NEBO OB25 West Targeted Vertebrate Fauna Survey

Report to BHP WAIO

30 October 2024

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Executive Summary

BHP Western Australian Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a targeted vertebrate fauna survey of the NEBO OB25 West Project Area (herein the Study Area). The Study Area is located approximately 3–8 kilometres (km) northeast of Newman and covers an area of approximately 2,603 hectares (ha).

The overarching objective of this survey was to determine the presence, or likely presence, of significant vertebrate fauna species within the Study Area, with a specific focus on Matters of National Environmental Significance (MNES; i.e. species listed under the *Environment Protection and Biodiversity Conservation Act 1999*), comprising ten target species:

- northern quoll (*Dasyurus hallucatus*) – Endangered
- greater bilby (*Macrotis lagotis*) – Vulnerable
- ghost bat (*Macroderma gigas*) – Vulnerable
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia* 'Pilbara form') – Vulnerable
- night parrot (*Pezoporus occidentalis*) – Endangered
- grey falcon (*Falco hypoleucos*) – Vulnerable
- princess parrot *(Polytelis alexandrae*) – Vulnerable
- southern whiteface *(Aphelocephala leucopsis*) – Vulnerable
- Pilbara olive python *(Liasis olivaceus* subsp. *barroni*) – Vulnerable
- great desert skink *(Liopholis kintorei*) – Vulnerable.

A comprehensive desktop assessment was conducted prior to the field survey to identify previous records of the target species within the Study Area and the local region. A field survey was undertaken during April 2024, with species specific sampling comprising habitat and habitat feature assessments, ultrasonic and acoustic recordings, camera trap transects and targeted searches.

Ten broad fauna habitat types were recorded and mapped across the Study Area, comprising Hillcrest/ Hillslope (21.77%, 566.56 ha), Drainage Area/ Floodplain (15.39%, 400.69 ha), Major Drainage Line (5.83%, 140.13 ha), Sand Plain (3.10%, 80.62 ha), Stony Plain (2.87%, 74.83 ha), Undulating Low Hills (2.37%, 61.60 ha), Minor Drainage Line (2.12%, 55.26 ha), Mulga Woodland (0.73%, 19.11 ha), Gorge/ Gully (0.25%, 6.45 ha), and Breakaway/ Cliff (0.01%, 0.29 ha), with the remaining area classified as Cleared/ Disturbed (46.00%, 1,197.48 ha). Five of these habitat types provide critical habitat for one or more of the target significant species; Drainage Area/ Floodplain, Sand Plain, Gorge/ Gully, Major Drainage Line, and Breakaway/ Cliff.

The desktop assessment identified 382 vertebrate fauna species (48 mammals, 207 birds, 118 reptiles and nine amphibians) which have previously been recorded and/or have the potential to occur within the Study Area. Of these, 43 are classified as significant species, three of which have previously been recorded within the Study Area: ghost bat, western pebble-mound mouse and Pilbara olive python. All three species were recorded during the current survey.

Ghost bat was recorded on one occasion during the current survey via secondary evidence (scats), with approximately 1,000 scats recorded within a Category 3 roost (diurnal roost caves with occasional occupancy; cave CER-06). A total of six caves were recorded and assessed within the Study Area, with one cave (CER-06) classified as a Category 3 ghost bat roost, and the remaining five caves classified as Category 4 roosts (nocturnal roost caves with opportunistic usage). Supporting foraging and dispersal habitat within the Study Area is provided by Drainage Area/ Floodplain, Mulga Woodland, Stony Plain, Sand Plain, Undulating Low Hills, Minor Drainage Line, and Major Drainage Line, and supporting dispersal habitat is provided by Gorge/ Gully and Breakaway/ Cliff habitats when proximal (<12 km) to roosting caves. Due to the presence of a Category 3 roost and supporting foraging habitat, the individuals present in the Study Area forms part of the broader meta-population of ghost bats in the Pilbara. As such, the population within the Study Area aligns with the DoE (2013b) definition of 'important'.

Pilbara olive python was recorded during the current survey, via one record of secondary evidence (slough) within Breakaway/ Cliff habitat. Ten water features were recorded in the Study Area during the current survey including one artificial/ persistent, four semi-persistent and five ephemeral water features. For Pilbara olive pythons, these water features often act as critical foraging locations and for that reason it is often associated with such features, particularly in rocky habitats. Naturally occurring permanent water features are considered critical habitat for the Pilbara olive python, however, none were recorded in the Study Area. While the artificial water feature in the Study Area is currently present the prolonged existence is limited by mining activity and its significance in the landscape will be periodical. The remaining nine ephemeral pools recorded in Major Drainage Line habitat are considered supporting habitat. Overall, the Major Drainage Line, Gorge/ Gully and Breakaway/ Cliff habitats provide critical habitat for Pilbara olive python. Minor Drainage Line and Hillcrest/Hillslope is considered supporting habitat where in the home range (88–450 ha) of critical habitat and where important microhabitats are present. The Pilbara olive python has been recorded twice within the Study Area, and the Study Area contains both critical and supporting habitat. Based on this, the individuals present would be considered to contribute to an 'important population'.

No Pilbara leaf-nosed bat or evidence of the species' occurrence was recorded within the Study Area during the current survey; however, it has previously been recorded on many occasions within the vicinity (within 40 km) of the Study Area, with the closest record being approximately 2.4 km north. All six caves recorded in the Study Area are classified as non-critical Category 4 nocturnal refuges for this species. No critical foraging habitat for the species was identified based on the absence of any diurnal roosts (Category 1–3) within the Study Area; however, the occurrence of a provisional Category 2 roost within 14 km of the Study Area (cave CNIN-12) means the species is likely to frequently forage within the habitats present within the Study Area. All habitats within the Study Area provide varying degrees of supporting foraging habitat, with Breakaway/ Cliff habitat classified as a Habitat Rating 4 (very high), Gorge/ Gully and Major Drainage Line classified as a Habitat Rating 3 (high), and Hillcrest/ Hillslope, Drainage Area/ Floodplain, Stony Plain, Sand Plain, Undulating Low Hills, Minor Drainage line and Mulga Woodland classified as Habitat Rating 2 (moderate) for the species. The Pilbara population of the leaf-nosed bat is regarded as a single interbreeding population and therefore, the entire population of Pilbara leaf-nosed bat is classified as an 'important population'. Based on the results of the current survey, the Study Area is considered unlikely to represent a significant area for Pilbara leaf-nosed bats due to the absence of Category 1, 2 and 3 roosts; however, due to a provisional permanent diurnal roost (preliminary categorisation as Category 2) within 14 km the Study Area (cave CNIN-12), the species if present within the Study Area would likely be foraging and dispersing.

Northern quoll was not recorded during the current survey and there is a scarcity of records within the local vicinity and region. The Gorge/ Gully, Breakaway/ Cliff, and Major Drainage Line habitats provide critical breeding/denning, foraging and dispersal habitat for northern quoll. Potential supporting habitat for the northern quoll occurs in the Hillcrest/ Hillslope and Minor Drainage Line habitats, where proximal to critical habitat (Gorge/ Gully, Breakaway/ Cliff, and Major Drainage Line). The species occurrence within the Study Area is considered Possible; however, may be limited to infrequent visitations by dispersing individuals only.

No southern whiteface records were made during the current survey and there is a scarcity of records in the broader vicinity due to the location of the Study Area on the northern edge of this species distribution. However, in the Study Area, Drainage Area/ Floodplain provides critical breeding/ nesting, foraging and dispersal habitat for the species, and Major Drainage Line, Minor Drainage Line and Sand Plain habitats may provide supporting breeding/ nesting, foraging and dispersal for the species. Mulga Woodland and Stony Plain habitats may provide supporting foraging and dispersal for the species. As the Study Area currently occurs on the periphery of southern whiteface distribution, any records present may

contribute to an important population of the species; however, the distribution of southern whiteface in the Pilbara may not be well defined.

No grey falcons were recorded during the current survey. The Major Drainage Line habitat is considered critical habitat for grey falcon, with supporting habitat occurring within Drainage Area/ Floodplain and Minor Drainage Line. The grey falcon is considered a single interbreeding population across its distribution, therefore if present, its occurrence within the Study Area would contribute to an 'important population'.

No records or evidence of the greater bilby was recorded within the Study Area during the current survey; however, critical breeding, foraging and dispersal habitat for the species is present in areas of suitable Sand Plain habitat. Supporting habitat is found within Major Drainage Line, Mulga Woodland and Drainage Area/ Floodplain, when adjacent to critical habitat. Based on the presence of suitable critical habitat, nearby previous records and the Study Area being within the likely distribution for the species, the greater bilby is considered Possible to occur.

The habitat present in the Study Area is considered unsuitable for the night parrot (lack of large, long-unburnt hummocks and chenopod shrubland) and the species is rare within the local region. Based on these factors the night parrot is considered Unlikely to occur in the Study Area.

The Study Area is outside the modelled and known distribution for both the princess parrot and great desert skink, and there is an absence of records in the local vicinity (within 40 km). As such, these species are considered to not be reliant on the habitats present in the Study Area and Unlikely to occur.

Additional significant fauna species were identified during the desktop assessment. One significant species was recorded within the Study Area during the current survey, the Priority 4 (DBCA) western pebble-mouse mound (*Pseudomys chapmani*). Another significant species is considered as Likely to occur (brush-tailed mulgara) and six are considered Possible to occur within the Study Area (long-tailed dunnart, northern short-tailed mouse, peregrine falcon, fork-tailed swift, spotted ctenotus (northeast), and Gane's blind snake). The remaining 25 significant species that were identified in the desktop assessment are considered Unlikely or Highly Unlikely.

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1 Introduction

1.1 Background

BHP Western Australian Iron Ore (BHP WAIO) commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a targeted vertebrate fauna survey of the NEBO OB25 West Project Area (herein the Study Area). The Study Area is located approximately 3–8 kilometres (km) northeast of the Newman township and covers an area of approximately 2,603 hectares (ha) (Figure 1.1).

1.2 Survey Objectives

The overarching objective of this survey was to determine the presence, or likely presence, of significant vertebrate fauna species within the Study Area, with a specific focus on Matters of National Environmental Significance (MNES; i.e. species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)). The survey also considered fauna species listed under the Biodiversity Conservation Act 2016 (BC Act) and as Priority by the Department of Biodiversity, Conservation, and Attractions (DBCA) (Appendix A). The MNES species (and their status under the EPBC Act) targeted for this survey included:

- northern quoll (*Dasyurus hallucatus*) – Endangered;
- ghost bat (*Macroderma gigas*) – Vulnerable;
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia* 'Pilbara form') – Vulnerable;
- greater bilby (*Macrotis lagotis*) – Vulnerable;
- southern whiteface (*Aphelocephala leucopsis*) – Vulnerable;
- grey falcon (*Falco hypoleucos*) – Vulnerable;
- night parrot (*Pezoporus occidentalis*) – Endangered;
- princess parrot (*Polytelis alexandreae*) – Vulnerable;
- great desert skink (*Liopholis kintorei*) – Vulnerable; and
- Pilbara olive python (*Liasis olivaceus* subsp. *barroni*) – Vulnerable.

1.3 Compliance

This assessment was carried out in accordance with the following guidelines and recommendations developed by the relevant state and federal regulatory bodies, relevant survey-specific license conditions and, where relevant, BHP WAIO procedures:

- Bat Call (2021a) A review of ghost bat ecology, threats and survey requirements
- Bat Call (2021b) A review of Pilbara leaf-nosed bat ecology, threats
- BHP WAIO (2023b) Vertebrate fauna surveys in Western Australia procedure (Document Number: SPR-IEN-EMS-012) Version: 12.0

- BHP WAIO (2023a) Biological survey spatial data requirements (SPR-IEN-EMS-015) Version 12.0
- DBCA (2017) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia
- Department of Environment, Water, Heritage and the Arts (DEWHA) (2010a) Survey guidelines for Australia's threatened bats
- DEWHA (2010b) Survey guidelines for Australia's threatened birds
- Department of the Environment (DoE) (2016) EPBC Act referral guideline for the endangered northern quoll (*Dasyurus hallucatus)*
- Department of Parks and Wildlife (2017) Interim guidelines for the preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia
- DoE (2013a) Significant impact guidelines 1.1: Matters of National Environmental Significance
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011a) Survey guidelines for Australia's threatened mammals
- DSEWPaC (2011b) Survey guidelines for Australia's threatened reptiles
- Environmental Protection Authority (EPA (2020a) Statement of environmental principles, factors and objectives
- EPA (2020b) Technical guidance: terrestrial vertebrate fauna surveys for environmental impact assessment
- EPA (2016) Environmental factor guideline: Terrestrial fauna
- and survey requirements
- Threatened Species Scientific Committee (TSSC (2016b) Conservation advice: *Macroderma gigas*, ghost bat
- TSSC (2020) Conservation advice: *Falco hypoleucos*, grey falcon
- TSSC (2016c) Conservation advice: *Rhinonicteris aurantia* (Pilbara form), Pilbara leaf-nosed bat
- TSSC (2008) Approved conservation advice for *Liasis olivaceus barroni* (Olive Python – Pilbara subspecies).

775000 780000 785000 790000

7420000

7415000

Ethel Creek Station

Great Northern Hwy

Ore Body 24

Port Hedland Newman Railway

Marble Bar Rd

Newman

LEGEND

- Study Area
- Ethel Creek Station
- State Road
- Rail

Biologic

Scale 1:50,000

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024

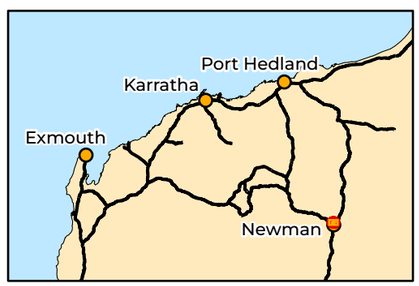

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Figure 1.1: Study Area and regional context

2 Existing Environment

2.1 Biogeography

The Study Area is located within the Hamersley subregion of the Pilbara bioregion (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 (PIL3) 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 dominant 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, 2023; 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 eight regolith (1:500,000) geology units (Figure 2.1). The Marra Mamba Iron Formation (419.42 ha, 16.11% of the Study Area) is the bedrock geology most predisposed to forming deep caves in the Pilbara suitable for use by ghost bats and Pilbara leaf-nosed bats; however, the larger hills of Brockman Iron Formation (747.96 ha, 28.73%) also form suitable caves (Armstrong & Anstee, 2000; Cramer *et al.*, 2022).

775000
780000
785000
790000
7420000
7415000
Great Northern Hwy
Ore Body 24
Port Hedland Newman Railway
Marble Bar Rd

Bedrock Geology
- A-FO-od; Fortescue Group
- A-FOj-xs-b; Jeerinah Formation
- A-FOu-bbo; Bunjinah Formation
- A-HAd-kd; Wittenoom Formation
- A-HAm-cib; Marra Mamba Iron Formation
- A-g-PYV; Sylvania Inlier granitic unit
- AP-HAu-xsl-ci; Mount McRae Shale and Mount Sylvia Formation
- P-HAb-cib; Brockman Iron Formation
- P-HAj-xci-od; Weeli Wolli Formation
- P-HAo-ci; Boolgeeda Iron Formation
- P-HAw-fr; Woongarra Rhyolite

LEGEND
- Study Area
- State Road
- Rail

Biologic

Scale 1:50,000
0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator
Created: 09/08/2024

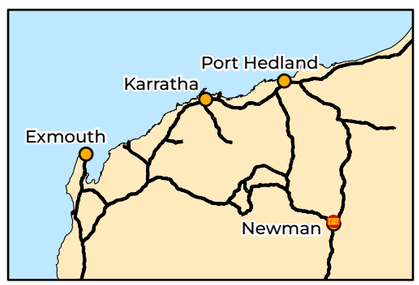

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Figure 2.1: Broad geology of the Study Area

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 two soil units, Fa13 (1,483.64 ha, 57.00% of the Study Area) and BE6 (1,119.39 ha, 43.00%) (Figure 2.2). Soil unit Fa13 occurs across the northern portion of the Study Area and 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. Soil unit BE6 occurs across the southern section of the Study Area and is characterised by extensive flat and gently sloping plains.

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. Four land systems occur within the Study Area, the dominant being the Newman land system, which covers approximately 46.93% (1,221.47 ha) of the Study Area (Figure 2.3; Table 2.1). The Newman land system is defined as "rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands" (van Vreeswyk *et al.*, 2004). The remaining three land systems account for the remaining 53.07% (1,381.56 ha) of the Study Area and include Elimunna, Boolgeeda and River (Figure 2.3; Table 2.1). The Newman land system contains the most significant habitats for many of the target MNES species with rocky ridges and mountains supporting important refugia and foraging habitats for Pilbara leaf-nosed bat, ghost bat and northern quoll.

Table 2.1: Land systems of the Study Area

Land system	Land type	Description	Extent in Study Area	
			Ha	%
Newman (New)	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1,221.47	46.93
Elimunna (Eli)	Stony plains with Acacia shrublands	Stony plains on basalt supporting sparse *Acacia* and *Cassia* shrublands and patchy tussock grasslands.	696.21	26.75
Boolgeeda (Bgd)	Stony plains with spinifex grasslands	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	685.11	26.31
River (Riv)	Water course and drainage systems	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	0.24	0.01
Total			**2,603.03**	**100**

775000
780000
785000
790000
7420000
7415000
Great Northern Hwy
Ore Body 24
Port Hedland Newman Railway
Marble Bar Rd
Newman

LEGEND

- Study Area
- State Road
- Rail

Soil Unit

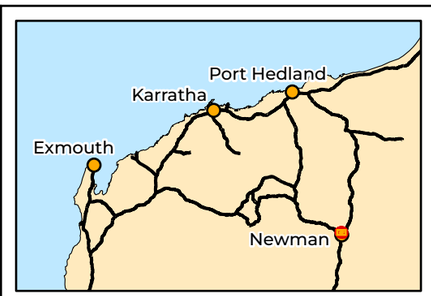
- BE6
- Fa13
- Fa14
- Mz25
- Oc64

Biologic

Scale 1:50,000

0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator Created: 09/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 2.2: Soils of the Study Area

775000
780000
785000
790000
7420000
7415000
Great Northern Hwy
Ore Body 24
Port Hedland Newman Railway
Marble Bar Rd
Newman

LEGEND

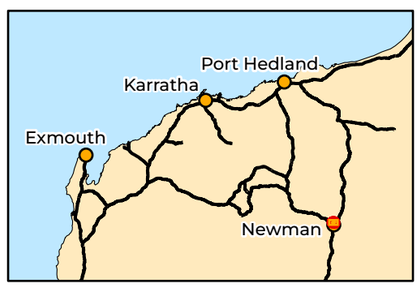
Study Area
State Road
Rail

Land System
Boolgeeda System
Elimunna System
McKay System
Newman System
River System
Rocklea System
Spearhole System
Wannamunna System
Washplain System

Biologic

Scale 1:50,000
0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024



BHP WAIO
NEBO Targeted
Vertebrate Fauna Survey

Figure 2.3: Land systems of the Study Area

2.6 Surface Hydrology

One minor watercourse (Homestead Creek) intersects the southern section of the Study Area, along with several other unnamed minor watercourses steaming from the creek (Figure 2.4). These watercourses are considered ephemeral and often only flow during and/or following large rainfall events. Homestead Creek flows in a north-easterly direction joining with the Fortescue River less than 2 km east of the Study Area. Ophthalmia Dam is a major catchment area within the broader region and is situated less than 10 km southeast 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.

Two vegetation associations occur within the Study Area (Figure 2.5; Table 2.2). The dominant vegetation association is HAMMERSLEY-82 which covers approximately 56.32% (1,466.15 ha) of the Study Area and comprises hummock grasslands and low snappy gum (*Eucalyptus leucophloia*) trees. The mulga woodlands of the HAMMERSLEY-18 vegetation association largely occur on the flats between the ranges and can be sheet flow dependent.

Table 2.2: Vegetation associations within the Study Area

Vegetation Association	Description	Extent in Study Area	
		Ha	%
HAMMERSLEY-82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	1,466.15	56.32
HAMMERSLEY-18	Low woodland; mulga (*Acacia aneura*)	1,136.88	43.68
Total		**2,603.03**	**100**

2.8 Land Use and Tenure

The dominant land uses in the Hamersley subregion include grazing, native pastures, conservation, urban areas and mining (Kendrick, 2003), as well as recreation and tourism. No pastoral leases intersect the Study Area and land use within the Study Area includes extensive exploration activities and active mining throughout. Tenure within the Study Area comprises one live mining lease (AML700244), which includes BHP WAIO's Eastern Ridge mining operations located centrally and directly north of the Study Area. There is one exploration licence (E 5203760) held by BHP intersecting and overlapping a small section in the west of the Study Area. BHP rail infrastructure also intersects the southern portion of the Study Area.

775000
780000
785000
790000
7420000
7415000

Homestead Creek
Great Northern Hwy
Ore Body 24
Homestead Creek
Port Hedland Newman Railway
Marble Bar Rd
Fortescue River
Warrawanda Creek
Newman

LEGEND

Study Area
State Road
Rail

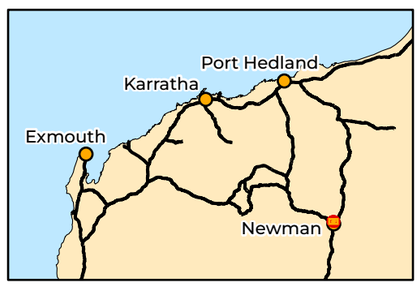
Subcatchment
Ophthalmia Dam
Unnamed

Surface Hydrology
Minor
Major

Biologic

Scale 1:50,000
0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 14/08/2024



BHP WAIO
NEBO Targeted
Vertebrate Fauna Survey

Figure 2.4: Surface hydrology of the Study Area

775000
780000
785000
790000
7420000
7415000
Great Northern Hwy
Ore Body 24
Port Hedland Newman Railway
Marble Bar Rd
Newman

LEGEND

Study Area
State Road
Rail

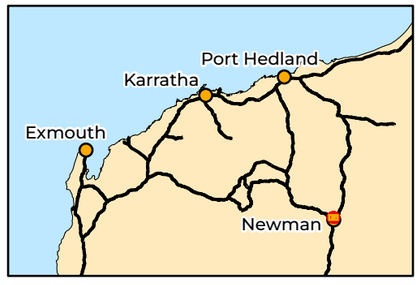
Pre-European Vegetation

Fortescue Valley 29
Fortescue Valley 82
Fortescue Valley 216
Hammersley 18
Hammersley 82
Kumarina Hills 29
Kumarina Hills 216

Biologic

Scale 1:50,000
0 0.5 1 1.5 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024



BHP WAIO
NEBO Targeted
Vertebrate Fauna Survey

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 was undertaken to determine current distribution and records of the ten target MNES species and other significant vertebrate fauna potentially occurring within the Study Area (Table 3.1; Table 3.2).

Six fauna databases were searched (Table 3.1), three contain information on all vertebrate species previously recorded (ALA, 2024; BirdLife Australia, 2024; DBCA, 2024b), two identify species of significance previously recorded (BHP, 2023; DBCA, 2024a) and one identifies species of significance known or likely to occur within the region based on modelled distribution (DCCEEW, 2024).

Twenty-eight reports were reviewed (six detailed surveys, 14 targeted surveys, six basic surveys, one desktop and one monitoring report) (Table 3.2; Figure 3.1; Appendix B). Four of these overlapped with a portion of the Study Area and 16 assessments were undertaken within 20 km (Table 3.2; Figure 3.1).

Table 3.1: Databases reviewed for the desktop assessment

Database	Data Access/ Receival Date	Search Area
ALA (2024) Atlas of Living Australia	February 2024	40 km
BHP (2023) Fauna Records Database		
BirdLife Australia (2024) Birdata		
DBCA (2024a) Threatened and Priority Fauna Database		
DBCA (2024b) NatureMap		
DCCEEW (2024) Protected Matters Search Tool		

Table 3.2: Literature reviewed for the desktop assessment

Report	Survey Type	Distance from Study Area
Astron (2024). Newman water treatment plant area targeted significant fauna survey	Targeted	3 km SW
Biologic (2013). Orebody 24 targeted vertebrate fauna survey	Targeted	Partially overlaps
Biologic (2014a). Dynasty Tenement desktop review of vertebrate fauna and habitats	Desktop	16 km ESE
Biologic (2014b). Orebody 19 Level 2 vertebrate fauna survey	Detailed	17 km E
Biologic (2014c). Orebody 25 targeted vertebrate fauna survey	Targeted	Completely overlaps
Biologic (2014d). Orebody 31 vertebrate fauna survey	Detailed	27 km E
Biologic (2016a). Cathedral Gorge Level 1 and targeted vertebrate fauna survey	Targeted	3 km NW
Biologic (2016b). Dynasty Level 1 vertebrate fauna survey	Basic	17 km ESE
Biologic (2016c). Dynasty Level 2 vertebrate fauna survey	Detailed	17 km ESE
Biologic (2018b). Dynasty vertebrate fauna monitoring 2018	Monitoring	17 km ESE
Biologic (2019). Shearer's West targeted vertebrate and short-range endemic invertebrate fauna assessment	Targeted	30 km ESE
Biologic (2020b). Jimblebar greenhouse gas abatement study Basic vertebrate fauna survey	Basic	18 km ESE
Biologic (2021b). Western Ridge pipelines vertebrate fauna survey	Targeted	1 km S
Biologic (2022a). North Jimblebar: targeted northern quoll assessment	Targeted	16 km E
Biologic (2022b). Western Ridge Paddy Bore Area vertebrate fauna assessment memorandum	Targeted	7 km SW
Biologic (2023a). OB32 West, OB28 and OB33: targeted fauna survey	Targeted	1 km NW
Biologic (2023b). Warrawandu targeted significant vertebrate fauna survey	Targeted	10 km E
Biota (2022). Orebody 32 surplus water targeted MNES vertebrate fauna survey	Targeted	Partially overlaps
Ecologia (2004). Eastern Ophthalmia range expansion biological survey	Detailed	12 km E
ENV (2007). Orebody 18 fauna assessment phase II	Detailed	24 km E

Report	Survey Type	Distance from Study Area
ENV (2011b). Orebody 31 fauna assessment	Basic	32 km E
GHD (2021). Jimblebar targeted ghost bat survey	Targeted	31 km E
GHD (2022). OB32 West, OB28 and OB33 targeted vertebrate fauna surveys	Targeted	Partially overlaps
MWH (2015). Ophthalmia Dam avian fauna survey	Targeted	5 km E
Onshore (2015a). OB31 Jimblebar access track VCP Level 1 flora & vegetation survey and vertebrate fauna assessment	Basic	35 km E
Onshore (2015b). Tenement E52/2238 Level 1 flora and vegetation and Level 1 vertebrate fauna survey	Basic	24 km E
Onshore (2017). Reconnaissance flora and vegetation survey and fauna assessment Newman to Mining Area C powerline corridor	Basic	3 km NE
Outback Ecology (2009). Jimblebar linear development terrestrial vertebrate fauna assessment	Detailed	3 km E

3.2 Results

The desktop assessment identified 382 vertebrate fauna species (48 mammals, 207 birds, 118 reptiles and nine amphibians) which have previously been recorded and/or have the potential to occur within the Study Area (Appendix B).

