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HANCOCK PROSPECTING PTY LTD

MULGA EAST BASELINE TERRESTRIAL VERTEBRATE FAUNA ASSESSMENT

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EXECUTIVE SUMMARY

Hancock Prospecting Pty Ltd (HPPL) is seeking to develop the Mulga East Iron Ore Project. In order to meet the Environmental Protection Authority's (EPA) environmental objectives for the environmental factor "*Terrestrial Fauna*" (Environmental Protection Authority 2016a) for the project, Ecologia Environmental Consultants (*ecologia*) was engaged by Strategen-JBS&G, on behalf of HPPL, to undertake a baseline fauna habitat and terrestrial fauna assessment of the Mulga East Project Area to better understand the environmental values and constraints of the area and to facilitate primary and secondary environmental approvals for the future development of these areas. Terrestrial fauna surveys completed by *ecologia* within the Project Area have included a Level 1 fauna habitat assessment, two-phase Level 2 terrestrial vertebrate fauna assessment and multiple targeted surveys for the Pilbara leaf-nosed bat and other conservation significant fauna species. This report outlines the results of the terrestrial fauna and targeted surveys conducted for the northern quoll, Pilbara leaf-nosed bat, ghost bat, Pilbara olive python, bilby and night parrot.

Based on the results of the Level 1 fauna habitat assessment, eight broad fauna habitat types were identified within the Project Area: Mulga Woodland, Mixed Eucalypt/Mulga Floodplain, Rocky Hills, Stony Spinifex Plains and Hillslopes, Calcrete Stony Plain, Chenopod/Cracking Clay Floodplain, Drainage Line and Claypan. The extent of these habitat types within the Project Area was refined following extensive ground truthing.

Two habitat types, the Rocky Hills and Claypan, were identified as providing suitable habitat for several species of conservation significance and are of higher conservation value than other habitats within the Project Area. Critical habitat for the northern quoll, Pilbara leaf-nosed bat, ghost bat and Pilbara olive python is found within the Rocky Hills in the form of ranges, caves and breakaways which provide refuge, roosting, denning and foraging opportunities. Priority 2, 3 and 5 foraging habitat for the Pilbara leaf-nosed bat is present within the Rocky Hills, Drainage Line, and Stony Spinifex Plains and Hillslopes habitat types within the Newman land system with specific reference to a valley in the north western portion of the Mulga East tenement.

The Gnalka Gnoona and Koodjeepindarranna Claypans form part of the Priority 1 Priority Ecological Community (PEC) Freshwater Claypans of the Fortescue Valley, which when inundated provides foraging habitat for migratory bird species. Three migratory wading species, the common greenshank, the red-necked stint and the wood sandpiper were recorded foraging in surface water in the Gnalka Gnoona Claypan during the initial phase of the Level 2 survey in 2019.

Eighteen trap sites were established in six of the eight broad fauna habitat types in each survey phase using a combination of pitfall, Elliott, funnel and cage traps. Combined trapping effort within the Project Area over the two survey phases was equivalent to 11,812 trap nights.

A total of 201 terrestrial vertebrate fauna species were recorded within the Project Area including 26 mammal species (four introduced), 103 birds, 70 reptiles and two amphibians. The results of the two-phase Level 2 terrestrial fauna survey indicate the Project Area supports a relatively rich vertebrate fauna assemblage. Survey effort was considered adequate after data analysis was completed and comparisons were made to similar surveys conducted in the Pilbara.

An additional 46 species were recorded during the phase 2 survey that were not recorded during phase 1 including three mammal species, 18 birds, 24 reptiles and one amphibian. Similarly, three mammals, 24 birds and 13 reptiles were recorded in phase 1 that were not recorded in phase 2.

