Australian Museum, Perth.
- Johnstone, R.E. & Storr, G.M. (2004). *Handbook of Western Australian Birds. Volume 2: Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum, Perth.
- Kendrick, P. and McKenzie, N. L. (2001b). Pilbara 1 (PIL1 - Chichester subregion). In: A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002. Department of Conservation and Land Management, Kensington.
- King, D. R. (1989). An assessment of the hazard posed to Northern Quolls (*Dasyurus hallucatus*) by aerial baiting with 1080 to control Dingoes. *Australian Wildlife Research* 16: 569–574.
- Masters, P. and Dickman, C. (2012). Population dynamics of *Dasyercus blythi* (Marsupialia: Dasyuridae) in central Australia: How does the mulgara persist? *Wildlife Research* 39(5), 419-428.
- McKenzie, N, van Leeuwen, S and Pinder, A. (2009). *Introduction to the Pilbara Biodiversity Survey 2002 – 2007*. Records of the Western Australian Museum Supplement 78:3 – 89.
- Menkhorst, P. and Knight, F. (2011). *A field guide to the mammals of Australia*. 3rd Edition. Oxford University Press, South Melbourne.
- MWH Australia (2014). Wodgina DSO Project: Northern Quoll Monitoring 2014. Unpublished report to Atlas Iron Limited.
- NPRT (Night Parrot Recovery Team (2019). Night Parrot Recovery Team Website URL: <https://nightparrot.com.au>
- Ottewell K, McArthur S, van Leeuwen S, Byrne M (2017). *Population genetics of the ghost bat (Macrorderma gigas) in the Pilbara bioregion*. Department of Biodiversity, Conservation and Attractions, Kensington, WA.
- Outback Ecology (2009). *Wodgina DSO Project: Terrestrial Vertebrate Fauna Assessment*. Unpublished report prepared for Atlas Iron Limited.

Outback Ecology (2010). *Turner River Hub: Terrestrial Vertebrate Fauna Baseline Survey*. Unpublished report prepared for Atlas Iron Limited.

Outback Ecology (2011). *Mt Dove DSO Project: Vertebrate Fauna Assessment*. Unpublished report prepared for Atlas Iron Limited.

Outback Ecology (2012). *Hercules Project: Terrestrial Vertebrate Fauna Baseline Survey*. Unpublished report prepared for Atlas Iron Limited.

Pavey, C. (2006). National Recovery Plan for the Greater Bilby *Macrotis lagotis*. Northern Territory Department of Natural Resources, Environment and the Arts.

Pearson, D. (2003). Giant Pythons of the Pilbara. *Landscape* 19 (1) 35 – 42.

Phoenix Environmental Sciences (2012). *Targeted Fauna Surveys for the Buckland Project*. Unpublished report for Iron Ore Holdings Ltd, November 2012.

Schmitt, L. H., Bradley, A. J., Kemper, C. M., Kitchener, D. J., Humphreys, W. F. & How, R. A. (1989). Ecology and physiology of the northern quoll, *Dasyurus hallucatus* (Marsupialia, Dasyuridae), at Mitchell Plateau, Kimberley, Western Australia. *Journal of Zoology* 217: 539–558.

Shaw, R. (In press) 'Linking life history to landscape for threatened species conservation in a multi-use region', *Conservation Biology* [Preprint].

Specialised Zoological (2022a). *Acoustic analysis and bat call identification from Mallina, Western Australia*. Unpublished report by Specialised Zoological for Western Wildlife Pty Ltd, 4 April 2022, project reference SZ580.

Specialised Zoological (2022b). *Acoustic analysis and bat call identification from Mallina, Western Australia*. Unpublished report by Specialised Zoological for Western Wildlife Pty Ltd, 21 August 2022, project reference SZ601.

Stantec (2017). *Wodgina DSO Project: Northern Quoll Monitoring Survey 2017*. Unpublished report to Atlas Iron Limited.

Stantec (2018a). *Results of the Wodgina Supplementary Bat Survey*. Unpublished memo to Mineral Resources Limited, November 2018.

Stantec (2018b). *Wodgina Project: Level 1 fauna Survey, targeted conservation significant fauna survey and desktop assessment*. Unpublished report prepared for Mineral Resources Limited, September 2018.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1983). *Lizards of Western Australia. II. Dragons and Monitors*. W.A. Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (2002). *Snakes of Western Australia*. W.A. Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1990). *Lizards of Western Australia. III. Geckoes and Pygopods*. W.A. Museum, Perth.

Storr, G.M., Smith, L.A. and Johnstone, R.E. (1999). *Lizards of Western Australia. I. Skinks*. 2nd edition. W.A. Museum, Perth.

Tidemann, C. R., Priddel, D. M., Nelson, J. E., & Pettigrew, J. D. (1985). Foraging behaviour of the Australian Ghost Bat, *Macroderma gigas* (Microchiroptera: Megadermatidae). *Australian Journal of Zoology* 33, 705-713.

TSSC (Threatened Species Scientific Committee) (2016a). Conservation Advice – *Macroderma gigas*, Ghost Bat.

TSSC (Threatened Species Scientific Committee) (2016b). *Conservation Advice Macrotis lagotis greater bilby*. Canberra: Department of the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/282-conservation-advice-15072016.pdf>. In effect under the EPBC Act from 15-Jul-2016.

TSSC (2016c). *Conservation Advice Pezoporus occidentalis night parrot*. Canberra: Department of the Environment. URL: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/59350-conservation-advice-15072016.pdf>. In effect under the EPBC Act from 15-Jul-2016.

TSSC (2016d). Conservation Advice – *Rhinonictis aurantia* (Pilbara form), Pilbara Leaf-nosed Bat.

TSSC (2018). *Conservation Advice Polytelis alexandrae princess parrot*. Canberra: Department of the Environment and Energy. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/758-conservation-advice-01022018.pdf>. In effect under the EPBC Act from 01-Feb-2018.

TSSC (2020). *Conservation Advice Falco hypoleucos Grey Falcon*. Canberra: Department of Agriculture, Water and the Environment. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/929-conservation-advice-09072020.pdf>. In effect under the EPBC Act from 09-Jul-2020.

Tutt, M. Fekete, S. Mitchell, S., Brace, P. and Pearson, D. (2004). *Unravelling the Mysteries of Pilbara Olive Python Ecology. Threatened Species Network Community Grants Final Report- Project WA11/101*. Karratha: Nickol Bay Naturalists' Club/WA CALM.

Tyler, M.J. (1998). *The Action Plan for Australian Frogs*. Environment Australia, Canberra.

Tyler, M.J., Smith, L.A. and Johnstone, R.E. (2000). *Frogs of Western Australia*. W.A. Museum, Perth.

Umwelt Australia (2022). *Hemi Gold Deposit Baseline Flora and Vegetation Assessment. Mallina Gold Project. Draft*. Unpublished report to De Grey Mining Ltd.

Van Dyck and Strahan, R. (Ed.) (2008). *The Mammals of Australia*. 3rd Edition. Australian Museum/Reed Books, Sydney.

Westerman, M., Blacket, M.J., Hintz, A., Armstrong, K., Woolley, P.A. and Krajewski, C. (2016). A plethora of planigales: genetic variability and cryptic species in a genus of dasyurid marsupials from northern Australia. *Australian Journal of Zoology* 64(5) 303-311.

Western Wildlife (2020). *Wodgina Lithium Project: Level 2 Vertebrate Fauna Survey 2019*. Unpublished Report to MARBL Lithium Operation Pty Ltd.

Western Wildlife (2022). *Unpublished Regional Fauna Survey Data collected within 50km of the Hemi Project, 2021 – 2022*.

Wilson, S. and Swan, G. (2017). *A complete guide to the reptiles of Australia. 5<sup>th</sup> Edition*. New Holland Publishers (Australia).

Woinarski, J.C.Z., Burbidge, A.A. and Harrison, P.L. (2014). *The Action Plan for Australian Mammals 2012*. CSIRO Publishing.

Woinarski, J.C.Z, Burbidge, A.A, and Harrison, P.L. (2015). Ongoing unraveling of a continental fauna: Decline and extinction of Australian mammals since European settlement. *Proceedings of the National Academy of Science of the United States of America* 112(15): 4531-4540.

Woinarski, J.C.Z, Murphy, B. P., Palmer, R., Legge, S. M., Dickman, C. R., Doherty, T. S., Edwards, G., Nankivell, A., Read, J. L. and Stokeld, D. (2018). How many reptiles are killed by cats in Australia? *Wildlife Research* 45(3) 247-266.

## Appendices.

### Appendix 1. Daily weather observations before and during each survey period.

Data after BOM (2022).

Month	Date	Survey Period	Daily Temperature (°C)		Rainfall (mm)
			Minimum	Maximum	
September 2021	01 – 09 – 21		17.5	30.6	0.4
	02 – 09 – 21		15.3	34.1	0
	03 – 09 – 21		17.7	31.9	0
	04 – 09 – 21		19	32.3	-
	05 – 09 – 21		13	32.9	0
	06 – 09 – 21		21.1	33.9	0
	07 – 09 – 21		18.5	31.5	0
	08 – 09 – 21		14.2	30.8	0
	09 – 09 – 21		14.7	33.5	0
	10 – 09 – 21		13.9	34.8	0
	11 – 09 – 21		15.3	35.8	0
	12 – 09 – 21		16.9	30.6	0
	13 – 09 – 21		14.3	30.9	0
	14 – 09 – 21		14.4	31.1	0
	15 – 09 – 21		15.5	31.9	0
	16 – 09 – 21		17.9	32	0
	17 – 09 – 21		14.6	35.6	0
	18 – 09 – 21		15.9	35.5	0
	19 – 09 – 21	Phase 1	16.9	36.6	0
	20 – 09 – 21	Phase 1	17	39.2	0
	21 – 09 – 21	Phase 1	23.3	38.9	0
	22 – 09 – 21	Phase 1	26.4	36.3	0
	23 – 09 – 21	Phase 1	22.2	32.8	0
	24 – 09 – 21	Phase 1	14.8	35.4	0
	25 – 09 – 21	Phase 1	14.5	31	0
	26 – 09 – 21	Phase 1	15.7	32.9	0
	27 – 09 – 21	Phase 1	15.7	33.8	0
	28 – 09 – 21	Phase 1	15.9	34.3	0
	29 – 09 – 21	Phase 1	14.8	32.7	0
	30 – 09 – 21	Phase 1	14.3	31.3	0.2

