



Biologic
ENVIRONMENTAL
SURVEY

Central Pilbara Hub Stage 2 Targeted MNES Vertebrate Fauna Survey

Report to BHP Western Australian Iron Ore

6 January 2025

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Executive Summary

BHP Western Australia Iron Ore commissioned Biologic Environmental Survey Pty Ltd to undertake a targeted vertebrate fauna survey of the Central Pilbara Hub (CPH) Stage 2 area. The survey was completed over two phases during 2022 (phase 1) and 2023 (phase 2). The CPH Stage 2 area (hereafter referred to as the 'Study Area') is located approximately 80 kilometres (km) north-west of Newman and covers an area of approximately 36,500 hectares (ha).

The Study Area has had a large number of vertebrate fauna surveys previously undertaken within or adjacent to it; 14 and 17 surveys, respectively. Six species listed as Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have previously been recorded in the Study Area. These six species, and an additional seventh species (the night parrot), were targeted during the field surveys:

- night parrot (*Pezoporus occidentalis*) – Endangered/ Critically Endangered;
- northern quoll (*Dasyurus hallucatus*) – Endangered;
- ghost bat (*Macroderma gigas*) – Vulnerable;
- greater bilby (*Macrotis lagotis*) – Vulnerable;
- Pilbara leaf-nosed bat (*Rhinonicteris aurantius* 'Pilbara form') – Vulnerable;
- grey falcon (*Falco hypoleucos*) – Vulnerable; and
- Pilbara olive python (*Liasis olivaceus* subsp. *barroni*) – Vulnerable.

The field surveys were undertaken by nine experienced zoologists over two years following the Pilbara wet season in 2022 and 2023 (three trips during phase 1: April 2022, April-May 2022 and May 2022, and two trips during phase 2: February 2023 and March 2023). Species specific targeted sampling during the field surveys comprised habitat and habitat feature assessments, ultrasonic and acoustic sound recordings, camera trap transects, targeted searches and nocturnal searches.

A total of 10 broad fauna habitat types were recorded and mapped across the Study Area; Stony Plain, Hillcrest/ Hillslope, Mulga Woodland, Drainage Area/ Floodplain, Hardpan Plain, Undulating Low Hills, Gorge/ Gully, Minor Drainage Line, Breakaway/ Cliff, and Medium Drainage Line. Areas of Cleared/ Disturbed were also mapped within the Study Area. Seven of the fauna habitat types provide critical habitat for MNES species: Stony Plain, Mulga Woodland, Drainage Area/ Floodplain, Gorge/ Gully, Minor Drainage Line, Breakaway/ Cliff, and Medium Drainage Line.

Three MNES species were recorded within the Study Area during the current surveys:

1. Pilbara leaf-nosed bat

Nineteen individual calls from Pilbara leaf-nosed bats were recorded at eight locations during the surveys. These calls were recorded within Stony Plain, Hillcrest/ Hillslope, Gorge/ Gully and Breakaway/ Cliff habitats. Sampling was undertaken in 70 locations, for a combined total of 387 recording nights (141 in phase 1 and 246 in phase 2) (Song Meter (SM4) recorders) and 217.5 person hours of targeted searches.

No evidence of a Pilbara leaf-nosed bat diurnal roost caves was recorded within the Study Area. The timing of the calls suggest that the records are likely from foraging individual/s, and the Study Area may form part of a larger foraging territory. It is unlikely that the Study Area represents a significant area for this species based on the absence of Category 1, 2 and 3 roosts.

2. Ghost bat

Scats were recorded from three caves during the surveys; CMUD-47 (2,000 scats), CMUD-54 (20 scats) and CMUD-59 (10 scats). Scats were also recorded in an additional six caves that were searched during a subsequent survey overlapping the Study Area; CPOW-038 (100 scats), CPOW-046 (2000 scats), CPOW-048 (7 scats), CPOW-060 (500 scats), CPOW-063 (30 scats), and CPOW-072 (1 scat). Fifty-seven caves have been recorded in the Study Area, of which four (CMUD-01, CMUD-02, CMUD-47, and CPOW-72) were identified as Category 2 roosts (maternity/ diurnal roost caves with regular occupancy for ghost bats), nine were identified as Category 3 (diurnal roost caves with occasional occupancy) and 33 were identified as Category 4 (nocturnal roost caves with opportunistic usage). The remaining 11 caves recorded in the Study Area showed no evidence of use and are unlikely to be suitable for this species, as such they are classified as Category 5 roost caves.

Sampling for ghost bats comprised targeted searches at 40 locations, totalling approximately 217.5 person hours, and 387 nights of Song Meter (SM4) recordings at 78 locations. In addition, cave assessments were undertaken during an additional targeted ghost bat survey for the Power2030 project (Biologic, in prep). Ghost bats within the Study Area and at the adjacent Mining Area C have been well studied since 2010 (references provided herein). The ghost bats recorded within the Study Area are likely to form part of an 'important population' as defined by the Department of Environment (DoE) (2013). A key source population for breeding could use the Study Area given the presence of four Category 2 roosts. Critical foraging habitat exists across the entire extent of the Study Area, supporting this important population.

3. Pilbara olive python

A single live individual was recorded within the Study Area during a concurrent survey by Biologic in March 2023, and is therefore included in this survey results. This species has been previously recorded a further three times in the Study Area, all in 2013. Water features, such as water holes in rocky gullies and rivers are considered supporting foraging habitat for Pilbara olive pythons, with seven water features recorded in the Study Area. The Pilbara olive python is consistently recorded in the region surrounded the Study Area, and has been recorded several times within the Study Area and over multiple years, with both critical and supporting habitat present. As such, the Pilbara olive pythons recorded within the Study Area are likely to form part of an 'important population' as defined by DoE (2013).

The northern quoll, although not recorded in the current surveys, is considered likely to occur in the Study Area in low numbers. Within the local area, it is only known from a small number of records to the east (eDNA sample and scat records), despite extensive targeted and baseline surveys. Within the Study Area, the Gorge/ Gully and Breakaway/ Cliff habitats meet the definition of critical denning and foraging habitat for the species. Potential supporting foraging and dispersal habitat is provided by Hillcrest/ Hillslope, Minor Drainage Line and Medium Drainage Line habitat where proximal (within 35 ha and up to 100 ha during breeding season, as defined in BHP's Vertebrate Fauna Survey guidance) to breeding habitat. The scarcity and concentration of records suggests the species on a regional scale is unlikely to be reliant on the habitats within the Study Area for long-term persistence; however, the habitat is considered critical for persistence of any individuals within the Study Area. The Study Area is unlikely to form part of a 'population important for the long-term survival of the species, as defined by the DoE (2013, 2016).

Habitat within the Study Area is considered marginal for the greater bilby as no spinifex sandplain habitat was mapped. It is considered unlikely that this species occurs within the Study Area due to the lack of critical (e.g. sandplains) or supporting habitat, and lack of contemporary records in the vicinity of the Study Area (only one recent greater bilby record, located approximately 65.3 km to the north-east of the Study Area). In the unlikely event that this species is present in the Study Area, it is unlikely that this would contribute to an 'important population' as defined by DoE (2013).

There is no critical habitat present for night parrot within the Study Area, as there are limited instances of large, long-unburnt hummocks *Triodia* grasslands that are suitable for the species. There is one recent night parrot record approximately 77 km to the north-east of the Study Area. Given the lack of quality habitat within the Study Area, absence of nearby foraging habitat, and lack of records, it is unlikely that the Night Parrot would occur within the Study Area.

No habitat within the Study Area is considered critical habitat for the grey falcon, primarily due to the lack of Major Drainage Line habitat. The Drainage Area/ Floodplain, Minor Drainage Line, and Medium Drainage Line habitats may provide supporting foraging and dispersal habitat. The closest record to the Study Area of grey falcons (with a confirmed location) are two birds observed 0.5 km south of Mudlark Well in 1997. The grey falcon is considered to be a single interbreeding population (Mullin *et al.*, 2020), and therefore grey falcons in the Pilbara form part of an 'important population'. Given the presence of suitable foraging and dispersal habitat, this species is considered to possibly occur; however, it is unlikely to be reliant on the habitats for long-term survival at a local or regional scale.

One non-target species of significance was identified during the surveys: the western pebble-mound mouse (*Pseudomys chapmani* – Department of Biodiversity, Conservation and Attractions (DBCA) Priority 4).

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1 Introduction

1.1 Background

BHP Western Australia Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a targeted vertebrate fauna survey for species classified as Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), within BHP's Central Pilbara Hub (CPH) Stage 2 area (the Study Area), located approximately 80 kilometres (km) north-west of Newman. The Study Area comprises two separate areas covering a total of approximately 36,500 hectares (ha) (Figure 1.1).

The overarching objective of this assessment was to determine the presence, or likely presence, of MNES and other significant vertebrate fauna species. The species targeted for this survey were:

- night parrot (*Pezoporus occidentalis*) – Endangered/ Critically Endangered;
- northern quoll (*Dasyurus hallucatus*) – Endangered;
- ghost bat (*Macroderma gigas*) – Vulnerable;
- greater bilby (*Macrotis lagotis*) – Vulnerable;
- Pilbara leaf-nosed bat (*Rhinonictis aurantius* 'Pilbara form') – Vulnerable;
- grey falcon (*Falco hypoleucos*) – Vulnerable; and
- Pilbara olive python (*Liasis olivaceus* subsp. *barroni*) – Vulnerable.

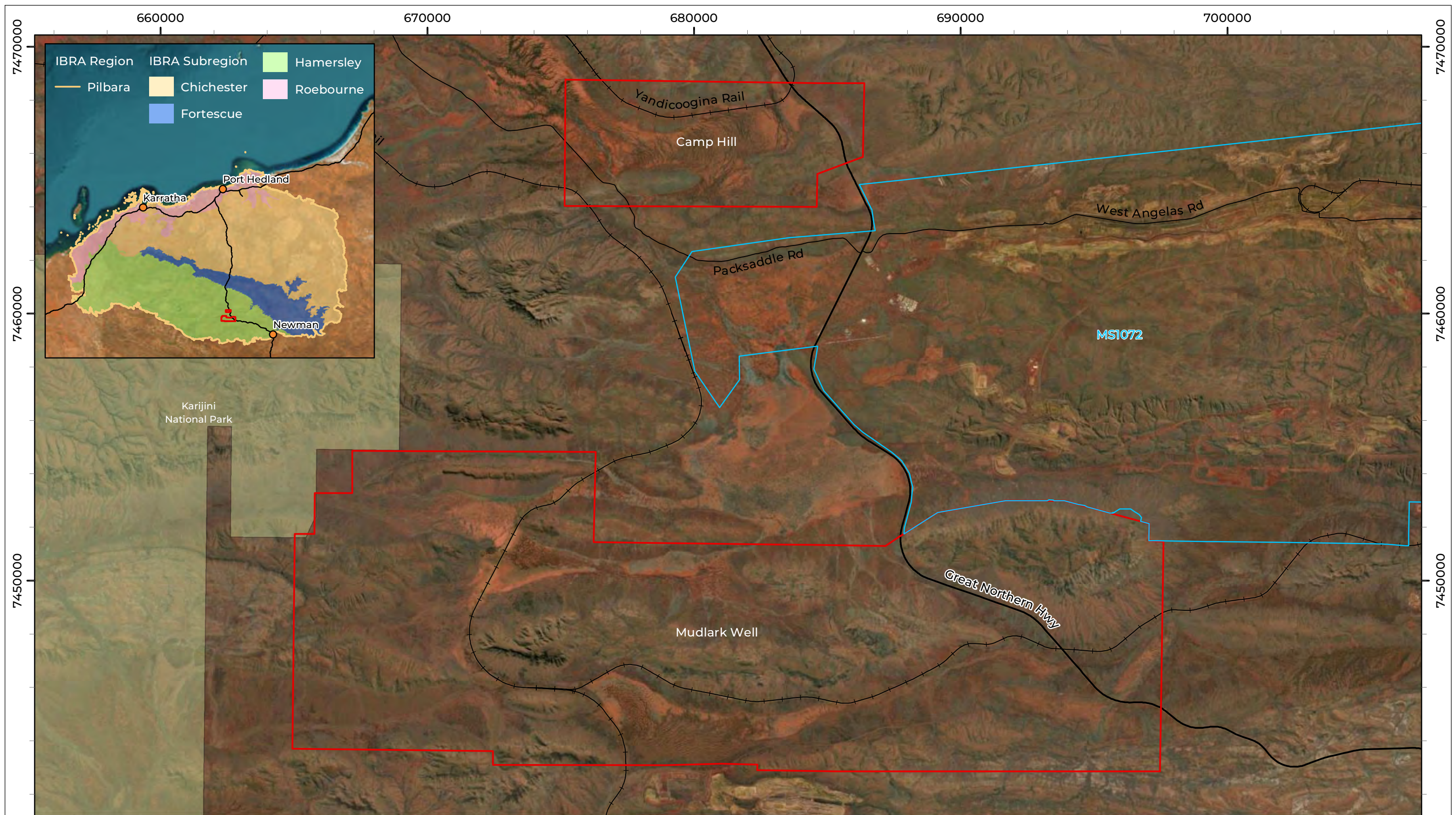
All but the night parrot has previously been recorded within the Study Area.

1.2 Compliance

This assessment was carried out in a manner consistent with the following documents:

- (BHP WAIO, 2023b) Vertebrate Fauna Surveys in Western Australia Procedure (Document Number: SPR-IEN-EMS-012) Version: 9;
- (BHP WAIO, 2023a) Biological survey spatial data requirements (SPR-IEN-EMS-015);
- DBCA (2017) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia;
- DEWHA (2010a) Survey guidelines for Australia's threatened bats;
- DEWHA (2010b) Survey guidelines for Australia's threatened birds;
- DoE (2016) EPBC Act referral guideline for the endangered northern quoll (*Dasyurus hallucatus*);
- DPaW (2017) Interim guidelines for the preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia;

- DoE (2013) Significant impact guidelines 1.1: Matters of National Environmental Significance;
- DSEWPaC (2011a) Survey guidelines for Australia's threatened mammals;
- DSEWPaC (2011b) Survey guidelines for Australia's threatened reptiles;
- EPA (2020b) Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment;
- EPA (2020a) Statement of environmental principles, factors and objectives;
- TSSC (2016a) Conservation advice: *Macroderma gigas*, ghost bat;
- TSSC (2016c) Conservation advice: *Rhinonictoris aurantia* (Pilbara form), Pilbara leaf-nosed bat;
- TSSC (2016b) Conservation advice: *Macrotis lagotis*, Greater bilby;
- EPA (2016) Environmental factor guidelines – terrestrial fauna;
- TSSC (2008a) Approved conservation advice for *Liasis olivaceus barroni* (olive python – Pilbara subspecies); and
- TSSC (2008b) Approved conservation advice for *Pezoporus occidentalis*, night parrot.



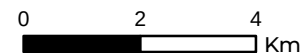
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| |  Rail | |

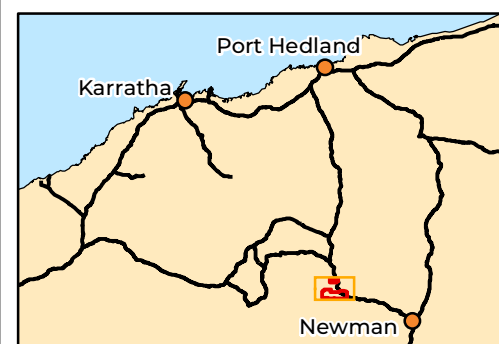


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Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 1.1: Study Area and regional context

2 Existing Environment

2.1 Biogeography

The Study Area is located within the Hamersley (PIL03) subregion of the Pilbara bioregion, as defined by the *An Interim Biogeographical Regionalisation for Australia* (IBRA; Thackway & Cresswell, 1995) (Figure 1.1). The Pilbara bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges (Thackway & Cresswell, 1995). Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Bastin, 2008). The Hamersley subregion is characterised by mountainous areas of Proterozoic sedimentary ranges (ironstone ranges) and plateaux dissected by gullies and gorges (Kendrick, 2003). Vegetation comprises mulga low woodland over bunch grasses on fine-textured soils dominates in valley floors, while skeletal soils of the ranges are dominated by snappy gum (*Eucalyptus leucophloia*) over *Triodia brizoides* (Kendrick, 2003). Drainage is typically into the Fortescue River to the north, the Ashburton River to the south, or the Robe River to the west (Kendrick, 2003).

2.2 Climate

The Pilbara bioregion has a semi-desert to tropical climate, with rainfall occurring sporadically throughout the year, although mostly during summer (Thackway & Cresswell, 1995). Summer rainfall is usually the result of tropical low pressure systems and cyclonic activity in the region (Leighton, 2004). Winter rainfall is generally lighter and often associated with cold fronts moving north easterly across the state (Leighton, 2004). The average annual rainfall ranges from 200–350 mm, although there are significant fluctuations between years (BoM, 2022; McKenzie *et al.*, 2009).

2.3 Geology

The Hamersley subregion contains Proterozoic sedimentary ranges and gorges of basalt, shale and dolerite. This subregion also contains calcrete deposits (Kendrick, 2003). The Study Area occurs across five broad (1:500,000) geological units, Wittenoom Formation (A-HAd-kd), Mount McRae Shale and Mount Sylvia Formation (A-HAu-xsl-ci), Marra Mamba Iron Formation (A-HAm-cib), Brockman Iron Formation (P-HAb-cib), and Jeerinah Formation (A-FOj-xs-b) (Figure 2.1; Table 2.1). The three dominant formations of the Study Area are Wittenoom Formation, Mount McRae Shale and Mount Sylvia Formation and Marra Mamba Iron Formation. The Wittenoom Formation is characterised by thinly bedded dolomite and dolomitic shale, with minor black chert, shale, banded iron formation and sandstone. The Mount McRae Shale and Mount Sylvia Formation is characterized by Mudstone, siltstone, chert, banded iron-formation, and dolomite. While Marra Mamba Iron Formation is characterised by chert, banded iron-formation, mudstone, and siltstone; minor carbonate; metamorphosed.

Marra Mamba Iron Formation is also the geology most predisposed to forming deep caves in the Pilbara suitable for use by ghost bats, while the larger hills of Brockman Iron Formation also form suitable caves (Armstrong & Anstee, 2000; Cramer *et al.*, 2022).

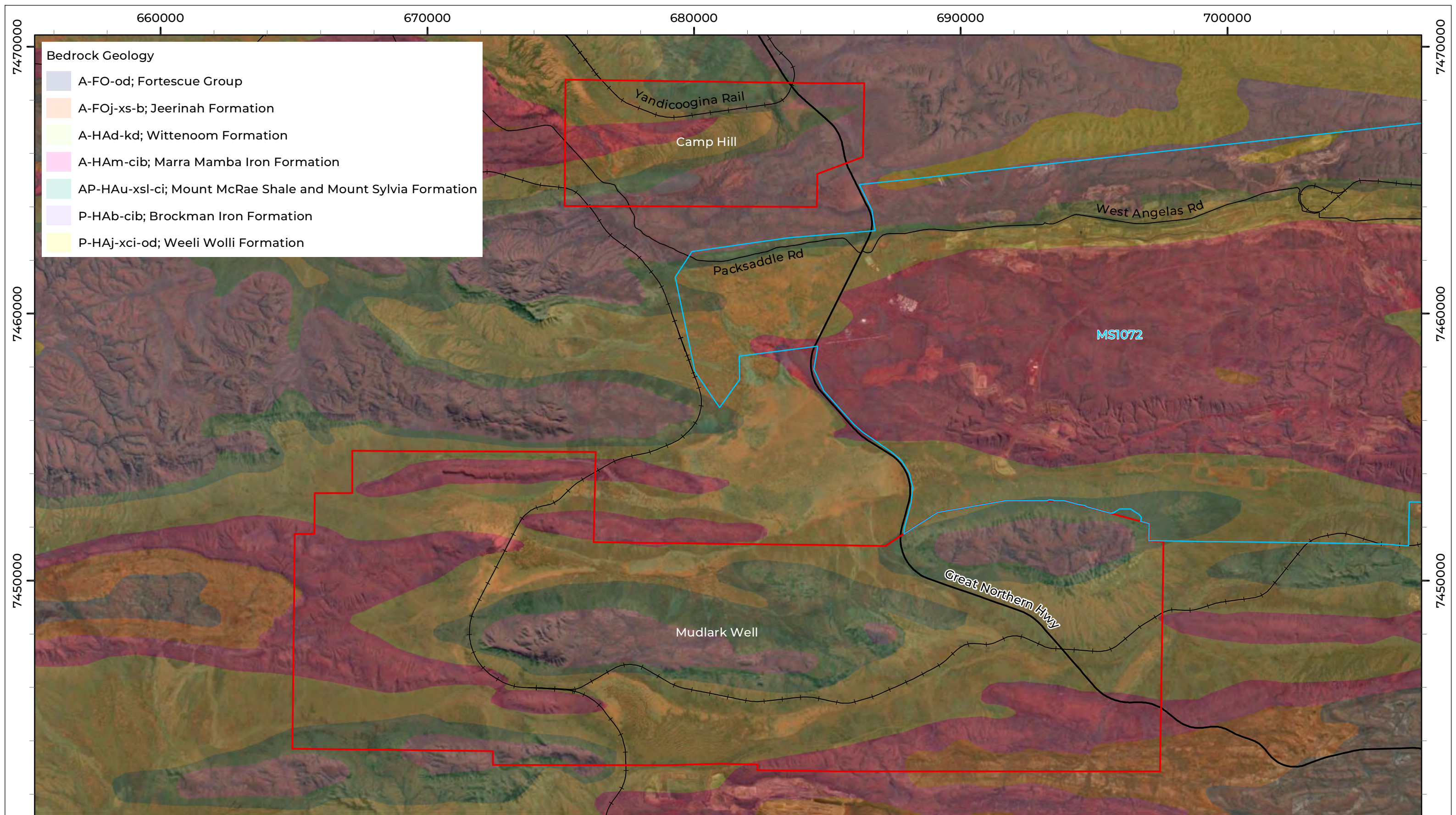
Table 2.1: Geology units within the Study Area

Unit Name	Geological unit	Description	Extent in Study Area	
			Ha	%
Wittenoom Formation	A-HAd-kd	Thinly bedded dolomite and dolomitic shale, with minor black chert, shale, banded iron formation and sandstone	15,931.04	43.66
Mount McRae Shale and Mount Sylvia Formation	A-HAu-xsl-ci	Mudstone, siltstone, chert, banded iron-formation, and dolomite; metamorphosed	7,435.75	20.38
Marra Mamba Iron Formation	A-HAm-cib	Chert, banded iron-formation, mudstone, and siltstone; minor carbonate; metamorphosed	6,982.58	19.14
Brockman Iron Formation	P_-HAb-cib	Banded iron-formation, chert, mudstone, and siltstone; metamorphosed	5,289.12	14.50
Jeerinah Formation	A-FOj-xs-b	Siliciclastic sedimentary rocks, mafic volcanic rocks and minor felsic volcanic rocks; local carbonate rocks, chert, and dolerite sills	847.86	2.32
Total			36,486.35	100

2.4 Soils

The CSIRO (2009) *Atlas of Australian Soils* described and mapped the soils of Australia following Bettany *et al.* (1967). The Study Area occurs over three soil units, Fa13 (15,556.45 ha, 42.64%), Fa14 (11,990.49 ha, 32.86%) and Fb3 (8,939.41 ha, 24.50%) (Figure 2.2). The dominant soil type, Fa13, is characterised by ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations, some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5. 11) soils on the steeper slopes. Associated are (Dr2.33 and Dr2.32) (Bettany *et al.*, 1967).

The second most dominant soil type is Fa14, characterised by steep hills and steeply dissected pediments on areas of banded jaspilite and chert along with shales, dolomite and iron ore formations; some narrow winding valley plains: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. (Dr2.33 and Dr2.32) soils which occur on the pediments are more extensive than in unit Fa13. (Um5.52) and (Uf6.71) soils occur on the valley plains (Bettany *et al.*, 1967). The remainder of the Study Area is soil type Fb3, which is characterised by high-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: principal soils are deep earthy loams (Um5.52) along with small areas of (Gn2.12) soils (Bettany *et al.*, 1967).



LEGEND

- Study Area
- Approval Boundary
- Local Road
- State Road
- Rail



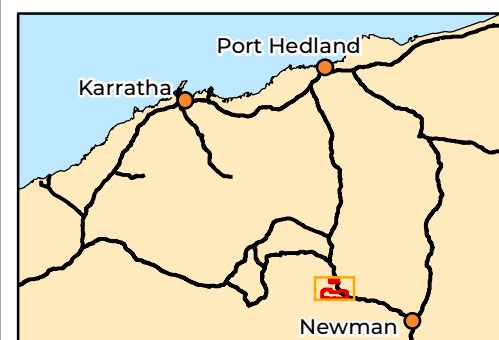
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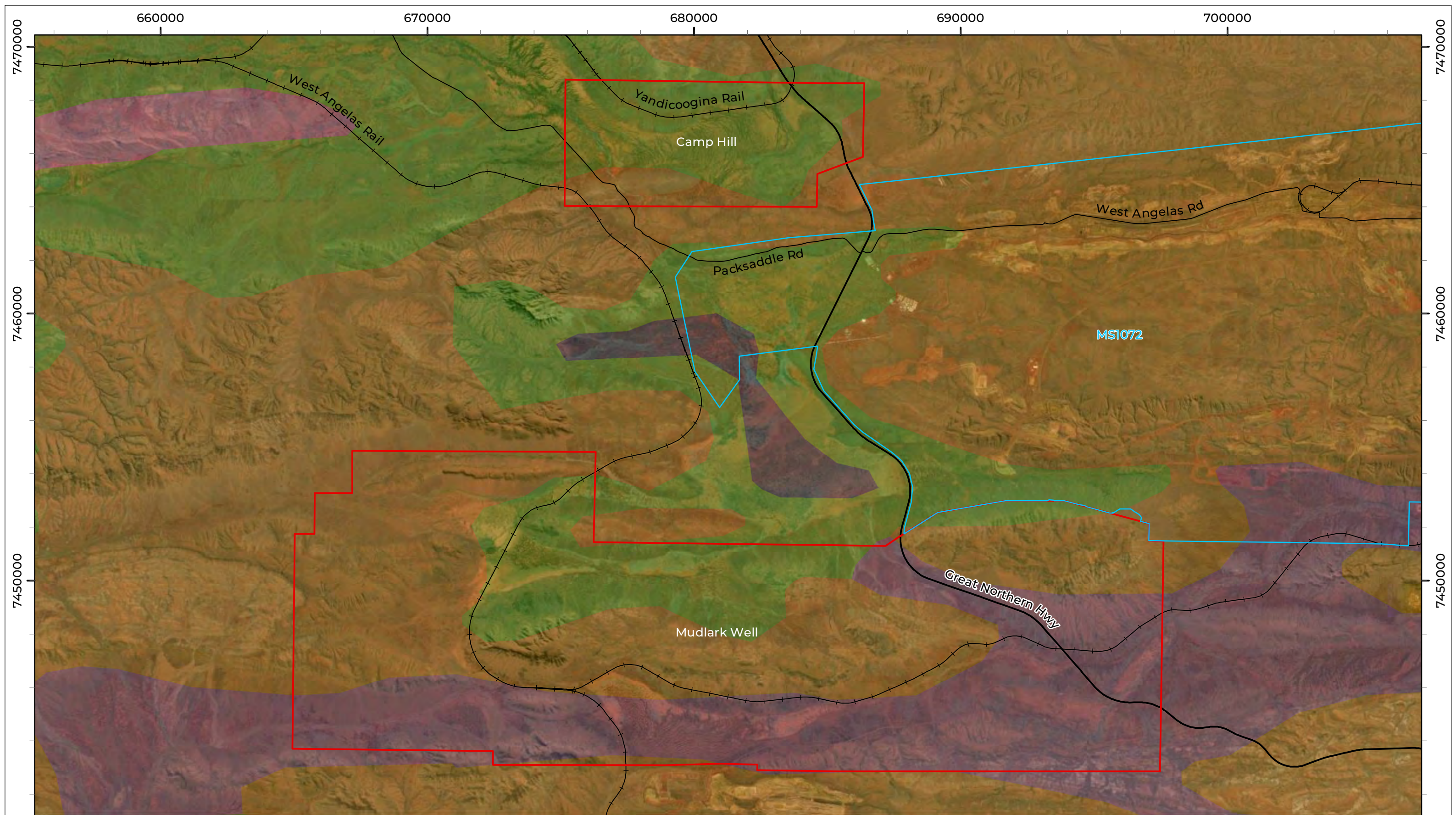


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CPH Targeted MNES
Vertebrate Fauna Survey
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Figure 2.1: Broad geology
of the Study Area



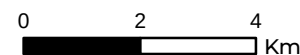
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|--|--|--|--|
|  Study Area |  Local Road | Soil Unit |  Fa15 |
|  Approval Boundary |  State Road |  Fa13 |  Fb3 |
| |  Rail |  Fa14 |  Ja2 |



Biologic

Scale 1:130,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 2.2: Soils of the Study Area

2.5 Land Systems

Payne *et al.* (1988) and Van Vreeswyk *et al.* (2004) classified and mapped the land systems of the Pilbara bioregion according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides an indication of the diversity and distribution of fauna habitats present within the Study Area.

Six land systems occur within the Study Area, the dominant being the Boolgeeda land system, which covers approximately 46% (16,838.56 ha) of the Study Area (Figure 2.3; Table 2.2). The Boolgeeda land system is defined as “stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands” (van Vreeswyk *et al.*, 2004). The second most dominant is the Newman land system, covering approximately 33.89% (12,363.87 ha) of the Study Area, which is defined as “rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands”. The third most dominant system is the Wannamunna land system, accounting for 15.95% (5,821.00 ha) of the Study Area and characterised as “hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands)”. The remaining three land systems account for the remaining 4.01% (1,462.91 ha) and include Platform, Egerton and Rocklea systems (Figure 2.3; Table 2.2).

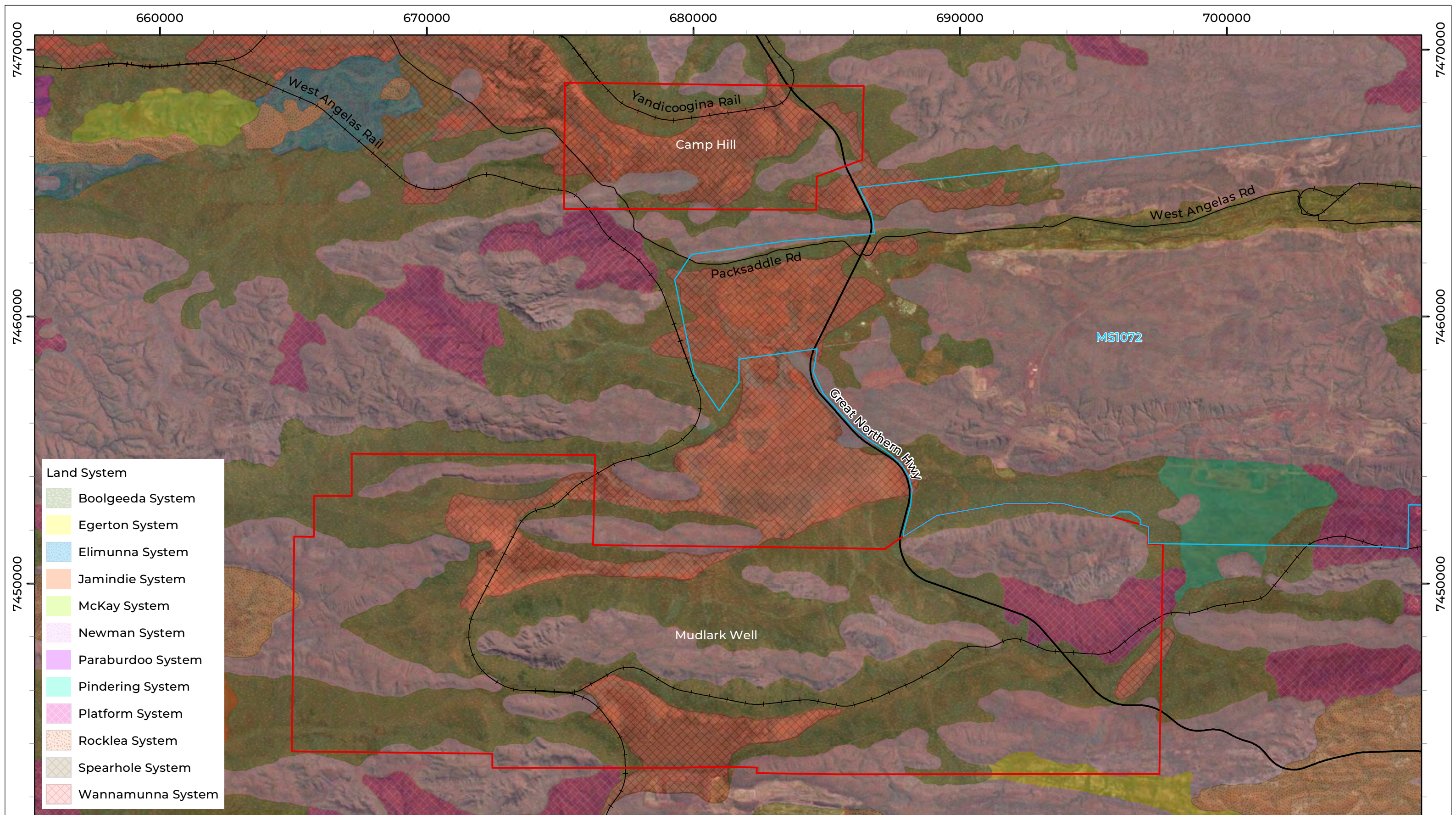
Of the six land systems occurring within the Study Area, the Newman land system contains the most significant habitats for many of the target MNES species. The rocky ridges and mountains associated with this land system can support important refugia and foraging habitats for Pilbara leaf-nosed bat, ghost bat and northern quoll. The occurrence of this land system within the Study Area is however, patchily distributed throughout the area (Figure 2.3).

Table 2.2: Land systems of the Study Area

Land system	Land type	Description	Extent in Study Area	
			Ha	%
Boolgeeda (Bgd)	Stony plains with spinifex grasslands	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	16,838.56	46.15
Newman (New)	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	12,363.87	33.89
Wannamunna (Wnm)	Wash plains on hardpan with mulga shrublands	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands).	5,821.00	15.95
Platform (Pla)	Stony plains with spinifex grasslands	Dissected slopes and raised plains supporting hard spinifex grasslands.	1,236.23	3.39
Egerton (Ege)	Stony plains with spinifex grasslands	Highly dissected hardpan plains supporting mulga shrublands and hard spinifex hummock grasslands.	214.67	0.59
Rocklea (Roc)	Hills and ranges with spinifex grasslands	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	12.01	0.03
Total			36486.36	100

2.6 Surface Hydrology

Three major watercourses are located within close proximity to the Study Area (Marillana Creek, Weeli Wolli Creek and Turee Creek East). No major water courses intersect the Study Area, although numerous un-named tributaries of Yandicoogina Creek and Marillana Creek occur the southern portion (Figure 2.4). Marillana Creek and Yandicoogina Creek (flows to the north) are important sources of surface water runoff to Weeli Wolli Creek, which flows to the north and discharges into the Fortescue River Valley. Both Marillana Creek and Yandicoogina Creek typically only flow during the wet season following significant rainfall and are periodically subject to major flooding as a result of cyclonic weather events in the region. Marillana Creek and Yandicoogina Creek are also influenced by dewatering discharge from BHP WAIO's Yandi operations and Rio Tinto Iron Ore's Yandicoogina operations. Marillana Creek is a source of recharge to the Marillana Creek Channel Iron Deposit groundwater aquifer (WRC, 2003).



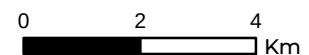
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- | | |
|-------------------|------------|
| Study Area | Local Road |
| Approval Boundary | State Road |
| | Rail |

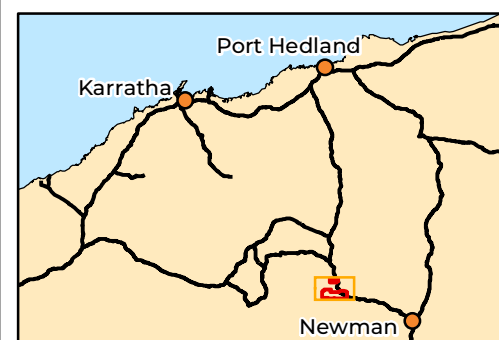


Biologic

Scale 1:130,000

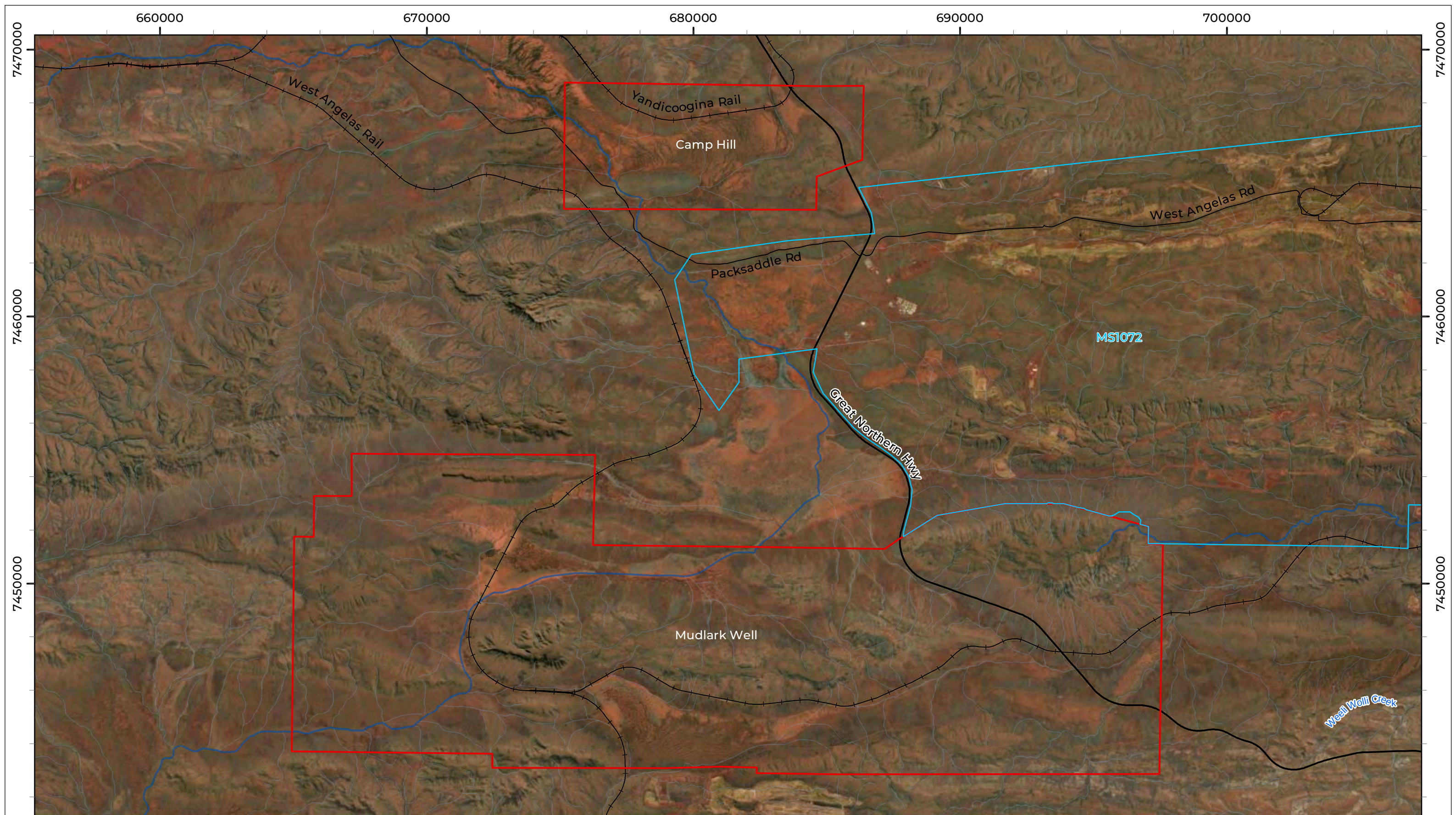


Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



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Vertebrate Fauna Survey
Stage 2

Figure 2.3: Land systems
of the Study Area



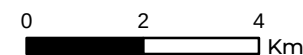
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- | | | |
|--|--|---|
|  Study Area |  Local Road | Surface Hydrology |
|  Approval Boundary |  State Road |  Minor |
| |  Rail |  Major |



Biologic

Scale 1:130,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



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Vertebrate Fauna Survey
Stage 2

Figure 2.4: Surface hydrology
of the Study Area

2.7 Pre-European Vegetation

Beard (1975) broadly (1:1,000,000) mapped the major structural vegetation types of Western Australia. Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). This update also accounts for extensive clearing since Beard (1975) mapping.

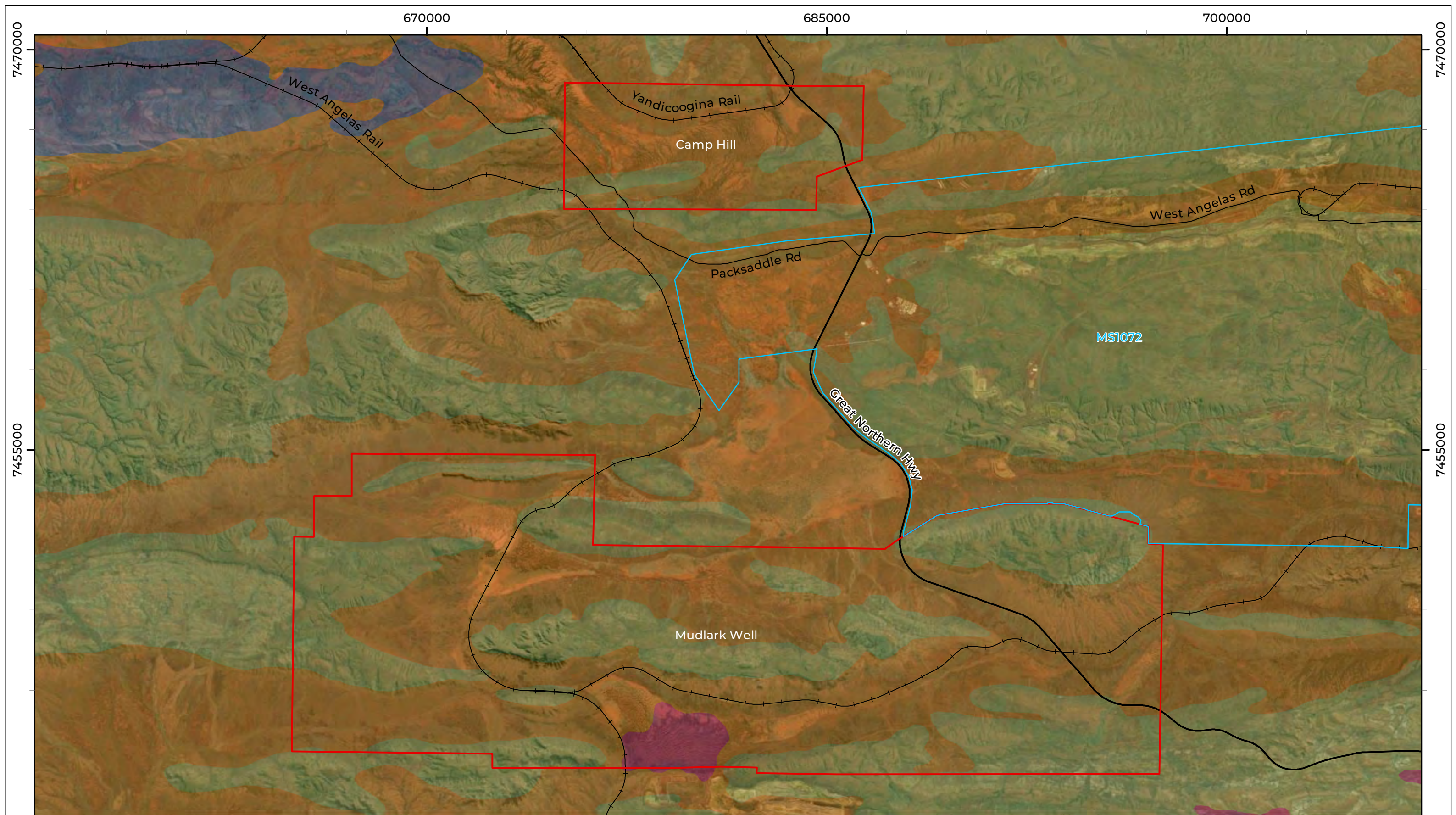
Three vegetation associations occur within the Study Area (Figure 2.5; Table 2.3). The dominant vegetation association is HAMMERSLEY-18 which covers approximately 62.69% (22,872.64 ha) of the Study Area, followed by HAMMERSLEY-82, which covers approximately 35.37% (12,903.52 ha) of the Study Area. The remaining 1.95% (710.21 ha) of the Study Area is comprised of the HAMMERSLEY-29 association. HAMMERSLEY-18 comprises low Mulga woodland dominated by *Acacia aneura*, and HAMMERSLEY-82 includes hummock grasslands (Table 2.3).

Table 2.3: Vegetation associations within the Study Area

Vegetation Association	Description	Extent in Study Area	
		Ha	%
HAMMERSLEY-18	Low woodland; mulga (<i>Acacia aneura</i>)	22,872.64	62.69
HAMMERSLEY-82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	12,903.52	35.37
HAMMERSLEY-29	Sparse low woodland; mulga, discontinuous in scattered groups	710.21	1.95
Total		36,486.37	100

2.8 Land Use and Tenure

The Study Area is covered under numerous exploration and mining leases. The Great Northern Highway intersect the eastern portion of the Study Area. The Study Area is located partially within Juna Downs Station and vacant Crown Land, and is located immediately adjacent to Karijini National Park (Figure 1.1).



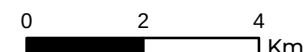
LEGEND

- | | | |
|-------------------|------------|--------------------------------|
| Study Area | Local Road | Pre-European Vegetation |
| Approval Boundary | State Road | |
| | Rail | |
| | | |
| | | Hamersley 18 |
| | | Hamersley 29 |
| | | Hamersley 82 |
| | | Hamersley 567 |



Biologic

Scale 1:130,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

**Figure 2.5: Pre-European
vegetation associations
of the Study Area**

3 Desktop Assessment

3.1 Methods

A desktop assessment, comprising database searches and a literature review (Table 3.1), was undertaken prior to phase 1 and reviewed prior to phase 2 of the field survey. The purpose of the desktop assessment was to identify vertebrate fauna potentially occurring within the Study Area, with a focus on targeted MNES and other significant species.

3.1.1 Database Searches

Five fauna databases were searched to obtain information on all vertebrate species previously recorded within the Study Area and surrounds (Table 3.1); three contain information on all vertebrate species previously recorded (BirdLife Australia, 2022; DBCA, 2022a; WAIO, 2022), one identifies species of significance previously recorded (DBCA, 2022b) and one identifies species of significance known or likely to occur within the region based on modelled distribution (DCCEEW, 2022).

Table 3.1: Details of database searches conducted

Database	Data Access/ Receival Date	Search Area
DBCA (2022a) NatureMap	14/03/2022	Approximate central point of the Study Area (-22.9600 S, 118.7700 E) with a 50 km buffer
DBCA (2022b) Threatened and Priority Fauna Database	14/03/2022	
BirdLife Australia (2022) Birdata	3/03/2022	
DCCEEW (2022) Protected Matters Search Tool	3/03/2022	
BHP WAIO (2022) BHP WAIO Fauna Records Database	24/05/2022	

3.1.2 Literature Review

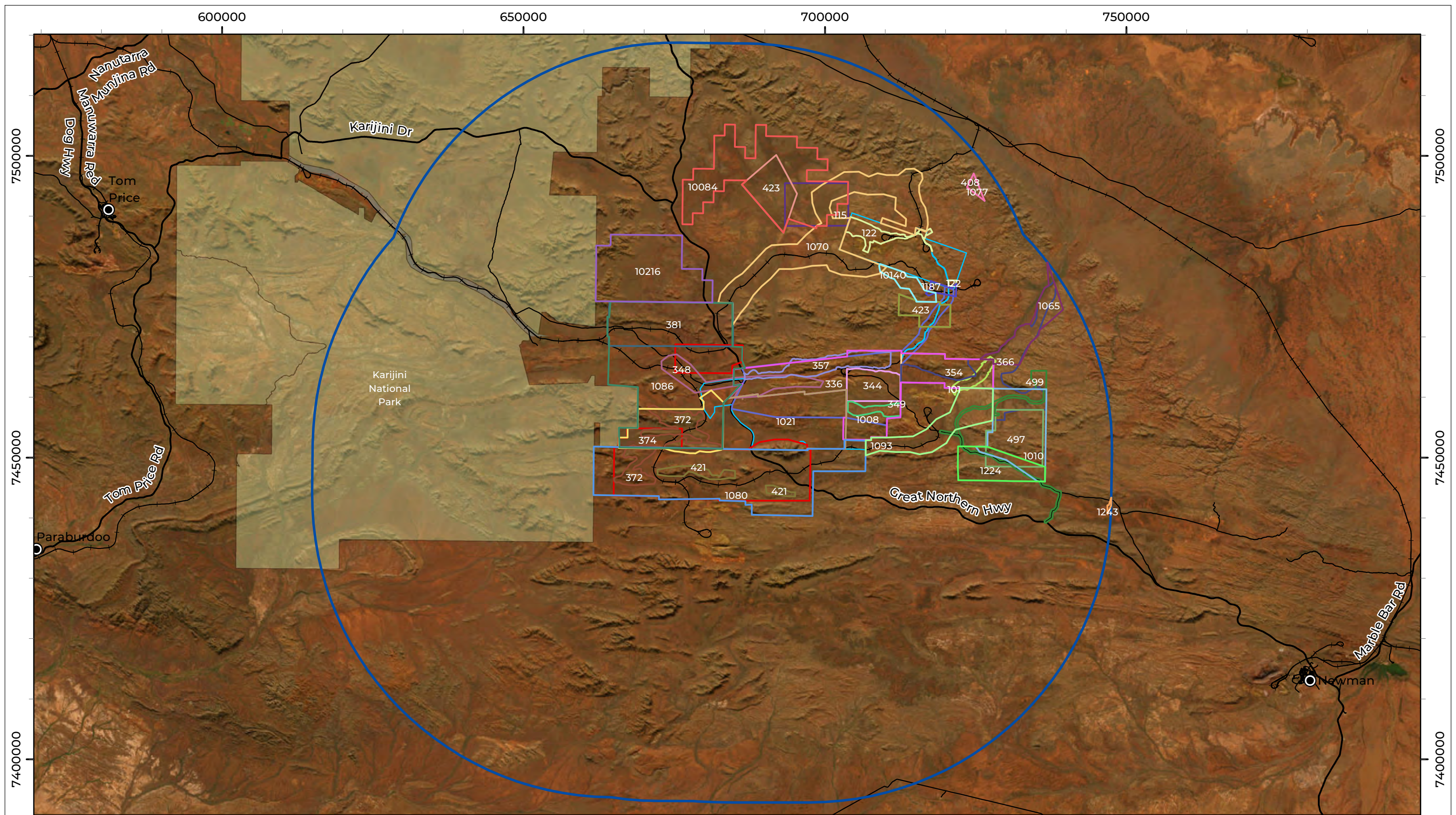
A total of 75 assessments were reviewed, comprising 44 detailed surveys, 21 basic surveys, six targeted surveys, three monitoring surveys and one desktop assessment (Table 3.2; detailed summary in Appendix A). Fourteen assessments overlapped with a portion of the Study Area, 17 were undertaken within 10 km of the Study Area and the remaining 44 were undertaken within 50 km of the Study Area (Table 3.2; Appendix A). Figure 3.1 illustrates the location of surveys conducted for BHP (BHP survey ID in Table 3.2; Appendix A) in relation to the Study Area.