Ten species of conservation significance were recorded within the Project Area including:

- northern quoll (*Dasyurus hallucatus*) (Endangered EPBC and BC Act);
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (Vulnerable EPBC Act and BC Act);
- ghost bat (*Macroderma gigas*) (Vulnerable EPBC Act and BC Act);

- western pebble-mound mouse (*Pseudomys chapmani*) (Priority 4 BC Act);
- Pilbara olive python (*Liasis olivaceus barroni*) (Vulnerable EPBC Act and BC Act);
- Gane's blind snake (*Anilios ganei*) (Priority 1 BC Act);
- common greenshank (*Tringa nebularia*) (Migratory EPBC and BC Act);
- wood sandpiper (*Tringa glareola*) (Migratory EPBC and BC Act);
- red-necked stint (*Calidris ruficollis*) (Migratory EPBC and BC Act); and
- grey falcon (*Falco hypoleucos*) (Vulnerable BC Act).

Species listed as threatened or migratory under the EPBC Act confirmed to occur within the Project Area or deemed likely to occur are considered Matters of National Environmental Significance (MNES) (Department of the Environment 2013). In total, seven MNES species were recorded. In addition to those species recorded, three species of conservation significance including the bilby (Vulnerable EPBC and BC Act), peregrine falcon (OS EPBC Act and Migratory BC Act) and glossy ibis (Migratory EPBC and BC Act) have previously been recorded in the Project Area. The brush-tailed mulgara (P4 BC Act) was deemed 'Likely' to occur within the northern portion of the proposed rail corridor while the northern short-tailed mouse (P4 BC Act) and fork tailed swift (Migratory EPBC and BC Act) were deemed to have likelihood of occurrence category of 'Possible'.

Targeted surveys conducted within Rocky Hills habitat for the northern quoll including 91 motion sensor camera sites (4237 camera trap nights), 45 cage trap sites (315 cage trap nights), 248 hrs targeted searches and 107 km of UAV flights searching for suitable habitat identified a low-density northern quoll population within the Project Area. Within the Rocky Hills, breakaway, gorge and gully habitat was defined and is considered habitat critical to the survival of this species. The population of quolls has been deemed important as it occurs in habitat that is unlikely to support cane toads upon their arrival in the Pilbara.

Survey effort targeting the Pilbara leaf-nosed bat has been extensive including five targeted surveys, 82 cave habitat assessments, 252 ARUs deployments (for a total of 504 recording nights) and UAV/drone flights and videos searching for suitable roosting habitat. Echolocation call analysis and seasonal records clearly demonstrate that Pilbara leaf-nosed bats utilise the Project Area for foraging and nocturnal refuge year-round. Call patterns from recordings at cave entrances within target areas were inconsistent with diurnal roosting and were more consistent with nocturnal refuges or sites of occasional visitation. Call times recorded close to civil twilight suggest that a diurnal roost is nearby, either within or outside of the Project Area, however extensive searches for caves within the target valley and call times analysed from cave entrances indicate that the caves surveyed are highly unlikely to be utilised as diurnal roosts.

Priority 2, 3 and 5 foraging habitats are present within the Project Area in the Rocky Hills, Drainage Line and Stony Spinifex Plains and Hillslopes habitat types which are all considered widespread on a local and regional scale.

A single ghost bat call and two ghost bat middens were recorded, confirming the presence of this species within the Project Area. The ghost bat can travel more than 15 km a night and is considered likely to visit habitats within the Project Area while foraging. Despite undertaking 82 cave habitat assessments, no roosting bats or echolocation calls were recorded while extensively surveying for Pilbara leaf-nosed bats.

An opportunistic sighting of the Pilbara olive python during the initial phase indicates that this species intermittently occupies suitable habitat in the Project Area. Database searches show that records of this species have been documented to the south, west, north and north-east of the Project Area, suggesting that this species is not restricted to specialised habitats within the Project Area.

Targeted surveys for the bilby, including 228 km of UAV flights, did not identify any suitable habitat or primary or secondary evidence for the species. Therefore, the bilby is considered unlikely to occur within the Project Area. Acoustic recording units were deployed at eight locations within long unburnt spinifex and two locations within potentially suitable foraging habitat to target the night parrot. Despite considerable survey effort, no calls were recorded, and this species is also considered unlikely to occur within the Project Area.

Three migratory species (EPBC Act and BC Act) including the common greenshank (*Tringa nebularia*), wood sandpiper (*Tringa glareola*), red-necked stint (*Calidris ruficollis*) were recorded foraging at the PEC Gnalka Gnoona Claypan. These highly mobile species are common visitors to inland water bodies following rain and are considered likely to be infrequent visitors to Claypans when inundated with water.