**Appendix 1. (cont.)**

Month	Date	Survey Period	Daily Temperature (°C)		Rainfall (mm)
			Minimum	Maximum	
February 2022	21 – 02 – 22		24.9	41.1	-
	22 – 02 – 22		26.1	36.4	0.2
	23 – 02 – 22		26.9	37	0
	24 – 02 – 22		27.7	38	0
	25 – 02 – 22		29	38.6	0
	26 – 02 – 22		26.8	35.7	0
	27 – 02 – 22		27.6	35.1	0
	28 – 02 – 22		27.2	36	0
March 2022	01 – 03 – 22		27.2	36.6	0
	02 – 03 – 22		21.7	36.7	19.6
	03 – 03 – 22		27.1	37.7	0.2
	04 – 03 – 22		27	35.4	0
	05 – 03 – 22		24.8	38	0
	06 – 03 – 22		23.9	38.5	0
	07 – 03 – 22		25.3	42.2	0
	08 – 03 – 22		27.4	39.8	0
	09 – 03 – 22		26.5	38.2	0
	10 – 03 – 22		26.1	36.7	0
	11 – 03 – 22		27.2	40.5	0
	12 – 03 – 22		26.2	42	0
	13 – 03 – 22		26	40.2	0
	14 – 03 – 22	Phase 2	26.3	38.5	0
	15 – 03 – 22	Phase 2	27.8	39.4	0
	16 – 03 – 22	Phase 2	28.1	42.3	0
	17 – 03 – 22	Phase 2	25.7	43.7	0
	18 – 03 – 22	Phase 2	28.5	36.2	0
	19 – 03 – 22	Phase 2	26.4	39.6	0
	20 – 03 – 22	Phase 2	23	39.2	1.8
	21 – 03 – 22	Phase 2	26.3	39	0.2
	22 – 03 – 22	Phase 2	26.1	39.9	0
	23 – 03 – 22	Phase 2	31	42.8	0
	24 – 03 – 22	Phase 2	29.7	37.9	0
	25 – 03 – 22	Phase 2	26.5	38.4	0

**Appendix 1. (cont.)**

Month	Date	Survey Period	Daily Temperature (°C)		Rainfall (mm)
			Minimum	Maximum	
July 2022	11 – 07 – 22		9.3	27.2	0
	12 – 07 – 22		10.8	28.2	0
	13 – 07 – 22		13.0	28.2	0
	14 – 07 – 22		10.6	25.8	0
	15 – 07 – 22		9.6	28.2	0
	16 – 07 – 22		10.6	28.0	0
	17 – 07 – 22		11.1	28.6	0
	18 – 07 – 22		11.1	28.9	0
	19 – 07 – 22		12.5	28.1	0
	20 – 07 – 22		13.0	29.3	0
	21 – 07 – 22		11.7	30.4	0
	22 – 07 – 22		13.9	29.0	0
	23 – 07 – 22		17.8	28.1	0
	24 – 07 – 22		12.9	28.2	0.2
	25 – 07 – 22		13.8	29.0	0
	26 – 07 – 22		15.1	30.1	0
	27 – 07 – 22		13.2	32.0	0
	28 – 07 – 22		14.6	28.3	0
	29 – 07 – 22		13.2	28.4	0
	30 – 07 – 22		10.9	30.1	0
31 – 07 – 22		15.6	29.2	0	
August 2022	01 – 08 – 22		14.8	28.8	0
	02 – 08 – 22		20.9	25.9	0
	03 – 08 – 22		17.2	27.9	1.8
	04 – 08 – 22		12.6	27.6	0
	05 – 08 – 22		11.2	27.9	0
	06 – 08 – 22		13.3	28.5	0
	07 – 08 – 22		9.6	29.1	0
	08 – 08 – 22		10.7	30.0	0
	09 – 08 – 22	Survey	11.0	31.3	0
	10 – 08 – 22	Survey	17.8	22.8	0
	11 – 08 – 22	Survey	11.9	29.2	0
	12 – 08 – 22	Survey	17.7	29.6	0

## Appendix 2. Sampling Locations.

Appendix 2						
Site Type	Site Name	Zone	Easting	Northing	Start Date	Stop Date
Anabat	Bat01	50	643769.798	7690313.383	21/9/21	23/9/21
Anabat	Bat02	50	661248.06	7694420.317	23/9/21	25/9/21
Anabat	Bat03	50	659381.457	7701353.459	25/9/21	27/9/21
Anabat	Bat04	50	591435.422	7680020.814	27/9/21	29/9/21
Anabat	Bat05	50	656879.819	7694048.08	20/9/21	21/9/21
Anabat	Bat06	50	645066.126	7687877.761	21/9/21	23/9/21
Anabat	Bat07	50	624344.836	7689710.563	23/9/21	25/9/21
Anabat	Bat08	50	624806	7687949	25/9/21	27/9/21
Anabat	Bat09	50	591336.78	7679986.602	27/9/21	29/9/21
Anabat	Bat10	50	656440.421	7700083.816	19/9/21	21/9/21
Anabat	Bat11	50	649850	7692702	21/9/21	23/9/21
Anabat	Bat12	50	621522.296	7688730.206	24/9/21	26/9/21
Anabat	Bat13	50	649035.189	7695165.997	26/9/21	27/9/21
Anabat	Bat14	50	639354	7687572	27/9/21	29/9/21
Anabat	Bat17	50	643799	7690390	17/3/2022	19/3/2022
Anabat	Bat18	50	645079	7688087	17/3/2022	19/3/2022
Anabat	Bat19	50	649797.917	7692742.931	19/3/2022	21/3/2022
Anabat	Bat20	50	656877.764	7694051.198	19/3/2022	21/3/2022
Anabat	Bat21	50	659023.162	7701647.693	21/3/2022	23/3/2022
Anabat	Bat22	50	661248.931	7694412.996	21/3/2022	23/3/2022
Anabat	Bat24	50	656450	7700056	23/3/2022	25/3/2022
Anabat	Bat23	50	653220.158	7694349.542	23/3/2022	25/3/2022
Camera Trap	Cam02	50	651328.629	7690351.291	24/9/21	29/9/21
Camera Trap	Cam03	50	641670	7693394	24/9/21	29/9/21
Camera Trap	Cam04	50	653553.807	7697519.584	24/9/21	29/9/21
Camera Trap	Cam05	50	653153.71	7695369.101	24/9/21	29/9/21
Camera Trap	Cam06	50	623711.027	7690361.727	24/9/21	29/9/21
Camera Trap	Cam07	50	639365	7687675	24/9/21	29/9/21
Camera Trap	Cam08	50	622166.952	7688905.716	24/9/21	29/9/21
Camera Trap	Cam09	50	641381	7690490	24/9/21	29/9/21
Camera Trap	Cam10	50	646051	7696056	24/9/21	29/9/21
Camera Trap	Cam13	50	648179	7695335	24/9/21	29/9/21
Camera Trap	Cam17	50	644939	7695259	24/9/21	29/9/21
Camera Trap	Cam20	50	638789	7691303	24/9/21	29/9/21
Camera Trap	Cam21	50	661347	7694257	24/9/21	29/9/21
Camera Trap	Cam22	50	642550	7691820	24/9/21	29/9/21

Appendix 2						
Site Type	Site Name	Zone	Easting	Northing	Start Date	Stop Date
Camera Trap	Cam23	50	646683	7693860	24/9/21	29/9/21
Camera Trap	Cam24	50	646682	7692177	24/9/21	29/9/21
Camera Trap	Cam25	50	643209	7688131	24/9/21	29/9/21
Camera Trap	Cam26	50	646445	7688260	24/9/21	29/9/21
Camera Trap	Cam27	50	639864	7687504	24/9/21	29/9/21
Camera Trap	Cam29	50	655149.033	7699617.21	24/9/21	29/9/21
Camera Trap	Cam30	50	658027	7693574	24/9/21	29/9/21
Camera Trap	Cam31	50	641343	7688148	24/9/21	29/9/21
Camera Trap	Cam32	50	649241	7693651	24/9/21	29/9/21
Camera Trap	Cam35	50	659438.996	7701141.125	24/9/21	29/9/21
Camera Trap	Cam40	50	661364	7694418	24/9/21	29/9/21
Camera Trap	Cam41	50	639966	7689778	24/9/21	29/9/21
Camera Trap	Cam42	50	645350	7690105	24/9/21	29/9/21
Camera Trap	Cam44	50	655629.493	7688242.31	24/9/21	29/9/21
Camera Trap	Cam45	50	656382.565	7698846.084	24/9/21	29/9/21
Camera Trap	Cam45	50	656383	7698846	24/9/21	29/9/21
Camera Trap	Cam46	50	642689	7690919	24/9/21	29/9/21
Camera Trap	Cam47	50	624801.159	7687949.755	24/9/21	29/9/21
Camera Trap	Cam48	50	657233	7693532	24/9/21	29/9/21
Camera Trap	Cam49	50	659426.065	7701095.416	24/9/21	29/9/21
Camera Trap	Cam50	50	656348.858	7688927.755	24/9/21	29/9/21
Camera Trap	Rde02sl2409	50	648674	7696864	24/9/21	29/9/21
Camera Trap	Cam07B	50	651668.139	7692589.922	16/3/22	24/3/22
Camera Trap	Cam05B	50	652665.345	7693891.299	16/3/22	24/3/22
Camera Trap	Cam23B	50	650587.667	7691869.231	16/3/22	24/3/22
Camera Trap	Cam31B	50	651036.793	7690271.344	16/3/22	24/3/22
Camera Trap	Cam42B	50	652615.397	7688919.759	16/3/22	24/3/22
Camera Trap	Cam20B	50	649122.659	7690534.624	16/3/22	24/3/22
Camera Trap	Cam27B	50	649053.097	7688848.522	16/3/22	24/3/22
Camera Trap	Cam30B	50	639351.102	7687653.67	17/3/22	24/3/22
Camera Trap	Cam40B	50	639312.041	7687585.796	17/3/22	24/3/22
Camera Trap	Cam25B	50	640109.936	7689301.868	17/3/22	24/3/22
Camera Trap	Cam47B	50	641048.666	7688185.725	17/3/22	24/3/22
Camera Trap	Cam32B	50	641407.835	7690591.689	17/3/22	24/3/22
Camera Trap	Cam09B	50	643732.437	7690348.686	17/3/22	24/3/22
Camera Trap	Cam08B	50	645305.05	7690099.958	17/3/22	24/3/22
Camera Trap	Cam45B	50	649754.165	7692761.259	18/3/22	24/3/22