Table 3.2: Literature sources used for the review

Report	BHP Survey ID	Survey Type	Distance from Study Area
Astron (2010a) Packsaddle West Flora and Fauna Assessment.	-	Basic	Within Study Area
Biologic (2011f) Southern Flank Vertebrate Fauna Study.	1021	Detailed	Within Study Area
Biologic (2013a) Area C West Vertebrate Fauna Survey.	1086	Detailed	Within Study Area
Biologic (2013d) Mudlark Vertebrate Fauna Survey.	1080	Detailed	Within Study Area
Biologic (2023a) Central Pilbara Ghost Bat Monitoring: 2020 – 2021.	-	Monitoring	Within Study Area
Biologic (2023b) Central Pilbara Ghost Bat Monitoring: 2021 – 2022.	-	Monitoring	Within Study Area
Biologic (2023c) Central Pilbara Ghost Bat Monitoring: 2022 – 2023.	-	Monitoring	Within Study Area
Biologic (2023d) Targeted Pilbara Olive Python Survey: South Flank and Mining Area C.	-	Targeted	Within Study Area
Biota (2004) Fauna Habitats and Fauna Assemblage of the Proposed FMG phase A Rail Corridor	-	Detailed	Within Study Area
Ecologia (2004a) Area C: Deposits D, E and F Biological Survey.	348	Detailed	Within Study Area
Ecologia (2005a) Mudlark Well Exploration Project Biological Survey.	421	Detailed	Within Study Area
ENV (2008b) Area C West Fauna Assessment.	372	Detailed	Within Study Area
ENV (2010a) Area C West NVCP Flora, Vegetation and Fauna Assessment.	374	Basic and detailed	Within Study Area
Onshore and Biologic (2011) Camp Hill Exploration Leases Level 2 Flora & Vegetation Survey and Level 1 Fauna Assessment.	381	Basic	Within Study Area
Biologic (2011a) Area C and Surrounds Vertebrate Fauna Survey.	1008	Detailed	<1km
Ecologia (1998a) Mining Area C Biological Survey.	336	Detailed	<1km
Ecologia (2004b) Packsaddle Range Biological Survey.	357	Basic	1.9km
ENV (2008a) Area C Southern Flank Deposit Fauna Assessment.	-	Basic	2.7km
Biota (2013a) Area C West to Yandi level 2 Vertebrate Fauna Survey.	1070	Detailed	3.3km
Ecologia (2008a) Area A and Additional Areas Level 2 Terrestrial Fauna Survey.	-	Detailed	3.5km
ENV (2010a) Area C West NVCP Flora, Vegetation and Fauna Assessment.	374	Basic and detailed	4.1km
Rapallo (2012) Level 2 Fauna Survey and Targeted Northern Quoll Survey of the Lamb Creek	-	Detailed	5.2km
Ecologia (1998c) West Angelas Iron Ore Project Vertebrate Fauna Assessment Survey	-	Detailed	5.6km
Ecologia (2014) Greater West Angelas Terrestrial Fauna Assessment	-	Detailed	6.9km
Biologic (2019) Pineapple Hill Detailed Vertebrate Fauna Survey.	10216	Detailed	7km
ENV (2007a) Area C R-Deposit Fauna Assessment.	349	Detailed	8.6km
Integrated Environmental (1980) An Ecological Appreciation of the West Angelas Environment, Western Australia 1979	-	Detailed	8.6km

Report	BHP Survey ID	Survey Type	Distance from Study Area
HGM (1999) Marillana Creek Western Access Corridor - Biological Assessment.	-	Basic	8.8km
Biota (2012d) South Flank to Jinidi Level 2 Fauna Survey.	1093	Detailed	9.2km
Biota (2005a) Fauna Habitats and Fauna Assemblage of Deposits E and F at West Angelas Survey	-	Detailed	9.4km
Outback Ecology (2008) Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial Vertebrate Fauna Assessment.	344	Detailed	9.7km
Astron (2019) Hope Downs 2 Proposal Fauna Survey March 2019.	-	Detailed	10.2km
Biologic (2013e) Targeted conservation significant fauna survey- Karijini tenement E47/17	-	Basic targeted	11.2km
GHD (2010) Coondewanna Exploration Tenement Level 2 Flora and Level 1 Fauna Report.	-	Basic	16.0km
Outback Ecology (2010) Area C to Jinayri to Mount Newman Railway Terrestrial Vertebrate Fauna Survey.	366	Detailed and basic	18.7km
360 Environmental (2017) Upper Marillana and Munjina Baseline Vertebrate Fauna survey.	10084	Detailed	19.9km
Ecologia (2005b) Upper Marillana Exploration Project Biological Survey.	115	Basic	20.9km
ENV (2010b) Jinayri Access Road Vertebrate Fauna Survey.	499	Detailed	21.6km
Ecologia (1997) Hope Downs Biological Survey	-	Detailed	22.9km
Biota (2013b) South Parmelia Vertebrate Fauna Survey.	1224	Detailed	24.6km
Maunsell Australia and Bamford Consulting (2003) Yandi Life of Mine Fauna and Flora	-	Basic	24.7km
Ecologia (2008b) Marillana Creek (Yandi) Iron Ore Mine Modification.	122	Detailed	25.6km
Ecologia (1998b) Weeli Wolli Creek Biological Assessment Survey.	101	Detailed	25.6km
Biologic (2010) East Packsaddle Level 1 Vertebrate Fauna Study.	350	Targeted	26.3km
Biologic (2017) Ministers North level 2 vertebrate fauna survey.	10082	Detailed	26.3km
ENV (2009a) Munjina and Ministers North (Yandi Hub) Fauna Assessment.	423	Detailed	26.3km
Ecologia (1995) Yandi phase II Iron Ore Project: Biological Assessment Survey	-	Detailed	26.6km
Ecologia (2004c) Yandi Overland Conveyor and Stockyard Fauna and Flora Assessment	-	Flora survey with fauna desktop survey	27.3km
ENV (2008c) Jinayri Vertebrate Fauna Assessment.	1010	Detailed	27.4km
Biota (2012c) Koodaideri Southern Infrastructure Corridor Fauna Survey	-	Detailed	27.8km
Biologic (2011b) Area C to Yandi Fauna Survey	-	Basic	28.8km
ENV (2011) Upper Marillana and Munjina Flora, Vegetation and Fauna Assessment	-	Basic	28.8km
ENV (2007b) Upper Marillana Exploration Lease Fauna Assessment	-	Basic	29.2km
Ecologia (2006b) Jirridi Terrestrial Vertebrate Fauna Survey.	497	Detailed	29.3km
Ecologia (2006d) Ministers North Biological Survey.	-	Basic	29.6km

Report	BHP Survey ID	Survey Type	Distance from Study Area
Biologic (2018) Ministers North to Yandi Corridor Two phase Targeted Fauna Survey.	10140	Targeted	29.7km
Biota (2010) Yandicoogina Junction South West and Oxbow Fauna Survey.	1187	Detailed	31.7km
ENV (2010c) Jinayri Mining Lease Vertebrate Fauna Survey	-	Detailed	34.6km
Biologic (2011e) Jinidi Vertebrate Fauna Survey	-	Basic	34.7km
Specialised Zoological (2008) Survey for conservation significant bats between Kurrajura siding and the Yandi WYE.	-	Basic	37.4km
Ecologia (2008c) RGP5 fauna survey Kurrajura Siding to Yandi WYE including Yandi repeater	-	Basic	39.0km
Biologic (2012) Jinidi to Mainline Vertebrate Fauna Survey.	1065	Detailed	39.4km
Biologic (2011g) Yandi Vertebrate Fauna Review	-	Basic and targeted	40.3km
Biologic (2011c) Barimunya Camp Vertebrate Fauna Survey	-	Basic	41.2km
ENV (2009b) Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment	-	Basic	41.9km
Biota (2012b) Koodaideri Project Targeted Fauna Survey	-	Detailed	43.0km
Biota (2009) Yandicoogina Targeted Northern Quoll survey.	-	Targeted	43.3km
Biologic (2013c) Marillana Vertebrate Fauna Survey.	1077	Detailed	45.4km
Ecologia (2006c) Marillana Terrestrial Vertebrate Fauna Survey.	408	Detailed	45.4km
Biota (2012a) Koodaideri Northern Extension Fauna Survey	-	Detailed	46.1km
Biota (2014a) Yandi Billiards phase 1 Seasonal Fauna Survey	-	Detailed	46.8km
Biota (2014b) Yandi Billiards Targeted Northern Quoll Survey	-	Targeted	46.8km
Biologic (2016a) Marillana targeted vertebrate fauna survey.	-	Targeted	47.0km
Ninox (2009) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Mining Area, Near Newman, Western Australia.	1243	Detailed	49.4km
Bamford Consulting (2012) Vertebrate Fauna Assessment of the Iron Valley Project Area	-	Detailed and targeted	49.4km



LEGEND

- | | | |
|-------------------|------------|-------------------------|
| Desktop StudyArea | Local Road | National Park |
| Study Area | State Road | Section 5(1)(g) Reserve |
| Approval Boundary | Rail | |



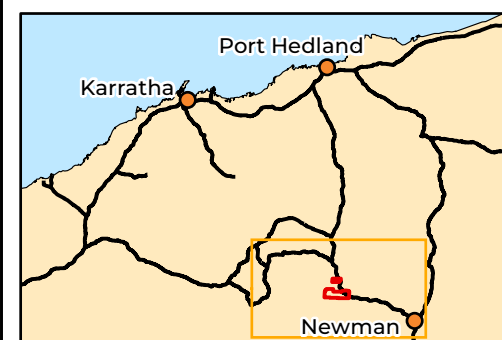
Biologic

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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/06/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 3.1: Fauna
Study Areas from
the desktop assessment

Year - Survey ID - Report Title	
2019 - 10216 - Pineapple Hill Level 2 Vertebrate Fauna Survey	2009 - 366 - Area C to Jinayri to Mount Newman Railway Terrestrial Vertebrate Fauna Survey
2017 - 10082 - Ministers North Level 2 Vertebrate Fauna Survey	2009 - 1243 - Fauna Survey of Proposed Hope Downs 4 Mining Area
2017 - 10084 - Upper Marillana and Munjina Baseline Vertebrate Fauna Survey	2009 - 423 - Munjina and Minsters North (Yandi Hub) Fauna Assessment
2017 - 10140 - Ministers North to Yandi Corridor Level 2 Vertebrate Fauna survey	2008 - 372 - Area C West Fauna Assessment
2013 - 1224 - South Parmelia Level 2 Vertebrate Fauna survey	2008 - 344 - Area C Deposit A, D, P1 and P3 Vertebrate Fauna Survey Outback Ecology
2013 - 1070 - Area C West to Yandi Level 2 Vertebrate Fauna Survey	2008 - 1010 - Jinayri Vertebrate Fauna Assessment
2013 - 1086 - Area C West Vertebrate Fauna Survey	2008 - 122 - Marillana Creek (Yandi) Iron Ore Mine Modification Level 2 Fauna Survey
2013 - 1080 - Mudlark Vertebrate Fauna Study	2007 - 349 - Area C Deposit R Fauna Assessment
2013 - 1077 - Marillana Vertebrate Fauna Survey	2006 - 497 - Jirridi Terrestrial Fauna Survey
2012 - 1093 - South Flank to Jinidi Level 2 Vertebrate Fauna Survey	2006 - 408 - Marillana Terrestrial Vertebrate Fauna Survey
2011 - 381 - Camp Hill Flora and Vegetation Survey Report and Fauna Assessment	2005 - 115 - Upper Marillana Exploration Project Biological Survey
2011 - 1021 - Southern Flank Vertebrate Fauna Study	2005 - 421 - Mudlark Well Exploration Project Biological Survey
2011 - 1008 - Area C and Surrounds Vertebrate Fauna Survey	2004 - 357 - Area C Packsaddle Range Biological Survey
2011 - 1065 - Jinidi to Mainline Vertebrate Fauna Survey	2004 - 348 - Area C Deposits D, E and F Biological Survey
2010 - 499 - Jinayri Access Road Vertebrate Fauna Survey	2001 - 354 - Area C Packsaddle Vertebrate Fauna Assesssment
2010 - 374 - Area C West NVCP Flora Vegetation and Fauna Assessment	1998 - 101 - Weeli Wolli Creek Biological Assessment Survey
2010 - 1187 - Yandicoogina Junction South West Oxbow Fauna Survey	1998 - 336 - Mining Area C Biological Survey

3.2 Results

In addition to the seven target MNES species (Figure 3.2; Appendix B), a further 24 significant species were identified in the desktop assessment as previously recorded and/or potentially occurring within the Study Area (31 total; Figure 3.3). These comprised 10 mammals, 15 birds and six reptiles, of which, the following 16 have previously been recorded within the Study Area (Biologic, 2011f, 2013a, 2013d, 2023d; Biota, 2004; DBCA, 2022b; Onshore & Biologic, 2011; WAIO, 2022) (Appendix B):

- northern quoll (*Dasyurus hallucatus*) – Endangered (EPBC Act)/ Critically Endangered (BC Act);
- ghost bat (*Macroderma gigas*) – Vulnerable (EPBC Act and BC Act);
- greater bilby (*Macrotis lagotis*) – Vulnerable (EPBC Act and BC Act);
- grey falcon (*Falco hypoleucos*) – Vulnerable (EPBC Act and BC Act);
- Pilbara leaf-nosed bat (*Rhinonictis aurantius* 'Pilbara form') – Vulnerable (EPBC Act and BC Act);
- Pilbara olive python (*Liasis olivaceus* subsp. *barroni*) – Vulnerable (EPBC Act and BC Act);
- blind-snake (*Anilius ganeii*) – Priority 1 (DCBA);
- Pilbara barking gecko (*Underwoodisaurus seorsus*) – Priority 2 (DCBA);
- spotted ctenotus (*Ctenotus uber* subsp. *johnstonei*) – Priority 2 (DCBA);
- brush-tailed mulgara (*Dasycercus blythi*) – Priority 4 (DCBA);
- letter-winged kite (*Elanus scriptus*) – Priority 4 (DCBA);
- northern short-tailed mouse (*Leggadina lakedownensis*) – Priority 4 (DCBA);
- western pebble-mound mouse (*Pseudomys chapmani*) – Priority 4 (DCBA);
- peregrine falcon (*Falco peregrinus*) – Specially Protected (BC Act);
- fork-tailed swift (*Apus pacificus*) – Migratory (EPBC Act and BC Act); and
- wood sandpiper (*Tringa glareola*) – Migratory (EPBC Act and BC Act).

The remaining 15 species have previously been recorded within a 50 km radius of the Study Area (Figure 3.3; Table 3.3). Several of these records may be inaccurate as the Study Area is outside of the species' current known distribution, e.g. north-western free-tailed bat, dwarf bearded dragon and Gunther's skink (Figure 3.3). The northern brushtail possum (*Trichosurus vulpecula arnhemensis*) record from the desktop (Vulnerable EPBC/BC Act) does not represent either this species, or the southwest species (*Trichosurus vulpecula hypoleucus*) as per Biologic (2021b), as such it has been excluded as a species of significance throughout.

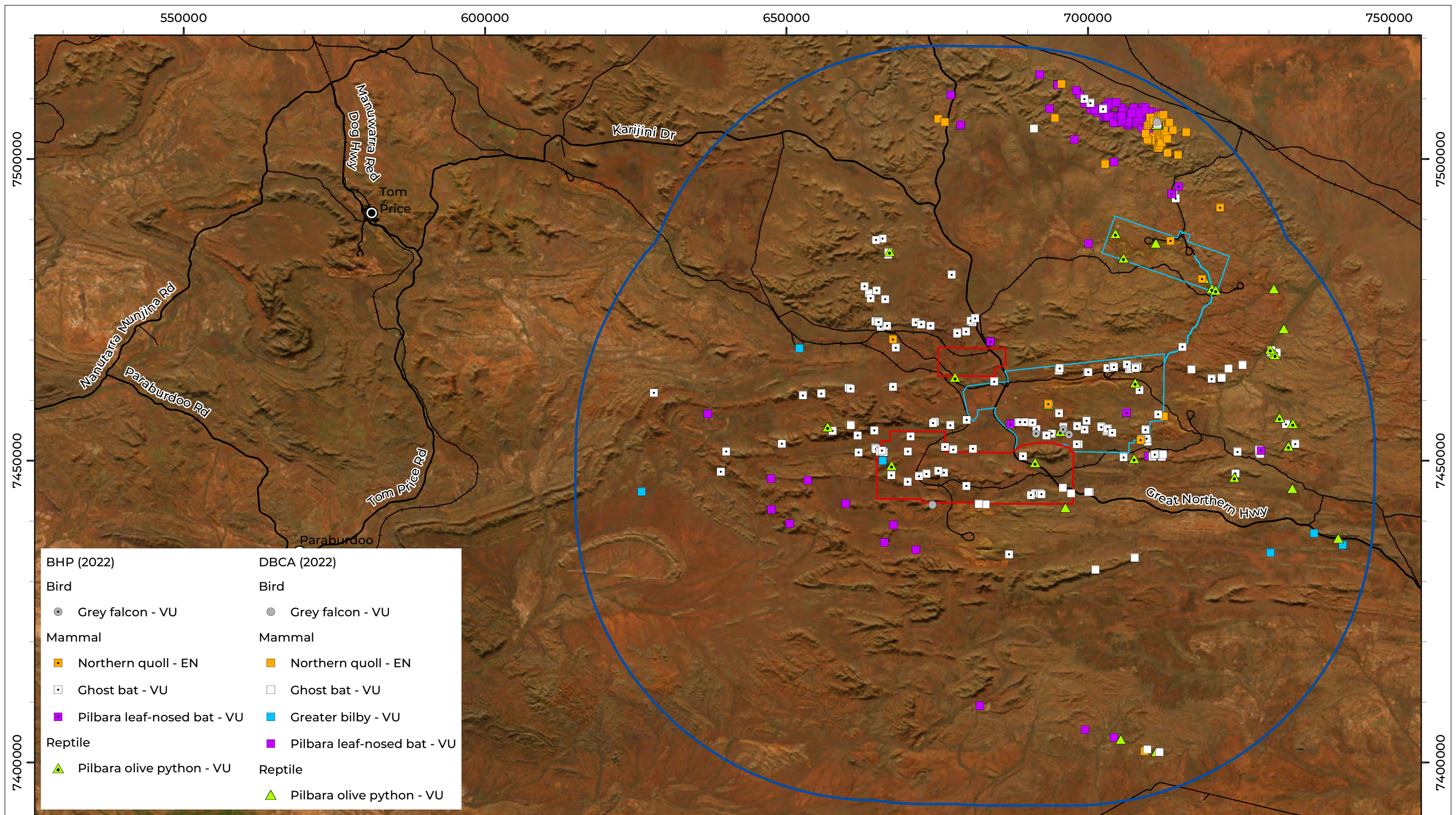
The desktop assessment identified 397 vertebrate fauna species which have previously been recorded within or have the potential to occur within the Study Area, comprising 62 mammals, 178 birds, 146 reptiles and 11 amphibians.

Table 3.3: Significance species with the potential to occur within the Study Area

Species		Conservation Status				Recorded within Study Area
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	
MAMMALS						
DASYURIDAE						
<i>Dasyercus blythi</i>	Brush-tailed mulgara			P4		•
<i>Dasyurus hallucatus</i>	Northern quoll	EN	EN		EN	•
<i>Sminthopsis longicaudata</i>	Long-tailed dunnart			P4		
MEGADERMATIDAE						
<i>Macroderma gigas</i>	Ghost bat	VU	VU		VU	•
MOLOSSIDAE						
<i>Ozimops cobourgianus</i>	North-western free-tailed bat			P1		
MURIDAE						
<i>Leggadina lakedownensis</i>	Northern short-tailed mouse			P4		•
<i>Notomys longicaudatus</i>	Long-tailed hopping-mouse, koolawa	EX	EX		EX	
<i>Pseudomys chapmani</i>	Western pebble-mound mouse			P4		•
RHINONYCTERIDAE						
<i>Rhinonictis aurantia</i>	Pilbara leaf-nosed bat	VU	VU			•
THYLACOMYIDAE						
<i>Macrotis lagotis</i> ¹	Greater bilby	VU	VU		VU	•
BIRDS						
ACCIPITRIDAE						
<i>Elanus scriptus</i>	Letter-winged kite			P4	NT	•
<i>Pandion haliaetus</i>	Eastern osprey	MI	MI			
APODIDAE						
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI			•
CHARADRIIDAE						
<i>Charadrius veredus</i>	Oriental plover	MI	MI			
FALCONIDAE						
<i>Falco hypoleucos</i>	Grey falcon	VU	VU		VU	•
<i>Falco peregrinus</i>	Peregrine falcon		OS			•
LARIDAE						
<i>Gelochelidon nilotica</i>	Gull-billed tern	MI	MI			
<i>Sterna caspia</i>	Caspian tern	MI	MI			
PSITTACIDAE						

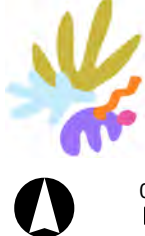
¹ Record from 1984. Location considered likely to be incorrect based on habitat.

Species		Conservation Status				Recorded within Study Area
Scientific Name	Common Name	EPBC	BC	DBCA	IUCN	
<i>Pezoporus occidentalis</i>	Night parrot	EN	CR		EN	
ROSTRATULIDAE						
<i>Rostratula australis</i>	Australian painted snipe	EN	EN		EN	
SCOLOPACIDAE						
<i>Calidris ferruginea</i>	Curlew sandpiper	CR/MI	CR/MI		NT	
<i>Tringa glareola</i>	Wood sandpiper	MI	MI			•
<i>Actitis hypoleucos</i>	Common sandpiper	MI	MI			
<i>Tringa nebularia</i>	Common greenshank	MI	MI			
THRESKIORNITHIDAE						
<i>Plegadis falcinellus</i>	Glossy ibis	MI	MI			
REPTILES						
CARPHODACTYLIDAE						
<i>Underwoodisaurus seorsus</i>	Pilbara barking gecko			P2		•
PYTHONIDAE						
<i>Liasis olivaceus</i> subsp. <i>barroni</i>	Pilbara olive python	VU	VU			•
SCINCIDAE						
<i>Ctenotus uber</i> subsp. <i>johnstonei</i>	Spotted ctenotus			P2		•
<i>Cyclodomorphus branchialis</i>	Gunther's skink		VU		NT	
<i>Lerista macropisthopus remota</i>	Unpatterned robust slider (Robertson Range)			P2		
TYPHLOPIDAE						
<i>Anilius ganei</i>	Blind-snake			P1		•



BHP (2022)	DBCA (2022)
Bird	Bird
● Grey falcon - VU	● Grey falcon - VU
Mammal	Mammal
■ Northern quoll - EN	■ Northern quoll - EN
◻ Ghost bat - VU	◻ Ghost bat - VU
■ Pilbara leaf-nosed bat - VU	■ Greater bilby - VU
Reptile	■ Pilbara leaf-nosed bat - VU
▲ Pilbara olive python - VU	Reptile
	▲ Pilbara olive python - VU

LEGEND	
 Study Area	 Local Road
 Desktop Assessment Area	 State Road
 Approval Boundary	 Rail

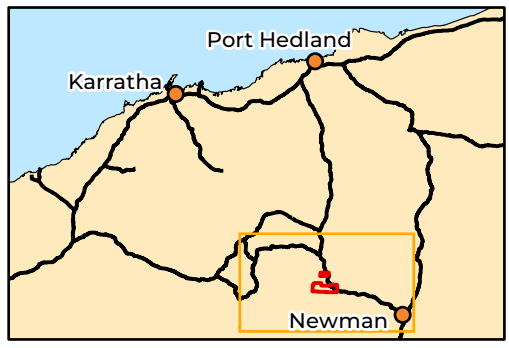


Biologic

Scale 1:575,000

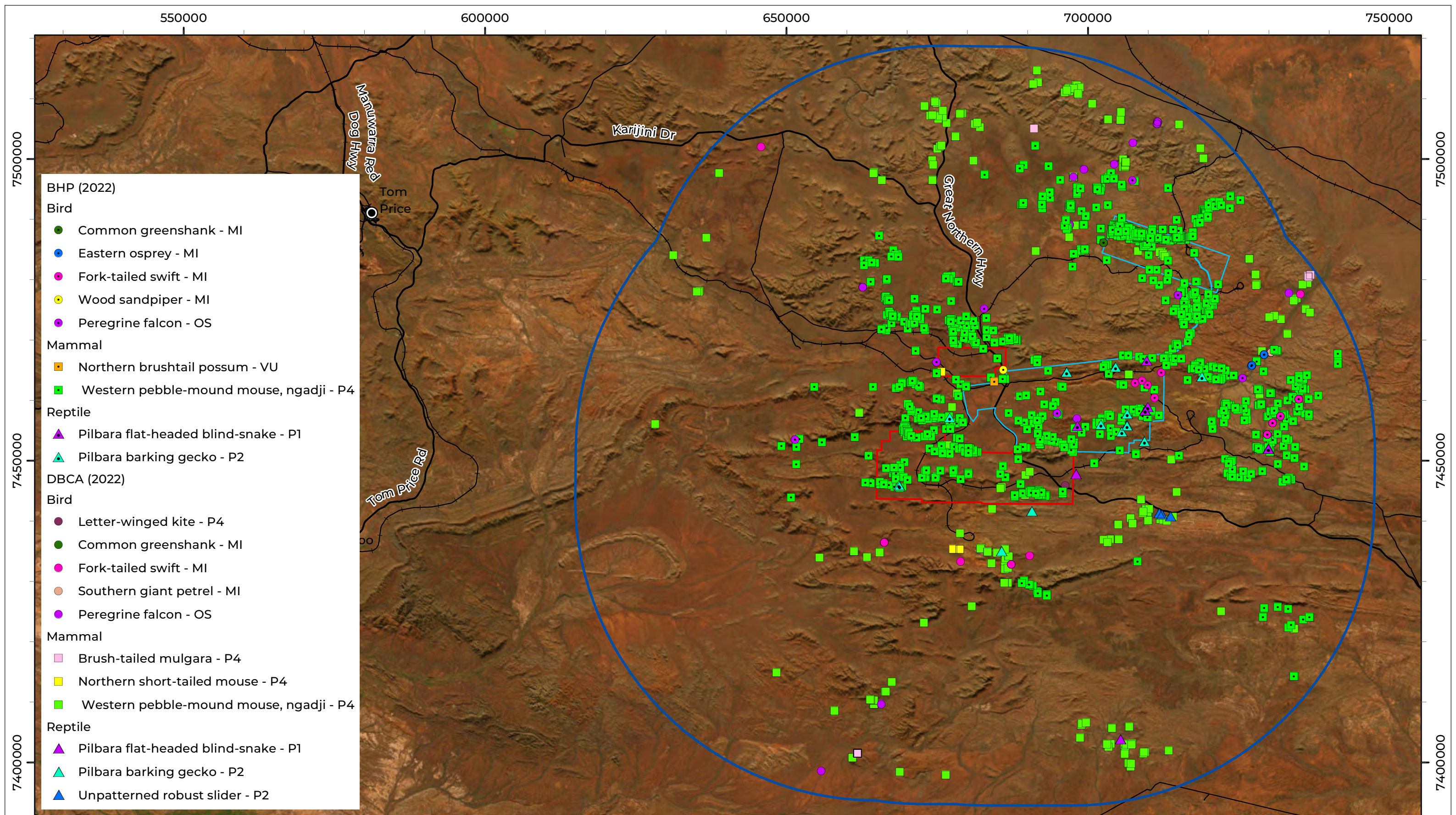
0 10 20 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/06/2024



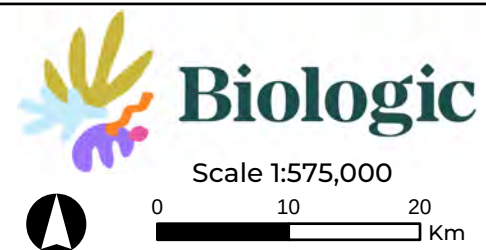
BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 3.2: Targeted MNES
fauna records from
the desktop assessment

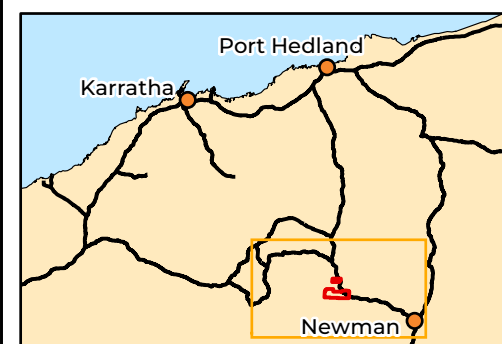


LEGEND

- Study Area
- Desktop Assessment Area
- Approval Boundary
- Local Road
- State Road
- Rail



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
Created 04/06/2024



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Figure 3.3: Other significant fauna records from the desktop assessment

4 Methods

4.1 Survey Timing and Personnel

The field survey was undertaken over two phases following the 2022 and 2023 wet seasons (phase 1 and phase 2). Five separate field trips were undertaken, with areas of focus for each trip determined by BHP (Table 4.1; Figure 1.1):

- Phase 1 – 2022
 - o Trip 1: 4–13 April
 - o Trip 2: 27 April – 6 May
 - o Trip 3: 25–30 May
- Phase 2 - 2023
 - o Trip 4: 15–24 February
 - o Trip 5: 7–17 March

In addition, a targeted ghost bat survey was undertaken for the Power2030 survey (Biologic, in prep) which overlapped with part of the Study Area. The targeted survey was undertaken from 18–23 March 2024. The results of the applicable cave assessments have been included in this report.

The field surveys were completed by zoologists with extensive experience undertaking targeted vertebrate fauna surveys in the Pilbara region, including with the target species. Personnel involved in the field surveys are shown in Table 4.1.

The survey was conducted under the *Animal Welfare Act 2002*'s Licence to use animals for scientific purposes (Licence No. U244/2022-2024), administered through the Department of Primary Industries and Regional Development (DPIRD). This is enabled through Biologic's chosen Animal Ethics Committee (AEC), Murdoch University, under permit RW3354/21. DBCA Regulation 27 "Fauna Taking (Biological Assessment) Licence", issued to Chris Knuckey (licence number BA27000783). Under Section 40 of the BC Act, threatened species sampling was completed under a DBCA "Authorisation to Take or Disturbed Threatened Species" issued to Chris Knuckey (authorisation number TFA 2223-0170).

Table 4.1: Survey personnel and experience

Name	Qualifications	Experience	Phase 1			Phase 2	
			Trip 1	Trip 2	Trip 3	Trip 4	Trip 5
Andrew Hide	BSc (Hons) Natural Resource Management	17 years' EIA (consulting) 17 years' field survey 17 years' vertebrate zoology/ecology	•	•	•	•	
Thomas Rasmussen	-	18 years' EIA (consulting) 18 years' field survey 18 years' vertebrate zoology/ecology					•
Sam Lostrom	BSc (Hons) Marine Biology and Zoology	5 years' EIA (consulting) 7 years' field survey 7 years' vertebrate zoology/ecology	•	•			
Andrew McCreery	BSc (Hons) Environmental Science and Conservation Biology	9 years' EIA (consulting) 10 years' field survey 10 years' vertebrate zoology/ecology			•		
Jari Cornelis	MSc Philosophy, BSc Zoology and Ecology	5 years' EIA (consulting) 6 years' field survey 6 years' vertebrate zoology/ecology			•		•
Aleesha Turner	BSc Applied Science (Wildlife Biology) (Hons)	3 years' EIA (consulting) 5 years' field survey 5 years' vertebrate zoology/ecology	•	•			•
Sam Edwards	BSc Environmental Management and Sustainability	2 years' EIA (consulting) 3 years' field survey 3 years' vertebrate zoology/ecology	•				•
Georgina Mattner	BSc Animal Ecology	2 years' EIA (consulting) 3 years' field survey 3 years' vertebrate zoology/ecology		•	•	•	
David Symons	-	1 years' EIA (consulting) 1 years' field survey 1 years' vertebrate zoology/ecology				•	•

4.2 Weather Conditions

Observed weather conditions prior to and during all surveys are shown in Figure 4.1. Current and long-term climatic data is available from the Bureau of Meteorology (BoM) weather station at Newman Aero (Station 007176), located approximately 110 km north-west of the Study Area (BoM, 2022). The Newman Aero weather station is expected to provide the most accurate long-term average (LTA) dataset for climatic conditions experienced within the Study Area.

In the six months prior to the phase 1 surveys (April – May 2022), minimum and maximum temperatures recorded at Newman Aero were similar to or slightly higher than long-term averages for most months, with above average temperatures recorded throughout the wet season of 2021 and 2022 (Figure 4.1). In total, the rainfall received at Newman Aero in the six months prior to the first survey phase (October 2021 – March 2022; 140.4 mm) was below the long-term average for the same period (234.1 mm). However, it was significantly above average during the second and third field trips undertaken in May 2022 (59.4 mm compared to 19 mm (LTA) (Figure 4.1).

Minimum and maximum temperatures recorded at Newman Aero in the 12 months prior to the phase 2 surveys (February – March 2023), were similar to or slightly lower than long-term averages for most months, with below average temperatures recorded throughout the dry season of 2022 (Figure 4.1). Rainfall was generally below the long-term average in the months preceding the February 2023 survey, with the exception of May (59.4 mm compared to 19 mm (LTA)), June (22.8 mm compared to 15.8 mm (LTA)) and September (57.2 mm compared to 4.7 mm (LTA)), all of which received significantly higher rainfall than the long-term average (Figure 4.1). In total, the rainfall received at Newman Aero in the 12 months prior to phase 2 (February 2022 – January 2023, 363.8 mm) was slightly above the annual long-term average for the same period (323.8 mm) (Figure 4.1). Observed maximum and minimum temperatures and total rainfall recorded during each phase are provided in Table 4.2.

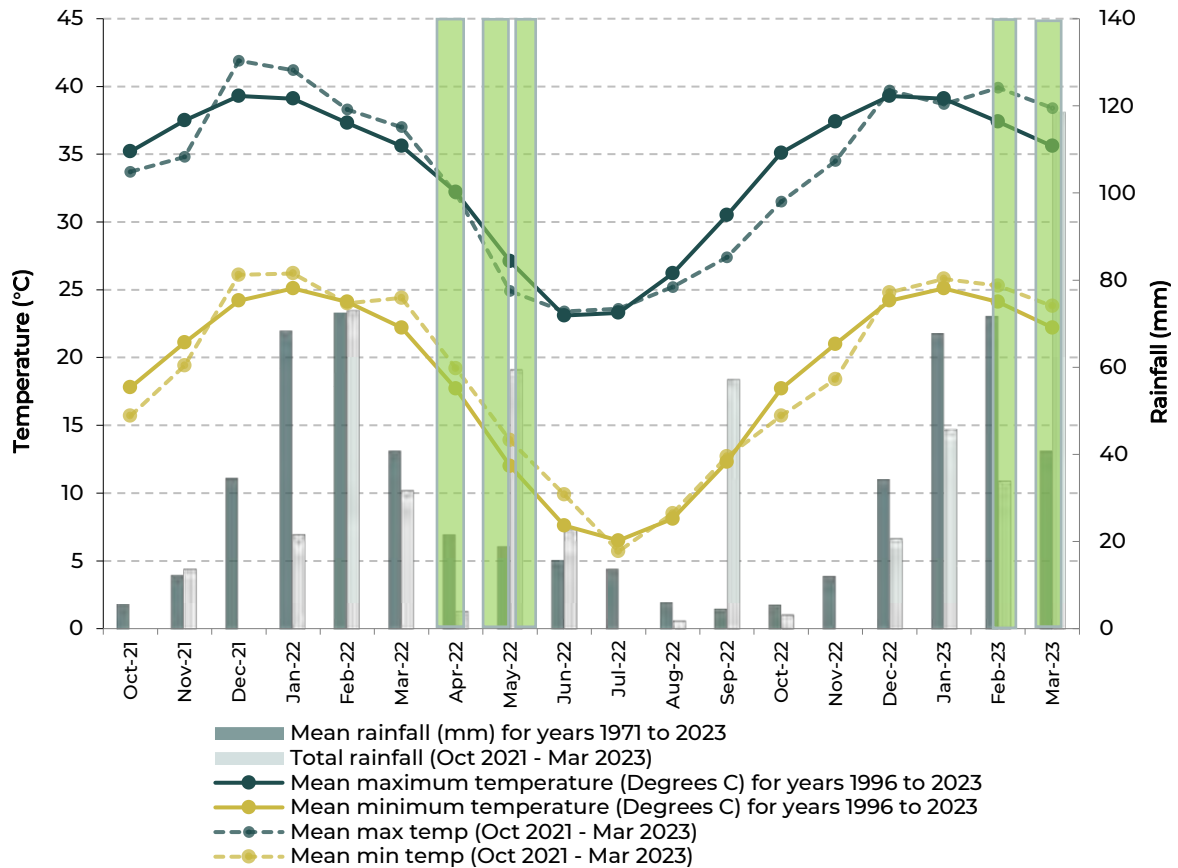


Figure 4.1: Current and long-term climatic data for Newman Airport (BoM, 2022) with approximate survey timing of the five trips shown in green shaded box

Table 4.2: Climatic conditions recorded Newman Airport (BoM, 2022) during the surveys

Date	Min. temp (°C)	Max. temp (°C)	Rainfall (mm)
Trip 1			
4/04/2022	20.1	33.2	0.8
5/04/2022	20.5	33.2	0.0
6/04/2022	20.6	31.5	0.0
7/04/2022	20.7	32.3	0.0
8/04/2022	21.4	33.5	0.0
9/04/2022	22.2	34.0	0.0
10/04/2022	18.2	34.0	0.0
11/04/2022	17.2	33.1	0.0
12/04/2022	15.8	32.1	0.0
13/04/2022	18.8	32.8	0.0
Trip 2			
27/04/2022	20.1	24.5	0.0
28/04/2022	16.2	22.4	11.2
29/04/2022	16.6	22.4	0.0
30/04/2022	17.0	21.9	0.0
1/05/2022	16.0	24.1	1.0
2/05/2022	16.6	26.5	0.0
3/05/2022	14.2	28.6	0.0
4/05/2022	18.2	27.5	0.0

Date	Min. temp (°C)	Max. temp (°C)	Rainfall (mm)
5/05/2022	14.2	24.1	0.0
6/05/2022	13.2	24.6	0.0
Trip 3			
25/05/2022	10.8	23.6	0.2
26/05/2022	13.3	25.5	0.0
27/05/2022	16.6	20.7	0.0
28/05/2022	16.4	23.0	1.0
29/05/2022	14.9	17.5	17.4
30/05/2022	9.0	16.2	6.0
Trip 4			
15/02/2023	27.9	42	0
16/02/2023	26	42.4	0
17/02/2023	25.4	43.4	0
18/02/2023	27.8	44	0
19/02/2023	23.1	39.1	10.8
20/02/2023	23.2	40.6	0
21/02/2023	22.6	35.5	0
22/02/2023	22.6	37.9	15.2
23/02/2023	26.3	37.6	0
24/02/2023	21.5	33	4
Trip 5			
07/03/2023	28.6	39.2	0.0
08/03/2023	27	38.2	0.0
09/03/2023	21.3	39.2	0.0
10/03/2023	21.6	40.2	0.0
11/03/2023	22	39.3	0.0
12/03/2023	23.1	39.7	0.0
13/03/2023	21.1	39.5	0.0
14/03/2023	20	39.9	0.0
15/03/2023	18.1	41.3	0.0
16/03/2023	20	42.4	0.0
17/03/2023	23	42	0.0

4.3 Habitat Assessments and Mapping

A total of 283 habitat assessments were undertaken (176 assessments completed during phase 1; 107 during phase 2), to define and delineate broad fauna habitats present and their suitability to species of significance. Habitat assessments were undertaken at all sampling locations and opportunistically where changes and/or variation in habitats occurred to ensure representative coverage of the whole Study Area. Habitat assessments were undertaken according to BHP WAIO (2023b) guidelines, with the following information recorded:

- site information, photo and location;
- landform: slope, relative inclination of slope, morphological type and landform type;
- vegetation: leaf litter %, wood litter, hollow bearing trees and dominant species;
- land surface: abundance and size of coarse fragments, rock outcropping, water bodies;
- substrate: bare ground, rock size, rock type, rock outcropping, soil texture and colour; and
- disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

Fauna habitat in the Study Area was mapped at a scale of approximately 1:25,000 utilising the habitat assessment data, previously completed mapping, high-resolution aerial imagery, vegetation, topographical, geology and soil mapping. Categories followed those defined by BHP WAIO (2023b).

4.4 Targeted Searching and Sampling

The methods used during the survey were specific to each targeted species and comprised:

- northern quoll camera traps and scat searches;
- greater bilby plot searches;
- Pilbara leaf-nosed bat ultrasonic recorders and roost searches;
- ghost bat ultrasonic recorders and roost searches;
- grey falcon targeted searches;
- night parrot acoustic recorders; and
- Pilbara olive python targeted searches.

Detailed information on species-specific methods is provided in Figure 4.2 and Section 6.

4.5 Opportunistic Fauna Records

Opportunistic fauna observations within the Study Area were recorded from primary (i.e. direct observation of species) or secondary (e.g. burrows, scratching's, diggings and scats) evidence.

4.6 Assessment of Significance

Habitat types within the Study Area were categorised as providing i) critical, ii) supporting or iii) nil habitat for MNES species. The categorisation of critical and supporting habitat followed that of BHP WAIO (2023b), as per the classification from DCCEEW (*in prep.*). The assessment of habitat significance considered the presence/ absence of habitat features and/or suitable connecting habitat (e.g. wildlife movement corridors) which are required for the species persistence, the influence of other habitats occurring within and adjacent to the Study Area and species records. For the target species, an assessment was made on the significance of their occurrence based on the most relevant and prescriptive guidance documents relative to each species (see Section 6 for details).

All caves within the Study Area (with the exception of three currently being monitored by BHP) were assessed for suitability for Pilbara leaf-nosed bat and ghost bat and classified accordingly according to categories defined by (Bat Call, 2021a):

Ghost bat

- Category 1 - maternity/ diurnal roost caves with permanent ghost bat occupancy
- Category 2 - maternity/ diurnal roost caves with regular occupancy
- Category 3 - diurnal roost caves with occasional occupancy
- Category 4 - nocturnal roost caves with opportunistic usage

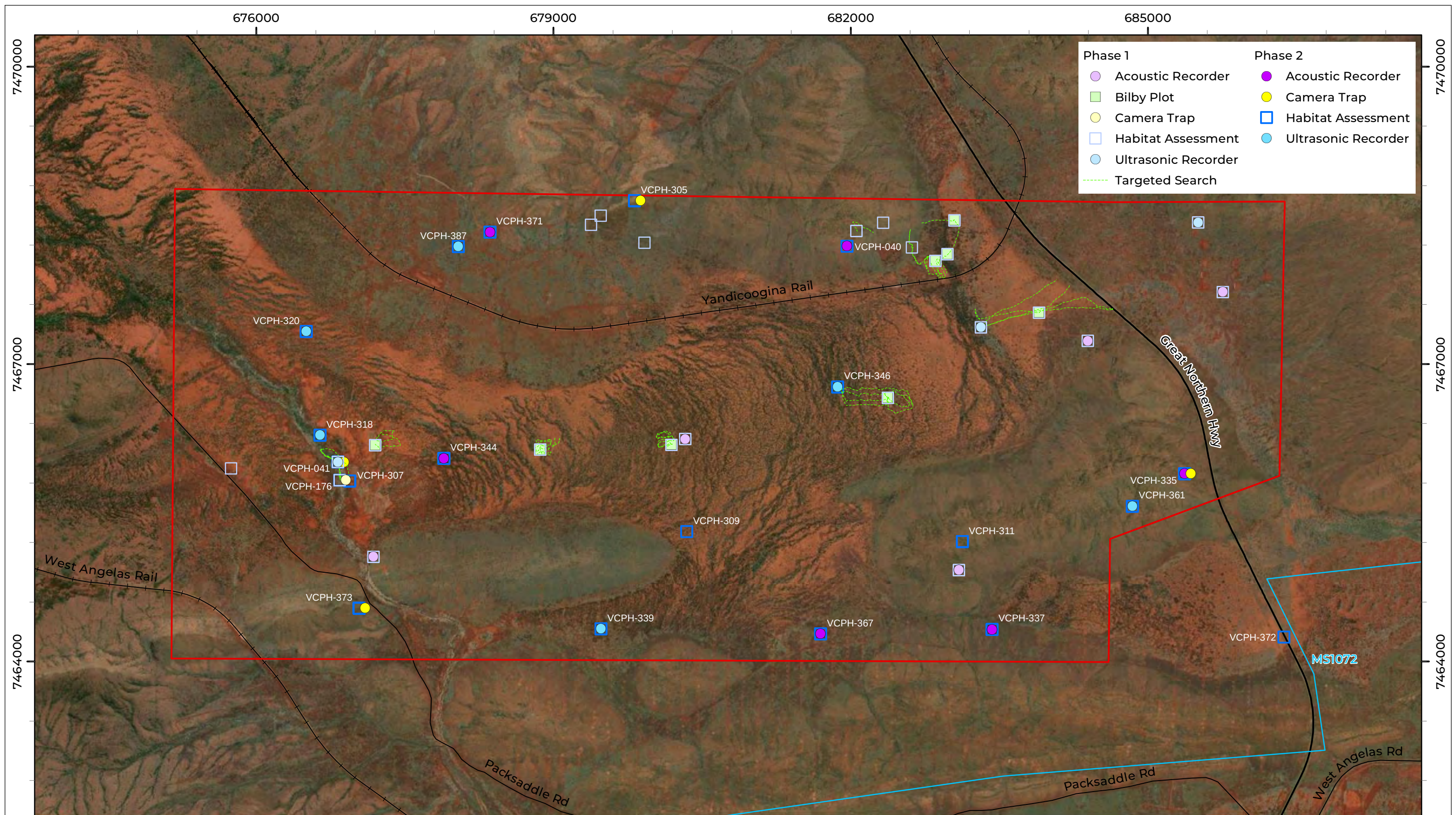
In addition to the above categories, a further category – Category 5 – was defined to categorise caves that were not suitable for use by the ghost bat. Category 5 is not described by (Bat Call, 2021a), but is used here for consistency with the terminology used in this guide.

Pilbara leaf-nosed bat

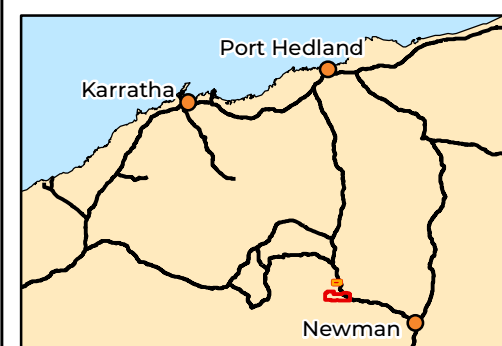
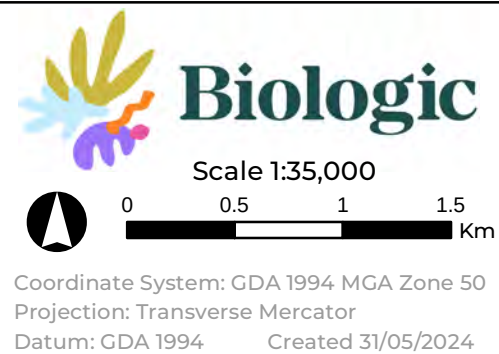
- Category 1 and 2 - permanent diurnal roosts
- Category 3 - semi-permanent diurnal roosts
- Category 4 - nocturnal refuge.

Further information on survey methods and categorisation is provided in Sections 6.3 and 6.5.

Cave searching survey effort was focussed on the areas of Gorge/ Gully habitat most likely to have the highest quality caves, therefore it is possible that not all caves have been located within the Study Area and additional caves may occur.



- LEGEND
- | | |
|---|--|
| Study Area | Local Road |
| Approval Boundary | State Road |
| | Rail |



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Figure 4.2a: Fauna sample sites and traverses - Camp Hill

5 Fauna Habitats

5.1 Fauna Habitats of the Study Area

Ten broad fauna habitat types were recorded and mapped across the Study Area, comprising in decreasing extent of occurrence:

- Stony Plain (32.60%, 11,895.31 ha);
- Hillcrest/ Hillslope (25.23%, 9,205.06 ha);
- Mulga Woodland (10.37%, 3,784.73 ha);
- Drainage Area/ Floodplain (10.06%, 3,671.74 ha);
- Hardpan Plain (6.78%, 2, 472.49 ha);
- Undulating Low Hills (5.43%, 1,980.96 ha);
- Gorge/ Gully (3.50%, 1,277.69 ha);
- Minor Drainage Line (2.31%, 842.90 ha);
- Breakaway/ Cliff (2.10%, 767.24 ha); and
- Medium Drainage Line (0.33%, 119.56 ha).

The remainder of the Study Area (1.28%, 468.63 ha) were mapped as Cleared/ Disturbed areas. Descriptions of the distinguishing characteristics and the occurrence within the Study Area for each of these habitat types are presented in Table 5.1, and the data from the habitat assessments are presented in Appendix C.

The Stony Plain, Mulga Woodland, Drainage Area/ Floodplain, Gorge/ Gully, Minor Drainage Line, Breakaway/ Cliff, and Medium Drainage Line habitats all provide critical habitats for some target MNES species (northern quoll, ghost bat, and Pilbara olive python) (Table 5.1). Critical breeding, roosting, foraging and/or dispersal habitat for these species is present particularly in areas with caves and overhangs (Gorge/ Gully and Breakaway/ Cliff habitat) or where pooling water occurs for prolonged periods (Gorge/ Gully habitat). These habitats are essential for permanent presence of the species within the Study Area.

The Hillcrest/ Hillslope, Drainage Area/ Floodplain, Undulating Low Hills, Gorge/ Gully, Minor Drainage Line, Breakaway/ Cliff and Medium Drainage Line habitats potentially provide supporting foraging and dispersal habitat for ghost bat, grey falcon, northern quoll, Pilbara leaf-nosed bat and Pilbara olive python; however, this is dependent on the proximity of the habitat to other areas of critical habitat. Therefore, while the habitat may still be utilised, it is likely to be less frequent. None of the supporting habitats occurring within the Study Area are likely to be relied upon by any significant species for long-term survival within the Study Area or surrounds. All these habitats are broadly distributed and well represented across the Pilbara bioregion, and therefore support fauna assemblages which are generally common and widespread.

The condition of habitats within the Study Area was largely rated as Excellent to Good. The greatest disturbance was caused by access tracks/ exploration activity, invasive weeds, frequent fires and grazing by cattle (*Bos taurus*); however, the overall level of disturbance was minimal.

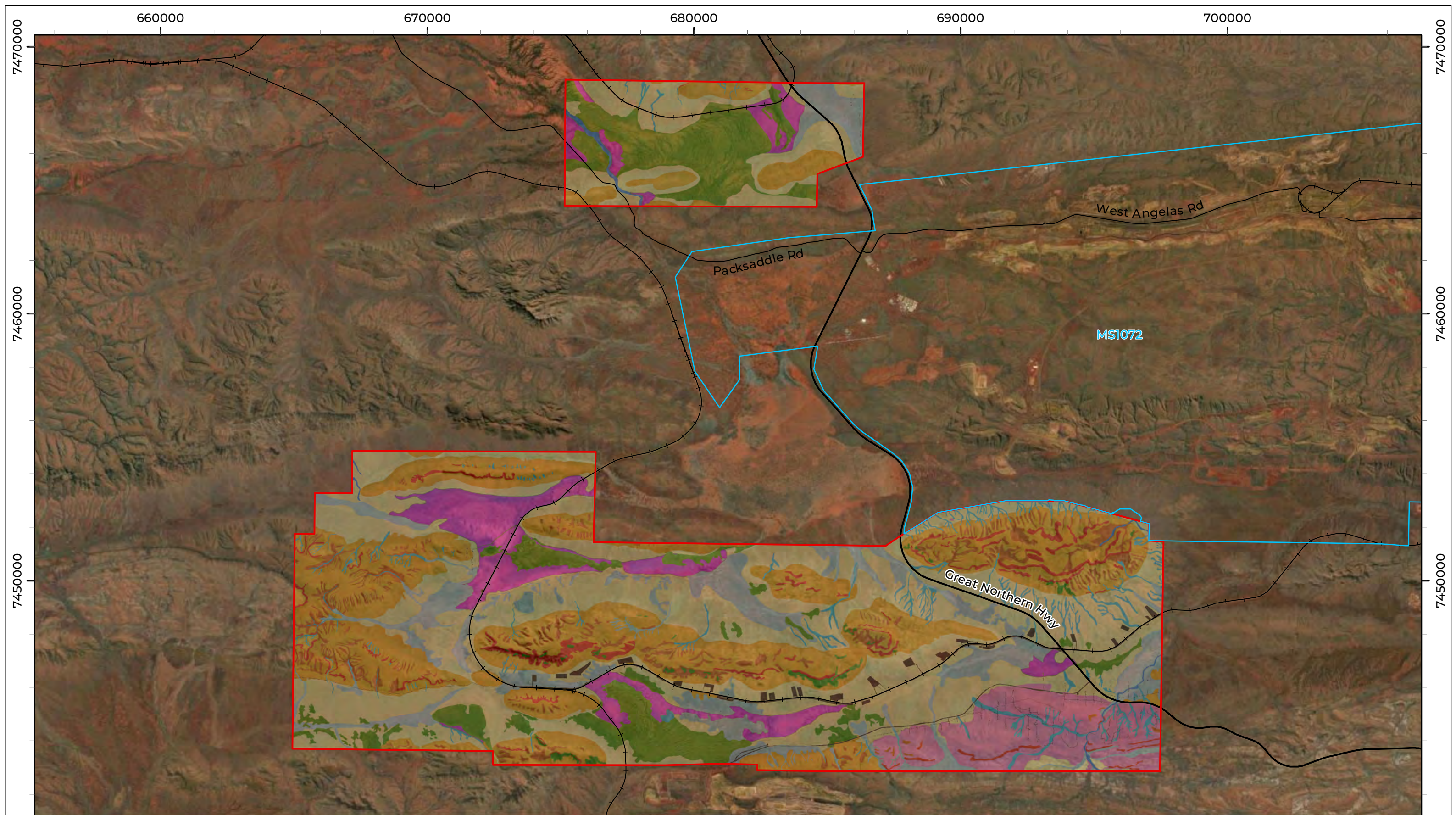
Table 5.1: Broad fauna habitats occurring within the Study Area

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES species	Habitat for other significant species	Photo
Stony Plain 11,895.31 ha 32.60%	Stony Plain comprise low-lying open plains and the rolling hills below upland areas, with very slight to no gradient. The substrate consists of gravel and pebbles, with vegetation dominated by <i>Triodia</i>, although scattered trees also occur. Vegetation within this habitat varied in composition but was generally dominated by scattered Mulga and <i>Acacia</i> forming an over-storey, with patches of various small to medium shrub species, over low hummock grasslands of <i>Triodia</i>. Scattered <i>Corymbia</i> and <i>Eucalyptus</i> are usually present.	Within the Study Area Stony Plain habitat is common throughout the Study Area, primarily at the base of the Hillcrest/ Hillslope habitat. Stony Plain is one of the most common and widespread habitat types within the Pilbara region. The vegetation and substrate which make up this habitat type are characteristic features of the region.	• Critical habitat for: - o Ghost bat – foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat (entire extent in the Study Area)	• Important habitat for: - o Western pebble-mound mouse – important breeding, denning, foraging and dispersal habitat	
Hillcrest/ Hillslope 9,205.06 ha 25.23%	The Hillcrest/ Hillslope habitat comprised a rocky substrate, often with exposed bedrock, on moderate to steep slopes leading into lower foot slopes. This habitat was characterised by steep slopes with a high proportion of coarse fragments dominated by ironstone. These can contain cracks and crevices. Instances of Gorge/ Gully is contained within this habitat. This habitat is usually dominated by open <i>Eucalyptus</i> woodlands, <i>Acacia</i> and <i>Grevillea</i> scrublands and <i>Triodia</i> low hummock grasslands.	Within the Study Area Hillcrest/ Hillslope habitat is common and widespread throughout, it is of particularly high density within the Mudlark Well area. Hillcrest/ Hillslope habitat is common and widespread habitat types within the Pilbara region. The vegetation and substrate which make up this habitat type are characteristic features of the region.	• Supporting habitat for: - o Northern quoll – foraging and dispersal habitat where proximal to breeding habitat	• Important habitat for: - o Western pebble-mound mouse – important breeding, denning, foraging and dispersal habitat	
Mulga Woodland 3,784.73 ha 10.37%	Mulga Woodland habitat comprises stands of mulga (<i>Acacia aneura</i>) over clay or stony substrates. Differs from other plains by having a monoculture of mulga compared to a diversity of other <i>Acacia</i> species.	Within the Study Area Mulga Woodland habitat primarily occurs within low lying and rocky areas, within the Study Area. This habitat is relatively common throughout the Pilbara region, usually occurring in areas of drainage or sheet flow.	• Critical habitat for: - o Ghost bat – foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat (entire extent in the Study Area)		

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES species	Habitat for other significant species	Photo
Drainage Area/ Floodplain 3,671.74 ha 10.06%	Lower lying plain often subjected to sheet flow following large rainfall events. Vegetation and substrates of this habitat was variable, often comprising scattered <i>Eucalyptus</i> over <i>Acacia</i> and/or <i>Grevillea</i> shrubs with an understory dominated by <i>Triodia</i> hummock grasses and/or mixed tussock grasses on alluvial substrates, often comprising heavy clays and gravel. Tussock grasses can be dominant within Drainage Area/ Floodplain habitat as a result of high rainfall events.	Within the Study Area Drainage Area/ Floodplain habitat occurs within the northeast of Camp Hill and scattered areas of Mudlark Well. This fauna habitat is common throughout the Pilbara bioregion. Across the region its structure and condition are variable as a result of rainfall events and disturbance (i.e. fire and cattle grazing).	• Critical habitat for: - o Ghost bat – foraging foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat (entire extent of the Study Area) • Supporting habitat for: - o Grey falcon – foraging and dispersal habitat where proximal to breeding habitat		
Hardpan Plain 2, 472.49 ha 6.78%	Hardpan Plain habitat comprised flat low-lying clay based plain dominated by stands of mulga, with a high proportion of the substrate comprising bare soil. Often sparsely vegetated with large areas often void of vegetation.	Within the Study Area Hardpan Plain habitat occurs within low lying areas. This fauna habitat is common throughout parts of the Pilbara bioregion. Structure and condition is variable as a result of rainfall events and disturbance (i.e. fire and cattle grazing).	• N/A		
Undulating Low Hills 1,980.96 ha 5.43%	The Undulating Low Hills habitat comprises low hills and undulating stony plains of higher elevation than Stony Plain. The habitat supports hard spinifex with a mantle of gravel and larger rocks with occasional outcropping or minor breakaway. Vegetation is dominated by hard <i>Triodia</i> hummock grasslands with scattered <i>Eucalyptus</i> trees and <i>Acacia</i>, <i>Eremophila</i> and/or <i>Grevillea</i> shrubs.	Within the Study Area Undulating Low Hills habitat primarily occurs within the south-eastern portion of Mudlark Well. Undulating Low Hills habitat is a characteristic habitat type of the Pilbara region. Its occurrence throughout the region is widespread and common.	• Supporting habitat for: - o Ghost bat – foraging and dispersal habitat where proximal to roosting habitat		

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES species	Habitat for other significant species	Photo
Gorge/ Gully 1,277.69 ha 3.50%	Gorge/ Gully habitat was characterised by rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Minor Drainage Lines). Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	Within the Study Area Gorge/ Gully habitat occurs primarily within Mudlark Well. A reasonably common habitat in the Pilbara, usually associated with ranges; however, because this habitat type is narrow and linear, they only represent a small proportion of the total land area.	• Critical habitat for: - o Northern quoll – important denning and foraging habitat - o Ghost bat - critical roosting habitat (CMUD-01, CMUD-02, and CMUD-47) - o Pilbara olive python – important denning and foraging habitat • Supporting habitat for: - o Ghost bat - foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat - o Pilbara leaf-nosed bat – foraging and dispersal habitat where proximal to roosting habitat		
Minor Drainage Line 842.90 ha 2.31%	Minor Drainage Line habitat usually lacked a tall dense upper storey, but with a dense mid storey, including sparse <i>Eucalyptus</i> sp., and <i>Acacia</i> sp. over tussock grasses and <i>Triodia</i> sp. hummock grasses.	Within the Study Area Minor Drainage Line habitat occurs primarily within Mudlark Well, surrounding areas of higher elevation, particularly the Hillcrest/ Hillslope habitat. This fauna habitat is widespread throughout the Pilbara bioregion, though its structure and condition are variable as a result of rainfall events and susceptible to degradation from cattle grazing.	• Critical habitat for: - o Ghost bat – foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat (entire extent in the Study Area) • Supporting habitat for: - o Grey falcon – foraging and dispersal habitat where proximal to breeding habitat - o Northern quoll – foraging and dispersal habitat where proximal to breeding habitat - o Pilbara olive python – foraging and dispersal habitat where proximal to breeding habitat		

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES species	Habitat for other significant species	Photo
Breakaway/ Cliff 767.24 ha 2.10%	The Breakaway/ Cliff habitat comprised a single sided rock face, within the steep mid-upper slope comprising bare rock outcrops or cliffs. Does not comprise the entire slope.	Within the Study Area Breakaway/ Cliff habitat occurs primarily within Mudlark Well. A reasonably common habitat in the Pilbara, usually associated with ranges; however, because this habitat type is narrow and linear, they only represent a small proportion of the total land area.	• Critical habitat for: - o Northern quoll – important breeding, denning, foraging and dispersal habitat - o Pilbara olive python – important breeding, denning, foraging and dispersal habitat • Supporting habitat for: - o Ghost bat - foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat (entire extent in the Study Area) - o Pilbara leaf-nosed bat – foraging and dispersal habitat where proximal to roosting habitat		
Cleared/ Disturbed 468.63 ha 1.28%	Cleared/ Disturbed areas include areas where the natural vegetation and microhabitats have been disrupted, usually devoid of native vegetation. This includes tracks, laydown areas, camps, major roads/ highways and historic, large-scale clearing.	Within the Study Area Cleared/ Disturbed areas are primarily restricted to discrete linear corridors, including roads and access tracks.	• N/A		No photo
Medium Drainage Line 119.56 ha 0.33%	Medium Drainage Line habitat comprised scattered <i>Eucalyptus</i> and <i>Acacias</i> , or mulga woodland, with an understory dominated by tussock grasses. The structure and condition of vegetation often varies seasonally, particularly following rainfall events. Vegetation condition often subject to heavy cattle grazing. This habitat type is prone to pooling and ponding in areas.	Within the Study Area Medium Drainage Line habitat occurs in discrete linear areas. This fauna habitat is widespread throughout the Pilbara bioregion, though its structure and condition are variable as a result of rainfall events and susceptible to degradation from cattle grazing.	• Critical habitat for: - o Ghost bat – foraging and dispersal habitat where proximal (<12 km) to critical roosting habitat (entire extent in the Study Area) • Supporting habitat for: - o Grey falcon – foraging and dispersal habitat where proximal to breeding habitat - o Northern quoll – foraging and dispersal habitat where proximal to breeding habitat - o Pilbara olive python – foraging and dispersal habitat where proximal to breeding habitat		



LEGEND

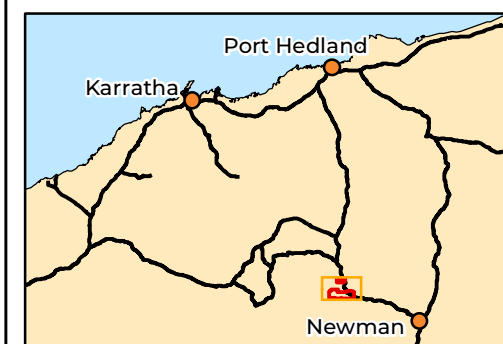
- | | | |
|-------------------|---------------------------|----------------------|
| Study Area | Habitat Type | Hillcrest/ Hillslope |
| Approval Boundary | Breakaway/ Cliff | Medium Drainage Line |
| Local Road | Cleared/ Disturbed | Minor Drainage Line |
| State Road | Drainage Area/ Floodplain | Mulga Woodland |
| Rail | Gorge/ Gully | Stony Plain |
| | Hardpan Plain | Undulating Low Hills |

 **Biologic**

Scale 1:130,000

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 5.1: Fauna habitats
in the Study Area

5.2 Habitat Features of the Study Area

5.2.1 Water Features

Water sources are a limiting factor for many ecosystems (James *et al.*, 1995), particularly within the Pilbara (Burbidge *et al.*, 2010; Doughty *et al.*, 2011). They often represent areas of high ecological productivity (Murray *et al.*, 2003) and are of particular importance for northern quolls, Pilbara leaf-nosed bats and Pilbara olive pythons.