Twenty-eight western pebble-mound mouse mounds were recorded within the Stony Spinifex Plains and Hillslopes and Rocky Hills habitat, confirming that suitable habitat for this species is present. Suitable habitats are widespread at both a local and regional scale and the distribution of this species is not limited to the Project Area. The Gane's blind snake was recorded within the Mulga Woodland and Stony Spinifex Plains and Hillslopes habitat types and recorded during both phase of the level 2 survey.

Only minor limitations were associated with the surveys. Access to the northern portion of the proposed rail corridor within the Yandeyarra Aboriginal Reserve had not been granted at the time of the surveys. Access to the western portion of Malay Well (E47/2112) tenement was prohibited due to restrictions in accessing the Wittenoom Asbestos Management Area (WAMA) as no ground-disturbing activities are permitted within this area.

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Abbreviations and Acronyms

BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016* (WA)
BOM	Bureau of Meteorology
BIF	Banded Ironstone Formation
CALM	Department of Conservation and Land Management (now DBCA and DWER)
CAMBA	China – Australia Migratory Bird Agreement
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFWA	Department of Agriculture and Food Western Australia (now DPIRD)
DAWE	Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions (previously DPaW)
DEC	Department of Environment and Conservation (now DBCA)
DWER	Department of Water and Environmental Regulation
DER	Department of Environmental Regulation (now DWER)
DoEE	Department of the Environment and Energy (now DAWE)
DPaW	Department of Parks and Wildlife (now DBCA)
DPIRD	Department of Primary Industry and Regional Development (previously DAFWA)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now DAWE)
EPA	Environment Protection Authority
EP ACT	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCAVI	Executive Steering Committee for Australian Vegetation Information
IA	International Agreement
IBRA	Interim Biogeographic Regionalisation for Australia
ICE	Incidence-based Coverage Estimators
IPA	Indigenous Protected Area
IUCN	International Union for Conservation of Nature
LGA	Local Government Area
NMDS	Non-metric Multidimensional Scaling
NVIS	National Vegetation Information System
PEC	Priority Ecological Community
SAC	Species accumulation curve
SRE	Short Range Endemic
TEC	Threatened Ecological Community
TO	Traditional Owners
TPFL	Threatened and Priority Flora database
TPFR	Threatened and Priority Flora Report form
TP List	Threatened and Priority Flora List
WA	Western Australia
WAH	Western Australian Herbarium
WAHERB	Western Australian Herbarium Specimen Database
WAOL	Western Australian Organism List
WC Act	*Wildlife Conservation Act 1950*
WONS	Weeds of National Significance

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Hancock Prospecting Pty Ltd (HPPL) is seeking to develop the Mulga East Iron Ore Project to meet the Environmental Protection Authority's (EPA) environmental objectives for the environmental factor "*Terrestrial Fauna*" (Environmental Protection Authority 2016a). Ecologia Environmental Consultants (*ecologia*) was commissioned by Strategen-JBS&G, on behalf of HPPL, to conduct a two phase baseline terrestrial fauna assessment, including Level 1 fauna habitat assessment, Level 2 terrestrial fauna surveys and targeted surveys within the Mulga East Project Area. The Mulga East Project is comprised of the Mulga East (R47/0012) and Malay Wells (E47/2117) tenements and a proposed rail corridor (E45/380, L45/381, L45/382 and L45/447 with E47/2044, E45/3593) (Figure 1.1). The primary objective of the surveys is to better understand the faunal values and constraints of the area and to help facilitate primary and secondary environmental approvals (i.e. Part IV *Environmental Protection Act* 1986 (EP Act*), Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act), *Mining Act* 1978) for the future development of these areas.

This report outlines the results of the Level 1 fauna habitat assessment, two-phase Level 2 vertebrate fauna survey and targeted conservation significant fauna surveys undertaken within the Project Area.