Appendix 2						
Site Type	Site Name	Zone	Easting	Northing	Start Date	Stop Date
Camera Trap	Cam16B	50	650173.125	7694259.895	18/3/22	24/3/22
Camera Trap	Cam10B	50	646699.459	7694130.273	18/3/22	24/3/22
Camera Trap	Cam13B	50	646699.436	7693046.478	18/3/22	24/3/22
Camera Trap	Cam41B	50	668933.938	7697217.071	15/3/22	22/3/22
Camera Trap	Cam24B	50	653849	7694292	16/3/22 0:00	24/3/22
Camera Trap	Cam29B	50	653074	7696317	18/3/22 0:00	24/3/22
Camera Trap	Cam04B	50	668795	7697145	15/3/22 0:00	24/3/22
Camera Trap	Cam44B	50	655649	7695406	16/3/22 0:00	24/3/22
Camera Trap	Cam46B	50	653244	7694354	16/3/22 0:00	24/3/22
Camera Trap	Cam48B	50	652853	7698899	18/3/22 0:00	24/3/22
Camera Trap	Cam49B	50	654043	7702083	18/3/22 0:00	24/3/22
Camera Trap	Cam06B	50	668624	7697080	15/3/22 0:00	24/3/22
Camera Trap	Cam21B	50	650431	7694911	18/3/22	24/3/22
Camera Trap	Cam22B	50	654858	7698394	18/3/22	24/3/22
Camera Trap	Cam24B	50	653849	7694292	16/3/22	24/3/22
Camera Trap	Cam26B	50	652222	7694568	18/3/22	24/3/22
Camera Trap	DeGrey Cam 01	50	639674	7687936	20/3/22	9/4/22
Camera Trap	DeGrey Cam 02	50	639653	7688002	20/3/22	9/4/22
Camera Trap	DeGrey Cam 03	50	639672	7687998	20/3/22	9/4/22
Camera Trap	DeGrey Cam 04	50	653122	7697179	21/3/22	9/4/22
Camera Trap	DeGrey Cam 05	50	653100	7697251	21/3/22	9/4/22
Camera Trap	DeGrey Cam 06	50	653295	7697213	21/3/22	9/4/22
Camera Trap	Cam25D	50	643656.545	7697280.912	10/8/2022	18/8/2022
Camera Trap	Cam40D	50	649240.124	7683310.42	10/8/2022	18/8/2022
Camera Trap	Cam46D	50	649148.067	7683284.678	10/8/2022	18/8/2022
Camera Trap	Cam48D	50	652573.025	7680415.2	10/8/2022	18/8/2022
Camera Trap	Cam49D	50	642244.78	7701645.619	10/8/2022	18/8/2022
Diurnal Search (Point)	MB_T01	50	639364	7687675	28/9/21	28/9/21
Diurnal Search (Point)	Yule	50	639354	7687572	28/9/21	28/9/21

### Appendix 3. Habitat Assessment.

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab001</p> <p><b>Habitat:</b> Sand Dune</p> <p><b>Landform:</b> slope</p> <p><b>Vegetation:</b> Tall Acacia shrubland over open spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> leaf litter, sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab002</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over mixed low Acacia and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab003</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse Acacia shrubland over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab004</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse Acacia shrubs and Corymbia trees over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> near recently burnt area.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab005</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Tall Acacia shrubland with occasional Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, near recently burnt area.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab006</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered tall Acacia, Hakea and Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab007</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered tall Acacia and Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> edge of recently burnt area.</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> surface gravel.</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab008</p> <p><b>Habitat:</b> Stony Hill</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Scattered tall Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> edge of recently burnt area.</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> fine pink sand</p> <p><b>Rock:</b> stony surface.</p> <p><b>Important elements:</b> small stones for Western Pebble-mound Mouse.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab009</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab010</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia, Hakea and Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab011</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia, Hakea and Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab012</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia, Hakea and Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab013</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia and Corymbia over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab014</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia and open tall Acacia shrubland over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab015</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland in bands over open spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sandy clay</p> <p><b>Rock:</b> sparse surface stones.</p> <p><b>Important elements:</b> small claypans</p> <p><b>Wetlands:</b> small claypans, seasonally wet.</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab016</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open tall Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab017</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, near recently burnt area.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab018</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab019</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional tall Acacia shrub over mixed low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> leaf litter.</p> <p><b>Wetlands:</b> seasonally wet?</p>	
<p>Mghab020</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patches of Acacia shrubland on higher ground, low spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> seasonally wet.</p>	
<p>Mghab021</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland and scattered Corymbia over mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> leaf litter, occasional small tree hollows.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab022</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Tall Acacia shrubland with occasional eucalypts over sparse spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> dense vegetation, leaf litter, woody debris.</p> <p><b>Wetlands:</b> drainage area.</p>	
<p>Mghab023</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Open Acacia and Hakea shrubland with sparse Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> stony surface</p> <p><b>Important elements:</b> leaf litter, woody debris, small tree hollows.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab024</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy tall Acacia shrubland with sparse Corymbia over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, potential bilby habitat</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab025</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia, Hakea and Corymbia over mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, potential bilby habitat</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab026</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse Acacia and Hakea over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab027</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse Corymbia, Acacia and Hakea over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab028</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open tall Acacia shrubland over mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, large termite mounds</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab029</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia, Hakea and Melaleuca over mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, seasonal nectar (Melaleuca)</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab030</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted</p> <p><b>Wetlands:</b> seasonally damp (?)</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab031</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Small patches of Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted</p> <p><b>Wetlands:</b> seasonally damp (?)</p>	
<p>Mghab032</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Small patches of Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted</p> <p><b>Wetlands:</b> seasonally damp (?)</p>	
<p>Mghab033</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Small patches of Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted</p> <p><b>Wetlands:</b> seasonally damp (?)</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab034</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Small patches of Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, drill pad</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted</p> <p><b>Wetlands:</b> seasonally damp (?)</p>	
<p>Mghab035</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open tall Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> seasonally damp (?)</p>	
<p>Mghab036</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Hakea over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab037</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse Coymbia and Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, near recently burnt area.</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> some very large spinifex, small tree hollows.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab038</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Sparse tall Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab039</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia over open spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> large spinifex clumps</p> <p><b>Wetlands:</b> seasonally wet</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab040</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> gentle slope</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> fine pink sand</p> <p><b>Rock:</b> stony surface, small pebbles, very occasional rocky outcrop.</p> <p><b>Important elements:</b> rocky outcrops, small pebbles for Western Pebble-mound Mouse.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab041</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> gentle slope</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> fine pink sand</p> <p><b>Rock:</b> stony surface, small pebbles.</p> <p><b>Important elements:</b> small pebbles for Western Pebble-mound Mouse.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab042</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia over open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> tree hollows, some large spinifex clumps.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab043</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab044</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab045</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Scattered Corymbia over open low Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> stony surface</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab046</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia and Melaleuca shrubland over degraded understory.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, bore</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> none</p>	 <p>A wide-angle photograph of a Spinifex sandplain. The ground is a mix of red sand and sparse, low-lying vegetation. Several cattle are scattered across the landscape, some grazing. The background shows a line of trees under a blue sky with light clouds.</p>
<p>Mghab047</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	 <p>A close-up photograph of a Spinifex sandplain. The foreground is dominated by tall, clumpy hummock grasses growing on red sand. In the background, there are several Acacia shrubs and a clear blue sky.</p>
<p>Mghab048</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	 <p>A photograph of a Spinifex sandplain, similar to Mghab047. It shows a mix of red sand, hummock grasses, and Acacia shrubs. The sky is blue with some light clouds.</p>