Seven water features were recorded (Table 5.2; Appendix F); five waterholes within Gorge/ Gully habitat, and two river pools within Medium Drainage Line habitat (Table 5.2; Figure 5.2) (Biologic, 2022a). WMUD-01 was recorded during the CPH Stage 1 targeted surveys (Biologic, 2022b) and was not re-visited during the current surveys but has been included in the results for completeness. All of the waterholes recorded during the surveys were considered to provide significant foraging habitat for northern quoll, Pilbara leaf-nosed bat and Pilbara olive python and are discussed further in Section 6.

Table 5.2: Summary of water features recorded in the Study Area

Water Feature ID	Description	Coordinates		Habitat
		Latitude	Longitude	
WMUD-01	Waterhole	-23.0653	118.7074	Gorge/ Gully
WMUD-02	Waterhole	-23.0781	118.6134	Gorge/ Gully
WMUD-03	Waterhole	-23.0484	118.6374	Gorge/ Gully
WMUD-04	River Pool	-22.9040	118.7231	Medium Drainage Line
WMUD-05	Waterhole	-23.0388	118.8537	Gorge/ Gully
WMUD-06	Waterhole	-23.0677	118.7317	Gorge/ Gully
WTAN-01	River Pool	-23.0383	118.8444	Medium Drainage Line

5.2.2 Caves

Fifty-seven caves have been recorded within the Study Area (Table 5.3), including three caves that are being currently monitored as part of Ministerial Statement (MS) 1072 Fauna Management Plan (BHP, 2020). Fourteen caves were recorded during the current surveys (CMUD-47 – 59, and CTAN-38); the remaining caves were recorded during the CPH Stage 1 targeted surveys (Biologic (2022b) (CMUD-01 - 20) and Power2030 targeted ghost bat survey (Biologic, in prep) (CPOW-015 - 074) . Thirty-three caves were recorded within Gorge/ Gully habitat, 13 within Breakaway/ Cliff habitat and the remaining caves from Hillcrest/ Hillslope, Undulating Low Hills or Minor Drainage Line habitats (Table 5.3). The cave characteristics recorded at each cave are provided in Appendix G. The importance of these caves to the two MNES bat species is detailed in Sections 6.3 and 6.5.

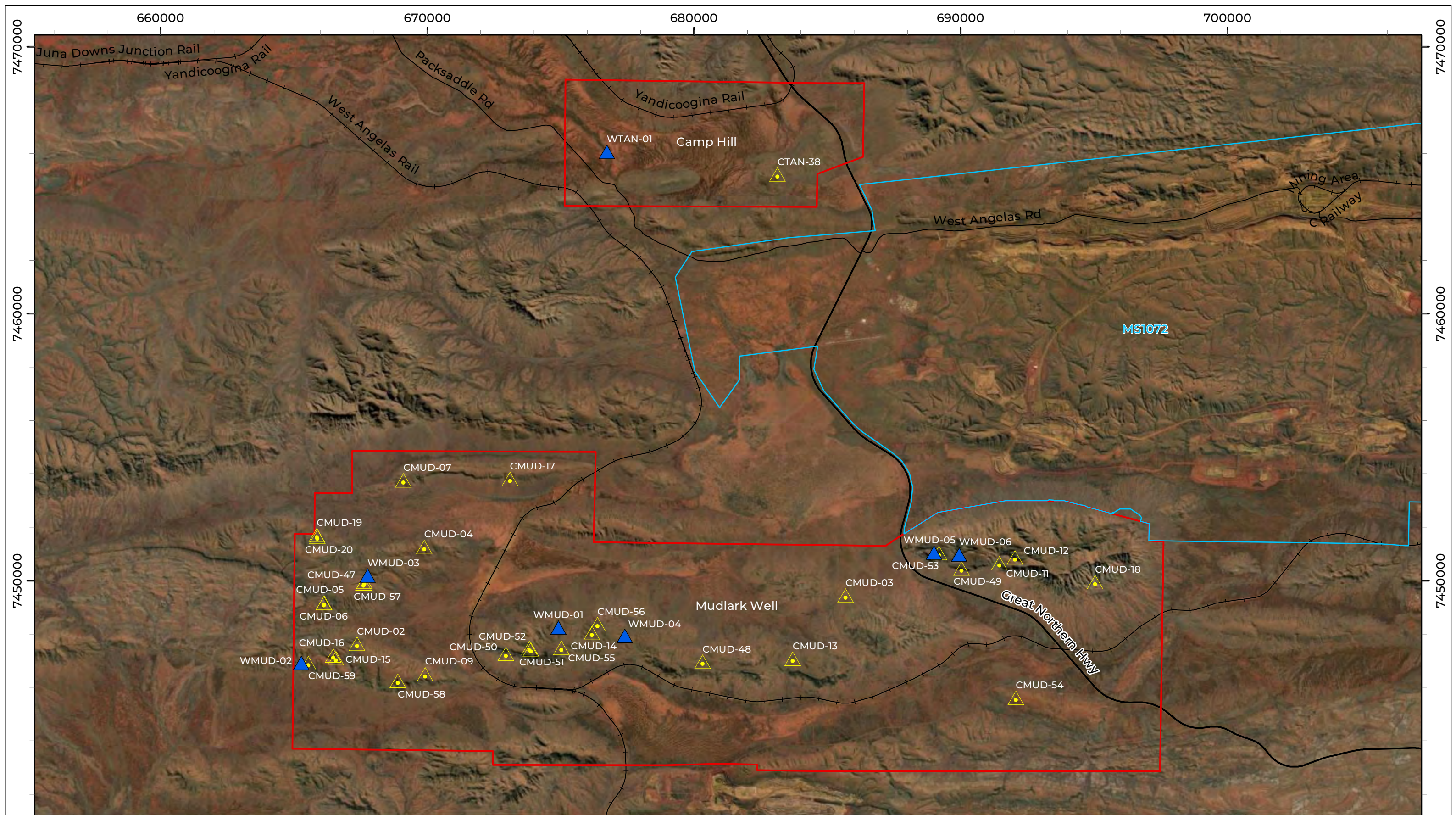
Table 5.3: Summary of caves recorded in the Study Area

Cave ID	Previous Cave ID	Coordinates		Habitat	Ghost Bat Significance	Pilbara Leaf-nosed Bat Significance
		Latitude	Longitude			
CMUD-01 ²	M01	-23.0815	118.6608	Gorge/ Gully	Category 2	Category 4
CMUD-02 ²	M02	-23.0715	118.6334	Gorge/ Gully	Category 2	Category 4
CMUD-08 ²	ACW08	-23.0363	118.6605	Gorge/ Gully	Category 3	Category 4
CMUD-03	-	-23.0532	118.8123	Breakaway/ Cliff	Category 4	Category 4
CMUD-04	-	-23.0385	118.6580	Gorge/ Gully	Category 4	Category 4
CMUD-05	-	-23.0577	118.6216	Gorge/ Gully	Category 4	Category 4
CMUD-06	-	-23.0579	118.6216	Gorge/ Gully	Category 4	Category 4
CMUD-07	-	-23.0160	118.6501	Gorge/ Gully	Category 4	Category 4
CMUD-09	-	-23.0816	118.6588	Gorge/ Gully	Category 4	Category 4
CMUD-11	-	-23.0417	118.8685	Breakaway/ Cliff	Category 4	Category 4
CMUD-12	-	-23.0396	118.8741	Gorge/ Gully	Category 5	Category 4
CMUD-13	-	-23.0748	118.7932	Breakaway/ Cliff	Category 4	Category 4
CMUD-14	-	-23.0669	118.7197	Gorge/ Gully	Category 4	Category 4
CMUD-15	-	-23.0765	118.6262	Gorge/ Gully	Category 4	Category 4
CMUD-16	-	-23.0756	118.6251	Gorge/ Gully	Category 4	Category 4
CMUD-17	-	-23.0151	118.6891	Gorge/ Gully	Category 4	Category 4
CMUD-18	-	-23.0476	118.9036	Gorge/ Gully	Category 4	Category 4
CMUD-19	-	-23.0349	118.6186	Gorge/ Gully	Category 4	Category 4
CMUD-20	-	-23.0354	118.6188	Gorge/ Gully	Category 4	Category 4
CMUD-47	-	-23.0384	118.6362	Gorge/ Gully	Category 2	Category 4
CMUD-48	-	-23.0505	118.7603	Gorge/ Gully	Category 4	Category 4
CMUD-49	-	-23.0510	118.8546	Breakaway/ Cliff	Category 4	Category 4
CMUD-50	-	-23.0762	118.6883	Breakaway/ Cliff	Category 4	Category 4

Cave ID	Previous Cave ID	Coordinates		Habitat	Ghost Bat Significance	Pilbara Leaf-nosed Bat Significance
		Latitude	Longitude			
CMUD-51	-	-23.0435	118.6974	Gorge/ Gully	Category 5	Category 4
CMUD-52	-	-23.0723	118.6969	Gorge/ Gully	Category 4	Category 4
CMUD-53	-	-23.0384	118.8463	Gorge/ Gully	Category 4	Category 4
CMUD-54	-	-23.0870	118.8751	Gorge/ Gully	Category 3	Category 4
CMUD-55	-	-23.0720	118.7085	Breakaway/ Cliff	Category 4	Category 4
CMUD-56	-	-23.0638	118.7217	Breakaway/ Cliff	Category 4	Category 4
CMUD-57	-	-23.0510	118.6359	Gorge/ Gully	Category 4	Category 4
CMUD-58	-	-23.0838	118.6489	Gorge/ Gully	Category 5	Category 4
CMUD-59	-	-23.0781	118.6161	Gorge/ Gully	Category 3	Category 4
CMUD-063	CPOW-013	-23.0140	118.6813	Breakaway/ Cliff	Category 3	Category 4
CMUD-064	CPOW-014	-23.0144	118.6810	Breakaway/ Cliff	Category 3	Category 4
CPOW-015		-23.0132	118.6648	Breakaway/ Cliff	Category 4	Category 4
CPOW-036		-23.0372	118.6152	Gorge/ Gully	Category 4	Category 4
CPOW-037		-23.0366	118.6153	Gorge/ Gully	Category 3	Category 4
CPOW-038		-23.0361	118.6167	Hillcrest/ Hillslope	Category 3	Category 4
CPOW-043		-23.0354	118.6188	Hillcrest/ Hillslope	Category 4	Category 4
CPOW-044		-23.0349	118.6186	Gorge/ Gully	Category 4	Category 4
CPOW-045		-23.0765	118.6262	Hillcrest/ Hillslope	Category 4	Category 4
CPOW-046		-23.0691	118.6912	Hillcrest/ Hillslope	Category 3	Category 4
CPOW-047		-23.0757	118.6251	Gorge/ Gully	Category 4	Category 4
CPOW-048		-23.0750	118.6259	Hillcrest/ Hillslope	Category 4	Category 4
CPOW-049		-23.0694	118.6913	Gorge/ Gully	Category 4	Category 4
CPOW-050	-	-23.0373	118.6217	Hillcrest/ Hillslope	Category 5	Category 4
CPOW-051	-	-23.0532	118.8124	Breakaway/ Cliff	Category 5	Category 4

Cave ID	Previous Cave ID	Coordinates		Habitat	Ghost Bat Significance	Pilbara Leaf-nosed Bat Significance
		Latitude	Longitude			
CPOW-053	-	-23.0962	118.8673	Undulating Low Hills	Category 5	Category 4
CPOW-060	-	-23.0151	118.6891	Breakaway/ Cliff	Category 3	Category 4
CPOW-063	-	-23.0645	118.7102	Hillcrest/ Hillslope	Category 4	Category 4
CPOW-064	-	-23.0974	118.8778	Undulating Low Hills	Category 5	Category 4
CPOW-065	-	-23.0966	118.8750	Minor Drainage Line	Category 5	Category 4
CPOW-070	-	-23.0160	118.6501	Gorge/ Gully	Category 5	Category 4
CPOW-072	-	-23.0715	118.6340	Hillcrest/ Hillslope	Category 2	Category 4
CPOW-073	-	-23.0385	118.6580	Gorge/ Gully	Category 4	Category 4
CPOW-074	-	-23.0751	118.7934	Breakaway/ Cliff	Category 5	Category 4
CTAN-38	-	-22.9111	118.7855	Gorge/ Gully	Category 5	Category 4

² Caves currently monitored by BHP under compliance to Ministerial Statement 1072.



LEGEND

- | | | |
|--|--|---|
|  Study Area |  Local Road |  Cave |
|  Approval Boundary |  State Road |  Water Feature |
| |  Rail | |

 **Biologic**

Scale 1:130,000

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 15/10/2024



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Stage 2

Figure 5.2: Fauna habitat
features recorded in the
Study Area

6 Target Species

6.1 Night Parrot (*Pezoporus occidentalis*)

6.1.1 Species Profile

The night parrot is an elusive, nocturnal ground dwelling parrot listed as Endangered under the EPBC Act and Critically Endangered under the BC Act. The species inhabits arid and semi-arid areas that contain dense, low vegetation (DPaW, 2017). Based on accepted records, the species' habitat consists of *Triodia* grasslands in stony or sandy environments (McGilp, 1931; North, 1898; Whitlock, 1924; Wilson, 1937), samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and claypans, as well as on the margins of salt lakes, creeks or other sources of water (McGilp, 1931; Wilson, 1937). The current interim guidelines for preliminary surveys of night parrot in Western Australia suggest the species requires old-growth spinifex (*Triodia*) (often more than 50 years' unburnt) for roosting and nesting (DPaW, 2017).

Although little is known about foraging sites, habitats that comprise various grasses and herbs are thought to be suitable (DPaW, 2017; Murphy *et al.*, 2017). Foraging habitat is not necessarily within or adjacent to roosting habitat as the night parrot has been known to fly up to 40 km in a single night to forage (Murphy *et al.*, 2017). It is assumed that the species may fly cumulative distances of up to 100 km per night during productive seasons and considerably greater than 100 km per night during drought conditions (Night Parrot Recovery Team, 2017). *Triodia* is likely to provide a good seasonal food resource, particularly in times of mass flowering and seeding. *Sclerolaena* and other succulent chenopods also provide a source of food and moisture throughout the year, and are also likely to provide significant habitat (DPaW, 2017). Foraging habitat is likely to be more important when it occurs adjacent to or within approximately 10 km of suitable roosting habitat (DPaW, 2017).

The distribution of the night parrot is very poorly understood. The small number of confirmed/ verifiable records prevents the population size from being assessed with any accuracy; however, the population size is speculatively estimated to consist of approximately 50 breeding birds that occur in five subpopulations. The largest of these subpopulations is estimated, with low reliability, to consist of 20 breeding birds (Garnett & Crowley, 2000).

6.1.2 Previous Records

The distribution of the night parrot is very poorly understood in Western Australia; however, the Study Area occurs within the species' potential distribution, as currently mapped by DoEE (2019b). The nearest record of the night parrot to the Study Area is approximately 77 km to the north-east, which was recorded at the Cloudbreak mine in 2021 (FMG, 2021) (Table 6.1). This is the most recent documented record of the species in Western Australia and is the first to provide evidence of the night parrot persisting in suitable habitat areas adjacent to active mining operations (three individuals sighted in 2005 (Davis & Metcalf, 2008)) (Table 6.1). The

2005 record is from a permanent soak that was heavily degraded by cattle and lacking a vegetative understory; however, larger patches of old-growth *Triodia* grasslands were noted to occur in the vicinity near the Fortescue Marsh and chenopod shrublands occur within the marsh itself. Kanyirninpa Jukurrpa rangers recorded night parrot calls at two locations on Martu country in 2020 (Michelmores & Birch, 2020) (Table 6.1).

Table 6.1: Previous records of night parrot within Western Australia

Location	Date of Observation	Source	Distance from Study Area	Recorded Habitat Type/ Comments
Minga Well, south of Cloudbreak mine site	12/04/2005	Davis and Metcalf (2008)	~77 km north-east	Mulga woodland. No understorey Permanent water soak. 3 individuals observed at dusk in a targeted survey
Adjacent to Cloudbreak Mine	~2021 (exact date not given)	(FMG, 2021)	~77 km north-east	Not noted but located near Fortescue Marsh Adjacent to mining operations
Moojarri Well	~2005 (exact date not noted)	Biota (2005b)	~55 km north north-east	Not noted Unconfirmed Biota record between Fortescue Marsh and FMG phase B Rail Corridor
Vacant crown land	15/07/1970	DBCA (2022a)	Undisclosed location	Spinifex grassland (Spinifex and scattered gums) Crest/summit. Four individuals observed
Martu country (Great Sandy and Little Sandy Deserts)	~2020 (exact date not provided)	Michelmores and Birch (2020)	Undisclosed location	Salt Lake system Acoustic recording
Matuwa (Lorna Glen)	24/11/2009 05/12/2009	Hamilton <i>et al.</i> (2017)	~450 km south-east	Lake system-native and introduced grasses, samphire, sedges, chenopods. Thick <i>Eremophila</i> , Mulga and grasses One individual each night
East Murchison	March 2017	Night Parrot Recovery Team (2017), Jakkett <i>et al.</i> (2017)	Undisclosed location	Spinifex hummock grassland on sandy substrate, encompassed by mulga woodland and a breakaway, separated from the <i>Triodia</i> by an open plain of samphire Living individuals and an active nest

6.1.3 Survey Methods

6.1.3.1 Acoustic Recorders

Song Meter (SM4; Wildlife Acoustics Inc.) acoustic recorders were deployed at 35 sites within the Study Area (Table 6.2). Units were placed within habitat considered most suitable for roosting and nesting as recommended by DPaW (2017). Song Meters were deployed for between two and 20 consecutive nights each, for a total of 340 recording nights (206 during phase 1; 134 during phase 2). Sampling at 21 of the locations met the recommended sampling period of six consecutive nights (DPaW, 2017). Acoustic recordings were analysed for night parrot calls by specialists Nigel Jackett and Nicholas Leseberg (Adaptive NRM; Appendix E).

Although general avifauna surveys have been conducted in the Study Area previously, no acoustic sampling targeting the night parrot had been undertaken prior to the current surveys.

Table 6.2: Acoustic sampling for night parrot within the Study Area

Site	Habitat	Deployment	Retrieval	Sampling Nights
Phase 1				
VCPH-002	Stony Plain	5/04/2022	11/04/2022	6
VCPH-008	Drainage Area/ Floodplain	5/04/2022	11/04/2022	6
VCPH-021	Drainage Area/ Floodplain	6/04/2022	13/04/2022	7
VCPH-065	Stony Plain	11/04/2022	1/05/2022	20
VCPH-066	Stony Plain	11/04/2022	1/05/2022	20
VCPH-067	Stony Plain	11/04/2022	1/05/2022	20
VCPH-068	Stony Plain	11/04/2022	1/05/2022	20
VCPH-069	Stony Plain	11/04/2022	1/05/2022	20
VCPH-070	Mulga Woodland	11/04/2022	1/05/2022	20
VCPH-074	Stony Plain	11/04/2022	13/04/2022	2
VCPH-075	Stony Plain	11/04/2022	30/04/2022	19
VCPH-076	Hillcrest/ Hillslope	11/04/2022	1/05/2022	20
VCPH-077	Drainage Area/ Floodplain	11/04/2022	1/05/2022	20
VCPH-082	Hillcrest/ Hillslope	30/04/2022	6/05/2022	6
Phase 2				
VCPH-344	Mulga Woodland	16/02/2023	22/02/2023	6
VCPH-347	Stony Plain	16/02/2023	22/02/2023	6
VCPH-349	Mulga Woodland	16/02/2023	23/02/2023	7
VCPH-355	Stony Plain	16/02/2023	23/02/2023	7
VCPH-337	Stony Plain	22/02/2023	9/03/2023	15
VCPH-343	Stony Plain	23/02/2023	10/03/2023	15
VCPH-350	Drainage Area/ Floodplain	23/02/2023	10/03/2023	15
VCPH-335	Breakaway/ Cliff	9/03/2023	17/03/2023	8
VCPH-367	Hillcrest/ Hillslope	9/03/2023	14/03/2023	5
VCPH-370	Drainage Area/ Floodplain	9/03/2023	14/03/2023	5

Site	Habitat	Deployment	Retrieval	Sampling Nights
VCPH-376	Stony Plain	9/03/2023	14/03/2023	5
VCPH-40	Hillcrest/ Hillslope	9/03/2023	14/03/2023	5
VCPH-360	Mulga Woodland	10/03/2023	14/03/2023	4
VCPH-371	Hardpan Plain	10/03/2023	14/03/2023	4
VCPH-377	Hillcrest/ Hillslope	10/03/2023	14/03/2023	4
VCPH-378	Drainage Area/ Floodplain	10/03/2023	14/03/2023	4
VCPH-379	Stony Plain	10/03/2023	14/03/2023	4
VCPH-380	Stony Plain	10/03/2023	14/03/2023	4
VCPH-381	Stony Plain	10/03/2023	14/03/2023	4
VCPH-383	Stony Plain	10/03/2023	14/03/2023	4
VCPH-386	Stony Plain	11/03/2023	14/03/2023	3
Total acoustic recorders deployed				35
Total sampling nights				340

6.1.4 Survey Results

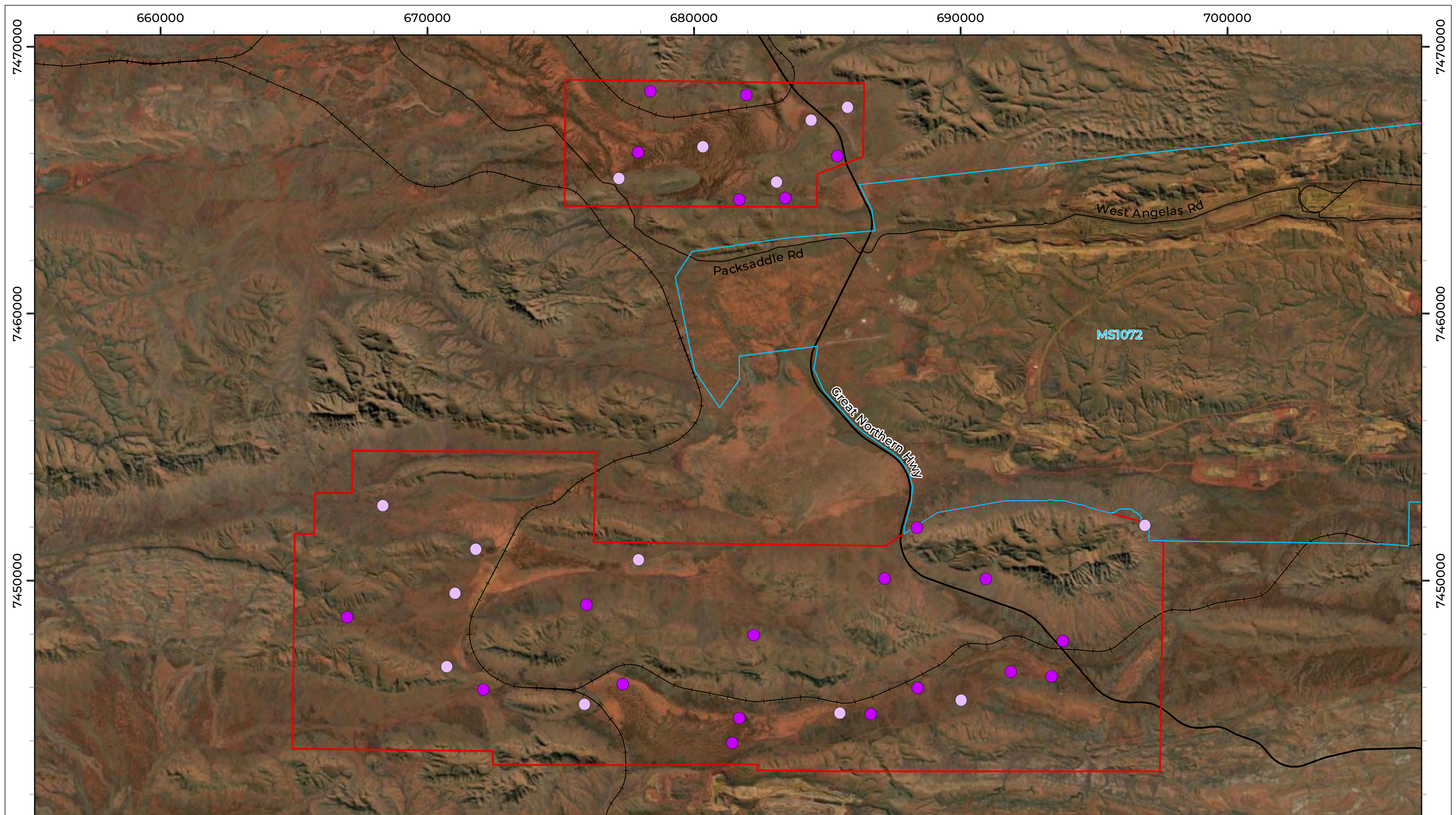
6.1.4.1 Acoustic Recorders

No evidence of night parrot was recorded on any of the Song Meters. Thirty-five non-target species were identified (Appendix D; Appendix E).

6.1.5 Discussion

Any night parrots occurring near the Cloudbreak mine could potentially use the Study Area as only 77 km separates these two areas. Despite this, no evidence of the night parrot was detected during the current surveys. Foraging and nesting habitat within the Study Area was considered marginal for the species (not meeting the definition of supporting habitat as per BHP WAIO (2023b) but with some limited areas of long-unburnt hummock grasses present). Spinifex hummocks that are not long-unburnt (i.e. less than 50 years) or collapsed (40 – 50 cm in height) are not likely to provide adequate shelter (DPaW, 2017). Thirty-one areas of potentially suitable habitat were recorded, but these were small in size with no connectivity to other areas of suitable nesting and/or foraging habitat within or close to the Study Area.

Given the lack of quality habitat within the Study Area, limited presence of proximate and quality foraging habitat, and lack of records, it is unlikely that the Night Parrot would occur within the Study Area unless occasionally while moving to other areas with high quality habitat. It is unlikely that this would constitute a significant occurrence based on the definitions by DoE (2013).



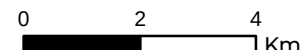
LEGEND

- | | | |
|--|--|---|
|  Study Area |  Local Road | Phase 1 |
|  Approval Boundary |  State Road |  Acoustic Recorder |
| |  Rail | Phase 2 |
| | |  Acoustic Recorder |

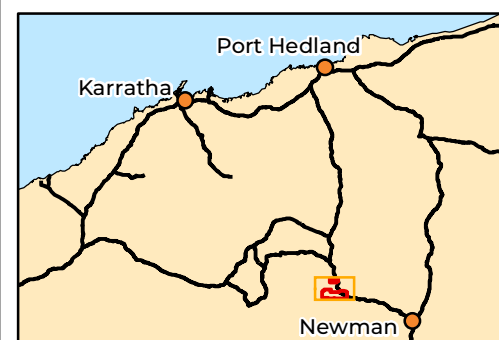


Biologic

Scale 1:130,000



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 15/10/2024



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CPH Targeted MNES
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Stage 2

**Figure 6.1: Night parrot
sampling in the Study Area**

6.2 Northern Quoll (*Dasyurus hallucatus*)

6.2.1 Species Profile

The northern quoll is listed as Endangered under the EPBC Act and BC Act. It was once widely distributed across northern Australia, however, it is now restricted to three isolated populations in the Pilbara, Kimberley and Northern Territory, and Queensland (DoE, 2016).

As a result of facultative die-off, the abundance of the species is cyclical, and the annual reproduction is highly synchronised (Oakwood *et al.*, 2001). In the Pilbara, abundance is lowest toward the end of winter into early spring after the mating season, as a significant proportion of adult males die off and young have not yet begun to forage independently (Braithwaite & Griffiths, 1994; Oakwood, 2000). Population density is thought to be highest in the summer months, prior to the mating season and when juveniles have begun foraging independently (Oakwood, 2000). Schmitt *et al.* (1989) reported relatively small home ranges in rugged habitat in the Kimberley (2.3 ha for females and 1.8 ha for males), whereas in the western Pilbara, minimum activity areas (often used as an estimator of home range) are 75–443 ha for females and 5–1,109 ha for males (King, 1989).

The northern quoll is both arboreal and terrestrial, inhabiting ironstone and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats (Braithwaite & Griffiths, 1994; Oakwood, 2002), dissected rocky escarpments, open forest of lowland savannah and woodland (Oakwood, 2002, 2008). They are opportunistic omnivores, consuming a wide range of invertebrates and small vertebrates also in addition to fruit, nectar, carrion and human refuse (Dunlop *et al.*, 2017). Rocky habitats tend to support higher densities, as they offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994; Oakwood, 2000). Other microhabitat features important to the species include rock cover, proximity to permanent water, and time-since last fire (Woinarski *et al.*, 2008). Dens occur in a wide range of habitat features, including rock overhangs, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings/infrastructure, where individuals usually den alone (Oakwood, 2002; Woinarski *et al.*, 2008). At present, northern quolls are relatively common in the northern Pilbara region (generally within 150 km of the coast) but are much less common in southern and south-eastern parts of the region (Cramer *et al.*, 2016b).

Northern quolls have experienced a precipitous decline in most of its former range in northern Queensland and the Northern Territory, largely due to the presence of cane toad, *Rhinella marina* (Braithwaite & Griffiths, 1994; Fitzsimons *et al.*, 2010). Other threats include predation from foxes and cats, changed fire regimes, disease, habitat degradation and destruction (Woinarski *et al.*, 2011). It is anticipated that cane toads will expand into the Pilbara within coming years, which will be the most significant threat to its presence here.

6.2.2 Previous Records

The Study Area falls within the current modelled distribution of the northern quoll (DoE, 2022a). Within 50 km of the Study Area, there are 498 northern quoll records (DBCA, 2022b; WAIO, 2022) (Figure 6.2). The vast majority of these records (97%; 481 records) occur in the vicinity of Rio Tinto's Gudai-Darri mine, located approximately 21.5 km north-east of the Study Area, as recently as 2019. The scarcity of records elsewhere within the desktop assessment search area (50 km of Study Area) suggests that the species is patchily distributed and/or occurs at low abundance.

There are no previous records of northern quoll within the Study Area. Evidence of the species within close proximity of the Study Area has been recorded previously, with scats recorded on five occasions between 2011 and 2019 within 12 km of the Study Area (Biologic, 2011e, 2013d; Onshore & Biologic, 2011), and alive individuals (10 camera trap detection images and one individual trapped) being recorded during surveys in 2019 and 2020, located 9.5 km east of the southern portion of the Study Area (Astron (2019, 2020).

Northern quolls were recorded from scats at 12 locations at Jinidi (located to the east) in 2023 (Biologic, 2024). No northern quolls were recorded in the Jinidi survey area prior to this despite seven surveys undertaken within the survey area (Biologic, 2011d, 2011e; Biota, 2013b; Ecologia, 2006a, 2006b; ENV, 2010c; Onshore & Biologic, 2009) and a further nine surveys which intersected the survey area.

Biologic detected northern quoll eDNA during a survey in March 2023, located approximately 9 km east from the Study Area (Biologic, 2023d).

6.2.3 Survey Methods

6.2.3.1 Targeted Searches

Targeted searches for northern quoll scats, remains and tracks were conducted along 81 transects equalling a total of approximately 224 person hours (Table 6.3).

6.2.3.2 Camera Trap Transects

Twenty-two camera trap transects were deployed in suitable northern quoll breeding/shelter habitat (e.g. Breakaway/ Cliff), high quality foraging/ dispersal habitat (e.g. Gorge/ Gully) or habitat directly adjacent to breeding/ shelter habitat (Table 6.4; Figure 6.3). Where possible, survey effort followed methods recommended by DoE (2016); however, due to the size of the Study Area, the number of cameras deployed at any given site were based on the extent of suitable habitat with an approximate spread of one camera every 50–100 meters (m). Cameras were deployed for between four and 22 consecutive nights, for a total of 2,100 camera trap sampling nights (Table 6.4). Cameras were oriented to enable differentiation of individuals via spot patterning (following Hohnen *et al.*, 2012) and baited with universal bait mixture (comprising oats, peanut butter and sardines) contained within a non-reward receptacle (perforated and capped PVC pipe).

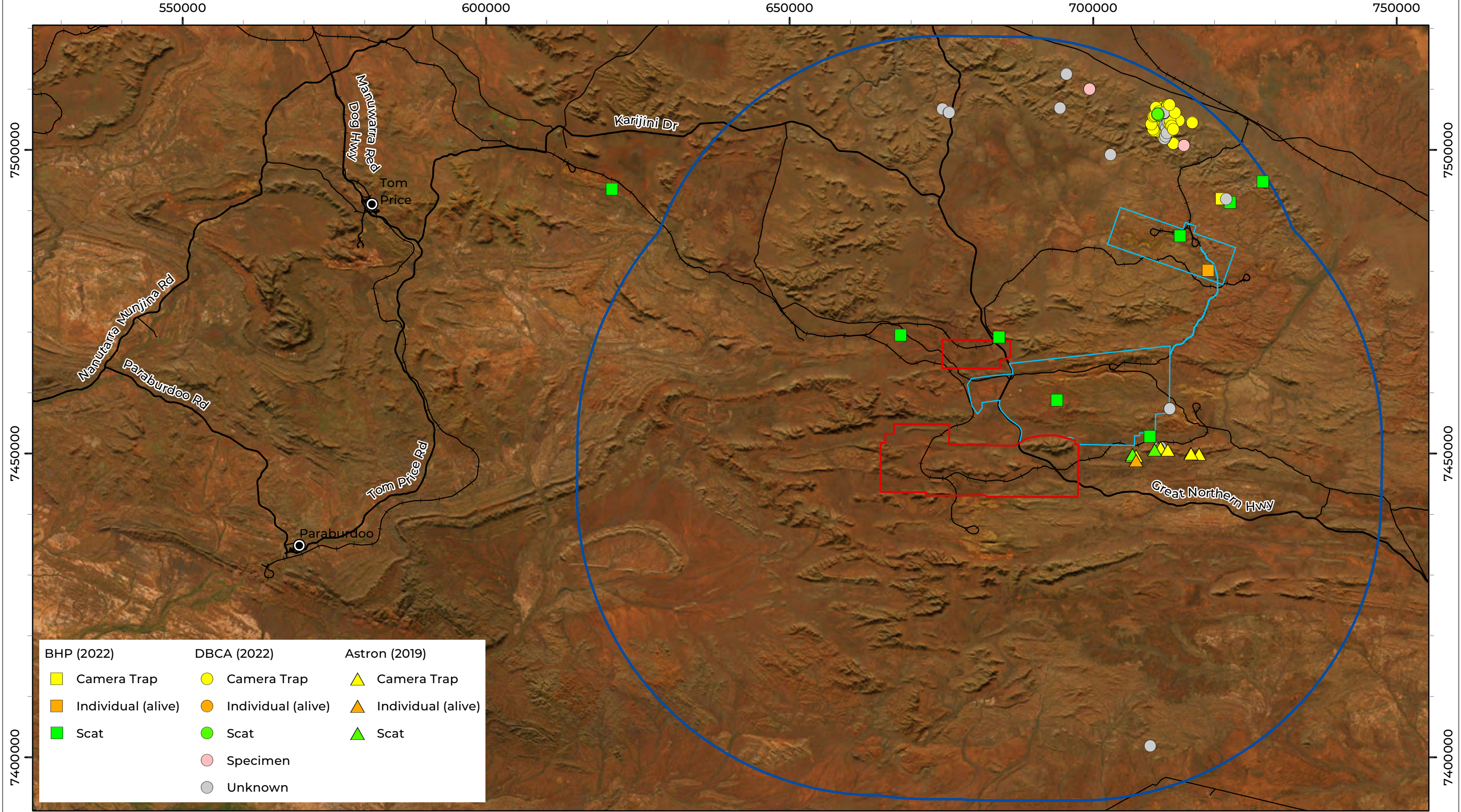


Table 6.3: Targeted searches completed for northern quoll within the Study Area

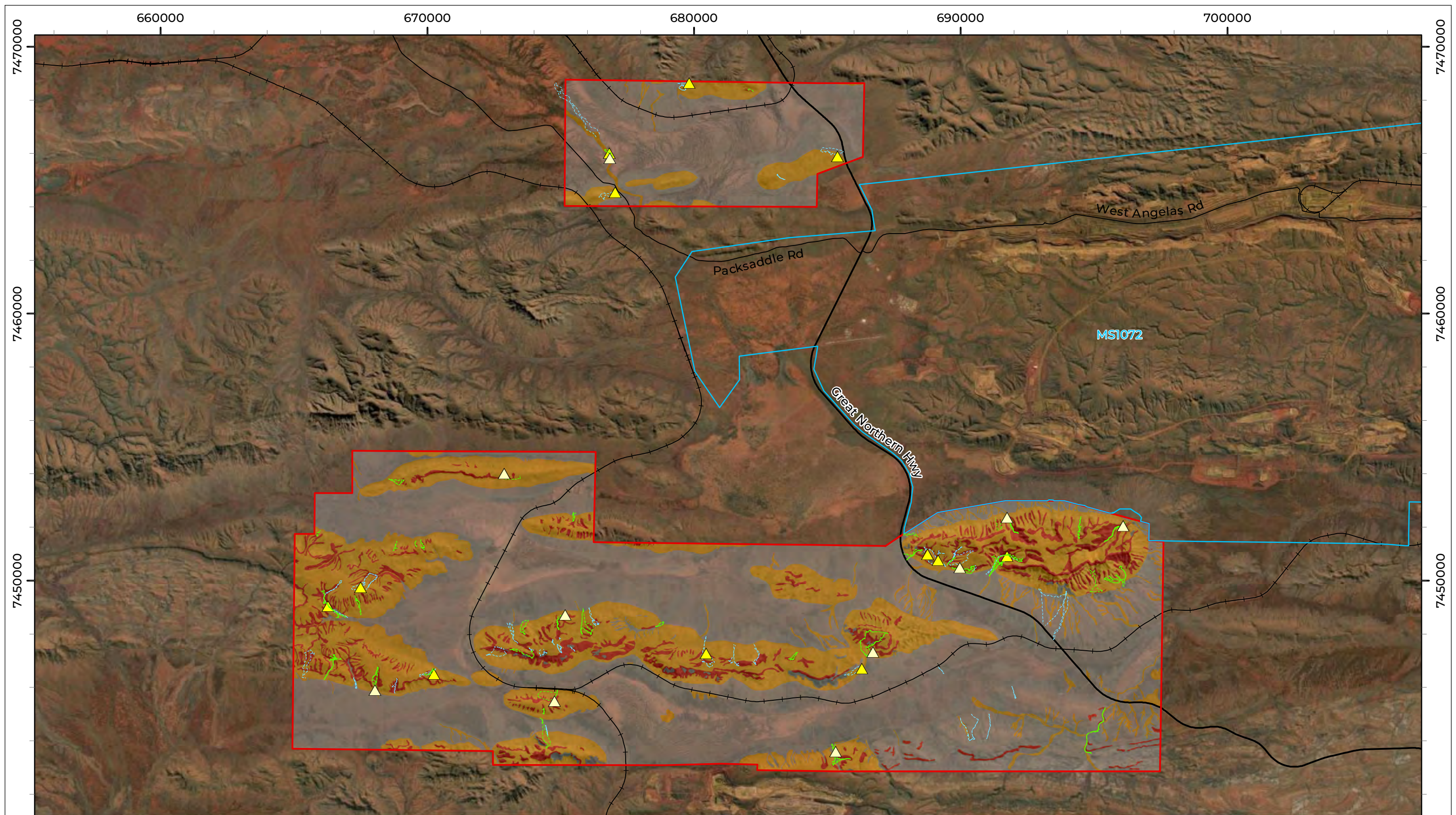
Transect Name	Date	Habitat	Person hours
Phase 1			
TCPH-035	8/04/2022	Breakaway/ Cliff	1.0
TCPH-041	9/04/2022	Medium Drainage Line	1.5
TCPH-085	28/04/2022	Gorge/ Gully	2.0
TCPH-086	28/04/2022	Breakaway/ Cliff	5.0
TCPH-087	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-088	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-089	29/04/2022	Gorge/ Gully	1.5
TCPH-090	29/04/2022	Hillcrest/ Hillslope	2.0
TCPH-095	30/04/2022	Gorge/ Gully	6.0
TCPH-100	30/04/2022	Gorge/ Gully	5.0
TCPH-117	1/05/2022	Gorge/ Gully	4.0
TCPH-123	1/05/2022	Gorge/ Gully	1.2
TCPH-125	1/05/2022	Gorge/ Gully	1.0
TCPH-127	1/05/2022	Gorge/ Gully	2.0
TCPH-140	1/05/2022	Gorge/ Gully	2.0
TCPH-109	2/05/2022	Gorge/ Gully	2.0
TCPH-130	2/05/2022	Gorge/ Gully	1.0
TCPH-132	2/05/2022	Gorge/ Gully	2.5
TCPH-133	2/05/2022	Gorge/ Gully	2.0
TCPH-140	3/05/2022	Gorge/ Gully	9.0
TCPH-145	3/05/2022	Gorge/ Gully	2.0
TCPH-149	3/05/2022	Gorge/ Gully	4.0
TCPH-153	3/05/2022	Gorge/ Gully	2.0
TCPH-091	4/05/2022	Medium Drainage Line	3.0
TCPH-160	4/05/2022	Gorge/ Gully	4.5
TCPH-166	4/05/2022	Medium Drainage Line	2.0
TCPH-170	4/05/2022	Gorge/ Gully	2.0
TCPH-128	5/05/2022	Gorge/ Gully	4.0
TCPH-129	5/05/2022	Gorge/ Gully	2.0
TCPH-131	5/05/2022	Breakaway/ Cliff	2.5
TCPH-134	6/05/2022	Hillcrest/ Hillslope	1.0
TCPH-180	26/05/2022	Breakaway/ Cliff	1.0
TCPH-181	26/05/2022	Breakaway/ Cliff	2.0
TCPH-185	26/05/2022	Gorge/ Gully	4.0
TCPH-193	27/05/2022	Gorge/ Gully	4.0
TCPH-194	27/05/2022	Hillcrest/ Hillslope	1.0
TCPH-195	27/05/2022	Gorge/ Gully	1.5
TCPH-200	27/05/2022	Breakaway/ Cliff	6.4
TCPH-209	28/05/2022	Gorge/ Gully	3.0

Transect Name	Date	Habitat	Person hours
TCPH-229	28/05/2022	Gorge/ Gully	5.5
TCPH-242	29/05/2022	Hillcrest/ Hillslope	3.5
Phase 2			
TCPH-345	16/02/2023	Gorge/ Gully	1.5
TCPH-348	16/02/2023	Hillcrest/ Hillslope	1.2
TCPH-356	16/02/2023	Gorge/ Gully	0.6
TCPH-358	16/02/2023	Undulating Low Hills	0.6
TCPH-300	17/02/2023	Gorge/ Gully	7.0
TCPH-301	17/02/2023	Gorge/ Gully	4.5
TCPH-302	17/02/2023	Breakaway/ Cliff	8.2
TCPH-303	17/02/2023	Gorge/ Gully	5.0
TCPH-304	18/02/2023	Gorge/ Gully	6.0
TCPH-305	18/02/2023	Breakaway/ Cliff	2.0
TCPH-311	18/02/2023	Gorge/ Gully	1.0
TCPH-315	18/02/2023	Gorge/ Gully	1.5
TCPH-310	19/02/2023	Breakaway/ Cliff	1.5
TCPH-315_1	19/02/2023	Gorge/ Gully	1.0
TCPH-317	19/02/2023	Breakaway/ Cliff	3.6
TCPH-319	19/02/2023	Gorge/ Gully	2.5
TCPH-321	19/02/2023	Breakaway/ Cliff	2.0
TCPH-323	19/02/2023	Gorge/ Gully	3.0
TCPH-327	20/02/2023	Gorge/ Gully	2.0
TCPH-329	20/02/2023	Gorge/ Gully	2.0
TCPH-324	21/02/2023	Breakaway/ Cliff	3.0
TCPH-331	21/02/2023	Breakaway/ Cliff	4.0
TCPH-333	21/02/2023	Breakaway/ Cliff	2.6
TCPH-335	22/02/2023	Breakaway/ Cliff	3.3
TCPH-303_1	23/02/2023	Gorge/ Gully	3.0
TCPH-323_1	23/02/2023	Gorge/ Gully	3.0
TCPH-300_1	24/02/2023	Gorge/ Gully	6.0
TCPH-368	9/03/2023	Gorge/ Gully	4.0
TCPH-373	9/03/2023	Breakaway/ Cliff	1.5
TCPH-374	9/03/2023	Hillcrest/ Hillslope	3.0
TCPH-041	9/03/2023	Medium Drainage Line	1.5
TCPH-392	12/03/2023	Gorge/ Gully	2.0
TCPH-397	15/03/2023	Gorge/ Gully	3.0
TCPH-398	15/03/2023	Gorge/ Gully	4.0
TCPH-402	15/03/2023	Breakaway/ Cliff	0.5
TCPH-403	15/03/2023	Breakaway/ Cliff	0.8
TCPH-405	15/03/2023	Gorge/ Gully	2.0
TCPH-375	17/03/2023	Gorge/ Gully	2.5

Transect Name	Date	Habitat	Person hours
TCPH-401	17/03/2023	Gorge/ Gully	2.0
TCPH-406	17/03/2023	Medium Drainage Line	2
Total targeted searches completed			81
Total person hours			224

Table 6.4: Camera transects sampled for northern quoll within the Study Area

Site	Habitat	Deployment	Retrieval	Total Trap Nights
Phase 1				
VCPH-085	Gorge/ Gully	28/04/2022	2/05/2022	40
VCPH-086	Breakaway/ Cliff	28/04/2022	2/05/2022	40
VCPH-095	Breakaway/ Cliff	30/04/2022	4/05/2022	40
VCPH-100	Gorge/ Gully	30/04/2022	4/05/2022	40
VCPH-108	Medium Drainage Line	1/05/2022	6/05/2022	40
VCPH-132	Gorge/ Gully	2/05/2022	6/05/2022	50
VCPH-176	Medium Drainage Line	25/05/2022	29/05/2022	40
VCPH-180	Gorge/ Gully	26/05/2022	30/05/2022	40
VCPH-181	Breakaway/ Cliff	26/05/2022	30/05/2022	40
VCPH-185	Gorge/ Gully	26/05/2022	30/05/2022	40
Phase 2				
VCPH-300	Gorge/ Gully	17/02/2023	10/03/2023	210
VCPH-301	Gorge/ Gully	17/02/2023	11/03/2023	220
VCPH-302	Breakaway/ Cliff	17/02/2023	8/03/2023	190
VCPH-303	Gorge/ Gully	17/02/2023	8/03/2023	190
VCPH-304	Gorge/ Gully	18/02/2023	11/03/2023	210
VCPH-305	Breakaway/ Cliff	18/02/2023	22/02/2023	40
VCPH-335	Breakaway/ Cliff	22/02/2023	9/03/2023	150
VCPH-345	Gorge/ Gully	19/02/2023	11/03/2023	200
VCPH-041	Medium Drainage Line	9/03/2023	16/03/2023	70
VCPH-368	Gorge/ Gully	9/03/2023	16/03/2023	70
VCPH-373	Breakaway/ Cliff	9/03/2023	16/03/2023	70
VCPH-374	Hillcrest/ Hillslope	9/03/2023	16/03/2023	70
Total camera transects deployed				22
Total trap nights				2,100



LEGEND

Study Area	Habitat	Phase 1	Phase 2
Approval Boundary	Critical	Camera Trap	Camera Trap
Local Road	Supporting	Targeted Search	Targeted Search
State Road	Nil		
Rail			

Scale 1:130,000

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 15/10/2024

BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.3: Northern quoll
sampling and habitat in
the Study Area

6.2.4 Survey Results

No evidence of northern quoll was recorded within the Study Area during the current surveys.

6.2.5 Discussion

There was no evidence of northern quoll presence during the surveys in 2022 and 2023. The species has not been recorded previously within the Study Area, however evidence of the species has been recorded within 12 km of the Study Area, including on five occasions via scat records (Biologic, 2011e, 2013d; Onshore & Biologic, 2011), as well as evidence of alive individuals being recorded via camera traps and trapping during 2019 and 2020 (Astron (2019, 2020). There have been 14 previous vertebrate fauna surveys within the Study Area, all of which have used survey techniques suitable to sample for northern quoll. At least 4,878 trap nights were undertaken between 2004 to 2010 (Biologic, 2011f, 2013a; Ecologia, 2005a; ENV, 2008b). Additionally, 1,698 camera trap nights were undertaken in 2010 and 2011 (Biologic, 2011f, 2013a). There are a small number of records in the surrounding areas, with most records from the vicinity made at the Hope Downs 2 and Gudai-Darri, 10-20 km east of the Study Area.

Within the Study Area, the Gorge/ Gully and Breakaway/ Cliff habitats meet the definition of critical denning and foraging habitat for northern quoll (BHP WAO, 2023b; DoE, 2016) (Figure 5.1; Figure 6.3). Potential supporting foraging and dispersal habitat for the northern quoll includes the Hillcrest/ Hillslope, Minor Drainage Line and Medium Drainage Line habitats, where located close (within 35 ha, or up to 100 ha during breeding season) to the Gorge/ Gully and Breakaway/ Cliff habitats (BHP WAO, 2023b).

Although the northern quoll has not been previously recorded in the Study Area (despite surveys employing trapping and motion cameras dating back to 2004), critical and supporting habitat is present in the Study Area. Subsequently, it is possible that northern quolls occur in the Study Area either in very low densities, or when animals are dispersing from larger populations to the east. Northern quoll is unlikely to be reliant on the habitats within the Study Area for long-term survival on a local or regional scale. Therefore, the Study Area is considered unlikely to form part of a 'population important for the long-term survival of the species' as defined by DoE (2013, 2016) as any individuals that may occur would not be part of a key source population.

6.3 Ghost Bat (*Macroderma gigas*)

6.3.1 Species Profile

The ghost bat is listed as Vulnerable under the EPBC Act and BC Act. It occurs in disjunct colonies across northern Australia (TSSC, 2016a) and in the Pilbara region, occurs in all four subregions. The Pilbara population is estimated to comprise between 1,300 and 2,000 individuals (TSSC, 2016a). The largest population occurs within the Chichester subregion (estimated at approximately 1,500 individuals) where known populations are largely restricted to disused mines (TSSC, 2016a).

The distribution of ghost bats in the Pilbara is determined by the presence of suitable roosting sites. Natural roosts generally comprise deep, complex caves beneath bluffs or low rounded hills (Armstrong & Anstee, 2000). Centralised breeding sites in the Pilbara are largely restricted to abandoned mines in the Chichester Ranges; however, there are also a number of smaller maternity roosts in the Chichester and Hamersley Ranges (Armstrong & Anstee, 2000). To date, breeding has been documented in natural caves at Mining Area C (including South Flank), Mt Brockman and West Angeles in the Hamersley subregion, and at Callawa and Tambrey Station in the Chichester subregion (Armstrong & Anstee, 2000; Biologic 2013; 2015; M. O'Connell, pers. obs.). Ghost bats are known to move between a number of caves seasonally, or as dictated by weather conditions, and require a range of cave sites (Hutson *et al.*, 2001). Outside the breeding season, male bats are known to disperse widely, most likely during the wet season when conditions would allow bats to use caves that would otherwise not be suitable (Worthington-Wilmer *et al.*, 1994). Genetic studies indicate that females are likely to stay close to the maternity roosts (Worthington-Wilmer *et al.*, 1994).

Caves and roosts used by the species can be classified into four categories (Bat Call, 2021a):

- **Category 1 maternity/ diurnal roost caves with permanent ghost bat occupancy:** Maternity/ diurnal roost caves with permanent ghost bat occupancy. There are several documented permanent roost caves and underground mines in northern Australia. These may be abandoned underground mines.
- **Category 2 maternity/ diurnal roost caves with regular occupancy:** Maternity/ Diurnal roost caves with regular (but not continuous) ghost bat occupancy that are capable of supporting one or more reproducing females. These may be abandoned underground mines.
- **Category 3 diurnal roost caves with occasional occupancy:** There are many caves and adits where one to a few ghost bats roost occasionally, or rarely.
- **Category 4 nocturnal roost caves with opportunistic usage:** shallow caves, shelters and deep overhangs that support opportunistic usage for resting and feeding.

In addition to the above categories, a further category – Category 5 – was defined to categorise caves that were not suitable for use by the ghost bat. Category 5 is not described by (Bat Call, 2021a), but is used here for consistency with the terminology used in this guide.

Foraging habitat for ghost bats is classified as occurring within 12 km radius of these categorised caves (Bat Call, 2021a) or 1,200 ha of habitat surrounding each of these caves. Their habitat includes:

- productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia* spp.) on sand or stony ground;
- isolated trees and trees on the edge of thin thickets on the plains;
- trees along the edges of watercourse woodlands; and
- gully or gorge system that opens onto a plain or riparian line.

Historically, ghost bats were documented to have a short-range foraging strategy of up to 3 km (average 1.9 km), with vantage points changing approximately every 15 minutes, and average foraging areas of 61 ha having been recorded in the Northern Territory (Tidemann *et al.*, 1985). However, recent studies using VHF tracking and GPS/satellite tracking technologies show that ghost bats, both male and female, forage over much larger areas up to 12 km from their diurnal roost (Augusteyn *et al.*, 2018; Bat Call, 2021a). However, more recently, Bullen *et al.* (2023) found that ghost bats forage up to 17.7 km from their diurnal roost in the Pilbara (compared with 12 km at Mount Etna in Queensland) (Augusteyn *et al.*, 2018).

It also appears that bats generally return to the same area each night (Tidemann *et al.*, 1985), although it has been suggested that ghost bats in the arid zone are semi-transient through most areas and will readily travel large distances (>4 km) (Biologic, 2020b). Ghost bats have a 'sit and inspect' foraging strategy; whereby they hang on a perch and visually inspect their surroundings for movement. Once their prey is detected it may be captured in the air, gleaned (i.e. taken from the surface of a substrate by a flying bat) from the ground or vegetation, or dropped on from a perch (Boles, 1999).

6.3.2 Previous Records

The Study Area falls within the current distribution of the ghost bat, whereby the species or species' habitat is likely to occur (DoE, 2022d). In Western Australia, the species has experienced a significant north-westward distribution contraction, presumably associated with increasing aridity (TSSC, 2016a). Numerous caves regarded as important for ghost bats are known to occur within and around the Study Area, including at South Flank and West Angelas.

A total of 559 records of ghost bat occur within 50 km of the Study Area (Figure 6.4), with 355 of these from within 12 km of the Study Area (classified foraging range), which were recorded mostly between 2011 and 2018 (DBCA, 2022b; WAIO, 2022). There are 66 records within the southern portion of the Study Area and none from the northern portion (DBCA, 2022b; WAIO, 2022).

Other than current long-term ghost bat monitoring studies currently being undertaken in the Study Area that include monitoring of four Category 2 and three Category 3 roosts (Biologic, 2023a), the majority of ghost bat records within the Study Area are around a decade old (up until 2014) (Table 6.5).

At least 514 ultrasonic recording nights, 243 video monitoring recording nights, and 27 hours of Anabat recordings have been undertaken previously in the Study Area (Biologic, 2011f, 2013a, 2023c; Biota, 2004; Ecologia, 2004a, 2005a; ENV, 2008b; Onshore & Biologic, 2011).

Table 6.5: Ghost bats previously recorded within 12 km of the Study Area

Report	Records
Biologic (2019)	Recorded the ghost bat 13 times (11 times from scats collected from caves, once from direct observation of two individuals within a cave and once from ultrasonic recorder) all within Gorge/ Gully and Hillcrest/ Hillslope habitats within the Pineapple Hills tenements Study Area. Scats were also recorded at 12 of the caves.
Biologic (2013a)	Recorded at 35 wide-spread locations at Area C West in 2011. A confirmed maternity roost at South Flank.
Biologic (2013e)	Recorded ghost bat 18 times (15 times from scats within caves, and three from direct observations of individuals within these caves).
Biologic (2011a)	20 confirmed ghost bat roosts based on the presence of scats and observed a total of 18 individual ghost bats at two caves.
Biologic (2011f)	Observed seven individual ghost bats at two cave locations and identified 16 ghost bat roosts by the presence of ghost bat scats.
(Onshore & Biologic, 2011)	Camp Hill, also located within the Study Area, has suitable caves and overhangs and scats were recorded in 2010 from a number of locations, suggesting that this species may be resident in this area.
Astron (2010b)	Ghost bat scats in known roost.
Ecologia (2005a)	Ghost bat calls recorded across four broad habitat types.

6.3.3 Survey Methods

6.3.3.1 Targeted Searches

Targeted searches were undertaken at 78 locations across the Study Area (38 in phase 1 and 40 in phase 2). In addition, cave assessments were undertaken during an additional targeted ghost bat survey for the Power2030 project that overlaps the Study Area (Biologic, in prep). The searches were conducted on foot to determine the presence of caves likely to be used by ghost bats and/or Pilbara leaf-nosed bats (Table 6.6; Figure 6.5). Where suitable caves or overhangs were located, detailed cave assessments were undertaken to search for evidence of occurrence and determine the cave classification. Where a cave was not deemed safe for entry, efforts were made to assess the cave without entering. Approximately 217.5 person hours of search effort was undertaken (107.1 in phase 1; 110.4 in phase 2) (Table 6.6; Figure 6.5).