The Project Area is located wholly within the Mulga Downs pastoral station and includes the Mulga East (R47/0012), Malay Well (E47/2117) tenements. The associated proposed 50 km rail extending from the Roy Hill Iron Ore rail line to the Project Area lies partially within the Mulga Downs Pastoral station, vacant Crown Land and other reserves. The nearest key landscape features include the Karijini National Park which is 15 km to the south-west and the Fortescue Marsh (Figure 1.1), the western portion of which is approximately 60 km east of the Mulga East exploration camp.

A comprehensive description of the proposed Project, which is subject to ongoing studies, is likely to include the following:

- A series of open cut mine pits;
- On site ore processing plant, waste rock landforms, waste fine storage area (or tailings storage facility);
- Mine infrastructure including rail load out facility, workshops, access and service roads, accommodation camp and airport; and
- A rail spur of approximately 50km in length from the site to the existing Roy Hill Iron Ore rail line.

1.2 SURVEY OBJECTIVES

The Environmental Protection Authority's (EPA) environmental objectives for the factors *Terrestrial Fauna* (Environmental Protection Authority 2016a) are: "To protect terrestrial fauna so that biological diversity and ecological integrity are maintained." In this context, 'ecological integrity' is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements. The surveys are intended for use as a supporting document for the environmental impact assessment of the proposal, which has been referred under Section 38 of the *Environmental Protection Act* 1986 (EP Act). The project is also being assessed as controlled action under the terms of the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), and the document provides technical support and data to inform those assessments. To this end, the following were completed as part of this assessment:

- A desktop study to evaluate biological values of the Project Area and surrounds, including a review of existing environmental values, threatened and priority fauna databases, and other relevant available literature;
- Description and mapping of habitat types within the Project Area;
- Conduct a detailed two-phase Level 2 baseline vertebrate fauna field survey consistent with EPA guidelines for terrestrial vertebrate fauna survey within the Project Area;
- Undertake targeted searches within the Rocky Hills habitat for northern quolls, ghost bats (scats), Pilbara leaf-nosed bats and important cave features;
- Undertake cave assessments to map and rank the importance of cave habitat present within the Project Area;
- Undertake spotlighting/targeted searches for the Pilbara olive python;
- Undertake surveys for detection of the Night Parrot in accordance with the *'Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia*' (DPaW, 2017); and
- Undertake surveys for the bilby in accordance with the '*Guidelines for surveys to detect the presence of bilbies and assess the importance of habitat in Western Australia*' (DBCA, 2017) within the Project Area.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The survey was designed and undertaken to comply with the following guidance documents:

- Environmental Factor Guideline: Terrestrial Fauna (Environmental Protection Authority 2016a);
- Technical Guidance: Sampling methods for terrestrial vertebrate fauna (Environmental Protection Authority 2016b);
- Technical Guidance: Terrestrial Fauna Surveys (Environmental Protection Authority 2016c);
- EPBC Act Referral Guideline for the Endangered Northern Quoll (Commonwealth of Australia 2016);
- Survey Guidelines for Australia's Threatened Bats (Department of Sustainability Environment Water Population and Communities 2010);
- Survey Guidelines for Australia's Threatened Reptiles (Department of Sustainability Environment Water Population and Communities 2011b); and
- Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability Environment Water Population and Communities 2011a);

Definitions and Threatened and Priority fauna categories can be seen in Appendix A.