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab049</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia over an open Acacia shrubland over a mix of low Acaica shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter, small tree hollows.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab050</p> <p><b>Habitat:</b> Rocky Outcrops</p> <p><b>Landform:</b> hill</p> <p><b>Vegetation:</b> Occasional Fig, open Acacia and Hakea shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> rocky outcropping and stony surfaces.</p> <p><b>Important elements:</b> small rock crevices, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab051</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> large spinifex clumps.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab052</p> <p><b>Habitat:</b> Major River</p> <p><b>Landform:</b> drainage valley</p> <p><b>Vegetation:</b> Tall forest of Melaleuca and Eucalyptus over Typha.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> brown coarse sand</p> <p><b>Rock:</b> surface river stones</p> <p><b>Important elements:</b> permanent water, tree hollows, leaf litter.</p> <p><b>Wetlands:</b> permanent river pool, seasonal flows.</p>	
<p>Mghab053</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland and scattered Corymbia over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab054</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab055</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland and scattered Corymbia over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab056</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Corymbia, Hakea and Acacia over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, small tree hollows.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab057</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Hakea over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab058</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low hill</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> drill pads</p> <p><b>Soil:</b> fine red sand</p> <p><b>Rock:</b> surface rocks and stones</p> <p><b>Important elements:</b> small pebbles for Western Pebble-mound Mouse.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab059</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (1-2 yrs)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab060</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Hakea over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab061</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia, Melaleuca and Hakea over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, seasonal nectar (Melaleuca)</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab062</p> <p><b>Habitat:</b> Sand Dune</p> <p><b>Landform:</b> slope</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab063</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab064</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Open Grevillea and Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> seasonal nectar (Grevillea).</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab065</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy Acacia shrubland and scattered Corymbia over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, small tree hollows, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab066</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab067</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open tall Acacia shrubland and occasional Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab068</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open tall Acacia shrubland and occasional Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> none noted</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab069</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> gentle slope</p> <p><b>Vegetation:</b> Scattered Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> small pebbles for Western Pebble-mound Mouse.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab070</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia and Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab071</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> depression</p> <p><b>Vegetation:</b> Open eucalypt woodland over tussock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> tree hollows, claypan</p> <p><b>Wetlands:</b> seasonally wet.</p>	
<p>Mghab072</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> leaf litter, large spinifex clumps</p> <p><b>Wetlands:</b> seasonally wet (?)</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab073</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> leaf litter</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab074</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab075</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, near recently burnt area.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab076</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Melaleuca shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, drilling</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, leaf litter.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab077</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia, Hakea and Melaleuca over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, seasonal nectar (Melaleuca)</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab078</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Melaleuca over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, seasonal nectar (Melaleuca)</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab079</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> large spinifex clumps.</p> <p><b>Wetlands:</b> seasonally wet (?)</p>	
<p>Mghab080</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Patchy Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> surface pebbles and stones.</p> <p><b>Important elements:</b> none noted.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab081</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Hakea over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, near recently burnt area.</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab082</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia and scattered Acacia, Grevillea and Hakea over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, seasonal nectar (Grevillea).</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab083</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia shrubland over a mix of low Acacia shrubland and spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> large spinifex hummocks.</p> <p><b>Wetlands:</b> seasonally wet</p>	
<p>Mghab084</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy Corymbia and Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sandy-clay</p> <p><b>Rock:</b> some surface gravel</p> <p><b>Important elements:</b> large spinifex hummocks, termite mounds, small hollows</p> <p><b>Wetlands:</b> seasonally wet</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab085</p> <p><b>Habitat:</b> Major River</p> <p><b>Landform:</b> drainage valley</p> <p><b>Vegetation:</b> Open Eucalypt and Melaleuca woodland over sparse spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, cats</p> <p><b>Soil:</b> coarse brown sand</p> <p><b>Rock:</b> river stones and pebbles, some outcropping rock.</p> <p><b>Important elements:</b> tree hollows, seasonal water</p> <p><b>Wetlands:</b> seasonal water flow</p>	
<p>Mghab086</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> slope</p> <p><b>Vegetation:</b> Occasional Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> none noted.</p> <p><b>Soil:</b> fine red sand</p> <p><b>Rock:</b> rocky outcropping, stones, pebbles.</p> <p><b>Important elements:</b> rock crevices, pebbles for Western Pebble-mound Mouse.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab087</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia, open Acacia and Melaleuca shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing, seasonal nectar (Melaleuca)</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab088</p> <p><b>Habitat:</b> Sandplain Drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Scattered Acacia and Hakea over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> orange sandy-clay</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> some large spinifex clumps</p> <p><b>Wetlands:</b> seasonally wet</p>	
<p>Mghab089</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia shrubland with occasional Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle, bore</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> small tree hollows.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab090</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia and Hakea shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, grasses</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab091</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open Acacia, Melaleuca and Hakea shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab092</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Patchy mixed Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab093</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Occasional Corymbia and Acacia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab094</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open mixed Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, bore</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab095</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open mixed Acacia shrubland with occasional Melaleuca and Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab096</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Open Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> outcropping rocks, stones</p> <p><b>Important elements:</b> rock crevices</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab097</p> <p><b>Habitat:</b> Stony Hills</p> <p><b>Landform:</b> low rise</p> <p><b>Vegetation:</b> Open Acacia and Grevillea shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1 yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> stony outwash</p> <p><b>Important elements:</b> seasonal nectar (Grevillea)</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab206</p> <p><b>Habitat:</b> Sandplain drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open mixed Acacia shrubland with occasional Melaleuca and Corymbia over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> surface rocks and pebbles</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	
<p>Mghab211</p> <p><b>Habitat:</b> Rocky Outcrop</p> <p><b>Landform:</b> hill</p> <p><b>Vegetation:</b> Sparse Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> brown silty sand</p> <p><b>Rock:</b> outcropping rocks, rocky surface</p> <p><b>Important elements:</b> rock crevices.</p> <p><b>Wetlands:</b> none</p>	

Appendix 3	
Habitat Assessment	Photograph
<p>Mghab217</p> <p><b>Habitat:</b> Spinifex sandplain</p> <p><b>Landform:</b> valley</p> <p><b>Vegetation:</b> Open Melaleuca and Eucalypt woodland over sparse Acacia shrubland.</p> <p><b>Evidence of fire:</b> none</p> <p><b>Disturbance:</b> cattle, 4WD, people.</p> <p><b>Soil:</b> coarse river sand</p> <p><b>Rock:</b> rocky outcrops in riverbed.</p> <p><b>Important elements:</b> waterhole, woody debris, rock crevices, <b>tree hollows.</b></p> <p><b>Wetlands:</b> seasonal waterhole, seasonally flooded</p>	
<p>Mghab230</p> <p><b>Habitat:</b> Sandplain drainage</p> <p><b>Landform:</b> plain</p> <p><b>Vegetation:</b> Open mixed Acacia shrubland over spinifex hummock grassland.</p> <p><b>Evidence of fire:</b> recently burnt (&lt;1yr)</p> <p><b>Disturbance:</b> cattle</p> <p><b>Soil:</b> red sand</p> <p><b>Rock:</b> none</p> <p><b>Important elements:</b> sand for burrowing.</p> <p><b>Wetlands:</b> none</p>	

## Appendix 4. Amphibians potentially occurring in the Study Area.

### Key to records:

- Regional = species recorded within 50km of the study area 2021 – 2022 (Western Wildlife 2022).
  - Wodgina Project = species recorded at the Wodgina Project 2009 – 2019 by Western Wildlife (2020), 360 Environmental (2018a), Stantec (2017), Outback Ecology (2012) and/or Outback Ecology (2009).
  - Wodgina Pipeline = species recorded on the Wodgina Pipeline and Mine in 2018 (Stantec 2018b).
  - Mt Dove Project = species recorded at the Mt Dove Project in 2010 (Outback Ecology 2011).
  - FMG Stage A Rail = species recorded in the northern section of the FMG Stage A Rail in 2004 (Biota 2004).
  - Hope Downs Rail = species recorded in the northern section of the Hope Downs Rail Corridor in 2001 (Biota 2002a, 2002b).
- EPBC = modelled occurrence of species or species habitat in the area on the EPBC Protected Matters Search Tool.  
 DBCA = species recorded in the area on DBCA’s Threatened and Priority Fauna Database (DBCA 2021).  
 Dandjoo = species recorded within 100km on the Dandjoo Database (DBCA 2023)  
 ALA = species recorded within 20km on ALA Database (ALA 2022).

Species	Conservation Status	Recorded	Records								
			Surveys					Databases			
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo
<b>Pelodryadidae</b> (tree frogs and water-holding frogs)											
Giant Frog						+	+			+	+
<i>Cyclorana australis</i>											
Main’s Frog		+	+	+		+	+			+	+
<i>Cyclorana maini</i>											
Desert Tree Frog		+	+	+		+	+			+	+
<i>Litoria rubella</i>											
<b>Limnodynastidae</b> (burrowing frogs)											
Centralian Burrowing Frog		+	+			+	+			+	
<i>Platyplectrum spenceri</i>											
Northern Burrowing Frog											+
<i>Neobatrachus aquilonius</i>											
Sudell’s Frog											+
<i>Neobatrachus sudellae</i>											
Desert Spadefoot		+	+	+		+	+			+	+
<i>Notaden nichollsi</i>											
<b>Myobatrachidae</b> (ground frogs)											
Glandular Toadlet		+	+								+
<i>Uperoleia glandulosa</i>											
Pilbara Toadlet		+	+	+		+	+			+	
<i>Uperoleia saxatilis</i>											
Ratcheting Toadlet											
<i>Uperoleia talpa</i>											
<b>Number of frog species predicted:</b>		<b>10</b>									

## Appendix 5. Reptiles potentially occurring in the Study Area.

**Key to records:**

- Regional = species recorded within 50km of the study area 2021 – 2022 (Western Wildlife 2022).
  - Wodgina Project = species recorded at the Wodgina Project 2009 – 2019 by Western Wildlife (2020), 360 Environmental (2018a), Stantec (2017), Outback Ecology (2012) and/or Outback Ecology (2009).
  - Wodgina Pipeline = species recorded on the Wodgina Pipeline and Mine in 2018 (Stantec 2018b).
  - Mt Dove Project = species recorded at the Mt Dove Project in 2010 (Outback Ecology 2011).
  - FMG Stage A Rail = species recorded in the northern section of the FMG Stage A Rail in 2004 (Biota 2004).
  - Hope Downs Rail = species recorded in the northern section of the Hope Downs Rail Corridor (Biota 2002a, 2002b).
- EPBC = modelled occurrence of species or species habitat in the area on the EPBC Protected Matters Search Tool.  
 DBCA = species recorded in the area on DBCA's Threatened and Priority Fauna Database (DBCA 2021).  
 Dandjoo = species recorded within 100km on the Dandjoo Database (DBCA 2023)  
 ALA = species recorded within 20km on ALA Database (ALA 2022).

Species	Conservation Status	Recorded	Records									
			Survey					Database				
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA
<b>Cheloniidae</b>												
Flat-shelled Turtle <i>Chelodina steindachneri</i>						+						
<b>Carpodactylidae</b> (knob-tailed geckoes)												
Smooth Knob-tailed Gecko <i>Nephurus levis</i>		+	+			+						
<b>Diplodactylidae</b> (ground geckoes)												
Clawless Gecko <i>Crenadactylus pilbarensis</i>												
Western Fat-tailed Gecko <i>Diplodactylus bilybara</i>				+								
Northern Pilbara Beak-faced Gecko <i>Diplodactylus galaxias</i>				+								
Desert Fat-tailed Gecko <i>Diplodactylus laevis</i>		+	+	?		?	?	?			?	?
Southern Pilbara Beak-faced Gecko <i>Diplodactylus savagei</i>				+							+	+
<i>Lucasium stenodactylum</i>		+	+	+		+	+	+				+
<i>Lucasium wombeyi</i>				+		+						
Western Marbled Velvet Gecko <i>Oedura fimbria</i>				+		+						
Beaked Gecko <i>Rhynchoedura ornata</i>		+	+			+						+
Northern Spiny-tailed Gecko <i>Strophurus ciliaris</i>		+										+
Jewelled Gecko <i>Strophurus elderi</i>				+				+	+		+	
<i>Strophurus jeanae</i>								+				+
<b>Gekkonidae</b> (geckoes)												
Robust Termitaria Gecko <i>Gehyra kimberleyi</i>				+								
Large Pilbara Rock Gehyra <i>Gehyra macra</i>		+										
Medium Pilbara Spotted Rock Gehyra <i>Gehyra media</i>		+										
Small Pilbara Spotted Rock Gehyra <i>Gehyra micra</i>		+	+									
<i>Gehyra montium</i>		+	+									
Pilbara Dtella <i>Gehyra pilbara</i>				+		+						
Spotted Dtella <i>Gehyra punctata</i>				+					+		+	+
Purplish Dtella <i>Gehyra purpurascens</i>						+	+					
Variegated Dtella <i>Gehyra variegata</i>				+		+	+	+				+

Appendix 5. (cont.)