Forty-three are classified as significant species, including the ten target MNES species (Table 3.3; Figure 3.2; Figure 3.3; Appendix B). The following three species have previously been recorded within the Study Area prior to the current survey:

- ghost bat (*Macroderma gigas*) – Vulnerable (EPBC Act and BC Act): three records
- western pebble-mound mouse (*Pseudomys chapmani*) – Priority 4 (DBCA): 12 records
- Pilbara olive python (*Liasis olivaceus* subsp. *barroni*) – Vulnerable (EPBC Act and BC Act): one record.

Due to the size of the desktop assessment search area, and likelihood of encompassing habitats which may not occur within the Study Area, results of the desktop assessment are likely to include species which may not occur within the Study Area (e.g. marine bird species). Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants. For the purposes of this desktop assessment, extinct species, marine bird species (i.e. petrels and albatross) and/or species that cannot physically occur within the Study Area (i.e. aquatic marine species) have been excluded from the database search results and are not discussed further herein.

720000
760000
800000
840000
7440000
7400000

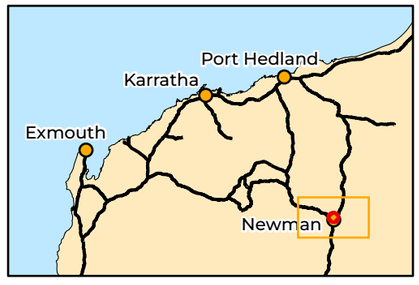
Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

LEGEND
- Study Area
- Desktop Assessment Area
- State Road
- Rail

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO
NEBO Targeted Vertebrate Fauna Survey

Figure 3.1: Literature sources used in the desktop assessment

Literature Source

- Astron Environmental Services (2024). Newman Water Tank Area Targeted Significant Fauna Survey. Unpublished report for BHP Western Australian Iron Ore.
- Biologic Environmental Survey (2013). Ore Body 24 Targeted Vertebrate Fauna Survey
- Biologic Environmental Survey (2014). Orebody 19 Level 2 Vertebrate Fauna Survey
- Biologic Environmental Survey (2014). Orebody 31 Vertebrate Fauna Survey
- Biologic Environmental Survey (2014). Orebody 25 Targeted Vertebrate Fauna Survey
- Biologic Environmental Survey (2014). Dynasty Tenement Desktop Review of Vertebrate Fauna and Habitats
- Biologic Environmental Survey (2015). Orebody 31 to Ophthalmia Dam Pipeline Level 1 Flora, Vegetation and Vertebrate Fauna Survey
- Biologic Environmental Survey (2016). Dynasty Level 2 Vertebrate Fauna Survey
- Biologic Environmental Survey (2016). Dynasty Level 1 Vertebrate Fauna Survey
- Biologic Environmental Survey (2016). Cathedral Gorge Level 1 and Targeted Vertebrate Fauna Survey
- Biologic Environmental Survey (2018). Consolidated Fauna Habitat Mapping 2017
- Biologic Environmental Survey (2018). Dynasty Vertebrate Fauna Monitoring 2018
- Biologic Environmental Survey (2019). Shearer's West Targeted Vertebrate and Short-range Endemic Invertebrate Fauna Assessment
- Biologic Environmental Survey (2020). Jimblebar Greenhouse Gas Abatement Level 1 Terrestrial Vertebrate Fauna Survey. Unpublished report prepared for BHP Iron Ore.
- Biologic Environmental Survey (2022). Western Ridge Pipeline Targeted Fauna. Unpublished report prepared for BHP Iron Ore.
- Biologic Environmental Survey (2022). Western Ridge Paddy Bore Area Vertebrate Fauna Assessment Memorandum. Unpublished report prepared for BHP WAIO.
- Biologic Environmental Survey (2022). North Jimblebar Targeted Northern Quoll Assessment. Unpublished report prepared for BHP WAIO
- Biologic Environmental Survey (2023). OB28, OB32, OB33 Targeted Fauna Survey. Unpublished report prepared for BHP WAIO.
- Biologic Environmental Survey (2023). Warrawandu Targeted Vertebrate Fauna Survey. Unpublished report prepared for BHP WAIO
- Biota (2022). Orebody 32 Surplus Water Targeted MNES Vertebrate Fauna Survey. Unpublished report for BHP WAIO.
- ENV (2007). Orebody 18 Fauna Assessment Phase II
- ENV (2011). Orebody 31 Fauna Assessment
- Ecologia (2004). Eastern Ophthalmia Range Expansion Biological Survey
- GHD Pty Ltd (2021). Jimblebar targeted ghost bat survey. Unpublished report for BHP Iron Ore
- GHD Pty Ltd (2022). OB32 West, OB33 and OB29 Targeted Vertebrate Fauna Survey. Report prepared for BHP Western Australia Iron Ore.
- MWH (2015). Ophthalmia Dam Avian Fauna Survey
- Onshore (2015). OB31 Jimblebar Access Track VCP Level 1 Flora & Vegetation Survey and Vertebrate Fauna Assessment
- Onshore (2015). Tenement E52/2238 Level 1 Flora & Vegetation and Vertebrate Fauna Survey
- Onshore (2017). Reconnaissance Flora and Vegetation Survey and Fauna Assessment Newman to Mining Area C
- Outback Ecology (2009). Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment

Biologic

Table 3.3: Species of significance identified in the desktop assessment

Species		Conservation Status				Recorded within Study Area
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	
MAMMALS						
DASYURIDAE						
Antechinomys longicaudatus	Long-tailed dunnart			P4		
Dasycercus blythi	Brush-tailed mulgara			P4		
Dasyurus hallucatus	Northern quoll	EN	EN		EN	
MACROPODIDAE						
Lagorchestes conspicillatus subsp. *leichardti*	Spectacled hare-wallaby			P4		
Petrogale lateralis subsp. *lateralis*	Black-flanked rock-wallaby	EN	EN		EN	
MEGADERMATIDAE						
Macroderma gigas	Ghost bat	VU	VU		VU	•
MURIDAE						
Leggadina lakedownensis	Northern short-tailed mouse			P4		
Pseudomys chapmani	Western pebble-mound mouse			P4		•
RHINONYCTERIDAE						
Rhinonicteris aurantia 'Pilbara form'	Pilbara leaf-nosed bat	VU	VU			
THYLACOMYIDAE						
Macrotis lagotis	Greater bilby	VU	VU		VU	
BIRDS						
ACANTHIZIDAE						
Aphelocephala leucopsis	Southern whiteface	VU				
ANATIDAE						
Anas querquedula	Garganey	MI	MI			
APODIDAE						
Apus pacificus	Fork-tailed swift	MI	MI			
CHARADRIIDAE						
Charadrius dubius	Little ringed plover	MI	MI			
Charadrius leschenaultii	Greater sand plover	MI / VU	VU			
Charadrius veredus	Oriental plover	MI	MI			
FALCONIDAE						
Falco hypoleucos	Grey falcon	VU	VU		VU	

Species		Conservation Status				Recorded within Study Area
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	
Falco peregrinus	Peregrine falcon		OS			
HIRUNDINIDAE						
Hirundo rustica	Barn swallow	MI	MI			
LARIDAE						
Gelochelidon nilotica	Gull-billed tern	MI	MI			
Sterna caspia	Caspian tern	MI	MI			
MOTACILLIDAE						
Motacilla cinerea	Grey wagtail	MI	MI			
Motacilla flava	Yellow wagtail	MI	MI			
PSITTACIDAE						
Pezoporus occidentalis	Night parrot	EN	CR		EN	
Polytelis alexandrae	Princess parrot	VU		P4	NT	
ROSTRATULIDAE						
Rostratula australis	Australian painted snipe	EN	EN		EN	
SCOLOPACIDAE						
Actitis hypoleucos	Common sandpiper	MI	MI			
Calidris acuminata	Sharp-tailed sandpiper	MI / VU	MI		VU	
Calidris ferruginea	Curlew sandpiper	MI / CR	MI / CR		NT	
Calidris melanotos	Pectoral sandpiper	MI	MI			
Calidris ruficollis	Red-necked stint	MI	MI		NT	
Calidris subminuta	Long-toed stint	MI	MI			
Limosa limosa	Black-tailed godwit	MI / EN	MI		NT	
Philomachus pugnax	Ruff	MI	MI			
Tringa glareola	Wood sandpiper	MI	MI			
Tringa nebularia	Common greenshank	MI / EN	MI			
Tringa stagnatilis	Marsh sandpiper	MI	MI			
Tringa totanus	Common redshank	MI	MI			
THRESKIORNITHIDAE						
Plegadis falcinellus	Glossy ibis	MI	MI			
REPTILES						
PYTHONIDAE						
Liasis olivaceus subsp. *barroni*	Pilbara olive python	VU	VU			•
SCINCIDAE						

Species		Conservation Status				Recorded within Study Area
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	
Ctenotus uber subsp. *johnstonei*	Spotted ctenotus (northeast)			P2		
Liopholis kintorei	Great desert skink	VU	VU		VU	
TYPHLOPIDAE						
Anilios ganei	Gane's blind-snake			P1		

720000
760000
800000
840000
7440000
7400000

Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

DBCA (2024)
Mammal
- Northern quoll - EN
- Ghost bat - VU
- Greater bilby - VU
- Pilbara leaf-nosed bat - VU

Reptile
- Pilbara olive python - VU

BHP (2023)
Bird
- Grey Falcon - VU
- Southern whiteface - VU

Mammal
- Northern quoll - EN
- Ghost bat - VU
- Pilbara leaf-nosed bat - VU

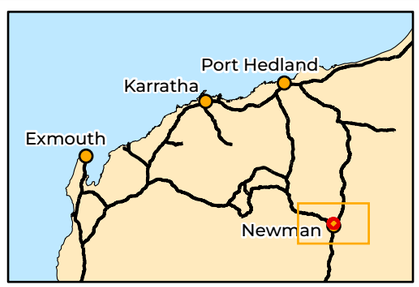
Reptile
- Pilbara olive python - VU

LEGEND
- Study Area
- Desktop Assessment Area
- State Road
- Rail

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 12/08/2024



BHP WAIO
NEBO Targeted Vertebrate Fauna Survey

Figure 3.2: Targeted MNES fauna records from the desktop assessment

680000 720000 760000 800000

7440000 7400000

DBCA (2024)

Bird

- Curlew sandpiper - CR
- Princess parrot - P4
- Caspian tern - MI
- Common greenshank - MI
- Common redshank - MI
- Common sandpiper - MI
- Fork-tailed swift - MI
- Glossy ibis - MI
- Gull-billed tern - MI
- Long-toed stint - MI
- Marsh sandpiper - MI
- Oriental plover - MI
- Pectoral sandpiper - MI
- Red-necked stint - MI
- Sharp-tailed sandpiper - MI
- Wood sandpiper - MI
- Peregrine falcon - OS

Mammal

- Black-flanked rock-wallaby - EN
- Brush-tailed mulgara - P4
- Long-tailed dunnart - P4
- Spectacled hare-wallaby (mainland) - P4
- Western pebble-mound mouse - P4

Reptile

- Gane's blind snake - P1

BHP (2023)

Bird

- Curlew sandpiper - CR
- Barn swallow - MI
- Black-tailed godwit - MI
- Common greenshank - MI
- Common sandpiper - MI
- Fork-tailed swift - MI
- Garganey - MI
- Glossy ibis - MI
- Little ringed plover - MI
- Long-toed stint - MI
- Marsh Sandpiper - MI
- Pectoral sandpiper - MI
- Ruff - MI
- Sharp-tailed sandpiper - MI
- Wood sandpiper - MI
- Peregrine falcon - OS

Mammal

- Brush-tailed mulgara - P4
- Western pebble-mound mouse - P4

Reptile

- Gane's blind snake - P1
- Spotted ctenotus - P2

Great Northern Hwy

Port Hedland Newman Railway

Marble Bar Rd

Newman

LEGEND

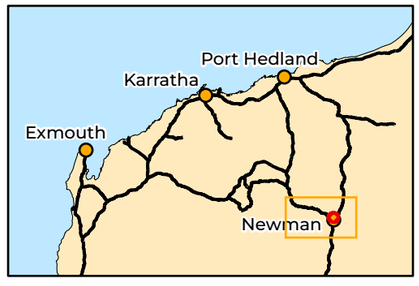
- Study Area
- Desktop Assessment Area
- State Road
- Rail

Biologic

Scale 1:420,000

0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 12/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 3.3: Other significant fauna records from the desktop assessment

4 Survey Methods

4.1 Survey Timing and Weather

A single-season targeted field survey was undertaken concurrently with the Power 2030 targeted field survey (Biologic, *in prep.-b*) from 15–24 April 2024. This meant there was some overlap with sampling sites due to the overlap in Study Areas. Observed weather conditions prior to and during the survey are shown in Table 4.1 and 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 9 km south-west of the Study Area (BoM, 2024). In the six months prior to the field survey (April 2024), minimum and maximum temperatures recorded at Newman Aero were higher than long-term averages for most months, except for March 2024 (Figure 4.1). Temperatures during the survey were slightly lower than the long-term minimum and maximum averages, recording 0.5°C below and 0.8°C below respectively.

Overall, rainfall was higher than long-term average for the six months prior to the survey with a total of 297.4 mm compared to the long-term average (LTA) of 235.1 mm. This was largely due to substantially higher than average rainfall in the months of January (188.6mm compared with LTA 70.2 mm) and March (102 mm compared with LTA 43.5 mm) 2024 (Figure 4.1). All other months in this period received lower than average rainfall. April recorded 0.4 mm total rainfall, although no rain was recorded during the survey (Table 4.1). This is well below the long-term average of 21.6 mm for April.

Table 4.1: Climatic conditions recorded at Newman Aero (BoM, 2024) during the field survey

Date	Min. temp (°C)	Max. temp (°C)	Rainfall (mm)
15/04/2024	18.8	34.9	0
16/04/2024	18.4	34.2	0
17/04/2024	22.2	33.2	0
18/04/2024	20	30.3	0
19/04/2024	17	29.1	0
20/04/2024	14.7	27.4	0
21/04/2024	9.8	29.3	0
22/04/2024	11.2	29.4	0
23/04/2024	11	30.2	0
24/04/2024	17.1	28.3	0

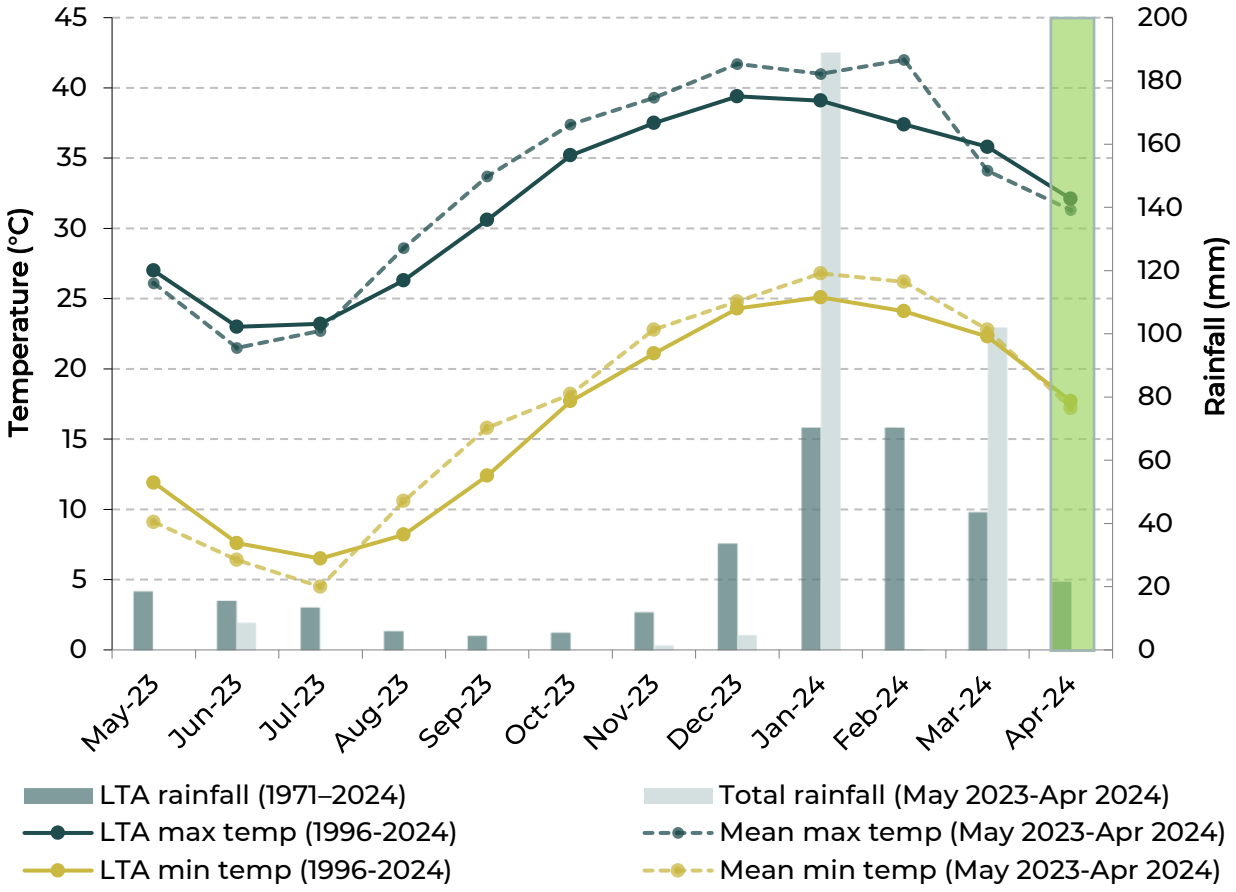


Figure 4.1: Current and long-term climatic data for Newman Airport (BoM, 2024) with approximate survey timing shown in green shaded box

4.2 Personnel and Licences

The field survey was completed by zoologists with extensive experience undertaking vertebrate fauna surveys in the Pilbara region (Table 4.2). The survey was conducted under the following licences and permits; Department of Primary Industries and Regional Development (DPIRD) *Animal Welfare Act 2002's* Licence to use animals for scientific purposes (Licence No. U244/2022-2024); DBCA Regulation 27 "Fauna Taking (Biological Assessment) Licence", issued to Chris Knuckey (licence number BA27000980); DBCA "Authorisation to Take or Disturbed Threatened Species" issued to Chris Knuckey (authorisation number TFA 2324-0159); and Murdoch University Animal Ethics Committee permit RW3354/21.

Table 4.2: Survey personnel and experience

Name	Qualification	Experience
Aidan Williams (Senior Zoologist)	BSc Conservation Biology and Botany	7 years Zoology 9 years Field Survey 9 years EIA (consulting)
Jari Cornelis (Senior Zoologist)	MSc Philosophy BSc Zoology and Ecology	7 years Zoology 7 years Field Survey 6 years EIA (consulting)
Anders Zimny (Senior Zoologist)	BSc Biological Science	14 years Zoology 14 years Field Survey 6 years EIA (consulting)
Sammy Alatas (Zoologist)	BSc Conservation and Wildlife Biology (in progress)	1 year Zoology 3 years Field Survey 2 years EIA (consulting)

4.3 Habitat Assessments and Mapping

A total of 36 habitat assessments were undertaken in representative habitats across the Study Area (Figure 4.2). The aim of these were 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 or variation in habitats occurred. The assessments were conducted using methodology and terminology prescribed by BHP WAIO (2023b). The characteristics recorded during the habitat assessments included:

- site information: location and photo;
- habitat: broad habitat type, landform, aspect, slope, soil type and availability, rocky outcropping presence and type;
- ground cover: rock size, vegetation litter and woody debris;
- vegetation: broad vegetation type, structure and dominant species;
- microhabitat: rocky cracks/ crevices, burrowing suitability, hollow presence and abundance, water presence; and
- condition: time since fire, disturbance, and overall habitat condition.

Fauna habitats were mapped at a scale of approximately 1:10,000 using data collected from the habitat assessments, previously completed fauna habitat and vegetation mapping within and adjacent to the Study Area, disturbance and rehabilitation mapping (provided by BHP WAIO), and high-resolution aerial imagery, vegetation, topographical, geology and soil mapping as relevant.

4.3.1 Cave Assessments

Cave searching survey effort focussed on areas of habitat (i.e. Gorge/ Gully) most suitable for cave formation. Information recorded during each cave assessment was consistent with those attributes required by BHP WAIO (2023a) and BHP WAIO (2023b), and included:

- entrance location and photograph;
- entrance shape, dimensions, position in the landscape, aspect and level of sun exposure;
- internal structure and dimensions including depth, floor slope, number and size of chambers;
- presence of water either within the cave or near its entrance; and
- presence or signs of bat use (such as remains, scats or feeding signs).

Each cave was categorised based on data from the cave assessments, including the presence of any target bat species via primary or secondary evidence (i.e. calls, scats and individual remains). Cave utilisation/ roost type classifications followed those described by Bat Call (2021b); TSSC (2016c) for Pilbara leaf-nosed bats, and Bat Call (2021a) for ghost bats.

4.3.2 Water Feature Assessment

Water feature assessments were conducted for any water features that were found within the Study Area. The assessments were aimed to define and characterise the water features and identify their likelihood of supporting significant fauna species (i.e. critical habitat for Pilbara olive python or water sources for Pilbara leaf-nosed bat). Water feature assessments were conducted and attributes assessed using attribute terminology prescribed by BHP WAIO (2023b). The characteristics recorded during the habitat assessments were:

- site information, photo and location;
- dimensions: length, width, depth;
- water presence: above the surface, in the intermediate zone; and
- vegetation: obligate phreatophytes, emergent macrophytes.

Naturally occurring water features were assessed, and their persistence classified into three categories, comprising:

- permanent/ persistent – fed by ground water and/or surface drainage, persisting year-round;
- semi-persistent – fed by rainfall/ surface drainage following rainfall, persisting for long periods (i.e. several months, 3-9 months) after rainfall; and
- ephemeral – fed by rainfall/ surface drainage following rainfall, persisting for short periods (i.e. weeks or less than three months) after rainfall.

The assessment of persistence was made at time of survey and is not based on long-term data, as such there is uncertainty in the categorisation of some water features as ephemeral or temporary ephemeral. Artificial water features were also recorded when present.

4.4 Targeted Searching and Sampling

Targeted searches were undertaken within areas considered to provide suitable habitat for significant fauna species. Sampling methods undertaken during the survey were specific to each targeted species and comprised (Figure 4.2):

- targeted searches and/or transects (including cave searches) for northern quoll, Pilbara leaf-nosed bat, ghost bat and Pilbara olive python;
- camera trap transects for northern quoll;
- plot searches for greater bilby;
- ultrasonic recorders targeting Pilbara leaf-nosed bat and ghost bat;
- acoustic recorders targeting night parrot and other significant birds.

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

4.5 Opportunistic Fauna Records

Opportunistic fauna observations from direct observation or secondary evidence (e.g. burrows, scratching's, diggings, and scats) were documented for all significant fauna species, rare species or other fauna of interest.

4.6 Likelihood of Significant Species Occurrence

Significant fauna species identified by the desktop assessment were assessed post-survey for their likelihood of occurring within the Study Area using a decision matrix which considers the presence and suitability of habitat within the Study Area, and the proximity of previous records (Table 4.3). Based on this decision matrix, each species was assigned to one of six categories of likelihood: Confirmed, Highly Likely, Likely, Possible, Unlikely, or Highly Unlikely.

The decision matrix is intended to be an indicative guide only, and the way in which it is interpreted may vary between species, depending on a given species' habitat preferences and ability to disperse, as well as the reliability and availability of contextual information. For example, considering species which have been previously recorded close to the Study Area, a species with a limited dispersal capability will have a reduced likelihood of occurring in the Study Area compared with a species with greater dispersal capability. It is also recognised that a lack of records in the vicinity of a Study Area may indicate limited sampling effort rather than species' absence, and that previous records may include historic or presumed erroneous information which may misrepresent a species' current distribution. Where the determination of a species' likelihood of occurrence within the Study Area deviates from the decision matrix, detailed justification for any variation will be presented.