500000 550000 600000 650000 700000 750000 800000 850000

7650000 7600000 7550000 7500000 7450000

Millstream Chichester National Park

Millstream Pools

MILLSTREAM YARRALOOLA ROAD

ROEBOURNE WITTENOOM ROAD

Mungaroona Range Nature Reserve

PORT HEDLAND WITTENOOM ROAD

HILLSIDE MARBLE BAR ROAD

RIPON HILLS ROAD

HILLSIDE WOODSTOCK ROAD

SKULL SPRINGS ROAD

BONNEY DOWNS HILLSIDE ROAD

MARBLE BAR ROAD

BONNEY DOWNS NOREENA ROAD

MOUNT BROCKMAN ROAD

TOM PRICE RAILWAY ROAD

HAMERSLEY ROAD

MUNJINA WITTENOOM ROAD

Fortescue Marshes

HAMERSLEY MOUNT BRUCE ROAD

BANJIMA DRIVE

Karijini (Hamersley Range) Gorges

NOREENA ROY HILL ROAD

KARIJINI DRIVE

Mt. Bruce coolibah-lignum flats

MARANDOO ROAD

NANUTARRA WITTENOOM ROAD

TOM PRICE NORTH ROAD

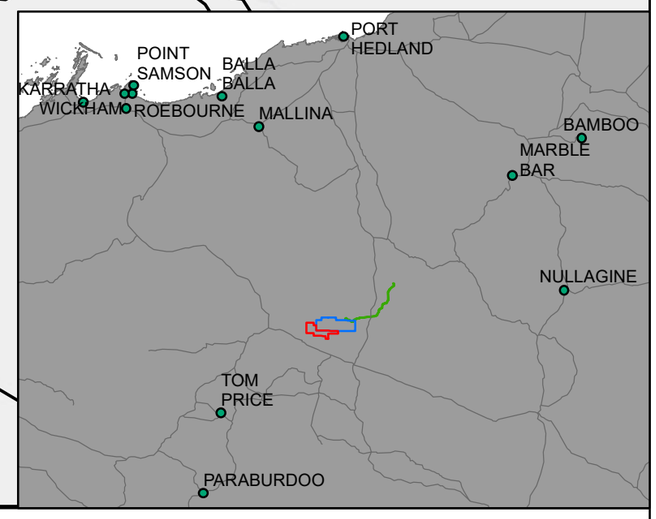
GREAT NORTHERN HIGHWAY

MUNJINA ROY HILL ROAD

JUNA DOWNS ROAD

Karijini National Park

PARABURDOO TOM PRICE ROAD



Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Main Roads
- Nationally Important Wetlands
- DBCA managed lands
- Wittenoom Asbestos Management Area

ecologia ENVIRONMENT

Project: 1757
Date: 30 August 2019
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:1,000,000@A3

Figure 1.1 Project Area

0 25 50
Kilometers

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

2 EXISTING ENVIRONMENT

2.1 CLIMATE

The Project Area is in the Pilbara region of Western Australia (WA) and experiences an arid-tropical climate with two distinct seasons: a hot summer from October to April and a mild winter from May to September. Temperatures are generally high, with summer temperatures frequently exceeding 40°C. Light frosts occasionally occur inland during the winter months of July and August.

Rainfall is generally localised, variable and unpredictable, and temperatures are high, resulting in annual evaporation exceeding rainfall by as much as 500 mm per year. Most of the Pilbara has a bimodal rainfall distribution; from December to March rains result from tropical storms producing isolated, sporadic thunderstorms. Tropical cyclones moving south also bring heavy rains. From May to June, extensive cold fronts move eastwards across the state and occasionally reach the Pilbara. These fronts usually produce only light rains. Surface water can be found in some pools and springs in the Pilbara all year round, although watercourses generally flow intermittently due to the short wet season (Beard 1975).

Climate data is collected by the Bureau of Meteorology (BOM) and long term rainfall data is available from the Mulga Downs weather station (Station Number 5015) (Bureau of Meteorology 2020) (Figure 2.1); however, this station did not provide temperature data and ceased recording rainfall in June 2018. Mean maximum and minimum temperature data was taken from the nearest weather station at Wittenoom (Station number 5026) and 2019/2020 rainfall data was taken from the nearest weather station at Karijini North (Station Number 5098) (Bureau of Meteorology 2020) (Figure 2.1). These stations are located approximately 10 km south west and 12 km south from the Project Area, respectively.