Species	Conservation Status	Recorded	Records								
			Survey					Database			
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo
<b>Gekkonidae (cont.)</b>											
Bynoe's Gecko	<i>Heteronotia binoei</i>	+		+		+	+	+			+
Pilbara Cave Gecko	<i>Heteronotia spelea</i>			+							+
Asian House Gecko	<i>Hemidactylus frenatus</i>	Int.									+
<b>Pygopodidae (legless lizards)</b>											
	<i>Delma butleri</i>	+	+	+							+
	<i>Delma elegans</i>										
	<i>Delma nasuta</i>			+		+	+				
	<i>Delma pax</i>	+	+	+		+	+			+	+
	<i>Delma tincta</i>			+		+	+			+	+
Burton's Legless Lizard	<i>Lialis burtonis</i>	+	+	+		+	+	+		+	+
Hooded Scaly-foot	<i>Pygopus nigriceps</i>	+	+					+		+	+
<b>Agamidae (dragon lizards)</b>											
Western Ring-tailed Dragon	<i>Ctenophorus caudicinctus</i>	+	+	+	+	+	+	+			+
Military Dragon	<i>Ctenophorus isolepis</i>	+	+	+	+	+	+	+		+	+
Central Netted Dragon	<i>Ctenophorus nuchalis</i>	+	+			+		+		+	+
Western Netted Dragon	<i>Ctenophorus reticulatus</i>										+
Pindan Dragon	<i>Diporiphora pindan</i>	+	+								
Northern Pilbara Tree Dragon	<i>Diporiphora vescus</i>			?		?		?			
Long-nosed Dragon	<i>Gowidon longirostris</i>	+	+	+			+	+			+
Bearded Dragon	<i>Pogona minor</i>	+	+	+		+		+		+	+
Fortescue Pebble Dragon	<i>Tympanocryptis fortescuensis</i>						+				+
<b>Scincidae (skink lizards)</b>											
	<i>Carlia munda</i>	+	+	+		+	+	+			+
	<i>Carlia triacantha</i>	+	+	+		+	+	+		+	
	<i>Cryptoblepharus buchananii</i>										
	<i>Cryptoblepharus ustulatus</i>										
	<i>Ctenotus duricola</i>			+		+	+	+		+	
	<i>Ctenotus grandis</i>	+	+	+		+	+	+		+	+
Nimble Ctenotus	<i>Ctenotus hanloni</i>	+		+							
	<i>Ctenotus helenae</i>	+	+	+		+	+	+			+
	<i>Ctenotus leonhardii</i>			+							
Pin-striped Finesnout Ctenotus	<i>Ctenotus nigrilineatus</i>	P									
	<i>Ctenotus pallasotus</i>	+	+								
Leopard Ctenotus	<i>Ctenotus pantherinus</i>	+	+	+		+	+	+		+	+
	<i>Ctenotus piankai</i>									+	+
Fourteen-lined Ctenotus	<i>Ctenotus quattuordecimlineatus</i>	+	+								

Appendix 5. (cont.)

Species	Conservation Status	Recorded	Records								
			Survey					Database			
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo
<b>Scincidae (cont.)</b>											
	<i>Ctenotus rubicundus</i>			+				+			+
Rufous Finesnout Ctenotus	<i>Ctenotus rufescens</i>	+	+								+
Rock Ctenotus	<i>Ctenotus saxatilis</i>	+	+	+		+	+	+			+
	<i>Ctenotus schomburgkii</i>	+	+					+			
	<i>Ctenotus serventyi</i>									+	+
Sharp-browed Ctenotus	<i>Ctenotus superciliaris</i>										
Slender Blue-tongue	<i>Cyclodomorphus melanops</i>			+			+	+			
Eastern Pilbara Spiny-tailed Skink	<i>Egernia epcisolus</i>	+	+	+				+			+
	<i>Egernia formosa</i>										
Pilbara Skink	<i>Egernia pilbarensis</i>			+							
Mosaic Desert Skink	<i>Eremiascincus musivus</i>									+	
Western Narrow-banded Skink	<i>Eremiascincus pallidus</i>	+	+	+							+
Broad-banded Sand Swimmer	<i>Eremiascincus richardsonii</i>							+		+	
	<i>Lerista bipes</i>	+	+	+		+	+	+		+	+
	<i>Lerista clara</i>	+	+								
	<i>Lerista jacksoni</i>			+						+	
	<i>Lerista muelleri</i>			+		+	+			+	
	<i>Lerista verhmens</i>									+	
Night Skink	<i>Liopholis striata</i>					+					
Dwarf Skink	<i>Menetia greyii</i>	+	+	+			+	+		+	+
	<i>Menetia surda</i>			+							
	<i>Morethia ruficauda</i>	+	+	+	+	+	+	+		+	+
	<i>Notoscincus ornatus</i>						+				
	<i>Proablepharus reginae</i>						+	+		+	
Central Blue-tongue	<i>Tiliqua multifasciata</i>	+	+	+			+	+		+	
<b>Varanidae (goanna or monitor lizards)</b>											
Spiny-tailed Goanna	<i>Varanus acanthurus</i>	+	+	+			+	+		+	+
Short-tailed Pygmy Goanna	<i>Varanus brevicauda</i>	+	+	+			+	+		+	
Bush's Monitor	<i>Varanus bushi</i>	+	+							+	
Pygmy Desert Goanna	<i>Varanus eremius</i>	+	+	+		+	+	+		+	
Perentie	<i>Varanus giganteus</i>	+	+	+	+			+			
Pygmy Mulga Monitor	<i>Varanus gilleni</i>										+
Gould's Monitor	<i>Varanus gouldii</i>	+	+	+		+	+	+		+	+
	<i>Varanus panoptes</i>	+	+	+			+			+	+
Northern Pilbara Rock Monitor	<i>Varanus pilbarensis</i>			+	+					+	
Black-tailed Monitor	<i>Varanus tristis</i>	+	+								

Appendix 5. (cont.)

Species	Conservation Status	Recorded	Records									
			Survey					Database				
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA
<b>Typhlopidae</b> (blind snakes)												
<i>Anilius ammodytes</i>		+	+	+		+	+					
Gane's Blind Snake <i>Anilius ganei</i>	P									+		+
Beaked Blind Snake <i>Anilius grypus</i>			+	+			+					+
<i>Anilius hamatus</i>		+	+									
Pilbara Blind Snake <i>Anilius pilbarensis</i>			+	+			+					
<b>Boidae</b> (pythons)												
Pygmy Python <i>Antaresia perthensis</i>							+	+				+
Stimson's Python <i>Antaresia stimsoni</i>			+	+			+	+				+
Black-headed Python <i>Aspidites melanocephalus</i>				+			+					+
Woma <i>Aspidites ramsayi</i>		+	+									+
Pilbara Olive Python <i>Liasis olivaceus barroni</i>	T								+	+		
<b>Elapidae</b> (front-fanged snakes)												
Desert Death Adder <i>Acanthophis pyrrhus</i>												+
Pilbara Death Adder <i>Acanthophis wellsi</i>												
Northwestern Shovel-nosed Snake <i>Brachyuropis approximans</i>								+				+
Narrow-banded Shovel-nosed Snake <i>Brachyuropis fasciolatus</i>												+
Yellow-faced Whipsnake <i>Demansia psammophis</i>		+	+	+				+	+			+
Rufous Whipsnake <i>Demansia rufescens</i>		+	+	+				+				+
Moon Snake <i>Furina ornata</i>		+	+	+			+	+				+
Mulga Snake <i>Pseudechis australis</i>		+	+	+				+	+			+
Ringed Brown Snake <i>Pseudonaja modesta</i>		+	+				+					
Gwardar <i>Pseudonaja mengdeni</i>		+	+	+					+			+
Desert Banded Snake <i>Simoselaps anomalus</i>		+	+						+			+
Rosen's Snake <i>Suta fasciata</i>				+				+				
Spotted Snake <i>Suta punctata</i>			+					+	+			+
Pilbara Bandy-bandy <i>Vermicella snelli</i>												
<b># reptile species predicted:</b>			<b>115 (114 native, 1 introduced)</b>									

## Appendix 6. Birds potentially occurring in the Study Area.

**Key to records:**

- Regional = species recorded within 50km of the study area 2021 – 2022 (Western Wildlife 2022).
  - Wodgina Project = species recorded at the Wodgina Project 2009 – 2019 by Western Wildlife (2020), 360 Environmental (2018a), Stantec (2017), Outback Ecology (2012) and/or Outback Ecology (2009).
  - Wodgina Pipeline = species recorded on the Wodgina Pipeline and Mine in 2018 (Stantec 2018b).
  - Mt Dove Project = species recorded at the Mt Dove Project in 2010 (Outback Ecology 2011).
  - FMG Stage A Rail = species recorded in the northern section of the FMG Stage A Rail in 2004 (Biota 2004).
  - Hope Downs Rail = species recorded in the northern section of the Hope Downs Rail Corridor (Biota 2002a, 2002b).
- EPBC = modelled occurrence of species or species habitat in the area on the EPBC Protected Matters Search Tool.  
 DBCA = species recorded in the area on DBCA’s Threatened and Priority Fauna Database (DBCA 2021).  
 Dandjoo = species recorded within 100km on the Dandjoo Database (DBCA 2023)  
 ALA = species recorded within 20km on ALA Database (ALA 2022).