Table 6.6: Targeted searches for Pilbara leaf-nosed bat and ghost bat within the Study Area

Transect Name	Date	Habitat	Person hours
Phase 1			
TCPH-035	8/04/2022	Breakaway/ Cliff	1.0
TCPH-085	28/04/2022	Gorge/ Gully	2.0
TCPH-086	28/04/2022	Breakaway/ Cliff	5.0
TCPH-087	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-088	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-089	29/04/2022	Gorge/ Gully	1.5
TCPH-090	29/04/2022	Hillcrest/ Hillslope	2.0
TCPH-095	30/04/2022	Gorge/ Gully	6.0
TCPH-100	30/04/2022	Gorge/ Gully	5.0
TCPH-117	1/05/2022	Gorge/ Gully	4.0
TCPH-123	1/05/2022	Gorge/ Gully	1.2
TCPH-125	1/05/2022	Gorge/ Gully	1.0
TCPH-127	1/05/2022	Gorge/ Gully	2.0
TCPH-140	1/05/2022	Gorge/ Gully	2.0
TCPH-109	2/05/2022	Gorge/ Gully	2.0
TCPH-130	2/05/2022	Gorge/ Gully	1.0
TCPH-132	2/05/2022	Gorge/ Gully	2.5
TCPH-133	2/05/2022	Gorge/ Gully	2.0
TCPH-140	3/05/2022	Gorge/ Gully	9.0
TCPH-145	3/05/2022	Gorge/ Gully	2.0
TCPH-149	3/05/2022	Gorge/ Gully	4.0
TCPH-153	3/05/2022	Gorge/ Gully	2.0
TCPH-160	4/05/2022	Gorge/ Gully	4.5
TCPH-170	4/05/2022	Gorge/ Gully	2.0
TCPH-128	5/05/2022	Gorge/ Gully	4.0
TCPH-129	5/05/2022	Gorge/ Gully	2.0
TCPH-131	5/05/2022	Breakaway/ Cliff	2.5
TCPH-134	6/05/2022	Hillcrest/ Hillslope	1.0
TCPH-180	26/05/2022	Breakaway/ Cliff	1.0
TCPH-181	26/05/2022	Breakaway/ Cliff	2.0
TCPH-185	26/05/2022	Gorge/ Gully	4.0
TCPH-193	27/05/2022	Gorge/ Gully	4.0
TCPH-194	27/05/2022	Hillcrest/ Hillslope	1.0
TCPH-195	27/05/2022	Gorge/ Gully	1.5
TCPH-200	27/05/2022	Breakaway/ Cliff	6.4
TCPH-209	28/05/2022	Gorge/ Gully	3.0
TCPH-229	28/05/2022	Gorge/ Gully	5.5
TCPH-242	29/05/2022	Hillcrest/ Hillslope	3.5
Phase 2			
TCPH-345	16/02/2023	Gorge/ Gully	1.5
TCPH-348	16/02/2023	Hillcrest/ Hillslope	1.2

Transect Name	Date	Habitat	Person hours
TCPH-356	16/02/2023	Gorge/ Gully	0.6
TCPH-358	16/02/2023	Undulating Low Hills	0.6
TCPH-300	17/02/2023	Gorge/ Gully	7.0
TCPH-301	17/02/2023	Gorge/ Gully	4.5
TCPH-302	17/02/2023	Breakaway/ Cliff	8.2
TCPH-303	17/02/2023	Gorge/ Gully	5.0
TCPH-304	18/02/2023	Gorge/ Gully	6.0
TCPH-305	18/02/2023	Breakaway/ Cliff	2.0
TCPH-311	18/02/2023	Gorge/ Gully	1.0
TCPH-315	18/02/2023	Gorge/ Gully	1.5
TCPH-310	19/02/2023	Breakaway/ Cliff	1.5
TCPH-315_1	19/02/2023	Gorge/ Gully	1.0
TCPH-317	19/02/2023	Breakaway/ Cliff	3.6
TCPH-319	19/02/2023	Gorge/ Gully	2.5
TCPH-321	19/02/2023	Breakaway/ Cliff	2.0
TCPH-323	19/02/2023	Gorge/ Gully	3.0
TCPH-327	20/02/2023	Gorge/ Gully	2.0
TCPH-329	20/02/2023	Gorge/ Gully	2.0
TCPH-324	21/02/2023	Breakaway/ Cliff	3.0
TCPH-331	21/02/2023	Breakaway/ Cliff	4.0
TCPH-333	21/02/2023	Breakaway/ Cliff	2.6
TCPH-335	22/02/2023	Breakaway/ Cliff	3.3
TCPH-303_1	23/02/2023	Gorge/ Gully	3.0
TCPH-323_1	23/02/2023	Gorge/ Gully	3.0
TCPH-300_1	24/02/2023	Gorge/ Gully	6.0
TCPH-368	9/03/2023	Gorge/ Gully	4.0
TCPH-373	9/03/2023	Breakaway/ Cliff	1.5
TCPH-374	9/03/2023	Hillcrest/ Hillslope	3.0
TCPH-041	9/03/2023	Medium Drainage Line	1.5
TCPH-392	12/03/2023	Gorge/ Gully	2.0
TCPH-397	15/03/2023	Gorge/ Gully	3.0
TCPH-398	15/03/2023	Gorge/ Gully	4.0
TCPH-402	15/03/2023	Breakaway/ Cliff	0.5
TCPH-403	15/03/2023	Breakaway/ Cliff	0.8
TCPH-405	15/03/2023	Gorge/ Gully	2.0
TCPH-375	17/03/2023	Gorge/ Gully	2.5
TCPH-401	17/03/2023	Gorge/ Gully	2.0
TCPH-406	17/03/2023	Medium Drainage Line	2
Total targeted searches completed			78
Total person hours			217.5

6.3.3.2 Ultrasonic Recorders

Overnight recordings of bat echolocation calls were undertaken with SM4 ultrasonic bat recorders at 78 sites (34 in phase 1 and 44 in phase 2) (Table 6.7; Figure 6.5). Detectors were placed near water features, caves and foraging/ dispersal corridors. Recorders were deployed for between three and 20 consecutive nights at each site, resulting in a total of 387 recording nights (141 in phase 1 and 246 in phase 2) (Table 6.7).

The audio settings used for the SM4 units followed the manufacturer's recommendations (Wildlife Acoustics, 2011, 2017) and were set to account for all species known to occur within the region (McKenzie & Bullen, 2009). All recordings were analysed by Robert Bullen of Bat Call WA for the presence of ghost bat and Pilbara leaf-nosed bat calls only.

6.3.3.3 Habitat Classification

Recent studies of ghost bat home range and foraging behaviour in the Pilbara region have identified Drainage Area/ Floodplain, Gorge/ Gully, and Minor Drainage Line as important foraging habitats for the species (Biologic, 2020b).

Habitats within the Study Area were classified as Critical, Supporting or Nil, based on the following criteria:

1. Critical:
 - a. Roosting habitat: Caves classified as Category 1 or 2.
 - b. Foraging habitat: Stony Plain, Mulga Woodland, Drainage Area/ Floodplain, Minor Drainage Line and Medium Drainage Line within 12 km of Category 1 or 2 caves.
2. Supporting: caves classified as Category 3 or 4 and Undulating Low Hills and Gorge/ Gully habitats.

Table 6.7: Ultrasonic sampling for Pilbara leaf-nosed bat and ghost bat within the Study Area

Site	Habitat	Deployment	Retrieval	Sampling Nights
Phase 1				
VCPH-041	Medium Drainage Line	9/04/2022	13/04/2022	4
VCPH-048	Mulga Woodland	9/04/2022	12/04/2022	3
VCPH-082	Hillcrest/ Hillslope	13/04/2022	29/04/2022	16
VCPH-085	Gorge/ Gully	28/04/2022	2/05/2022	4
VCPH-087	Gorge/ Gully	29/04/2022	2/05/2022	3
VCPH-088	Gorge/ Gully	29/04/2022	2/05/2022	3
VCPH-089	Gorge/ Gully	29/04/2022	2/05/2022	3
VCPH-090	Gorge/ Gully	29/04/2022	2/05/2022	3
VCPH-091	Breakaway/ Cliff	29/04/2022	2/05/2022	3
VCPH-092	Drainage Area/ Floodplain	29/04/2022	2/05/2022	3
VCPH-093	Gorge/ Gully	29/04/2022	2/05/2022	3
VCPH-094	Breakaway/ Cliff	29/04/2022	2/05/2022	3
VCPH-108	Medium Drainage Line	1/05/2022	6/05/2022	5

Site	Habitat	Deployment	Retrieval	Sampling Nights
VCPH-128	Gorge/ Gully	2/05/2022	5/05/2022	3
VCPH-129	Gorge/ Gully	2/05/2022	5/05/2022	3
VCPH-130	Gorge/ Gully	2/05/2022	5/05/2022	3
VCPH-131	Gorge/ Gully	2/05/2022	5/05/2022	3
VCPH-132	Gorge/ Gully	2/05/2022	6/05/2022	4
VCPH-133	Gorge/ Gully	2/05/2022	5/05/2022	3
VCPH-138	Gorge/ Gully	3/05/2022	6/05/2022	3
VCPH-140	Breakaway/ Cliff	3/05/2022	26/05/2022	20
VCPH-143	Gorge/ Gully	3/05/2022	6/05/2022	3
VCPH-177	Minor Drainage Line	25/05/2022	29/05/2022	4
VCPH-178	Stony Plain	26/05/2022	29/05/2022	3
VCPH-179	Hardpan Plain	26/05/2022	29/05/2022	3
VCPH-180	Gorge/ Gully	26/05/2022	30/05/2022	4
VCPH-181	Breakaway/ Cliff	26/05/2022	30/05/2022	4
VCPH-182	Hardpan Plain	26/05/2022	29/05/2022	3
VCPH-183	Stony Plain	26/05/2022	29/05/2022	3
VCPH-184	Drainage Area/ Floodplain	26/05/2022	29/05/2022	3
VCPH-185	Gorge/ Gully	26/05/2022	30/05/2022	4
VCPH-186	Undulating Low Hills	26/05/2022	29/05/2022	3
VCPH-187	Drainage Area/ Floodplain	26/05/2022	29/05/2022	3
VCPH-188	Stony Plain	26/05/2022	29/05/2022	3
Phase 2				
VCPH-344	Mulga Woodland	16/02/2023	20/02/2023	4
VCPH-345	Gorge/ Gully	16/02/2023	19/02/2023	3
VCPH-346	Mulga Woodland	16/02/2023	20/02/2023	4
VCPH-348	Hillcrest/ Hillslope	16/02/2023	19/02/2023	3
VCPH-351	Mulga Woodland	16/02/2023	20/02/2023	4
VCPH-353	Stony Plain	16/02/2023	19/02/2023	3
VCPH-356	Gorge/ Gully	16/02/2023	19/02/2023	3
VCPH-357	Drainage Area/ Floodplain	16/02/2023	20/02/2023	4
VCPH-358	Undulating Low Hills	16/02/2023	19/02/2023	3
VCPH-359	Stony Plain	16/02/2023	19/02/2023	3
VCPH-308	Drainage Area/ Floodplain	19/02/2023	22/02/2023	3
VCPH-310	Breakaway/ Cliff	19/02/2023	22/02/2023	3
VCPH-312	Drainage Area/ Floodplain	19/02/2023	23/02/2023	4
VCPH-314	Drainage Area/ Floodplain	19/02/2023	23/02/2023	4
VCPH-316	Drainage Area/ Floodplain	19/02/2023	23/02/2023	4
VCPH-323	Gorge/ Gully	19/02/2023	23/02/2023	4
VCPH-318	Drainage Area/ Floodplain	20/02/2023	23/02/2023	3
VCPH-320	Mulga Woodland	20/02/2023	23/02/2023	3
VCPH-327	Gorge/ Gully	20/02/2023	24/02/2023	4
VCPH-349	Mulga Woodland	20/02/2023	23/02/2023	3
VCPH-334	Minor Drainage Line	22/02/2023	8/03/2023	14

Site	Habitat	Deployment	Retrieval	Sampling Nights
VCPH-336	Minor Drainage Line	22/02/2023	8/03/2023	14
VCPH-338	Drainage Area/ Floodplain	22/02/2023	9/03/2023	15
VCPH-303	Gorge/ Gully	23/02/2023	8/03/2023	13
VCPH-339	Mulga Woodland	23/02/2023	8/03/2023	13
VCPH-341	Gorge/ Gully	23/02/2023	8/03/2023	13
VCPH-342	Stony Plain	23/02/2023	8/03/2023	13
VCPH-352	Drainage Area/ Floodplain	23/02/2023	8/03/2023	13
VCPH-354	Drainage Area/ Floodplain	23/02/2023	8/03/2023	13
VCPH-327	Gorge/ Gully	8/03/2023	12/03/2023	4
VCPH-361	Gorge/ Gully	8/03/2023	12/03/2023	4
VCPH-362	Gorge/ Gully	8/03/2023	12/03/2023	4
VCPH-363	Minor Drainage Line	8/03/2023	13/03/2023	5
VCPH-364	Drainage Area/ Floodplain	8/03/2023	12/03/2023	4
VCPH-365	Minor Drainage Line	8/03/2023	13/03/2023	5
VCPH-366	Stony Plain	8/03/2023	12/03/2023	4
VCPH-369	Gorge/ Gully	8/03/2023	13/03/2023	5
VCPH-387	Minor Drainage Line	12/03/2023	15/03/2023	3
VCPH-388	Drainage Area/ Floodplain	12/03/2023	15/03/2023	3
VCPH-392	Gorge/ Gully	12/03/2023	15/03/2023	3
VCPH-389	Drainage Area/ Floodplain	13/03/2023	16/03/2023	3
VCPH-393	Gorge/ Gully	13/03/2023	16/03/2023	3
VCPH-394	Gorge/ Gully	13/03/2023	16/03/2023	3
VCPH-395	Hillcrest/ Hillslope	13/03/2023	16/03/2023	3
Total ultrasonic recorders deployed				78
Total trap nights				387

6.3.4 Survey Results

6.3.4.1 Targeted searches

Thirty-three caves were searched for presence of ghost bat during the current survey, as well as 24 caves searched during the additional targeted ghost bat survey (Biologic, in prep.). Scats were recorded in 10 of these caves (two Category 2, six Category 3 caves, and two Category 4 caves) (Figure 5.2, Appendix G). This comprised four caves searched during the current surveys; CMUD-08 (8 scats), CMUD-47 (2000 scats), CMUD-54 (20 scats) and CMUD-59 (10 scats); and six caves searched during the additional targeted survey overlapping the Study Area; CPOW-038 (100 scats), CPOW-046 (2000 scats), CPOW-048 (7 scats), CPOW-060 (500 scats), CPOW-063 (30 scats), and CPOW-072 (1 scat) (Biologic, in prep.).

Overall, four caves were classified as Category 2 roosts (CMUD-01, CMUD-02, CMUD-47, and CPOW-72), nine as Category 3 (CMUD-08, CMUD-54, CMUD-59, CMUD-063, CMUD-064, CPOW-037, CPOW-038, CPOW-046, and CPOW-060), 33 as Category 4, and eleven as Category 5 (Figure 5.2).

6.3.4.2 Ultrasonic Recording

No ghost bats calls were recorded within the Study Area. Unlike the majority of microbats, ghost bats are proficient in navigating and hunting visually without needing to constantly echolocate (Strahan, 2004). For this reason, it is not uncommon to not record ghost bats in areas where they are physically observed.

6.3.4.3 Habitat Classification

Critical roosting habitat for the ghost bat comprises the four caves classified as Category 2 roosts (CMUD-01, CMUD-02, CMUD-47, and CPOW-72),

Within the Study Area, critical foraging habitat covers 55.7% of the Study Area; comprising Stony Plain (32.6%, 11,895.31 ha), Mulga Woodland (10.4%, 3,784.73 ha), Drainage Area/ Floodplain (10.1%, 3,671.74 ha), Minor Drainage Line (2.3%, 842.90 ha) and Medium Drainage Line (0.3%, 119.56 ha). As the entire Study Area occur within 12 km of the critical (Category 2) roost caves, the entire extent of these habitats within the Study Area is considered critical foraging habitat.

Supporting habitat covers approximately 11% of the Study Area: Undulating Low Hills (5.4%, 1,980.96 ha), Gorge/ Gully (3.5%, 1,277.70 ha) and Breakaway (2.1%, 767.24 ha). Twenty-six caves are classified as supporting habitat (Category 3 and 4 caves). All but one of these caves occur in the Mudlark Well portion of the Study Area.

6.3.5 Discussion

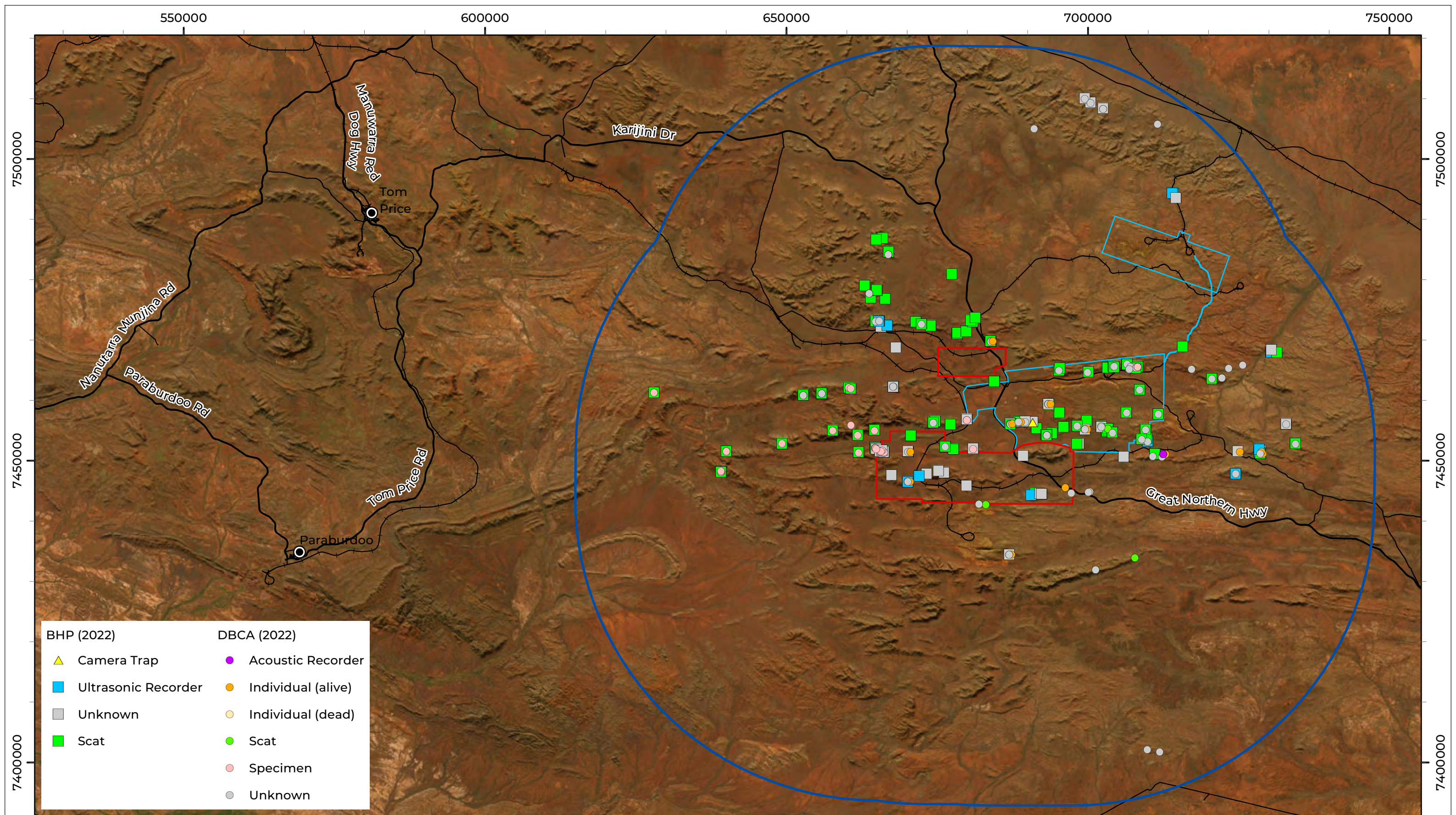
There have been no records of ghost bat to date from the northern portion of the Study Area, and this area only contains one cave (CTAN-38) which is classified as a Category 5 roost. Whilst there are no records from within this part of the Study Area, there are numerous records in all directions occurring within the typical foraging range of ghost bat (~ 12 km). As such, it is very likely that ghost bats recorded elsewhere could utilise suitable habitats in this northern area for foraging and dispersal.

The southern portion of the Study Area likely supports a permanent population of ghost bats, with 66 records from this area made prior to the survey, and a further three records from the current surveys and six scat records from the additional Power2030 targeted survey overlapping the Study Area (Biologic, in prep).

There are 56 caves recorded from this portion of the Study Area, of which four are classified as critical roost caves (Category 2) and 42 as supporting habitat (Category 3 and 4 caves). All the caves were located in the Gorge/Gully, Hillcrest/ Hillslope, or Breakaway/Cliff habitat types.

CMUD-01 has evidence of utilisation by pregnant females with elevated progesterone (> 1,000 ng/g; Keeley *et al.*, 2023) detected in scats across seven (out of eight) consecutive years of monitoring (Biologic, 2013b, 2015, 2020a, 2021a, 2023a, 2023b, 2023c) making it the most consistently used cave by pregnant females of the caves monitored in the MS1072 Fauna Management Plan monitoring program (Biologic, 2023c). CMUD-10, which is located directly adjacent to the northern boundary outside of the Study Area (at Mudlark Well), has also demonstrated evidence of utilisation by pregnant females over six (out of eight) years of monitoring (Biologic, 2013b, 2015, 2020a, 2021a, 2023a, 2023b, 2023c).

The ghost bats recorded within the Study Area are likely to form part of an 'important population' as defined by the DoE (2013). A key source population for breeding could use the Study Area given the presence of four Category 2 (maternity/ diurnal roost caves with regular occupancy for ghost bats) roosts (CMUD-01, CMUD-02, CMUD-47, and CPOW-72). Critical foraging habitat, comprising Stony Plain, Mulga Woodland, Drainage Area/ Floodplain, Minor Drainage Line and Medium Drainage Line, exists across the entire extent of the Study Area, supporting this important population.



BHP (2022)		DBCA (2022)	
	Camera Trap		Acoustic Recorder
	Ultrasonic Recorder		Individual (alive)
	Unknown		Individual (dead)
	Scat		Scat
			Specimen
			Unknown

LEGEND	
	Study Area
	Desktop Assessment Area
	Approval Boundary
	Local Road
	State Road
	Rail



Biologic

Scale 1:575,000

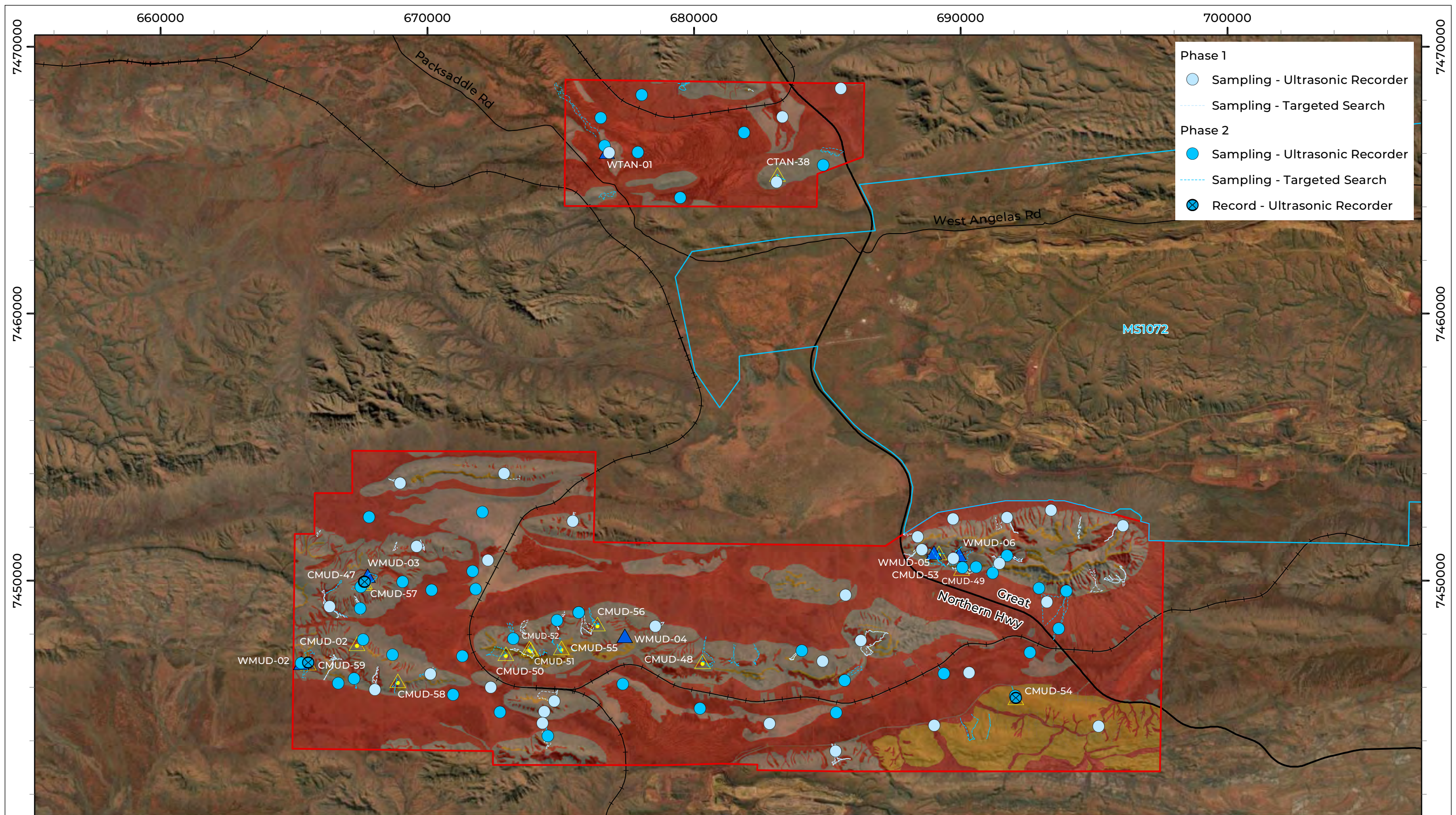
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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/06/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.4: Previous ghost bat records in the Study Area and region



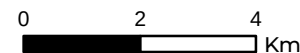
LEGEND

- | | | | |
|-------------------|------------|---------------|----------------|
| Study Area | Local Road | Cave | Habitat |
| Approval Boundary | State Road | Water Feature | Critical |
| | Rail | | Supporting |
| | | | Nil |

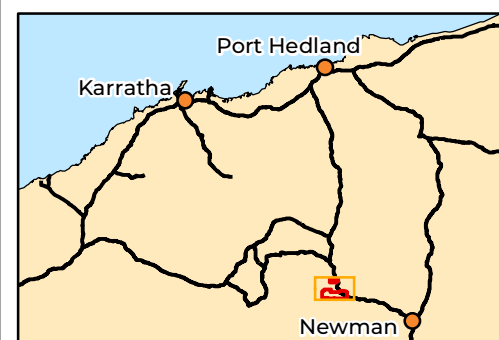


Biologic

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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 15/10/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.5: Ghost bat
sampling, records and habitat
in the Study Area

6.4 Greater Bilby (*Macrotis lagotis*)

6.4.1 Species Profile

The greater bilby is listed as Vulnerable under the EPBC Act and BC Act. It is one of many Australian arid zone marsupial species that are within a 'critical weight range' (35 grams [g] to 5,500 g) considered significant based on the high risk of predation by introduced foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) (Johnson & Isaac, 2009). Greater bilbies are semi-fossorial and nocturnal, remaining in their burrows during the day and intermittently during the night for rest and refuge. Greater bilby populations naturally occur as scattered solitary individuals or small groups (Smythe & Philpott, 1968; Southgate, 1990a). They are regarded as having low site fidelity and high mobility (Southgate *et al.*, 2007); males regularly move three to five kilometres between burrows on consecutive days and have been recorded moving up to 15 km in a few weeks (Southgate & Possingham, 1995). This high mobility, together with low population density, ensures that the area of occupancy is often far less than the extent of occurrence. As greater bilbies are solitary in nature, lack territoriality and have large home ranges, it is likely that males adopt a roving strategy to find receptive females, consistent with an overlapping promiscuous mating system (Miller *et al.*, 2010).

Populations of greater bilby exist in the Pilbara bioregion, particularly within the Chichester subregion, along the Fortescue River and north-east to Goldsworthy and Shay Gap, in the Dampier bioregion (along 80 Mile Beach north to Beagle Bay) and in the Central Kimberley and Ord-Victoria Plains bioregions south of the Fitzroy and Margaret Rivers (Southgate, 1990a). The species' distribution within the Pilbara region is highly fragmented (Cramer *et al.*, 2017).

Greater bilbies occupy three major vegetation types - open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate, 1990b). Laterite and rock feature substrates are an important part of their habitat as they support shrub species, such as *Acacia kempeana*, *A. hilliana* and *A. rhodophloia*, which have root-dwelling larvae that supports a constant food source (Dziminski & Carpenter, 2017; Southgate *et al.*, 2007). These habitats also contain spinifex hummocks, which are quite uniform and discrete, providing runways between hummocks and enabling easier movement and foraging (Southgate *et al.*, 2007). Minimal ground cover is a common feature in greater bilby habitats, as it allows easy foraging (Dawson *et al.*, 2018). Habitat within the Pilbara bioregion seems to consist mostly of spinifex sand plain associated with major drainage line sandy terraces. In general, the distribution of greater bilbies can be limited by the availability of suitable burrowing habitat, such as dunes where burrow excavation is easier (Moseby & O'Donnell, 2003), and are not found in predominantly rocky areas or mountains where they would be unable to dig suitable burrow systems or dig for food.

6.4.2 Previous Records

The Study Area falls within the western extent of the current distribution of the greater bilby, whereby the species or species' habitat is likely to occur (DoE, 2022b). The desktop assessment identified six previous records of the species within 50 km of the Study Area (DBCA, 2022b; WAIO, 2022) (Figure 6.6). One record of a burrow from 1984 is located within the western extent of the Mudlark Well portion of Study Area. This location is on a stony hill, which is not considered suitable habitat, so it is likely that this record locality is inaccurate, or a misidentified goanna burrow. The next closest record occurs 20 km north-west, also from 1984. There are no contemporary records within 50 km of the Study Area, with the closest current record, noted as 'possibly greater bilby diggings' recorded in 2020 from the Fortescue Valley, 65.3 km north-east of the Study Area. Integrated Environmental (1980) recorded a potential greater bilby individual when undertaking nocturnal searches 8.7 km west of the Study Area. The animal was observed at a distance of 80 m and could not be approached closely enough for a confirmed identification.

6.4.3 Survey Methods

6.4.3.1 Greater Bilby Plots Searches

Greater bilby sampling within the Study Area comprised 2 ha survey plots (greater bilby plots) distributed within areas considered to be most suitable as habitat, in accordance with survey guidelines for the species (DBCA, 2017). Each greater bilby plot was subjected to targeted searches for burrows, diggings, tracks and scats for a minimum of 18 minutes, as described by Southgate *et al.* (2019).

Twenty greater bilby plots were sampled. Each plot was searched for between 0.3 and 1 person hours, equalling a total of 17.2 person hours (Table 6.8; Figure 6.7).

Table 6.8: Targeted searches for greater bilby within the Study Area

Transect Name	Date	Habitat	Person hours
Phase 1			
TCPH-010	5/04/2022	Mulga Woodland	1.0
TCPH-036	8/04/2022	Mulga Woodland	1.0
TCPH-037	8/04/2022	Hardpan Plain	1.0
TCPH-064	11/04/2022	Mulga Woodland	1.0
TCPH-047	12/04/2022	Hardpan Plain	1.0
TCPH-101	30/04/2022	Drainage Area/ Floodplain	0.4
TCPH-102	30/04/2022	Drainage Area/ Floodplain	0.3
TCPH-171	4/05/2022	Hardpan Plain	1.0
TCPH-173	5/05/2022	Hardpan Plain	0.5
TCPH-174	5/05/2022	Mulga Woodland	1.0
TCPH-192	27/05/2022	Mulga Woodland	1.5
TCPH-199	27/05/2022	Mulga Woodland	1.5
TCPH-201	27/05/2022	Mulga Woodland	1.0

Transect Name	Date	Habitat	Person hours
TCPH-231	28/05/2022	Drainage Area/ Floodplain	0.5
TCPH-232	28/05/2022	Hardpan Plain	0.5
TCPH-243	29/05/2022	Hardpan Plain	0.7
TCPH-249	29/05/2022	Mulga Woodland	0.8
Phase 2			
TCPH-396	16/03/2023	Stony Plain	0.5
TCPH-399	16/03/2023	Minor Drainage Line	1.0
TCPH-400	16/03/2023	Drainage Area/ Floodplain	1.0
Total 2 ha plots completed			20
Total person hours			17.2

6.4.4 Survey Results

6.4.4.1 Greater Bilby Plots Searches

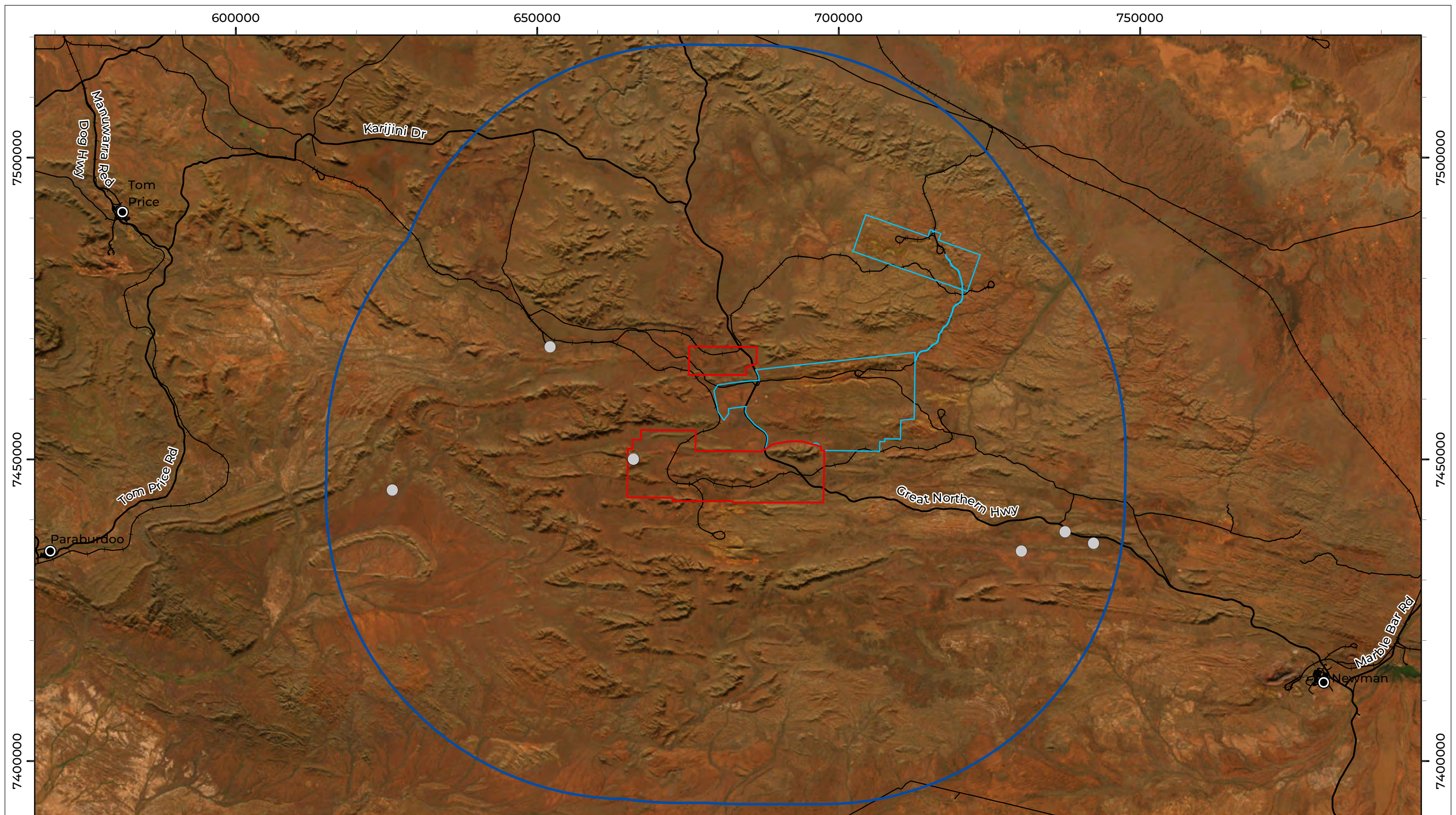
No evidence of greater bilby was recorded within the Study Area. None of the habitat types present in the Study Area align with the preferred habitat defined for the Pilbara bioregion, i.e. spinifex sand plain associated with major drainage line sandy terraces. All of the habitats were classified to have 'Nil' value to the greater bilby, with no supporting or critical habitat present for the species.

6.4.5 Discussion

Although the Study Area is located within the western extent of the current distribution of the greater bilby (DoE, 2022b), no evidence of their presence was recorded. There are no recent records from within or near the Study Area, and the burrow record that was made in 1984 from within the Study Area is considered to be inaccurate or a misidentification.

Within the Pilbara region, the species is often recorded within spinifex sandplains associated with paleo-drainage lines and perched drainage lines where the substrate of sand, soil, sandy clay, or sandy gravel is suitable for burrowing (Dziminski & Carpenter, 2017). Within these sandplain habitats, there is also an association with particular *Acacia* species containing root dwelling larvae that the species use for food resources (Dziminski & Carpenter, 2017).

Habitat within the Study Area is considered marginal for the greater bilby with no spinifex sandplain habitat located. Sampling for the species was conducted in Stony Plain, Mulga Woodland, Drainage Area/ Floodplain, Hardpan Plain and Minor Drainage Line habitats; however, these habitats had low burrowing suitability for the greater bilby. It is considered unlikely that greater bilby occurs within the Study Area due to the lack of critical (e.g. sandplains) or supporting habitat (which can only occur alongside critical habitat). This is supported by the lack of contemporary records in the vicinity of the Study Area. In the unlikely event that this species is present in the Study Area, it is unlikely that this would contribute to an 'important population' as defined by DoE (2013).



LEGEND

- | | | |
|--|--|---|
|  Study Area |  Local Road |  DBCA (2022) |
|  Desktop Assessment Area |  State Road |  Unknown |
|  Approval Boundary |  Rail | |



Biologic

Scale 1:575,000

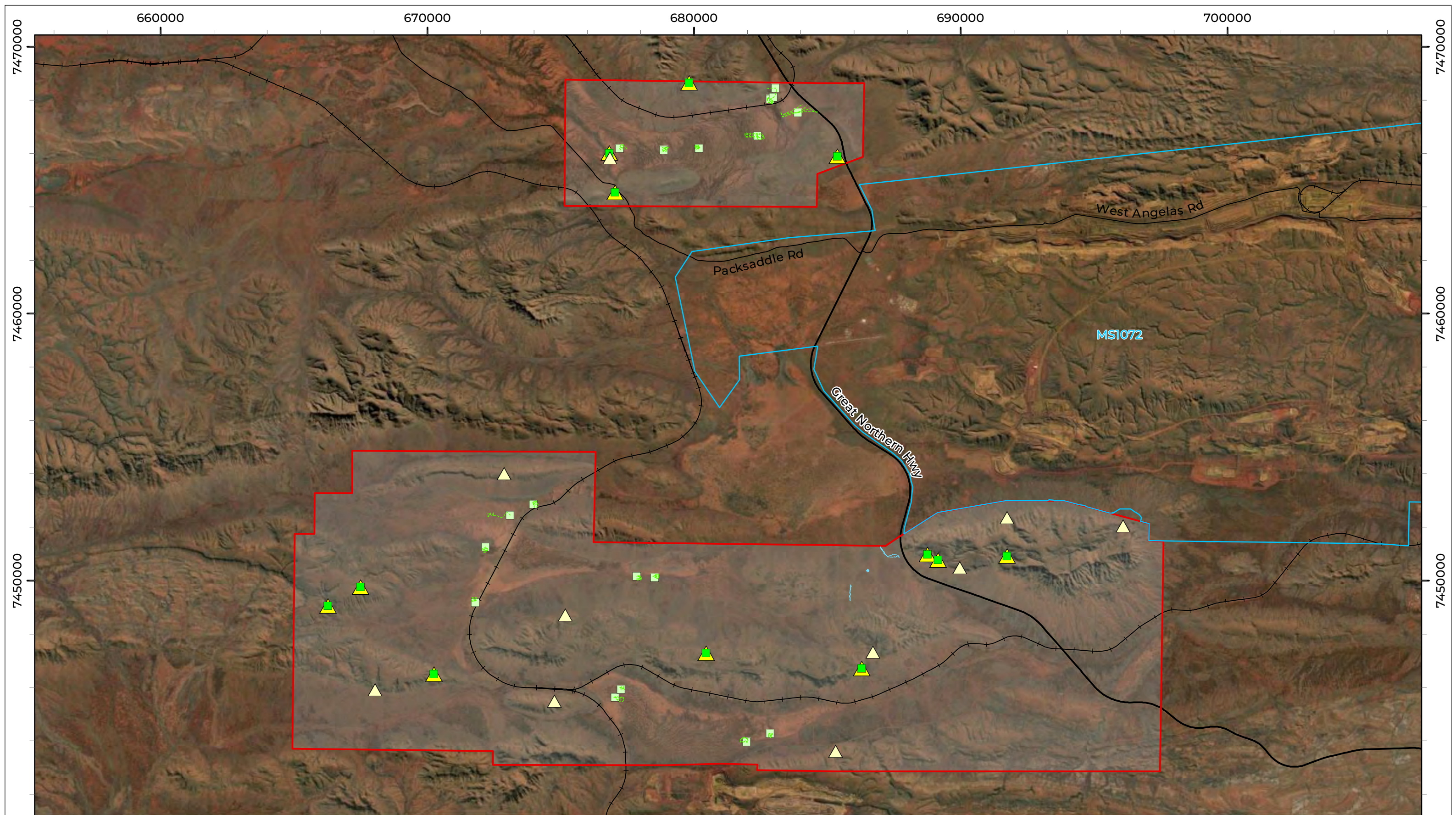
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Projection: Transverse Mercator
Datum: GDA 1994 Created 04/06/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.6: Previous greater bilby records in the Study Area and region



LEGEND

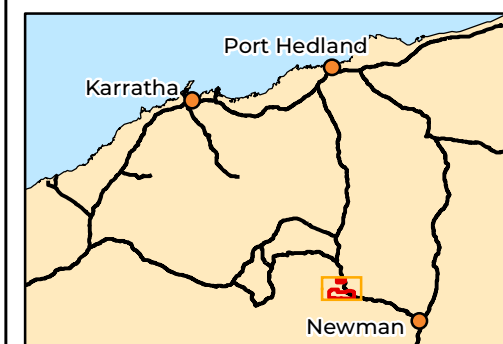
- | | | | |
|-------------------|----------------|-----------------|-----------------|
| Study Area | Habitat | Phase 1 | Phase 2 |
| Approval Boundary | Nil | Bilby Plot | Bilby Plot |
| Local Road | | Camera Trap | Camera Trap |
| State Road | | Targeted Search | Targeted Search |
| Rail | | | |

 **Biologic**

Scale 1:130,000

0 2 4 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 15/10/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.7: Greater bilby
sampling and habitat in
the Study Area

6.5 Pilbara Leaf-nosed Bat (*Rhinonictoris aurantia*, Pilbara form)

6.5.1 Species Profile

The Pilbara leaf-nosed bat is listed as Vulnerable under the EPBC Act and the BC Act. The Pilbara form is recognised as a geographically isolated population of the orange leaf-nosed bat, which is distributed across northern Australia and separated from the Pilbara population by approximately 400 km of the Great Sandy Desert (Armstrong, 2001). The Pilbara leaf-nosed bat is regarded as a single interbreeding population comprising multiple colonies (TSSC, 2016c; Umbrello *et al.*, 2022). Currently, there are 48 confirmed permanent diurnal Category 1 and 2 roost sites (17 of known location and 31 yet to be found) throughout the Pilbara region (Bat Call, 2021b).

Pilbara leaf-nosed bats typically roost in undisturbed caves, deep fissures or abandoned mine shafts (Armstrong, 2000, 2001). Its limited ability to conserve heat and water (Baudinette *et al.*, 2000) means they require warm (28–32°C) and very humid (85–100%) roost sites to persist in arid and semi-arid climates (Armstrong, 2001; Churchill, 1991). Roost sites with such attributes are relatively uncommon in the Pilbara and are the limiting factor of the species' distribution (Armstrong, 2001). During the dry season (June to November), individuals are believed to aggregate in roosts that provide a suitably warm, humid microclimates (Armstrong, 2000, 2001; Bullen & McKenzie, 2011). In the wet season (December to May), when conditions are generally wetter and more humid, individuals typically disperse, roosting in seasonally suitable features (Armstrong, 2000, 2001; Bullen & McKenzie, 2011).

Foraging sites surrounding known or suspected roosts can be critical to the survival of the species as the species forages within the vicinity of roost caves and more broadly along waterbodies with suitable fringing vegetation supporting prey species (TSSC, 2016c). It is predicted to travel up to 20 km from roost caves during nightly foraging in the dry season (Cramer *et al.*, 2016a) and up to 50 km during the wet season (Bullen, 2013). The Study Area is located at the eastern extent of the current distribution of the Pilbara leaf-nosed bat, whereby the species or species' habitat may occur (DoE, 2022d).

6.5.2 Previous Records

The database search identified 1,311 records within 50 km of the Study Area (Figure 6.8), however almost all (98%, 1,281 records) originate from a single location at Gudai-Darri, approximately 39.2 km north-east of the Study Area (DBCA, 2022b; WAIO, 2022). Of the remaining records, eight occur within 10 km of the Study Area (with records from 2013 – 2018) (DBCA, 2022b; WAIO, 2022).

At least 514 ultrasonic recording nights, 243 video monitoring recording nights, and 27 hours of Anabat recordings have been undertaken previously in the Study Area (Biologic, 2011f, 2013a, 2023c; Biota, 2004; Ecologia, 2004a, 2005a; ENV, 2008b; Onshore & Biologic, 2011). The Pilbara leaf-nosed bat has been recorded twice within the Study Area in 2010 (Biologic, 2011e) and 2011 (Biologic, 2011f; Onshore & Biologic, 2011). Both these records were a single call and

based on the timing of the call deemed likely to be indicative of a transient or foraging individual originating from another area.

Records in close proximity to the Study Area include foraging records from three sites: one site (with records indicating multiple individuals present) approximately 6.9 km west (Ecologia, 2014), one ultrasonic call record approximately 8.6 km east (ENV (2007a), and one ultrasonic call record approximately 3.3 km between southern and northern portions of the Study Area (Biota, 2013a).

The nearest permanent diurnal roost to the Study Area is believed to be the East Turee Creek roost, and a yet to be located roost in the south-east corner of Karijini National Park, approximately 20 km west of the Study Area (Bat Call, 2021b). The next nearest permanent diurnal roost, the Kalgan Creek roost, is located approximately 50 km east of the eastern extent of the Study Area.

6.5.3 Survey Methods

6.5.3.1 Targeted Searches

Targeted searches were undertaken at 78 locations across the Study Area (Table 6.6; Figure 6.9). In addition, cave assessments were undertaken during an additional targeted ghost bat survey for the Power2030 project (Biologic, in prep). Searches were conducted on foot to determine the presence and extent of any caves or overhangs likely to be used by Pilbara leaf-nosed bats (Table 6.6; Figure 6.9). Where these were located, detailed cave assessments and searches were undertaken to search for evidence of occurrence and determine the likely use of the cave as a roost site. Where a cave was not deemed safe for entry, efforts were made to assess the cave without entering. Approximately 217.5 person hours of search effort was undertaken (107.1 in phase 1 and 110.4 in phase 2) (Table 6.6; Figure 6.9).

6.5.3.2 Ultrasonic Recorders

Overnight recordings of bat echolocation calls were undertaken with Song Meter (SM4; Wildlife Acoustics Inc.) ultrasonic bat recorders at 78 sites (34 in phase 1 and 44 in phase 2) (Table 6.7; Figure 6.9). Detectors were placed near suitable habitat features, such as water holes, caves or foraging and dispersal corridors in Medium Drainage Line habitat. Recorders were deployed for between three and 20 consecutive nights at each site, resulting in a total of 387 recording nights (141 in phase 1 and 246 in phase 2) (Table 6.7; Figure 6.9).

The audio settings used for the SM4 units followed the manufacturer's recommendations (Wildlife Acoustics, 2011, 2017) and were set to account for all species known to occur within the region (McKenzie & Bullen, 2009). All recordings were analysed by Robert Bullen of Bat Call WA for the presence of Pilbara leaf-nosed bat and ghost bat calls only.

6.5.3.3 Habitat Classification

Roost habitats within the Study Area were classified as Critical, Supporting, or Nil, based on the following criteria developed by Bat Call (2021b)

Critical roost habitat:

- **Permanent diurnal (Categories 1 and 2) roosts** – critical habitat that is essential for the daily and long-term survival of the Pilbara leaf-nosed bat. Category 1 are maternity roosts where seasonal presence of young is proven. Category 2 are occupied year-round but without the proven presence of young.
- **Semi-permanent diurnal (Category 3) roosts** – critical habitat that is essential for the long-term survival of the Pilbara leaf-nosed bat. Used diurnally during some part of the year, but not occupied year-round. May be used during the breeding cycle and may facilitate long distance dispersal in the region, particularly in autumn. Often associated with nearby Category 1 or 2 permanent roost as a ‘satellite’ roost, that together make up a colony.

Supporting roost habitat:

- **Nocturnal refuge (Category 4)** – not considered critical but important for persistence in the local area. Are occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Includes most moderately deep caves and shallow abandoned mines.

Foraging habitat was classified according to Bat Call (2021b) Habitat Ratings:

Critical foraging habitat:

- **Habitat Rating 5 (outside a diurnal roost)** – Pilbara leaf-nosed bats are present permanently and will be detected nightly. Areas immediately outside a diurnal roost entrance.
- **Habitat Rating 4 (very high)** – Pilbara leaf-nosed bats are very likely to forage and/or drink if in range of a roost. Includes deep gorges.

Supporting foraging habitat:

- **Habitat Rating 3 (high)** – Pilbara leaf-nosed bats are likely to forage if in range of a roost. May be detected passing along creek lines, vegetation lines, rock faces or foraging in the most productive areas. Includes deep gorges.
- **Habitat Rating 2 (moderate)** – Pilbara leaf-nosed bats may occasionally forage due to presence of suitable vegetation, seasonal water and may also use areas as a flyway.
- **Habitat Rating 1 (low)** – Pilbara leaf-nosed bats are unlikely to forage but may traverse while crossing to more productive areas.

Nil habitat:

- **Habitat Rating 0 (poor)** – Pilbara leaf-nosed bats are unlikely to be detected. Includes bare open ground (e.g. salt and clay pans without vegetation and bare mesa and ridgeline tops).

6.5.4 Survey Results

6.5.4.1 Targeted searches

Fifty-seven caves have been recorded within the Study Area. Forty-two caves were classified as Category 4 nocturnal refuges (supporting habitat) but showed no evidence of use. The remaining 15 caves recorded in the Study Area showed no evidence of use are unlikely to be suitable for this species (Table 5.3). The Category 4 nocturnal refuges recorded within the Study Area are likely to be intermittently used by foraging and dispersing individuals from diurnal roost(s) located outside the Study Area.

6.5.4.2 Ultrasonic Recorders

Calls of Pilbara leaf-nosed bats were recorded at eight locations from 19 individual calls (15 calls in phase 1; four calls in phase 2). These calls were captured by ultrasonic units deployed within Stony Plain, Hillcrest/ Hillslope, Gorge/ Gully and Breakaway/ Cliff habitats (Table 6.9). These locations were primarily close to Category 4 (nocturnal refuge) caves, water features, or moderate to major outcropping (Table 6.9).

Table 6.9: Pilbara leaf-nosed bat recorded within the Study Area

Site	Habitat feature	Habitat	Date	Call Times	Calls
Phase 1					
VCPH-128	Major outcropping	Gorge/ Gully	2/05/2022	2011	1
VCPH-130	Cave (CMUD-04)	Gorge/ Gully	3/05/2022	2330 - 0454	1
VCPH-133	Moderate outcropping	Hillcrest/ Hillslope	2/05/2022	2159	9
VCPH-140	Cave (CMUD-11)	Breakaway/ Cliff	19/05/2022	2130	4
Phase 2					
VCPH-303	Cave (CMUD-57)	Gorge/ Gully	25/02/2023	0134	1
VCPH-342	-	Stony Plain	27/02/2023	2302	1
VCPH-342	-	Stony Plain	1/03/2023	2349	1
VCPH-393	WMUD-02, major outcropping	Hillcrest/ Hillslope	14/03/2023	2046	1

6.5.4.3 Habitat Classification

No habitats within the Study Area are considered critical for the Pilbara leaf-nosed bat, as it is not within 20 km of any known diurnal roosts (Bat Call, 2021b). The Gorge/ Gully and Breakaway/ Cliff habitats provide supporting foraging and dispersal habitat and are classified as Habitat Rating 2 (moderate) (Bat Call, 2021b). The Study Area also contains water features likely to provide supporting foraging habitat for the Pilbara leaf-nosed bat, with calls recorded at water feature WMUD-02 and approximately 500 metres (m) from WMUD-03, both in the western section of Mudlark Well. These water features would provide supporting habitat rather than critical habitat because they are not permanent and are situated further than 8.7 km from the nearest roost (BHP WAIO, 2023b).

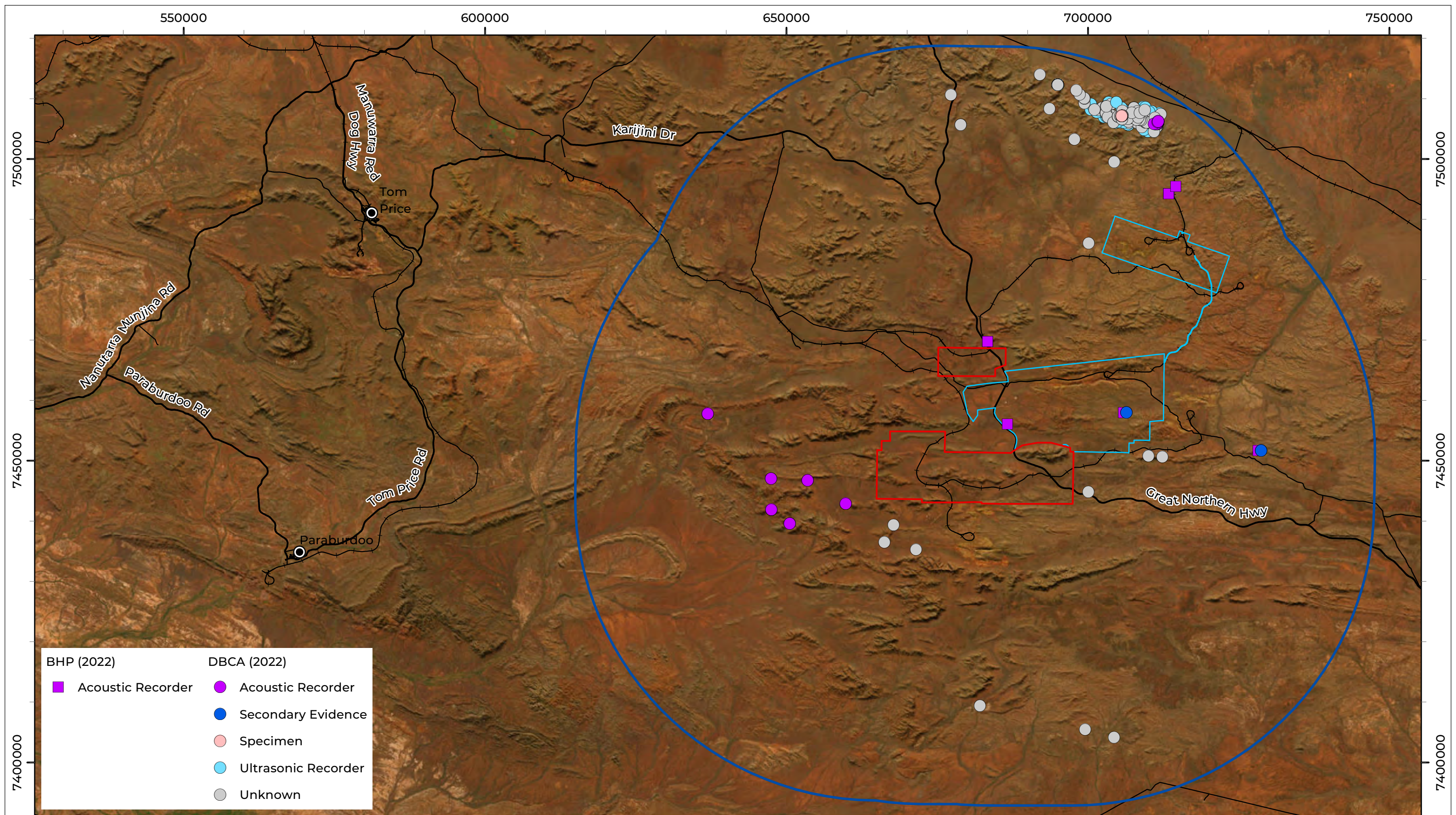
6.5.5 Discussion

The Pilbara leaf-nosed bat was recorded from eight locations during the current surveys, all within the Mudlark Well portion of the Study Area, and all but one of these were from the western end in close proximity to Karijini National Park. The timing of the calls (late evening and outside of civil twilight when roost emergence occurs) indicate that they are likely to be from foraging individuals, which are unlikely to be habitually using a nearby cave as a diurnal roost. This is consistent with observations from previous studies.

The nearest known permanent diurnal roosts for this species are at East Turee Creek, and an unknown location within Karijini National Park, both approximately 20 km west of the Study Area (Bat Call, 2021b). Pilbara leaf-nosed bats are predicted to travel up to 20 km from roost caves during nightly foraging (Cramer *et al.*, 2016a); however, seasonal variation is known to occur, with foraging occurring up to 20 km in the dry season and up to 50 km during the wet season (Bullen, 2013). Long-distance movements by the species have also been recorded, with a single monitored individual recorded from two roost caves located 170 km from each other approximately 12 months apart (Bullen & Reiffer, 2019), suggesting the species may forage and/or disperse over greater distances than previously thought. It is considered likely that the Pilbara leaf-nosed bats recorded in the Study Area may come from the East Turee Creek or Karijini roosts, although their presence during the late wet season could also mean that they have travelled to the Study Area from Gudai-Darri, which is about 40 km north-east.

The results of the current surveys support previous studies (summarised by Biologic (2020c)) which have showed that the Pilbara leaf-nosed bat is relatively scarce within the broader Newman area, due to the limited availability of roosting habitat. The scarcity of records within the Study Area and its immediate surrounds indicates its occurrence is likely restricted to foraging and/or dispersal events only.