Table 4.3: Species likelihood of occurrence decision matrix

		Habitat Suitability of Study Area			
		Breeding habitat present	**Foraging and dispersal habitat present**	**Marginally suitable habitat present**	**No suitable habitat present**
Species Records[1]	**Recorded in Study Area**	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within 10 km of Study Area	Highly Likely	Likely	Possible	Possible
	Recorded within 10-50 km of Study Area	Likely	Possible	Possible	Unlikely
	Recorded within 50–100 km of Study Area	Possible	Possible	Unlikely	Unlikely
	Recorded >100 km of Study Area	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

[1] Only records within the previous 50 years are considered.

4.7 Assessment of Significance

4.7.1 Fauna Habitats

For each MNES species, habitat was categorised as either providing critical (foraging, breeding, or roosting) habitat or supporting (foraging, roosting or dispersal) habitat, as per the DoE (2013b) definitions. For non-MNES species, these habitats were classified as important (foraging, breeding, or roosting) habitat for the species or supporting foraging, breeding, roosting or dispersal, for habitat types where the species may occur, but it is not necessary for such activities. The categorisation of critical and supporting habitat followed that of BHP WAIO (2023b). The presence or absence of habitat features, suitable connecting habitat (e.g. movement corridors), the influence of other habitats (i.e. caves, water features) occurring within and adjacent to the Study Area, and species records were also considered.

4.7.2 Significances of Species Occurrence

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.

For northern quoll the significance of occurrence was based on definitions of the DoE (2016), specifically whether the individuals present in the Study Area formed part of or contributed to "populations important for the long-term survival of the northern quoll". These are populations that are (DoE, 2016):

- high density quoll populations, which occur in refuge-rich habitat critical to the survival of the species, including where cane toads are present;
- occurring in habitat that is free of cane toads and unlikely to support cane toads upon arrival i.e. granite habitats in WA, populations surrounded by desert and without permanent water; and/or
- subject to ongoing conservation or research actions i.e. populations being monitored by government agencies or universities or subject to reintroductions or translocation.

For the Pilbara leaf-nosed bat and ghost bat, the entire Pilbara is suggested to represent an 'important population' (Bat Call, 2021a, 2021b; TSSC, 2016c). Thus, the significance of occurrence was based on the presence of critical roosting habitat.

For the night parrot, the significance of occurrence was based on definitions by the DoE (2013a), specifically the presence of a 'population'. A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area, including, but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

For the greater bilby, southern whiteface, grey falcon, princess parrot, Pilbara olive python and great desert skink (species listed as Vulnerable under the EPBC Act, but with no specific criteria to assess significance of occurrence), the significance of occurrence was based on criteria defined by DoE (2013a), specifically whether their occurrence in the Study Area represented an 'important population'. An 'important population' is a population that is necessary for a species' long-term survival and recovery; this may include populations identified as such in recovery plans, and/or that are (DoE, 2013a):

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species range.

4.8 Constraints and Limitations

The EPA (2020b) outlines several potential limitations to vertebrate fauna surveys. These aspects are assessed and discussed in Table 4.4 below. No major limitations or constraints were identified during the survey.

Table 4.4: 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 surrounding region (e.g. Eastern Ridge hub and Jimblebar hub) which provided contextual data for the current survey. At least 28 surveys have been undertaken within the vicinity or intersecting the Study Area.
Competency/ experience of the survey team	No	The field personnel involved in the survey and analyses are experienced in undertaking fauna surveys in the Pilbara, including with the significant species targeted during the survey.
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope was a targeted fauna survey and was conducted within that framework (EPA, 2020b). Sampling for target species was undertaken in accordance with relevant guidelines and recommendations (see Section 1.3).
Timing, weather, and season	No	The field survey occurred over appropriate or optimal periods for sampling the target species.
Disturbances (e.g. fire or flood)	No	No disturbances were observed during the survey periods that may have impacted the outcomes of the survey.
Proportion of fauna identified	No	Most fauna observed during the field survey was identified to species level. Fauna recorded via camera traps and ultrasonic and acoustic recorders were identified by technical personnel with relevant expertise.
Adequacy of the survey intensity and proportion of the survey achieved	No	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.
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.

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7420000 7417500 7415000

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VPWR-129
VNEB-011
VPWR-088
VPWR-086
VPWR-090
VPWR-028
VPWR-092
Ore Body 24
VPWR-056
VPWR-128
VPWR-018
VPWR-038
VPWR-020
VNEB-012
VNEB-017
VNEB-004
VNEB-014
VNEB-016
VNEB-008
VNEB-006
VPWR-066
VNEB-013
VPWR-021
VPWR-052
VNEB-001
VNEB-005
VNEB-015
VPWR-064
VPWR-119
VPWR-117
VNEB-009
VNEB-003
Port Hedland Newman Railway
VNEB-018
VNEB-002
VNEB-007
VNEB-010
Great Northern Hwy
Marble Bar Rd

LEGEND

- Study Area
- State Road
- Rail

Sampling Type

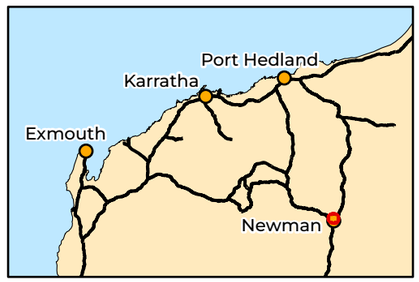
- Acoustic Recorder
- Camera Trap
- Habitat Assessment
- Nocturnal Search
- Targeted Search
- Ultrasonic Recorder
- Targeted Search
- Bilby Plot
- Bilby Plot

Biologic

Scale 1:25,000

0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 22/10/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 4.2: Fauna sample sites and traverses

5 Fauna Habitats

5.1 Fauna Habitats of the Study Area

A total of ten broad fauna habitat types were recorded and mapped across the Study Area, comprising, in decreasing extent (Table 5.1; Figure 5.1):

- Hillcrest/ Hillslope (566.56 ha, 21.77%);
- Drainage Area/ Floodplain (400.69 ha, 15.39%);
- Major Drainage Line (140.13 ha, 5.83%);
- Sand Plain (80.62 ha, 3.10%);
- Stony Plain (74.83 ha, 2.87%);
- Undulating Low Hills (61.60 ha, 2.37%);
- Minor Drainage Line (55.26 ha, 2.12%);
- Mulga Woodland (19.11 ha, 0.73%);
- Gorge/ Gully (6.45 ha, 0.25%); and
- Breakaway/ Cliff (0.29 ha, 0.01%).

The remaining areas within the Study Area comprised Cleared/ Disturbed areas (1,197.48 ha, 46.00%). The condition of habitats within the Study Area ranged from 'very good' to 'poor'. The greatest disturbance was caused by tracks and cleared areas, as a result of exploration activity throughout parts of the Study Area, most often within Hillcrest/ Hillslope habitat. Descriptions of the distinguishing characteristics and the occurrence within the Study Area for each of habitat type is presented in Table 5.1. Data from on-site habitat assessments is presented in Appendix C.

A total of five habitats (Breakaway/ Cliff, Gorge/ Gully, Major Drainage Line, Drainage Area/ Floodplain and Sand Plain) within the Study Area provide critical habitat for various significant species (Table 5.1). Breakaway/ Cliff, Gorge/ Gully and Major Drainage Line provide potential critical breeding (Pilbara olive python), denning (northern quoll), foraging and dispersal habitat (Pilbara olive python and northern quoll), particularly in areas with caves and overhangs (i.e. Gorge/ Gully and Breakaway/ Cliff) and where pooling water remains for prolonged periods following rainfall events (i.e. Major Drainage Line) (Table 5.1). Major Drainage Line and Drainage Area/ Floodplain provides critical breeding/ nesting habitat for grey falcon and southern whiteface, respectively (Table 5.1). Sand Plain habitat provides critical breeding, foraging and dispersal habitat for the greater bilby.

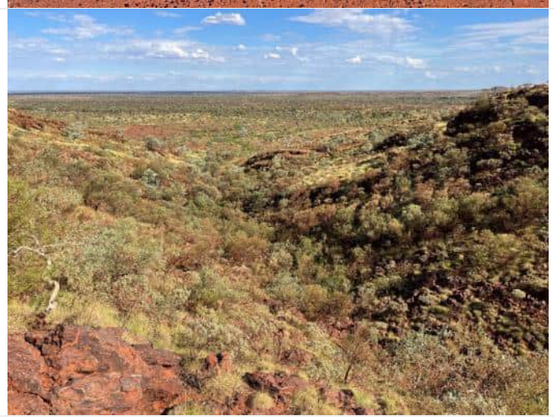
The remaining habitats, Hillcrest/ Hillslope, Stony Plain, Undulating Low Hills, Minor Drainage Line and Mulga Woodland, provide various levels of supporting habitat for certain significant

species. More detailed discussion on the habitats and their usage by the target significant species are discussed in Section 6.

Although critical and/or supporting habitat for numerous significant species was identified within the Study Area, the occurrence of suitable habitat does not necessarily indicate species presence. Many of the fauna habitats mapped that provide supporting habitat are broadly distributed and well represented across the Pilbara bioregion and surrounding regions, and therefore support fauna assemblages which are generally common and widespread.

Table 5.1: Broad fauna habitats within the Study Area

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES and other significant species	Photo
Hillcrest/ Hillslope 566.56 ha 21.77%	The Hillcrest/ Hillslope habitat comprised a rocky substrate, often with exposed bedrock, on moderate to steep slopes as well as flat-top crests leading into lower footslopes. 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 *Eucalyptus* woodlands, *Acacia* and *Grevillea* scrublands and *Triodia* low hummock grasslands.	Hillcrest/ Hillslope habitat occurs in a wide horizontal band through the centre and northern parts of the Study Area. Much of the habitat has been or is currently disturbed with large portions of what would have also been Hillcrest/ Hillslope habitat, now being categorised as Cleared/ Disturbed. Within the Study Area and greater Pilbara region, Hillcrest/ Hillslope habitat is common and widespread. The vegetation and substrate which make up this habitat type are characteristic features of the region.	**Supporting habitat for:** • **northern quoll** – foraging and dispersal habitat where proximal to breeding habitat • **ghost bat –** roosting habitat only, Category 4 cave CER-11 occurs within this habitat in the Study Area. • **Pilbara leaf-nosed bat** — foraging and dispersal • **Pilbara olive python** — foraging and dispersal **Important habitat for:** • **western pebble-mound mouse** - breeding, foraging and dispersal	
Drainage Area/ Floodplain 400.69 ha 15.39%	Lower lying plain often subjected to sheet flow following large rainfall events. Vegetation and substrates of this habitat was variable, often comprising scattered *Eucalyptus* over *Acacia* and/or *Grevillea* shrubs with an understory dominated by *Triodia* hummock grasses and/or mixed tussock grasses on alluvial substrates, often with heavy clays and gravel. Tussock grasses can be dominant within Drainage Area/ Floodplain habitat as a result of high rainfall events.	Drainage Area/ Floodplain habitat extends along the southern boundary of the Study Area, flanking the Major Drainage Line habitat. A small additional projection of the habitat occurs in the northwestern corner where the Major Drainage Line also curves to the northwest. This fauna habitat is common throughout the Pilbara bioregion. Across the region its structure and condition are variable because of rainfall events and disturbance (i.e. fire and cattle grazing).	**Critical habitat for:** • **southern whiteface –** nesting/ breeding, foraging and dispersal **Supporting habitat for:** • **greater bilby –** foraging and dispersal • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat –** foraging and dispersal • **grey falcon –** foraging and dispersal habitat where proximal to breeding habitat **Important habitat for:** • **brush-tailed mulgara –** breeding, foraging, and dispersal	
Major Drainage Line 140.13 ha 5.83%	Comprises scattered *Eucalyptus* and *Acacia,* 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, Major Drainage Line habitat occurs in a linear band that extends from the northwest of the Study Area in a southeasterly direction following the southern boundary and curving toward the east, associated with Homestead Creek. 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:** • **northern quoll –** denning, foraging and dispersal • **Pilbara olive python –** breeding, foraging, dispersal • **grey falcon –** breeding, foraging and dispersal **Supporting habitat for:** • **greater bilby -** foraging and dispersal • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat –** foraging and dispersal • **southern whiteface –** nesting/ breeding, foraging and dispersal	

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES and other significant species	Photo
Sand Plain 80.62 ha 3.10%	Low-lying or elevated sandy areas with accumulated loose sandy substrates. Often supporting an open vegetation cover, dominated by *Acacia* shrubs and/ or eucalypt trees over *Triodia* hummock grasses of various life stages.	Sand Plain habitat occurs alongside Drainage Area/ Floodplain habitat in the southwestern portion of the Study Area. The extent of this band of habitat stops approximately in the centre of the Study Area where it is replaced by Cleared/ Disturbed habitat due to mining-related activity extending to the east. The habitat has a reasonable amount of linear disturbance from roads and tracks throughout. Sand Plain is common and widespread habitat throughout the Pilbara region.	**Critical habitat for:** • **greater bilby –** breeding, foraging and dispersal **Supporting habitat for:** • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat –** foraging and dispersal • **southern whiteface –** nesting/ breeding, foraging and dispersal **Important habitat for:** • **brush-tailed mulgara –** breeding, foraging and dispersal	
Stony Plain 74.83 ha 2.87%	Comprises 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 *Triodia* and scattered Mulga, eucalypt and *Acacia* trees, with patches of various small to medium shrub species.	Stony Plain habitat occurs in a few small areas throughout the Study Area, often occurring as the intervening area between Minor Drainage Line and Hillcrest/ Hillslope habitats. 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.	**Supporting habitat for:** • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat –** foraging and dispersal • **southern whiteface –** foraging and dispersal **Important habitat for:** • **western pebble-mound mouse** - breeding, foraging and dispersal • **brush-tailed mulgara -** foraging and dispersal	
Undulating Low Hills 61.60 ha 2.37%	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 *Triodia* hummock grasslands with scattered *Eucalyptus* trees and *Acacia*, *Eremophila* and/or *Grevillea* shrubs.	Undulating Low Hills habitat occurs in two locations within the Study Area in the central northern portion, separated by a range. Both occurrences of the habitat are highly fragmented via disturbance and clearing. 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:** • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat –** foraging and dispersal **Important habitat for:** • **western pebble-mound mouse** - breeding, foraging and dispersal	

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES and other significant species	Photo
Minor Drainage Line 55.26 ha 2.12%	Usually lacks a tall dense upper storey, but with a dense mid storey, including sparse *Eucalyptus* and *Acacia* species over tussock grasses and *Triodia* hummock grasses.	Within the Study Area Minor Drainage Line habitat occurs throughout the Study Area, surrounding areas of higher elevation, particularly the Hillcrest/ Hillslope habitat. It 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.	**Supporting habitat for:** • **northern quoll** – foraging and dispersal habitat where proximal to breeding habitat • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat –** foraging and dispersal • **grey falcon** – foraging and dispersal habitat where proximal to breeding habitat • **southern whiteface –** nesting/ breeding, foraging and dispersal • **Pilbara olive python** – foraging and dispersal habitat where proximal to breeding habitat	
Mulga Woodland 19.11 ha 0.73%	Comprises stands of mulga (*Acacia aneura*) over clay or stony substrates. Differs from other plains by having a monoculture of mulga compared to a diversity of other *Acacia* species.	Within the Study Area, Mulga Woodland habitat primarily occurs within low lying areas adjacent to Drainage Area/ Flood Plain, with little or no connectivity between small areas of habitat. This habitat is relatively common throughout the Pilbara region, usually occurring in areas of drainage or sheet flow.	**Supporting habitat for:** • **greater bilby -** foraging and dispersal • **ghost bat –** foraging and dispersal where proximal to roosting habitat • **Pilbara leaf-nosed bat -** foraging and dispersal • **southern whiteface -** foraging and dispersal	
Gorge/ Gully 6.45 ha 0.25%	Characterised by rugged, steep-sided valleys incised into the surrounding landscape. Gorges are deeply incised with vertical cliff faces, while gullies are more open (but not as open or shallow 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.	Gorge/ Gully habitat occurs centrally within the Study Area within Hillcrest/ Hillslope habitat. Only five occurrences of this specific habitat are located within the Study Area and are therefore considered limited within the Study Area itself as well as surrounding region. 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:** • **northern quoll –** breeding, denning, foraging and dispersal • **Pilbara olive python –** breeding, foraging and dispersal **Supporting habitat for:** • **ghost bat –** dispersal; may contain critical roosting habitat (Category 1 and 2 caves, and Category 3 caves when found in an apartment block) but the broad habitat itself is not considered critical habitat • **Pilbara leaf-nosed bat –** foraging and dispersal; may contain critical roosting habitat (Category 1-3 caves) but the broad habitat itself is not considered critical	

Habitat	Distinguishing habitat characteristics	Extent of habitat	Habitat for target MNES and other significant species	Photo
Breakaway/ Cliff 0.29 ha 0.01%	Comprises single sided rock faces within steep mid-upper slopes with bare rock outcrops or cliffs (not the entire slope).	Breakaway/ Cliff habitat occurs in three very small, isolated patches within Hillcrest/ Hillslope habitat in the center of the Study Area. 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:** • **northern quoll –** breeding, denning, foraging and dispersal • **Pilbara olive python –** breeding, foraging and dispersal **Supporting habitat for:** • **ghost bat –** dispersal; may contain critical roosting habitat (Category 1 and 2 caves, and Category 3 caves when found in an apartment block) but the broad habitat itself is not considered critical habitat • **Pilbara leaf-nosed bat –** foraging and dispersal; may contain critical roosting habitat (Category 1-3 caves) but the broad habitat itself is not considered critical	
Cleared/ Disturbed 1,197.48 ha 46.00%	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.	A large proportion of the Study Area is mapped as Cleared/ Disturbed including more than 50% of the western half of the total Study Area. Within the Study Area, there are large Cleared/ Disturbed areas associated with large scale mining activities including drill pad arrays and pit mining activities associated with the Eastern Ridge hub. A number of linear corridors, including road, rail and access tracks dissect the many other fauna habitats occurring throughout the Study Area.	**N/A**	No photo

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Ore Body 24
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

Study Area
State Road
Rail

Fauna Habitat

Breakaway/ Cliff
Cleared/ Disturbed
Drainage Area/ Floodplain
Gorge/ Gully
Hillcrest/ Hillslope
Major Drainage Line
Minor Drainage Line
Mulga Woodland
Sand Plain
Stony Plain
Undulating Low Hills

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator
Created: 25/10/2024

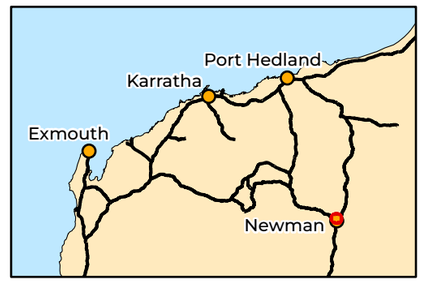

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Figure 5.1: Fauna habitats in the Study Area

5.2 Habitat Features of the Study Area

5.2.1 Caves

Four caves were recorded and assessed within the Study Area during the current survey, with a further two additional caves recorded and assessed during a concurrent targeted fauna survey which overlaps a portion of the Study Area (Biologic, *in prep.-b*). One cave (CER-08) was recorded within Breakaway/ Cliff habitat, two within Hillcrest/ Hillslope habitat (CER-11 and CER-06), and the remaining three (CER-07, CER-09 and CER-10) were recorded within Gorge/ Gully habitat within the Study Area (Figure 5.2; Appendix D).

Of the six caves occurring within the Study Area, one was classified as a Category 3 ghost bat roost (diurnal roost caves with occasional occupancy; CER-06). While no ghost bats were observed or calls recorded at the time of the survey, the present of recent scats (~1,000), and the dimensions (two chambers, depth approx. 18 m) and microclimate were indicative of being suitable for diurnal roosting of ghost bats. The classification of CER-06 could not be confirmed to be a Category 2 roost (diurnal roost caves with regular occupancy) due to a lack of evidence of usage from one visit; however, further evidence of regular usage and breeding from ghost bats is required to confirm it to be a Category 2 roost. The remaining five caves CER-11, CER-07, CER-08, CER-09 and CER-10 were classified as Category 4 ghost bat roosts (nocturnal roost caves with opportunistic usage) (Figure 5.2; Appendix D). All six caves were classified as Category 4 Pilbara leaf-nosed bat roosts (nocturnal refuge).

Cave searching survey effort was focussed on the areas of Breakaway/ Cliff and 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.

5.2.2 Water Features

A total of ten water features were recorded in the Study Area, including seven during the current survey, as well as three recorded during the concurrent survey (Biologic, *in prep.-b*) (Figure 5.2; Appendix E). One water feature located in the Study Area is artificial and classified as likely permanent/ persistent at the time of the survey (WER-06, turkey nest). This turkey nest is located in the south-western portion of the Study Area between Stony Plain and Drainage Area/ Floodplain habitats (Appendix E; Figure 5.2). Of the naturally occurring water features, four were classified as semi-persistent (likely to persist for 3-9 months of the year, most years), and the remaining five features were classified ephemeral (likely to persist for three months) (Appendix E). All natural water features occurring in the Study Area were recorded in Major Drainage Line habitat (n = 9), and likely a result of the high rainfall received the month prior to the survey (Figure 4.1) (Appendix E; Figure 5.2). It is possible that following large rainfall events that additional semi-persistent and ephemeral water features occur

within the Study Area, particularly within Gorge/ Gully, Major Drainage Line, and Minor Drainage Line habitats.

All water features known from within the Study Area are considered to provide supporting foraging habitat for the northern quoll, Pilbara leaf-nosed bat and Pilbara olive python. For northern quolls, they often represent areas of high productivity, and therefore may contain a relatively high abundance of feeding resources (Braithwaite & Griffiths, 1994; Oakwood, 2000), particularly when occurring within rocky habitats, and to a lesser degree, drainage lines. For Pilbara leaf-nosed bats they can provide significant drinking and foraging sources, and are a key component to 'Gorges with Pools' being recognised as the priority foraging habitat for the species (TSSC, 2016c). For Pilbara olive pythons, these features can often act as primary foraging locations and for that reason the species is more often than not associated with such features, particularly within rocky habitats, but also, to a lesser extent within drainage line habitats (Pearson, 1993). This occurrence is likely to be seasonal and irregular, dependent on the permanency of the water feature. Permanent water features are considered critical habitat for Pilbara olive python; however, as the permanent water feature in the Study Area is artificial (WER-06, turkey nest) and the prolonged existence is limited by mining activity, it's significance in the landscape will be periodical.

780000
782500
785000
787500
7420000
7417500
7415000

CER-11
CER-06
CER-10
CER-09
CER-07
CER-08
WHST-01
Ore Body 24
WHST-03
WHST-02
WER-06 (Turkey Nest)
WER-07
Port Hedland Newman Railway
WER-08
WER-09
WER-12
WER-10
WER-11
Great Northern Hwy
Marble Bar Rd

LEGEND

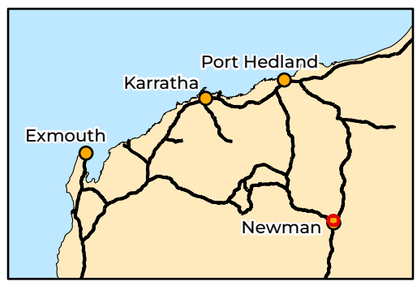
- Study Area
- State Road
- Rail
- Cave
- Water Feature

Biologic

Scale 1:25,000

0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 5.2: Fauna habitat features recorded in the Study Area

6 Target Species

Forty-three potentially occurring significant fauna species were identified during the desktop assessment, three of which have previously been recorded within the Study Area: ghost bat, western pebble-mound mouse, and Pilbara olive python (Table 6.1). During the current survey, all three previously recorded species were recorded (Table 6.1). A further two species are considered Likely to occur (brush-tailed mulgara and Pilbara leaf-nosed bat), 10 as Possible (long-tailed dunnart, northern quoll, northern short-tailed mouse, greater bilby, grey falcon, peregrine falcon, southern whiteface, fork-tailed swift, spotted ctenotus (northeast) and Gane's blind snake), and the remaining 28 species are considered Unlikely or Highly Unlikely to occur primarily due to the absence of any habitats found in the Study Area likely to be used by the species (Table 6.1).