Species	Conservation Status	Records										
		Recorded	Surveys					Database				
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA
<b>Dromaiidae</b> (emus)												
Emu <i>Dromaius novaehollandiae</i>		+	+			+	+	+			+	+
<b>Anatidae</b> (ducks & swans)												
Grey Teal <i>Anas gracilis</i>		+	+	+							+	+
Pacific Black Duck <i>Anas superciliosus</i>		+	+	+		+	+				+	+
Hardhead <i>Aythya australis</i>				+								+
Australian Wood Duck <i>Chenonetta jubata</i>											+	+
Black Swan <i>Cygnus atratus</i>												+
Pink-eared Duck <i>Malacorhynchus membranaceus</i>												+
Australasian Shoveler <i>Spatula rhynchotis</i>												+
<b>Phasianidae</b> (quails)												
Stubble Quail <i>Coturnix pectoralis</i>						+						
Brown Quail <i>Synoicus ypsilophora</i>		+	+			+						+
<b>Podicipedidae</b> (grebes)												
Hoary-headed Grebe <i>Poliiocephalus poliocephalus</i>												+
Australasian Grebe <i>Tachybaptus novaehollandiae</i>			+	+				+				+
<b>Ciconiidae</b> (storks)												
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>		+	+	+			+	+				+
<b>Threskiornithidae</b> (ibis & spoonbills)												
Yellow-billed Spoonbill <i>Platalea flavipes</i>												+
Royal Spoonbill <i>Platalea regis</i>												+
Glossy Ibis <i>Plegadis falcinellus</i>	Mi									+		+
Australian White Ibis <i>Threskiornis moluccus</i>								+				+
Straw-necked Ibis <i>Threskiornis spinicollis</i>		+	+					+			+	+

Appendix 6. (cont.)

Species	Conservation Status	Recorded	Records										
			Surveys					Database					
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA	
<b>Ardeidae</b> (herons, egrets, bitterns & night-herons)													
Little Egret	<i>Ardea garzetta</i>								+				+
Eastern Great Egret	<i>Ardea modesta</i>	+	+						+				+
White-faced Heron	<i>Egretta novaehollandiae</i>	+	+					+					+
Cattle Egret	<i>Ardea ibis</i>												+
White-necked Heron	<i>Ardea pacifica</i>			+	+				+			+	+
Rufous Night-heron	<i>Nycticorax caledonicus</i>								+				+
<b>Pelecanidae</b> (pelicans)													
Australian Pelican	<i>Pelecanus conspicillatus</i>	+	+						+				+
<b>Phalacrocoracidae</b> (cormorants)													
Great Cormorant	<i>Phalacrocorax carbo</i>												+
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	+	+						+			+	+
Pied Cormorant	<i>Phalacrocorax varius</i>								+				+
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	+	+						+				+
<b>Anhingidae</b> (darter)													
Australasian Darter	<i>Anhinga novaehollandiae</i>	+	+						+	+			+
<b>Accipitridae</b> (osprey, hawks, eagles & harriers)													
Black-shouldered Kite	<i>Elanus axillaris</i>			+					+	+			+
Square-tailed Kite	<i>Lophoictinia isura</i>								+				+
Black-breasted Buzzard	<i>Hamirostra melanosternon</i>				+				+	+			
Black Kite	<i>Milvus migrans</i>	+	+	+	+				+	+		+	+
Brahminy Kite	<i>Haliastur indus</i>								+			+	+
Whistling Kite	<i>Haliastur sphenurus</i>	+	+	+	+	+			+	+		+	+
White-bellied Sea-eagle	<i>Haliaeetus leucogaster</i>												+
Brown Goshawk	<i>Accipiter fasciatus</i>	+	+	+					+	+		+	+
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	+	+						+				+
Little Eagle	<i>Hieraaetus morphnoides</i>	+	+						+	+			+
Wedge-tailed Eagle	<i>Aquila audax</i>	+	+	+	+	+			+	+		+	+
Eastern Osprey	<i>Pandion cristatus</i>									+	+		+
Swamp Harrier	<i>Circus approximans</i>								+				+
Spotted Harrier	<i>Circus assimilis</i>	+	+	+					+	+		+	+
<b>Otididae</b> (bustard)													
Australian Bustard	<i>Ardeotis australis</i>	+	+	+					+	+		+	+

Appendix 6. (cont.)

Species	Conservation Status	Recorded	Records										
			Surveys					Database					
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA	
<b>Rallidae</b> (crakes, rails and gallinules)													
Eurasian Coot	<i>Fulica atra</i>			+									+
Buff-banded Rail	<i>Gallirallus philippensis</i>												+
Purple Swamp Hen	<i>Porphyrio porphyrio</i>			+									
Spotless Crake	<i>Porzana tabuensis</i>												
Black-tailed Native-hen	<i>Tribonyx ventralis</i>												+
<b>Turnicidae</b> (button-quails)													
Little Button-Quail	<i>Turnix velox</i>	+	+	+	+		+	+				+	+
<b>Burhinidae</b> (stone-curlews)													
Bush Stone-Curlew	<i>Burhinus grallarius</i>	+	+	+			+	+				+	+
<b>Recurvirostridae</b> (stilts & avocets)													
Black-winged Stilt	<i>Himantopus himantopus</i>			+			+	+				+	+
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>												+
<b>Charadriidae</b> (plovers, dotterels & lapwings)													
Oriental Plover	<i>Charadrius veredus</i>	Mi							+	+			
Black-fronted Dotterel	<i>Euseyonis melanops</i>		+	+			+	+				+	+
Red-kneed Dotterel	<i>Erythrogonys cinctus</i>											+	+
Masked Lapwing	<i>Vanellus miles</i>												+
<b>Scolopacidae</b> (sandpipers, tattlers, godwits & allies)													
Common Sandpiper	<i>Actitis hypoleucos</i>	Mi			+			+	+	+			+
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	Mi							+	+			+
Pectoral Sandpiper	<i>Calidris melanotos</i>	Mi							+	+			
Red-necked Stint	<i>Calidris ruficollis</i>	Mi								+			+
Wood Sandpiper	<i>Tringa glareola</i>	Mi			+					+			+
Common Greenshank	<i>Tringa nebularia</i>	Mi								+			+
Marsh Sandpiper	<i>Tringa stagnatilis</i>	Mi								+			+
<b>Glareolidae</b> (pratincoles)													
Oriental Pratincole	<i>Glareola maldivarum</i>	Mi								+	+		+
Australian Pratincole	<i>Siltia isabella</i>			+									+
<b>Laridae</b> (noddies, gulls & terns)													
Silver Gull	<i>Chroicocephalus novaehollandiae</i>								+			+	+
Gull-billed Tern	<i>Gelochelidon nilotica</i>	Mi						+		+	+	+	+
Caspian Tern	<i>Hydroprogne caspia</i>	Mi						+		+		+	+
Whiskered Tern	<i>Sterna hybrida</i>												+

Appendix 6. (cont.)

Species	Conservation Status	Records									
		Recorded	Surveys					Database			
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo
<b>Columbidae</b> (pigeons and doves)											
Common Bronzewing	<i>Phaps chalcoptera</i>	+	+	+		+		+		+	+
Flock Bronzewing	<i>Phaps histrionica</i>									+	+
Crested Pigeon	<i>Ocyphaps lophotes</i>	+	+	+	+	+	+	+		+	+
Spinifex Pigeon	<i>Geophaps plumifera</i>	+	+	+	+	+	+	+		+	+
Diamond Dove	<i>Geopelia cuneata</i>	+	+	+	+		+	+		+	+
Bar-shouldered Dove	<i>Geopelia humeralis</i>	+	+					+			+
Peaceful Dove	<i>Geopelia striata</i>	+	+	+				+		+	+
<b>Cuculidae</b> (cuckoos)											
Pheasant-Coucal	<i>Centropus phasianinus</i>							+			+
Pallid Cuckoo	<i>Cacomantis pallidus</i>	+		+			+	+			+
Black-eared Cuckoo	<i>Chalcites osculans</i>	+	+					+			+
Horsfield's Bronze-Cuckoo	<i>Chalcites basalis</i>	+	+	+		+	+	+		+	+
<b>Tytonidae</b> (barn owls)											
Barn Owl	<i>Tyto alba</i>		+								+
<b>Strigidae</b> (hawk owls)											
Barking Owl	<i>Ninox connivens</i>		+								+
Southern Boobook	<i>Ninox boobook</i>	+	+		+	+	+	+			+
<b>Podargidae</b> (frogmouths)											
Tawny Frogmouth	<i>Podargus strigoides</i>			+			+	+			+
<b>Caprimulgidae</b> (nightjars)											
Spotted Nightjar	<i>Eurostopodus argus</i>	+	+	+	+	+	+	+		+	+
<b>Aegothelidae</b> (owlet-nightjars)											
Australian Owlet-Nightjar	<i>Aegotheles cristatus</i>	+	+	+			+	+			
<b>Apodidae</b> (swifts)											
Fork-tailed Swift	<i>Apus pacificus</i>	Mi	+	+			+	+	+	+	+
<b>Alcedinidae</b> (kingfishers)											
Blue-winged Kookaburra	<i>Dacelo leachii</i>	+	+	+	+		+	+		+	+
Red-backed Kingfisher	<i>Todiramphus pyrrhopygius</i>	+	+	+	+	+	+	+		+	+
Sacred Kingfisher	<i>Todiramphus sanctus</i>	+	+	+			+	+		+	+
<b>Meropidae</b> (bee-eaters)											
Rainbow Bee-eater	<i>Merops ornatus</i>	+	+	+	+	+	+	+		+	+

Appendix 6. (cont.)