The Pilbara population is regarded as a single interbreeding population (TSSC, 2016c; Umbrello *et al.*, 2022), and therefore, the entire population of Pilbara leaf-nosed bat present is classified as an 'important population'. The Study Area is considered unlikely to represent a significant area for Pilbara leaf-nosed bats based on the absence of Category 1, 2 and 3 roosts and of critical foraging habitat, as stipulated by (Bat Call, 2021b).



LEGEND

Study Area	Local Road
Desktop Assessment Area	State Road
Approval Boundary	Rail

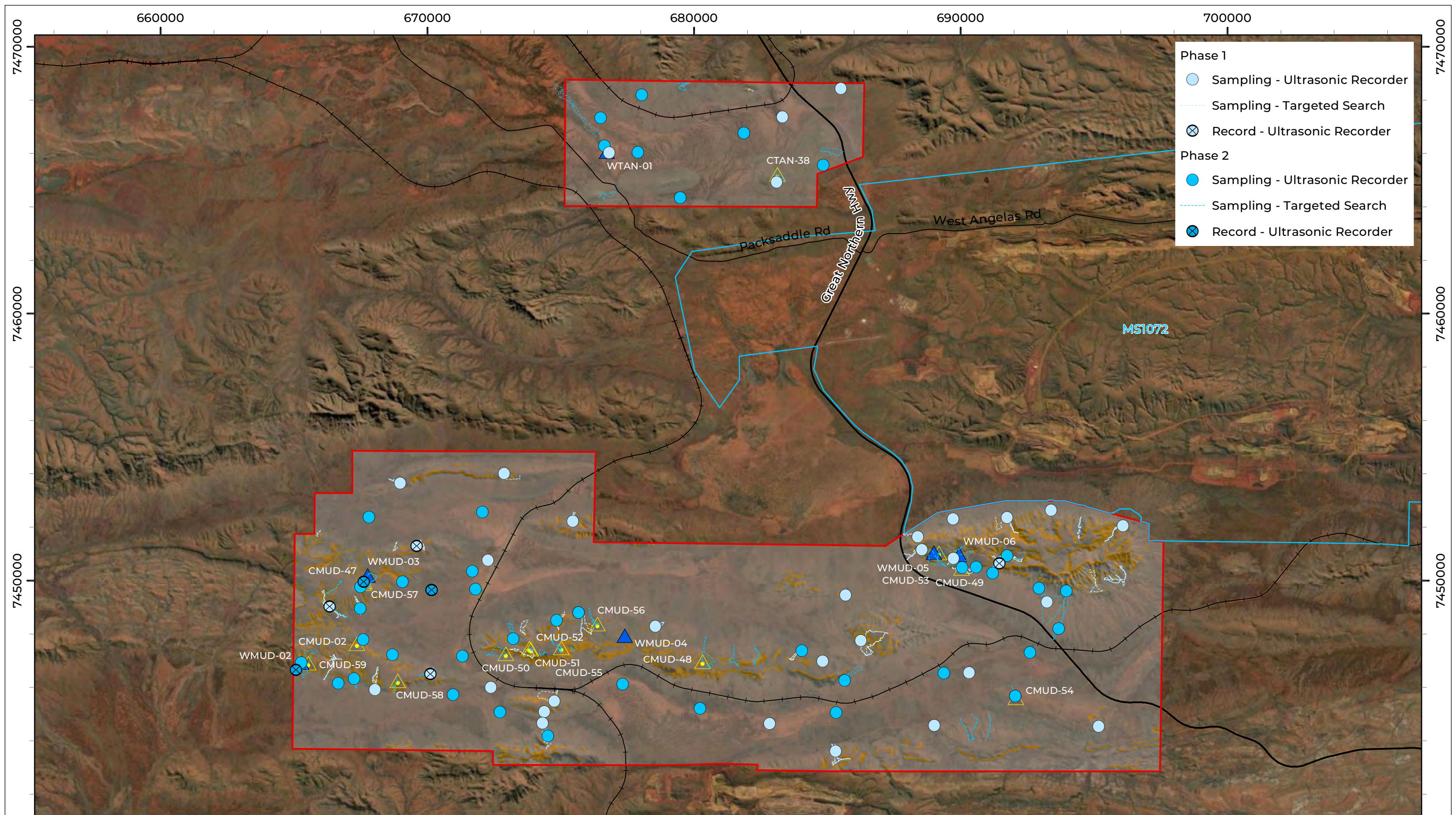
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0 10 20 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/06/2024

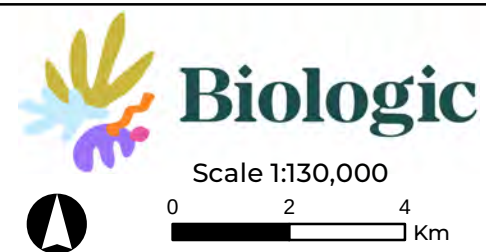
BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.8: Previous Pilbara
leaf-nosed bat records in the
Study Area and region



LEGEND

- | | | | |
|-------------------|------------|---------------|------------|
| Study Area | Local Road | Cave | Supporting |
| Approval Boundary | State Road | Water Feature | Nil |
| | Rail | | |



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 15/10/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.9: Pilbara leaf-nosed bat sampling, records and habitat in the Study Area

6.6 Grey Falcon (*Falco hypoleucos*)

6.6.1 Species Profile

The grey falcon is listed as Vulnerable under the EPBC Act and BC Act and is widely distributed over the northern parts of Australia's arid and semi-arid zone (Mullin *et al.*, 2020). Climate characteristics appear to play a crucial role in this species' distribution (Schoenjahn *et al.*, 2019), perhaps because these birds rely on low levels of relative humidity for efficient evaporative cooling (Schoenjahn *et al.*, 2022). Recent studies suggest the grey falcon comprises a single, widely distributed interbreeding population (although there may be weak population structure between breeding grounds in the east and west of Australia) with around 1,415 females (Mullin *et al.*, 2020). The Pilbara is thought to potentially be a stronghold (Sutton, 2010).

Grey falcons do not appear to be associated with particular vegetation types (Schoenjahn *et al.*, 2019); they often sit motionless in the canopies of trees or dead branches of eucalypts (Falkenberg, 2010). It tends to prefer sparsely-treed, open plains and creek lines for hunting (Olsen & Olsen, 1986).

Breeding takes place between mid to late winter and the end of spring (Schoenjahn *et al.*, 2019). Breeding habitat comprises riparian vegetation as well as other productive 'oases' within arid environments, though not necessarily immediately adjacent to waterholes (Sutton, 2010). Nesting often occurs in the abandoned nest of a raptor or corvid in trees or tall infrastructure such as power line towers or communications towers (Olsen & Olsen, 1986; Schoenjahn *et al.*, 2019). Within the Pilbara nests (made using disused stick nests of crows) were observed in two riparian eucalypts (*Eucalyptus coolabah* and *E. camaldulensis*; 23 km apart) on a dry river bed (Sutton, 2010). Ten years later, the area had a lot of scrubby regrowth and the grey falcons were absent (Sutton, 2010). Above-average rainfall in the first half of the year may encourage breeding if summer rainfall triggers growth of seed grasses which in turn increases abundance of granivorous birds which the species prey on (Sutton, 2010).

Grey falcons have an almost exclusive diet of birds, especially budgerigars (*Melopsittacus undulatus*), pigeons, doves and zebra finches (*Taeniopygia castanoides*) but can, under unusual circumstances, include small non-avian species (Schoenjahn, 2013). Whether they scavenge carrion has been disputed, although they do have a tendency to consume their prey on the ground, sometimes by the side of roads and tracks (Schoenjahn, 2018).

Modelling by Runge *et al.* (2014) estimated the minimum range size as 882,558 km². Recent research has shown that it is a 'reluctant nomad'; only if conditions become a risk to their survival are they likely to move on and then, when they do, they move no further than necessary (Schoenjahn, 2018). The grey falcon tends to stay and forego breeding rather than search for more favourable conditions (Schoenjahn, 2018). In general, it tends to keep physical activity levels low (Schoenjahn *et al.*, 2022).

6.6.2 Previous Records

The desktop assessment returned five records of grey falcon within 50 km of the Study Area (Figure 6.10) (DBCA, 2022b; WAIO, 2022). In 2008, multiple observations were made on the same day of an individual foraging 1.5–2.7 km north of Mudlark Well (DBCA, 2022b; ENV, 2008a). Two birds were observed 0.5 km south of Mudlark Well in 1997 (Ecologia, 1998c). Ecologia (2004b) opportunistically recorded an individual in the Packsaddle range in 2004, just outside the Study Area (exact location undescribed). The remaining record from the desktop assessment is located 45.1 km north of the Study Area. More than 327 person hours of avifauna sampling has been previously undertaken in the Study Area.

6.6.3 Survey Methods

6.6.3.1 Targeted Searches

A total of 81 targeted searches were undertaken within the Study Area (41 in phase 1; 40 in phase 2) with a focus on the Hillcrest/ Hillslope, Undulating Low Hills, Gorge/ Gully, Breakaway/ Cliff and Medium Drainage Line habitats (Table 6.10; Figure 6.11). Grey falcon is largely an opportunistically recorded species. Given that there was limited preferred habitat for the species (e.g. sparsely-treed, open plains and creek lines for hunting), most of the targeted searches were undertaken alongside targeted searches for other species, including ghost bat, Pilbara leaf-nosed bat and Pilbara olive python. A total of 224 person hours were undertaken (113.6 in phase 1; 110.4 in phase 2) (Table 6.10). Opportunistic searches were also undertaken whilst undertaking sampling for other target species and traversing the Study Area.

Table 6.10: Targeted searches completed for grey falcon within the Study Area

Transect Name	Date	Habitat	Person hours
Phase 1			
TCPH-132	2/05/2022	Gorge/ Gully	2.5
TCPH-242	29/05/2022	Hillcrest/ Hillslope	3.5
TCPH-229	28/05/2022	Gorge/ Gully	5.5
TCPH-128	5/05/2022	Gorge/ Gully	4.0
TCPH-091	4/05/2022	Medium Drainage Line	3.0
TCPH-166	4/05/2022	Medium Drainage Line	2.0
TCPH-087	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-180	26/05/2022	Breakaway/ Cliff	1.0
TCPH-100	30/04/2022	Gorge/ Gully	5.0
TCPH-153	3/05/2022	Gorge/ Gully	2.0
TCPH-117	1/05/2022	Gorge/ Gully	4.0
TCPH-090	29/04/2022	Hillcrest/ Hillslope	2.0
TCPH-133	2/05/2022	Gorge/ Gully	2.0
TCPH-193	27/05/2022	Gorge/ Gully	4.0
TCPH-200	27/05/2022	Breakaway/ Cliff	6.4
TCPH-134	6/05/2022	Hillcrest/ Hillslope	1.0

Transect Name	Date	Habitat	Person hours
TCPH-035	8/04/2022	Breakaway/ Cliff	1.0
TCPH-123	1/05/2022	Gorge/ Gully	1.2
TCPH-086	28/04/2022	Breakaway/ Cliff	5.0
TCPH-194	27/05/2022	Hillcrest/ Hillslope	1.0
TCPH-160	4/05/2022	Gorge/ Gully	4.5
TCPH-170	4/05/2022	Gorge/ Gully	2.0
TCPH-181	26/05/2022	Breakaway/ Cliff	2.0
TCPH-125	1/05/2022	Gorge/ Gully	1.0
TCPH-127	1/05/2022	Gorge/ Gully	2.0
TCPH-109	2/05/2022	Gorge/ Gully	2.0
TCPH-195	27/05/2022	Gorge/ Gully	1.5
TCPH-085	28/04/2022	Gorge/ Gully	2.0
TCPH-145	3/05/2022	Gorge/ Gully	2.0
TCPH-041	9/04/2022	Medium Drainage Line	1.5
TCPH-089	29/04/2022	Gorge/ Gully	1.5
TCPH-140	1/05/2022	Gorge/ Gully	2.0
TCPH-088	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-129	5/05/2022	Gorge/ Gully	2.0
TCPH-185	26/05/2022	Gorge/ Gully	4.0
TCPH-095	30/04/2022	Gorge/ Gully	6.0
TCPH-130	2/05/2022	Gorge/ Gully	1.0
TCPH-131	5/05/2022	Breakaway/ Cliff	2.5
TCPH-140	3/05/2022	Gorge/ Gully	9.0
TCPH-149	3/05/2022	Gorge/ Gully	4.0
TCPH-209	28/05/2022	Gorge/ Gully	3.0
Phase 2			
TCPH-345	16/02/2023	Gorge/ Gully	1.5
TCPH-348	16/02/2023	Hillcrest/ Hillslope	1.2
TCPH-356	16/02/2023	Gorge/ Gully	0.6
TCPH-358	16/02/2023	Undulating Low Hills	0.6
TCPH-300	17/02/2023	Gorge/ Gully	7.0
TCPH-301	17/02/2023	Gorge/ Gully	4.5
TCPH-302	17/02/2023	Breakaway/ Cliff	8.2
TCPH-303	17/02/2023	Gorge/ Gully	5.0
TCPH-304	18/02/2023	Gorge/ Gully	6.0
TCPH-305	18/02/2023	Breakaway/ Cliff	2.0
TCPH-311	18/02/2023	Gorge/ Gully	1.0
TCPH-315	18/02/2023	Gorge/ Gully	1.5
TCPH-310	19/02/2023	Breakaway/ Cliff	1.5
TCPH-315_1	19/02/2023	Gorge/ Gully	1.0
TCPH-317	19/02/2023	Breakaway/ Cliff	3.6
TCPH-319	19/02/2023	Gorge/ Gully	2.5

Transect Name	Date	Habitat	Person hours
TCPH-321	19/02/2023	Breakaway/ Cliff	2.0
TCPH-323	19/02/2023	Gorge/ Gully	3.0
TCPH-327	20/02/2023	Gorge/ Gully	2.0
TCPH-329	20/02/2023	Gorge/ Gully	2.0
TCPH-324	21/02/2023	Breakaway/ Cliff	3.0
TCPH-331	21/02/2023	Breakaway/ Cliff	4.0
TCPH-333	21/02/2023	Breakaway/ Cliff	2.6
TCPH-335	22/02/2023	Breakaway/ Cliff	3.3
TCPH-303_1	23/02/2023	Gorge/ Gully	3.0
TCPH-323_1	23/02/2023	Gorge/ Gully	3.0
TCPH-300_1	24/02/2023	Gorge/ Gully	6.0
TCPH-368	9/03/2023	Gorge/ Gully	4.0
TCPH-373	9/03/2023	Breakaway/ Cliff	1.5
TCPH-374	9/03/2023	Hillcrest/ Hillslope	3.0
TCPH-041	9/03/2023	Medium Drainage Line	1.5
TCPH-392	12/03/2023	Gorge/ Gully	2.0
TCPH-397	15/03/2023	Gorge/ Gully	3.0
TCPH-398	15/03/2023	Gorge/ Gully	4.0
TCPH-402	15/03/2023	Breakaway/ Cliff	0.5
TCPH-403	15/03/2023	Breakaway/ Cliff	0.8
TCPH-405	15/03/2023	Gorge/ Gully	2.0
TCPH-375	17/03/2023	Gorge/ Gully	2.5
TCPH-401	17/03/2023	Gorge/ Gully	2.0
TCPH-406	17/03/2023	Medium Drainage Line	2
Total targeted searches completed			81
Total person hours			224

6.6.4 Survey Results

No evidence of grey falcon presence was observed in the Study Area during the current surveys.

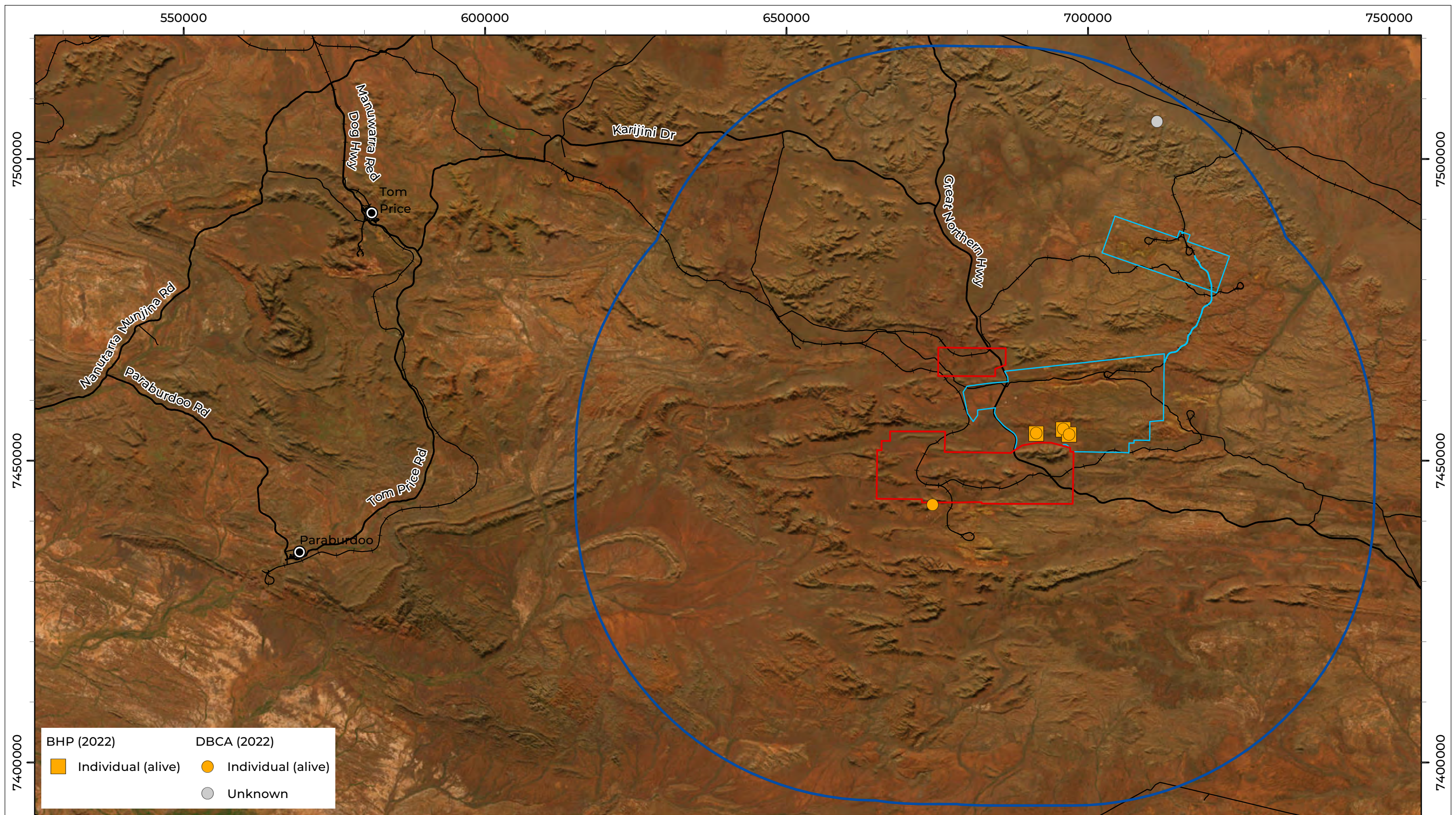
No habitat within the Study Area is considered critical habitat for grey falcon, primarily due to the lack of Major Drainage Line habitat. The Drainage Area/ Floodplain (10.06%, 3,671.74 ha), Minor Drainage Line (2.31%, 842.90 ha) and Medium Drainage Line (0.33%, 119.56 ha), may provide supporting habitat for the species. These habitats are unlikely to provide nesting habitat due to the lack of large eucalypts, although there is an isolated section of tall infrastructure (tall power lines) within the Study Area, located within the far western section of Mudlark Well, which may provide nesting habitat.

6.6.5 Discussion

The grey falcon comprises a single interbreeding population (Mullin *et al.*, 2020) and the Pilbara is thought to be a stronghold (Sutton, 2010). Thus, any grey falcon present in the Pilbara is considered to be part of an 'important population'.

There is no critical habitat for the grey falcon in the Study Area, due to the lack of Major Drainage Line Habitat and large eucalypts that it uses for nesting. Although not considered critical habitat, there is a section of Medium Drainage Line habitat that occurs alongside an isolated section of tall power line towers within the Study Area, located in western section of Mudlark Well. This may provide valuable supporting habitat to the species. This tall infrastructure extends outside the Study area into the surrounding local area.

The Drainage Area/ Floodplain, Minor Drainage Line and Medium Drainage Line areas may provide supporting habitat for the species, and therefore this species is likely to only occur transiently within the Study Area. It is unlikely to be reliant on habitats within the Study Area for long-term survival on a local or regional scale.



LEGEND

 Study Area	 Local Road
 Desktop Assessment Area	 State Road
 Approval Boundary	 + Rail



Biologic

Scale 1:575,000

0 10 20 Km

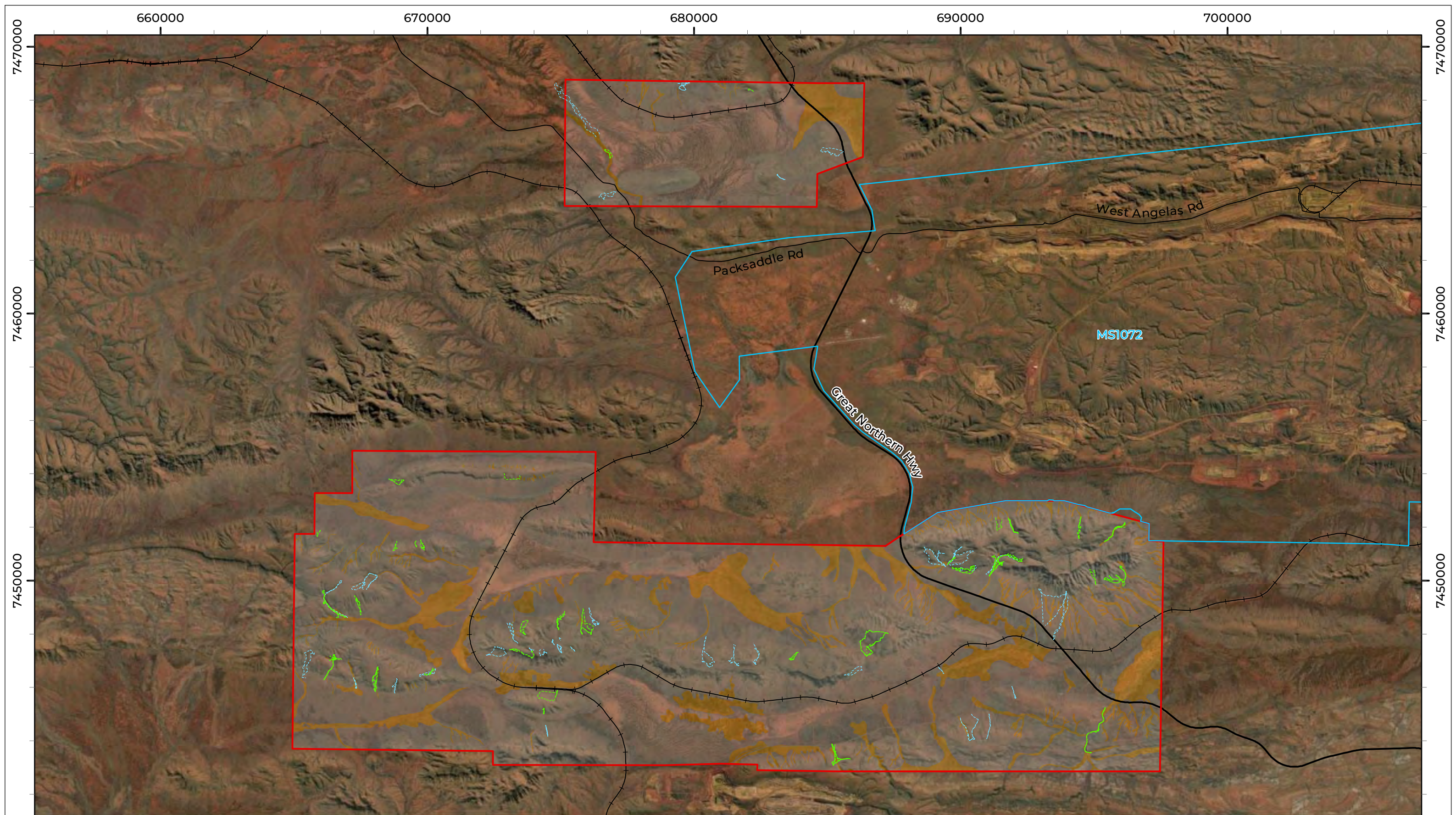
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Port Hedland
Karratha
Newman

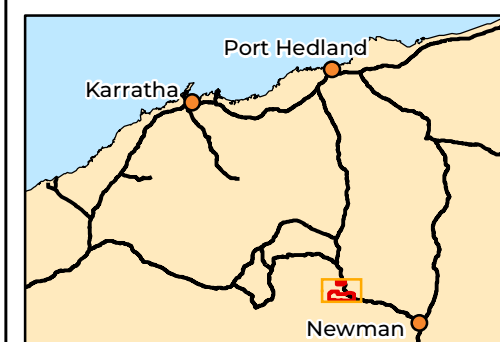
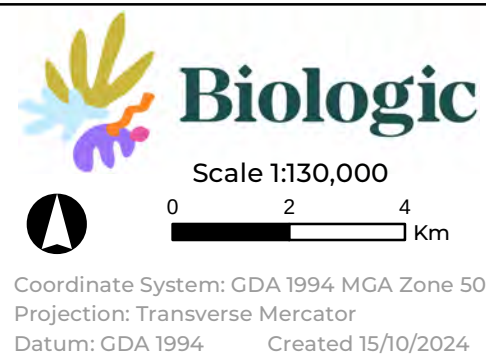
BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.10: Previous grey falcon records in the Study Area and region



LEGEND

- | | | | |
|--|--|--|---|
|  Study Area |  Local Road | Habitat |  Phase 1 Targeted Search |
|  Approval Boundary |  State Road |  Supporting |  Phase 2 Targeted Search |
| |  Rail |  Nil | |



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2
Figure 6.11: Grey falcon
sampling and habitat in
the Study Area

6.7 Pilbara Olive Python (*Liasis olivaceus* subsp. *barroni*)

6.7.1 Species Profile

The Pilbara olive python is listed as Vulnerable under the EPBC Act and the BC Act. It is Western Australia's largest snake, averaging 2.5 m in length, with records up to 4.5 m (Bush & Maryan, 2011; Cogger, 2014). It has a dull olive-brown upper surface and a pale cream underbelly (Burbidge, 2004; Cogger, 2014). It is endemic to the Pilbara and northern parts of the Gascoyne bioregions, distributed from Burrup Peninsula, Ord Ranges and Meentheena south to Nanutarra and Newman in the Pilbara, with an isolated population occurring at Mt Augustus in the Gascoyne region (Bush & Maryan, 2011; Storr *et al.*, 2002).

It is primarily nocturnal and tends to shelter amongst rocky habitats, in small caves or under vegetation during the day. During summer months they will emerge from daytime shelters soon after dark and continue to move until the early hours of the morning (DSEWPaC, 2011b). In the winter months, it is primarily nocturnal, although adult pythons can sometimes be found basking in the morning sun (DSEWPaC, 2011b). The breeding season takes place in the cooler months, which extends from June to August, and males will travel up to 3 km in search of a mate (DSEWPaC, 2011b). It is a well-adapted opportunistic ambush predator and common prey items include rock-wallabies, small euros, fruit bats, waterbirds, and doves/pigeons (Ellis, 2013; Ellis & Johnstone, 2016; Pearson, 2007; Pearson, 2003; TSSC, 2008a).

It commonly inhabits moist areas such as gorges, rivers, pools and surrounding hills, but can be found in a range of habitats (Burbidge, 2004; DSEWPaC, 2011b). In the Hamersley region, it is most often encountered in the vicinity of permanent waterholes in rocky ranges or among riverine vegetation (DSEWPaC, 2011b; Pearson, 1993). It is likely to be attracted to these areas due to the productivity and abundance of suitably-sized prey (Pearson, 2003).

6.7.2 Previous Records

The Study Area is located within the current distribution of Pilbara olive python, whereby the species or species' habitat is likely to occur (DoE, 2022c). The desktop assessment returned 56 records of the species, including four within the Study Area (Figure 6.12) (Biologic, 2013a, 2013d, 2023d). This comprises an individual observed in the Study Area in 2023, two live individuals observed within two gorges in Mudlark Well in 2013, and a live individual within Major Drainage Line habitat at Area C West in 2013 (Biologic, 2013a, 2013d, 2023d). A total of 44.5 person hours of targeted sampling for Pilbara olive pythons, as well as eDNA sampling at 10 water features, has been previously undertaken in the Study Area (Biologic, 2023d).

From the local vicinity, four previous records of Pilbara olive python are within 5 km of the Study Area. This includes a dead roadkill Pilbara olive python recorded 2.1 km outside of the boundary of the Study Area on Great Northern Highway (O'Connell pers. comm.) and three opportunistic records at the South Flank mine during a targeted northern quoll survey (Biologic, 2016b). Further afield, an eDNA sample collected by Biologic (2023d) confirmed the species presence within Gorge/ Gully habitat 7.4 km north of the Study Area.

6.7.3 Survey Methods

6.7.3.1 Targeted Searches

Diurnal searches were conducted along 84 transects within suitable habitat (41 in phase 1 and 43 in phase 2), including at known water features (Figure 6.13; Table 6.11). Nocturnal searches were completed at an additional 12 locations during phase 2 (

Table 6.12). Searches focused on observing active individuals and/or secondary evidence such as scats, sloughs or remains. A total of 226.1 person hours of targeted diurnal searches (113.6 in phase 1; 119.9 in phase 2) and 51.5 person hours of nocturnal searches were undertaken (Table 6.11;

Table 6.12).

Table 6.11: Targeted searches completed for Pilbara olive python within the Study Area

Transect Name	Date	Habitat	Person hours
Phase 1			
TCPH-132	2/05/2022	Gorge/ Gully	2.5
TCPH-242	29/05/2022	Hillcrest/ Hillslope	3.5
TCPH-229	28/05/2022	Gorge/ Gully	5.5
TCPH-128	5/05/2022	Gorge/ Gully	4.0
TCPH-091	4/05/2022	Medium Drainage Line	3.0
TCPH-166	4/05/2022	Medium Drainage Line	2.0
TCPH-087	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-180	26/05/2022	Breakaway/ Cliff	1.0
TCPH-100	30/04/2022	Gorge/ Gully	5.0
TCPH-153	3/05/2022	Gorge/ Gully	2.0
TCPH-117	1/05/2022	Gorge/ Gully	4.0
TCPH-090	29/04/2022	Hillcrest/ Hillslope	2.0
TCPH-133	2/05/2022	Gorge/ Gully	2.0
TCPH-193	27/05/2022	Gorge/ Gully	4.0
TCPH-200	27/05/2022	Breakaway/ Cliff	6.4
TCPH-134	6/05/2022	Hillcrest/ Hillslope	1.0
TCPH-035	8/04/2022	Breakaway/ Cliff	1.0
TCPH-123	1/05/2022	Gorge/ Gully	1.2
TCPH-086	28/04/2022	Breakaway/ Cliff	5.0
TCPH-194	27/05/2022	Hillcrest/ Hillslope	1.0
TCPH-160	4/05/2022	Gorge/ Gully	4.5
TCPH-170	4/05/2022	Gorge/ Gully	2.0
TCPH-181	26/05/2022	Breakaway/ Cliff	2.0
TCPH-125	1/05/2022	Gorge/ Gully	1.0
TCPH-127	1/05/2022	Gorge/ Gully	2.0
TCPH-109	2/05/2022	Gorge/ Gully	2.0
TCPH-195	27/05/2022	Gorge/ Gully	1.5
TCPH-085	28/04/2022	Gorge/ Gully	2.0

Transect Name	Date	Habitat	Person hours
TCPH-145	3/05/2022	Gorge/ Gully	2.0
TCPH-041	9/04/2022	Medium Drainage Line	1.5
TCPH-089	29/04/2022	Gorge/ Gully	1.5
TCPH-140	1/05/2022	Gorge/ Gully	2.0
TCPH-088	29/04/2022	Hillcrest/ Hillslope	1.0
TCPH-129	5/05/2022	Gorge/ Gully	2.0
TCPH-185	26/05/2022	Gorge/ Gully	4.0
TCPH-095	30/04/2022	Gorge/ Gully	6.0
TCPH-130	2/05/2022	Gorge/ Gully	1.0
TCPH-131	5/05/2022	Breakaway/ Cliff	2.5
TCPH-140	3/05/2022	Gorge/ Gully	9.0
TCPH-149	3/05/2022	Gorge/ Gully	4.0
TCPH-209	28/05/2022	Gorge/ Gully	3.0
Phase 2			
TCPH-345	16/02/2023	Gorge/ Gully	1.5
TCPH-348	16/02/2023	Hillcrest/ Hillslope	1.2
TCPH-356	16/02/2023	Gorge/ Gully	0.6
TCPH-358	16/02/2023	Undulating Low Hills	0.6
TCPH-300	17/02/2023	Gorge/ Gully	7.0
TCPH-301	17/02/2023	Gorge/ Gully	4.5
TCPH-302	17/02/2023	Breakaway/ Cliff	8.2
TCPH-303	17/02/2023	Gorge/ Gully	5.0
TCPH-304	18/02/2023	Gorge/ Gully	6.0
TCPH-305	18/02/2023	Breakaway/ Cliff	2.0
TCPH-307	18/02/2023	Medium Drainage Line	1.0
TCPH-311	18/02/2023	Gorge/ Gully	1.5
TCPH-315	18/02/2023	Gorge/ Gully	1.5
TCPH-310	19/02/2023	Breakaway/ Cliff	1.0
TCPH-315_1	19/02/2023	Gorge/ Gully	3.6
TCPH-317	19/02/2023	Breakaway/ Cliff	2.5
TCPH-319	19/02/2023	Gorge/ Gully	2.0
TCPH-321	19/02/2023	Breakaway/ Cliff	3.0
TCPH-323	19/02/2023	Gorge/ Gully	2.0
TCPH-327	20/02/2023	Gorge/ Gully	2.0
TCPH-329	20/02/2023	Gorge/ Gully	3.0
TCPH-324	21/02/2023	Breakaway/ Cliff	1.5
TCPH-331	21/02/2023	Breakaway/ Cliff	1.2
TCPH-333	21/02/2023	Breakaway/ Cliff	0.6
TCPH-308	22/02/2023	Medium Drainage Line	0.6
TCPH-335	22/02/2023	Breakaway/ Cliff	7.0
TCPH-303_1	23/02/2023	Gorge/ Gully	4.5
TCPH-323_1	23/02/2023	Gorge/ Gully	8.2

Transect Name	Date	Habitat	Person hours
TCPH-300_1	24/02/2023	Gorge/ Gully	5.0
TCPH-368	9/03/2023	Gorge/ Gully	6.0
TCPH-373	9/03/2023	Breakaway/ Cliff	2.0
TCPH-374	9/03/2023	Hillcrest/ Hillslope	0.5
TCPH-041	9/03/2023	Medium Drainage Line	1.0
TCPH-392	12/03/2023	Gorge/ Gully	1.5
TCPH-397	15/03/2023	Gorge/ Gully	1.5
TCPH-398	15/03/2023	Gorge/ Gully	1.0
TCPH-402	15/03/2023	Breakaway/ Cliff	3.6
TCPH-403	15/03/2023	Breakaway/ Cliff	2.5
TCPH-405	15/03/2023	Gorge/ Gully	2.0
TCPH-393	16/03/2023	Gorge/ Gully	3.0
TCPH-375	17/03/2023	Gorge/ Gully	2.0
TCPH-401	17/03/2023	Gorge/ Gully	2.0
TCPH-406	17/03/2023	Medium Drainage Line	3.0
Total targeted searches completed			84
Total person hours			226.1

Table 6.12: Nocturnal searches completed for Pilbara olive python within the Study Area

Transect Name	Date	Habitat	Person hours
Phase 2			
TCPH-315	20/02/2023	Gorge/ Gully	8.0
TCPH-328	21/02/2023	Gorge/ Gully	6.0
TCPH-340	22/02/2023	Medium Drainage Line	8.0
TCPH-303	23/02/2023	Gorge/ Gully	3.0
TCPH-176	10/03/2023	Medium Drainage Line	4.0
TCPH-373	10/03/2023	Breakaway/ Cliff	4.0
TCPH-93	10/03/2023	Gorge/ Gully	2.5
TCPH-304	11/03/2023	Gorge/ Gully	3.0
TCPH-132	12/03/2023	Gorge/ Gully	3.0
TCPH-122	13/03/2023	Breakaway/ Cliff	3.0
TCPH-345	13/03/2023	Gorge/ Gully	4.0
TCPH-304_1	16/03/2023	Gorge/ Gully	3.0
Total targeted searches completed			12
Total person hours			51.5

6.7.4 Survey Results

6.7.4.1 Targeted Searches

No Pilbara olive python individuals or evidence of the species' occurrence were recorded within the Study Area during the targeted searches (Figure 6.13).

An individual was observed in the Study Area on the 10 March 2023, during a concurrent targeted Pilbara olive python survey undertaken by Biologic (Biologic, 2023d), and so is included in the results of this survey. This individual was observed within Gorge/ Gully habitat in Mudlark Well, where it is thought to occur permanently due to the presence of critical habitat.

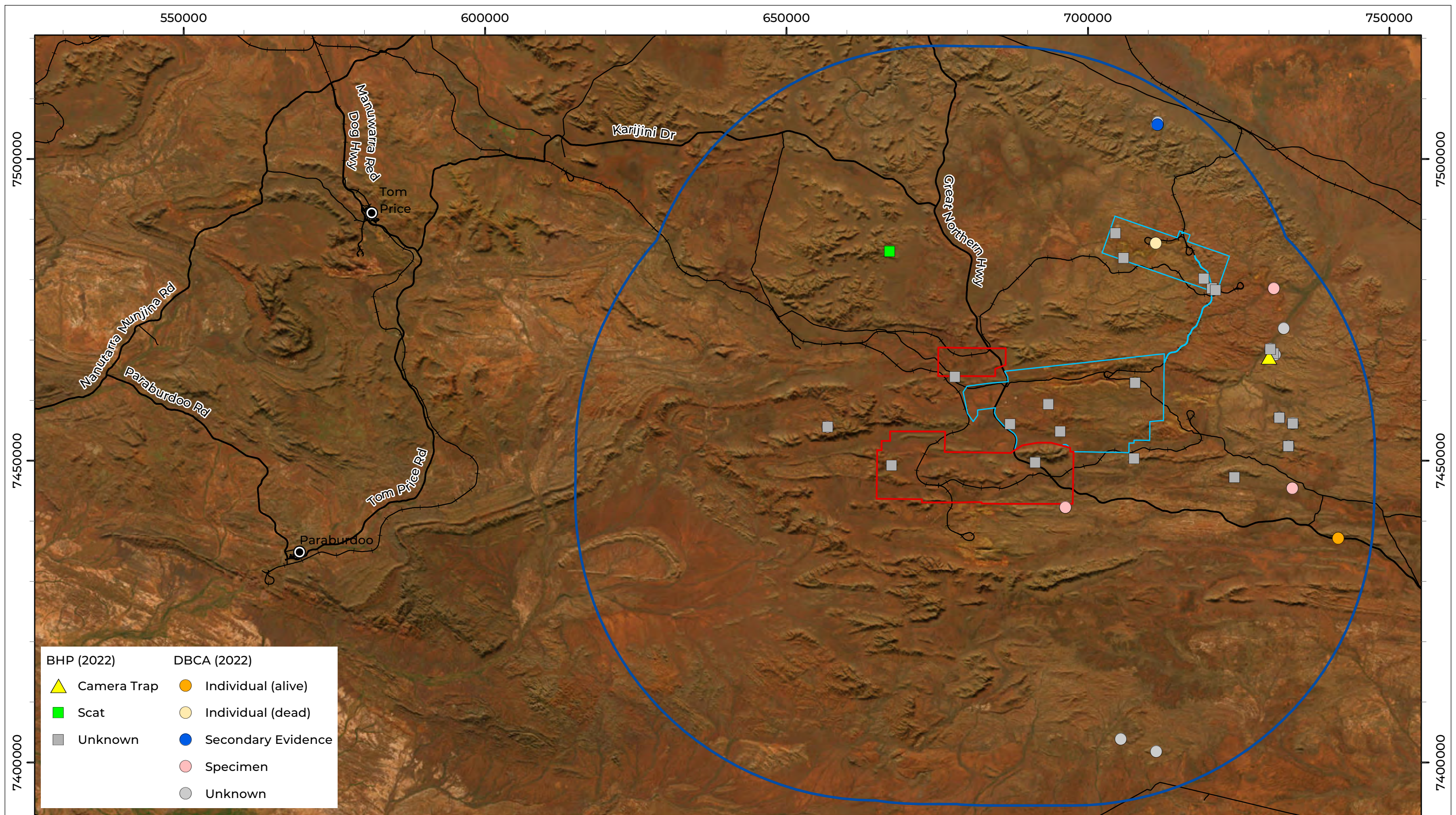
The Gorge/ Gully (3.50%, 1,277.69 ha) and Breakaway/ Cliff (2.10%, 767.24 ha) habitats provide critical habitat within the Study Area (Figure 6.13). The Medium Drainage Line (0.33%, 119.56 ha) and Minor Drainage Line (2.31%, 842.90 ha) areas provide supporting habitat, particularly in areas where it provides connectivity between areas of critical habitat, and those containing persistent water pools (Figure 5.1). Seven water features were recorded in the Study Area (two semi-permanent, five temporary), located within Gorge/ Gully, Mulga Woodland and Medium Drainage Line habitat (Figure 5.2). These water features are considered supporting habitat features for the species in the Study Area (BHP WAI0, 2023b).

6.7.5 Discussion

One individual was recorded within the Study Area during the survey period (Biologic, 2023d), and the species has previously been recorded on four other occasions (Biologic, 2011f, 2013a, 2023d). Within the Study Area, the Gorge/ Gully and Breakaway/ Cliff habitats provide critical breeding and dispersal/ foraging habitat (Figure 6.13). The Medium Drainage Line and Minor Drainage Line areas provide supporting foraging and dispersal habitat.

Seven water features were recorded in the Study Area (two semi-permanent, five temporary). For Pilbara olive pythons, these water features often act as critical foraging locations and for that reason it is more often than not associated with such features, particularly in rocky habitats, but also to a lesser degree in Major Drainage Line and Medium Drainage Line habitats where suitable vegetation cover is present (Pearson, 1993). As the water features present in the Study Area are temporary and semi-permanent, the water features themselves have been classified as supporting habitat (BHP WAI0, 2023b).

The Pilbara olive python is consistently recorded in the region surrounding the Study Area, and has been recorded several times within the Study Area and over multiple years, with both critical and supporting habitat present. Based on this, the Pilbara olive pythons recorded within the Study Area are likely to form part of an 'important population' as defined by DoE (2013).



BHP (2022)		DBCA (2022)	
	Camera Trap		Individual (alive)
	Scat		Individual (dead)
	Unknown		Secondary Evidence
			Specimen
			Unknown

LEGEND	
	Study Area
	Desktop Assessment Area
	Approval Boundary
	Local Road
	State Road
	Rail



Biologic

Scale 1:575,000

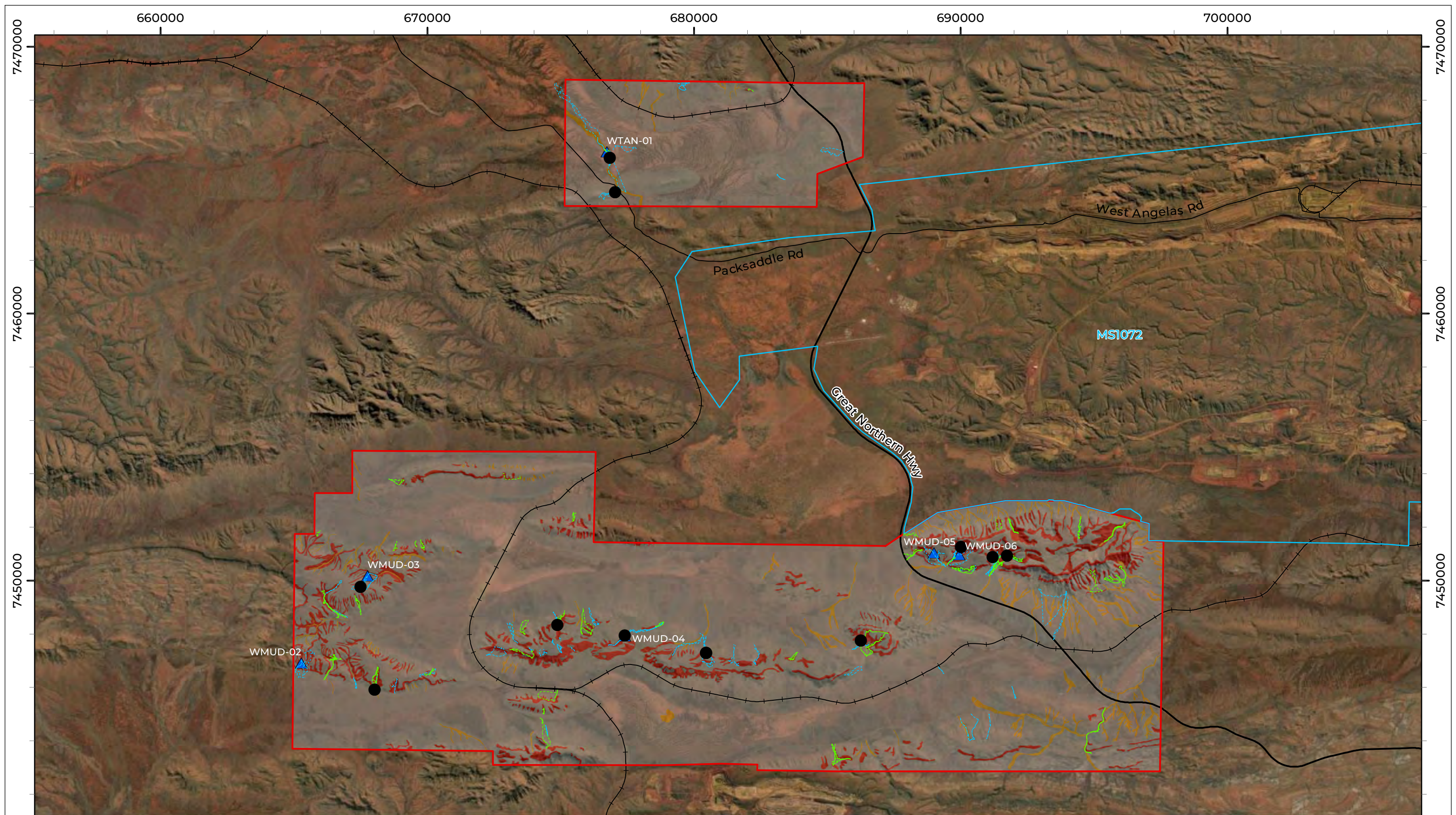
0 10 20 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 04/06/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.12: Previous Pilbara olive python records in the Study Area and region



LEGEND

Study Area

Approval Boundary

Local Road

State Road

Rail

Water Feature

Habitat

Critical

Supporting

Nil

Phase 1

Targeted Search

Phase 2

Nocturnal Search

Targeted Search



Biologic

Scale 1:130,000

0

2

4

Km

Coordinate System: GDA 1994 MGA Zone 50

Projection: Transverse Mercator

Datum: GDA 1994

Created 15/10/2024

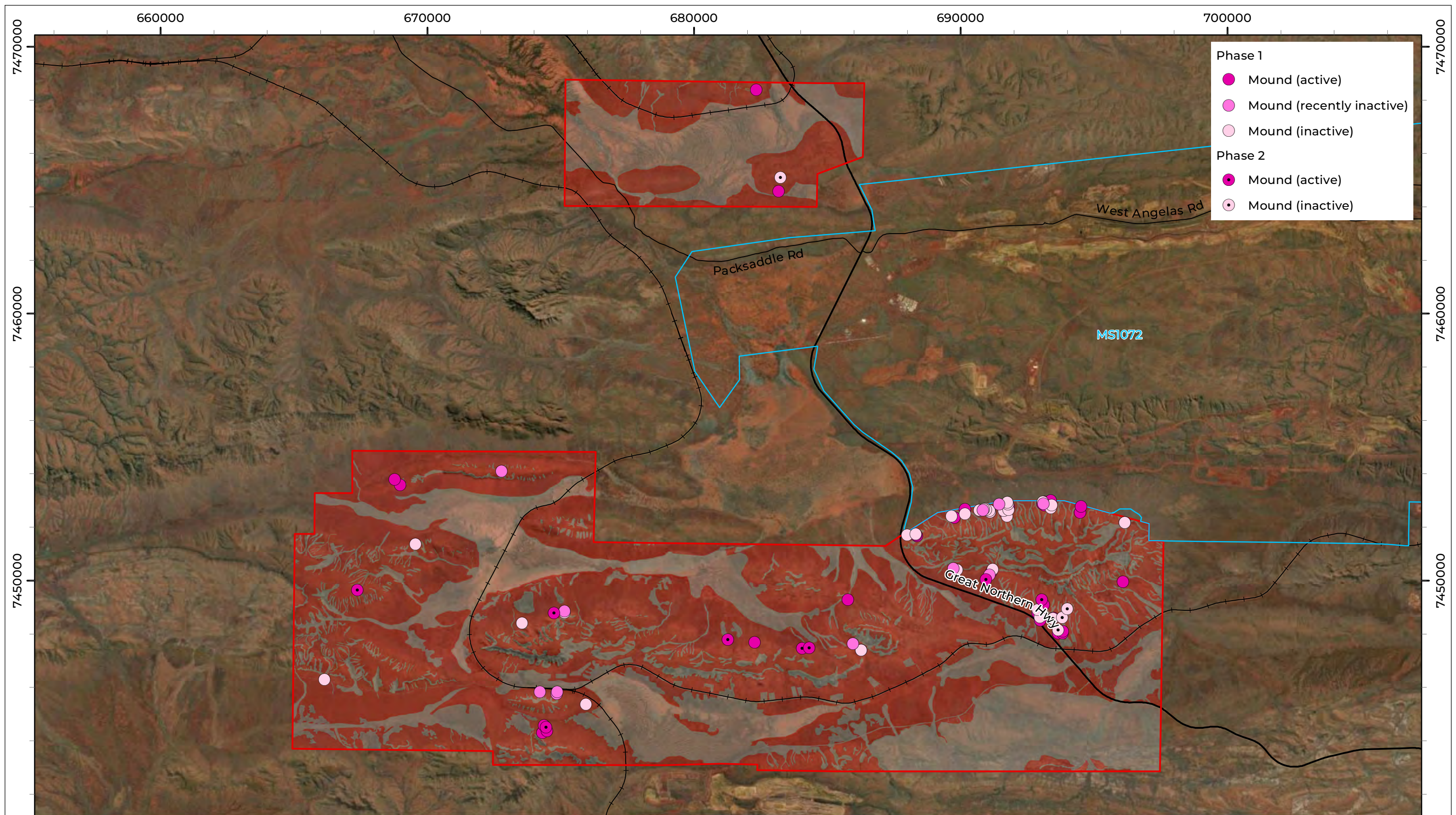
BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.13: Pilbara olive
python sampling and habitat
in the Study Area

6.8 Other Fauna of Significance

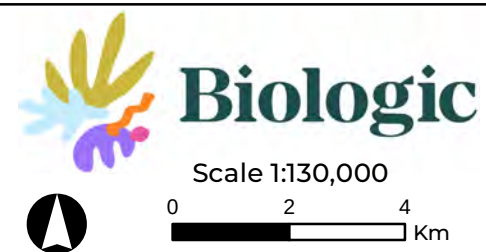
One non-target species of significance was identified during the current surveys: the western pebble-mound mouse (*Pseudomys chapmani*). Eighty-nine pebble-mounds were recorded, which were classified as 42 active mounds, 11 recently inactive mounds, 35 inactive mounds and one inactive burrow (Appendix H; Figure 6.14).

Evidence (mounds) of the western pebble-mound mouse has previously been recorded on 2,931 occasions within 50 km of the Study Area; 156 of these records were within the Study Area. The mounds of this species are most frequently recorded within the Hillcrest/ Hillslope and Stony Plain habitats.



LEGEND

- | | | |
|-------------------|------------|------------------|
| Study Area | Local Road | Habitat Critical |
| Approval Boundary | State Road | Nil |
| | Rail | |



Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 31/05/2024



BHP WAIO
CPH Targeted MNES
Vertebrate Fauna Survey
Stage 2

Figure 6.14: Western pebble-mound mouse records and habitat classification

6.9 Constraints and Limitations

The (EPA, 2020b) outlines several potential limitations to vertebrate fauna surveys. These aspects are assessed and discussed in Table 6.13 below. No major limitations or constraints were identified for the surveys.

Table 6.13: Survey constraints and limitations

Potential limitation or constraint	Constraint	Applicability to this survey
Sources/ availability of data and information (recent or historic) and availability of contextual information	No	A significant amount of survey work has been undertaken within the Study Area and in the surrounding region, and most of these previous survey results were available for review.
Competency/ experience of the survey team	No	The field personnel involved in the survey are experienced in undertaking fauna surveys of similar nature, including with the significant species targeted during the survey. Technical personnel with relevant expertise assisted with analysis of ultrasonic recordings (Bob Bullen) and analysis of acoustic recordings (Nigel Jackett and Nicholas Leseberg).
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope was a targeted fauna survey and was conducted within the EPA (2020b) <i>Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment</i>. Northern quoll – The species was sampled following survey guidelines in relation to survey design and effort, site coverage, and detectability (DoE, 2016). A total of 22 camera trap transects were set during this assessment (resulting in 2,080 sampling nights). Targeted searches were undertaken for secondary evidence (e.g. scats). Greater bilby – Sampling consisted of identifying suitable habitat, targeted greater bilby plots and opportunistic records. Pilbara leaf-nosed bat – Sampling consisted of 78 ultrasonic recorder deployments (387 sampling nights) and targeted searches for roosts. Ultrasonic detectors were placed at significant habitat areas including water features where possible. Ghost bat – Sampling consisted of 78 ultrasonic recorder deployments (387 sampling nights) and targeted searches for potential roosts. Night parrot – Sampling consisted of acoustic recorders at locations containing the best habitat present within the Study Area, resulting in 340 sampling nights. Conditions during the recording period was generally good, with limited rain and low winds whilst recorders were deployed. Grey falcon – Sampling consisted of 81 targeted searches at locations containing the best habitat present within the Study Area.

Potential limitation or constraint	Constraint	Applicability to this survey
Timing, weather, and season	No	Pilbara olive python – Targeted diurnal and nocturnal searches were undertaken in potential habitat for active individuals, scats, and water features likely to support the species. Field surveys occurred following two wet seasons which are considered optimal periods for sampling the target species
Disturbances (e.g. fire or flood)	No	There were no disturbances during the survey periods that may have impacted the outcomes of the survey.
Proportion of fauna identified	No	All fauna observed during the field surveys were identified to species level. Species identification of fauna recorded via camera traps and SM4 recorders were able to be accurately identified with the assistance of technical personnel with relevant expertise.
Adequacy of the survey intensity and proportion of the survey achieved	No	A targeted survey was undertaken across the Study Area to assist with decisions on future environmental approvals. The sampling methods and survey intensity was high and focussed on the species of interest.
Remoteness or access issues	No	The majority of the Study Area was accessible either by vehicle or on foot. A helicopter was utilised during phase 1 of the survey to access areas not able to be accessed by vehicle.
Problems with data and analysis, including sampling bias	No	No limitations with data collection and/or analysis were encountered during the field survey or during subsequent analysis.

7 References

- 360 Environmental. (2017). *Upper Marillana and Munjina baseline vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. 360 Environmental Pty Ltd, West Leederville, WA.
- Armstrong, K. N. (2000). Roost microclimates of the bat *Rhinonictis aurantius* in a limestone cave in Geike Gorge, Western Australia. *Australian Mammalogy*, 22, 69-70. doi:<https://doi.org/10.1071/AM00069>
- Armstrong, K. N. (2001). The distribution and roost habitat of the orange leaf-nosed bat, *Rhinonictis aurantius*, in the Pilbara region of Western Australia. *Wildlife Research*, 28, 95-104. doi:<https://doi.org/10.1071/WR00011>
- Armstrong, K. N., & Anstee, S. D. (2000). The ghost bat in the Pilbara: 100 years on. *Australian Mammalogy*, 22, 93-101. doi:<https://doi.org/10.1071/AM00093>
- Astron. (2010a). *Packsaddle West flora and fauna assessment*. Unpublished report prepared for BHP Billiton Iron Ore. Astron Environmental Services, Perth, WA.
- Astron. (2010b). *Packsaddle West vegetation and flora survey and fauna assessment*. Astron Environmental Services. Perth, WA.
- Astron. (2019). *Hope Downs 2 Proposal fauna survey*. Unpublished report prepared for Rio Tinto. Astron Environmental Services, Perth, WA.
- Astron. (2020). *Hope Downs 2 Proposal Survey Area: Ghost Bat Cave Characteristics, February/March 2020*.
- Augusteyn, J., Hughes, J., Armstrong, G., Real, K., & 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). doi:<https://doi.org/10.1071/AM16010>
- Bamford Consulting. (2012). *Vertebrate fauna assessment of the Iron Valley Project Area*. Unpublished report prepared for Iron Ore Holdings Ltd. Bamford Consulting Ecologists, Kingsley, WA.
- Bastin, G. (2008). *Rangelands 2008 - Taking the pulse*. Canberra, Australian Capital Territory: National Land & Water Resources Audit.
- Bat Call. (2021a). *A review of ghost bat ecology, threats and survey requirements*. Unpublished report prepared for the Department of Agriculture, Water and the Environment. Bat Call WA, Hillarys, WA.
- Bat Call. (2021b). *A review of Pilbara leaf-nosed bat ecology, threats and survey requirements*. Unpublished report prepared for the Department of Agriculture, Water and the Environment. Bat Call WA, Hillarys, WA.
- Baudinette, R. V., Churchill, S. K., Christian, K. A., Nelson, J. E., & Hudson, P. J. (2000). Energy, water balance and the roost microenvironment in three Australian cave-dwelling bats (Microchiroptera). *Journal of Comparative Physiology B*, 170(5), 439-446. doi:<http://10.1007/s0036000000121>
- Beard, J. S. (1975). *The vegetation of the Nullarbor Area: 1:1,000,000 vegetation series, map and explanatory notes to sheet 4*. Nedlands, Western Australia: University of Western Australia Press.
- Bettany, E., Churchward, H. M., & McArthur, W. M. (1967). *Atlas of Australian soils*. Melbourne, Victoria: CSIRO Australia and Melbourne University Press.
- BHP. (2020). *Mining Area C fauna management plan*. BHP Billiton Iron Ore, Perth, WA.
- BHP WAIO. (2022). *BHP WAIO fauna records database (custom search)*.
- BHP WAIO. (2023a). *Biodiversity survey spatial data requirements: Procedure*. Controlled document SPR-IEN-EMS-015 Version 12.0. BHP. Perth, WA.
- BHP WAIO. (2023b). *Vertebrate fauna surveys in Western Australia procedure*. Unpublished procedure prepared by BHP Billiton Iron Ore. BHP Billiton Iron Ore, Perth, WA.