Table 6.1: Significant species likelihood of occurrence assessment

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
MAMMALS																				
DASYURIDAE																				
long-tailed dunnart (*Antechinomys longicaudatus*)			P4	Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Burbidge *et al.*, 2008). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge *et al.*, 2008).	Yes	9.9 km WSW (1997) (DBCA, 2024c)	•									•		Possible	Resident	May occur as a resident in Breakaway/ Cliff and Hillcrest/ Hillslope habitats within the Study Area.
brush-tailed mulgara (*Dasycercus blythi*)			P4	Prefers spinifex *Triodia* spp. grasslands on sand plains and the swales between low dunes (Pavey *et al.*, 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner *et al.*, 2007).	Yes	3.1 km NE (2013) (BHP, 2023)				•	•				•			Likely	Resident	May occur as a resident in Sand Plain, Stony Plain and Drainage Area/ Floodplain habitats, particularly where suitable substrates permitting burrow excavation occur.
northern quoll (*Dasyurus hallucatus*)	EN	EN		The species tends to inhabit rocky habitats which 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).	Yes	5.1 km SW (2007) (BHP, 2023)	C	C	C				S			S		Possible	Resident (infrequent visitor, likely dispersing or foraging individuals)	Critical denning/ shelter habitat within Study Area includes Gorge/ Gully, Breakaway/ Cliff and Major Drainage Line habitats. May occur in Hillcrest/ Hillslope habitat of the Study Area to forage and/or for dispersal, particularly when occurring near suitable denning/shelter habitat. Major Drainage Line and Minor Drainage Line habitats may provide dispersal corridors. The extent of these habitats within the Study Area is limited; however, they form part of larger continuations of the habitat beyond the extent of the Study Area, therefore, may potentially act as foraging and/or dispersal corridors where connectivity to other areas of critical habitat is provided.
MACROPODIDAE																				

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
spectacled hare-wallaby (*Lagorchestes conspicillatus leichardti*)			P4	Inhabits spinifex hummock grasslands and *Acacia* shrublands (van Dyck & Strahan, 2008; Woinarski *et al.*, 2014).	Yes	41.7 km ESE (undated) (DBCA, 2024c)												Highly Unlikely	N/A	Has declined drastically in the Pilbara and Great Sandy Desert and is now a rare species. Marginally suitable habitat occurs within the Study Area, however there are a lack of contemporary records nearby with the closest record 'undated' so there is uncertainty as to when the record was made, however likely it is very old as it was a vouchered specimen.
black-flanked rock-wallaby (*Petrogale lateralis subsp. lateralis*)	EN	EN		Rocky habitats, including gorges and gullies or outcrops with sufficient shelter habitat. Often vegetated with *Acacia* thickets and open low eucalypt woodlands with an understory of grasses and low shrubs (Willers *et al.*, 2011).	No	10.1 km NNE (1975) (DBCA, 2024c)												Highly Unlikely	N/A	There is a lack of contemporary records nearby with the closest records being 49 years old. The Study Area is not within the species' current distribution, which questions the accuracy of the historic previous records.
MEGADERMATIDAE																				
ghost bat (*Macroderma gigas*)	VU	VU		Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned Mines (Armstrong & Anstee, 2000). These features often occur within habitats including gorge/gully, hill crest/ hill slope and low hills (Armstrong & Anstee, 2000). Forages broadly across habitats, particularly woodland and open woodland habitats, including eucalypt and Mulga woodlands (Biologic, 2020a; Richards *et al.*, 2008; Tidemann *et al.*, 1985; TSSC, 2016b)	Yes	Recorded within the Study Area (2006) (BHP, 2023; DBCA, 2024c)	S	S	S	S	S	S	S	S	S	S		Confirmed	Resident	Ghost bat was recorded from ~1,000 recent scats within cave CER-06 during current survey. Previously recorded on seven occasions within the Study Area from two locations. No critical (roosting or foraging) habitat is present within the Study Area. However, supporting roosting habitat is present in the form of six caves (one Category 3 and five Category 4). Supporting foraging habitat within the Study Area includes Stony Plain, Sand Plain, Major Drainage Line, Minor Drainage Line, Drainage Area/ Floodplain, Mulga Woodland and Undulating Low Hills, and supporting dispersal habitat includes Gorge/ Gully and Breakaway/ Cliff when proximal to roosting habitat.
MURIDAE																				
northern short-tailed mouse			P4	The species occupies a diverse range of habitats from the monsoon tropical coast to	Yes	~74.3 km NE (2004) (ALA, 2024)				•	•			•	•			Possible	Resident	Species is possible to occur in Drainage Area/ Floodplain, Sand Plain, Stony Plain and

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area										Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
(*Leggadina lakedownensis*)				semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical eucalypt and *Melaleuca* woodlands and stony ranges; however, the species is usually found in seasonally inundated habitats on red or white sandy-clay soils (Moro & Kutt, 2008).															Mulga Woodland habitat where sandy-clay soils are present; however, the Study Area does not contain cracking clays which is considered critical habitat for the species. Due to the species boom and bust nature, it may occur sporadically in the Study Area during the boom periods, particularly following large rainfall events.
western pebble-mound mouse (*Pseudomys chapmani*)			P4	This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee, 1996; Start *et al.*, 2000).	Yes	Recorded within the Study Area (2015) (BHP, 2023)				•		•				•		Confirmed	Resident	Recorded during the current survey on one occasion of an inactive mound. Species likely to occur as a resident within Stony Plain, Hillcrest/ Hillslope and Undulating Low Hills.
RHINONYCTERIDAE																			
Pilbara leaf-nosed bat (*Rhinonicteris aurantia* 'Pilbara form')	VU	VU		Species roosts within caves and abandoned mines with high humidity (95%) and temperature (32°C) (Armstrong, 2001). Species forages in caves and along waterbodies with fringing vegetation (TSSC, 2016c).	Yes	2.3 km NNW (2013) (BHP, 2023)	S HR=4	S HR=3	S HR=3	S HR=2	S HR=2	S HR=2	S HR=2	S HR=2	S HR=2	S HR=2		Likely	Infrequent visitor (foraging/ dispersal)	Not recorded within the Study Area during current or previous surveys. No suitable roosting habitat present within the Study Area, and no known critical roosts (Category 1–3) within the Study Area. Six caves recorded during the current survey are identified as nocturnal refuges (Category 4) for the species. A critical Category 2 roost occurs within 12 km of Study Area (CNIN-12). Supporting foraging within the Study Area includes all habitats (except Cleared/ Disturbed).
THYLACOMYIDAE																			
greater bilby (*Macrotis lagotis*)	VU	VU		Variety of habitats including spinifex hummock grassland and *Acacia* shrubland, on soft soils (Burrows *et al.*, 2012). In the Pilbara often associated with major drainage line sandy terraces (How *et al.*, 1991).	Yes	5.8 km S (1979) (DBCA, 2024c)				S		S				S	C		Possible	Infrequent visitor (foraging/ dispersal)	Not recorded but suitable habitat is present within the Study Area and includes potential critical habitat (Sand Plain) and supporting habitats for foraging and dispersal (Major Drainage Line, Drainage Area/ Floodplain and Mulga Woodland).

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
BIRDS																				
ACANTHIZIDAE																				
southern whiteface (*Aphelocephala leucopsis*)	VU			Occupies a wide range of open woodlands and shrublands with grass and/or shrub dominated understory (DCCEEW, 2023). Vegetation is often dominated by *Acacia* or *Eucalyptus/ Corymbia* species on ranges, foothills and lowlands, and plains (DCCEEW, 2023). Forages almost exclusively on the ground, favouring areas with low tree density and herbaceous understory litter cover (DCCEEW, 2023)	Yes	20.3 km E (2020) (BHP, 2023)			S	S	C		S	S	S			Possible	Resident	May occur within Drainage Area/ Floodplain habitats where suitable vegetation cover and structure are present, which provide breeding, foraging and dispersal habitat. May also utilise supporting habitats: Minor Drainage Line, Major Drainage Line, Stony Plain, Mulga Woodland and Sand Plain if in association with critical habitat.
ANATIDAE																				
Garganey (*Anas querquedula*)	MI	MI		Garganey is a small teal. This duck is a rare visitor to Australia recorded from sewage ponds, lakes and sometimes inland waterbodies (Johnstone & Storr, 1998).	Yes	25.3 km E (2013) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area.
APODIDAE																				
fork-tailed swift (*Apus pacificus*)	MI	MI		Inhabits dry/open habitats, inclusive of riparian woodlands and tea-tree swamps, low scrub, heathland or saltmarsh, as well as treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes (Johnstone & Storr, 1998). Aerial species, which forages high above the tree canopy and rarely lower (Johnstone & Storr, 1998).	Yes	6.4 km E (2022) (DBCA, 2024c)	•	•	•	•	•	•	•	•	•	•		Possible	Infrequent visitor (foraging/ migration only)	May occasionally occur within the airspace above the Study Area to forage in all habitats, unlikely to land or nest within Study Area.

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
CHARADRIIDAE																				
little ringed plover (Charadrius *dubius*)	MI	MI		Bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers. Also found in artificial habitats including gravel pits, sewage works, industrial wastelands and rubbish tips (BirdLife International, 2016b)	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
greater sand plover (*Charadrius leschenaultia*)	MI / VU	VU		Wide, sandy or shelly beaches, sandspits, sand clays, tidal mudflats, reefs, mangroves, saltmarsh, dunes and bare paddocks (Pizzey & Knight, 2007)	Yes	42 km SE (1982) (ALA, 2024)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
oriental plover (*Charadrius veredus*)	MI	MI		Variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	Yes	8.3 km S (1981) (DBCA, 2024c)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
FALCONIDAE																				
grey falcon (*Falco hypoleucos*)	VU	VU		Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge *et al.*, 2010; Olsen & Olsen, 1986)	Yes	~3.3 km NW (2021) (BHP, 2023)			C		S		S					Possible	Infrequent visitor (foraging or dispersal)	Species' occurrence is likely to be dependent on the proximity of nesting. Critical nesting habitat is considered Major Drainage Line within the Study Area; however, no records were observed during the current survey. May occasionally occur to forage within Drainage Area/ Floodplain and Minor Drainage Line habitats. Frequency of occurrence likely to be occasional and dependent on proximity of nesting to the Study Area.

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
peregrine falcon (*Falco peregrinus*)		OS		Arid areas and is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen *et al.*, 2004; Olsen & Olsen, 1989). In general it nests on cliffs, granite outcrops, quarries and in the wheatbelt, old Raven and Whistling Kite nests (Johnstone & Storr, 1998).	Yes	1.3 km NNE (2013) (BHP, 2023)	•		•							•		Possible	Infrequent visitor (foraging or dispersal)	Possible to occur within the Study Area to forage, particularly within Hillcrest/ Hillslope and Major Drainage Line habitats and, to a lesser extent, other habitats more broadly. Frequency of visitation may vary depending on proximity of nesting sites in the vicinity of the Study Area. Marginal suitable nesting habitat present in Breakaway/ Cliff habitat but are limited in extent. Tall eucalypts along the Major Drainage may also provide nesting opportunities.
HIRUNDINIDAE																				
barn swallow (*Hirundo rustica*)	MI	MI		Non-breeding summer visitor to the Pilbara and Kimberley. It favours areas near water (Johnstone *et al.*, 2013) (Menkhorst *et al.*, 2017).	Yes	5.7 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
LARIDAE																				
gull-billed tern (*Gelochelidon nilotica*)	MI	MI		Shallow sheltered seas close to land, estuaries, tidal creeks; and inundated samphire flats, flooded salt lakes, claypans and watercourses in the interior (Johnstone & Storr, 1998).	Yes	6.3 km E (1999) (DBCA, 2024c)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
caspian tern (*Sterna caspia*)	MI	MI		Mainly sheltered seas, estuaries and tidal creeks; occasionally near-coastal salt lakes (including saltwork ponds) and brackish pools in lower courses of rivers; rarely fresh water (Johnstone & Storr, 1998).	Yes	6.3 km E (2004) (DBCA, 2024c)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
MOTACILLIDAE																				
grey wagtail (*Motacilla cinerea*)	MI	MI		Higher altitudes near fast-running water (Simpson *et al.*, 2010).	Yes	658 km NE (2019) (ALA, 2024)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
yellow wagtail (*Motacilla flava*)	MI	MI		An uncommon but regular visitor to the Pilbara region (Johnstone *et al.*, 2013). Occupies a range of damp or wet habitats with low vegetation although favors	Yes	346 km NW (2022) (ALA, 2024)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
				edges of fresh water, especially sewage ponds (Johnstone & Storr, 2004).																
PSITTACIDAE																				
night parrot (*Pezoporus occidentalis*)	EN	CR		The night parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging (DPaW, 2017).	Yes	~90 km N (~2005) (Biota, 2005)												Unlikely	N/A	No records in proximity to the Study Area and preferred habitat not present.
princess parrot (*Polytelis alexandrae*)	VU		P4	The princess parrot inhabits low open eucalypt woodlands and savannah shrublands in arid deserts, usually where *Casuarina* and *Allocasuarina* species are present (Baxter & Henderson, 2000; Pavey *et al.*, 2014). The species also occurs and breeds in vegetated riverine and littoral areas, with breeding primarily occurring in marble gum hollows (DEWHA, 2008; Pavey *et al.*, 2014).	No	~38 km N (2012) (DBCA, 2024c)													Unlikely	N/A	Preferred habitat not present and outside modelled distribution for which species, or species habitat, is known, likely, or may occur.
ROSTRATULIDAE																				
Australian painted snipe (*Rostratula australis*)	EN	EN		Favours recently flooded areas in shallow lowland freshwater temporary or permanent wetlands. This includes swamps, marshes, reedbeds, overgrown rice fields, inundated grassland and saltmarsh, margins of pools, freshwater lakes, sewage pools, reservoirs and mudflats (BirdLife International, 2016a).	Yes	56.8 km N (2012) (ALA, 2024)													Highly Unlikely	N/A	Suitable habitat not present in the Study Area
SCOLOPACIDAE																				
common sandpiper *(Actitis hypoleucos)*	MI	MI		Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Geering *et al.*, 2007; Johnstone & Storr, 1998).	Yes	2.9 km E (2014) (BHP, 2023)													Highly Unlikely	N/A	Suitable habitat not present in the Study Area

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
sharp-tailed sandpiper (*Calidris acuminata*)	MI	MI		Coastal and inland areas saline and freshwater but prefers non-tidal fresh or brackish wetlands (Geering *et al.*, 2007). Favors flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone *et al.*, 2013).	Yes	4.1 km SSW (1981) (DBCA, 2024c)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
curlew sandpiper (*Calidris ferruginea*)	CR / MI	CR / MI		Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering *et al.*, 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering *et al.*, 2007).	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
pectoral sandpiper (Calidris melanotos)	MI	MI		Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone *et al.*, 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering *et al.*, 2007).	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
red-necked stint (*Calidris ruficollis*)	MI	MI		Lives in permanent or ephemeral wetlands of varying salinity, and regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998)	Yes	6.5 km E (2005) (DBCA, 2024c)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
long-toed stint (*Calidris subminuta*)	MI	MI		They prefer shallow freshwater or brackish wetlands but are also fond of muddy shorelines, growths of short grasses, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. Also frequents permanent wetlands and forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Johnstone & Storr, 1998).	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
black-tailed godwit (*Limosa limosa*)	MI	MI		Found mainly in coastal habitats like estuaries, tidal mudflats, sandspits, shallow river margins, sewage ponds. Inland habitats include large shallow fresh or brackish waters (Pizzey & Knight, 2007). There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks (Higgins & Davies, 1996).	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
ruff (*Calidris pugnax*)	MI	MI		Mainly fresh, brackish and saline wetlands with exposed mudflats. Found near lakes, swamps, pools, lagoons, tidal rivers and floodlands. Sometimes observed in sheltered coastal areas, including harbours and estuaries (DoEE, 2019b).	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
wood sandpiper (*Tringa glareola*)	MI	MI		Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, freshwater lagoons	Yes	2.9 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
				and bore overflows (Johnstone *et al.*, 2013). Freshwater wetlands and occasional brackish intertidal mudflats (Geering *et al.*, 2007).																
common greenshank (*Tringa nebularia*)	MI	MI		Species occurs as a non-breeding summer Migrant which occurs throughout the region. Occurs mainly in Tidal mudflats, mangrove creeks, flooded samphire flats, beaches, river pools, and saltwork and sewage ponds (Johnstone *et al.*, 2013).	Yes	4.8 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
marsh sandpiper (*Tringa stagnatilis*)	MI	MI		Lives in permanent or ephemeral wetlands of varying salinity, and regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	Yes	6.1 km E (2014) (BHP, 2023)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
common redshank (*Tringa tetanus*)	MI	MI		It is found at sheltered coastal wetlands with bare open flats and banks of mud or sand. They are also found around salt lakes, freshwater lagoons, artificial wetlands and saltworks and sewage farms. The species has been observed feeding in shallow water, on wet bare mud or sand, or on algal deposits and roosting on small elevated areas such as estuarine sandbars and muddy islets surrounded by water (Johnstone & Storr, 1998).	Yes	10.1 km SW (2012) (DBCA, 2024c)												Highly Unlikely	N/A	Suitable habitat not present in the Study Area
THRESKIORNITHIDAE																				

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
glossy ibis (*Plegadis falcinellus*)	MI	MI		Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone *et al.*, 2013).	Yes	2.9 km E (2014) (BHP, 2023)												Unlikely	N/A	Suitable habitat not present in the Study Area.
REPTILES																				
PYTHONIDAE																				
Pilbara olive python (*Liasis olivaceus* supsp. *barroni*)	VU	VU		Associated with drainage systems, including areas with localised drainage and watercourses (Pearson, 1993). In the inland Pilbara the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Pearson, 1993).	Yes	Within (2013) (BHP, 2023)	C	C	C				S			S		Confirmed	Resident	Recorded on one occasion during the current survey (skin/ slough) and has also previously been recorded within the Study Area on one occasion. Critical denning habitat includes Gorge/ Gully, Major Drainage Line and Breakaway/ Cliff habitats. Supporting foraging and dispersal habitat comprises Minor Drainage Line and Hillcrest/ Hillslope habitats.
SCINCIDAE																				
spotted ctenotus (northeast) (*Ctenotus uber* subsp. *johnstonei*)			P2	Within the Pilbara, the taxon is known from *Triodia* on hillslopes, *Acacia xiphophylla* over chenopods, and *Acacia xiphophylla* scattered tall shrubs to high open shrubland (Cogger, 2014).	Yes	19.2 km E (2016) (BHP, 2023)				•		•				•		Possible	Resident	May occur in Stony Plain, Undulating Low Hills and lower slopes of Hillcrest/ Hillslope habitats. Taxonomic status of the disjunct Pilbara population unknown, may represent an undescribed taxon (P. Doughty, Western Australian Museum, *pers. comm.*).
great desert skink (*Liopholis kintorei*)	VU	VU		Sandplain vegetated by spinifex and scattered shrubs appears to be the habitat type most widely used by the species, and some adjacent dunefield swales (Pavey, 2006). In the Tanami Desert and parts of the Great Sandy Desert they also inhabit paleodrainage lines characterised by giant termite mounds and titree (*Melaleuca* spp.) shrubs.	No	~62 km ESE (2010) (DBCA, 2024c)												Highly Unlikely	N/A	The Study Area is outside the modelled distribution for which the species, or species habitat, is known, or likely to occur. The Sand Plain habitat present within the Study Area is not considered suitable to support the species due to the absence of large undisturbed areas of the habitat.
TYPHLOPIDAE																				
Gane's blind snake (*Anilios ganei*)			P1	Little is known of the species' ecology, but it is often associated with moist soils	Yes	4.8 km E (2009) (BHP, 2023;	•	•								•		Possible	Resident	Likely to occur in Hillcrest/ Hillslope, Breakaway Cliff and Gorge/ Gully habitats,

Species	Conservation Status			Preferred Broad Habitats	Within Current Known Distribution	Nearest Records to the Study Area	Potential Habitat within the Study Area											Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA				Breakaway/ Cliff	Gorge/ Gully	Major Drainage Line	Stony Plain	Drainage Area/ Floodplain	Undulating Low Hills	Minor Drainage Line	Mulga Woodland	Sand Plain	Hillcrest/ Hillslope	Cleared/ Disturbed			
				and leaf litter within gorges and gullies (Wilson & Swan, 2021) and potentially within a wide range of other stony habitats. The species has been recorded from numerous habitats but is most likely to be present in rocky terrain and along drainage lines (DBCA, 2022).		DBCA, 2024c)														particularly where moist substrates are present for prolonged periods.

^C = critical habitat (MNES threatened species only), S = supporting habitat (MNES threatened species only), ● = important habitat (non-MNES threatened species)

6.1 Northern Quoll (*Dasyurus hallucatus*) – Endangered EPBC Act & BC Act

6.1.1 Species Profile

The northern quoll 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).

6.1.2 Previous Records

The Study Area falls within the current modelled distribution of the northern quoll; however, there are no prior records from within it. The nearest record located approximately 5 km southwest of the Study Area in 2007 at Mt Whaleback (BHP, 2023), however this record is unconfirmed and was reported to be of a dead (roadkill) individual. Within 40 km of the Study Area, there are a total of nine previous northern quoll records, between 2007–2022 (DBCA, 2024c). Three records are from secondary signs (historical scats, with only one scat confirmed

to be northern quoll) at Western Ridge mine, 12 km southwest of the Study Area in 2020 and four records are from Hope Downs 4 mine, 18 km northwest of the Study Area in 2021 and 2022 (DBCA, 2024c). Another record of a scat found on a rehabilitated waste dump in 2021 is located approximately 22 km east of the Study Area at Jimblebar mine (BHP, 2023). In addition, a recent study by Biologic (2022a) extensively surveyed the north Jimblebar area (approximately 20 km east of the Study Area) for northern quoll and no direct or indirect evidence of the species was recorded during the 52.5 person hours of targeted searches and over 5,000 camera trap nights during this survey.

6.1.3 Survey Methods

6.1.3.1 Targeted Searches

Targeted searches for direct or secondary evidence were undertaken in suitable habitat for northern quoll along 15 targeted search transects (Figure 6.2), equating to approximately 23.5 person hours (Appendix F).

6.1.3.2 Camera Trap Transects

One camera trap transect was deployed in suitable northern quoll breeding, foraging and dispersal habitat (e.g. Gorge/ Gully) at site VPWR-020 (Table 6.2; Figure 6.2). Where possible, survey effort followed methods recommended by DoE (2016). Ten cameras were deployed across the transect with an approximate spread of one camera every 50–100 m (Table 6.2). Cameras were deployed for four consecutive nights, for a total of 40 camera trap sampling nights (Table 6.2). Cameras were baited with universal bait mixture (oats, peanut butter and sardines) in a non-reward receptacle (perforated and capped PVC pipe).

Table 6.2: Camera transects sampled for northern quoll

Site	Habitat	Deployment	Retrieval	No. Cameras	Total Trap Nights
VPWR-020	Breakaway/ Cliff, Hillcrest/ Hillslope	17/04/2024	21/04/2024	10	40

6.1.4 Survey Results

No evidence of occurrence of northern quoll was recorded within the Study Area.

720000
760000
800000
840000
7440000
7400000
Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

LEGEND

Study Area
Desktop Assessment Area
State Road
Rail

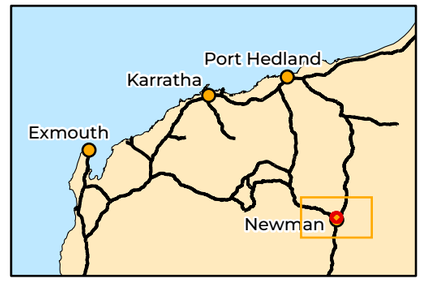
DBCA (2024)
Individual (alive)
Secondary Evidence

BHP (2023)
Scat
Unknown

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator
Created: 09/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.1: Previous northern quoll records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VNEB-011
VPWR-056
VPWR-038
VNEB-012
VNEB-014
VNEB-017
VNEB-004
VPWR-020
VNEB-016
VNEB-008
VPWR-021
VPWR-052
VNEB-001
VNEB-005
VNEB-015

Ore Body 24
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

Study Area
State Road
Rail

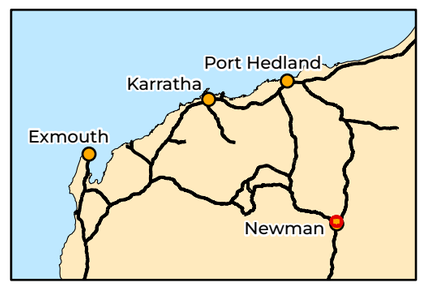
Sampling Type
Camera Trap
Targeted Search
Targeted Search

Fauna Habitat
Critical
Supporting
Nil

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO
NEBO Targeted Vertebrate Fauna Survey

Figure 6.2: Northern quoll sampling and habitat in the Study Area

6.1.5 Discussion

There are no previous records of northern quoll within the Study Area, and previous records of the species in the vicinity of the Study Area are scarce. It is only known in the vicinity from few (seven) records at Western Ridge mine (~12 km southwest) and Hope Downs 4 mine (~18 km northwest), and single records from 22 km east of the Study Area and at Mt Whaleback (~5 km southwest). There is uncertainty regarding some of these previous records, particularly with regard to the species long-term occurrence and persistence in the broader area, and recent survey effort for the species has resulted in no records (Biologic, 2022a).

The Gorge/ Gully (0.25%, 6.45 ha), Breakaway/ Cliff (0.01%, 0.29 ha), and Major Drainage Line (5.83%, 140.13 ha) habitats within the Study Area meet the definition of critical habitat for northern quoll (BHP WAIO, 2023b; DoE, 2016) (Figure 6.2). Potential supporting habitat for the northern quoll occurs in the Hillcrest/ Hillslope (21.77%, 566.56 ha) and Minor Drainage Line (2.12%, 55.26 ha) habitats, where proximal (<35 ha, BHP WAIO (2023b)) to critical habitat (Gorge/ Gully, Breakaway/ Cliff, and Major Drainage Line). The extent of critical habitat within the Study Area is limited; however, the supporting habitats form part of larger continuations of the habitat beyond the extent of the Study Area and may therefore potentially act as foraging and dispersal corridors where connectivity to other areas of critical habitat is provided.

With the exception of the unconfirmed record of the northern quoll record from Mt Whaleback (~5 km southwest of the Study Area), records of the species in the vicinity of the Study Area are sparse suggesting that the species' occurrence within the Study Area is extremely rare and it is unlikely a resident population occurs within the Study Area permanently. Due to the absence of any records of the species within the Study Area and the scarcity of records in the vicinity, the species occurrence within the Study Area is considered Possible; however, may be limited to infrequent visitations by dispersing individuals.

6.2 Greater Bilby (*Macrotis lagotis*) – Vulnerable EPBC Act & BC Act

6.2.1 Species Profile

The greater bilby is 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), and may move in response to foraging potential (Southgate, 1990a; Southgate *et al.*, 2019).

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. rhodophylla*, which have root-dwelling larvae prone that support 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.