Species	Conservation Status	Recorded	Records									
			Surveys					Database				
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA
<b>Falconidae</b> (falcons)												
Brown Falcon <i>Falco berigora</i>		+	+	+		+	+	+			+	+
Australian Kestrel <i>Falco cenchroides</i>		+	+	+	+	+	+	+			+	+
Australian Hobby <i>Falco longipennis</i>		+	+	+			+	+				+
Grey Falcon <i>Falco hypoleucos</i>	T						+		+			+
Peregrine Falcon <i>Falco peregrinus</i>	OS						+	+		+		+
Black Falcon <i>Falco subniger</i>				+								+
<b>Cacatuidae</b> (cockatoos)												
Galah <i>Eolophus roseicapilla</i>		+	+	+	+	+	+	+			+	+
Little Corella <i>Cacatua sanguinea</i>		+	+	+	+	+	+	+			+	+
Cockatiel <i>Nymphicus hollandicus</i>		+	+	+			+	+			+	+
<b>Psittacidae</b> (parrots, lorikeets and rosellas)												
Australian Ringneck <i>Barnardius zonarius</i>		+	+	+		+	+	+			+	+
Budgerigar <i>Melopsittacus undulatus</i>		+	+	+	+		+	+			+	+
Night Parrot <i>Pezoporus occidentalis</i>	T								+			
<b>Ptilonorhynchidae</b> (bowerbirds)												
Western Bowerbird <i>Chlamydera guttata</i>		+	+	+		+		+				+
<b>Climacteridae</b> (treecreepers)												
Black-tailed Treecreeper <i>Climacteris melanurus</i>												+
<b>Maluridae</b> (fairy-wrens, grasswrens and emu-wrens)												
Striated Grasswren <i>Amytornis striatus</i>			+	+			+				+	
Purple-backed Fairy-wren <i>Malurus assimilis</i>		+	+	+		+	+	+			+	+
White-winged Fairy-wren <i>Malurus leucopterus</i>		+	+	+		+	+	+			+	+
Rufous-crowned Emu-wren <i>Stipiturus ruficeps</i>	LS		+					+				+
<b>Meliphagidae</b> (honeyeaters and chats)												
Brown Honeyeater <i>Lichmera indistincta</i>		+	+	+	+		+	+			+	+
Black Honeyeater <i>Sugomel niger</i>				+			+	+				+
Pied Honeyeater <i>Certhionyx variegatus</i>				+			+					+
Singing Honeyeater <i>Gavicalis virescens</i>		+	+	+	+	+	+	+			+	+
Grey Honeyeater <i>Lacustroica whitei</i>				+								
Grey-headed Honeyeater <i>Ptilotula keartlandi</i>		+	+	+	+		+	+			+	+
White-plumed Honeyeater <i>Ptilotula penicillata</i>		+	+	+	+	+	+	+			+	+
Grey-fronted Honeyeater <i>Ptilotula plumulus</i>				+		+						
Black-chinned Honeyeater <i>Melithreptus gularis</i>							+					+
White-fronted Honeyeater <i>Purnella albifrons</i>												
Yellow-throated Miner <i>Manorina flavigula</i>		+	+	+	+	+	+	+			+	+
Spiny-cheeked Honeyeater <i>Acanthagenys rufogularis</i>				+			+	+				
Crimson Chat <i>Epthianura tricolor</i>		+	+	+		+	+	+				+

Appendix 6. (cont.)

Species	Conservation Status	Recorded	Records										
			Surveys					Database					
			Regional	Woodgina Project	Woodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA	
<b>Pardalotidae</b> (pardalotes)													
Red-browed Pardalote <i>Pardalotus rubricatus</i>		+	+	+			+	+			+	+	
Striated Pardalote <i>Pardalotus striatus</i>				+			+					+	
<b>Acanthizidae</b> (thornbills, gerygones & allies)													
Weebill <i>Smicrornis brevirostris</i>							+	+				+	
Western Gerygone <i>Gerygone fusca</i>				+								+	
<b>Pomatostomidae</b> (babblers)													
White-browed Babbler <i>Pomatostomus superciliosus</i>		+	+				+						
Grey-crowned Babbler <i>Pomatostomus temporalis</i>		+	+	+	+			+				+	
<b>Artamidae</b> (woodswallows)													
White-breasted Woodswallow <i>Artamus leucorhynchus</i>												+	+
Masked Woodswallow <i>Artamus personatus</i>		+	+				+					+	+
Black-faced Woodswallow <i>Artamus cinereus</i>		+	+	+	+	+	+	+				+	+
Little Woodswallow <i>Artamus minor</i>			+	+				+				+	+
<b>Cracticidae</b> (butcherbirds & magpie)													
Grey Butcherbird <i>Cracticus torquatus</i>				+		+	+	+					
Pied Butcherbird <i>Cracticus nigrogularis</i>		+	+	+		+	+	+				+	+
Australian Magpie <i>Gymnorhina tibicen</i>		+	+	+			+	+				+	+
<b>Neosittidae</b> (sittellas)													
Varied Sittella <i>Daphoenositta chrysoptera</i>							+						
<b>Campephagidae</b> (cuckoo-shrikes and trillers)													
Ground Cuckoo-shrike <i>Coracina maxima</i>													
Black-faced Cuckoo-Shrike <i>Coracina novaehollandiae</i>		+	+	+	+	+	+	+				+	+
White-winged Triller <i>Lalage tricolor</i>		+	+	+			+	+				+	+
<b>Oreoicidae</b> (bellbirds)													
Crested Bellbird <i>Oreoica gutturalis</i>		+	+	+			+	+	+				+
<b>Pachycephalidae</b> (shrike-tits, whistlers and allies)													
Rufous Whistler <i>Pachycephala rufiventris</i>		+	+	+		+	+	+				+	+
Grey Shrike-thrush <i>Colluricincla harmonica</i>		+	+	+			+					+	+
<b>Rhipiduridae</b> (fantails)													
Grey Fantail <i>Rhipidura albiscapa</i>													+
Willie Wagtail <i>Rhipidura leucophrys</i>		+	+	+	+	+	+	+				+	+
<b>Monarchidae</b> (flycatchers, monarchs and magpie-lark)													
Magpie-lark <i>Gallina cyanoleuca</i>		+	+	+	+	+	+	+				+	+
<b>Corvidae</b> (ravens and crows)													
Torresian Crow <i>Corvus orru</i>		+	+	+	+	+	+	+				+	+
Little Crow <i>Corvus bennetti</i>				+				+				+	+

Appendix 6. (cont.)

Species	Conservation Status	Recorded	Records									
			Surveys					Database				
			Regional	Woodgina Project	Woodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA
<b>Petroicidae</b> (robins)												
Red-capped Robin	<i>Petroica goodenovii</i>						+	+				+
Hooded Robin	<i>Melanodryas cucullata</i>						+					+
<b>Alaudidae</b> (larks)												
Horsfield's Bushlark	<i>Mirafra javanica</i>	+	+				+	+			+	+
<b>Hirundinidae</b> (swallows and martins)												
White-backed Swallow	<i>Cheramoeca leucosterna</i>											+
Welcome Swallow	<i>Hirundo neoxena</i>			+								+
Tree Martin	<i>Petrochelidon nigricans</i>	+	+	+			+	+				+
Fairy Martin	<i>Petrochelidon ariel</i>	+	+	+			+	+				+
<b>Acrocephalidae</b> (reed warblers)												
Australian Reed Warbler	<i>Acrocephalus australis</i>	+	+	+				+				+
<b>Locustellidae</b> (warblers, songlarks and grassbirds)												
Spinifexbird	<i>Poodytes carteri</i>	+	+	+	+	+	+	+			+	+
Rufous Songlark	<i>Cincloramphus mathewsi</i>	+	+	+	+		+	+				+
Brown Songlark	<i>Cincloramphus cruralis</i>			+		+	+	+			+	+
<b>Dicaeidae</b> (flowerpeckers)												
Mistletoebird	<i>Dicaeum hirundinaceum</i>						+	+			+	+
<b>Estrildidae</b> (grassfinches, sparrows and allies)												
Zebra Finch	<i>Taeniopygia guttata</i>	+	+	+	+	+	+	+			+	+
Star Finch	<i>Neochmia ruficauda</i>	+	+	+								+
Painted Finch	<i>Emblema pictum</i>	+	+	+	+	+	+	+			+	+
<b>Motacillidae</b> (pipits and wagtails)												
Australian Pipit	<i>Anthus australis</i>	+	+	+		+	+	+			+	+
<b># bird species predicted:</b>			166									

## Appendix 7. Mammals potentially occurring in the Study Area.

**Key to records:**

- Regional = species recorded within 50km of the study area 2021 – 2022 (Western Wildlife 2022).
  - Wodgina Project = species recorded at the Wodgina Project 2009 – 2019 by Western Wildlife (2020), 360 Environmental (2018a), Stantec (2017), Outback Ecology (2012) and/or Outback Ecology (2009).
  - Wodgina Pipeline = species recorded on the Wodgina Pipeline and Mine in 2018 (Stantec 2018b).
  - Mt Dove Project = species recorded at the Mt Dove Project in 2010 (Outback Ecology 2011).
  - FMG Stage A Rail = species recorded in the northern section of the FMG Stage A Rail in 2004 (Biota 2004).
  - Hope Downs Rail = species recorded in the northern section of the Hope Downs Rail Corridor (Biota 2002a, 2002b).
- EPBC = modelled occurrence of species or species habitat in the area on the EPBC Protected Matters Search Tool.  
 DBCA = species recorded in the area on DBCA’s Threatened and Priority Fauna Database (DBCA 2021).  
 Dandjoo = species recorded within 100km on the Dandjoo Database (DBCA 2023)  
 ALA = species recorded within 20km on ALA Database (ALA 2022).