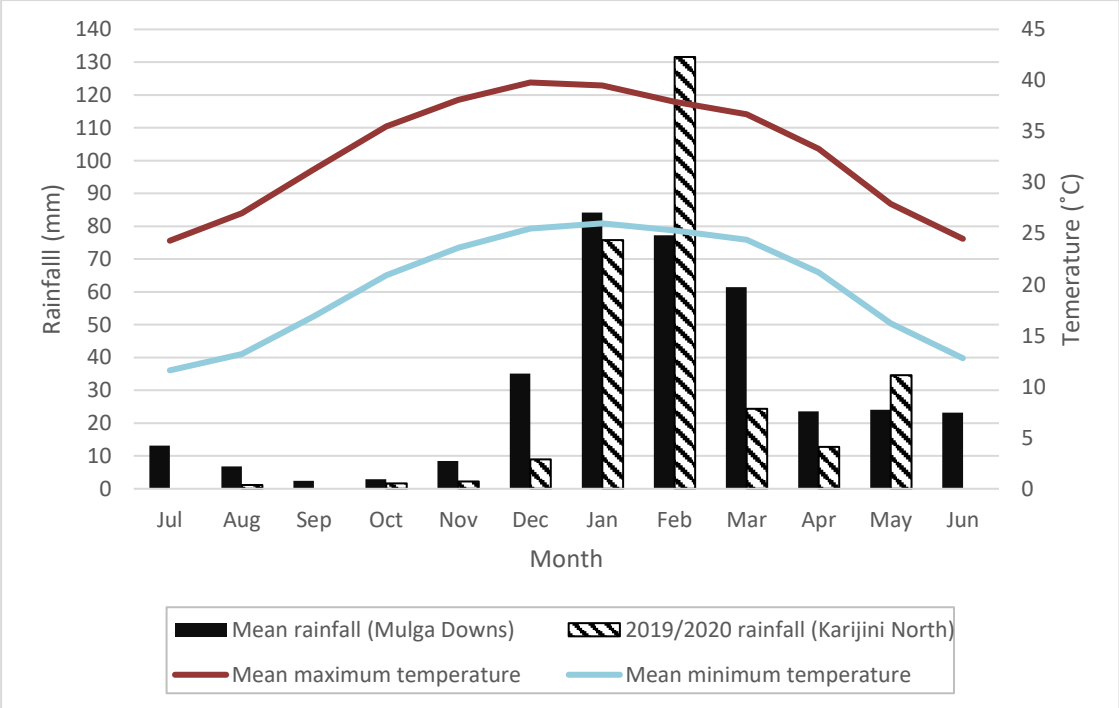


Figure 2.1: Climate data from Mulga Downs (mean rainfall), Karijini North (2019/2020 rainfall) and Wittenoom (mean temperature) BOM weather stations.

2.2 IBRA 7 BIOGEOGRAPHIC SUBREGIONS

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the Australian continent into 85 bioregions on the basis of similar geology, landform, vegetation, fauna and climate characteristics (Department of Sustainability Environment Water Population and Communities 2012). The Project Area is located within the Pilbara IBRA Bioregion 7 (Department of Sustainability Environment Water Population and Communities 2012), which is further divided into four subregions:

- The Hamersley subregion;
- The Fortescue Plains subregion;
- The Chichester subregion; and
- The Roebourne subregion.

The majority of the Project Area is situated within the Fortescue subregion, although the north eastern corner of the Mulga East tenement and majority of the proposed rail corridor falls within the Chichester sub-region (Figure 2.2).

The Fortescue Plains sub-region includes extensive salt marsh, mulga-bunch grass and short grass communities on alluvial plains in the east, and deeply incised gorges in the western part of the drainage (Kendrick 2001). An extensive calcrete aquifer feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with stands of *Eucalyptus camaldulensis* and *Melaleuca argentea* (Kendrick 2001). The climate is semi desert tropical, with an average rainfall of 300 mm, falling mainly in summer cyclonic events, and the sub-regional area is 2,041,914 ha (Kendrick 2001).

- The Fortescue Plains subregion is considered to have five ecosystems at risk (Kendrick 2001):
- Ethel Gorge Aquifer Stygobiont Community;
- Permanent wetland communities, Millstream;
- Fortescue Marsh saltbush community;
- Perennial grassland communities in the Fortescue Valley; and
- Grove/intergrove mulga communities at southern end of northern apron of Hamersley Range.

The Chichester sub-region comprises the northern section of the Pilbara Craton. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. Like the Fortescue Plains, the Chichester sub-region's climate is semi desert tropical and receives 300 mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule and Sherlock). The sub-regional area is 9,044,560 ha (Kendrick and McKenzie 2001).