6.2.2 Previous Records

The desktop assessment identified one previous record of greater bilby within 40 km of the Study Area, comprising secondary evidence (tracks) near Capricorn Roadhouse (~6 km south of the Study Area, exact record location unconfirmed/ uncertain) recorded in August 1979 (DBCA, 2024c) (Figure 6.3). An additional two records of greater bilby exist outside of the 40 km buffered Study Area, comprising secondary evidence (scats) from the Rhodes Ridge area and proposed Rio Tinto mine (42 km northwest of the Study Area) in 1983 that may be attributed to the species, and an old (unconfirmed) inactive burrow recorded in 2018 approximately 58 km east of the Study Area (Biologic, 2018a; DBCA, 2024c) (Figure 6.3). There are no previous records of the species within the Study Area.

6.2.3 Survey Methods

6.2.3.1 Greater Bilby Plots Searches

Three survey plots (2-hectare plot search) (sites VPWR-028, VPWR-117 and VPWR-119) equating to approximately 1.5 person hours were undertaken in Drainage Area/ Floodplain habitat for greater bilby (Figure 6.4). The targeted searches focused on identifying signs of secondary evidence (burrows, diggings, tracks and scats), as described by Southgate *et al.* (2019)).

6.2.4 Survey Results

No evidence of occurrence of greater bilby was recorded within the Study Area.

6.2.5 Discussion

No evidence of greater bilby was recorded during the current survey within the Study Area and there is a scarcity of records within the vicinity of the Study Area and within the local region. However, critical breeding, foraging and dispersal habitat for the species is present within the Study Area in areas of suitable Sand Plain habitat (80.62 ha, 3.10% of the Study Area). Although the species is known to utilise broad habitats that occur within the Study Area in other parts of its distribution (i.e. Major Drainage Line (5.83%, 140.13 ha), Mulga Woodland (0.73%, 19.11 ha) and Drainage Area/ Floodplain (15.39%, 400.69 ha)), these habitats are rarely utilised by the species within the Pilbara region, likely due to the high amount of alluvial material making substrates less suitable for burrowing activity compared to sand-plain habitats (Cramer *et al.*, 2017). The likelihood of these habitats being utilised by the species may also increase when larger areas of suitable habitat (e.g. Sand Plain) are present adjacent to or in the vicinity, therefore these habitats are considered supporting foraging habitat for the species. Based on the limited number of nearby recent records, and presence of critical and supporting habitats within the Study Area the greater bilby is considered Possible to occur in the Study Area.

720000
760000
800000
840000
7440000
7400000
Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

LEGEND

Study Area
Desktop Assessment Area
State Road
Rail

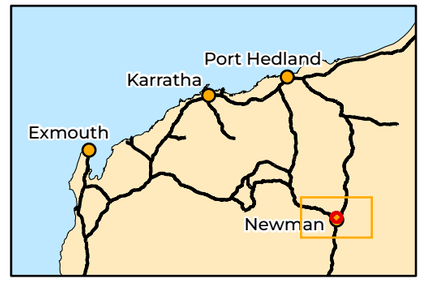
DBCA (2024)

Scat
Secondary Evidence
Unknown

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.3: Previous greater bilby records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VPWR-028
VPWR-119
VPWR-117
Ore Body 24
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

Study Area
State Road
Rail

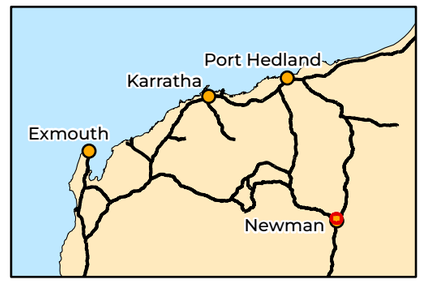
Sampling Type
Targeted Search
Targeted Search
Bilby Plot

Fauna Habitat
Critical
Supporting
Nil

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.4: Greater bilby sampling locations and habitat in the Study Area

6.3 Ghost Bat (*Macroderma gigas*) – Vulnerable EPBC Act & BC Act

6.3.1 Species Profile

The ghost bat occurs in disjunct colonies across northern Australia (TSSC, 2016b) and the Pilbara region. The Pilbara population is estimated to comprise between 1,300 and 2,000 individuals, the largest occurring within the Chichester subregion (estimated at approximately 1,500 individuals) where known populations are largely restricted to disused mines (TSSC, 2016b).

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), Western Ridge (Biologic, 2023c, 2024), Mt Brockman and West Angeles in the Hamersley subregion, and at Callawa and Tambrey Station in the Chichester sub-region (Armstrong and 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). The categories of cave significance for ghost bats followed the classifications defined by Bat Call (2021a):

- **Category 1** (maternity/ diurnal roost with permanent occupancy): Permanently occupied roost tending to have large fluctuating populations. Due to permanent presence maternity usage is assumed. Structurally, caves are often deep and dark with one or more elevated roosting chambers that provide a stable microhabitat. Critical for the ongoing presence of ghost bat in the area.
- **Category 2** (maternity/ diurnal roost with regular occupancy): Ghost bat presence regular, but not permanent/ continuous over long periods. Pregnant or pup-carrying individuals may be present. Similar to Category 1 caves, but often less complex, with only a single inner chamber and are often in less productive areas only used by the species periodically. Bats present for 25% to 75% but may be abandoned for weeks or months. Typically have several other caves, shelters and overhangs within a few hundred meters, which together make up an 'apartment block' grouping that supports the ongoing presence of the species. Critical for the ongoing presence of the species in the area.

- **Category 3** (diurnal roost with occasional occupancy): Diurnal roosts where the species roosts occasionally, or rarely. Structurally, less well-developed and often used as feeding sites (as evidenced by middens with food scraps) or temporary refuges. Scats and/or small food middens present but may be no evidence of roosting bats or observations of roosting not consistent. May facilitate long-distance movements of individuals more broadly across the landscape. When adjacent to Category 2 roosts, Category 3 caves are considered part of an 'apartment block' and therefore critical habitat for the ongoing presence of the species in the area. Where occurring in isolation, Category 3 caves are not considered critical habitat essential for the long-term viability of a local population.
- **Category 4** (nocturnal roost with opportunistic usage): Roosts used in at least an opportunistic manner by itinerant individuals and may comprise single visitations to longer periods including periods of rest or feeding during foraging. Includes majority of shallow caves, shelters and deep overhangs in the Pilbara. Not considered critical habitat.

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, studies using VHF tracking and GPS/satellite tracking technologies show that ghost bats, both male and female, may forage over much larger areas (up to 17 km) from their diurnal roost, with an average radial distance of 8.5 km (Augusteyn *et al.*, 2018; Bat Call, 2021a; Biologic, 2020a; Bullen *et al.*, 2023). Ghost bats will utilise the majority of an available foraging area, spending on average 116 minutes at particular foraging sites (Bullen *et al.*, 2023). 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).

Ghost bats have been confirmed as foraging across a variety of habitat types, however generally thinly wooded areas of mulga, other *Acacia* or *Eucalypt* species or linear woodland features are preferred in areas with a moderate percentage of open ground (typically 30–70%) (Bullen *et al.*, 2023). Tracking studies at BHP WAIO's South Flank mine have observed a ghost bat exiting a cave and moving immediately towards broad drainage plains with Mulga Woodland and Major Drainage Line (Biologic, 2020a). Such areas are often highly productive and contain an abundance of foraging structures (Biologic, 2020a).

6.3.2 Previous Records

A total of 516 previous records of ghost bat occur within 40 km of the Study Area, with three records from a similar location occurring within the Study Area (BHP, 2023; DBCA, 2024c)

(Figure 6.5). The first record is located within the central western section of the Orebody 24 Study Area (Biologic, 2013) and the second and third records relate to a nearby suitable ghost bat cave as described in ENV (2011a).

A large proportion of the previous records (466 records) were associated with monitoring (mostly echolocation calls) of the ghost bat population at Western Ridge southwest of the Study area, and Jimblebar east of the Study Area (Biologic, 2023c, 2024; DBCA, 2024c).

6.3.3 Survey Methods

6.3.3.1 Targeted Searches

Targeted searches for significant bat species were undertaken at 14 locations across the Study Area in habitats with rocky outcropping (i.e. Gorge/ Gully). 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 (Appendix F; Figure 6.6). Where suitable caves or overhangs were located, detailed cave assessments were undertaken to search for evidence of occurrence and determine the cave classification as detailed in Bat Call (2021a). Where a cave was not deemed safe for entry, efforts were made to assess the cave without entering. Approximately 22.5 person hours of search effort for significant bat species was undertaken during the survey (Figure 6.6; Appendix F).

6.3.3.2 Ultrasonic Recorders

Overnight recordings of bat echolocation calls were undertaken with Song Meter ultrasonic bat recorder at four sites during the field survey (Table 6.3; Figure 6.6). Recorders were placed in critical habitat near water features, caves, and foraging/ dispersal corridors. Recorders were deployed for three consecutive nights at three sites (VNEB-001, VNEB-010, and VNEB-020) and four nights at VPWR-018, resulting in a total of 13 recording nights (Table 6.3; Figure 6.6). All recordings were analysed by Robert Bullen of Bat Call WA for the presence of ghost bat and Pilbara leaf-nosed bat calls.

Table 6.3: Ultrasonic sampling for ghost bat and Pilbara leaf-nosed bat

Site	Habitat Feature	Habitat	Deployment	Retrieval	Sampling Nights
VNEB-001		Hillcrest/ Hillslope	16/04/2024	19/04/2024	3
VNEB-010	Water feature WER-10	Major Drainage Line	19/04/2024	22/04/2024	3
VPWR-018		Minor Drainage Line	19/04/2024	23/04/2024	4
VPWR-020	Cave CER-06	Breakaway/ Cliff	16/04/2024	19/04/2024	3
			Total ultrasonic recorders deployed		**4**
			Total recording nights		**13**

720000
760000
800000
840000
7440000
7400000

Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

DBCA (2024)
- Heard/ Call
- Individual (alive)
- Secondary Evidence
- Specimen
- Unknown

BHP (2023)
- Heard/ Call
- Individual (alive)
- Scat
- Secondary Evidence
- Unknown

LEGEND
- Study Area
- Desktop Assessment Area
- State Road
- Rail

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator
Created: 09/08/2024

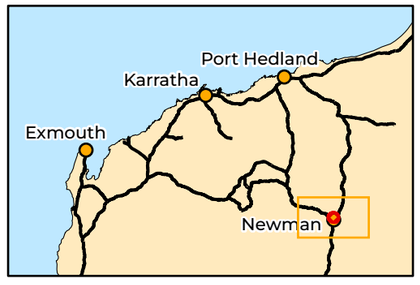


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Figure 6.5: Previous ghost bat records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VNEB-011
VPWR-056
VPWR-018
CER-11
VPWR-038
CER-06
VNEB-014
VNEB-012
CER-10
VNEB-004
VPWR-020
CER-07
CER-09
CER-08
VNEB-008
VPWR-052
VNEB-001
VNEB-005
VNEB-015
VNEB-010
Ore Body 24
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

- Study Area
- State Road
- Rail

Sampling Type

- Targeted Search
- Ultrasonic Recorder
- Targeted Search

Fauna Habitat

- Nil
- Supporting

Cave

- Category 3
- Category 4

Ghost bat - VU

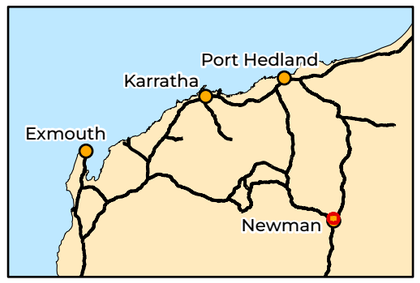
- Scat

Biologic

Scale 1:25,000

0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



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NEBO Targeted Vertebrate Fauna Survey

Figure 6.6: Ghost bat sampling locations, records and habitat in the Study Area

6.3.4 Survey Results

6.3.4.1 Targeted searches

Ghost bat was recorded on one occasion in the Study Area during the current survey (Figure 6.6; Appendix G). The species was recorded from secondary evidence (scats) observed at site VPWR-020 (within cave CER-06), with approximately 1,000 recent scats (estimated 1–6 months in age) observed (Plate 6.1).

Of the six caves recorded in the Study Area, cave CER-06 was categorised as a Category 3 ghost bat roost. The presence of recent scats (~1,000) and the dimensions (two chambers, depth approx. 18 m) and microclimate were indicative of being suitable for diurnal roosting of ghost bats. The classification of CER-06 could not be confirmed to be a Category 2 roost (diurnal roost caves with regular occupancy) due to a lack of evidence of usage from one visit. However, with continued monitoring further evidence of regular usage and breeding from ghost bats could suggest this cave to be a Category 2 roost. The remaining five caves were classified as Category 4 roosts (CER-07, CER-08, CER-09, CER-10 and CER-11) with the potential for night roosting (Figure 5.2).

6.3.4.2 Ultrasonic Recording

No calls from ghost bats were recorded by ultrasonic recorders during the current survey.

6.3.5 Discussion

Ghost bat was recorded on one occasion in the Study Area during the current survey via secondary evidence, comprising a large scat pile of approximately 1,000 recent (1–6 month old) scats at cave CER-06 (Figure 5.2; Figure 6.6). While bat detectors placed in areas targeting foraging or roosting habitats did not record calls over the survey period, it should be noted that ghost bat detectability via ultrasonic recorders, particularly of foraging individuals is difficult due to their foraging behaviour (i.e. infrequent and highly variable calling during foraging) and capabilities of ultrasonic recording devices (i.e. limited detection zones).

The most suitable areas of habitat (for potential caves/ roosts) to support the species are located in the centre of the Study Area in Gorge/ Gully, Breakaway/ Cliff and Hillcrest/ Hillslope habitats. Two caves (CER-08 and CER-06) were recorded within Breakaway/ Cliff habitat, one cave was located within Hillcrest/ Hillslope habitat (CER-11), and the remaining three caves (CER-07, CER-09 and CER-10) were recorded within Gorge/ Gully habitat within the Study Area (Figure 5.2; Figure 6.6; Appendix D). Cave CER-06 was classified a Category 3 roost with evidence of diurnal roosting, with all other caves classified as Category 4 roost caves (nocturnal roost caves with opportunistic usage).

No critical roosts were identified within the Study Area; however, supporting foraging and dispersal habitat is provided by Drainage Area/ Floodplain (15.39%, 400.69 ha), Stony Plain (2.87%, 74.83 ha), Sand Plain (3.10%, 80.62 ha), Major Drainage Line (5.83%, 140.13 ha), Minor Drainage line (2.12%, 55.26 ha), Undulating Low Hills (2.37%, 61.60 ha), and Mulga Woodland (0.73%, 19.11 ha) habitats within the Study Area when proximal (<12 km, usual foraging distance for the species (Bat Call, 2021a)) to roosting habitat. While Gorge/ Gully (0.25%, 6.45 ha) and Breakaway/ Cliff (0.01%, 0.29 ha) within the Study Area don't provide foraging habitat, these habitats can provide supporting dispersal habitat when proximal (<12 km) to roosting caves. While no records of ghost bat were made via ultrasonic recorders, this does not indicate that the species is not foraging in these areas. 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 their presence is observed. There are four Category 3 caves historically recorded within 8 km of CER-06 (CCAT-01, CCAT-02, CCAT-06 and CCAT-13) which could indicate the species to be foraging between these roosts. As CER-06 (Category 3 roost) occurs centrally within the Study Area, most of the occurrence of the aforementioned habitats within the Study Area provides foraging habitat for the species. The suitability of these habitats is variable throughout the Study Area depending on habitat characteristics, including the abundance of foraging structures (tree perches) and vegetation structure and density present. Due to the presence of known roosting caves and confirmed records within the Study Area and surrounds, it is likely ghost bat occur as a resident and utilise the above habitats within the Study Area regularly for foraging.

The occurrence of ghost bats within the Study Area is likely to form part of a broader ghost bat population with high genetic diversity across the Pilbara region (Ottewell *et al.*, 2017), in particular with the known populations at Jimblebar and Western Ridge. Due to the presence of a Category 3 (diurnal roost caves with occasional occupancy for ghost bats) roost and foraging habitat, plus other Category 3 caves within the vicinity of the Study Area, the individuals present in the Study Area would form part of the broader meta-population of ghost bats in the Pilbara. The individuals present likely contribute to the high genetic diversity present in the region, potentially linking larger populations at South Flank/Mining Area C, Western Ridge and Jimblebar through dispersing individuals. As such, the population within the Study Area aligns with the DoE (2013b) definition of 'important'.

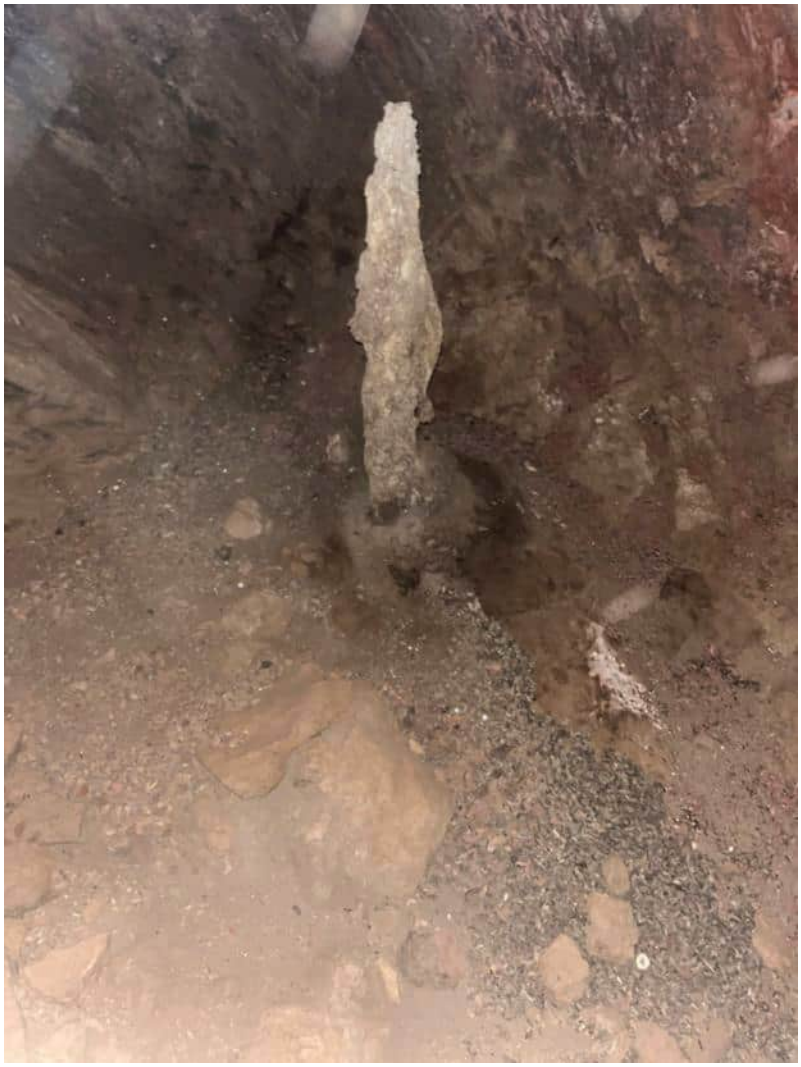


Plate 6.1: Ghost bat scat pile observed in cave CER-06

6.4 Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* 'Pilbara form') – Vulnerable EBPC Act & BC Act

6.4.1 Species Profile

The Pilbara leaf-nosed bat 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 permanent diurnal Category 1 and 2 roost sites (17 of known location and 31 yet to be found) assumed 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). Bat Call (2021b) categorised underground refuges used by the species into four categories:

- **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.
- **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 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). The species 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).

6.4.2 Previous Records

The Study Area is located within the current distribution of the Pilbara leaf-nosed bat, whereby the species or species' habitat may occur (DoE, 2022b). Pilbara leaf-nosed bat has not previously been recorded in the Study Area; however, the desktop assessment identified 475 records of the species within 40 km of the Study Area (BHP, 2023; DBCA, 2024c) (Figure 6.7). This includes five recent records from 2021 and 2023, comprising evidence of foraging within Major Drainage Line, Drainage Area/ Floodplain and Mulga Woodland habitats (Biologic, 2023b; Biota, 2022). A permanent preliminary Category 2 roost (CNIN-12) in the Jimblebar area, approximately 14 km east from the Study Area, has recently been identified

(Biologic, in prep.-a). It should be noted that the categorisation of CNIN-12 as a Category 2 permanent diurnal roost is based on a preliminary assessment and requires further monitoring to confirm the categorisation. In addition there has been roosting indicated at cave CNIN-09, located approximately 12 km east from the Study Area, and sporadic nocturnal visits recorded at caves CNIN-01 and CNIN-03, approximately 18 km east from the Study Area, throughout 2022–2023 (Biologic, 2024). The nearest known provisional permanent diurnal roost is cave CNIN-12 (mentioned above), followed by Kalgan Creek (Category 2 roost), approximately 15 km north of the Study Area; however, sampling within the intervening area is sparse and additional roost sites may occur closer to the Study Area.

6.4.3 Survey Methods

6.4.3.1 Targeted Searches

Targeted searches for significant bat species were undertaken at 14 locations across the Study Area in habitats with rocky outcropping (i.e. Gorge/ Gully, Breakaway/ Cliff and Hillcrest/ Hillslope), and potential foraging habitat (Major Drainage Line). 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 (Appendix F; Figure 6.8). Where suitable caves or overhangs were located, detailed cave assessments were undertaken to search for evidence of occurrence and determine the cave classification as detailed in Bat Call (2021b). Where a cave was not deemed safe for entry, efforts were made to assess the cave without entering. Approximately 22.5 person hours of search effort was undertaken during the survey (Figure 6.8; Appendix F).

6.4.3.2 Ultrasonic Recorders

Overnight recordings of bat echolocation calls were undertaken with Song Meter ultrasonic bat recorder at four sites across the Study Area (Table 6.3; Figure 6.8). Recorders were placed near water features, caves, and foraging/ dispersal corridors. Recorders were deployed for three to four consecutive nights at each site, resulting in a total of 13 recording nights (Table 6.3; Figure 6.8). All recordings were analysed by Robert Bullen of Bat Call WA for the presence of ghost bat and Pilbara leaf-nosed bat calls.

6.4.4 Survey Results

6.4.4.1 Targeted searches

Of the six caves occurring within the Study Area, all were classified as Category 4 for the Pilbara leaf-nosed bat (nocturnal refuge) (Figure 6.8; Appendix D).

6.4.4.2 Ultrasonic Recorders

No calls from Pilbara leaf-nosed bats were recorded by ultrasonic recorders during the current survey.

720000
760000
800000
840000
7440000
7400000
Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

LEGEND

Study Area
Desktop Assessment Area
State Road
Rail

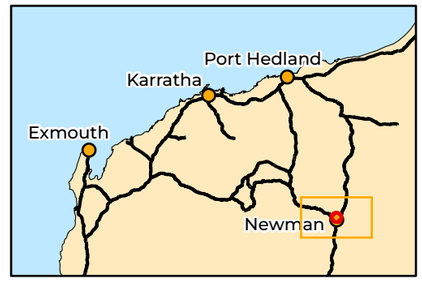
DBCA (2024)
Heard/ Call
Individual (alive)
Unknown

BHP (2023)
Heard/ Call

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator
Created: 09/08/2024



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NEBO Targeted Vertebrate Fauna Survey

Figure 6.7: Previous Pilbara leaf-nosed bat records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VNEB-011
WHST-01
WHST-03
WHST-02
VPWR-052
VPWR-020
CER-06
VNEB-014
VNEB-012
CER-07
CER-11
VPWR-038
CER-10
CER-09
VNEB-004
VNEB-008
CER-08
VPWR-056
VPWR-018
VNEB-001
VNEB-005
VNEB-015
Ore Body 24
WER-06
WER-07
WER-08
WER-09
Port Hedland Newman Railway
WER-12
WER-10
WER-11
VNEB-010
Great Northern Hwy
Marble Bar Rd

LEGEND

- Study Area
- State Road
- Rail

Sampling Type
- Targeted Search
- Ultrasonic Recorder
- Targeted Search

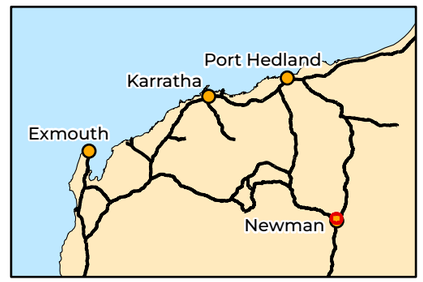
Fauna Habitat
- Supporting
- Nil

Cave
- Category 4
- Water Feature

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



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NEBO Targeted Vertebrate Fauna Survey

Figure 6.8: Pilbara leaf-nosed bat sampling locations and habitat in the Study Area

6.4.5 Discussion

The nearest known provisional permanent diurnal roost (preliminary categorisation as Category 2) for this species is cave CNIN-12, located approximately 14 km east of the Study Area (Biologic, in prep.-a). Pilbara leaf-nosed bats travel up to 20 km from roost caves during nightly foraging (Cramer *et al.*, 2016a), therefore foraging individuals from CNIN-12 may forage within the Study Area.