Species	Conservation Status	Recorded	Records										
			Other Survey					Database					
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA	
<b>Tachyglossidae</b> (echidnas)													
Echidna <i>Tachyglossus aculeatus</i>		+	+	+	+	+	+	+					
<b>Dasyuridae</b> (dasyurid marsupials)													
Brush-tailed Mulgara <i>Dasyercus blythi</i>	P	+	+				+	+		+			+
Little Red Kaluta <i>Dasykaluta rosamondae</i>		+	+	+	+	+	+	+				+	+
Northern Quoll <i>Dasyurus hallucatus</i>	T	+	+	+	+	+	+	+	+	+			+
Woolley’s Pseudantechinus <i>Pseudantechinus woolleyae</i>				+				+				+	
Pilbara Ningau <i>Ningau timealeyi</i>		+	+	+			+	+				+	+
Common Planigale <i>Planigale maculata</i>													
Pilbara Planigale <i>Planigale sp 1</i>		+	+	+		+	+	+					
Long-tailed Dunnart <i>Sminthopsis longicaudata</i>	P			+							+		
Striped-faced Dunnart <i>Sminthopsis macroura</i>			+		+	+	+	+				+	+
Ooldea Dunnart <i>Sminthopsis ooldea</i>													
Lesser Hairy-footed Dunnart <i>Sminthopsis youngsoni</i>		+	+					+	+			+	+
<b>Thylacomyidae</b> (bilbies)													
Bilby <i>Macrotis lagotis</i>	T	+	+					+	+	+			
<b>Macropodidae</b> (kangaroos and wallabies)													
Spectacled Hare-Wallaby <i>Lagorchestes conspicillatus</i>	P					+					+		+
Euro <i>Osphranter robustus</i>		+	+	+	+	+	+	+					+
Red Kangaroo <i>Osphranter rufus</i>		+	+			+		+					+
Rothschild’s Rock-Wallaby <i>Petrogale rothschildi</i>			+	+	+		+	+				+	
<b>Muridae</b> (rats and mice)													
Lakeland Downs Mouse <i>Leggadina lakedownensis</i>	P							+	+				
House Mouse <i>Mus musculus</i>	Int.	+	+	+			+	+				+	
Spinifex Hopping Mouse <i>Notomys alexis</i>		+	+	+	+	+		+				+	+

Appendix 7. (cont.)

Species	Conservation Status	Recorded	Records									
			Other Survey					Database				
			Regional	Wodgina Project	Wodgina Pipeline	Mt Dove Project	FMG Stage A Rail	Hope Downs Rail	EPBC	DBCA	Dandjoo	ALA
<b>Muridae (cont.)</b>												
Western Pebble-mound Mouse	<i>Pseudomys chapmani</i>	P	+	+	+	+	+			+	+	
Delicate Mouse	<i>Pseudomys delicatulus</i>						+	+			+	+
Desert Mouse	<i>Pseudomys desertor</i>		+	+	+		+	+			+	+
Sandy Inland Mouse	<i>Pseudomys hermannsburgensis</i>		+	+	+		+	+			+	+
Common Rock-Rat	<i>Zyzomys argurus</i>			+	+	+	+	+			+	+
<b>Rhinonycteridae (orange leaf-nosed bats)</b>												
Pilbara Leaf-nosed Bat	<i>Rhinonycteris aurantia</i> (Pilbara)	T	+	+	+	+	+			+	+	
<b>Megadermatidae (ghost bat)</b>												
Ghost Bat	<i>Macroderma gigas</i>	T		+	+	+	+		+	+		+
<b>Emballonuridae (sheath-tail bats)</b>												
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>		+	+	+		+				+	
Common Sheath-tail Bat	<i>Taphozous georgianus</i>		+	+	+	+	+		+			+
<b>Molossidae (freetail bats)</b>												
Greater Northern Freetail Bat	<i>Chaerephon jobensis</i>		+	+	+				+			
Northern Coastal Free-tailed Bat	<i>Ozimops cobourgiana</i>	P	+	+								
Northern Freetail Bat	<i>Ozimops lumsdenae</i>											
White-striped Freetail Bat	<i>Austronomus australis</i>				+	+			+			
<b>Vespertilionidae (ordinary bats)</b>												
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>		+	+	+	+	+	+	+		+	
Lesser Long-eared Bat	<i>Nyctophilus geoffroyi</i>											
Little Broad-nosed Bat	<i>Scotorepens greyii</i>		+	+	+	+	+	+			+	
Finlayson's Cave Bat	<i>Vespardelus finlaysoni</i>		+	+	+	+	+	+			+	+
<b>Canidae (dogs and foxes)</b>												
Dog / Dingo	<i>Canis familiaris</i>	Int.	+	+	+	+	+	+	+			+
Fox	<i>Vulpes vulpes</i>	Int.	+	+		+	+					
<b>Felidae (cats)</b>												
Feral / House Cat	<i>Felis catus</i>	Int.	+	+	+	+	+	+	+		+	
<b>Equidae (horses)</b>												
Donkey	<i>Equus asinus</i>	Int.					+	+	+			
Horse	<i>Equus caballus</i>	Int.			+							
<b>Camelidae (camels)</b>												
Camel	<i>Camelus dromedarius</i>	Int.	+	+			+	+				
<b>Bovidae (horned ruminants)</b>												
Cow	<i>Bos taurus</i>	Int.	+	+	+	+	+					
<b>Number of Mammals Predicted:</b>			<b>44 (36 native, 8 introduced)</b>									

## Appendix 8. EPBC Protected Matters Search Tool results.

Species listed for the study area with a 5km buffer.

Species	EPBC Act Status	Type of Presence
<i>Calidris ferruginea</i> <b>Curlew Sandpiper</b>	Critically Endangered, Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Numenius madagascariensis</i> <b>Eastern Curlew</b>	Critically Endangered, Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Pezoporus occidentalis</i> <b>Night Parrot</b>	Endangered	Species or species habitat <b>MAY</b> occur within area
<i>Dasyurus hallucatus</i> <b>Northern Quoll</b>	Endangered	Species or species habitat <b>KNOWN</b> to occur within area
<i>Rostratula australis</i> <b>Australian Painted Snipe</b>	Endangered	Species or species habitat <b>MAY</b> occur within area
<i>Macrotis lagotis</i> <b>Bilby</b>	Vulnerable	Species or species habitat <b>KNOWN</b> to occur within area
<i>Rhinonictes aurantia</i> <b>Pilbara Leaf-nosed Bat</b>	Vulnerable	Species or species habitat <b>KNOWN</b> to occur within area
<i>Macroderma gigas</i> <b>Ghost Bat</b>	Vulnerable	Species or species habitat <b>KNOWN</b> to occur within area
<i>Liasis olivaceus barroni</i> <b>Pilbara Olive Python</b>	Vulnerable	Species or species habitat <b>LIKELY</b> to occur within area
<i>Falco hypoleucos</i> <b>Grey Falcon</b>	Vulnerable	Species or species habitat <b>LIKELY</b> to occur within area
<i>Charadrius veredus</i> <b>Oriental Plover</b>	Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Actitis hypoleucos</i> <b>Common Sandpiper</b>	Migratory	Species or species habitat <b>KNOWN</b> to occur within area
<i>Calidris acuminata</i> <b>Sharp-tailed Sandpiper</b>	Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Calidris melanotos</i> <b>Pectoral Sandpiper</b>	Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Pandion cristatus</i> <b>Eastern Osprey</b>	Migratory	Species or species habitat <b>LIKELY</b> to occur within area
<i>Apus pacificus</i> <b>Fork-tailed Swift</b>	Migratory	Species or species habitat <b>LIKELY</b> to occur within area
<i>Glareola maldivarum</i> <b>Oriental Pratincole</b>	Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Hirundo rustica</i> <b>Barn Swallow</b>	Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Motacilla cinerea</i> <b>Grey Wagtail</b>	Migratory	Species or species habitat <b>MAY</b> occur within area
<i>Motacilla flava</i> <b>Yellow Wagtail</b>	Migratory	Species or species habitat <b>MAY</b> occur within area

## Appendix 9. Excluded Fauna

Fauna recorded on the DBCA's Threatened and Priority Fauna Database (Figure 9, DBCA 2021) or the EPBC Act Protected Matters Search Tool (Appendix 8) but excluded from the lists in Appendices 4 – 7.

Species	Status		Database		Reason for Exclusion
	EPBC Act	BC Act	DBCA	EPBC	
Australian Painted Snipe ( <i>Rostratula australis</i> )	En	En		+	Vagrant to the region.
Bar-tailed Godwit ( <i>Limosa lapponica</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Barn Swallow ( <i>Hirundo rustica</i> )	Mi	Mi		+	Vagrant to the region.
Black-tailed Godwit ( <i>Limosa limosa</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Bridled Tern ( <i>Onychoprion anaethetus</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Common Tern ( <i>Sterna hirundo</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Crested Tern ( <i>Thalasseus bergii</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Curlew Sandpiper ( <i>Calidris ferruginea</i> )	Cr, Mi	Cr, Mi	+	+	Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Eastern Curlew ( <i>Numenius madagascariensis</i> )	Cr, Mi	Cr, Mi	+	+	Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Flatback Turtle ( <i>Natator depressus</i> )	Mi	Mi	+		Marine turtle, does not use inland waters.
Great Knot ( <i>Calidris tenuirostris</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Greater Sand Plover ( <i>Charadrius leschenaultii</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Green Turtle ( <i>Chelonia mydas</i> )	Mi	Mi	+		Marine turtle, does not use inland waters.
Grey Plover ( <i>Pluvialis squatarola</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Grey Wagtail ( <i>Motacilla cinera</i> )	Mi	Mi		+	Vagrant to the region.
Grey-tailed Tattler ( <i>Tringa brevipes</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Lesser Frigatebird ( <i>Fregata ariel</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Lesser Sand Plover ( <i>Charadrius mongolus</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Little Curlew ( <i>Numenius minutus</i> )	Mi	Mi	+		Shorebird that primarily uses short dry grasslands and the grassy edges of freshwater wetlands.
Little Tern ( <i>Sternula albifrons</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Long-toed Stint ( <i>Calidris subminuta</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Pacific Golden Plover ( <i>Pluvialis fulva</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Red Knot ( <i>Calidris canutus</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Roseate Tern ( <i>Sterna dougallii</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.

**Appendix 9. (cont.)**

Species	Status		Database		Reason for Exclusion
	EPBC Act	BC Act	DBCA	EPBC	
Ruddy Turnstone ( <i>Arenaria interpres</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Ruff/Reeve ( <i>Philomachus pugnax</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Sanderling ( <i>Calidris alba</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Terek Sandpiper ( <i>Xenus cinereus</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
Wedge-tailed Shearwater ( <i>Ardenna pacifica</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Whimbrel ( <i>Numenius phaeopus</i> )	Mi	Mi	+		Shorebird that primarily uses coastal habitats (mudflats, mangroves, beaches)
White-winged Black Tern ( <i>Chlidonius leucopterus</i> )	Mi	Mi	+		Seabird that forages and breeds on coasts and offshore islands.
Yellow Wagtail ( <i>Motacilla flava</i> )	Mi	Mi		+	Vagrant to the region.

## **Appendix 10. Bat Call Analysis**





































## **Appendix 11. Night Parrot Call Analysis**