- Biologic. (2010). *East Packsaddle Level 1 vertebrate fauna study*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2011a). *Area C and surrounds vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2011b). *Area C to Yandi fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, Subiaco, WA.
- Biologic. (2011c). *Barimunya Camp vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2011d). *Jinidi targeted Northern Quoll survey*. Unpublished report for BHP Billiton Iron Ore Pty Ltd, Biologic Environmental Survey, East Perth, WA.
- Biologic. (2011e). *Jinidi vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, Biologic Environmental Survey, East Perth, WA.
- Biologic. (2011f). *Southern Flank vertebrate fauna study*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2011g). *Yandi vertebrate fauna review*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, Subiaco, WA.
- Biologic. (2012). *Jinidi to Mainline vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, Biologic Environmental Survey, East Perth, WA.
- Biologic. (2013a). *Area C West vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, Biologic Environmental Survey, East Perth, WA.
- Biologic. (2013b). *Central Pilbara Ghost Bat population and roost assessment*. Biologic Environmental Survey, East Perth, WA.,
- Biologic. (2013c). *Marillana vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, Biologic Environmental Survey, East Perth, WA.
- Biologic. (2013d). *Mudlark vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey, East Perth, WA.
- Biologic. (2013e). *Targeted conservation significant fauna survey - Karijini tenement E47/17*. Biologic Environmental Survey,
- Biologic. (2015). *Central Pilbara Ghost Bat population and roost assessment: 2014*. Unpublished report prepared for BHP Biliton Iron Ore. Biologic Environmental Survey, Subiaco, WA.
- Biologic. (2016a). *Marillana targeted vertebrate fauna survey*. Unpublished report for BHP Billiton Iron Ore. Biologic Environmental Survey, Subiaco, WA.
- Biologic. (2016b). *South Flank targeted fauna survey*. Biologic Environmental Survey,
- Biologic. (2017). *Ministers North Level 2 vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2018). *Ministers North to Yandi Corridor two-phase targeted fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2019). *Pineapple Hill detailed vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biologic Environmental Survey,
- Biologic. (2020a). *Central Pilbara ghost bat monitoring 2017-2018*. Unpublished report prepared for BHP WAI0.
- Biologic. (2020b). *Developments in knowledge of ghost bat home range and foraging areas, and its application at Mining Area C - South Flank*. Unpublished report prepared for BHP Western Australian Iron Ore. Biologic Environmental Survey, East Perth, WA.

- Biologic. (2020c). *Western Ridge targeted vertebrate fauna survey*. Unpublished report prepared for BHP Western Australian Iron Ore. Biologic Environmental Survey, East Perth, WA.
- Biologic. (2021a). *Central Pilbara Ghost Bat Monitoring 2018-2019*. Unpublished report prepared for BHP WAIO.
- Biologic. (2021b). *Pilbara Brushtail Possum Molecular Systematics Analysis*. Unpublished report prepared for BHP Western Australian Iron Ore.
- Biologic. (2022a). *Central Pilbara Hub targeted matters of national environmental significance vertebrate fauna survey*. Unpublished DRAFT report prepared for BHP WAIO. Biologic Environmental Survey, East Perth.
- Biologic. (2022b). *Central Pilbara Hub targeted matters of national environmental significance vertebrate fauna survey*. Unpublished report prepared for BHP WAIO. Biologic Environmental Survey, East Perth, WA.
- Biologic. (2023a). *Central Pilbara Ghost Bat Monitoring: 2020 - 2021*. Unpublished report prepared for BHP Western Australian Iron Ore. Biologic Environmental Survey,
- Biologic. (2023b). *Central Pilbara Ghost Bat Monitoring: 2021 - 2022*. Unpublished report prepared for BHP Western Australian Iron Ore. Biologic Environmental Survey,
- Biologic. (2023c). *Central Pilbara Ghost Bat Monitoring: 2022 - 2023*. Unpublished report prepared for BHP.
- Biologic. (2023d). *Targeted Pilbara Olive Python Survey: South Flank and Mining Area C*. Unpublished report prepared for BHP. Biologic Environmental Survey, East Perth, WA.
- Biologic. (2024). *Jinidi Targeted Fauna Survey*. Unpublished report prepared for BHP Western Australian Iron Ore.
- Biologic. (in prep). *BHP Power2030 Ghost Bat Tracking Study*. Unpublished report prepared for BHP WAIO. Biologic Environmental Survey, Perth, WA.
- Biota. (2004). *Fauna habitats and fauna assemblage of the proposed FMG Stage A Rail Corridor*. Unpublished report prepared for Fortescue Metals Group. Biota Environmental Sciences, Leederville, WA.
- Biota. (2005a). *Fauna habitats and fauna assemblage of Deposits E and F at West Angelas*. Unpublished report prepared for Robe River Iron Associates. Biota Environmental Sciences, Leederville, WA.
- Biota. (2005b). *Fauna habitats and fauna assemblage of the FMG stage B rail corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas mine areas*. Biota Environmental Sciences, Leederville, WA.
- Biota. (2009). *Yandicoogina targeted northern quoll survey*. Unpublished report prepared for Rio Tinto Iron Ore. Biota Environmental Sciences, Leederville, WA.
- Biota. (2010). *Yandicoogina Junction South West and Oxbow fauna survey*. Unpublished report prepared for Rio Tinto Iron Ore. Biota Environmental Sciences, Leederville, WA.
- Biota. (2012a). *Koodaideri northern extension fauna survey*. Unpublished report prepared for Rio Tinto. Biota Environmental Sciences, Leederville, WA.
- Biota. (2012b). *Koodaideri Project targeted fauna survey*. Unpublished report prepared for Rio Tinto Iron Ore. Biota Environmental Sciences, Leederville, WA.
- Biota. (2012c). *Koodaideri Southern Infrastructure Corridor fauna survey*. Unpublished report prepared for Rio Tinto Iron Ore. Biota Environmental Sciences, Leederville, WA.
- Biota. (2012d). *South Flank to Jinidi level 2 vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biota Environmental Sciences, Leederville, WA.
- Biota. (2013a). *Area C West to Yandi level 2 vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Biota Environmental Sciences, Leederville, WA.

- Biota. (2013b). *South Parmelia Level 2 vertebrate fauna survey*. Unpublished report prepared for BHP Biliton Iron Ore.
- Biota. (2014a). *Yandi Billiards phase 1 seasonal fauna survey*. Unpublished report prepared for Rio Tinto Iron Ore. Biota Environmental Sciences, Leederville, WA.
- Biota. (2014b). *Yandi Billiards targeted northern quoll survey*. Unpublished report prepared for Rio Tinto Iron Ore. Biota Environmental Sciences, Leederville, WA.
- BirdLife Australia. (2022). Birddata (custom search). <http://www.birddata.com.au/custom.vm>
- Boles, W. E. (1999). Avian prey of the Australian ghost bat *Macroderma gigas* (Microchiroptera: Megadermatidae): Prey characteristics and damage from predation. *Australian Zoologist*, 31(1), 82-91.
- BoM, Bureau of Meteorology. (2022). Climate Data Online. Retrieved 2022 <http://www.bom.gov.au/climate/data/index.shtml>
- Braithwaite, R. W., & Griffiths, A. D. (1994). Demographic variation and range contraction in the northern quoll, *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Wildlife Research*, 21, 203-217.
- Bullen, R. D. (2013). *Pilbara leaf-nosed bat (Rhinonictis aurantia); summary of current data on distribution, energetics, threats*. Paper presented at the Pilbara Leaf-nosed Bat workshop, Kensington, Western Australia.
- Bullen, R. D., & McKenzie, N. L. (2011). Recent developments in studies of the community structure, foraging ecology and conservation of Western Australian bats. In B. Law, P. Eby, D. Lunney, & L. Lumsden (Eds.), *The Biology and Conservation of Australasian Bats* (pp. 31-43). Mosman, New South Wales: Royal Zoological Society of NSW.
- Bullen, R. D., & Reiffer, S. (2019). A record of movement of a Pilbara leaf-nosed bat between distant diurnal roosts using PIT tags. *Australian Mammalogy*, 42(4), 119-121. doi:<https://doi.org/10.1071/AM18054>
- Bullen, R. D., Reiffer, S., & Trainer, J. (2023). Satellite tracking Ghost Bats (*Macroderma gigas*) in the Pilbara, Western Australia. *Records of the Australian Museum*, 38, 1-10. doi:<https://doi.org/10.18195/issn.0312-3162.38.2023.001-010>
- Burbidge, A. A. (2004). *Threatened Animals of Western Australia*. Kensington, Western Australia: Department of Conservation and Land Management.
- 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 Supplement*, 78, 247-270.
- Bush, B., & Maryan, B. (2011). *Field guide to snakes of the Pilbara, Western Australia*. Perth, Western Australia: Western Australian Museum.
- Churchill, S. K. (1991). Distribution, abundance and roost selection of the orange horseshoe-bat, *Rhinonycteris aurantius*, a tropical cave-dweller. *Wildlife Research*, 18, 343-353.
- Cogger, H. G. (2014). *Reptiles and amphibians of Australia* (Seventh ed.). Collingwood, Victoria: CSIRO Publishing.
- Cramer, V. A., Armstrong, K. N., Bullen, R. D., Cross, S. A., Lesley, G., Hanrahan, N., . . . Van Leeuwen, S. (2022). Research priorities for the ghost bat (*Macroderma gigas*) in the Pilbara region of Western Australia. *Australian Mammalogy*.
- Cramer, V. A., Armstrong, K. N., Bullen, R. D., Ellis, R., Gibson, L. A., McKenzie, N. L., . . . van Leeuwen, S. (2016a). Research priorities for the Pilbara leaf-nosed bat (*Rhinonictis aurantia* Pilbara form). *Australian Mammalogy*, 38(2), 149-157. doi:<https://doi.org/10.1071/AM15012>
- Cramer, V. A., Dunlop, J., Davis, R. A., Ellis, R., Barnett, B., Cook, A., . . . van Leeuwen, S. (2016b). Research priorities for the northern quoll (*Dasyurus hallucatus*) in the Pilbara region of Western Australia. *Australian Mammalogy*, 38(2), 135-148. doi:<https://doi.org/10.1071/AM15005>

- Cramer, V. A., Dziminski, M. A., Southgate, R., Carpenter, F. M., Ellis, i. R. J., & van Leeuwen, S. (2017). A conceptual framework for habitat use and research priorities for the greater bilby (*Macrotis lagotis*) in the north of Western Australia. *Australian Mammalogy*, 39(2), 137-151. doi:<https://doi.org/10.1071/AM16009>
- CSIRO, Commonwealth Scientific and Industrial Research Organisation. (2009). *Australian soil and land survey field handbook* (Third ed.). Collingwood, Australia: CSIRO Publishing.
- Davis, R. A., & Metcalf, B. M. (2008). The night parrot (*Pezoporus occidentalis*) in northern Western Australia: a recent sighting from the Pilbara region. *Emu - Austral Ornithology*, 108(3), 233-236. doi:<http://dx.doi.org/10.1071/MU07058>
- Dawson, S., Adams, P. J., Moseby, K. E., Waddington, K. I., Kobryn, H., Bateman, P. W., & Fleming, P. A. (2018). Peak hour in the bush: linear anthropogenic clearings funnel predator and prey species. *Austral Ecology*, 43, 159–171.
- DBCA, Department of Biodiversity, Conservation and Attractions. (2017). *Guidelines for surveys to detect the presence of bilbies and assess the importance of habitat in Western Australia*. Department of Biodiversity, Conservation and Attractions, Kensington, WA.
- DBCA, Department of Biodiversity, Conservation and Attractions. (2022a). NatureMap: Mapping Western Australia's biodiversity (custom search). Retrieved 2022 <http://naturemap.dec.wa.gov.au/default.aspx>
- DBCA, Department of Biodiversity, Conservation and Attractions. (2022b). Threatened and Priority Fauna database (custom search). Retrieved 2022, from Department of Biodiversity, Conservation and Attractions <http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals>
- DCCEEW, Department of Climate Change, Energy, the Environment and Water. (2022). Protected Matters Search Tool (custom search). Retrieved 2022 www.environment.gov.au/erin/ert/epbc/index.html
- DCCEEW, Department of Climate Change, Energy, the Environment and Water. (in prep.). *Interim guidelines for Pilbara MNES critical and supporting habitat characterisation (draft version)*. Department of Agriculture, Water and the Environment, Canberra,
- DEWHA, Department of Environment, Water, Heritage and the Arts. (2010a). *Survey guidelines for Australia's threatened bats*. Canberra, Australian Capital Territory: Department of Environment, Water, Heritage and the Arts.
- DEWHA, Department of Environment, Water, Heritage and the Arts. (2010b). *Survey guidelines for Australia's threatened birds*. Canberra, Australian Capital Territory: Department of Environment, Water, Heritage and the Arts.
- DoE, Department of the Environment. (2013). *Matters of national environmental significance: significant impact guidelines*. Department of the Environment, Canberra.
- DoE, Department of the Environment. (2016). *EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus**. Canberra, Australian Capital Territory: Department of the Environment.
- DoE, Department of the Environment. (2022a). *Dasyurus hallucatus* in Species Profile and Threats Database. <https://www.environment.gov.au/sprat>
- DoE, Department of the Environment. (2022b). *Macrotis lagotis* in Species Profile and Threats Database. <https://www.environment.gov.au/sprat>
- DoE, Department of the Environment (2022c). *Liasis olivaceus barroni* in Species Profile and Threats Database. Retrieved 20/07/2022 <https://www.environment.gov.au/sprat>
- DoE, Department of the Environment (2022d). *Macroderma gigas* in Species Profile and Threats Database. Retrieved 20/07/22 <https://www.environment.gov.au/sprat>
- Doughty, P., Rolfe, J. K., Burbidge, A. H., Pearson, D. J., & 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, Supplement*, 78, 315-341.
- DPaW, Department of Parks and Wildlife. (2017). *Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia*. Department of Parks and Wildlife, Kensington, Western Australia.
- DSEWPaC, Department of Sustainability, Environment, Water, Population and Communities. (2011a). *Survey guidelines for Australia's threatened mammals*. Canberra, Australian Capital Territory: Department of Sustainability, Environment, Water, Population and Communities.
- DSEWPaC, Department of Sustainability, Environment, Water, Population and Communities. (2011b). *Survey guidelines for Australia's threatened reptiles*. Canberra, Australian Capital Territory: Department of Sustainability, Environment, Water, Population and Communities.
- Dunlop, J. A., Rayner, K., & Doherty, T. S. (2017). Dietary flexibility in small carnivores: a case study on the endangered northern quoll, *Dasyurus hallucatus*. *Journal of Mammalogy*, 98(3), 858-866. doi:https://10.1093/jmammal/gyx015
- Dziminski, M. A., & Carpenter, F. (2017). *The conservation and management of the bilby (Macrotis lagotis) in the Pilbara: Progress Report 2017*. Department of Parks and Wildlife., Perth, Western Australia.
- Ecologia. (1995). *Yandi stage II iron ore project: Biological assessment survey*. Unpublished report prepared for BHP Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (1997). *Hope Downs biological survey*. Unpublished report prepared for Hancock Prospecting. Ecologia Environmental Consultants. West Perth, WA.
- Ecologia. (1998a). *Mining Area C biological survey*. Unpublished report prepared for BHP Iron Ore. Ecologia Environmental Consultants. West Perth, WA.
- Ecologia. (1998b). *Weeli Wolli creek biological assessment survey*. Unpublished report prepared for BHP Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (1998c). *West Angelas iron ore project vertebrate fauna assessment survey*. Unpublished report prepared for Robe River Mining Company. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2004a). *Area C: Deposits D, E and F biological survey*. Unpublished report prepared for BHP Billiton Iron Ore. Ecologia Environmental Consultants. West Perth, WA.
- Ecologia. (2004b). *Packsaddle Range biological survey*. Unpublished report prepared for BHP Billiton Iron Ore. Ecologia Environmental Consultants. West Perth, WA.
- Ecologia. (2004c). *Yandi overland conveyor and stockyard fauna and flora assessment*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants. West Perth, WA.
- Ecologia. (2005a). *Mudlark Well exploration project biological survey*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2005b). *Upper Marillana Exploration Project biological survey*. Unpublished report prepared for BHP Biliton Iron Ore.
- Ecologia. (2006a). *Jirridi biological survey summary report*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2006b). *Jirridi terrestrial vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2006c). *Marillana terrestrial vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants, West Perth, WA.

- Ecologia. (2006d). *Ministers North biological survey*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2008a). *Area A and additional areas level 2 terrestrial fauna survey*. Unpublished report prepared for United Minerals Corporation. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2008b). *Marillana Creek (Yandi) iron ore mine modification - Level 2 fauna survey*. Unpublished report prepared for Kellogg, Brown and Root. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2008c). *RGP5 fauna survey Kurrajura Siding to Yandi WYE including Yandi repeater 1*. Unpublished report prepared for BHP Billiton Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ecologia. (2014). *Greater West Angelas terrestrial fauna assessment*. Unpublished report prepared for Rio Tinto Iron Ore. ecologia Environmental Consultants, West Perth, WA.
- Ellis, R. J. (2013). *Liasis olivaceus barroni* (Pilbara olive python) Diet. *Herpetological Review*, 44(4), 693.
- Ellis, R. J., & Johnstone, R. E. (2016). *Liasis olivaceus barroni* (Pilbara olive python). Diet. *Herpetological Review*, 47(4), 685.
- ENV. (2007a). *Area C R-Deposit Fauna Assessment*.
- ENV. (2007b). *Upper Marillana Exploration Lease fauna assessment*. Unpublished report prepared for BHP Billiton Iron Ore. ENV Australia, Perth, WA.
- ENV. (2008a). *Area C Southern Flank deposit fauna assessment*. Unpublished report prepared for BHP Biliton Iron Ore. ENV Australia, Perth, WA.
- ENV. (2008b). *Area C West fauna assessment*. Unpublished report prepared for BHP Biliton Iron Ore. ENV Australia, Perth, WA.
- ENV. (2008c). *Jinayri vertebrate fauna assessment*. Unpublished report for BHP Billiton Iron Ore. ENV Australia, Perth, WA.
- ENV. (2009a). *Munjina and Ministers North (Yandi Hub) fauna assessment*. Unpublished report prepared for BHP Billiton Iron Ore. ENV Australia, Perth, WA.
- ENV. (2009b). *Newman to Yandi transmission line terrestrial vertebrate fauna assessment*. Unpublished report prepared for BHP Biliton Iron Ore. ENV Australia, Perth, WA.
- ENV. (2010a). *Area C West NVCP flora, vegetation and fauna assessment*. Unpublished report to BHP Billiton Iron Ore Pty Ltd. ENV Australia. Perth, WA.
- ENV. (2010b). *Jinayri Access Road vertebrate fauna survey*. Unpublished report to BHP Billiton Iron Ore Pty Ltd, Peth Western Australia. ENV Australia, Perth, WA.
- ENV. (2010c). *Jinayri Mining Lease vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore Pty Ltd. ENV Australia, Perth, WA.
- ENV. (2011). *Upper Marillana and Munjina flora, vegetation and fauna assessment*. Unpublished report prepared for BHP Billiton Iron Ore. ENV Australia. Perth, WA.
- EPA, Environmental Protection Authority. (2016). *Environmental Factor Guideline: Terrestrial Fauna*. Perth, Western Australia: Environmental Protection Authority.
- EPA, Environmental Protection Authority. (2020a). *Statement of Environmental Principles, Factors and Objectives*. Perth, Western Australia: Environmental Protection Authority.
- EPA, Environmental Protection Authority. (2020b). *Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Western Australia: Environmental Protection Authority.
- ESCAVI, Executive Steering Committee for Australian Vegetation Information. (2003). *Australian vegetation attribute manual: National vegetation information system (version 6.0)*. Canberra, ACT: ESCAVI, Executive Steering Committee for Australian Vegetation Information.

- Falkenberg, D. (2010). Aspects of the ecology of the Grey Falcon *Falco hypoleucos* in the South Australian arid zone. *Corella*, 35(1), 23-28.
- Fitzsimons, J., Legge, S., Traill, B., & Woinarski, J. (2010). *Into oblivion? The disappearing native mammals of northern Australia*. Melbourne, Victoria. http://www.australianwildlife.org/images/file/Into_Oblivion_-_Nth_Aus_Mammal_Decline_Report.pdf
- FMG, Fortescue Metals Group. (2021, 25 June 2021). Fortescue research confirms endangered night parrot co-existing with mining. Retrieved from <https://www.fmg.com.au/isobar-development/blog-preview-page/our-stories/2021/06/25/fortescue-research-confirms-endangered-night-parrot-co-existing-with-mining>
- Garnett, S., & Crowley, G. (2000). *The action plan for Australian birds 2000* (1st ed.). Canberra, Australian Capital Territory: Environment Australia and the Royal Australia Ornithologists Union.
- GHD. (2010). *Report for Coondewanna exploration tenement level 2 flora and level 1 fauna report*. Unpublished report prepared for BHP Billiton Iron Ore Pty Ltd. GHD Pty Ltd, Perth, WA.
- Hamilton, N. A., Onus, M., Withnell, B., & Withnell, K. (2017). Recent sightings of the Night Parrot *Pezoporus occidentalis* from Matuwa (Lorna Glen) and Milrose Station in Western Australia. *Australian Field Ornithology*, 34, 71-75.
- HGM, Halpern Glick Maunsell. (1999). *Marillana Creek Western Access Corridor - Biological assessment*. Unpublished report prepared for BHP Iron Ore Pty Ltd. Halpern Glick Maunsell, Perth, WA.
- Hohnen, R., Ashby, J., Tuft, K., & McGregor, H. (2012). Individual identification of northern quolls (*Dasyurus hallucatus*) using remote cameras. *Australian Mammalogy*, 35(2), 131-135. doi:<http://dx.doi.org/10.1071/AM12015>
- Hutson, A. M., Mickelburgh, S. P., & Racet, P. A. (2001). *Microchiropteran bats: global status survey and conservation action plan*: IUCN.
- Integrated Environmental. (1980). *An ecological appreciation of the West Angelas environment, Western Australia 1979*. Unpublished report prepared for Cliffs International Inc. Integrated Environmental Services, South Perth, WA.
- Jackett, N. A., Greatwich, B. R., Swann, G., & Boyle, A. (2017). A nesting record and vocalisations of the night parrot *Pezoporus occidentalis* from the East Murchison, Western Australia. *Australian Field Ornithology*, 34, 144-150.
- James, C. D., Landsberg, J., & Morton, S. R. (1995). Ecological functioning in arid Australia and research to assist conservation of biodiversity. *Pacific Conservation Biology*, 2, 126-142.
- Johnson, C. N., & Isaac, J. L. (2009). Body mass and extinction risk in Australian marsupials: The 'Critical Weight Range' revisited. *Austral Ecology*, 34(1), 35-40. doi:<http://doi.org/10.1111/j.1442-9993.2008.01878.x>
- Keeley, T., O'Connell, M., Kelman, L., Laming, B., & Knuckey, C. (2023). Validation of non-invasive hormone analysis techniques to assist in the future identification of maternal roosts of ghost bats (*Macroderma gigas*). *Theriogeneology Wild*. doi:<https://doi.org/10.1016/j.therwi.2023.100060>
- Kendrick, P. (2003). Pilbara 3 (PIL3 - Hamersley subregion). In J. E. May & N. L. McKenzie (Eds.), *A biodiversity audit of Western Australia's 53 biogeographic subregions in 2002* (pp. 568-580). Kensington, WA: Department of Conservation and Land Management.
- 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(5), 569-574.
- Leighton, K. A. (2004). Climate. In A. M. E. van Vreeswyk, A. L. Payne, K. A. Leighton, & P. Hennig (Eds.), *An inventory and condition survey of the Pilbara region, Western Australia. Technical Bulletin No. 92*. Perth, Western Australia: Western Australian Department of Agriculture.

- Maunsell Australia, & Bamford Consulting. (2003). *Yandi life of mine fauna and flora*. Unpublished report prepared for BHP Billiton Iron Ore. Maunsell Australia Pty Ltd, and Bamford Consulting Ecologists. Kingsley, WA.
- McGilp, J. N. (1931). *Geopsittacus occidentalis*, night parrot. *South Australian Ornithologist*, 11, 68-70.
- McKenzie, N. L., & Bullen, R. D. (2009). The echolocation calls, habitat relationships, foraging niches and communities of Pilbara microbats. *Records of the Western Australian Museum Supplement*, 78, 123-155.
- McKenzie, N. L., van Leeuwen, S., & Pinder, A. M. (2009). Introduction to the Pilbara biodiversity survey, 2002-2007. *Records of the Western Australian Museum Supplement*, 78, 3-89.
- Michelmores, K., & Birch, L. (2020). Night parrot located by KJ rangers on Martu country in the Pilbara. Retrieved from <https://www.abc.net.au/news/2020-08-21/elusive-night-parrot-discovered-in-the-pilbara/12581900>
- Miller, E. J., Eldridge, M. D. B., Thomas, N., Marlow, N., & Herbert, C. A. (2010). The genetic mating system, male reproductive success and lack of selection on male traits in the greater bilby. *Australian Journal of Zoology*, 58(2), 113-120. doi:<http://dx.doi.org/10.1071/ZO09092>
- Moseby, K. E., & O'Donnell, E. (2003). Reintroduction of the greater bilby, *Macrotis lagotis* (Reid) (Marsupialia: Thylacomyidae), to northern South Australia: survival, ecology and notes on reintroduction protocols. *Wildlife Research*, 30(1), 15-27.
- Mullin, D. W., McCulloch, G. A., Schoenjahn, J., & Walter, G. H. (2020). Phylogeography of the rare Australian endemic grey falcon *Falco hypoleucos*: implications for conservation. *Bird Conservation International*, in press, 1-9. doi:10.1017/S0959270920000106
- Murphy, S. A., Silcock, J., Murphy, R., Reid, J., & Austin, J. J. (2017). Movements and habitat use of the night parrot *Pezoporus occidentalis* in south-western Queensland. *Austral Ecology*, 42(7), 858-868. doi:<https://doi.org/10.1111/aec.12508>
- Murray, B. R., Zeppel, M. J. B., Hose, G. C., & Eamus, D. (2003). Groundwater-dependent ecosystems in Australia: It's more than just water for rivers. *Ecological Management & Restoration*, 4(2), 110-113. doi:<https://doi.org/10.1046/j.1442-8903.2003.00144.x>
- Night Parrot Recovery Team. (2017). Leading night parrot conservation. Retrieved from <https://nightparrot.com.au/>
- Ninox. (2009). *A fauna survey of the proposed Hope Downs 4 Mining Area, near Newman, Western Australia*. Unpublished report prepared for Matiske Consulting on behalf of Pilbara Iron Company. Ninox Wildlife Consulting, Albany, WA.
- North, A. J. (1898). List of birds collected by the Calvert Exploring Expedition in Western Australia. *Transactions of the Royal Society of South Australia*, 22, 125-192.
- Oakwood, M. (2000). Reproduction and demography of the northern quoll, *Dasyurus hallucatus*, in the lowland savanna of northern Australia. *Australian Journal of Zoology*, 48, 519-539. doi:<https://doi.org/10.1071/ZO00028>
- Oakwood, M. (2002). Spatial and social organization of a carnivorous marsupial *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Journal of Zoology*, 257, 237-248.
- Oakwood, M. (2008). Northern quoll *Dasyurus hallucatus*. In R. Strahan (Ed.), *The Mammals of Australia* (3rd ed.). Sydney: Reed New Holland.
- Oakwood, M., Bradley, A. J., & Cockburn, A. (2001). Semelparity in a large marsupial. *Proceedings of the Royal Society B*, 268(1465), 407-411.
- Olsen, P. D., & Olsen, J. (1986). Distribution, status, movement and breeding of the grey falcon *Falco hypoleucos*. *Emu - Austral Ornithology*, 86(1), 47-51.
- Onshore, & Biologic. (2009). *Biological survey: South Parmelia exploration leases*. Unpublished report prepared for BHP Billiton Iron Ore. Onshore Environmental Consultants & Biologic Environmental Survey. Yallingup, WA.

- Onshore, & Biologic. (2011). *Camp Hill exploration leases Level 2 flora & vegetation survey and Level 1 fauna assessment*. Unpublished report prepared for BHP Billiton Iron Ore. Onshore Environmental Consultants & Biologic Environmental Survey.
- Outback Ecology. (2008). *Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial vertebrate fauna assessment*. Unpublished report prepared for BHP. Outback Ecology Services, Jolimont, WA.
- Outback Ecology. (2010). *Area C to Jinayri to Mount Newman Railway terrestrial vertebrate fauna survey*. Unpublished report prepared for BHP Billiton Iron Ore. Outback Ecology Services, Jolimont, WA.
- Payne, A. L., Mitchell, A. A., & Holman, W. F. (1988). *An inventory and condition survey of rangelands in the Ashburton River catchment, Western Australia*. Western Australian Department of Agriculture, South Perth, Western Australia.
- Pearson, D. (2007). Pilbara olive python *Liasis olivaceus barroni* (Smith, 1981). In M. Swan (Ed.), *Keeping and Breeding Australian Pythons* (pp. 174-181). Lilydale, Vic.: Mike Swan Herp Books.
- Pearson, D. J. (1993). Distribution, status and conservation of pythons in Western Australia. In D. Lunney & D. Ayers (Eds.), *Herpetology in Australia: A diverse discipline* (pp. 383-395). Sydney, New South Wales: Royal Zoological Society of NSW.
- Pearson, D. J. (2003). Giant pythons of the Pilbara. *Landscape*, 19(1), 32-39.
- Rapallo. (2012). *Level 2 fauna survey and targeted northern quoll survey of the Lamb Creek*. Unpublished report prepared for Process Minerals International. Rapallo Environmental, Subiaco, WA.
- Runge, C., Tulloch, A., Hammill, E., Possingham, H., & Fuller, R. (2014). Geographic range size and extinction risk assessment in nomadic species. *Conservation Biology*, 29(3), 865-876. doi:10.1111/cobi.12440
- Schmitt, L., Bradley, A., Kemper, C., Kitchener, D., Humphreys, W., & How, R. (1989). Ecology and physiology of the northern quoll, *Dasyurus hallucatus* (Marsupialia, Dasyuridae), at Mitchell Plateau, Kimberley, Western Australia. *Journal of Zoology*, 217(4), 539-558.
- Schoenjahn, J. (2013). A hot environment and one type of prey: investigating why the Grey Falcon (*Falco hypoleucos*) is Australia's rarest falcon. *Emu - Austral Ornithology*, 113(1), 19-25.
- Schoenjahn, J. (2018). *Adaptations of the rare endemic Grey Falcon Falco hypoleucos that enable its permanent residence in the arid zone of Australia*. The University of Queensland,
- Schoenjahn, J., Pavey, C., & Walter, G. (2022). Low activity levels are an adaptation to desert-living in the Grey Falcon, an endotherm that specializes in pursuing highly mobile prey. *Journal of Thermal Biology*, 103. doi:https://doi.org/10.1016/j.jtherbio.2021.103108
- Schoenjahn, J., Pavey, C. R., & Walter, G. H. (2019). Ecology of the grey falcon *Falco hypoleucos* – current and required knowledge. *Emu - Austral Ornithology*, 120(1), 1-9. doi:https://doi.org/10.1080/01584197.2019.1654393
- Shepherd, D. P., Beeston, G. R., & Hopkins, A. J. M. (2002). *Native vegetation in Western Australia: Extent, type and status*. Perth, Western Australia: Western Australian Department of Agriculture.
- Smythe, D. R., & Philpott, C. M. (1968). A field study of the rabbit bandicoot *Macrotis lagotis* Reid (Marsupialia), from central Western Australia. *Transactions of the Royal Society of South Australia*, 92, 3-14.
- Southgate, R. (1990a). Distribution and abundance of the greater bilby *Macrotis lagotis* Reid (Marsupialia: Peramelidae). In J. H. Seebach, P. R. Brown, R. L. Wallis, & C. M. Kemper (Eds.), *Bandicoots and Bilbies* (pp. 293-302): Surrey Beatty & Sons.
- Southgate, R. (1990b). Habitat and diet of the greater bilby *Macrotis lagotis* (Marsupialia: Peramelidae). In J. H. Seebach, P. R. Brown, R. L. Wallis, & C. M. Kemper (Eds.), *Bandicoots and Bilbies* (pp. 303-309): Surrey Beatty & Sons.

- Southgate, R., Dziminski, M. A., Paltridge, R., Schubert, A., & Gaikhorst, G. (2019). Verifying bilby presence and the systematic sampling of wild populations using sign-based protocols – with notes on aerial and ground survey techniques and asserting absence. *Australian Mammalogy*, 41(1). doi:<https://doi.org/10.1071/AM17028>
- Southgate, R., Paltridge, R., Masters, P., & Carthew, S. (2007). Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia. *Ecography*, 30(6), 759-776. doi:10.1111/j.2007.0906-7590.04956.x
- Southgate, R., & Possingham, H. (1995). Modelling the reintroduction of the Greater Bilby *Macrotis lagotis* using the metapopulation model analysis of the likelihood of extinction (ALEX). *Biological Conservation*, 73, 151-160.
- Specialised Zoological. (2008). *Survey for conservation significant bats between Kurrajara siding and the Yandi WYE*. Unpublished report prepared for BHP Billiton Iron Ore.
- Storr, G. M., Smith, L. A., & Johnstone, R. E. (2002). *Snakes of Western Australia* (Revised ed.). Perth, Western Australia: Western Australian Museum.
- Strahan, R. (2004). *The Mammals of Australia* (Revised Edition ed.): Reed Books, Chatswood, NSW.
- Sutton, A. (2010). Aspects of the biology of the Grey Falcon *Falco hypoleucos* in the Pilbara region of Western Australia. *Corella*, 10(35), 11-15.
- Thackway, R., & Cresswell, I. D. (1995). *An interim biogeographical regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperation Plan*. Canberra, ACT: Australian Nature Conservation Agency.
- 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(5), 705-713. doi:<http://dx.doi.org/10.1071/ZO9850705>
- TSSC, Threatened Species Scientific Committee. (2008a). *Approved conservation advice for Liasis olivaceus barroni (Olive Python – Pilbara subspecies)*. Commonwealth of Australia, Canberra, ACT.
- TSSC, Threatened Species Scientific Committee. (2008b). *Approved conservation advice for night parrot Pezoporus occidentalis*. Department of the Agriculture, Water and the Environment, Canberra, ACT.
- TSSC, Threatened Species Scientific Committee. (2016a). *Conservation advice: Macroderma gigas, ghost bat*. Commonwealth of Australia, Canberra, ACT.
- TSSC, Threatened Species Scientific Committee. (2016b). *Conservation advice: Macrotis lagotis, greater bilby*. Department of the Agriculture, Water and the Environment, Canberra, ACT.
- TSSC, Threatened Species Scientific Committee. (2016c). *Conservation advice: Rhinonicteris aurantia (Pilbara form), Pilbara leaf-nosed bat*. Commonwealth of Australia, Canberra, ACT.
- Umbrello, L., Bullen, R. D., Shaw, R. E., McArthur, S., Byrne, M., van Leeuwen, S., & Ottewell, K. (2022). Extensive gene flow in a threatened bat (*Rhinonicteris aurantia*) in an arid landscape. *Global Ecology and Conservation*, e02154. doi:<https://doi.org/10.1016/j.gecco.2022.e02154>
- van Vreeswyk, A. M. E., Payne, A. L., Leighton, K. A., & Hennig, P. (2004). *An inventory and condition survey of the Pilbara region, Western Australia*. South Perth, Western Australia: Western Australian Department of Agriculture.
- WAIO, B. (2022). *BHP fauna records database (custom search)*.
- Whitlock, F. L. (1924). Journey to central Australia in search of the night parrot. *Emu - Austral Ornithology*, 23, 248-281.
- Wildlife Acoustics, Inc. (2011). *Song meter SM2BAT+ ultrasonic recorder*. Wildlife Acoustics Inc., Massachusetts, United States of America.

- Wildlife Acoustics, Inc. (2017). *Song Meter SM4BAT FS bioacoustics recorder user guide*. Wildlife Acoustics Inc., Massachusetts, United States of America.
- Wilson, H. (1937). Notes on the night parrot, with references to recent occurrences. *Emu - Austral Ornithology*, 37(2), 79-87.
- Woinarski, J. C. Z., Legge, S., Fitzsimons, J. A., Traill, B. J., Burbidge, A. A., Fisher, A., . . . Ziemnicki, M. (2011). The disappearing mammal fauna of northern Australia: context, cause, and response. *Conservation Letters*, 4(3), 192-201. doi:10.1111/j.1755-263X.2011.00164.x
- Woinarski, J. C. Z., Oakwood, M., Winter, J., Burnett, S., Milne, D., Foster, P., . . . Holmes, B. (2008). *Surviving the toads: Patterns of persistence of the northern quoll Dasyurus hallucatus in Queensland*. Report to the Australian Government's Natural Heritage Trust.
http://www.nt.gov.au/nreta/wildlife/programs/quoll/pdf/qld_quolls_finalreport.pdf
- Worthington-Wilmer, J., Moritz, C., Hall, L., & Toop, J. (1994). Extreme population structuring in the threatened ghost bat, *Macroderma gigas*: evidence from mitochondrial DNA. *Proceedings of the Royal Society B*, 257, 193-198.
- WRC, Water and Rivers Commission. (2003). *Mine Void Water Resource Issues in Western Australia*. Water and Rivers Commission,

Appendix A: Summary of the Literature Review

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
1. Astron (2010a)	<u>Project:</u> West Packsaddle Flora and Fauna Assessment <u>Client:</u> BHP <u>Survey date:</u> 10–19 April 2010 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Principal Zoologist	Within Study Area	- Active searching - Targeted transects - Avifauna census - Motion sensitive cameras - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Rocky Ridges/Cliff Faces	<u>87 vertebrate species</u> 13 native mammals 0 introduced mammals 60 birds 14 reptiles 0 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Northern brushtail possum (<i>Trichosurus vulpecula arnhemensis</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
2. Biologic (2011f)	<u>Project:</u> Southern Flank Vertebrate Fauna Study. 1021 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 7–19 April 2010 Phase 2: 23 August – 4 September 2010 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Principal Zoologist Principal Ecologist Senior Zoologist x 2 Herpetologist	Within Study Area	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Motion sensitive cameras - Hair traps - Bat echolocation recording - Nocturnal surveys - Avifauna census - Opportunistic observations - Secondary evidence	- Major drainage line - Mulga - Gorge/ Gully - Hillcrest/slope - Stony plain - Sandy areas - Coolabah-Lignum	<u>161 vertebrate species</u> 26 native mammals 7 introduced mammals 68 birds 58 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Northern quoll (<i>Dasyurus hallucatus</i>) - Pilbara leaf-nosed bat (<i>Rhinionictis aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind-snake (<i>Anilius ganei</i>) - Pilbara barking gecko (<i>Underwoodisaurus seorsus</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	
3. Biologic (2013a)	<u>Project:</u> Area C West Vertebrate Fauna Survey. 1086 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 18 April – 1 May; 8–21 May 2011 Phase 2: 12–25 September; 3–14 October 2011 Nocturnal survey: 19–22 January 2012 <u>Survey type:</u> Two phase Detailed baseline fauna surveys <u>Experience:</u> Principal Zoologist/ecologist x2 Senior Zoologist x 4 Zoologist	Within Study Area	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Motion sensitive cameras - Bat echolocation recording - Avifauna census - Nocturnal survey - Opportunistic observations - Secondary evidence	- Major drainage line - Minor drainage line - Gorge/ Gully - Hillcrest/slope - Sandy/stony plain - Basalt Gilgi rocky plain	<u>213 vertebrate species</u> 26 native mammals 5 introduced mammals 100 birds 79 reptiles 3 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Northern quoll (<i>Dasyurus hallucatus</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Northern short-tailed mouse (<i>Leggadina lakedownensis</i>) <u>Migratory:</u> - Wood sandpiper (<i>Tringa glareola</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
4. Biologic (2013d)	<u>Project:</u> Mudlark Vertebrate Fauna Survey. 1080 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 12–19 May and 31 May – 11 June 2011 Phase 2: 6–15 October 2011 and 18 – 28 May 2012 Phase 3: 19–22 January 2012 <u>Survey type:</u> Three phase Detailed fauna survey <u>Experience:</u> Senior Zoologist x5 Principle Zoologist x2 Zoologist	Within Study Area	- Active searching - Targeted searches - Targeted trapping – pitfall, funnel, Elliott, cage - Nocturnal Surveys - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Opportunistic observations - Secondary evidence	- Hillcrest/slope - Gorge/ Gully - Major drainage line - Stony plain - Mulga woodland	<u>178 vertebrate species</u> 21 native mammals 4 introduced mammals 80 birds 70 reptiles 3 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
5. Biologic (2023a)	<u>Project:</u> Central Pilbara Ghost Bat Monitoring: 2020 – 2021 <u>Client:</u> BHP <u>Survey date:</u> Trip 1: October 2020 Trip 2: February 2021 Trip 3: May 2021 <u>Survey type:</u> Annual monitoring survey <u>Experience:</u> Principle Zoologist x1 Zoologist x3	Within Study Area	- Targeted searches - Cave assessments - Secondary evidence - DNA analysis - Hormone analysis	Caves (categories 2, 3 & 4)	<u>1 vertebrate species</u> 1 native mammal 0 introduced mammals 0 birds 0 reptiles 0 amphibians	<u>Threatened:</u> Ghost bat (<i>Macroderma gigas</i>)	No sampling was completed between December 2019 – October 2020 due to administrative, safety and covid related concerns. Additionally genotyping success rate was low, possible due to a decline in scat deposition rate.
6. Biologic (2023b)	<u>Project:</u> Central Pilbara Ghost Bat Monitoring: 2021 – 2022 <u>Client:</u> BHP <u>Survey date:</u> Trip 1: July 2021 Trip 2: September 2021 Trip 3: January 2022 Trip 4: March 2022 Trip 5: May 2022 <u>Survey type:</u> Annual monitoring survey <u>Experience:</u> Principle Zoologist x1 Senior Zoologist x2 Zoologist x3	Within Study Area	- Targeted searches - Cave assessments - Secondary evidence - DNA analysis - Hormone analysis	Caves (categories 2, 3 & 4)	<u>1 vertebrate species</u> 1 native mammal 0 introduced mammals 0 birds 0 reptiles 0 amphibians	<u>Threatened:</u> Ghost bat (<i>Macroderma gigas</i>)	Genotyping success rate was low.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
7. Biologic (2023c)	<u>Project:</u> Central Pilbara Ghost Bat Monitoring: 2022 – 2023 <u>Client:</u> BHP <u>Survey date:</u> Trip 1: July 2022 Trip 2: September 2022 Trip 3: January 2023 Trip 4: March 2023 Trip 5: May 2023 <u>Survey type:</u> Annual monitoring survey <u>Experience:</u> Principle Zoologist x2 Senior Zoologist x3 Zoologist x3	Within Study Area	- Targeted searches - Cave assessments - Secondary evidence - DNA analysis - Hormone analysis	Caves (categories 2, 3 & 4)	<u>1 vertebrate species</u> 1 native mammal 0 introduced mammals 0 birds 0 reptiles 0 amphibians	<u>Threatened:</u> Ghost bat (<i>Macroderma gigas</i>)	Temperature and HR was not recorded at several of the caves during the monitoring period, due to technical issues.
8. Biologic (2023d)	<u>Project:</u> Targeted Pilbara Olive Python Survey: South Flank and Mining Area C <u>Client:</u> BHP <u>Survey date:</u> 7–14 March 2023 <u>Survey type:</u> Targeted Fauna Survey <u>Experience:</u> Senior Zoologist x2	Within Study Area	- Targeted searches - Nocturnal Surveys - eDNA sampling - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Major drainage line - Medium drainage line - Drainage Area/ Floodplain	<u>178 vertebrate species</u> 4 native mammals 2 introduced mammals 5 birds 12 reptiles 2 amphibians	<u>Threatened:</u> - Northern Quoll (<i>Dasyurus hallucatus</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>)	Restricted access to the Study Area, due to lack of access tracks, heritage exclusion zones and minoring operations resulted in a reduced survey effort.
9. Biota (2004)	<u>Project:</u> Fauna Habitats and Fauna Assemblage of the Proposed FMG phase A Rail Corridor. <u>Client:</u> FMG <u>Survey date:</u> 20 March – 7 April 2004 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist	Within Study Area	- Active searching - Targeted searching - Systematic trapping – pitfall, Elliott - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Stony Plain - Sandy Plain - Mulga Woodland - Drainage Line - Creekline - Hilcrest/slope	<u>178 vertebrate species</u> 25 native mammals 5 introduced mammals 84 birds 58 reptiles 6 amphibians	<u>Priority:</u> - Northern short-tailed mouse (<i>Leggadina lakedownensis</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	Rainfall events during the survey resulted in some trap sites being closed early, and limited access to sites.
10. Ecologia (2004a)	<u>Project:</u> Area C: Deposits D, E and F Biological Survey. 348 <u>Client:</u> BHP <u>Survey date:</u> 28 May – 7 June 2004 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x 4 Biologist Research assistant	Within Study Area	- Active searching - Systematic trapping – pitfall, funnel, Elliott - Avifauna census - Nocturnal surveys - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope - Mulga woodland - Mallee woodland	<u>104 vertebrate species</u> 16 native mammals 1 introduced mammals 55 birds 32 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
11. Ecologia (2005a)	<u>Project:</u> Mudlark Well Exploration Project Biological Survey. 421 <u>Client:</u> BHP <u>Survey date:</u> 18–23 August 2005 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x2	Within Study Area	- Active searching - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Medium drainage area - Gorge/ Gully - Hillcrest/slope - Sand/ stony plain	<u>56 vertebrate species</u> 7 native mammals 1 introduced mammals 30 birds 19 reptiles 0 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	No nocturnal surveying undertaken due to low temperatures.
12. ENV (2008b)	<u>Project:</u> Area C West Fauna Assessment. 372 <u>Client:</u> BHP <u>Survey date:</u> 15 August – 4 September 2007 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> N/A	Within Study Area	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope - Breakaway - Stony plain	<u>126 vertebrate species</u> 17 native mammals 2 introduced mammals 72 birds 34 reptiles 1 amphibian	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
13. ENV (2010a)	<u>Project:</u> Area C West NVCP Flora, Vegetation and Fauna Assessment. 374 <u>Client:</u> BHP <u>Survey date:</u> 22–31 March 2010 15 August – 4 September 2007 <u>Survey type:</u> 2010 - Basic fauna assessment 2007 – Detailed fauna survey <u>Experience:</u> Senior biologist x2 Biologist x2 Field assistant	Within Study Area	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Avifauna census - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope - Breakaway - Stony plain - Alluvial plain	2007 <u>113 vertebrate species</u> 18 native mammals 0 introduced mammals 72 birds 32 reptiles 1 amphibian 2010 <u>72 vertebrate species</u> 9 native mammals 0 introduced mammals 46 birds 17 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
14. Onshore and Biologic (2011)	<u>Project:</u> Camp Hill Exploration Leases Level 2 Flora & Vegetation Survey and Level 1 Fauna Assessment. 381 <u>Client:</u> BHP <u>Survey date:</u> 2–15 August 2010 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior Zoologist Zoologist	Within Study Area	- Active searching - Targeted transects - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Medium drainage area - Gorge/ Gully - Hillcrest/slope - Basalt plain - Sand/ stony plain	<u>89 vertebrate species</u> 13 native mammals 4 introduced mammals 60 birds 12 reptiles 0 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Northern quoll (<i>Dasyurus hallucatus</i>) - Pilbara leaf-nosed bat (<i>Rhinonicteris aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Cooler temperatures and continuing dry conditions may have inhibited reptile and amphibian activity.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
15. Biologic (2011a)	<u>Project:</u> Area C and Surrounds Vertebrate Fauna Survey. 1008 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 5–18 October 2009 Phase 2: 20 March – 1 May 2010 <u>Survey type:</u> Two phase Detailed survey <u>Experience:</u> Principal Zoologist Senior Zoologist x 3 Herpetologist	<1km	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Hair traps - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Opportunistic observations - Secondary evidence	- Major drainage line - Minor drainage line - Gorge/ Gully - Hillcrest/slope - Calcrete plain - Sandplain	<u>166 vertebrate species</u> 22 native mammals 4 introduced mammals 76 birds 60 reptiles 4 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind snake (<i>Anilius ganei</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>) - Pilbara barking gecko (<i>Underwoodisaurus seorsus</i>)	
16. Ecologia (1998a)	<u>Project:</u> Mining Area C Biological Survey. 336 <u>Client:</u> BHP <u>Survey date:</u> 14–30 April 1997 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x 4 Research assistant	<1km	- Active searching - Systematic trapping – pitfall, Elliott - Avifauna census - Nocturnal surveys - Mist netting - Opportunistic observations - Secondary evidence	- Medium drainage line - Gorge/ Gully - Hillcrest/slope - Mulga woodland - Acacia shrubland	<u>143 vertebrate species</u> 17 native mammals 4 introduced mammals 78 birds 43 reptiles 2 amphibians	<u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	Pre bat echolocation and motion sensitive camera use.
17. Ecologia (2004b)	<u>Project:</u> Packsaddle Range Biological Survey. 357 <u>Client:</u> BHP <u>Survey date:</u> 5–10 May 2004 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior Zoologist Herpetologist Zoologist Research assistant	1.9km	- Active searching - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Medium drainage line - Gorge/ Gully - Mulga woodland - Eucalypt woodland - Valley plain	<u>88 vertebrate species</u> 10 native mammals 1 introduced mammals 56 birds 20 reptiles 0 amphibian	<u>Threatened:</u> - Grey falcon (<i>Falco hypoleucos</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	No trapping or motion sensitive camera use.
18. ENV (2008a)	<u>Project:</u> Area C Southern Flank Deposit Fauna Assessment. <u>Client:</u> BHP <u>Survey date:</u> 30 January – 6 February 2007 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior zoologist Zoologist	2.7km	- Active searching - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope - Alluvial plain	<u>100 vertebrate species</u> 13 native mammals 4 introduced mammals 56 birds 23 reptiles 4 amphibians	<u>Threatened:</u> - Grey falcon (<i>Falco hypoleucos</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
19. Biota (2013a)	<u>Project:</u> Area C West to Yandi level 2 Vertebrate Fauna Survey. 107 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 25 May – 2 June 2011 Phase 2: 7–15 September 2011 Phase 3: 5–8 February 2012 <u>Survey type:</u> Three phase Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist Ecologist	3.3km	- Active searching - Targeted searching - Systematic trapping – pitfall, funnel, Elliott - Avifauna census - Bat echolocation recording - Harp trapping - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Gorge/gullies - Stony and Loamy Plains - Major Creeks - Minor Creeks - Hillcrest/slopes - calcrete Plain - Mulga Plain	<u>172 vertebrate species</u> 24 native mammals 4 introduced mammals 84 birds 57 reptiles 3 amphibians	<u>Threatened:</u> - Pilbara leaf-nosed bat (<i>Rhinonictis aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Common greenshank (<i>Tringa nebularia</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	No motion sensitive cameras.
20. Ecologia (2008a)	<u>Project:</u> Area A and Additional Areas Level 2 Terrestrial Fauna Survey. <u>Client:</u> United Minerals Corporation <u>Survey date:</u> Phase 1: 22 May – 3 June 2008 Phase 2: 29 September – 10 October 2008 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x 4	3.5km	- Active searching - Targeted searching - Systematic trapping – pitfall, funnel, Elliott, cage - Avifauna census - Nocturnal surveys - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Degraded Mulga Woodland - Spinifex Plain - Spinifex Hillslope - Mulga woodland - Acacia Shrubland - Cracking Clay	<u>135 vertebrate species</u> 19 native mammals 3 introduced mammals 70 birds 41 reptiles 1 amphibian	<u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	
21. ENV (2010a)	<u>Project:</u> Area C West NVCP Flora, Vegetation and Fauna Assessment. 374 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 22 – 31 March 2010 Phase 2: 15 August – 4 September 2007 <u>Survey type:</u> 2010 - Basic fauna assessment 2007 – Detailed fauna survey <u>Experience:</u> Senior biologist x2 Biologist x2 Field assistant	4.1km	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Avifauna census - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope - Breakaway - Stony plain - Alluvial plain	2007 <u>113 vertebrate species</u> 18 native mammals 0 introduced mammals 72 birds 32 reptiles 1 amphibian 2010 <u>72 vertebrate species</u> 9 native mammals 0 introduced mammals 46 birds 17 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
22. Rapallo (2012)	<u>Project:</u> Level 2 Fauna Survey and Targeted Northern Quoll Survey of the Lamb Creek. <u>Client:</u> Process Minerals International Pty Ltd. <u>Survey date:</u> Phase 1: 19–20 March 2012 Phase 2: 26–12 April 2012 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Senior Ecologist Ecologist x5 Field assistant x2	5.2km	- Active searching - Targeted searching - Systematic trapping – pitfall, Elliott, funnel, cage - Bat echolocation recording - Harp trapping - Motion sensitive cameras - Avifauna census - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Hillcrest/slope - Minor Drainage Line - Alluvial/flood Plain - Stony/sandy Plain	<u>158 vertebrate species</u> 19 native mammals 3 introduced mammals 76 birds 58 reptiles 2 amphibians	<u>Threatened:</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) - Ghost bat (<i>Macroderma gigas</i>) - Northern quoll (<i>Dasyurus hallucatus</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>)	
23. Ecologia (1998c)	<u>Project:</u> West Angelas Iron Ore Project Vertebrate Fauna Assessment Survey. <u>Client:</u> Robe River Mining Company <u>Survey date:</u> Phase 1: 10 June – 10 July 1997 Phase Two: 18–30 October 1997 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Not listed	5.6km	- Active searching - Systematic trapping – pitfall, Elliott - Avifauna census - Nocturnal surveys - Mist netting - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope/ridges - Major creek line - Valley floor/Outwash valley - Mulga woodland - Eucalyptus woodland - Acacia shrubland - Spinifex steppe	<u>West Angelas mine area:</u> <u>119 vertebrate species</u> 19 native mammals 2 introduced mammals 70 birds 27 reptiles 1 amphibian <u>Rail Corridor:</u> <u>195 vertebrate species</u> 19 native mammals 4 introduced mammals 108 birds 60 reptiles 4 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Grey falcon (<i>Falco hypoleucos</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Pre bat echolocation and motion sensitive cameras
24. Ecologia (2014)	<u>Project:</u> Greater West Angelas Terrestrial Fauna Assessment. <u>Client:</u> RTIO <u>Survey date:</u> Phase 1: 26 September – 6th October 2012 Phase Two: 18–27 March 2013 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x4 Research assistant	6.9km	- Active searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Nocturnal surveys - Bat echolocation recording - Motion sensitive cameras - Opportunistic observations - Secondary evidence	- Major drainage line - Gorge/ Gully - Hillcrest/slope/ridges - Mixed Acacia woodland - Mesa top - Cracking clay - Foot slope or plain	<u>169 vertebrate species</u> 23 native mammals 2 introduced mammals 80 birds 64 reptiles 0 amphibians	<u>Threatened:</u> - Pilbara leaf-nosed bat (<i>Rhinionictes aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>) <u>Other significant:</u> - Pilbara barking gecko (<i>Underwoodisaurus seorsus</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
25. Biologic (2019)	<u>Project:</u> Pineapple Hill Detailed Vertebrate Fauna Survey. 10216 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 26 April – 6 May 2019 Phase 2: 28 August – 9 September 2019 <u>Survey type:</u> Two phase Detailed survey <u>Experience:</u> Senior Zoologist x 4 Ecologist	7km	- Active searching - Targeted searches - Targeted trapping – pitfall, funnel, Elliott, cage - Nocturnal Surveys - Bat echolocation recording - Acoustic recording - Motion sensitive cameras - Cave assessments - Remotely piloted aircraft searches - Opportunistic observations - Secondary evidence	- Stony Plain - Drainage Area/Floodplain - Hillcrest/slope - Gorge/ Gully - Major drainage line - Mulga Woodland - Minor drainage line	<u>129 vertebrate species</u> 19 native mammals 4 introduced mammals 73 birds 33 reptiles 0 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
26. ENV (2007a)	<u>Project:</u> Area C R-Deposit Fauna Assessment. 349 <u>Client:</u> BHP <u>Survey date:</u> 22–27 November 2006 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Biologist/Ornithologist Ornithologist Herpetologist Biologist Taxonomist	8.6km	- Active searching - Systematic trapping – pitfall, funnel, Elliott, cage - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope - Ridges/range crests - Riverine areas - breakaways - flood plains/ valley plains	<u>183 vertebrate species</u> 28 native mammals 0 introduced mammals 89 birds 64 reptiles 1 amphibian	<u>Threatened:</u> - Pilbara leaf-nosed bat (<i>Rhinonicteris aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind-snake (<i>Anilius ganei</i>)	Fire swept through sampling sites on the 24 th of November, damaging traps, reducing site access and reducing length of survey time.
27. Integrated Environmental (1980)	<u>Project:</u> An Ecological Appreciation of the West Angelas Environment, Western Australia 1979. <u>Client:</u> Cliffs International Inc. <u>Survey date:</u> 1978/79 <u>Survey type:</u> Detailed fauna surveys <u>Experience:</u> Senior Ecologist Zoologist	8.6km	- Active searching - Systematic trapping – pitfall, funnel, Elliott and break back traps - Avifauna census - Nocturnal surveys - Mist netting - Opportunistic observations - Secondary evidence	- Major drainage line - Gorge/ Gully - Hillcrest/slope/ridges - Mulga woodland - Eucalyptus woodland - Stony plain	<u>125 vertebrate species</u> 18 native mammals 3 introduced mammals 64 birds 48 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Grey falcon (<i>Falco hypoleucos</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Western pebble-mound mouse (<i>Pseudomys chapmani</i>) first described from this survey.
28. HGM (1999)	<u>Project:</u> Marillana Creek Western Access Corridor - Biological Assessment. <u>Client:</u> BHP <u>Survey date:</u> 23–30 April 1999 <u>Survey type:</u> Opportunistic fauna survey <u>Experience:</u> Unknown	8.8km	- Active searching - Opportunistic observations - Secondary evidence	- Minor drainage line - Riverine - Alluvial plains - Hillcrest/slope - Mulga woodland	<u>50 vertebrate species</u> 5 native mammals 1 introduced mammals 42 birds 1 reptile 1 amphibian	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Opportunistic survey only.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
29. Biota (2012d)	<u>Project:</u> South Flank to Jinidi Level 2 Fauna Survey. 1093 <u>Client:</u> BHP <u>Survey date:</u> Phase 1:11–20 April 2011 Phase 2: 2–11 November 2011 Phase 3: 31 January – 3 February 2012 <u>Survey type:</u> Three phase Detailed fauna survey <u>Experience:</u> Senior Zoologist x3 Zoologist x8	9.2km	- Active searching - Targeted searching - Systematic trapping – pitfall, Elliott, funnel - Avifauna census - Bat echolocation recording - Harp trapping - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Hilly Areas - Calcrete Plain - Creeks with shrubland/hummock grasslands - Mulga Plains - Stony/Loamy Plains - Major Creeks - Gorge and Breakaway	<u>173 vertebrate species</u> 24 native mammals 2 introduced mammals 79 birds 63 reptiles 5 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Parts of the Study Area were inaccessible by vehicle and were surveyed on foot only.
30. Biota (2005a)	<u>Project:</u> Fauna Habitats and Fauna Assemblage of Deposits E and F at West Angelas Survey. <u>Client:</u> Robe River Iron Associates <u>Survey date:</u> 4–12 May 2004 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Zoologist x3 Ecologist x1	9.4km	- Active searching - Targeted trapping – pitfall, funnel, Elliott - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Broad colluvial valleys dominated by Acacia - Hillcrest/slope - Stony plain and valley floors - Incised gullies and creeks	<u>98 vertebrate species</u> 12 native mammals 2 introduced mammals 47 birds 37 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	No motion sensitive cameras.
31. Outback Ecology (2008)	<u>Project:</u> Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial Vertebrate Fauna Assessment. 344 <u>Client:</u> BHP <u>Survey date:</u> 17–31 March 2008 <u>Survey type:</u> Detailed Fauna survey <u>Experience:</u> Zoologist x 3	9.7km	- Active searching - Targeted trapping – pitfall, funnel, Elliott, cage - Nocturnal survey - Avifauna census - Opportunistic observations - Secondary evidence	- Major drainage line - Minor drainage line - Gorge/ Gully - Hillcrest/slope	<u>100 vertebrate species</u> 8 native mammals 3 introduced mammals 61 birds 26 reptiles 2 amphibians	<u>Threatened:</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
32. Astron (2019)	<u>Project:</u> Hope Downs 2 Proposal Fauna Survey March 2019 <u>Client:</u> RITO <u>Survey date:</u> Phase 1: 21 November to 2 December 2017 Phase 2: 18–27 May 2018 Phase 3: 8–18 March 2019 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> All technical survey personnel have over five years of experience conducting Level 2 vertebrate fauna surveys	10.2km	- Active searching - Targeted trapping – pitfall, funnel, Elliott - Avifauna census - Motion sensitive cameras - Bat echolocation recording - Night parrot survey - Targeted searches - Nocturnal spotlighting	- Minor drainage line - Gorge/ Gully - Breakaway - Rocky hill - Low hill and slopes - Alluvial plain - Mulga woodland - Stony plain	<u>174 vertebrate species</u> 26 native mammals 7 introduced mammals 84 birds 55 reptiles 2 amphibians	<u>Threatened:</u> - Northern quoll (<i>Dasyurus hallucatus</i>) - Ghost bat (<i>Macroderma gigas</i>) - Pilbara leaf-nosed bat (<i>Rhinonictis aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - North-western free-tailed bat (<i>Ozimops cobourgiensis</i>) - Letter-winged kite (<i>Elanus scriptus</i>) <i>Lerista macropisthopus remota</i>	Rainfall in the three months preceding phase 2 and phase 3 was below average, this led to potentially dry unfavourable conditions for vertebrate fauna sampling.
33. Biologic (2013e)	<u>Project:</u> Targeted conservation significant fauna survey- Karijini tenement E47/17. <u>Client:</u> BHP <u>Survey date:</u> 17–25 June 2013 <u>Survey type:</u> Basic targeted fauna assessment <u>Experience:</u> Senior Zoologist x 5	11.2km	- Active searching - Motion sensitive cameras - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Major drainage line - Drainage area - Gorge/ Gully - Hillcrest/slope - Stony plain	<u>23 vertebrate species</u> 6 native mammals 0 introduced mammals 13 birds 4 reptiles 0 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	Four days of rainfall and lower than long-term average temperatures disrupted survey period.
34. GHD (2010)	<u>Project:</u> Coondewanna Exploration Tenement Level 2 Flora and Level 1 Fauna Report. <u>Client:</u> BHP <u>Survey date:</u> 27–31 May 2010 <u>Survey type:</u> Basic fauna assessment <u>Experience:</u> Zoologist x 1	16.0km	- Active searching - Avifauna census - Targeted searches - Opportunistic observations - Secondary evidence	- Hillcrest/slope - Gorge/ Gully - Hillcrest/slope - Breakaway/ cliff - Stony plain - Minor drainage line	<u>63 vertebrate species</u> 5 native mammals 5 introduced mammals 39 birds 14 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	The survey was restricted to a reconnaissance survey during a single field season, and therefore is not representative of all species that may occupy with the Study Area. Assess within the Study Area was also limited due to lack of suitable tracks..