Currently, no habitat within the Study Area is considered critical for the Pilbara leaf-nosed bat, as there are no diurnal roosts (Category 1–3) within the Study Area (Bat Call, 2021b); however, due to the proximity (within 20 km) of a provisional Category 2 roost (CNIN-12) the species is likely to forage within the habitats present within the Study Area. As such Breakaway/ Cliff habitat is classified as a Habitat Rating 4 (very high) and Gorge/ Gully and Major Drainage Line habitats are classified as a Habitat Rating 3 (high) as defined by Bat Call (2021b). Presently, the Gorge/ Gully (0.25%, 6.45 ha), Breakaway/ Cliff (0.01%, 0.29 ha), and Major Drainage Line (5.83%, 140.13 ha) habitats within the Study Area provide supporting foraging and dispersal habitat for the species and contain important habitat features such as nocturnal refuges (Category 4 caves) and water features (Figure 6.8). Other supporting foraging and dispersal habitat for Pilbara leaf-nosed bat within the Study Area is provided by Hillcrest/ Hillslope (21.77%, 566.56 ha), Drainage Area/ Floodplain (15.39%, 400.69 ha), Stony Plain (2.87%, 74.83 ha), Sand Plain (3.10%, 80.62 ha), Undulating Low Hills (2.37%, 61.60 ha), Minor Drainage line (2.12%, 55.26 ha) and Mulga Woodland (0.73%, 19.11 ha), and are classified as Habitat Rating 2 (moderate) (Bat Call, 2021b).

The Pilbara population of the leaf-nosed bat 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, as defined by (Bat Call, 2021b); however, due to the close proximity of a provisional permanent diurnal roost (preliminary categorisation as Category 2 CNIN-12), it is likely the Study Area would be used for foraging and dispersal. Therefore, the species is Likely to occur within the Study Area.

6.5 Night Parrot (*Pezoporus occidentalis*) – Endangered EPBC Act & Critically Endangered BC Act

6.5.1 Species Profile

The night parrot is an elusive, nocturnal ground dwelling parrot that inhabits arid and semi-arid areas that contain a specific structure of dense, low vegetation (DPaW, 2017). Based on accepted records, the species' habitat consists of long-unburnt mature *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 (Garnett & Crowley, 2000). The largest of these subpopulations is estimated, with low reliability, to consist of 20 breeding birds (Garnett & Crowley, 2000).

6.5.2 Previous Records

No previous surveys within the Study Area deployed acoustic recorders as targeted search effort for night parrot. The nearest record of the night parrot to the Study Area is approximately 100 km to the north, which was recorded from Cloudbreak mine in 2021 (FMG, 2021) (Table 6.4). 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, following the original record in the area of three individuals sighted in 2005 (Davis & Metcalf, 2008) (Table 6.4). The 2005 record is from an artificial water source from a pastoral bore that was heavily degraded by cattle and lacking an 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. Despite this observation, subsequent targeted survey for the species at the location and in the vicinity have failed to record the species again. Kanyirninpa Jukurrpa rangers recorded night parrot calls at two locations on Martu country in 2020 (Michelmore & Birch, 2020). The night parrot is especially cryptic and rare in occurrence and therefore difficult to record so the records to date may underestimate the occurrence of the species.

Table 6.4: 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)	~100 km north-east	Mulga woodland. No understorey Artificial water source from a pastoral bore. 3 individuals observed at dusk in a targeted survey
Adjacent to Cloudbreak Mine	~2021 (exact date not given)	(FMG, 2021)	~100 km north-east	Not noted but located near Fortescue Marsh Adjacent to mining operations
Moojarri Well	~2005 (exact date not noted)	Biota (2005)	~90 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 (2022)	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)	Michelmore and Birch (2020)	Undisclosed location	Salt Lake system Acoustic recording
Matuwa (Lorna Glen)	24/11/2009 05/12/2009	Hamilton *et al.* (2017)	~370 km south-east	Lake system-native and introduced grasses, samphire, sedges, chenopods. Thick *Eremophila*, Mulga and grasses

Location	Date of Observation	Source	Distance from Study Area	Recorded Habitat Type/ Comments
				One individual each night
East Murchison	March 2017	Night Parrot Recovery Team (2017), Jackett *et al.* (2017)	Undisclosed location	Spinifex hummock grassland on sandy substrate, encompassed by mulga woodland and a breakaway, separated from the *Triodia* by an open plain of samphire Living individuals and an active nest
Telfer area, Great Sandy Desert	Oct–Nov 2020 April–May 2021 (exact date not given)	Biologic (2021a)	~310 km northeast	Spinifex hummock grassland on sandy loam substrate, with scattered *Acacia* shrubs and eucalypts. Acoustic recordings (two confirmed and one unconfirmed)

6.5.3 Survey Methods

6.5.3.1 Acoustic Recorders

Song Meter acoustic recorders were deployed at two sites within the Study Area (VNEB-002 and VPWR-028) (Table 6.5; Figure 6.9). No critical habitat aligning with habitat preferences of the species was recorded within the Study Area, therefore acoustic recorders were deployed in best available habitats; however, overall, these habitats were considered marginal and unlikely to provide critical nesting/ roosting or foraging habitat for the species. Units were placed within habitat considered most suitable for roosting and nesting as recommended by DPaW (2017). Song Meters were deployed for six consecutive nights as per DPaW (2017) recommendations, for a total of 12 recording nights. Acoustic recordings were analysed for night parrot calls by specialist Louis Masarei (Malu Fauna).

Table 6.5: Acoustic sampling for night parrot and other significant bird species

Site	Habitat	Deployment	Retrieval	Sampling Nights
VNEB-002	Drainage Area/ Floodplain	17/04/2024	23/04/2024	6
VPWR-028	Drainage Area/ Floodplain	17/04/2024	23/04/2024	6
			Total acoustic recorders deployed	**2**
			Total recording nights	**12**

780000
782500
785000
787500
7420000
7417500
7415000

VPWR-028
VNEB-002
Ore Body 24
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

Study Area
State Road
Rail

Sampling Type
Acoustic Recorder

Fauna Habitat
Nil

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024

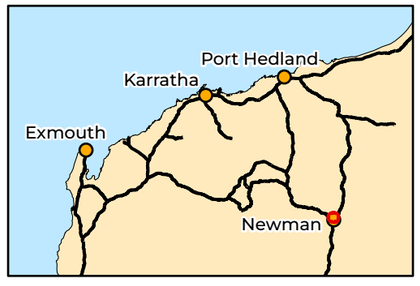

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Figure 6.9: Night parrot sampling locations and habitat in the Study Area

6.5.4 Survey Results

No evidence of night parrot was recorded at the acoustic recorder sampling sites.

6.5.5 Discussion

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). No evidence of occurrence of night parrot was recorded within the Study Area during the current survey, including from targeted acoustic recorders deployed in areas of marginally suitable habitat. Habitat within the Study Area was considered suboptimal for the species, particularly due to most areas of *Triodia* grasslands lacking large, long-unburnt hummocks and the absence of any chenopod shrubland habitat within the Study Area or surrounding area. Although little is known about the species' habitat preferences and occurrence, particularly within the Pilbara region, the extent of which these habitats may still provide habitat for the species is unknown. It is possible that any night parrots occurring near the Cloudbreak mine could potentially disperse into the Study Area as it is located 100 km north and within the known cumulative foraging distance (Night Parrot Recovery Team, 2017). However, based on the absence of any suitable habitat considered to be of significance to the species, it is considered Unlikely to occur within the Study Area either as a resident or infrequent visitor during foraging and or dispersal.

6.6 Southern Whiteface (*Aphelocephala leucopsis*) – Vulnerable EPBC Act

6.6.1 Species Profile

The southern whiteface is distributed across the majority of mainland Australia, inhabiting a variety of open woodlands and shrublands containing an understorey of grasses or shrubs, or both (Higgins & Peter, 2002). The distribution within the Pilbara is largely outside the "known" mapped distribution, with the Study Area mapped as the "species or species habitat may occur" (DCCEEW, 2023). Typically these woodlands are dominated by acacias or eucalyptus on ranges, foothills and lowlands and plains (Higgins & Peter, 2002). The species is considered to be sedentary; however, records suggest that individuals move to wetter areas outside their normal range during drought conditions (Higgins & Peter, 2002). Southern whiteface primarily forage on the ground, preferring areas with sparse tree cover and an herbaceous understory litter cover, primarily feeding on insects, spiders, and seeds (DCCEEW, 2023; Higgins & Peter, 2002). The species commonly forages in small groups of two to eight individuals, however, may flock in larger foraging parties during the winter months with as many as 70 individuals previously recorded (Higgins & Peter, 2002).

Breeding takes place between July to October, however exact timing in arid regions through the species range can be impacted by rainfall; individuals may breed outside of the known range following sufficient rainfall events, or not at all during periods of drought (Higgins & Peter, 2002). Nesting often occurs in a hollow or crevice, and less frequently in low bushes, where nests are made of a combination of grass, bark and roots forming a large, dome-like shape (Higgins & Peter, 2002). Southern whiteface are typically observed to nest in pairs, however little is known about the species' social organisation (DCCEEW, 2023). Cooperative breeding has been recorded, with multiple instances of up to four adults participating in chick rearing (Higgins & Peter, 2002).

6.6.2 Previous Records

There is one previous record of three southern whiteface individuals, approximately 20.3 km east of the Study Area on a hardpan plain in 2020 (Figure 6.10). The scarcity of southern whiteface records in the broader vicinity of the Study Area may be attributed to the occurrence of the Study Area in the northern peripheral of the species distribution, whereby the species may naturally occur at a lower abundance which has resulted in fewer records of the species. Additionally, the species' EPBC Act status has only recently been updated to Vulnerable, which could also be a contributing factor (i.e. less/ no specific consideration during previous surveys in the vicinity of the Study Area).

6.6.3 Survey Methods

6.6.3.1 Acoustic Recorders

Song Meter acoustic recorders were deployed at two sites (VNEB-002 and VPWR-028) within the Study Area in the best suitable habitat, including Drainage Area/ Floodplain (Table 6.5; Figure 6.11).

6.6.3.2 Avifauna Surveys

Avifauna sampling was undertaken whilst undertaking three targeted searches in suitable habitat (Drainage Area/ Floodplain) within the Study Area (Figure 6.11; Appendix F). Sampling was undertaken during periods of likely activity, with a focus on recording either direct observation, calls and/or secondary evidence (e.g. nests and/or feathers).

720000
760000
800000
840000
7440000
7400000
Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

LEGEND

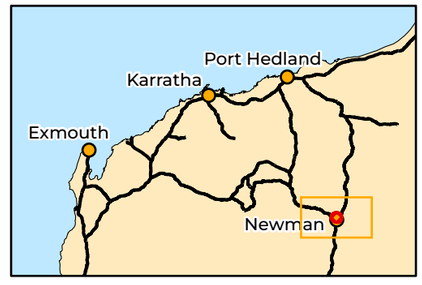
Study Area
Desktop Assessment Area
State Road
Rail

BHP (2023)
Individual (alive)

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.10: Previous southern whiteface records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VPWR-090
VPWR-028
Ore Body 24
VPWR-119
VPWR-117
VNEB-002
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

Study Area
State Road
Rail

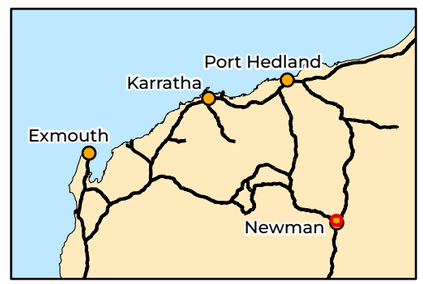
Sampling Type
Acoustic Recorder
Targeted Search
Targeted Search

Fauna Habitat
Critical
Supporting
Nil

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.11: Southern whiteface sampling locations and habitat in the Study Area

6.6.4 Survey Results

No southern whiteface or evidence of the species' occurrence was recorded during the current survey.

6.6.5 Discussion

The Study Area is outside the modelled distribution for which the species or species habitat is known or likely to occur; however, it is located within the modelled distribution for which the species or species habitat may occur (DCCEEW, 2023). Drainage Area/ Floodplain (15.39%, 400.69 ha) provides critical nesting/ breeding, foraging/ dispersal habitat for the species. Sand Plain (80.62 ha, 3.10% of the Study Area), Minor Drainage Line (2.12%, 55.62 ha), and Major Drainage Line (5.83%, 140.13 ha) habitats provides supporting habitat for nesting/ breeding, foraging and dispersal, while Stony Plain (2.87%, 74.83 ha) and Mulga Woodland (0.73%, 19.11 ha) habitats within the Study Area could provide suitable foraging and dispersal habitat for southern whiteface (Figure 6.11). Suitability of these habitats within the Study Area is variable, depending on particular habitat characteristics, including the presence of an understorey of grasses or shrubs, or both, with low tree densities and an herbaceous understorey litter cover (DCCEEW, 2023). The species may also forage and disperse more broadly across other habitats where suitable vegetation cover is present.

No southern whiteface records were made during the current survey and there is a scarcity of records in the broader vicinity. However, the species conservation status has only recently been updated to Vulnerable under the EPBC Act, and as such may not have been previously subjected to the same targeted search effort in the region as other significant fauna during historic surveys (which predominantly targeted significant species or were basic surveys), and other records may be present. The Study Area occurs on the northern periphery of the species distribution (DCCEEW, 2023), and as such any records present may represent part of or contribute to an important population of the species, with the habitats within the Study Area potentially relied upon for individuals for persistence at a local and/or regional scale. However, there is a level of uncertainty due to the species distribution only extending into the southern edges of the Pilbara, with its core range in the Gascoyne and Murchison (DCCEEW, 2023). Given these factors and the presence of suitable habitats the species is considered Possible to occur within the Study Area.

6.7 Princess Parrot (*Polytelis alexandreae*) – Vulnerable EPBC Act and Priority 4 (DBCA)

6.7.1 Species Profile

The princess parrot inhabits low open eucalypt woodlands and savannah shrublands in arid deserts, usually where *Casuarina* and *Allocasuarina* species are present (Baxter & Henderson, 2000; Pavey *et al.*, 2014). The species also occurs and breeds in vegetated riverine and littoral areas, with breeding primarily occurring in marble gum hollows (DEWHA, 2008; Pavey *et al.*, 2014). Princess parrots have been observed feeding on grass, *Acacia* seed pods flowers (mulga, *Grevillea* sp., *Leptosema* sp., *Hakea* sp., *Eremophila* sp.), leaf stems, lerps, and other plant material (Pavey *et al.*, 2014).

6.7.2 Previous Records

There are no records of princess parrot in the immediate vicinity of the Study Area; the nearest record is approximately 38 km north from 2012 (DBCA, 2024c). The Study Area is outside the modelled distribution for which the species or species habitat is known, likely, or may occur (DoEE, 2019a); the core range of the princess parrot occurs in the arid interior in the Great Sandy Desert, Gibson Desert, or Great Victorian Desert (Pavey *et al.*, 2014).

6.7.3 Survey Methods

6.7.3.1 Acoustic recorders

Song Meter acoustic recorders were deployed at two sites (VNEB-002 and VPWR-028) within the Study Area in marginally suitable habitat, within Drainage Area/ Floodplain (Table 6.5; Figure 6.11). No critical or supporting habitat aligning with habitat preferences of the species was recorded within the Study Area, therefore acoustic recorders were deployed in best available habitats.

6.7.3.2 Avifauna Surveys

Avifauna sampling was undertaken whilst undertaking targeted searches throughout the Study Area; sampling was undertaken during periods of likely activity, with a focus on recording either direct observation and/or calls.

6.7.4 Survey Results

No records or evidence of princess parrot were recorded within the Study Area during the current survey.

6.7.5 Discussion

The Study Area is outside the modelled distribution for which the species or species habitat is known, likely, or may occur (DoEE, 2019a), with the core range for the species occurring in

the arid interior in the Great Sandy Desert, Gibson Desert, or Great Victorian Desert (Pavey *et al.*, 2014). No princess parrot or evidence of the species' occurrence was recorded during the current survey, and there is a scarcity of records within the region. Princess parrot is a boom-bust species (Pavey *et al.*, 2014), and as such previous records of the species in the Pilbara may be attributed to population expansion during the time. Overall, the habitats present in the Study Area are unlikely to provide nesting/ roosting or foraging habitat to support the species outside these boom-bust periods. In consideration of the lack of previous records and location outside the known distribution, princess parrot is considered Unlikely to occur.

6.8 Grey Falcon (*Falco hypoleucos*) – Vulnerable EPBC Act & BC Act

6.8.1 Species Profile

The grey falcon 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 guttata*) 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 km^2. 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 lows (Schoenjahn *et al.*, 2022).

6.8.2 Previous Records

Two records of grey falcon occur within 11 km of the Study Area, comprising a single individual observed flying over Hillcrest/ Hillslope and Breakaway/ Cliff habitat, 4.5 km west-north-west in 2021 (GHD, 2022), and another sub-adult individual observed 10.9 km east-north-east in 2013 (Eco Logical, 2013). A third record of grey falcon occurs approximately 20 km north of the Study Area comprising a single individual observed during a targeted search in 2021 (Biota, 2022). There are no previous records of grey falcon within the Study Area (Figure 6.12).

6.8.3 Survey Methods

6.8.3.1 Avian Surveys

Avifauna sampling was undertaken whilst undertaking four targeted searches within the Study Area, focusing on suitable habitat (i.e. Major Drainage Line habitat) (TNEB-002, TNEB-003 (two searches), TPWR-001 and TPWR-090) totalling 3.8 person hours (Figure 6.13; Appendix F). Sampling was undertaken during periods of likely activity, with a focus on recording either direct observation, calls and/or secondary evidence (e.g. nests and/or, feathers).

Most of the targeted searches were undertaken alongside targeted searches for other species, including northern quoll and Pilbara olive python.

6.8.4 Survey Results

Grey falcon was not recorded during the current survey.

6.8.5 Discussion

The Study Area is located within the current distribution of the grey falcon, where the species or species' habitat is likely to occur (DoE, 2022a), The grey falcon is regarded as representing 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 therefore considered to be part of an 'important population'.

The Major Drainage Line habitat (5.83%, 140.13 ha) is considered critical habitat for grey falcon (Figure 6.13). The Drainage Area/ Floodplain (15.39%, 400.69 ha) and Minor Drainage Line (2.12%, 55.26 ha) habitats may provide supporting habitat for foraging and dispersal functions, and to a lesser extent, other habitats more broadly; however, the species' occurrence is likely to be dependent on the proximity of nesting (Figure 6.13). Nesting may occur in Major Drainage Line habitat where suitable tall trees are present or in other habitats where suitable tall infrastructure (i.e. powerline or transmission towers) occurs. Critical habitat within the Study Area is likely limited to the Major Drainage Line habitats that extend from the northwest corner of the Study Area along the southern boundary to the south-east. The major creekline contains large *Eucalyptus camaldulensis* and *E. victrix* trees that may provide suitable nesting sites. If breeding was recorded within the Study Area, these areas would be considered important on a local and regional scale. Grey falcons are known to be "reluctant nomads", only moving on from their home range when conditions become a risk to their survival (Schoenjahn, 2018); as such, if any individuals are recorded, they are likely to rely on the habitats within the Study Area or local vicinity for long-term persistence. Based on the suitability of nesting and foraging habitats within the Study Area and the previous contemporary records, the grey falcon is considered Possible to occur.

720000
760000
800000
840000
7440000
7400000
Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

LEGEND

Study Area
Desktop Assessment Area
State Road
Rail

BHP (2023)

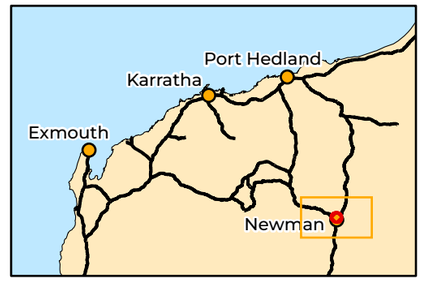
Individual (alive)

Biologic

Scale 1:420,000

0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator
Created: 14/08/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.12: Previous grey falcon records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VPWR-090
VPWR-021
VNEB-003
Ore Body 24
Port Hedland Newman Railway
Great Northern Hwy
Marble Bar Rd

LEGEND

Study Area
State Road
Rail

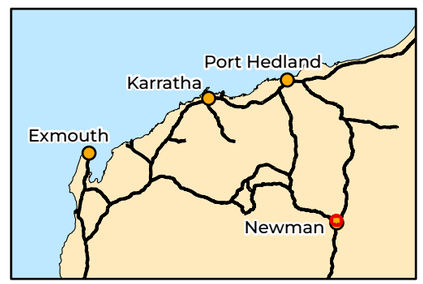
Sampling Type
Targeted Search
Targeted Search

Fauna Habitat
Critical
Supporting
Nil

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.13: Grey falcon sampling locations and habitat in the Study Area

6.9 Pilbara Olive Python (*Liasis olivaceus* subsp. *barroni*) – Vulnerable EPBC Act & BC Act

6.9.1 Species Profile

The Pilbara olive python is Western Australia's largest snake, averaging 2.5 metres (m) in length, with records up to 4.5 m (Bush & Maryan, 2011; Cogger, 2014). It has a dull olive-brown upper surface and is pale cream below (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, doves/pigeons (Ellis, 2013; Ellis & Johnstone, 2016; Pearson, 2007; Pearson, 2003; TSSC, 2008).

It commonly inhabits 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).

6.9.2 Previous Records

There are 61 records of the species within 40 km of the Study Area (BHP, 2023; DBCA, 2024c) (Figure 6.14). Of these, one occurs within the Study Area, a record of a scat collected in 2013 (BHP, 2023) (Figure 6.14). Seventeen additional records are within 10 km and the remaining 43 records are within 22 km of the Study Area (BHP, 2023; DBCA, 2024c).

6.9.3 Survey Methods

6.9.3.1 Targeted Searches

Diurnal searches were conducted along 18 targeted search traverses, with efforts focused in habitats with particular habitat features such as caves and overhangs (i.e. Gorge/ Gully and Breakaway/ Cliff) and where pooling water remains for prolonged periods following rainfall events (i.e. Major Drainage Line) (Figure 6.15; Appendix F). In addition, seven person hours of nocturnal searches were conducted across three sites (VNEB-010, VNEB-018 and VPWR-021) along a Major Drainage Line and Minor Drainage Line habitats and at water features (Figure 6.15; Appendix F). Searches focused on observing active individuals, particularly in or around water features, and from secondary evidence such as scats, sloughs or skeletal remains. A total of 33.3 person hours of targeted searches for Pilbara olive python were undertaken within the Study Area (Appendix F).

6.9.4 Survey Results

Evidence of Pilbara olive python was recorded from one location within the Study Area, from a shed/slough collected during a targeted search at site VPWR-020 (corresponding to cave CER-06) (Figure 6.15; Appendix G).

6.9.5 Discussion

Ten water features were recorded in the Study Area during the current survey (Figure 5.2). One artificial water feature (turkey nest) is classified as permanent/ persistent or likely permanent/persistent at the time of the survey. Of the nine naturally occurring water features, four are classified as semi-persistent and five as ephemeral. One water feature has previously been recorded within the Study Area within Gorge/ Gully habitat; however, was not located during the current survey, indicating it is likely ephemeral or semi-persistent. For Pilbara olive pythons, these water features often act as critical foraging locations and for that reason it is often associated with water features, particularly in rocky habitats. These water features also occur to a lesser degree in Major Drainage Line and Minor Drainage Line habitat where suitable vegetation cover is present (Pearson, 1993). Permanent water features are considered critical habitat; however, as the permanent water feature in the Study Area is artificial and the prolonged existence is limited by mining activity, it's significance in the landscape will be periodical. The ephemeral pools in Major Drainage Line habitat are considered supporting habitat; however, may play a more critical role allowing connectivity between water source sites seasonally.

Overall, the Major Drainage Line (5.83%, 140.13 ha), Breakaway/ Cliff (0.01%, 0.29 ha) and Gorge/ Gully (0.25%, 6.45 ha) habitats mapped within the Study Area provide critical habitat for the Pilbara olive python (Figure 6.15). Areas of Minor Drainage Line (2.12%, 55.26 ha) that do not

contain permanent water features are classified as supporting habitat, particularly in areas where they connect between areas of critical habitat (i.e. Gorge/ Gully); however, these areas may become of more value to the species seasonally when water is more abundant following rainfall events. In addition Hillcrest/Hillslope (21.77%, 566.56 ha) is considered supporting habitat where in the home range (88 - 440 ha, BHP WAIO, 2023b)) of critical habitat and where important microhabitats are present (BHP WAIO, 2023b).

The Pilbara olive python was recorded during the current survey and has been recorded previously within the Study Area so is Confirmed to occur. Based on this and the Study Area containing both critical and supporting habitat, the population would be considered part of or contributing to an 'important population' as defined by DoE (2013a).