The Chichester subregion is associated with five ecosystems at risk (Kendrick and McKenzie 2001):

- *Heliotropium, Eragrostis* community on seepages near Mt Montagu, Chichester Range;
- Cracking clay communities of the Chichester Range and Mungaroona Range;
- Specific snakewood communities. Between Roy Hill and Marillana Stations;
- Saltbush Shrublands (de Grey River west side); and
- Saltbush community of the duplex plains - Mosquito Creek series (Nullagine).

2.3 LAND SYSTEMS

The Department of Agriculture Western Australia (Van Vreeswyk *et al.* (2004b)) undertook a regional inventory of the Pilbara rangelands to document the land systems present and their condition. The Pilbara Regional Inventory (PRI) which covers 181,723 km^2 is bounded by the Indian Ocean and Roebourne Plains to the north and west, extending to Broome in the north-east and the Ashburton River catchment in the south. The extent of each of the land systems vary greatly, with almost half the

area comprised of just six land systems: Augustus, Little Sandy, Newman, Nita, Rocklea and Uaroo (Van Vreeswyk *et al.* 2004b).

A total of sixteen land systems occur within the Project Area (Table 2.1, Figure 2.3). Nine land systems account for over 97% of the Project Area with the remaining seven combining to account for less than 3% (Table 2.1, Figure 2.3). These nine land systems include the Coolibah Land System (26.1%), Jamindie Land System (22.7%), Newman Land System (17.7%), Calcrete Land System (7.5%), Boolgeeda Land System (6.3%), Jurrawarrina Land System (4.3%), Hooley Land System (6.7%), Brockman Land System (2.2%), Mackay Land System (3.7%).

Table 2.1: Land systems within the Project Area (Van Vreeswyk *et al.* 2004b)

Land System	Geomorphology	Land Management	Area (ha)	Percentage of Project Area
Coolibah Land System	Depositional surfaces; active flood plains and alluvial plains with shallow, meandering and anastomosing central channels of the Fortescue River.	Vegetation includes perennial grasses and forbs which are preferred by grazing animals and are prone to depletion under uncontrolled grazing. Flood plains highly susceptible to erosion.	8625	26.10%
Jamindie Land System	Depositional surfaces; level plains of clayey and stony alluvium as a mosaic of surfaces with gilgai microrelief, sometimes stony, and non-gilgaied surfaces with abundant stony mantles; mostly sluggish internal drainage but occasional drainage tracts with major through going channels.	Tussock grasslands and snakewood shrub communities are favoured by grazing animals and are prone to degradation (especially the snakewood communities) if overgrazed. Those parts of the system not protected by a stony surface mantle are moderately susceptible to soil erosion.	7503	22.70%
Newman Land System	Erosional surfaces; hill tracts, ridges, plateaux remnants and breakaways with steep upper slopes and more gently inclined lower foot slopes, restricted stony plains and interfluves; moderately spaced tributary drainage patterns incised in narrow valleys in upper parts becoming broader and more widely spaced downstream. Relief up to 100 m.	This system supports predominantly hard spinifex vegetation and is not preferred by livestock. Some areas are poorly accessible, and the system is not prone to degradation or soil erosion.	5846	17.70%
Calcrete Land System	Depositional surfaces; valley fill deposits - stony plains as a mosaic of calcrete tables and low rises elevated up to 10 m above the surrounding surfaces of narrow inter-table drainage areas and restricted sandy plains; drainage patterns absent to sparse tributary tracts and occasional through going trunk channels.	Some shrubs and grasses associated with the spinifex grasslands of this system are attractive to grazing animals and may be depleted if grazing levels are excessive. Low erosion risk.	2487	7.50%
Hooley Land System	Erosional surfaces; hill tracts and domes on granitic rocks with rough crests, associated rocky hill slopes, restricted lower stony plains; narrow, widely spaced tributary drainage floors and channels. Relief up to 100 m.	Much of the system is poorly accessible; hard spinifex vegetation is not preferred by livestock; soft spinifex is moderately preferred. The system is subject to fairly frequent burning and is not susceptible to erosion.	2218	6.70%
Boolgeeda Land System	Predominantly depositional surfaces; very gently inclined stony slopes and plains below hill systems becoming almost level further downslope; closely spaced, dendritic and sub-parallel drainage lines. Relief up to about 20 m.	Hard spinifex grasslands are not preferred by livestock, but soft spinifex is moderately preferred for a few years following fire. Vegetation is generally not prone to degradation and the system is not susceptible to erosion. The system is subject to fairly frequent burning.	2089	6.30%