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
35. Outback Ecology (2010)	<u>Project:</u> Area C to Jinayri to Mount Newman Railway Terrestrial Vertebrate Fauna Survey. 366 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 20 October – 1 November 2008 Phase 2: 5–29 March 2009 Recon: 8–12 October 2008 <u>Survey type:</u> Two phase Detailed fauna survey and reconnaissance survey <u>Experience:</u> Senior Zoologist Zoologist x6 Biologist	18.7km	- Active searching - Systematic trapping – pitfall, funnel, Elliott, cage - Targeted survey - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Drainage Line - Gorge/ Gully - Hillcrest/slope - Riverine - Sand and Stony Plain - Alluvial Plain - Mulga Woodland	<u>204 vertebrate species</u> 20 native mammals 6 introduced mammals 95 birds 76 reptiles 4 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind-snake (<i>Anilius ganei</i>) <u>Migratory:</u> - Eastern osprey (<i>Pandion haliaetus</i>)	
36. 360 Environmental (2017)	<u>Project:</u> Upper Marillana and Munjina Baseline Vertebrate Fauna survey. 10084 <u>Client:</u> BHP <u>Survey date:</u> 30 March – 9 April 2017 <u>Survey type:</u> Detailed survey <u>Experience:</u> Unknown	19.9km	- Systematic trapping – pitfall, Elliott, funnel, cage - Active searching - Avifauna census - Motion sensitive cameras - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Mulga Woodland - Drainage Line - Hill Crest/ Slope - Stony Plain	<u>126 vertebrate species</u> 15 native mammals 4 introduced mammals 77 birds 28 reptiles 2 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
37. Ecologia (2005b)	<u>Project:</u> Upper Marillana Exploration Project Biological Survey. 115 <u>Client:</u> BHP <u>Survey date:</u> 13–20 April 2005 <u>Survey type:</u> Basic survey <u>Experience:</u> Senior Zoologist Zoologist x2	20.9km	- Active searching - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Stony Plain - Low Ridge Line - Mulga Sandplain - Drainage Line	<u>69 vertebrate species</u> 11 native mammals 5 introduced mammals 37 birds 16 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Ghost bat recorded adjacent to Study Area at Marillana Creek waterhole.
38. (ENV, 2010b)	<u>Project:</u> Jinayri Access Road vertebrate fauna survey 499. <u>Client:</u> BHP <u>Survey date:</u> 20–30 May 2009 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x3 Field Assistant	21.6km	- Systematic trapping – pitfall, Elliott, funnel, cage - Active searching - Avifauna census - Targeted searches - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Riverine - Gorge/ Gully - Hillcrest/slope - Minor drainage line - Breakaway/ cliff - Alluvial Plain	<u>92 vertebrate species</u> 12 native mammals 3 introduced mammals 47 birds 28 reptiles 2 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Assess to the northern part of the Study Area was restricted due to lack of access tracks.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
39. Ecologia (1997)	<u>Project:</u> Hope Downs Biological Survey. <u>Client:</u> Hancock Prospecting Pty Ltd. <u>Survey date:</u> Phase 1: 18 August – 10 September 1993 Phase Two: 19–30 April 1994 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x4 Research assistant	22.9km	- Active searching - Systematic trapping – pitfall, Elliott - Avifauna census - Nocturnal surveys - Avifauna census - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope/ridges - Major creek lines - outwash plains/ valley plains	<u>158 vertebrate species</u> 20 native mammals 4 introduced mammals 88 birds 45 reptiles 1 amphibian	<u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	Pre bat echolocation and motion sensitive cameras
40. Biota (2013b)	<u>Project:</u> South Parmelia Vertebrate Fauna Survey. 1224 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 11–20 April 2011 Phase 2: 2–11 November 2011 Nocturnal Survey: 1– 4 February 2012 <u>Survey type:</u> Twp phase Detailed fauna survey <u>Experience:</u> Senior Zoologist x4 Zoologist x7	24.6km	- Active searching - Targeted searching - Targeted trapping – pitfall, funnel, Elliott - Avifauna census - Bat echolocation recording - Harp trapping - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Undulating Low Hills - Flood and Colluvial Plains - Minor Drainage - Rocky Gorges/gullies - Calcrete Plains - Major Drainage Line	<u>138 vertebrate species</u> 20 native mammals 1 introduced mammals 71 birds 43 reptiles 4 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
41. Maunsell Australia and Bamford Consulting (2003)	<u>Project:</u> Yandi Life of Mine Fauna and Flora <u>Client:</u> BHP <u>Survey date:</u> 23–28 September 2003 <u>Survey type:</u> Basic survey <u>Experience:</u> Ecologist x2	24.7km	- Opportunistic observations - Nocturnal surveys - Bat echolocation recording	- Creek Line - Low Hills and mesas - Mulga Woodland - Major Drainage Line	<u>80 vertebrate species</u> 2 native mammals 2 introduced mammal 69 birds 7 reptiles 0 amphibians	<u>Threatened:</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
42. Ecologia (2008b)	<u>Project:</u> Marillana Creek (Yandi) Iron Ore Mine Modification. 122 <u>Client:</u> Kellogg, Brown and Root Pty Ltd <u>Survey date:</u> 19–30 March 2008 <u>Survey type:</u> Single phase, Detailed survey <u>Experience:</u> Senior Zoologist Zoologist x3	25.6km	- Systematic trapping – pitfall, Elliott, cage, funnel - Active searching - Targeted searching - Avifauna census - Bat echolocation recording - Nocturnal survey - Opportunistic observations - Secondary evidence	- Minor Drainage Line - Hillslope - Stony Plain - Creek Line - Outwash and Valley Plain	<u>116 vertebrate species</u> 16 native mammals 3 introduced mammals 60 birds 37 reptiles 3 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Single phase survey. Reduced ANABAT usage due to rain.
43. Ecologia (1998b)	<u>Project:</u> Weeli Wolli Creek Biological Assessment Survey. 101 <u>Client:</u> BHP <u>Survey date:</u>	25.6km	- Active searching - Systematic trapping – pitfall, Elliott - Avifauna census - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Colluvial Flats - Melaleuca Forest - Creek Line - Acacia Thicket - Calcrete Gully - Shrub Steppe	<u>135 vertebrate species</u> 14 native mammals 3 introduced mammals 85 birds 30 reptiles 3 amphibians	<u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind-snake (<i>Anilius ganei</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	Pre bat echolocation use and motion sensitive cameras.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
	9–16 August 1999 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist x2 Zoologist x3 Ecologist						
44. Biologic (2010)	<u>Project:</u> East Packsaddle Level 1 Vertebrate Fauna Study. 350 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 5–18 October 2009 Phase 2: 20 March – 1 April 2009 <u>Survey type:</u> Two phase targeted fauna survey <u>Experience:</u> Senior Zoologist x3 Principal Zoologist Herpetologist	26.3km	- Active searching - Targeted searching – transects - Trapping – not specified - Hair trap - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Opportunistic observations - Secondary Evidence	- Mulga Association - Gorge/ Gully - Hillcrest/slope - Major Drainage Line - Drainage Area - Valley and Calcrete Plain - Sandplain	<u>110 vertebrate species</u> 17 native mammals 2 introduced mammals 48 birds 39 reptiles 4 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Eastern osprey (<i>Pandion haliaetus</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	
45. Biologic (2017)	<u>Project:</u> Ministers North level 2 vertebrate fauna survey. 10082 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 15–26 October 2016 Phase 2: 3–13 April 2017 <u>Survey type:</u> Two phase Detailed survey <u>Experience:</u> Principal Zoologist Senior Zoologist x 3	26.3km	- Active searching - Targeted transects - Targeted trapping – pitfall, funnel, Elliott, cage - Nocturnal surveys - Bat echolocation recording - Motion sensitive cameras - Opportunistic observations - Secondary evidence	- Major drainage line - Minor drainage line - Gorge/ Gully - Hillcrest/slope	<u>119 vertebrate species</u> 15 native mammals 2 introduced mammals 54 birds 45 reptiles 3 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Heavy rainfall during phase two survey resulted in site access issues and three sites (1,2,7) were changed (bringing the total number of sites to 10).
46. ENV (2009a)	<u>Project:</u> Munjina and Ministers North (Yandi Hub) Fauna Assessment. 423 <u>Client:</u> BHP <u>Survey date:</u> 21 November – 2 December 2007 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist/Ornithologist Zoologist x4 Taxonomist	26.3km	- Active searching - Systematic trapping – pitfall, funnel, Elliott, cage - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Minor Drainage Line - Gorge/ Gully - Hillcrest/slope - Riverine - Breakaway - Alluvial Plain	<u>134 vertebrate species</u> 15 native mammals 6 introduced mammals 66 birds 45 reptiles 1 amphibian	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Fires just prior to the field survey reduced survey efforts in the Minister's North site.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
47. Ecologia (1995)	<u>Project:</u> Yandi phase II Iron Ore Project: Biological Assessment Survey. <u>Client:</u> BHP <u>Survey date:</u> 14 May – 8 June 1995 <u>Survey type:</u> Single phase Detailed survey <u>Experience:</u> Senior Zoologist x 2 Zoologist Research Assistant Field Assistant	26.6km	- Active searching - Systematic trapping – pitfall, Elliott - Avifauna census - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Riverine - Drainage Gully - Colluvial Flat - Outwash Flat - Scree Slope - Mesa Top	<u>154 vertebrate species</u> 16 native mammals 4 introduced mammals 81 birds 47 reptiles 3 amphibians	<u>Threatened:</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	No cage or funnel trapping. Pre bat echolocation recording.
48. Ecologia (2004c)	<u>Project:</u> Yandi Overland Conveyor and Stockyard Fauna and Flora Assessment. <u>Client:</u> BHP <u>Survey date:</u> 18–19 October 2004 <u>Survey type:</u> Flora survey with fauna desktop survey <u>Experience:</u> Biologist	27.3km	Opportunistic observations	- Creek Line - Drainage Line - Acacia shrubland - Rocky hillslope	<u>1 vertebrate species</u> 1 native mammal	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Survey conducted to target rare and priority flora and weed species with opportunistic fauna sighting recorded only, no active fauna field component. Three active pebble mounds were recorded in the Yandi Stockyard survey area.
49. ENV (2008c)	<u>Project:</u> Jinayri Vertebrate Fauna Assessment. 1010 <u>Client:</u> BHP <u>Survey date:</u> 5–18 March 2008 <u>Survey type:</u> Detailed survey <u>Experience:</u> Zoologist(s)	27.4km	- Active searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary Evidence	- Minor Drainage Line - Gorge - Breakaways - Alluvial Plains - Hill Top - Scree Slope	<u>153 vertebrate species</u> 22 native mammals 5 introduced mammals 65 birds 60 reptiles 1 amphibian	<u>Threatened:</u> - Pilbara leaf-nosed bat (<i>Rhinonictoris aurantia</i>) - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind-snake (<i>Anilius ganei</i>)	
50. Biota (2012c)	<u>Project:</u> Koodaideri Southern Infrastructure Corridor Fauna Survey. <u>Client:</u> RTIO <u>Survey date:</u> Phase 1: 3–13 May 2011 Phase 2: 15–25 November 2011 Phase 3: 2–10 May 2012 <u>Survey type:</u> Three phase Detailed fauna survey <u>Experience:</u> Zoologist x12	27.8km	- Active searching - Targeted searching - Systematic trapping – pitfall, funnel, Elliott - Bat echolocation recording - Harp trapping - Avifauna census - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Hillcrest/Slopes - Drainage Lines - Alluvial Plains	<u>166 vertebrate species</u> 23 native mammals 4 introduced mammals 76 birds 61 reptiles 2 amphibians	<u>Threatened:</u> - Pilbara leaf-nosed bat (<i>Rhinonictoris aurantia</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind snake (<i>Anilius ganei</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
51. Biologic (2011b)	<u>Project:</u> Area C to Yandi Fauna Survey. <u>Client:</u> BHP <u>Survey date:</u> 13–20 September 2011 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior Zoologist Principle Zoologist	28.8km	- Active searching - Targeted searching – transects - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Opportunistic observations - Secondary Evidence	- Gorge/ Gully - Hillcrest/slope - Minor Drainage Line - Major Drainage Line - Valley	<u>74 vertebrate species</u> 13 native mammals 3 introduced mammals 47 birds 10 reptiles 1 amphibian	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
52. ENV (2011)	<u>Project:</u> Upper Marillana and Munjina Flora, Vegetation and Fauna Assessment. <u>Client:</u> BHP <u>Survey date:</u> 31 August – 10 September 2010 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior Zoologist Ornithologist Zoologist Biologist	28.8km	- Active searching - Opportunistic observations - Secondary evidence	- Minor Drainage Line - Hillcrest/slope - Riverine - Stony Plain - Alluvial Plain	<u>134 vertebrate species</u> 2 native mammals 4 introduced mammals 35 birds 5 reptiles 2 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	No trapping, bat echolocation recording, or motion sensitive cameras used.
53. ENV (2007b)	<u>Project:</u> Upper Marillana Exploration Lease Fauna Assessment. <u>Client:</u> BHP <u>Survey date:</u> 5–11 May 2007 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Ornithologist Taxonomist Biologist	29.2km	- Active searching - Bat echolocation recording - Avifauna census - Nocturnal survey - Opportunistic observations - Secondary evidence	- Minor Drainage Line - Hillcrest/slope - Sand Plain - Flood Plain	<u>118 vertebrate species</u> 14 native mammals 5 introduced mammals 79 birds 18 reptiles 2 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	No motion sensitive cameras used.
54. Ecologia (2006b)	<u>Project:</u> Jirridi Terrestrial Vertebrate Fauna Survey. 497 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 17–31 October 2005 Phase 2: 27 March – 5 April 2006 <u>Survey type:</u> Two phase Detailed survey <u>Experience:</u> Senior Zoologist x 3 Zoologist x3	29.3km	- Active searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Ridge top and Scree Slope - Minor Drainage Gully - Stony Plain - Alluvial Plain - Rocky Scree Slope - Mesa Top	<u>142 vertebrate species</u> 18 native mammals 4 introduced mammals 70 birds 48 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>)	.
55. Ecologia (2006d)	<u>Project:</u> Ministers North Biological Survey. <u>Client:</u> BHP <u>Survey date:</u>	29.6km	- Active searching - Avifauna census - Bat echolocation recording - Night survey - Opportunistic observations - Secondary evidence	- Minor drainage line - Gorge/ Gully - Hillcrest/slope	<u>71 vertebrate species</u> 10 native mammals 0 introduced mammals 42 birds 18 reptiles 1 amphibian	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	No trapping done.

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
	10–14 May 2006 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior Zoologist Zoologist						
56. Biologic (2018)	<u>Project:</u> Ministers North to Yandi Corridor Two phase Targeted Fauna Survey. 10140 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 9–13 October 2017 Phase 2: 15–23 June 2018 <u>Survey type:</u> Two phase targeted fauna survey <u>Experience:</u> Senior Zoologist x3 Zoologist	29.7km	- Active searching - Targeted searching – transects - Trapping – small and large Elliott - Avifauna census - Bat echolocation recording - Acoustic recording - Motion sensitive cameras - Opportunistic observations - Secondary Evidence	- Basalt Outcrop - Breakaway/ cliff - Gorge/ Gully - Hillcrest/slope - Minor Drainage Line - Major Drainage Line - Drainage Area/ Floodplain	<u>94 vertebrate species</u> 15 native mammals 2 introduced mammals 54 birds 23 reptiles 0 amphibian	<u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	
57. Biota (2010)	<u>Project:</u> Yandicoogina Junction South West and Oxbow Fauna Survey. 1187 <u>Client:</u> RITO <u>Survey date:</u> 5–12 July 2008 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Principal Zoologist Senior Zoologist Zoologist	31.7km	- Active searching - Targeted trapping – pitfall, funnel, Elliott - Avifauna census - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Major drainage line - Minor drainage line - Hillcrest/slope - Stony plain and valley floors - Rocky breakaways and screes	<u>72 vertebrate species</u> 10 native mammals 2 introduced mammals 46 birds 14 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Single season survey. Sections of site inaccessible by car however, fauna habitats surrounding still representative of the area as a whole. No nocturnal surveys.
58. ENV (2010c)	<u>Project:</u> Jinayri Mining Lease Vertebrate Fauna Survey. <u>Client:</u> BHP <u>Survey date:</u> 5–18 March 2008 <u>Survey type:</u> Detailed survey <u>Experience:</u> Senior Zoologist Zoologist x3 Ornithologist x2 Biologist Field Assistant x3	34.6km	- Active searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary Evidence	- Minor Drainage Line - Breakaways - Alluvial Plains - Hillcrest/slope	<u>149 vertebrate species</u> 22 native mammals 4 introduced mammals 65 birds 57 reptiles 1 amphibian	<u>Threatened:</u> - Pilbara leaf-nosed bat (<i>Rhinonictes aurantia</i>) - Ghost bat (<i>Macroderma gigas</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind-snake (<i>Anilius ganeii</i>)	
59. Biologic (2011e)	<u>Project:</u> Jinidi Vertebrate Fauna Survey. <u>Client:</u> BHP <u>Survey date:</u> 14–20 March 2011 6–10 April 2011 <u>Survey type:</u> Basic fauna survey	34.7km	- Active searching - Targeted searching – transects - Bat echolocation recording - Opportunistic observations - Secondary Evidence	- Gorge/ Gully - Hillcrest/slope - Drainage Area - Calcrete Plain - Mulga - Major Drainage Line	<u>92 vertebrate species</u> 12 native mammals 3 introduced mammals 59 birds 16 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
	<u>Experience:</u> Zoologist x2						
60. Specialised Zoological (2008)	<u>Project:</u> Survey for conservation significant bats between Kurrajura siding and the Yandi WYE. <u>Client:</u> BHP <u>Survey date:</u> 2–8 October 2008 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Zoologist x2	37.4km	- Targeted searching - Nocturnal surveys - Bat echolocation recording - Opportunistic observations - Secondary Evidence	- Gorge/ Gully - Major drainage line - Medium drainage line - Breakaway/ cliff - Hillcrest/slope	<u>6 vertebrate species</u> 6 native mammals	None	
61. Ecologia (2008c)	<u>Project:</u> RGP5 fauna survey Kurrajura Siding to Yandi WYE including Yandi repeater. <u>Client:</u> BHP <u>Survey date:</u> 9 May – 13 May 2008 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Zoologists x2	39.0km	- Active searching - Targeted searching - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary Evidence	- Hillcrest/slope - Open woodland - Gorge/ Gully - Breakaway/ cliff	<u>75 vertebrate species</u> 12 native mammals 0 introduced mammals 52 birds 9 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara leaf-nosed bat (<i>Rhinonictis aurantia</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Access was restricted due to the rail corridor and the presence of heritage exclusion zones.
62. Biologic (2012)	<u>Project:</u> Jinidi to Mainline Vertebrate Fauna Survey. 1065 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 28 March – 10 April 2011 Phase 2: 22 August – 3 September 2011 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Zoologists	39.4km	- Active searching - Targeted searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary Evidence	- Gorge/ Gully - Hillcrest/slope - Drainage Area - Dune - Sandplain - Grassland - Mulga woodland - Major Drainage Line	<u>197 vertebrate species</u> 27 native mammals 4 introduced mammals 89 birds 73 reptiles 4 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
63. Biologic (2011g)	<u>Project:</u> Yandi Vertebrate Fauna Review. <u>Client:</u> BHP <u>Survey date:</u> 9–17 December 2010 <u>Survey type:</u> Basic survey and Targeted <u>Experience:</u> Senior Ecologist Senior Zoologist	40.3km	- Targeted searching – transects and caves - Active searching - Motion sensitive cameras - Bat echolocation recording - Opportunistic observations - Secondary evidence	- Mulga Woodland - Major Drainage Line - Hill Crests and Slopes - Boulder Piles - Sandplain	<u>75 vertebrate species</u> 7 native mammals 1 introduced mammal 53 birds 12 reptiles 2 amphibians	<u>Threatened:</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
64. Biologic (2011c)	<u>Project:</u> Barimunya Camp Vertebrate Fauna Survey. <u>Client:</u> BHP <u>Survey date:</u> 29 April 2011 <u>Survey type:</u>	41.2km	- Active searching - Targeted searching - Opportunistic observations - Secondary Evidence	- Drainage Line - Alluvial Slope - Hillcrest/slope	<u>21 vertebrate species</u> 1 native mammals 0 introduced mammal 17 birds 3 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
	Basic baseline fauna survey <u>Experience:</u> Senior Ecologist Zoologist						
65. ENV (2009b)	<u>Project:</u> Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment. <u>Client:</u> Worley Parsons and BHP <u>Survey date:</u> 7–16 May 2009 <u>Survey type:</u> Basic fauna survey <u>Experience:</u> Senior Zoologist Zoologist	41.9km	- Active searching - Avifauna census - Nocturnal surveys - Opportunistic observations - Secondary Evidence	- Minor Drainage Line - Riverine - Alluvial Plain - Hillcrest/slope - Stony Plain - Gorge/ Gully	<u>78 vertebrate species</u> 8 native mammals 2 introduced mammal 59 birds 9 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
66. Biota (2012b)	<u>Project:</u> Koodaideri Project Targeted Fauna Survey. <u>Client:</u> RTIO <u>Survey date:</u> 19–27 July 2011 <u>Survey type:</u> Detailed targeted fauna survey <u>Experience:</u> Senior Zoologist Zoologist x3	43.0km	- Active searching - Targeted searching - Targeted trapping – medium and large Elliott - Bat echolocation recording - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Hillcrest/Slopes - Drainage Lines - Alluvial Plains	<u>16 vertebrate species</u> 8 native mammals 2 introduced mammals 0 birds 6 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
67. Biota (2009)	<u>Project:</u> Yandicoogina Targeted Northern Quoll survey <u>Client:</u> RITO <u>Survey date:</u> 6–12 October 2009 <u>Survey type:</u> Targeted fauna survey <u>Experience:</u> Unknown	43.3km	- Active searching - Targeted searching – transects			<u>None</u>	
68. Biologic (2013c)	<u>Project:</u> Marillana Vertebrate Fauna Survey. 1077 <u>Client:</u> BHP <u>Survey date:</u> Phase 1: 7–20 March 2011 Phase 2: 1–14 August 2011 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Senior Zoologist x4 Principal Zoologist Herpetologist	45.4km	- Active searching - Targeted searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary Evidence	- Gorge/ Gully - Hillcrest/slope - Sandy Areas - Sand Dunes - Mulga Woodland - Minor Drainage Line - Major Drainage Line	<u>175 vertebrate species</u> 25 native mammals 5 introduced mammal 77 birds 66 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) - Northern quoll (<i>Dasyurus hallucatus</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Blind snake (<i>Anilius ganei</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>) <u>Other significant:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
69. Ecologia (2006c)	<u>Project:</u> Marillana Terrestrial Vertebrate Fauna Survey. 408 <u>Client:</u> Brockman Resources Ltd. <u>Survey date:</u> Phase 1: 2–9 October 2005 Phase 2: 10–17 March 2006 <u>Survey type:</u> Two phase Detailed survey <u>Experience:</u> Senior Zoologist x3 Zoologist	45.4km	- Active searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Ridge Top and Scree Slope - Minor Drainage Gully - Stony Plain - Alluvial Plain - Mesa Top	<u>118 vertebrate species</u> 18 native mammals 2 introduced mammals 56 birds 42 reptiles 2 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	Access restriction phase one. Reduced reptile activity due to rain during phase two.
70. Biota (2012a)	<u>Project:</u> Koodaideri Northern Extension Fauna Survey. <u>Client:</u> RTIO <u>Survey date:</u> 10–20 October 2011 <u>Survey type:</u> Detailed fauna survey <u>Experience:</u> Senior Zoologist Zoologist x3	46.1km	- Active searching - Targeted searching - Targeted trapping – pitfall, funnel, Elliott - Avifauna census - Bat echolocation recording - Harp trapping - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Hillcrest/Slopes - Drainage Lines - Alluvial Plains - Stony Plain - Calcrete Plain	<u>87 vertebrate species</u> 15 native mammals 1 introduced mammals 31 birds 40 reptiles 0 amphibians	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	
71. Biota (2014a)	<u>Project:</u> Yandi Billiards phase 1 Seasonal Fauna Survey. <u>Client:</u> RTIO <u>Survey date:</u> Phase 1: 8–18 March 2014 <u>Survey type:</u> Two phase Detailed fauna survey <u>Experience:</u> Zoologist	46.8km	- Active searching - Targeted searching - Systematic trapping – pitfall, Elliott, funnel - Avifauna census - Bat echolocation recording - Motion sensitive cameras - Nocturnal surveys - Audio recordings for birds and amphibians - Opportunistic observations - Secondary evidence	- Alluvial Plain - Floodplain - Hillcrest/Slopes - Major Drainage Line - Minor Alluvial Fans - Mulga Woodlands - Pediment Slope	<u>155 vertebrate species</u> 19 native mammals 2 introduced mammals 78 birds 54 reptiles 2 amphibians	<u>Threatened:</u> - Ghost bat (<i>Macroderma gigas</i>) - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) - Brush-tailed mulgara (<i>Dasycercus blythi</i>) <u>Migratory:</u> - Fork-tailed swift (<i>Apus pacificus</i>)	
72. Biota (2014b)	<u>Project:</u> Yandi Billiards Targeted Northern Quoll Survey <u>Client:</u> RTIO <u>Survey date:</u> 5–13 August 2014 <u>Survey type:</u> Targeted fauna survey <u>Experience:</u> Zoologist x2	46.8km	- Targeted searching - Systematic trapping – cage and large Elliott - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Alluvial and Flood Plain - Hillcrest/Slopes - Major Drainage Line - Minor Drainage Line - Cave/Overhang	<u>10 vertebrate species</u> 5 native mammals 1 introduced mammals 3 birds 1 reptile 0 amphibians	None	Unconfirmed northern quoll scat found (Molecular results inconclusive)
73. Biologic (2016a)	<u>Project:</u> Marillana targeted vertebrate fauna survey <u>Client:</u> RTIO <u>Survey date:</u> 17–21 January 2016 <u>Survey type:</u> Targeted fauna survey	47.0km	- Targeted searching - Motion sensitive cameras - Bat echolocation recording - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Gorge/ Gully - Hillcrest/Slopes - Sand Plain - Stony Plain - Mulga Woodland - Sand Dunes - Minor Drainage Line - Major Drainage Line - Drainage Area/Floodplain	<u>3 vertebrate species</u> 1 native mammals 0 introduced mammal 1 birds 1 reptiles 0 amphibians	<u>Threatened:</u> - Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>) <u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	

Reference	Survey details	Proximity to Study Area	Survey methods	Significant species habitat	Vertebrate fauna assemblage found (summary of species richness)	Significant species	Survey limitations/ notes
<u>Experience:</u> Zoologist x2							
74. Ninox (2009)	<u>Project:</u> A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Mining Area, Near Newman, Western Australia. 1243 <u>Client:</u> Matiske Consulting Pty Ltd. <u>Survey date:</u> Phase 1: 6–13 May 2008 Phase 2: 12–18 September 2008 <u>Survey type:</u> Two phase Detailed survey <u>Experience:</u> Senior Zoologist x2 Zoologist	49.4km	- Active searching - Systematic trapping – pitfall, Elliott, funnel, cage - Avifauna census - Bat echolocation recording - Harp trapping - Opportunistic observations - Secondary evidence	- Ridge and Range - Rocky Hill/gully - Creekline - Spinifex with Eucalyptus - Mulga Groves - Stony Plain	<u>112 vertebrate species</u> 16 native mammals 1 introduced mammal 66 birds 29 reptiles 0 amphibians	<u>Priority:</u> - Western pebble-mound mouse (<i>Pseudomys chapmani</i>) <u>Other specially protected:</u> - Peregrine falcon (<i>Falco peregrinus</i>)	
75. Bamford Consulting (2012)	<u>Project:</u> Vertebrate Fauna Assessment of the Iron Valley Project Area. <u>Client:</u> Iron Ore Holdings Ltd. <u>Survey date:</u> Phase 1: 9–19 May 2011 Phase 2: 29–30 September 2011 <u>Survey type:</u> Two phase Detailed targeted fauna survey <u>Experience:</u> Senior Zoologist x3 Zoologist x8	49.4km	- Active searching - Targeted searching - Elliott trapping - Bat echolocation recording - Motion sensitive cameras - Nocturnal surveys - Opportunistic observations - Secondary evidence	- Alluvial and Flood Plain - Rocky Hillcrest/Slopes - Drainage Line - Stony Plain	<u>97 vertebrate species</u> 11 native mammals 2 introduced mammals 58 birds 25 reptiles 1 amphibian	<u>Priority:</u> Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	

Appendix B: Significant Vertebrate Fauna Recorded in the Desktop Assessment

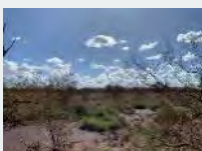
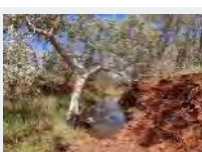
Species		Conservation Status				Database review					Literature review																																				
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	NatureMap (40 km)	EPBC (40km)	DBCA T&P (50 km)	ALA (50 km)	Birdlife (10km)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35		
MAMMALS																																															
DASYURIDAE																																															
<i>Dasycercus blythi</i>	Brush-tailed mulgara			P4		•		•											•																												
<i>Dasyurus hallucatus</i>	Northern quoll	EN	EN		EN	•	•	•				•	•	•				•	•					•							•										•						
<i>Sminthopsis longicaudata</i>	Long-tailed dunnart			P4		•				•																																					
MEGADERMATIDAE																																															
<i>Macroderma gigas</i>	Ghost bat	VU	VU		VU	•	•	•			•	•	•	•	•	•	•								•	•						•			•			•				•	•		•		
MOLOSSIDAE																																															
<i>Ozimops cobourgianus</i>	North-western free-tailed bat			P1																																											
MURIDAE																																															
<i>Leggadina lakedownensis</i>	Northern short-tailed mouse			P4		•		•					•						•															•													
<i>Notomys longicaudatus</i>	Long-tailed hopping-mouse	EX	EX		EX			•																																							
<i>Pseudomys chapmani</i>	Western pebble-mound mouse			P4		•		•				•	•	•					•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•		
RHINONYCTERIDAE																																															
<i>Rhinonictes aurantia</i>	Pilbara leaf-nosed bat	VU	VU			•						•													•					•				•		•						•					
THYLACOMYIDAE																																															
<i>Macrotis lagotis</i>	Greater bilby	VU	VU		VU	•	•	•																																							
BIRDS																																															
ACCIPITRIDAE																																															
<i>Elanus scriptus</i>	Letter-winged kite			P4	NT	•		•																																			•				
<i>Pandion haliaetus</i>	Eastern osprey	MI	MI			•																																								•	
APODIDAE																																															
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI			•		•		•			•						•						•						•		•								•						
CHARADRIIDAE																																															
<i>Charadrius veredus</i>	Oriental plover	MI	MI																																									•			
FALCONIDAE																																															
<i>Falco hypoleucos</i>	Grey falcon	VU	VU		VU	•	•	•											•									•	•							•											
<i>Falco peregrinus</i>	Peregrine falcon		OS			•		•		•		•	•	•					•						•	•				•	•												•				
LARIDAE																																															
<i>Gelochelidon nilotica</i>	Gull-billed tern	MI	MI				•																																								

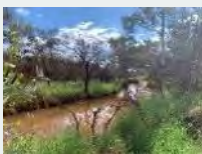
[illegible]

Species		Conservation Status				Literature review																																										
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75			
MAMMALS																																																
DASYURIDAE																																																
<i>Dasycercus blythi</i>	Brush-tailed mulgara			P4																																												
<i>Dasyurus hallucatus</i>	Northern quoll	EN	EN		EN																																											
<i>Sminthopsis longicaudata</i>	Long-tailed dunnart			P4																																												
MEGADERMATIDAE																																																
<i>Macroderma gigas</i>	Ghost bat	VU	VU		VU		•			•				•				•		•				•				•	•			•	•					•										
MOLOSSIDAE																																																
<i>Ozimops cobourgianus</i>	North-western free-tailed bat			P1																																												
MURIDAE																																																
<i>Leggadina lakedownensis</i>	<i>Northern short-tailed mouse</i>			<i>P4</i>																																												
<i>Notomys longicaudatus</i>	<i>Long-tailed hopping-mouse, koolawa</i>	<i>EX</i>	<i>EX</i>		<i>EX</i>																																											
<i>Pseudomys chapmani</i>	<i>Western pebble-mound mouse</i>			<i>P4</i>		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•		•		•	•	•	•		•	•	•		
RHINONYCTERIDAE																																																
<i>Rhinonictes aurantia</i>	Pilbara leaf-nosed bat	VU	VU																•	•								•			•																	
THYLACOMYIDAE																																																
<i>Macrotis lagotis</i>	Greater bilby	VU	VU		VU																																											
BIRDS																																																
ACCIPITRIDAE																																																
<i>Elanus scriptus</i>	Letter-winged kite			P4	NT																																											
<i>Pandion haliaetus</i>	Eastern osprey	MI	MI																																													
APODIDAE																																																
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI																					•				•				•					•			•								
CHARADRIIDAE																																																
<i>Charadrius veredus</i>	Oriental plover	MI	MI																																													
FALCONIDAE																																																
<i>Falco hypoleucos</i>	Grey falcon	VU	VU		VU								•				•			•						•																						
<i>Falco peregrinus</i>	Peregrine falcon		OS										•			•			•						•													•									•	
LARIDAE																																																
<i>Gelochelidon nilotica</i>	Gull-billed tern	MI	MI																																													

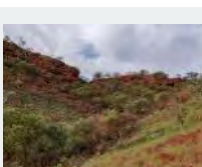
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Appendix C: Vertebrate Fauna Habitat Assessment

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
Phase 1																							
VCPH-002	-22.9131	118.7276	05/04/2022	Stony Plain	Stony Plain	South/ West	Low	Clay Loam	Scarce	Minor Outcropping	Iron stone	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Eucalypt Woodland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-008	-22.8881	118.8109	05/04/2022	Drainage Area/ Floodplain	Stony Plain	South/ East	Flat	Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	<i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-010	-22.9030	118.7277	05/04/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Light Clay	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Mulga Woodland, Tussock Grassland	-	-	0	Prone to Flooding	0.4	Cattle Grazing	Old (6+ yr)		-
VCPH-021	-22.8927	118.7977	07/04/2022	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	-	Negligible	Few Large Patches	<i>Spinifex</i> Hummock Grassland, <i>Acacia</i> Shrubland, Tussock Grassland	-	-	0	None	0.6	Cattle Grazing	Old (6+ yr)		-
VCPH-032	-22.8808	118.7486	08/04/2022	Breakaway/ Cliff	Breakaway	West	Steep	Sandy Clay Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Scattered Eucalypts, <i>Acacia</i> Shrubland	-	-	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-033	-22.8827	118.7487	08/04/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Small Rocks (11-20cm)	Few Small Patches	<i>Acacia</i> Shrubland, Eucalypt Woodland, Tussock Grassland	-	-	0	Prone to Pooling	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-034	-22.8842	118.7539	08/04/2022	Hillcrest/ Hillslope	Undulating Low Hills	South	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Spinifex</i> Hummock Grassland, Scattered Eucalypts, <i>Acacia</i> Shrubland	-	-	0	None	1	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-035	-22.8829	118.7748	08/04/2022	Breakaway/ Cliff	Breakaway	South	Moderate	Sandy Clay Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-036	-22.8819	118.7844	08/04/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Tussock Grassland	-	-	0	None	0.8	Weed Invasion	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-037	-22.8856	118.7826	08/04/2022	Hardpan Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Acacia Shrubland, Spinifex Hummock Grassland	-	-	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-038	-22.8850	118.7837	08/04/2022	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	-	Negligible	Many Small Patches	Mulga Woodland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-039	-22.8844	118.7802	08/04/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-040	-22.8822	118.7774	08/04/2022	Hillcrest/ Hillslope	Hillslope	East	Low	Sandy Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Acacia Shrubland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-041	-22.9045	118.7240	09/04/2022	Medium Drainage Line	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	-	Gravel (1-4cm)	Few Large Patches	Mulga Woodland, Tussock Grassland, Spinifex Hummock Grassland, Scattered Eucalypts	-	-	5	Permanen t	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-047	-22.8902	118.7928	09/04/2022	Hardpan Plain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Acacia Shrubland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-048	-22.8916	118.7871	09/04/2022	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Negligible	Many Small Patches	Acacia Shrubland, Scattered Eucalypts, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-050	-22.9052	118.7135	09/04/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Mulga Woodland, Tussock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-064	-22.9026	118.7568	11/04/2022	Mulga Woodland	Sand Plain	Flat	Flat	Light Clay	Many Large Patches	Negligible	-	Gravel (1-4cm)	Many Large Patches	Mulga Woodland, Spinifex Hummock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-065	-23.0247	118.6427	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Mulga Woodland	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-066	-23.0391	118.6769	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Mulga Woodland	-	-	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-067	-23.0789	118.6668	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland	-	-	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-068	-23.0420	118.7365	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-069	-23.0282	118.9216	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Scattered Eucalypts	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-070	-22.9021	118.7582	11/04/2022	Mulga Woodland	Sand Plain	Flat	Flat	Light Clay	Many Large Patches	Negligible	-	Gravel (1-4cm)	Many Large Patches	<i>Spinifex</i> Hummock Grassland, Mulga Woodland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-074	-23.0882	118.8551	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Moderate (3 to 5 yr)		-
VCPH-075	-23.0930	118.8109	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Mining Exploration	Moderate (3 to 5 yr)		-
VCPH-076	-23.0910	118.7173	11/04/2022	Hillcrest/ Hillslope	Undulating Low Hills	South	Low	Sandy Clay Loam	Scarce	Limited Outcropping	BIF	Small Rocks (11-20cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-

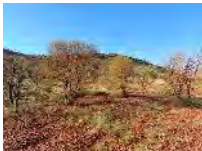
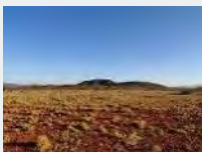
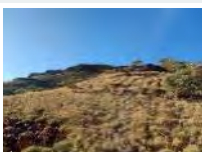
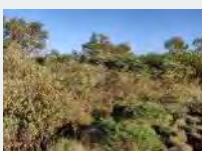
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-077	-23.0540	118.6695	11/04/2022	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-078	-23.0710	118.6742	11/04/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland	-	-	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-082	-22.9137	118.7853	13/04/2022	Hillcrest/ Hillslope	Gully	South/ East	Moderate	Clay Loam	Scarce	Minor Outcropping	BIF	Small Rocks (11-20cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.6	None Discernible	Old (6+ yr)		-
VCPH-085	-23.1060	118.8094	28/04/2022	Gorge/ Gully	Gorge	West	Moderate	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	1	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-086	-23.0442	118.8541	28/04/2022	Breakaway/ Cliff	Gorge	South	Steep	Clay Loam	None Discernible	Major Outcropping	BIF	Boulders (>61cm)	None Discernible	Spinifex Hummock Grassland, Eucalypt Woodland	-	-	1	None	0.6	Road/ Access Track	Moderate (3 to 5 yr)		-
VCPH-087	-23.0292	118.7122	29/04/2022	Gorge/ Gully	Gorge	North	Moderate	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	Acacia Shrubland, Eucalypt Woodland, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-088	-23.0644	118.7429	29/04/2022	Gorge/ Gully	Gorge	South	Steep	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-089	-23.0403	118.8516	29/04/2022	Gorge/ Gully	Gorge	South/ West	Very Steep	Sandy Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Tussock Grassland	-	-	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-090	-23.0374	118.8401	29/04/2022	Gorge/ Gully	Gorge	South	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	1	Prone to Pooling	1	Frequent Fire	Moderate (3 to 5 yr)		-

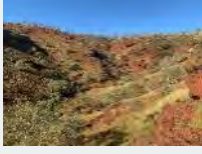
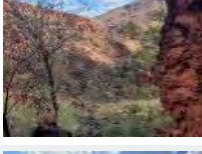
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-091	-23.0964	118.9056	29/04/2022	Breakaway/ Cliff	Major Drainage Line	Flat	Flat	Clay Loam	Many Small Patches	Major Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	3	Prone to Pooling	0.8	Weed Invasion	Old (6+ yr)		Buffel common. Recent burn where outcroppi ng is minimal but long unburned elsewhere
VCPH-092	-23.0968	118.8454	29/04/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Light Clay	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Tussock Grassland, <i>Acacia</i> Shrubland, Mulga Woodland	-	-	1	None	0.6	Cattle Grazing, Weed Invasion and Road/ Access Track	Old (6+ yr)		-
VCPH-093	-23.0685	118.8181	29/04/2022	Gorge/ Gully	Gorge	South/ West	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland, <i>Acacia</i> Shrubland	-	-	0	None	1	None Discernible	Old (6+ yr)		Recent burning surrounds
VCPH-094	-23.0532	118.8123	29/04/2022	Breakaway/ Cliff	Ironstone Outcrops	North/ East	Moderate	Clay Loam	Few Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Few Small Patches	Mulga Woodland, Tussock Grassland	-	-	0	None	0.6	Cattle Grazing	Old (6+ yr)		-
VCPH-095	-23.0722	118.8226	30/04/2022	Breakaway/ Cliff	Breakaway	South	Very Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-096	-23.0650	118.8211	30/04/2022	Gorge/ Gully	Gorge	West	Very Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-097	-23.0690	118.7791	30/04/2022	Stony Plain	Stony Plain	North	Low	Sandy Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-098	-23.0677	118.7691	30/04/2022	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-099	-23.0634	118.6912	30/04/2022	Minor Drainage Line	Minor Drainage Line	North	Low	Clayey Sand	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	Prone to Pooling	0.8	Mining Exploration	Old (6+ yr)		-
VCPH-100	-23.0609	118.7099	30/04/2022	Gorge/ Gully	Gorge	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-101	-23.0480	118.7424	30/04/2022	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Light Clay	Many Large Patches	Negligible	-	Gravel (1-4cm)	Many Large Patches	<i>Spinifex</i> Hummock Grassland, Mulga Woodland	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-102	-23.0475	118.7359	30/04/2022	Drainage Area/ Floodplain	Sandy/ Stony Plain	Flat	Flat	Light Clay	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-103	-23.0567	118.7365	30/04/2022	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Light Clay	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-104	-23.0581	118.7162	30/04/2022	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Light Clay	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-105	-23.0617	118.7000	30/04/2022	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Light Clay	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-106	-23.0935	118.6942	01/05/2022	Hillcrest/ Hillslope	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-108	-23.0285	118.9135	01/05/2022	Medium Drainage Line	Medium Drainage Line	Flat	Flat	Sandy Loam	Many Small Patches	Limited Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, Tussock Grassland	-	-	0	Prone to Flooding	1	Frequent Fire	Moderate (3 to 5 yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-109	-23.0298	118.9094	01/05/2022	Gorge/ Gully	Gorge	East	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Flooding	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-116	-23.0922	118.6951	01/05/2022	Gorge/ Gully	Gorge	South	Moderate	Sandy Clay Loam	Few Small Patches	Limited Outcropping	BIF	Small Rocks (11-20cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-117	-23.0461	118.9093	01/05/2022	Breakaway/ Cliff	Ironstone Outcrops	East	Moderate	Sandy Clay Loam	Scarce	Extensive Outcropping	BIF	Small Rocks (11-20cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-118	-23.0467	118.9072	01/05/2022	Breakaway/ Cliff	Ironstone Outcrops	East	Moderate	Sandy Clay Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Acacia Shrubland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-119	-23.0864	118.6868	01/05/2022	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Sandy Loam	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	Frequent Fire	Old (6+ yr)		-
VCPH-120	-23.0857	118.6838	01/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-121	-23.0335	118.6869	01/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Tussock Grassland	-	-	0	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-122	-23.0396	118.8660	01/05/2022	Breakaway/ Cliff	Gorge	North/ East	Steep	Sandy Clay Loam	Scarce	Extensive Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Acacia Shrubland, Mulga Woodland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-123	-23.0369	118.6570	01/05/2022	Gorge/ Gully	Gully	South/ East	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.6	None Discernible	Old (6+ yr)		-
VCPH-124	-23.0366	118.6479	01/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-125	-23.0376	118.6475	01/05/2022	Gorge/ Gully	Gully	South/ East	Moderate	Clay Loam	Scarce	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Scattered Eucalypts	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-126	-23.0456	118.9146	01/05/2022	Hillcrest/ Hillslope	Undulating Low Hills	East	Moderate	Sandy Clay Loam	None Discerni ble	Limited Outcropping	BIF	Pebbles (5-10cm)	None Discerni ble	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-127	-23.0424	118.9135	01/05/2022	Breakaway/ Cliff	Gorge	South/ West	Steep	Sandy Clay Loam	None Discerni ble	Major Outcropping	BIF	Small Rocks (11- 20cm)	None Discerni ble	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	0.6	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-128	-23.0590	118.6237	02/05/2022	Gorge/ Gully	Gorge	South/ East	Moderate	Sandy Clay Loam	None Discerni ble	Major Outcropping	BIF	Large Rocks (21-60cm)	None Discerni ble	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-129	-23.0937	118.7026	02/05/2022	Gorge/ Gully	Gully	South	Steep	Sandy Clay Loam	None Discerni ble	Moderate Outcropping	BIF	Large Rocks (21-60cm)	None Discerni ble	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-130	-23.0383	118.6552	02/05/2022	Gorge/ Gully	Breakaway	North	Steep	Sandy Clay Loam	Scarce	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-131	-23.0170	118.6490	02/05/2022	Gorge/ Gully	Gully	South	Steep	Sandy Clay Loam	Scarce	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	0.6	Frequent Fire	Recent (0 to 2 yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-132	-23.0870	118.6405	02/05/2022	Gorge/ Gully	Gorge	South	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	<i>Spinifex</i> Hummock Grassland, Scattered Eucalypts	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-133	-23.0815	118.6608	02/05/2022	Gorge/ Gully	Gorge	North/ East	Steep	Sandy Clay Loam	None Discernible	Major Outcropping	BIF	Large Rocks (21-60cm)	None Discernible	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-134	-23.0323	118.8336	03/05/2022	Stony Plain	Stony Plain	North/ West	Low	Sandy Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.6	Road/ Access Track	Recent (0 to 2 yr)		Patchy recent burn
VCPH-135	-23.0463	118.8309	03/05/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-136	-23.0508	118.8236	03/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-137	-23.0662	118.8065	03/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-138	-23.0332	118.8385	03/05/2022	Gorge/ Gully	Footslope	North/ West	Steep	Sandy Clay Loam	None Discernible	Major Outcropping	BIF	Small Rocks (11-20cm)	None Discernible	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-139	-23.0701	118.8124	03/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-140	-23.0417	118.8684	03/05/2022	Breakaway/ Cliff	Gorge	South/ West	Steep	Sandy Clay Loam	Scarce	Extensive Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-141	-23.0822	118.8164	03/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-142	-23.0408	118.8755	03/05/2022	Gorge/ Gully	Gorge	North/ West	Moderate	Sandy Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts	-	-	4	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-143	-23.0755	118.8043	03/05/2022	Gorge/ Gully	Gully	South/ East	Steep	Clay Loam	None Discernible	Major Outcropping	BIF	Boulders (>61cm)	None Discernible	Spinifex Hummock Grassland, Scattered Eucalypts	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-144	-23.0396	118.8741	03/05/2022	Gorge/ Gully	Gorge	North/ West	Moderate	Sandy Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts	-	-	2	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-145	-23.0726	118.7952	03/05/2022	Hillcrest/ Hillslope	Footslope	North	Low	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Moderate (3 to 5 yr)		-
VCPH-146	-23.0652	118.7555	03/05/2022	Hillcrest/ Hillslope	Undulating Low Hills	North	Low	Sandy Clay Loam	Few Small Patches	Minor Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-147	-23.0751	118.7935	03/05/2022	Breakaway/ Cliff	Gully	North	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-148	-23.0579	118.7215	03/05/2022	Hillcrest/ Hillslope	Undulating Low Hills	North	Low	Sandy Clay Loam	Few Small Patches	Minor Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-149	-23.0674	118.7169	03/05/2022	Gorge/ Gully	Gully	West	Steep	Sandy Clay Loam	Few Small Patches	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	2	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-150	-23.0662	118.7197	03/05/2022	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	West	Steep	Sandy Clay Loam	Few Small Patches	Minor Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-151	-23.0649	118.7202	03/05/2022	Gorge/ Gully	Gully	West	Steep	Sandy Clay Loam	Few Small Patches	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	2	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-152	-23.0587	118.7148	03/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	Acacia Shrubland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-153	-23.0671	118.6946	03/05/2022	Gorge/ Gully	Gorge	West	Steep	Sandy Clay Loam	Few Small Patches	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	1	None	0.8	Frequent Fire	Old (6+ yr)		-
VCPH-154	-23.0377	118.7311	03/05/2022	Stony Plain	Stony Plain	South	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-155	-23.0359	118.7138	03/05/2022	Stony Plain	Stony Plain	South	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-156	-23.0328	118.6990	03/05/2022	Hillcrest/ Hillslope	Undulating Low Hills	South	Moderate	Sandy Clay Loam	Few Small Patches	Minor Outcropping	BIF	Small Rocks (11-20cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-157	-23.0352	118.6983	03/05/2022	Mulga Woodland	Sandy/ Stony Plain	Flat	Flat	Light Clay	Few Small Patches	Limited Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-

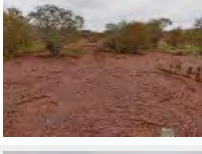
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-158	-23.0266	118.7039	03/05/2022	Stony Plain	Stony Plain	South	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-159	-23.0921	118.8676	04/05/2022	Minor Drainage Line	Medium Drainage Line	North/ West	Low	Clay Loam	Few Small Patches	Limited Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Acacia Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Flooding	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-160	-23.0838	118.6219	04/05/2022	Gorge/ Gully	Gorge	South	Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-161	-23.0889	118.9101	04/05/2022	Medium Drainage Line	Medium Drainage Line	Flat	Flat	Sandy Loam	Many Small Patches	Negligible	-	Small Rocks (11-20cm)	Many Small Patches	Acacia Shrubland, Eucalypt Woodland, Tussock Grassland	-	-	0	Prone to Flooding	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-162	-23.0896	118.9138	04/05/2022	Undulating Low Hills	Undulating Low Hills	South	Low	Sandy Clay Loam	Scarce	Limited Outcropping	BIF	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-163	-23.0994	118.9219	04/05/2022	Undulating Low Hills	Undulating Low Hills	South	Low	Sandy Clay Loam	Scarce	Limited Outcropping	BIF	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-164	-23.1018	118.9203	04/05/2022	Breakaway/ Cliff	Breakaway	North	Moderate	Sandy Clay Loam	Scarce	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-165	-23.1009	118.9105	04/05/2022	Undulating Low Hills	Undulating Low Hills	South	Low	Sandy Clay Loam	Scarce	Limited Outcropping	BIF	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-166	-23.1007	118.9013	04/05/2022	Medium Drainage Line	Medium Drainage Line	Flat	Flat	Silty Loam	Many Large Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Large Patches	Acacia Shrubland, Eucalypt Woodland, Tussock Grassland	-	-	2	Prone to Flooding	0.8	Frequent Fire	Moderate (3 to 5 yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-167	-23.1047	118.9028	04/05/2022	Breakaway/ Cliff	Breakaway	North	Moderate	Sandy Clay Loam	Scarce	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-168	-23.0962	118.8878	04/05/2022	Undulating Low Hills	Undulating Low Hills	South	Low	Sandy Clay Loam	Scarce	Limited Outcropping	BIF	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-169	-23.0943	118.8738	04/05/2022	Undulating Low Hills	Undulating Low Hills	South	Low	Sandy Clay Loam	Scarce	Limited Outcropping	BIF	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-170	-23.0574	118.6345	04/05/2022	Gorge/ Gully	Gorge	South	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-171	-23.0571	118.6769	04/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Tussock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-172	-23.0442	118.6837	04/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Tussock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-173	-23.0236	118.6978	05/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Gravel (1-4cm)	Many Large Patches	Mulga Woodland, Tussock Grassland	-	-	0	Prone to Flooding	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-174	-23.0383	118.6805	05/05/2022	Hardpan Plain	Sandy/ Stony Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Gravel (1-4cm)	Many Small Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	-	-	0	Prone to Flooding	0.8	Road/ Access Track	Moderate (3 to 5 yr)		-
VCPH-176	-22.9062	118.7242	26/05/2022	Medium Drainage Line	Medium Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	Acacia Shrubland, Eucalypt Woodland, Tussock Grassland	-	-	0	Prone to Pooling	0.6	Weed Invasion	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-177	-23.0545	118.8860	25/05/2022	Minor Drainage Line	Minor Drainage Line	West	Low	Clay Loam	Scarce	Limited Outcropping	CID	Gravel (1-4cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	1	Prone to Pooling	0.8	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-178	-23.0977	118.7020	26/05/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Spinifex</i> Hummock Grassland, <i>Acacia</i> Shrubland	-	-	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-179	-23.0427	118.6814	26/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Tussock Grassland	-	-	0	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-180	-23.0133	118.6869	26/05/2022	Gorge/ Gully	Gully	South	Steep	Clay Loam	Scarce	Extensive Outcropping	Conglomerate	Boulders (>61cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	Scarce	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-181	-23.0901	118.7062	26/05/2022	Breakaway/ Cliff	Breakaway	North/ East	Moderate	Clay Loam	Scarce	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-182	-23.0969	118.7851	26/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Tussock Grassland	-	-	0	Prone to Flooding	1	None Discernible	Old (6+ yr)		-
VCPH-183	-23.0857	118.6830	26/05/2022	Stony Plain	Stony Plain	South	Low	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-184	-23.0236	118.8872	26/05/2022	Drainage Area/ Floodplain	Drainage Area/ Floodplain	North	Low	Clay Loam	Few Small Patches	Minor Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	1	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-185	-23.0261	118.8710	26/05/2022	Gorge/ Gully	Gully	North	Moderate	Clay Loam	Scarce	Major Outcropping	BIF	Pebbles (5-10cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	3	None	1	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-186	-23.0269	118.8513	26/05/2022	Undulating Low Hills	Undulating Low Hills	East	Low	Clay Loam	Scarce	Limited Outcropping	CID	Pebbles (5-10cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	4	None	1	None Discernible	Old (6+ yr)		-
VCPH-187	-23.0788	118.8579	26/05/2022	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Mulga Woodland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-188	-22.8818	118.8084	26/05/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Mining Exploration	Moderate (3 to 5 yr)		-
VCPH-192	-22.9032	118.7439	10/04/2022	Mulga Woodland	Hardpan Plain	Flat	Flat	Sandy Clay Loam	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-193	-23.0465	118.9035	27/05/2022	Gorge/ Gully	Gorge	South	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-194	-23.0512	118.9018	27/05/2022	Breakaway/ Cliff	Breakaway	North	Moderate	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	Conglomerate	Small Rocks (11-20cm)	Many Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, Tussock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-195	-23.0349	118.6186	27/05/2022	Gorge/ Gully	Gorge	North	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	Conglomerate	Large Rocks (21-60cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-196	-23.0499	118.9026	27/05/2022	Hillcrest/ Hillslope	Undulating Low Hills	South	Moderate	Sandy Clay Loam	Few Small Patches	Limited Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-199	-22.8981	118.7781	27/05/2022	Mulga Woodland	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-