720000
760000
800000
840000
7440000
7400000

Port Hedland Newman Railway
Marble Bar Rd
Great Northern Hwy
Newman

DBCA (2024)
- Individual (alive)
- Individual (dead)
- Scat
- Secondary Evidence
- Specimen
- Unknown

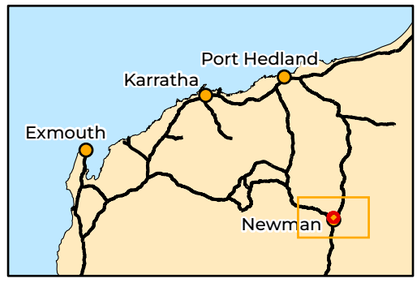
BHP (2023)
- Individual (alive)
- Individual (dead)
- Scat
- Secondary Evidence
- Unknown

LEGEND
- Study Area
- Desktop Assessment Area
- State Road
- Rail

Biologic

Scale 1:420,000
0 5 10 15 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/08/2024



BHP WAIO
NEBO Targeted Vertebrate Fauna Survey

Figure 6.14: Previous Pilbara olive python records in the Study Area and region

780000
782500
785000
787500
7420000
7417500
7415000

VNEB-011
VPWR-090
VPWR-056
VPWR-038
Ore Body 24
WHST-01
VPWR-020
VNEB-014
VNEB-012
VNEB-017
VNEB-004
VNEB-016
VNEB-008
WHST-02
WHST-03
VPWR-021
VPWR-052
VNEB-001
VNEB-005
VNEB-015
WER-06
WER-07
VNEB-003
Port Hedland Newman Railway
WER-08
WER-09
WER-12
VNEB-018
VNEB-010
WER-10
WER-11
Great Northern Hwy
Marble Bar Rd

LEGEND

- Study Area
- State Road
- Rail

Sampling Type

- Nocturnal Search
- Targeted Search
- Targeted Search

Fauna Habitat

- Critical
- Supporting
- Nil

- Water Feature

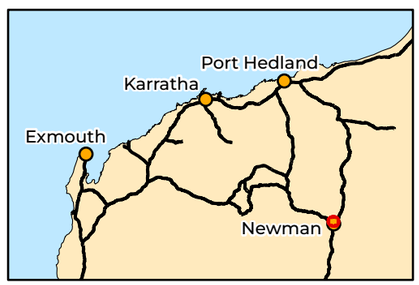
Pilbara olive python - VU

- Secondary Evidence

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.15: Pilbara olive python sampling locations, records and habitat in the Study Area

6.10 Great desert skink (*Liopholis kintorei*) – Vulnerable EPBC Act & BC Act

6.10.1 Species Profile

The great desert skink is endemic to the Australian arid zone in the western deserts region (TSSC, 2016a). Within Western Australia, the species appears to have undergone a range contraction in WA, with surveys failing to detect the species in former strongholds in the Gibson Desert north of Warburton and in the Great Victoria Desert (Pearson *et al.*, 2001).

Sandplain vegetated by spinifex and scattered shrubs appears to be the habitat type most widely used by the species, and some adjacent dunefield swales (Pavey, 2006). In the Tanami Desert and parts of the Great Sandy Desert they also inhabit paleodrainage lines characterised by giant termite mounds and titree (*Melaleuca* species) shrubs. The recently discovered population in northern South Australia is located in an area of spinifex and woollybutt grass (*Eragrostis* sp.) with scattered mulga. Extensive areas of dunefields, rocky ranges and mulga woodlands occur through the western deserts and are considered unsuitable habitat (Pavey, 2006).

6.10.2 Previous Records

The Study Area is outside the modelled distribution for which the species or species habitat is known or likely to occur (DoEE, 2019a). The closest record of great desert skink from database searches, includes a record of secondary evidence approximately 62 km east of the Study Area in 2010 (DBCA, 2024c); however, the accuracy of this record could not be confirmed.

6.10.3 Survey Methods

Opportunistic sampling was undertaken during targeted searches for greater bilby throughout the Study Area in the best suitable habitat (i.e. Sand Plain). No high value habitat aligning with habitat preferences of the species was recorded within the Study Area; overall, the habitats present were considered marginal and unlikely to provide critical habitat for the species due to the lack of suitable large sandplain areas present.

6.10.4 Survey Results

No records or evidence of great desert skink were recorded within the Study Area during the current survey.

6.10.5 Discussion

The Study Area is outside the modelled distribution for which the species or species habitat is known or likely, to occur (DoEE, 2019a), with the core range for the species occurring in the arid interior (Indigenous Desert Alliance, 2022). While marginally suitable habitat in the form of Sand Plain (3.10%, 80.62 ha) is present within the Study Area, the habitat is relatively small in size, impacted by tracks and mining activity, and isolated from other similar habitat outside of the Study Area, making it unlikely to support a population of the species. No great desert skink or evidence of the species' occurrence was recorded during the current survey. Given the lack of records from the survey, a scarcity of records within the region, and location of the Study Area outside the known distribution, great desert skink is considered Highly Unlikely to occur.

6.11 Other Fauna of Significance

In addition to the species discussed above, other fauna of significance were also targeted during searches undertaken throughout the Study Area (Figure 6.16; Appendix G). Eighteen non-target species were identified during the acoustic recordings (Appendix H).

One other significant species was recorded in the Study Area during the current survey, the western pebble-mound mouse (*Pseudomys chapmani* – Priority 4 DBCA). One inactive mound was recorded during a targeted search in Hillcrest/ Hillslope habitat (Appendix G; Figure 6.16). The western pebble-mound mouse has previously been recorded on more than 360 occasions within 40 km of the Study Area (BHP, 2023; DBCA, 2023), eight of which are from within the Study Area (none of which aligning with current record), primarily within Hillcrest/ Hillslope habitats. The species is likely to occur as a resident throughout the Study Area, primarily in Hillcrest/ Hillslope (21.77%, 566.56 ha), Undulating Low Hills (2.37%, 61.60 ha) and Stony Plain (2.87%, 74.83 ha) habitats. The species occurrence within the Study Area is unlikely to represent an important population and the species is not likely to be reliant upon the Study Area, or habitat within, for the long-term persistence of the species at a local or regional scale.

No brush-tailed mulgara were recorded during the current survey; however, one active burrow attributed to the species was recorded within Sand Plain habitat approximately 3 km west from the Study Area (Biologic, *in prep.-b*). This species has previously been recorded on eight occasions within the vicinity of the Study Area, primarily within Drainage Area/ Floodplain and Sand Plain habitats. The species is considered Likely to occur as a resident in small sections of the Study Area, in Drainage Area/ Floodplain (15.39%, 400.69 ha), Stony Plain (2.87%, 74.77 ha) and Sand Plain (3.10%, 80.62 ha) habitats. The species occurrence and abundance within the Study Area is likely to be influenced by resource abundance, particularly following rainfall events and increase in resource availability. The species'

occurrence within the Study Area is unlikely to represent an important population and the species is not likely to be reliant upon the Study Area, or habitat within, for the long-term persistence of the species at a local or regional scale.

Several other significant species were identified in the desktop assessment as recorded within the vicinity of the Study Area, of which six are Possible to occur (long-tailed dunnart, northern short-tailed mouse, peregrine falcon, fork-tailed swift, spotted ctenotus (northeast), and Gane's blind snake) (Table 6.1). Whilst they were not recorded during the current survey, they may possibly occur within the Study Area; however, habitats within are unlikely to be relied upon by any of these species for their long-term persistence at a local and/or regional scale. The remaining 25 significant species that were identified in the desktop assessment are considered Unlikely or Highly Unlikely to occur primarily due to the absence of any critical and/or supporting habitats likely to be used by the species (Table 6.1).

780000
782500
785000
787500
7420000
7417500
7415000

VPWR-028
VPWR-119
VPWR-117
VNEB-012
VNEB-017
VNEB-008
Ore Body 24
Port Hedland Newman Railway
Northern Hwy
Marble Bar Rd

Fauna Habitat
- Breakaway/ Cliff
- Cleared/ Disturbed
- Drainage Area/ Floodplain
- Gorge/ Gully
- Hillcrest/ Hillslope
- Major Drainage Line
- Minor Drainage Line
- Mulga Woodland
- Sand Plain
- Stony Plain
- Undulating Low Hills

LEGEND
- Study Area
- State Road
- Rail

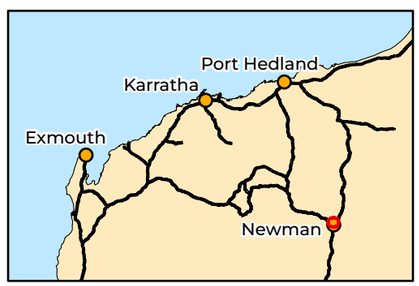
Sampling Type
- Targeted Search
- Targeted Search

Western pebble-mound mouse - P4
- Mound (inactive)

Biologic

Scale 1:25,000
0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 25/10/2024



BHP WAIO

NEBO Targeted Vertebrate Fauna Survey

Figure 6.16: Other significant species sampling, records and habitat in the Survey Area

7 Conclusion

7.1 Northern Quoll

Northern quoll was not recorded during the current survey and records within the vicinity of the Study Area and in the region are scarce. However, critical breeding, foraging and dispersal habitat for the species is present within the Study Area in Gorge/ Gully (0.25%, 6.45 ha), Breakaway/ Cliff (0.01%, 0.29 ha), and Major Drainage Line (5.83%, 140.13 ha) habitats. Potential supporting habitat for the northern quoll occurs in the Hillcrest/ Hillslope (21.77%, 566.56 ha) and Minor Drainage Line (2.12%, 55.26 ha) habitats, where proximal (<35 ha, BHP WAIO (2023b)) to critical habitat (Gorge/ Gully, Breakaway/ Cliff, and Major Drainage Line).

Overall, in consideration of the overall scarcity and concentration of records, it is unlikely a resident population occurs within the Study Area permanently. Due to this reason, the species occurrence within the Study Area is considered Possible; however, may be limited to infrequent visitations by dispersing individuals.

7.2 Greater Bilby

No records or evidence of the greater bilby was recorded within the Study Area during the current survey; the nearest previous record is approximately 40 km of the Study Area at Capricorn Roadhouse (year 1979). However, critical breeding, foraging and dispersal habitat for the species is present within the Study Area in areas of suitable Sand Plain habitat (3.10%, 80.62 ha). Other habitats within the Study Area (Major Drainage Line (5.83%, 140.13 ha), Mulga Woodland (0.73%, 19.11 ha) and Drainage Area/ Floodplain (15.39%, 400.69 ha)), may be used for foraging when adjacent to critical habitat (i.e. Sand Plain) if the species was present. Based on the limited number of nearby recent records, and presence of critical and supporting habitats within the Study Area the greater bilby is considered Possible to occur in the Study Area.

7.3 Ghost Bat

Ghost bat was recorded on one occasion via secondary evidence (approximately 1,000 scats) at cave CER-06 in the Study Area during the current survey. This cave was classified as a Category 3 roost (diurnal roost cave with occasional occupancy), with a further five additional caves recorded in the Study Area during the current survey identified as Category 4 (nocturnal roost caves with opportunistic usage) roosts for the species.

The most suitable areas of habitat to support the species for roosting within the Study Area are Gorge/ Gully (0.25%, 6.45 ha) and Breakaway/ Cliff (0.01%, 0.29 ha), and in some instances Hillcrest/ Hillslope (21.77%, 566.56 ha). Gorge/ Gully and Breakaway/ Cliff habitats also provide supporting dispersal habitat for the species. All other habitats (except Hillcrest/ Hillslope)

provide supporting foraging and dispersal habitat for the species when proximal (<12 km) to roosting caves, with some habitats containing more important features (e.g. trees for perching) for foraging than others (i.e. Drainage Area/ Floodplain, Stony Plain and Major Drainage Line).

Due to the presence of known roosting caves and confirmed records within the Study Area and surrounds, the ghost bat is likely to occur as a resident and utilise the above habitats within the Study Area for foraging. The individuals present within the Study Area contribute to a population aligning with the DoE (2013b) definition of 'important'.

7.4 Pilbara leaf-nosed Bat

No records or evidence of the Pilbara leaf-nosed bat was recorded within the Study Area during the current survey; however, it has been recorded on many occasions within the vicinity of the Study Area. The nearest known provisional permanent diurnal roost for this species is cave CNIN-12, approximately 14 km east of the Study Area.

No habitat within the Study Area is considered critical for the Pilbara leaf-nosed bat, as there are no diurnal roosts (Category 1–3) within the Study Area (Bat Call, 2021b) and no calls were identified during the current survey. The occurrence of a provisional Category 2 roost within 14 km of the Study Area (within the 20 km known foraging range) means the species is likely to frequently forage within the habitats present within the Study Area. As such Breakaway/ Cliff habitat (0.01%, 0.29 ha) is classified as a Habitat Rating 4 (very high), and Gorge/ Gully (0.25%, 6.45 ha) and Major Drainage Line (5.83%, 140.13 ha) habitats are classified as a Habitat Rating 3 (high) as defined by Bat Call (2021b). All other habitats within the Study Area provide varying degrees of supporting foraging habitat, with Hillcrest/ Hillslope (21.77%, 566.56 ha), Drainage Area/ Floodplain (15.39%, 400.69 ha), Stony Plain (2.87%, 74.83 ha), Sand Plain (3.10%, 80.62 ha), Undulating Low Hills (2.37%, 61.60 ha), Minor Drainage line (2.12%, 55.26 ha) and Mulga Woodland (0.73%, 19.11 ha), classified as Habitat Rating 2 (moderate) for the species (Bat Call, 2021b). The Study Area also contains ten water features likely to provide supporting foraging habitat for the species.

The results of this survey support previous studies which have showed that the Pilbara leaf-nosed bat is relatively scarce within the broader Newman region (summarised in Biologic (2020c)), due to the limited availability of roosting habitat. 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; however, due to a provisional permanent diurnal roost (preliminary categorisation as Category 2 cave CNIN-12) within 14km the Study Area, the species is considered Likely to occur in the Study Area and if present would likely be for foraging and dispersal.

7.5 Night parrot

No evidence of occurrence of night parrot was recorded within the Study Area during the current survey and the closest record is 100 km to the north, which was recorded from Cloudbreak mine in 2021 (FMG, 2021). Within the Study Area, Stony Plain habitat that contains large, long-unburnt *Triodia* hummocks could provide supporting foraging and dispersal habitat for the species. However, overall, the habitat within the Study Area was not considered suitable preferred habitat for the species to forage. Based on the absence of critical and/or supporting habitats present within the Study Area, it is considered Unlikely to occur within the Study Area either as a resident or infrequent visitor during foraging and or dispersal.

7.6 Southern Whiteface

No southern whiteface or evidence of the species' occurrence was recorded during the current survey and there is only one previous record within the vicinity of the Study Area. However, critical breeding/ nesting, foraging and dispersal habitat for the species exists within the Drainage Area/ Floodplain (15.39%, 400.69 ha) in the Study Area. Supporting breeding/ nesting, foraging and dispersal habitat for the species exists within the Study Area in Sand Plain (3.10%, 80.62 ha), Minor Drainage Line (2.12%, 55.26 ha), and Major Drainage Line (5.83%, 140.13 ha) habitats, while Stony Plain (2.87%, 74.83 ha) and Mulga Woodland (0.73%, 19.11 ha) habitats provide supporting foraging and dispersal habitat for the species.

Due to recent update of the species' conservation status, the scarcity of records in the broader vicinity, and the Study Area occurring on the northern periphery of the species distribution (DCCEEW, 2023), any records present may represent part of or contribute to an important population of the species, with the habitats within the Study Area potentially relied upon for individuals for persistence at a local and/or regional scale. Given these factors and the present of suitable habitats the species is considered Possible to occur within the Study Area.

7.7 Princess Parrot

The Study Area is outside the modelled distribution for which the species or species habitat is known, likely, or may occur. No princess parrot or evidence of the species' occurrence was recorded during the current survey, and the nearest record is approximately 38 km north (year 2012) of the Study Area. Overall, the habitats present in the Study Area are unlikely to provide nesting/ roosting or foraging habitat to support the species outside boom-bust periods. Due to lack of suitable nesting/ roosting or foraging habitat, the lack of previous records and location outside the known distribution the Princess parrot is considered Unlikely to occur.

7.8 Grey Falcon

No grey falcons were recorded within the Study Area during the current survey, but two records of the species occur within 11km of the Study Area (year 2021) (Eco Logical, 2013; GHD, 2022). Critical habitat for nesting/ roosting, foraging and dispersal exists within the Study Area in Major Drainage Line habitat (5.83%, 140.13 ha). Supporting foraging and dispersal habitat occurs in Drainage Area/ Floodplain (15.39%, 400.69 ha) and Minor Drainage Line (2.12%, 55.62 ha) habitats within the Study Area. The species' occurrence is likely to be dependent on the proximity of nesting. Nesting may occur in Major Drainage Line habitat where suitable tall trees are present or suitable tall infrastructure (i.e. powerline or transmission towers) occurs. No known nesting sites are present within or in the vicinity of the Study Area, therefore the species is Likely to occur as foraging or dispersing individuals.

7.9 Pilbara Olive Python

Pilbara olive python was recorded once (skin/slough) within the Study Area during the current survey (from cave CER-06). There is one previous record within the Study Area from 2013 (BHP, 2023). Ten water features were recorded within the Study Area during the current survey with one artificial water feature (turkey nest) classified as permanent/persistent or likely permanent/persistent at the time of the survey. This permanent water feature is considered critical habitat for the species, however, as this water feature is artificial and the prolonged existence is limited by mining activity, it's significance in the landscape will be periodical. The likely ephemeral pools are considered supporting habitat for the species. Critical habitat for the species is present within the Study Area in Major Drainage Line (5.83%, 140.13 ha), Gorge/ Gully (0.25%, 6.45 ha) and Breakaway/ Cliff (0.01%, 0.29 ha). Supporting habitat for the species occurs within the Study Area in Minor Drainage Line (2.12%, 55.62 ha), Hillcrest/Hillslope (21.77%, 566.56 ha) and Drainage Area/ Floodplain (15.39%, 400.69 ha), particularly in areas connecting between critical habitat (i.e. Gorge/ Gully).

Based on the records within and in the vicinity the Study Area, the present of both critical and supporting habitat including water features, the individuals present would form part of a population considered an 'important population' as defined by DoE (2013a).

7.10 Great Desert Skink

No great desert skink or evidence of the species' occurrence was recorded during the current survey, and there is a scarcity of records within the region. In addition, the Study Area is outside the modelled distribution for which the species or species habitat is known or likely to occur (Indigenous Desert Alliance, 2022). The Sand Plain habitat (3.10%, 80.62 ha) present in the Study Area is not considered suitable to support the species due to the absence of large undisturbed areas of the habitat. In consideration of this, the lack of previous records,

and location outside the known distribution, great desert skink is considered Highly Unlikely to occur.

7.11 Other Fauna of Significance

One other significant species was recorded in the Study Area during the current survey (inactive mound) and previous surveys, the western pebble-mound mouse. The species is likely to occur as a resident throughout the Study Area, primarily in Hillcrest/ Hillslope (21.77%, 566.56 ha), Undulating Low Hills (2.37%, 61.60 ha) and Stony Plain (2.87%, 74.83 ha) habitats. No brush-tailed mulgara were recorded during the current survey; however, has been recorded previously within the vicinity of the Study Area, primarily within Drainage Area/ Floodplain and Sand Plain habitats. The species is Likely to occur as a resident in small sections of the Study Area, in Drainage Area/ Floodplain (15.39%, 400.69 ha), Stony Plain (2.87%, 74.83 ha) and Sand Plain (3.10%, 80.62 ha) habitats. Both species' occurrence within the Study Area is unlikely to represent an important population and the species is not likely to be reliant upon the Study Area, or habitat within, for the long-term persistence of the species at a local or regional scale.

Six other significant species are considered Possible to occur within the Study Area: long-tailed dunnart, northern short-tailed mouse, peregrine falcon, fork-tailed swift, spotted ctenotus (northeast), and Gane's blind snake. Whilst they were not recorded during the current survey, they may possibly occur within the Study Area; however, habitats within are unlikely to be relied upon by any of these species for their long-term persistence at a local and/or regional scale. The remaining 25 significant species that were identified in the desktop assessment are considered Unlikely or Highly Unlikely.

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Appendix A: Conservation Codes

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened Fauna Species	
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Migratory (MIG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention)

Biodiversity Conservation Act 2016

Category	Definition
Threatened Fauna Species	
Critically Endangered (Cr)	Rare or likely to become extinct, as *critically endangered* fauna.
Endangered (En)	Rare or likely to become extinct, as *endangered* fauna.
Vulnerable (Vu)	Rare or likely to become extinct, as *vulnerable* fauna.
Extinct (Ex)	Being fauna that is presumed to be extinct.
Migratory (Mi)	Birds that are subject to international agreements relating to the protection of migratory birds.
Conservation Dependent (CD)	Special conservation need being species dependent on ongoing conservation intervention. (Conservation Dependant)
Other Specially Protected Species (OS)	In need of special protection, otherwise than for the reasons pertaining to Schedule 1 through to Schedule 6 Fauna. (Other specially protected species

Department of Biodiversity, Conservation and Attractions Priority Definitions

Category	Definition
Priority Fauna Species	
Priority 1 (P1)	**Poorly-known Species** Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2 (P2)	**Poorly-known Species** Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3 (P3)	**Poorly-known Species** Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4 (P4)	**Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

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Category	Definition
Extinct (Ex)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (Ex)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (Cr)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (En)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (Vu)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

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 Protected Matters (40km)	DBCA Priority and Threatened Database (40km)	ALA (40km)	Birdlife (40km)	BHP (5km)	Biologic (2014b)	Biologic (2013).	Biologic (2014c).	Biologic (2014d)	Onshore (2015b)	Biologic (2016a)	Biologic (2016b).	Biologic (2016c)	Biologic (2019)	Biologic (2018b).	Biologic (2020b).	GHD (2021).	Biologic (2022a).	GHD (2022).	Biologic (2021b).	Biologic (2023b).	Onshore (2017).	Biologic (2023a).	Biologic (2014a).	Biota (2022).	Astron (2024).	Onshore (2015a).	Biologic (2022b).	Ecologia (2004).	ENV (2007).	Outback Ecology (2009)	ENV (2011b).	MWH (2015).
MAMMALS																																										
DASYURIDAE																																										
Antechinomys longicaudatus	Long-tailed dunnart			P4		X		X	X																																	
Dasycercus blythi	Brush-tailed mulgara			P4		X		X			X		X		X			X	X		X				X															
Dasyurus hallucatus	Northern quoll	EN	EN		EN		Likely	X			X																															
MACROPODIDAE																																										
Lagorchestes conspicillatus subsp. *leichardti*	Spectacled hare-wallaby			P4		X		X	X																												X				
Petrogale lateralis subsp. *lateralis*	Black-flanked rock-wallaby	EN	EN		VU	X		X	X																																	
MEGADERMATIDAE																																										
Macroderma gigas	Ghost bat	VU	VU		VU	X	X	X	X		X	X	X				X						X																		
MURIDAE																																										
Leggadina lakedownensis	Northern short-tailed mouse			P4																															X		X				
Pseudomys chapmani	Western pebble-mound mouse			P4		X		X	X		X	X	X				X								X			X						X	X		X	X		
RHINONYCTERIDAE																																										
Rhinonicteris aurantia 'Pilbara form'	Pilbara leaf-nosed bat	VU	VU			X	X	X			X		X				X								X		X				X		X							
THYLACOMYIDAE																																										
Macrotis lagotis	Greater bilby	VU	VU		VU		Likely	X																																		
BIRDS																																										
ACANTHIZIDAE																																										
Aphelocephala leucopsis	Southern whiteface	VU				X	May		X													X																			
ANATIDAE																																										
Anas querquedula	Garganey	MI	MI								X																														
APODIDAE																																										
Apus pacificus	Fork-tailed swift	MI	MI				Likely	X	X		X																							X		X		X		X	
CHARADRIIDAE																																										
Charadrius dubius	Little ringed plover	MI	MI								X																														X
Charadrius leschenaultii	Greater sand plover	MI / VU	VU						X	X																															

Species		Conservation Status				Database review						Literature review																															
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	NatureMap (40 km)	EPBC Protected Matters (40km)	DBCA Priority and Threatened Database (40km)	ALA (40km)	Birdlife (40km)	BHP (5km)	Biologic (2014b)	Biologic (2013).	Biologic (2014c).	Biologic (2014d)	Onshore (2015b)	Biologic (2016a)	Biologic (2016b).	Biologic (2016c)	Biologic (2019)	Biologic (2018b).	Biologic (2020b).	GHD (2021).	Biologic (2022a).	GHD (2022).	Biologic (2021b).	Biologic (2023b).	Onshore (2017).	Biologic (2023a).	Biologic (2014a).	Biota (2022).	Astron (2024).	Onshore (2015a).	Biologic (2022b).	Ecologia (2004).	ENV (2007).	Outback Ecology (2009)	ENV (2011b).	MWH (2015).
Charadrius veredus	Oriental plover	MI	MI				May	X	X																															
FALCONIDA																																								
Falco hypoleucos	Grey falcon	VU	VU		VU		Likely		X		X														X					X		X							
Falco peregrinus	Peregrine falcon		OS			X		X	X	X	X		X												X															
HIRUNDINIDAE																																								
Hirundo rustica	Barn swallow	MI	MI				May				X																												X
LARIDAE																																								
Gelochelidon nilotica	Gull-billed tern	MI	MI			X		X	X	X																														
Sterna caspia	Caspian tern	MI	MI			X		X	X	X																														
MOTACILLIDAE																																								
Motacilla cinerea	Grey wagtail	MI	MI				May																																	
Motacilla flava	Yellow wagtail	MI	MI				May																																	
PSITTACIDAE																																								
Pezoporus occidentalis	Night parrot	EN	CR		CR		Likely																																	
Polytelis alexandrae	Princess parrot	VU		P4	NT		X	X	X																															
ROSTRATULIDAE																																								
Rostratula australis	Australian painted snipe	EN	EN		EN		May																																	
SCOLOPACIDAE																																								
Actitis hypoleucos	Common sandpiper	MI	MI			X	X	X	X	X	X																									X			X
Calidris acuminata	Sharp-tailed sandpiper	MI	MI		VU	X	May	X	X	X	X																												X
Calidris ferruginea	Curlew sandpiper	MI / CR	CR		NT	X	X	X	X	X	X																												X
Calidris melanotos	Pectoral sandpiper	MI	MI			X	May	X	X		X																												X
Calidris ruficollis	Red-necked stint	MI	MI		NT	X		X	X	X																													
Calidris subminuta	Long-toed stint	MI	MI			X		X	X	X	X																												X
Limosa limosa	Black-tailed godwit	MI	MI		NT						X																												X
Philomachus pugnax	Ruff	MI	MI								X																												X
Tringa glareola	Wood sandpiper	MI	MI			X		X	X	X	X																												X
Tringa nebularia	Common greenshank	MI	MI			X		X	X	X																													X
Tringa stagnatilis	Marsh sandpiper	MI	MI			X		X	X	X	X																												X

Species		Conservation Status				Database review						Literature review																															
Scientific Name	Common Name	EPBC Act	BC Act	DBCA	IUCN	NatureMap (40 km)	EPBC Protected Matters (40km)	DBCA Priority and Threatened Database (40km)	ALA (40km)	Birdlife (40km)	BHP (5km)	Biologic (2014b)	Biologic (2013).	Biologic (2014c).	Biologic (2014d)	Onshore (2015b)	Biologic (2016a)	Biologic (2016b).	Biologic (2016c)	Biologic (2019)	Biologic (2018b).	Biologic (2020b).	CHD (2021).	Biologic (2022a).	GHD (2022).	Biologic (2021b).	Biologic (2023b).	Onshore (2017).	Biologic (2023a).	Biologic (2014a).	Biota (2022).	Astron (2024).	Onshore (2015a).	Biologic (2022b).	Ecologia (2004).	ENV (2007).	Outback Ecology (2009)	ENV (2011b).	MWH (2015).
Tringa totanus	Common redshank	MI	MI			X		X																																
THRESKIORNITHIDAE																																								
Plegadis falcinellus	Glossy ibis	MI	MI			X		X	X	X	X																													X
REPTILES																																								
PYTHONIDAE (PREVIOUSLY BOIDAE)																																							
Liasis olivaceus subsp. *barroni*	Pilbara olive python	VU	VU			X	X	X	X		X	X	X	X			X									X													
SCINCIDAE																																								
Ctenotus uber subsp. *johnstonei*	Spotted ctenotus (northeast)			P2															X		X																		
Liopholis kintorei	Great desert skink	VU	VU		VU		May	X																															
TYPHLOPIDAE																																								
Anilios ganei	Gane's blind-snake			P1		X		X	X		X	X																								X	X		

Appendix C: Vertebrate Fauna Habitat Assessments

Site ID	Location		Date	Habitat Type	Landform	Aspect	Slope	Soil		Outcropping			Veg. Litter	Dominant Veg. Types	Rocky Cracks / Crevices	Burrowing Suitability	Hollow Count	Water Presence	Habitat Condition	Disturbances	Time Since Fire	Photo
	Latitude	Longitude						Type	Availability	Extent	Rock Type	Rock Size										
VNEB-001	-23.3264	119.7688	16/04/2024	Hillcrest/ Hillslope	Gully	South	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Moderate	Nil	0	Prone to Flooding	0.8	Mining Exploration	Old (6+ yr)	
VNEB-002	-23.3407	119.7731	17/04/2024	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Loamy Sand	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Nil	High	0	None	0.8	Road/ Access Track	Old (6+ yr)	
VNEB-003	-23.3392	119.7732	17/04/2024	Major Drainage Line	Major Drainage Line	East	Low	Clay Loam	Evenly Spread	Negligible	None Discernible	Small Rocks (11-20cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs	Nil	Low	0	Prone to Flooding	0.8	Mining Exploration	Old (6+ yr)	
VNEB-004	-23.3214	119.7857	18/04/2024	Breakaway / Cliff	Hillcrest/ Upper Hillslope	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	High	Nil	0	None	0.6	Mining Exploration	Moderate (3 to 5 yr)	
VNEB-005	-23.3291	119.7755	21/04/2024	Hillcrest/ Hillslope	Gully	South	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	High	Nil	0	Prone to Flooding	0.6	Mining Exploration	Moderate (3 to 5 yr)	
VNEB-006	-23.3232	119.7903	18/04/2024	Breakaway / Cliff	Hillcrest/ Upper Hillslope	North	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	High	Nil	0	None	0.6	Mining Exploration	Moderate (3 to 5 yr)	
VNEB-007	-23.3443	119.7853	22/04/2024	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	Scattered Shrubs	Nil	Low	0	Prone to Flooding	0.6	Mining Exploration	Old (6+ yr)	
VNEB-008	-23.3235	119.7863	18/04/2024	Hillcrest/ Hillslope	Gully	West	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland	High	Nil	0	Prone to Flooding	0.6	Mining Exploration	Recent (0 to 2 yr)	

Site ID	Location		Date	Habitat Type	Landform	Aspect	Slope	Soil		Outcropping			Veg. Litter	Dominant Veg. Types	Rocky Cracks / Crevices	Burrowing Suitability	Hollow Count	Water Presence	Habitat Condition	Disturbances	Time Since Fire	Photo
	Latitude	Longitude						Type	Availability	Extent	Rock Type	Rock Size										
VNEB-009	-23.3380	119.7652	22/04/2024	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	None Discernible	Pebbles (5-10cm)	Many Small Patches	Scattered Shrubs, Tussock Grassland	Nil	Low	0	Prone to Flooding	0.6	Road/ Access Track	Old (6+ yr)	
VNEB-010	-23.3437	119.8005	18/04/2024	Major Drainage Line	Major Drainage Line	East	Low	Clay Loam	Evenly Spread	Negligible	None Discernible	Small Rocks (11-20cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs	Nil	Low	0	Prone to Flooding	0.8	Mining Exploration	Old (6+ yr)	
VNEB-011	-23.3128	119.7523	23/04/2024	Hillcrest/ Hillslope	Hillslope	South	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	High	Nil	0	None	0.6	Mining Exploration	Old (6+ yr)	
VNEB-012	-23.3210	119.7759	18/04/2024	Hillcrest/ Hillslope	Gorge	North/ East	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Gravel (1-4cm)	Many Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	High	Nil	0	Prone to Flooding	0.6	Mining Exploration	Old (6+ yr)	
VNEB-013	-23.3234	119.8014	23/04/2024	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Gravel (1-4cm)	Scarce	Scattered Shrubs, Spinifex Hummock Grassland	Moderate	Nil	0	None	0.6	Mining Exploration	Moderate (3 to 5 yr)	
VNEB-014	-23.3217	119.7731	18/04/2024	Hillcrest/ Hillslope	Gully	East	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Gravel (1-4cm)	Many Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	High	Nil	0	None	0.6	Mining Exploration	Old (6+ yr)	
VNEB-015	-23.3299	119.7813	21/04/2024	Gorge/ Gully	Gully	South	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Small Rocks (11-20cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	High	Nil	0	Prone to Flooding	0.6	Mining Exploration	Moderate (3 to 5 yr)	
VNEB-016	-23.3233	119.7770	21/04/2024	Gorge/ Gully	Gorge	North	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Pebbles (5-10cm)	Few Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	High	Nil	0	Prone to Pooling	0.6	Mining Exploration	Old (6+ yr)	

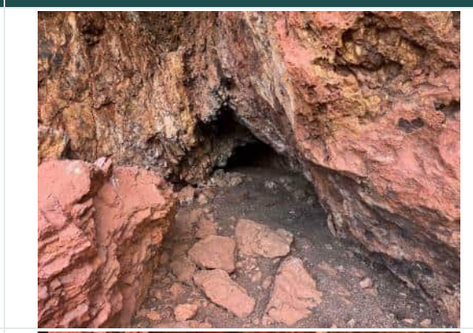
Site ID	Location		Date	Habitat Type	Landform	Aspect	Slope	Soil		Outcropping			Veg. Litter	Dominant Veg. Types	Rocky Cracks / Crevices	Burrowing Suitability	Hollow Count	Water Presence	Habitat Condition	Disturbances	Time Since Fire	Photo
	Latitude	Longitude						Type	Availability	Extent	Rock Type	Rock Size										
VNEB-017	-23.3215	119.7813	18/04/2024	Gorge/ Gully	Gully	West	Steep	Clay Loam	Scarce	Moderate Outcropping	BIF	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland	High	Nil	0	Prone to Flooding	0.6	Mining Exploration	Recent (0 to 2 yr)	
VNEB-018	-23.3390	119.8093	18/04/2024	Major Drainage Line	Major Drainage Line	East	Low	Clay Loam	Evenly Spread	Negligible	None Discernible	Small Rocks (11-20cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs	Nil	Low	0	Prone to Flooding	0.6	Mining Exploration	Old (6+ yr)	
VPWR-018	-23.3179	119.8118	19/04/2024	Minor Drainage Line	Minor Drainage Line	South	Low	Clay Loam	Evenly Spread	Moderate Outcropping	BIF	Pebbles (5-10cm)	Many Small Patches	Scattered Eucalypts, Scattered Shrubs	Moderate	Low	0	Permanent	0.6	Weed Invasion	Old (6+ yr)	
VPWR-020	-23.3213	119.7687	16/04/2024	Hillcrest/ Hillslope	Breakaway	West	Very Steep	Clay Loam	Scarce	Extensive Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	High	Nil	0	None	0.8	Mining Exploration	Old (6+ yr)	
VPWR-021	-23.3244	119.7549	16/04/2024	Major Drainage Line	Major Drainage Line	East	Flat	Clay Loam	Evenly Spread	Negligible	None Discernible	Pebbles (5-10cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Tussock Grassland	Low	Moderate	0	Prone to Pooling	0.8	Road/ Access Track	Old (6+ yr)	
VPWR-028	-23.3181	119.7546	17/04/2024	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	None Discernible	Small Rocks (11-20cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Nil	Moderate	0	Prone to Flooding	0.8	Mining Exploration	Old (6+ yr)	
VPWR-038	-23.3188	119.7845	18/04/2024	Hillcrest/ Hillslope	Breakaway	North	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Large Rocks (21-60cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	High	Nil	0	None	0.6	Mining Exploration	Moderate (3 to 5 yr)	
VPWR-052	-23.3252	119.7614	21/04/2024	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	West	Steep	Clay Loam	Scarce	Major Outcropping	BIF	Pebbles (5-10cm)	None Discernible	Spinifex Hummock Grassland	High	Nil	0	None	0.8	Mining Exploration	Old (6+ yr)	

Site ID	Location		Date	Habitat Type	Landform	Aspect	Slope	Soil		Outcropping			Veg. Litter	Dominant Veg. Types	Rocky Cracks / Crevices	Burrowing Suitability	Hollow Count	Water Presence	Habitat Condition	Disturbances	Time Since Fire	Photo
	Latitude	Longitude						Type	Availability	Extent	Rock Type	Rock Size										
VPWR-056	-23.3407	119.7368	21/04/2024	Minor Drainage Line	Minor Drainage Line	North/ East	Moderate	Clay Loam	Few Small Patches	Minor Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Scattered Shrubs, Tussock Grassland	Low	Low	0	Prone to Flooding	0.4	Weed Invasion	Old (6+ yr)	
VPWR-064	-23.3306	119.7513	22/04/2024	Drainage Area/ Floodplain	Calcrete Plain	Flat	Flat	Clay Loam	Scarce	Limited Outcropping	Sandstone	Pebbles (5-10cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Nil	Nil	0	None	0.6	Mining Exploration	Old (6+ yr)	
VPWR-066	-23.3223	119.8096	23/04/2024	Stony Plain	Hillslope	South	Low	Clay Loam	Scarce	Limited Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Low	Moderate	0	None	0.4	Mining Exploration	Old (6+ yr)	
VPWR-084	-23.3097	119.7820	23/04/2024	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	Shrubland, Spinifex Hummock Grassland	Nil	Low	0	None	0.4	Mining Exploration	Old (6+ yr)	
VPWR-086	-23.3123	119.7734	23/04/2024	Cleared/ Disturbed	Hillslope	North	Moderate	Clay Loam	Scarce	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	Weeds	Nil	Moderate	0	None	0.1	Rehab	Old (6+ yr)	
VPWR-088	-23.3128	119.7675	23/04/2024	Minor Drainage Line	Minor Drainage Line	South	Flat	Clayey Sand	Evenly Spread	Limited Outcropping	BIF	Gravel (1-4cm)	Many Small Patches	Mulga Woodland, Shrubland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	0	Prone to Flooding	0.8	Weed Invasion	Old (6+ yr)	
VPWR-090	-23.3154	119.7640	23/04/2024	Drainage Area/ Floodplain	Minor Drainage Line	Flat	Flat	Clay Loam	Few Small Patches	Negligible	None Discernible	Gravel (1-4cm)	Few Large Patches	Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	Low	Low	0	Prone to Flooding	0.2	Weed Invasion	Old (6+ yr)	
VPWR-092	-23.3184	119.7577	23/04/2024	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Scarce	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	Scattered Shrubs, Spinifex Hummock Grassland	Low	Moderate	0	None	0.6	Mining Exploration	Old (6+ yr)	

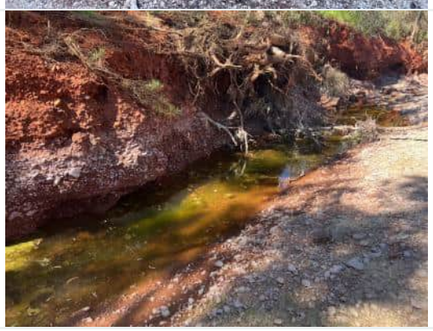
Site ID	Location		Date	Habitat Type	Landform	Aspect	Slope	Soil		Outcropping			Veg. Litter	Dominant Veg. Types	Rocky Cracks / Crevices	Burrowing Suitability	Hollow Count	Water Presence	Habitat Condition	Disturbances	Time Since Fire	Photo
	Latitude	Longitude						Type	Availability	Extent	Rock Type	Rock Size										
VPWR-117	-23.3361	119.7655	23/04/2024	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Clay Loam Sandy	Evenly Spread	Negligible	None Discernible	Pebbles (5-10cm)	Many Small Patches	Shrubland, Spinifex Hummock Grassland	Nil	High	0	Prone to Flooding	0.6	Weed Invasion	Moderate (3 to 5 yr)	
VPWR-119	-23.3331	119.7605	23/04/2024	Drainage Area/ Floodplain	Sand Plain	Flat	Flat	Clay Loam Sandy	Evenly Spread	Negligible	None Discernible	Pebbles (5-10cm)	Many Small Patches	Shrubland, Spinifex Hummock Grassland, Tussock Grassland	Nil	High	0	Prone to Flooding	0.4	Weed Invasion	Moderate (3 to 5 yr)	
VPWR-128	-23.3189	119.8029	23/04/2024	Hillcrest/ Hillslope	Hillslope	South	Low	Clay Loam	Scarce	Limited Outcropping	BIF	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Scattered Shrubs, Spinifex Hummock Grassland	Low	Moderate	0	None	0.4	Mining Exploration	Old (6+ yr)	
VPWR-129	-23.3113	119.7778	23/04/2024	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	None Discernible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland	Low	Low	0	None	0.2	Mining Exploration	Old (6+ yr)	

Appendix D: Caves Recorded in the Study Area

Cave ID	Sampling Site ID	Location		Habitat	Ghost bat significance	Pilbara leaf-nosed bat significance	Photo
		Latitude	Longitude				
Current survey							
CER-07	VNEB-016	-23.3232	119.7770	Gorge/ Gully	Category 4	Category 4	
CER-08	VNEB-006	-23.3233	119.7904	Breakaway/ Cliff	Category 4	Category 4	
CER-09	VNEB-017	-23.3215	119.7808	Gorge/ Gully	Category 4	Category 4	
CER-10	VNEB-017	-23.3212	119.7812	Gorge/ Gully	Category 4	Category 4	
Power 2030 targeted fauna survey							

Cave ID	Sampling Site ID	Location		Habitat	Ghost bat significance	Pilbara leaf-nosed bat significance	Photo
		Latitude	Longitude				
CER-06	VPWR-020	-23.3028	119.7693	Breakaway/ Cliff	Category 3	Category 4	
CER-11	VPWR-038	-23.3188	119.7845	Hillcrest/ Hillslope	Category 4	Category 4	

Appendix E: Water Features Recorded in the Study Area

Water Feature ID	Sampling Site ID	Type	Location		Dimensions			Photo
			Latitude	Longitude	Length (m)	Width (m)	Depth (m)	
Current survey								
WER-07	VNEB-003	Ephemeral (will persist for 3 months)	-23.3382	119.7721	10	3	0.3	
WER-09	VNEB-002	Ephemeral (will persist for 3 months)	-23.3417	119.7886	3	1.5	0.4	
WER-08	VNEB-002	Ephemeral (will persist for 3 months)	-23.3405	119.7854	15	1.5	0.4	

Water Feature ID	Sampling Site ID	Type	Location		Dimensions			Photo
			Latitude	Longitude	Length (m)	Width (m)	Depth (m)	
WER-06	VNEB-019	Artificial (turkey nest) Permanent/ Persistent	-23.3380	119.7656	20	20	2	
WER-12	VNEB-018	Semi-persistent (will persist 3 - 9 month of year, most years)	-23.3389	119.8092	30	20	1	
WER-11	VNEB-010	Ephemeral (will persist for 3 months)	-23.3435	119.8019	20	10	1	
WER-10	VNEB-010	Ephemeral (will persist for 3 months)	-23.3436	119.8006	20	10	0.5	

Water Feature ID	Sampling Site ID	Type	Location		Dimensions			Photo
			Latitude	Longitude	Length (m)	Width (m)	Depth (m)	
Power 2030 targeted fauna survey								
WHST-02	VPWR-021	Semi-persistent (will persist 3 - 9 month of year, most years)	-23.3244	119.7549	15	10	0.5	
WHST-03	VPWR-021	Semi-persistent (will persist 3 - 9 month of year, most years)	-23.3241	119.7553	30	30	0.5	
WHST-01	VPWR-021	Semi-persistent (will persist 3 - 9 month of year, most years)	-23.3222	119.7544	30	8	0.8	

Appendix F: Targeted Searches Undertaken

Transect ID	Sampling Site ID	Targeted Search Type	Date	Total Person Hours	Targeted Species	Habitat/s
TNEB-001	VNEB-001	Diurnal	18/04/2024	3	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope, Minor Drainage Line
TNEB-002	VNEB-003	Diurnal	17/04/2024	1	Grey Falcon, Pilbara Olive Python	Major Drainage Line, Drainage Area/ Floodplain
TNEB-003	VNEB-003	Diurnal	18/04/2024	1	Grey Falcon, Pilbara Olive Python	Major Drainage Line, Drainage Area/ Floodplain
TNEB-004	VNEB-004	Diurnal	18/04/2024	4	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope, Breakaway/ Cliff, Gorge/ Gully
TNEB-005	VNEB-005	Diurnal	21/04/2024	0.5	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope
TNEB-008	VNEB-008	Diurnal	18/04/2024	1	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Western Pebble-mound Mouse	Hillcrest/ Hillslope, Breakaway/ Cliff
TNEB-017	VNEB-017	Diurnal	18/04/2024	1	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Western Pebble-mound Mouse	Gorge/ Gully, Hillcrest/ Hillslope
TNEB-011	VNEB-011	Diurnal	23/04/2024	0.5	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope
TNEB-012	VNEB-012	Diurnal	18/04/2024	2	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Western Pebble-mound Mouse	Hillcrest/ Hillslope, Gorge/ Gully
TNEB-014	VNEB-014	Diurnal	18/04/2024	2	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope, Gorge/ Gully
TNEB-015	VNEB-015	Diurnal	21/04/2024	1	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope
TNEB-016	VNEB-016	Diurnal	21/04/2024	1	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope, Gorge/ Gully
TPWR-001	VPWR-021	Diurnal	16/04/2024	1	Northern Quoll, Grey Falcon and Pilbara Olive Python	Major Drainage Line
TPWR-002	VPWR-020	Diurnal	17/04/2024	4	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python	Hillcrest/ Hillslope, Breakaway/ Cliff
TPWR-028	VPWR-028	Diurnal	23/04/2024	0.5	Greater Bilby and Brush-tailed Mulgara	Drainage Area/ Floodplain

Transect ID	Sampling Site ID	Targeted Search Type	Date	Total Person Hours	Targeted Species	Habitat/s
TPWR-038	VPWR-038	Diurnal	18/04/2024	1	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope
TPWR-052	VPWR-052	Diurnal	21/04/2024	0.5	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope
TPWR-056	VPWR-056	Diurnal	23/04/2024	1	Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python	Hillcrest/ Hillslope, Major Drainage Line
TPWR-090	VPWR-090	Diurnal	23/04/2024	0.8	Grey Falcon, Southern Whiteface and Pilbara Olive Python	Drainage Area/ Floodplain, Minor Drainage Line
TPWR-117	VPWR-117	Diurnal	23/04/2024	0.5	Greater Bilby, Brush-tailed Mulgara, Southern Whiteface	Drainage Area/ Floodplain
TPWR-119	VPWR-119	Diurnal	23/04/2024	0.5	Greater Bilby, Brush-tailed Mulgara, Southern Whiteface	Drainage Area/ Floodplain
-	VNEB-010	Nocturnal	18/04/2024	3	Pilbara Olive Python	Major Drainage Line
-	VNEB-018	Nocturnal	18/04/2024	2	Pilbara Olive Python	Minor Drainage Line
-	VPWR-021	Nocturnal	18/04/2024	2	Pilbara Olive Python	Major Drainage Line

Appendix G: Significant Fauna Records

Scientific Name	Common Name	Conservation Status				Sampling Site ID	Date	Record Type	Habitat
		EPBC Act	BC Act	DBCA	IUCN				
Pseudomys chapmani	Western pebble-mound mouse			P4		VNEB-004	18/04/2024	Mound (inactive)	Hillcrest/ Hillslope
Macroderma gigas	Ghost bat	VU	VU			VPWR-020 (Cave CER-06)	17/04/2024	Scat, ~1,000	Breakaway/ Cliff
Liasis olivaceus barroni	Pilbara olive python	VU	VU			VPWR-020 (Cave CER-06)	17/04/2024	Skin/ Slough	Breakaway/ Cliff

Appendix H: Acoustic Analysis Report

Malu Fauna
0438052066
fauna.malu@gmail.com
malufauna.au

28-05-2024

Dear Hannah,

Analysis of 72 nights of acoustic recording across 12 sites for BHP WAIO Power 2030 during April 2024 presented no detection of Night Parrot (*Pezoporus occidentalis*) calls.

Conditions were calm for the majority of the survey period with significant wind detected across the survey area during the 16th, 17th, 18th & 19th of April. Machinery Noise was detected at all sites and may have masked some concurrent calls within those specific frequencies, especially for non-target species. These interferences are considered minimal and the recording quality was considered adequate for detection of Night Parrot vocal signals.

There is a very low likelihood that long-term stable Night Parrot roosts exist within two hundred metres of each recording point. It is also highly unlikely that Night Parrots foraged within the same areas during the survey. These statements pertain only to the areas within two hundred metres of each recording point and not the entire survey area.

A total of 43 non-target species were recorded. These are shown for each site in Appendix 1.

Regards,

Louis Masarei

fauna.malu@gmail.com

Appendix 1: Species detected during acoustic analyses

Common Name	VNEB-002	VPWR-004	VPWR-008	VPWR-012	VPWR-013	VPWR-014	VPWR-016	VPWR-026	VPWR-028	VPWR-032	VPWR-035	VPWR-043
Spotted Nightjar *Eurostopodus argus*			○		○	○		○		○	○	○
Australian Owlet-nightjar *Aegotheles cristatus*	○			○	○							
Horsfield's Bronze Cuckoo *Chalcites basalis*											○	○
Pallid Cuckoo *Heteroscenes pallidus*	○				○	○						
Crested Pigeon *Ocyphaps lophotes*					○			○			○	○
Little Buttonquail *Turnix velox*						○						
Bush Stone-curlew *Burhinus grallarius*		○										
Brown Goshawk *Accipiter fasciatus*								○				
Whistling Kite *Haliastur sphenurus*					○					○		
Eastern Barn Owl *Tyto javanica*	○		○									
Southern Boobook *Ninox boobook*	○				○			○		○		○
Blue-winged Kookaburra *Dacelo leachii*	○									○		
Nankeen Kestrel *Falco cenchroides*		○										
Brown Falcon *Falco berigora*								○	○	○		○
Cockatiel *Nymphicus hollandicus*					○							
Galah *Eolophus roseicapilla*					○		○					
Little Corella *Cacatua sanguinea*					○			○				
Australian Ringneck *Barnardius zonarius*	○				○							
Budgerigar *Melopsittacus undulatus*					○						○	○
Purple-backed Fairywren *Malurus assimilis*	○	○			○				○	○	○	
White-winged Fairywren *Malurus leucopterus*					○					○		

Rufous-crowned Emu-wren *Stipiturus ruficeps*												○
Brown Honeyeater *Lichmera indistincta*	○	○				○		○	○	○		
Singing Honeyeater *Gavicalis virescens*	○		○	○	○	○	○	○	○	○	○	○
White-plumed Honeyeater *Ptilotula penicillate*	○	○					○		○			
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*					○	○		○	○	○		○
Yellow-throated Miner *Manorina flavigula*					○	○						
Red-browed Pardalote *Pardalotus rubricatus*					○							
Striated Pardalote *Pardalotus striatus*					○							
Grey-crowned Babbler *Pomatostomus temporalis*					○							
Masked Woodswallow *Artamus personatus*											○	
Pied Butcherbird *Cracticus nigrogularis*	○				○				○			○
Black-faced Cuckooshrike *Coracina novaehollandiae*	○				○			○				
Crested Bellbird *Oreoica gutturalis*				○				○			○	○
Rufous Whistler *Pachycephala rufiventris*											○	
Willie Wagtail *Rhipidura leucophrys*	○										○	○
Magpie-lark *Grallina cyanoleuca*					○							
Torresian Crow *Corvus orru*					○			○	○		○	
Fairy Martin *Petrochelidon ariel*					○							
Spinifexbird *Poodytes carteri*			○					○	○	○	○	○
Rufous Songlark *Cincloramphus mathewsi*					○						○	
Painted Finch *Emblema pictum*			○		○		○					○
Zebra Finch *Taeniopygia castanotis*		○						○			○	○