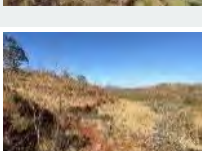
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-200	-23.0733	118.6925	27/05/2022	Breakaway/ Cliff	Breakaway	South	Cliff	Clay Loam	None Discerni ble	Major Outcropping	BIF	Boulders (>61cm)	None Discerni ble	Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland	-	-	5	None	0.8	Mining Exploration	Old (6+ yr)		-
VCPH-201	-23.0885	118.7284	27/05/2022	Mulga Woodland	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-207	-23.0229	118.8673	28/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-208	-23.0238	118.8667	28/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-209	-23.0276	118.8673	28/05/2022	Gorge/ Gully	Gorge	North	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-210	-23.0261	118.8689	28/05/2022	Hillcrest/ Hillslope	Undulating Low Hills	North	Low	Sandy Clay Loam	Few Small Patches	Limited Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-211	-23.0246	118.8654	28/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-212	-23.0237	118.8644	28/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-213	-23.0240	118.8613	28/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-

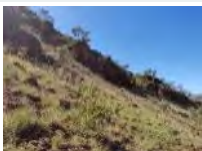
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-214	-23.0240	118.8594	28/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-215	-23.0819	118.8926	28/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-217	-23.0790	118.8718	28/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-218	-23.1008	118.8129	28/05/2022	Mulga Woodland	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-219	-23.0780	118.8836	28/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Gravel (1-4cm)	Many Small Patches	Acacia Shrubland, Mulga Woodland, Tussock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-220	-23.1026	118.8023	28/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-221	-23.0712	118.8543	28/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-222	-23.0896	118.8480	28/05/2022	Stony Plain	Hardpan Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Tussock Grassland	-	-	0	None	0.8	Road/ Access Track	Moderate (3 to 5 yr)		-
VCPH-223	-23.0950	118.8354	28/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Moderate (3 to 5 yr)		-

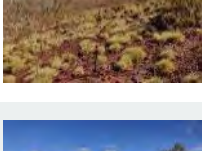
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-224	-23.0885	118.7918	28/05/2022	Mulga Woodland	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-225	-23.0835	118.8338	28/05/2022	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Road/ Access Track	Moderate (3 to 5 yr)		-
VCPH-226	-23.0205	118.8846	28/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-227	-23.0214	118.8836	28/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-228	-23.0263	118.8979	28/05/2022	Gorge/ Gully	Gully	North	Low	Clay Loam	Scarce	Minor Outcropping	BIF	Gravel (1-4cm)	Scarce	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	4	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-229	-23.0290	118.8980	28/05/2022	Hillcrest/ Hillslope	Hillslope	North/ West	Very Steep	Clay Loam	None Discerni ble	Extensive Outcropping	BIF	Boulders (>61cm)	None Discerni ble	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-231	-23.1031	118.7768	28/05/2022	Mulga Woodland	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-232	-23.1002	118.7854	26/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Tussock Grassland	-	-	0	Prone to Flooding	1	None Discernible	Old (6+ yr)		-
VCPH-236	-23.0247	118.8557	29/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	<i>Acacia</i> Shrubland, Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-

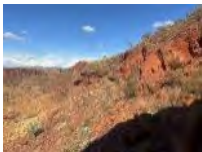
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-237	-23.0254	118.8544	29/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Eucalypt Woodland, Spinifex Hummock Grassland	-	-	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-238	-23.0258	118.8530	29/05/2022	Stony Plain	Undulating Low Hills	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-239	-23.0582	118.8841	29/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-240	-23.0652	118.8902	29/05/2022	Stony Plain	Stony Plain	Flat	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-241	-23.0679	118.8918	29/05/2022	Mulga Woodland	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, Spinifex Hummock Grassland	-	-	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-242	-23.1009	118.7020	29/05/2022	Breakaway/Cliff	Breakaway	North	Moderate	Clay Loam	Scarce	Moderate Outcropping	CID	Boulders (>61cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-243	-23.0274	118.6893	29/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Medium Heavy Clay	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-244	-23.0879	118.7670	29/05/2022	Cleared/Disturbed	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Acacia Shrubland	-	-	0	None	0.6	Mining Exploration	Old (6+ yr)		-
VCPH-245	-23.0839	118.7482	29/05/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Tussock Grassland, Acacia Shrubland	-	-	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-246	-23.0778	118.7325	29/05/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Tussock Grassland, <i>Acacia</i> Shrubland	-	-	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-247	-23.0823	118.7317	29/05/2022	Hardpan Plain	Hardpan Plain	Flat	Flat	Medium Heavy Clay	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Tussock Grassland	-	-	0	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-248	-23.0805	118.7331	29/05/2022	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	-	Gravel (1-4cm)	Few Large Patches	Mulga Woodland, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-249	-23.0859	118.7305	27/05/2022	Mulga Woodland	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-250	-23.0884	118.7335	29/05/2022	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	-	Gravel (1-4cm)	Few Large Patches	Mulga Woodland, Tussock Grassland	-	-	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-251	-23.0516	118.8597	30/05/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	None	0.6	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-252	-23.0554	118.8719	30/05/2022	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	0	Prone to Flooding	0.6	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-253	-23.0567	118.8769	30/05/2022	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, <i>Spinifex</i> Hummock Grassland	-	-	1	None	0.6	Frequent Fire	Recent (0 to 2 yr)		-
Phase 2																							
VCPH-300	-23.0407	118.8459	17/02/2023	Gorge/ Gully	Gully	South/ East	Low	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Eucalypt Woodland, <i>Spinifex</i> Hummock Grassland, Tussock Grassland	High	Low	0	None	1	Weed Invasion	Old (6+ yr)		-

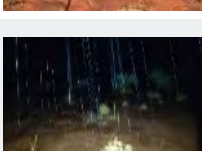
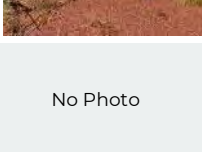
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-301	-23.0587	118.6230	17/02/2023	Gorge/ Gully	Gorge	South/ East	Moderate	Clay Loam	None Discerni ble	Major Outcropping	BIF	Large Rocks (21-60cm)	None Discerni ble	Scattered Eucalypts, Spinifex Hummock Grassland	Very High	Nil	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-302	-23.0389	118.8421	17/02/2023	Breakaway/ Cliff	Breakaway	South	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Tussock Grassland	Very High	Nil	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-303	-23.0522	118.6349	17/02/2023	Gorge/ Gully	Gorge	North	Moderate	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts	Very High	Low	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-304	-23.0732	118.7615	18/02/2023	Gorge/ Gully	Gully	West	Moderate	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-305	-22.8804	118.7529	18/02/2023	Breakaway/ Cliff	Breakaway	North/ West	Low	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	Very High	Low	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-306	-23.0778	118.7628	18/02/2023	Gorge/ Gully	Gully	West	Moderate	Sandy Clay Loam	Many Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-307	-22.9062	118.7251	18/02/2023	Medium Drainage Line	Medium Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Acacia Shrubland, Eucalypt Woodland, Tussock Grassland	Nil	Moderate	0	Prone to Pooling	0.6	Weed Invasion	Old (6+ yr)		-
VCPH-308	-23.0450	118.8660	19/02/2023	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-309	-22.9104	118.7584	18/02/2023	Mulga Woodland	Claypan	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland, Spinifex Hummock Grassland	Nil	Very High	0	None	1	None Discernible	Old (6+ yr)		-

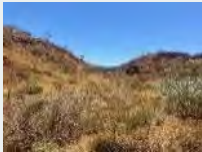
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-310	-23.0433	118.8549	16/02/2023	Breakaway/ Cliff	Breakaway	South	Steep	Sandy Clay Loam	None Discerni ble	Major Outcropping	BIF	Large Rocks (21-60cm)	None Discerni ble	Scattered Eucalypts, Tussock Grassland	High	Low	0	None	1	Weed Invasion	Old (6+ yr)		-
VCPH-311	-22.9110	118.7855	18/02/2023	Gorge/ Gully	Gully	South/ East	Moderate	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	Very High	Nil	1	None	1	None Discernible	Old (6+ yr)		-
VCPH-312	-23.0264	118.6791	19/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Scattered Shrubs, Mulga Woodland, Tussock Grassland	Nil	Low	0	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-313	-23.0389	118.8421	17/02/2023	Breakaway/ Cliff	Breakaway	South	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Eucalypt Woodland, Spinifex Hummock Grassland	High	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-314	-23.0883	118.6691	19/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Gravel (1-4cm)	Many Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Nil	High	0	Prone to Flooding	1	None Discernible	Old (6+ yr)		-
VCPH-315	-23.0363	118.8543	18/02/2023	Gorge/ Gully	Gorge	South/ West	Moderate	Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Scattered Eucalypts, Tussock Grassland	Very High	Nil	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-316	-23.0940	118.6864	19/02/2023	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Scattered Shrubs, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-317	-23.0719	118.6841	19/02/2023	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Many Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Many Small Patches	Scattered Shrubs, Spinifex Hummock Grassland, Tussock Grassland	Very High	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-318	-22.9021	118.7222	20/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Negligible	Many Small Patches	Mulga Woodland, Tussock Grassland	Nil	Nil	0	Prone to Pooling	0.8	Cattle Grazing	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-319	-23.0727	118.6974	19/02/2023	Gorge/ Gully	Gorge	South	Steep	Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Very High	Low	3	None	1	None Discernible	Old (6+ yr)		-
VCPH-320	-22.8926	118.7207	20/02/2023	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-321	-23.0736	118.7024	19/02/2023	Breakaway/ Cliff	Breakaway	South	Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Mulga Woodland, Spinifex Hummock Grassland	Very High	Nil	0	Prone to Pooling	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-322	-23.0815	118.7023	21/02/2023	Stony Plain	Stony Plain	South	Low	Sandy Clay Loam	Many Small Patches	Negligible	-	Small Rocks (11-20cm)	Many Small Patches	Mulga Woodland, Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-323	-23.0508	118.8930	19/02/2023	Gorge/ Gully	Gully	South	Moderate	Clay Loam	Many Large Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Many Large Patches	Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	High	Moderate	0	Prone to Flooding	1	None Discernible	Old (6+ yr)		-
VCPH-324	-23.0720	118.7086	21/02/2023	Breakaway/ Cliff	Breakaway	South	Very Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Very High	Nil	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-325	-23.0726	118.7077	21/02/2023	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South	Moderate	Sandy Clay Loam	Scarce	Major Outcropping	BIF	Small Rocks (11-20cm)	Scarce	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Nil	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-326	-23.0709	118.7991	21/02/2023	Stony Plain	Stony Plain	North	Low	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-327	-23.0864	118.8748	20/02/2023	Gorge/ Gully	Gully	North	Low	Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	High	Low	2	None	0.8	None Discernible	Recent (0 to 2 yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-328	-23.0642	118.7069	21/02/2023	Gorge/ Gully	Gorge	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Very High	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-329	-23.0767	118.7728	20/02/2023	Gorge/ Gully	Gully	North	Steep	Clay Loam	Many Large Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Many Large Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Very High	Low	5	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-330	-23.0602	118.8058	21/02/2023	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-331	-23.0625	118.7201	21/02/2023	Breakaway/ Cliff	Breakaway	North	Steep	Clay Loam	Many Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Many Small Patches	Spinifex Hummock Grassland, Scattered Eucalypts	Very High	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-332	-23.0578	118.8059	21/02/2023	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Shrubland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-333	-23.0764	118.7795	21/02/2023	Breakaway/ Cliff	Breakaway	North	Very Steep	Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland, Tussock Grassland	Very High	Nil	5	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-334	-23.0600	118.7147	22/02/2023	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland, Tussock Grassland	Low	Moderate	0	Prone to Pooling	0.8	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-335	-22.9046	118.8073	18/02/2023	Breakaway/ Cliff	Breakaway	North/ East	Low	Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Very High	Nil	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-

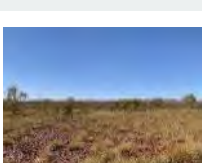
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-336	-23.0721	118.7966	22/02/2023	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5- 10cm)	Few Small Patches	Shrubland, Eucalypt Woodland, Spinifex Hummock Grassland	Nil	Moderate	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-337	-22.9190	118.7885	22/02/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Pebbles (5- 10cm)	Evenly Spread	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Nil	Moderate	3	Prone to Flooding	1	None Discernible	Old (6+ yr)		-
VCPH-338	-23.0662	118.7694	22/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Mulga Woodland, Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Moderate	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-339	-22.9194	118.7501	23/02/2023	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Pebbles (5- 10cm)	Evenly Spread	Mulga Woodland, Spinifex Hummock Grassland	Nil	High	0	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-340	-23.0676	118.7317	22/02/2023	Medium Drainage Line	Medium Drainage Line	Flat	Flat	Sandy Clay Loam	Few Small Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Few Small Patches	Scattered Shrubs, Eucalypt Woodland, Spinifex Hummock Grassland, Tussock Grassland	Moderate	Low	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-341	-23.0498	118.8830	23/02/2023	Gorge/ Gully	Gully	South/ West	Moderate	Clay Loam	Few Small Patches	Extensive Outcropping	Congl omera te	Small Rocks (11-20cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	0	Prone to Pooling	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-342	-23.0530	118.6609	23/02/2023	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5- 10cm)	Few Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	Nil	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-343	-23.0783	118.8731	23/02/2023	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5- 10cm)	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Low	1	None	0.8	Cattle Grazing	Old (6+ yr)		-
VCPH-344	-22.9041	118.7344	16/02/2023	Mulga Woodland	Claypan	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Mulga Woodland, Tussock Grassland	Nil	Moderate	0	Prone to Pooling	0.8	Weed Invasion	Old (6+ yr)		-

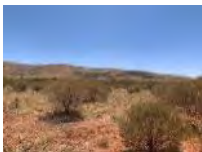
Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-345	-23.0390	118.8712	16/02/2023	Gorge/ Gully	Gorge	North	Moderate	Sandy Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts	High	Nil	2	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-346	-22.8971	118.7731	16/02/2023	Mulga Woodland	Claypan	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Negligible	Many Large Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	0	Prone to Pooling	1	Cattle Grazing	Old (6+ yr)		-
VCPH-347	-23.0470	118.8636	16/02/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Moderate	2	None	0.6	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-348	-23.0431	118.8600	16/02/2023	Hillcrest/ Hillslope	Hillslope	South	Steep	Sandy Clay Loam	Few Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	High	Low	0	None	1	Weed Invasion	Old (6+ yr)		-
VCPH-349	-23.0840	118.7312	16/02/2023	Mulga Woodland	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Negligible	Evenly Spread	Mulga Woodland	Nil	High	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-350	-23.1034	118.7715	23/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Gravel (1-4cm)	Many Small Patches	Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-351	-23.0920	118.7595	16/02/2023	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Gravel (1-4cm)	Many Large Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	0	Prone to Pooling	1	None Discernible	Old (6+ yr)		-
VCPH-352	-23.0752	118.6724	23/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Mulga Woodland, Tussock Grassland	Nil	Moderate	0	Prone to Pooling	1	None Discernible	Old (6+ yr)	No Photo	-
VCPH-353	-23.0465	118.6757	16/02/2023	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Many Large Patches	Negligible	-	Pebbles (5- 10cm)	Many Large Patches	Acacia Shrubland, Tussock Grassland	Low	High	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-354	-23.0526	118.6769	23/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Mulga Woodland, Tussock Grassland	Nil	Moderate	0	Prone to Pooling	1	None Discernible	Old (6+ yr)	No photo	-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-355	-23.0842	118.8392	16/02/2023	Stony Plain	Stony Plain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Low	Low	0	None	1	Frequent Fire	Moderate (3 to 5 yr)		-
VCPH-356	-23.0833	118.6329	16/02/2023	Gorge/ Gully	Gorge	North/ West	Moderate	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts	Very High	Nil	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-357	-23.0716	118.8800	16/02/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Few Large Patches	Negligible	-	Gravel (1-4cm)	Few Large Patches	Mulga Woodland, Scattered Eucalypts, Tussock Grassland	Nil	Low	0	Prone to Pooling	1	Weed Invasion	Old (6+ yr)		-
VCPH-358	-23.1019	118.7040	16/02/2023	Undulating Low Hills	Footslope	North	Low	Clay Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Low	10	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-359	-23.0634	118.8905	16/02/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	None Discernible	Negligible	-	Pebbles (5-10cm)	None Discernible	Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	1	None	0.6	Frequent Fire	Recent (0 to 2 yr)		-
VCPH-360	-23.0676	118.8920	10/03/2023	Mulga Woodland	Stony Plain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-361	-22.9076	118.8022	8/03/2023	Gorge/ Gully	Gully	South	Steep	Silty Loam	Scarce	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Scattered Shrubs	Moderate	Nil	0	Scarce	0.8	None Discernible	Old (6+ yr)		-
VCPH-362	-23.0627	118.7068	8/03/2023	Gorge/ Gully	Medium Drainage Line	West	Steep	Clay Loam	Few Small Patches	Moderate Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Spinifex Hummock Grassland, Scattered Eucalypts	High	Low	0	None	0.8	Road/ Access Track	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-363	-23.0504	118.6502	8/03/2023	Minor Drainage Line	Minor Drainage Line	Flat	Low	Silty Clay Loam	Scarce	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Scarce	Scattered Shrubs, Spinifex Hummock Grassland, Scattered Eucalypts	High	Low	0	Scarce	0.8	None Discernible	Old (6+ yr)		-
VCPH-364	23.0791	118.8486	8/03/2023	Drainage Area/ Floodplain	Minor Drainage Line	Flat	Low	Clay Loam Sandy	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Mulga Woodland, Tussock Grassland, Scattered Eucalypts	Nil	High	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-365	-23.0286	118.6376	8/03/2023	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Silty Loam	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Scattered Shrubs, Spinifex Hummock Grassland, Scattered Eucalypts, Tussock Grassland	Nil	Moderate	0	Prone to Flooding	0.8	None Discernible	Old (6+ yr)		-
VCPH-366	-23.0929	118.8094	8/03/2023	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Pebbles (5- 10cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-367	-22.9196	118.7717	9/03/2023	Hillcrest/ Hillslope	Hillslope	West	Low	Silty Loam	Few Small Patches	Negligible	-	Pebbles (5- 10cm)	Few Small Patches	Spinifex Hummock Grassland, Scattered Eucalypts, Scattered Shrubs, Tussock Grassland	Low	Low	0	None	0.6	Mining Exploration	Old (6+ yr)		-
VCPH-368	-23.0814	118.6620	9/03/2023	Gorge/ Gully	Minor Drainage Line	North	Moderate	Clay Loam	Many Large Patches	Minor Outcropping	BIF	Pebbles (5- 10cm)	Many Large Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Moderate	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-369	-23.0750	118.6468	8/03/2023	Gorge/ Gully	Gully	North	Moderate	Silty Loam	Scarce	Moderate Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Low	0	Scarce	0.8	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-370	-23.0866	118.6802	9/03/2023	Drainage Area/ Floodplain	Sandy/ Stony Plain	Flat	Flat	Clay Loam Sandy	Many Large Patches	Limited Outcropping	BIF	Pebbles (5-10cm)	Many Large Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	High	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-371	-22.8834	118.7387	10/03/2023	Hardpan Plain	Hardpan Plain	Flat	Flat	Silty Clay Loam	Many Small Patches	Negligible	-	Gravel (1-4cm)	Many Small Patches	Spinifex Hummock Grassland, Scattered Eucalypts	Nil	Moderate	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-372	-22.9194	118.8173	10/03/2023	Mulga Woodland	Claypan	Flat	Flat	Clay Loam	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Tussock Grassland	Nil	Low	0	Prone to Pooling	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-373	-22.9178	118.7262	9/03/2023	Breakaway/ Cliff	Breakaway	North	Steep	Silty Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Scattered Shrubs	High	Low	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-374	-23.0778	118.8186	9/03/2023	Hillcrest/ Hillslope	Hillslope	East	Moderate	Clay Loam	Many Large Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Many Large Patches	Scattered Eucalypts, Tussock Grassland	Moderate	Low	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-375	-23.0779	118.8490	17/03/2023	Gorge/ Gully	Gully	North	Steep	Silty Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Shrubs, Spinifex Hummock Grassland, Scattered Eucalypts	High	Low	0	Prone to Pooling	0.8	None Discernible	Moderate (3 to 5 yr)	No photo	-
VCPH-376	-23.0669	118.7789	9/03/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-377	-23.0280	118.8375	10/03/2023	Hillcrest/ Hillslope	Footslope	North	Low	Silty Clay Loam	Many Small Patches	Negligible	-	Pebbles (5-10cm)	Many Small Patches	Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Low	0	Prone to Pooling	0.8	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-378	-23.0952	118.7740	10/03/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	-	Gravel (1-4cm)	Many Large Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	High	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-379	-23.0931	118.8221	10/03/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-380	-23.0796	118.8879	10/03/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	-	Pebbles (5-10cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	High	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-381	-23.0574	118.7175	10/03/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-382	-23.0783	118.6843	15/03/2023	Stony Plain	Stony Plain	Flat	Low	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland, Scattered Shrubs	Nil	Low	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-383	-23.0473	118.8265	10/03/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Low	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-384	-23.0850	118.6953	15/03/2023	Mulga Woodland	Stony Plain	Flat	Low	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Mulga Woodland, Scattered Shrubs, Spinifex Hummock Grassland	Nil	Moderate	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-385	-23.0748	118.7159	15/03/2023	Stony Plain	Stony Plain	Flat	Low	Clay Loam	Scarce	Negligible	-	Pebbles (5-10cm)	Scarce	Scattered Shrubs, Spinifex Hummock Grassland, Scattered Eucalypts	Nil	Low	0	None	0.8	Road/ Access Track	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
VCPH-386	-23.0624	118.6300	11/03/2023	Stony Plain	Stony Plain	South/ East	Low	Clay Loam	Many Large Patches	Limited Outcropping	BIF	Pebbles (5- 10cm)	Many Large Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Low	Moderate	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-387	-22.8847	118.7356	12/03/2023	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Silty Loam	Many Small Patches	Negligible	-	Pebbles (5- 10cm)	Many Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	0	Scarce	0.8	None Discernible	Old (6+ yr)		-
VCPH-388	-23.0819	118.8123	12/03/2023	Drainage Area/ Floodplain	Stony Plain	Flat	Low	Clay Loam	Scarce	Negligible	-	Pebbles (5- 10cm)	Scarce	Eucalypt Woodland, Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	0	None	0.8	None Discernible	Old (6+ yr)		-
VCPH-389	-23.0594	118.6348	13/03/2023	Drainage Area/ Floodplain	Medium Drainage Line	East	Low	Clay Loam	Few Large Patches	Moderate Outcropping	BIF	Small Rocks (11-20cm)	Few Large Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	0	None	1	None Discernible	Old (6+ yr)		-
VCPH-390	-23.0428	118.8333	12/03/2023	Medium Drainage Line	Medium Drainage Line	Flat	Low	Clay Loam Sandy	Scarce	Negligible	-	Small Rocks (11-20cm)	Scarce	Scattered Eucalypts	Nil	Moderate	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-391	-23.0835	118.7182	15/03/2023	Mulga Woodland	Hardpan Plain	Flat	Low	Clay Loam	Few Small Patches	Negligible	-	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland, Scattered Shrubs	Nil	Low	0	None	0.6	Road/ Access Track	Old (6+ yr)		-
VCPH-392	-23.0691	118.6909	12/03/2023	Gorge/ Gully	Gully	North	Steep	Silty Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Scattered Shrubs	High	Low	0	Prone to Pooling	0.8	None Discernible	Old (6+ yr)		-
VCPH-393	-23.0781	118.6134	12/03/2023	Gorge/ Gully	Gully	South	Very Steep	Silty Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland,	Very High	Low	0	Prone to Pooling	0.8	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type									
														Tussock Grassland									
VCPH-394	-23.0700	118.6360	13/03/2023	Gorge/ Gully	Ironstone Outcrops	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Eucalypt Woodland	Very High	Low	1	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-395	-23.0849	118.6271	13/03/2023	Hillcrest/ Hillslope	Hillslope	South	Low	Silty Loam	Scarce	Minor Outcropping	BIF	Pebbles (5- 10cm)	Scarce	Spinifex Hummock Grassland, Scattered Shrubs	Low	Low	0	Scarce	0.8	None Discernible	Old (6+ yr)		-
VCPH-396	-23.0446	118.8210	16/03/2023	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	-	Pebbles (5- 10cm)	Scarce	Scattered Shrubs	Nil	Low	0	None	0.8	Road/ Access Track	Old (6+ yr)		-
VCPH-397	-23.0838	118.6489	15/03/2023	Gorge/ Gully	Granite Outcrops/ Domes	West	Steep	Clay Loam	Many Small Patches	Major Outcropping	BIF	Large Rocks (21-60cm)	Many Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	High	Low	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-398	-23.0782	118.6161	15/03/2023	Gorge/ Gully	Gully	South	Steep	Silty Loam	Scarce	Major Outcropping	BIF	Boulders (>61cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Scattered Shrubs	High	Low	0	Prone to Pooling	0.8	None Discernible	Old (6+ yr)		-
VCPH-399	-23.0396	118.8276	16/03/2023	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Silty Loam	Evenly Spread	Negligible	-	Pebbles (5- 10cm)	Evenly Spread	Scattered Shrubs, Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Nil	0	None	0.6	None Discernible	Moderate (3 to 5 yr)		-
VCPH-400	-23.0495	118.8139	16/03/2023	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clayey Sand	Evenly Spread	Negligible	-	Gravel (1-4cm)	Evenly Spread	Scattered Shrubs, Tussock Grassland	Nil	High	0	None	1	None Discernible	Moderate (3 to 5 yr)		-
VCPH-401	-23.1010	118.8645	17/03/2023	Gorge/ Gully	Gully	North	Steep	Silty Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Shrubs, Spinifex Hummock Grassland, Scattered Eucalypts	High	Low	0	Prone to Pooling	0.8	None Discernible	Moderate (3 to 5 yr)		-
VCPH-402	-23.0685	118.7077	15/03/2023	Breakaway/ Cliff	Breakaway	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland,	Very High	Low	0	None	1	None Discernible	Old (6+ yr)		-

Site ID	Location		Date	Habitat type	Landform	Aspect	Slope	Soil		Outcropping		Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Hollow count	Water presence	Habitat condition	Disturbances	Time since last fire (years)	Photo	Notes				
	Latitude	Longitude						Type	Availability	Extent	Rock type	Rock Size	Veg. Litter	Dominant Veg. Type													
Tussock Grassland																											
VCPH-403	-23.0692	118.7053	15/03/2023	Breakaway/ Cliff	Breakaway	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Boulders (>61cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Very High	Low	0	None	1	None Discernible	Old (6+ yr)		-				
VCPH-404	-23.0792	118.7150	15/03/2023	Stony Plain	Stony Plain	South	Low	Clay Loam	Evenly Spread	Negligible		Pebbles (5- 10cm)	Evenly Spread	Scattered Shrubs, Spinifex Hummock Grassland	Low	Moderate	0	None	0.8	None Discernible	Moderate (3 to 5 yr)		-				
VCPH-405	-23.0715	118.7117	15/03/2023	Gorge/ Gully	Gully	South	Steep	Clay Loam	Few Small Patches	Extensive Outcropping	BIF	Boulders (>61cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Tussock Grassland	Very High	Nil	2	Prone to Pooling	1	None Discernible	Old (6+ yr)		-				
VCPH-406	-23.0956	118.8554	17/03/2023	Medium Drainage Line	Medium Drainage Line	North	Low	Clay Loam	Evenly Spread	Minor Outcropping	BIF	Small Rocks (11-20cm)	Evenly Spread	Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	4	Prone to Flooding	0.8	None Discernible	Moderate (3 to 5 yr)		-				

Appendix D: Fauna Species Recorded During the Two Survey phases

Species		Phase 1		Phase 2	
Scientific Name	Common Name	Sampling Method		Sampling Method	
		Acoustic	Ultrasonic	Camera Trap	Opp/Targeted
MAMMALS					
BOVIDAE					
<i>Bos taurus</i>	European cattle			•	•
CANIDAE					
* <i>Canis familiaris</i>	Dog			•	•
DASYURIDAE					
<i>Ningaui timealeyi</i>	Pilbara ningau			•	
<i>Pseudantechinus woolleyae</i>	Woolley's pseudantechinus			•	
EMBALLONURIDAE					
<i>Taphozous georgianus</i>	Common sheath-tailed bat				•
<i>Taphozous hilli</i>	Hill's sheath-tail-bat				•
FELIDAE					
* <i>Felis catus</i>	Domestic cat			•	
LEPORIDAE					
* <i>Oryctolagus cuniculus</i>	European rabbit				•
MACROPODIDAE					
<i>Osphranter robustus</i> subsp. <i>erubescens</i>	Euro			•	
<i>Osphranter rufus</i>	Red kangaroo			•	
<i>Petrogale rothschildi</i>	Rothschild's rock-wallaby			•	
MEGADERMATIDAE					
<i>Macroderma gigas</i>	Ghost bat				•
MURIDAE					
<i>Pseudomys chapmani</i>	Western pebble-mound mouse			•	•
<i>Zyzomys argurus</i>	Common rock rat			•	•
RHINONYCTERIDAE					
<i>Rhinonycteris aurantia</i>	Pilbara leaf-nosed bat		•		•
TACHYGLOSSIDAE					
<i>Tachyglossus aculeatus</i> subsp. <i>acanthion</i>	Short-beaked Echidna			•	
VESPERTILIONIDAE					
<i>Vespadelus finlaysoni</i>	Finlayson's cave bat			•	•
BIRDS					
ACANTHIZIDAE					
<i>Acanthiza apicalis</i>	Inland thornbill	•			•
<i>Acanthiza uropygialis</i>	Chestnut-rumped thornbill				•

Species		Phase 1				Phase 2			
Scientific Name	Common Name	Sampling Method				Sampling Method			
		Acoustic	Ultrasonic	Camera Trap	Opp/Targeted	Acoustic	Ultrasonic	Camera Trap	Opp/Targeted
<i>Gerygone fusca</i>	Western gerygone				•				
<i>Smicrornis brevirostris</i>	Weebill	•			•				
ACCIPITRIDAE									
<i>Aquila audax</i>	Wedge-tailed eagle			•					
<i>Haliastur sphenurus</i>	Whistling kite				•				
<i>Lophoictinia isura</i>	Square-tailed kite				•				
<i>Milvus migrans</i>	Black kite				•				
AEGOTHELIDAE									
<i>Aegotheles cristatus</i>	Aegotheles cristatus	•							
ALAUDIDAE									
<i>Mirafra javanica</i>	Horsfield's bushlark	•							
ALCEDINIDAE									
<i>Dacelo leachii</i> subsp. <i>leachii</i>	Blue-winged kookaburra				•				
<i>Todiramphus pyrrhopygius</i>	Red-backed kingfisher	•			•				
<i>Todiramphus sanctus</i>	Sacred kingfisher				•				
ANATIDAE									
<i>Anas gracilis</i>	Grey teal	•							
<i>Artamus personatus</i>	Masked woodswallow				•				•
ARTAMIDAE									
<i>Artamus cinereus</i>	Black-faced woodswallow				•				
<i>Artamus minor</i>	Little woodswallow				•				
<i>Cracticus nigrogularis</i>	Pied butcherbird	•		•	•			•	
<i>Cracticus tibicen</i>	Australian magpie	•		•	•				
<i>Cracticus torquatus</i>	Grey butcherbird	•		•	•				
BURHINIDAE									
<i>Burhinus grallarius</i>	Bush stone-curlew	•							
CACATUIDAE									
<i>Cacatua roseicapilla</i>	Galah	•			•				
<i>Cacatua sanguinea</i>	Little corella	•							
<i>Nymphicus hollandicus</i>	Cockatiel				•				
CAMPEPHAGIDAE									
<i>Coracina maxima</i>	Ground cuckoo-shrike				•				
<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike				•				
CAPRIMULGIDAE									
<i>Eurostopodus argus</i>	Spotted nightjar	•							
COLUMBIDAE									

Species		Phase 1				Phase 2			
Scientific Name	Common Name	Sampling Method				Sampling Method			
		Acoustic	Ultrasonic	Camera Trap	Opp/Targeted	Acoustic	Ultrasonic	Camera Trap	Opp/Targeted
<i>Geopelia cuneata</i>	Diamond dove				•				
<i>Geophaps plumifera</i> subsp. <i>ferruginea</i>	Spinifex pigeon				•				
<i>Ocyphaps lophotes</i>	Crested pigeon			•	•			•	
CORVIDAE									
<i>Corvus orru</i> subsp. <i>ceciliae</i>	Torresian crow	•		•	•				
CUCULIDAE									
<i>Cacomantis pallidus</i>	Pallid cuckoo	•			•				
<i>Chrysococcyx basalis</i>	Horsfield's bronze cuckoo	•			•				
<i>Chrysococcyx osculans</i>	Black-eared cuckoo	•							
ESTRILDIDAE									
<i>Emblema pictum</i>	Painted finch				•				
<i>Taeniopygia castanotis</i>	Zebra finch				•				•
FALCONIDAE									
<i>Falco berigora</i>	Brown falcon	•			•				
<i>Falco cenchroides</i>	Nankeen kestrel				•				
LOCUSTELLIDAE									
<i>Cincloramphus mathewsi</i>	Rufous songlark			•	•				
<i>Eremiornis carteri</i>	Spinifex bird								•
MALURIDAE									
<i>Amytornis striatus</i> subsp. <i>whitei</i>	Striated grasswren				•				
<i>Malurus assimilis</i> subsp. <i>assimilis</i>	Purple-backed fairywren	•			•				
<i>Malurus leucopterus</i> subsp. <i>leuconotus</i>	White-winged fairywren	•			•				
<i>Stipiturus ruficeps</i>	Rufous-crowned emu-wren	•							
MELIPHAGIDAE									
<i>Acanthagenys rufogularis</i>	Spiny-cheeked honeyeater	•			•				
<i>Epthianura tricolor</i>	Crimson chat				•				
<i>Gavicalis virescens</i> subsp. <i>virescens</i>	Inland singing honeyeater	•			•				
<i>Lichmera indistincta</i>	Brown honeyeater				•				
<i>Manorina flavigula</i>	Yellow-throated miner				•			•	
<i>Ptilotula keartlandi</i>	Grey-headed Honeyeater				•				
<i>Ptilotula penicillata</i>	White-plumed honeyeater				•				
MEROPIIDAE									

Species		Phase 1				Phase 2			
Scientific Name	Common Name	Sampling Method				Sampling Method			
		Acoustic	Ultrasonic	Camera Trap	Opp/Targeted	Acoustic	Ultrasonic	Camera Trap	Opp/Targeted
<i>Merops ornatus</i>	Rainbow bee-eater				•				
MONARCHIDAE									
<i>Grallina cyanoleuca</i>	Magpie-lark	•			•				
OREOICIDAE									
<i>Oreoica gutturalis</i>	Crested bellbird	•			•				
OTIDIDAE									
<i>Ardeotis australis</i>	Australian bustard				•				
PACHYCEPHALIDAE									
<i>Colluricincla harmonica</i>	Grey shrike thrush			•	•			•	
<i>Pachycephala rufiventris</i> subsp. <i>rufiventris</i>	Rufous whistler	•			•				
<i>Petroica goodenovii</i>	Red-capped robin				•				
PETROICIDAE									
<i>Melanodryas cucullata</i>	Hooded robin	•			•				
<i>Petroica goodenovii</i>	Red-capped robin				•				
PHASIANIDAE									
<i>Synoicus ypsilophorus</i>	Brown quail	•			•				
PODARGIDAE									
<i>Podargus strigoides</i>	Tawny frogmouth								•
POMATOSTOMIDAE									
<i>Pomatostomus superciliosus</i>	White-browed babbler				•				
<i>Pomatostomus temporalis</i> subsp. <i>rubeculus</i>	Grey-crowned babbler				•			•	
PSITTACIDAE									
<i>Barnardius zonarius</i> subsp. <i>zonarius</i>	Australian ringneck parrot				•				
<i>Melopsittacus undulatus</i>	Budgerigar	•			•				
PTILINORHYNCHIDAE									
<i>Ptilonorhynchus maculatus</i> subsp. <i>guttatus</i>	Western bowerbird				•			•	
RHIPIDURIDAE									
<i>Rhipidura albiscapa</i>	Grey fantail				•				
<i>Rhipidura leucophrys</i> subsp. <i>leucophrys</i>	Willie wagtail	•			•			•	
STRIGIDAE									
<i>Ninox boobook</i>	Boobook owl	•			•				
TURNICIDAE									
<i>Turnix velox</i>	Little button quail	•			•			•	
TYTONIDAE									
<i>Tyto javanica</i>	Eastern barn owl	•							

Species		Phase 1				Phase 2			
Scientific Name	Common Name	Sampling Method				Sampling Method			
		Acoustic	Ultrasonic	Camera Trap	Opp/ Targeted	Acoustic	Ultrasonic	Camera Trap	Opp/ Targeted
REPTILES									
AGAMIDAE									
<i>Ctenophorus caudicinctus</i>	Ring-tailed dragon				•				
<i>Ctenophorus isolepis</i> subsp. <i>isolepis</i>	Crested dragon				•				•
<i>Diporiphora amphiboluroides</i>	Mulga dragon								•
<i>Gowidon longirostris</i>	Long-nosed dragon				•				
<i>Pogona minor</i> subsp. <i>minor</i>	Dwarf bearded dragon				•				
<i>Tympanocryptis diabolicus</i>	Pebble dragon								•
ELAPIDAE									
<i>Demansia psammophis</i> subsp. <i>cupreiceps</i>	Yellow-faced whipsnake				•				
<i>Vermicella snelli</i>	Pilbara bandy bandy				•				
GEKKONIDAE									
<i>Heteronotia binoei</i>	Binoe's gecko				•				
<i>Heteronotia spelea</i>	Desert cave gecko								•
PYGOPODIDAE									
<i>Lialis burtonis</i>	Burton's legless lizard				•				
PYTHONIDAE									
<i>Antaresia childreni</i>	Children's python								•
<i>Antaresia perthensis</i>	Pygmy python								•
SCINCIDAE									
<i>Ctenotus inornatus</i>	Skink							•	
<i>Ctenotus pantherinus</i>	Leopard skink				•				
<i>Ctenotus rubicundus</i>	Ruddy ctenotus				•				
<i>Egernia cygnitos</i>	Western Pilbara spiny-tailed skink								•
<i>Egernia formosa</i>	Goldfields crevice-skink							•	
VARANIDAE									
<i>Varanus acanthurus</i>	Spiny-tailed monitor							•	
<i>Varanus giganteus</i>	Perentie			•				•	
<i>Varanus gouldii</i>	Bungarra			•					•
<i>Varanus panoptes</i>	Yellow spotted monitor							•	
<i>Varanus tristis</i> subsp. <i>tristis</i>	Racehorse goanna			•				•	
AMPHIBIANS									
MYOBATRACHIDAE									
<i>Pseudophryne douglasi</i>	Gorge toadlet				•				
Total		34	1	19	84	0	1	19	19

Appendix E: Night Parrot Acoustic Analysis Report

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THE REPORT

Appendix F: Water Features

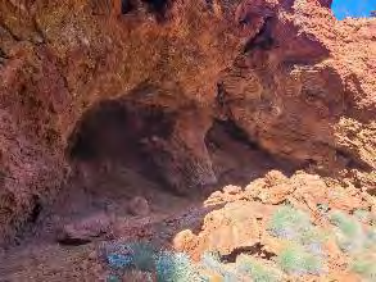
Water ID	Latitude	Longitude	Date Assessed	Length	Width	Water Present Above Surface	Water Depth	Days Since Last Rain	Rain Amount	Comment	Water Feature Photo
WMUD-01 (Biologic, 2022b)	-23.0653	118.7074	4/05/2022	2	1.2	-	-	-	-	Temporary (will persist for <3 months)	
WMUD-02	-23.0781	118.6135	12/03/2023	2	2	Yes	1	7	2.4	Semi-persistent (will persist 3 - 9 month of year, most years)	
WMUD-03	-23.0484	118.6374	23/02/2023	3	2.5	Yes	0.3	1	14	Temporary (will persist for <3 months)	

Water ID	Latitude	Longitude	Date Assessed	Length	Width	Water Present Above Surface	Water Depth	Days Since Last Rain	Rain Amount	Comment	Water Feature Photo
WMUD-04	-23.0678	118.7317	22/02/2023	4	3	No		0	14	Temporary (will persist for <3 months). No water present during current survey, however, will hold water after rain.	
WMUD-05	-23.0384	118.8444	17/02/2023	0.4	0.25	Yes	0.1	3	3.2	Temporary (will persist for <3 months)	
WMUD-06	-23.0389	118.8538	17/02/2023	0.4	0.25	Yes	0.1	3	3.2	Temporary (will persist for <3 months)	
WTAN-01	-22.90406825	118.7231	9/03/2023	50	4	Yes	1	4	21.6	Semi-persistent (will persist 3 - 9 month of year, most years)	

Appendix G: Cave Assessments

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-01	-23.081	118.661	13/07/2022	2019	Yes	Lower Slope	North/East	Semi Exposed	Round/Oval	5	2	20	1	5	no		Category 2	Category 4	no	
CMUD-02	-23.071	118.634	13/07/2022	2019	Yes	Upper Slope	North	Semi Exposed	Round/Oval	20	3.5	20	1	2.5	no		Category 2	Category 4	no	
CMUD-03	-23.053	118.812	29/04/2022	2022		Upper Slope	North/East	Sheltered	Round/Oval	3	2	12	2	2	no		Category 4	Category 4	yes	
CMUD-04	-23.039	118.658	1/05/2022	2022		Upper Slope	West	Sheltered	Round/Oval	7.8	3.1	11.2	2	1.3	no		Category 4	Category 4	yes	
CMUD-05	-23.058	118.622	5/05/2022	2022		Upper Slope	North/East	Semi Exposed	Round/Oval	7.5	4.3	17	1	2	no		Category 4	Category 4	no	

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-06	-23.058	118.622	5/05/2022	2022		Upper Slope	North/East	Semi Exposed	Round/Oval	2.75	1.26	7.5	1	1.46	no		Category 4	Category 4	yes	
CMUD-07	-23.016	118.65	5/05/2022	2022		Upper Slope	South/West	Sheltered	Round/Oval	3.1	2.5	12.4	2	2.5	no		Category 4	Category 4	yes	
CMUD-08	-23.036	118.66	14/07/2022	2022	Yes	Upper Slope	South	Semi Exposed	Horizontal	7	2	40	1	3	no	8 (count)	Category 3	Category 4	no	
CMUD-09	-23.082	118.659	5/05/2022	2022		Upper Slope	East	Sheltered	Round/Oval	4.2	1.2	10.4	2	1	no		Category 4	Category 4	yes	
CMUD-11	-23.042	118.868	3/05/2022	2022		Upper Slope	South/West	Sheltered	Vertical	1.5	4	15	2	3	no		Category 4	Category 4	yes	

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-12	-23.04	118.874	3/05/2022	2022		Mid Slope	South/ West	Sheltered	Round/Oval	3	1.5	10	1	1.5	no		Category 5	Category 5	no	
CMUD-13	-23.075	118.793	3/05/2022	2022		Mid Slope	North/ West	Sheltered	Horizontal	4	1	12	1	2	no		Category 4	Category 4	yes	
CMUD-14	-23.067	118.72	3/05/2022	2022		Upper Slope	West	Semi Exposed	Round/Oval	7	2.9	9.6	1	2.7	no		Category 4	Category 4	no	
CMUD-15	-23.076	118.626	4/05/2022	2022		Upper Slope	South/ West	Exposed	Round/Oval	13.7	6.2	13.8	1	13.8	no		Category 4	Category 4	no	
CMUD-16	-23.076	118.625	4/05/2022	2022		Upper Slope	South/ East	Semi Exposed	Round/Oval	6.9	4.3	11.2	1	1	no		Category 4	Category 4	no	

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-17	-23.015	118.689	26/05/2022	2022		Lower Slope	South	Sheltered	Round/Oval	5.64	1.53	12.34	1	1.6	no		Category 4	Category 4	no	
CMUD-18	-23.048	118.904	27/05/2022	2022		Mid Slope	South	Sheltered	Round/Oval	1.16	2.2	13.2	1	2.5	no		Category 4	Category 4	yes	
CMUD-19	-23.035	118.619	27/05/2022	2022		Upper Slope	North/East	Semi Exposed	Round/Oval	1.83	1.71	13.17	2	2.5	no		Category 4	Category 4	yes	
CMUD-20	-23.035	118.619	27/05/2022	2022		Mid Slope	West	Semi Exposed	Round/Oval	4.9	1.35	7.35	2	2.5	no		Category 4	Category 4	no	
CMUD-47	-23.05	118.636	17/02/2023	2023		Upper Slope	West	Semi Exposed	Round/Oval	3.5	1.6	32	2	3.7	no	2000 (Estimate)	Category 2	Category 4	yes	

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-48	-23.076	118.76	18/02/2023	2023		Upper Slope	East	Sheltered	Round/Oval	5	3	2	1	1.8	no		Category 4	Category 4	no	
CMUD-49	-23.044	118.855	19/02/2023	2023		Mid Slope	South	Sheltered	Horizontal	3.65	0.72	7.3	1	2.5	no		Category 4	Category 4	no	
CMUD-50	-23.074	118.688	19/02/2023	2023		Lower Slope	West	Exposed	Round/Oval	4	1.5	6	1	1.5	no		Category 4	Category 4	no	
CMUD-51	-23.073	118.697	19/02/2023	2023		Upper Slope	South	Exposed	Horizontal	1.5	0.5	6	1	0.5	no		Category 5	Category 5	no	
CMUD-52	-23.072	118.697	19/02/2023	2023		Upper Slope	South	Exposed	Horizontal	2	1	15	2	2.5	no		Category 4	Category 4	yes	

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-53	-23.038	118.846	20/02/2023	2023		Mid Slope	South/West	Sheltered	Round/Oval	5.2	1.5	14.9	1	1.4	no		Category 4	Category 4	yes	
CMUD-54	-23.087	118.875	20/02/2023	2023		Upper Slope	North	Exposed	Round/Oval	3.4	1.3	9.1	1	1.8	no	20 (Estimate)	Category 3	Category 4	no	
CMUD-55	-23.072	118.709	21/02/2023	2023		Upper Slope	South/East	Semi Exposed	Round/Oval	1.2	2	10.5	1	1.9	no		Category 4	Category 4	yes	
CMUD-56	-23.064	118.722	21/02/2023	2023		Upper Slope	North	Exposed	Round/Oval	3.7	1.4	9.8	3	4.9	no		Category 4	Category 4	yes	
CMUD-57	-23.051	118.636	23/02/2023	2023		Upper Slope	East	Semi Exposed	Round/Oval	7.1	3.2	16.9	1	2.9	no		Category 4	Category 4	yes	

Cave ID	Latitude	Longitude	Date Assessed	First Assessed	Monitoring Cave	Cave Position	Entrance Bearing	Entrance Exposure	Entrance Shape	Entrance Width	Entrance Height	Cave Depth	Number of Chambers	Height of First Chamber	Ghost Bat Present	Ghost Bat Scat	GB Roost Category	PLNB Roost Category	Other Bat Spp.	Cave Entrance Photo
CMUD-58	-23.084	118.649	15/03/2023	2023		Upper Slope	West	Sheltered	Horizontal	5	3	12	1	3	no		Category 5	Category 5	no	
CMUD-59	-23.078	118.616	15/03/2023	2023		Lower Slope	South/East	Sheltered	Vertical	5	3	15	2	2.5	no	10 (count)	Category 3	Category 4	yes	
CTAN-38	-22.911	118.786	18/02/2023	2023		Upper Slope	South/East	Semi Exposed	Round/Oval	2.4	0.7	10.2	1	0.5	no		Category 5	Category 5	no	

Appendix H: Records of Western Pebble Mound Mouse During the Survey

Date	Latitude	Longitude	Observation	Habitat Type
Phase 1				
8/04/2022	-22.8826	118.7774	Mound (active)	Hillcrest/ Hillslope
11/04/2022	-23.0910	118.7178	Mound (inactive)	Hillcrest/ Hillslope
28/04/2022	-23.0441	118.8525	Mound (active)	Hillcrest/ Hillslope
28/04/2022	-23.0441	118.8530	Mound (inactive)	Hillcrest/ Hillslope
28/04/2022	-23.0437	118.8516	Mound (recently inactive)	Hillcrest/ Hillslope
29/04/2022	-22.9167	118.7859	Mound (active)	Stony Plain
29/04/2022	-23.0716	118.8182	Mound (active)	Hillcrest/ Hillslope
29/04/2022	-23.0547	118.8131	Mound (active)	Hillcrest/ Hillslope
30/04/2022	-23.0694	118.7792	Mound (active)	Stony Plain
30/04/2022	-23.0716	118.8183	Mound (inactive)	Hillcrest/ Hillslope
30/04/2022	-23.0601	118.7095	Mound (inactive)	Hillcrest/ Hillslope
1/05/2022	-23.0473	118.9137	Mound (active)	Minor Drainage Line
1/05/2022	-23.0273	118.9141	Mound (inactive)	Hillcrest/ Hillslope
2/05/2022	-23.0176	118.6489	Mound (active)	Hillcrest/ Hillslope
2/05/2022	-23.0273	118.9141	Mound (inactive)	Hillcrest/ Hillslope
2/05/2022	-23.0695	118.8152	Mound (recently inactive)	Hillcrest/ Hillslope
3/05/2022	-23.0445	118.8655	Mound (active)	Stony Plain
3/05/2022	-23.0325	118.8378	Mound (active)	Hillcrest/ Hillslope
3/05/2022	-23.0638	118.6941	Mound (inactive)	Stony Plain
3/05/2022	-23.0438	118.8660	Mound (inactive)	Stony Plain
3/05/2022	-23.0325	118.8346	Mound (inactive)	Minor Drainage Line
3/05/2022	-23.0322	118.8376	Mound (inactive)	Stony Plain
3/05/2022	-23.0458	118.8648	Mound (recently inactive)	Minor Drainage Line
4/05/2022	-23.0836	118.6219	Mound (inactive)	Hillcrest/ Hillslope
4/05/2022	-23.0597	118.7095	Mound (recently inactive)	Hillcrest/ Hillslope
5/05/2022	-23.0159	118.6468	Mound (active)	Hillcrest/ Hillslope
5/05/2022	-23.0375	118.6547	Mound (inactive)	Hillcrest/ Hillslope
6/05/2022	-23.0328	118.8382	Mound (active)	Hillcrest/ Hillslope
25/05/2022	-23.0608	118.8836	Mound (active)	Stony Plain

Date	Latitude	Longitude	Observation	Habitat Type
26/05/2022	-23.0226	118.8716	Mound (active)	Stony Plain
26/05/2022	-23.0259	118.8507	Mound (inactive)	Stony Plain
26/05/2022	-23.0236	118.8715	Mound (inactive)	Stony Plain
26/05/2022	-23.0227	118.8869	Mound (inactive)	Minor Drainage Line
26/05/2022	-23.0217	118.8713	Mound (inactive)	Stony Plain
26/05/2022	-23.0210	118.8710	Mound (inactive)	Stony Plain
26/05/2022	-23.0877	118.7070	Mound (recently inactive)	Hillcrest/ Hillslope
26/05/2022	-23.0872	118.7009	Mound (recently inactive)	Hillcrest/ Hillslope
26/05/2022	-23.0870	118.7072	Mound (recently inactive)	Hillcrest/ Hillslope
26/05/2022	-23.0126	118.6858	Mound (recently inactive)	Hillcrest/ Hillslope
28/05/2022	-23.0234	118.8632	Burrow (inactive)	Stony Plain
28/05/2022	-23.0244	118.8647	Mound (active)	Stony Plain
28/05/2022	-23.0241	118.8977	Mound (active)	Hillcrest/ Hillslope
28/05/2022	-23.0220	118.8980	Mound (active)	Stony Plain
28/05/2022	-23.0245	118.8648	Mound (inactive)	Stony Plain
28/05/2022	-23.0240	118.8611	Mound (inactive)	Minor Drainage Line
28/05/2022	-23.0239	118.8645	Mound (inactive)	Stony Plain
28/05/2022	-23.0238	118.8608	Mound (inactive)	Stony Plain
28/05/2022	-23.0236	118.8632	Mound (inactive)	Stony Plain
28/05/2022	-23.0235	118.8625	Mound (inactive)	Minor Drainage Line
28/05/2022	-23.0238	118.8621	Mound (recently inactive)	Stony Plain
29/05/2022	-23.1008	118.7020	Mound (active)	Hillcrest/ Hillslope
29/05/2022	-23.0983	118.7025	Mound (active)	Stony Plain
29/05/2022	-23.0651	118.8902	Mound (active)	Stony Plain
29/05/2022	-23.0650	118.8919	Mound (active)	Stony Plain
29/05/2022	-23.0645	118.8919	Mound (active)	Stony Plain
29/05/2022	-23.0586	118.8839	Mound (active)	Stony Plain
29/05/2022	-23.0583	118.8826	Mound (active)	Stony Plain
29/05/2022	-23.0556	118.8848	Mound (active)	Stony Plain

Date	Latitude	Longitude	Observation	Habitat Type
29/05/2022	-23.0264	118.8517	Mound (active)	Minor Drainage Line
29/05/2022	-23.0235	118.8556	Mound (active)	Stony Plain
29/05/2022	-23.0218	118.8845	Mound (active)	Stony Plain
29/05/2022	-23.0214	118.8840	Mound (active)	Stony Plain
29/05/2022	-23.0207	118.8848	Mound (active)	Stony Plain
29/05/2022	-23.0202	118.8869	Mound (active)	Stony Plain
29/05/2022	-23.0597	118.8835	Mound (inactive)	Stony Plain
29/05/2022	-23.0572	118.8827	Mound (inactive)	Stony Plain
29/05/2022	-23.0251	118.8556	Mound (inactive)	Stony Plain
29/05/2022	-23.0218	118.8872	Mound (inactive)	Drainage Area/ Floodplain
29/05/2022	-23.0208	118.8841	Mound (inactive)	Stony Plain
29/05/2022	-23.0214	118.8842	Mound (recently inactive)	Stony Plain
30/05/2022	-23.0245	118.8703	Mound (active)	Stony Plain
30/05/2022	-23.0256	118.8710	Mound (inactive)	Hillcrest/ Hillslope
30/05/2022	-23.0239	118.8697	Mound (inactive)	Stony Plain
30/05/2022	-23.0218	118.8681	Mound (recently inactive)	Stony Plain
Phase 2				
16/02/2023	-23.0472	118.8635	Mound (active)	Hillcrest/ Hillslope
16/02/2023	-23.1002	118.7037	Mound (active)	Hillcrest/ Hillslope
16/02/2023	-23.0990	118.7033	Mound (active)	Stony Plain
17/02/2023	-23.0532	118.6337	Mound (active)	Stony Plain
18/02/2023	-22.9121	118.7866	Mound (inactive)	Stony Plain
19/02/2023	-23.0598	118.8916	Mound (inactive)	Hillcrest/ Hillslope
19/02/2023	-23.0568	118.8934	Mound (inactive)	Hillcrest/ Hillslope
19/02/2023	-23.0640	118.8902	Mound (inactive)	Stony Plain
21/02/2023	-23.0710	118.7992	Mound (active)	Stony Plain
21/02/2023	-23.0603	118.7058	Mound (active)	Stony Plain
22/02/2023	-23.0687	118.7694	Mound (active)	Stony Plain
23/02/2023	-23.0538	118.8841	Mound (active)	Stony Plain

Date	Latitude	Longitude	Observation	Habitat Type
23/02/2023	-23.0599	118.8884	Mound (active)	Stony Plain
23/02/2023	-23.0601	118.8883	Mound (inactive)	Hillcrest/ Hillslope
8/03/2023	-23.0713	118.7967	Mound (active)	Hillcrest/ Hillslope