Land System	Geomorphology	Land Management	Area (ha)	Percentage of Project Area
Jurrawarrina Land System	Depositional surfaces; non-saline plains with hardpan at shallow depth and groved vegetation, stony upper plains and low rises on hardpan or rock, very widely spaced tributary drainage tracts and channels; minor stony gilgai plains, sandy banks and low ridges and hills. Relief up to 30 m.	Most vegetation is only moderately preferred by grazing animals but can become degraded by overgrazing. Drainage tracts (unit 6) are moderately susceptible to erosion, some hardpan plains (unit 3) are slightly susceptible and other parts are inherently resistant.	1424	4.30%
McKay Land System	Erosional surfaces; gently undulating stony plains and interfluves with quartz surface mantles, sandy surfaced plains, minor calcrete plains, closely spaced tributary drainage lines in upper parts of system becoming much wider downslope; minor granite hills, tor fields and quartz ridges. Relief is up to 25 m.	Mature spinifex vegetation is not preferred by grazing animals but younger stands after burning are moderately preferred. Vegetation is generally not prone to grazing induced changes, but fairly regular fires change botanical composition and vegetation structure in the short term. The system has low or very low erosion hazard.	1224	3.70%
Brockman Land System	Depositional surfaces; level, non-saline alluvial plains with clay soils and gilgai microrelief and flanked by slightly more elevated hardpan wash plains, sluggish internal drainage zones on plains and occasional through going trunk channels.	Tussock grasslands on this system are highly preferred by livestock and other animals and are susceptible to overgrazing and degradation. Overgrazing can be prevented by appropriate and management including control of total grazing pressure. Soil erosion, despite the inherent resistance of the system, can occur if vegetative cover is severely depleted.	737	2.20%
Wona Land System	Mostly depositional surfaces; residual plains with a mosaic of stony non-gilgaied and stony gilgaied surfaces, minor gilgai plains without stone mantles, low rises and short slopes on outer margins of the system. Drainage is internal or as short, dendritic, tributary patterns confined to the outer margins of the system. Relief up to 10 m.	Tussock grasslands on gilgai plains (unit 2) are preferentially grazed by livestock and other animals and are prone to degrade if stocking is uncontrolled. Hard spinifex may tend to invade degraded tussock grass sites. The system is generally not susceptible to erosion.	244	0.70%
Rocklea Land System	Flood plains and river terraces subject to fairly regular overbank flooding from major channels and watercourses, sandy banks and poorly defined levees and cobble plains. Banks, levees and slightly higher upper terraces receive less regular flooding than lower terraces and flood plains.	Buffel grass and soft spinifex on this system are highly and moderately preferred respectively by livestock. The system is largely stabilised by buffel and spinifex and accelerated erosion is uncommon. However, susceptibility to erosion is high or very high if vegetative cover is removed.	183	0.60%

Land System	Geomorphology	Land Management	Area (ha)	Percentage of Project Area
White Springs Land System	Depositional surfaces; level stony plains and plains and fans of sandy alluvium with widely spaced through going or sub-parallel distributary creek lines and channels; subject to sheet flow and overbank flooding. Relief less than 10 m.	The system supports soft spinifex vegetation which, except for old mature stands, is moderately preferred by grazing animals. The system is prone to fairly regular burning. Most of the system is not susceptible to erosion or vegetation degradation.	170	0.50%
Urandy Land System	Erosional surfaces; hills, ridges and plateaux remnants on basalt with steep stony slopes, restricted lower slopes, stony interfluves and minor gilgai plains; moderately spaced tributary drainage patterns of small channels in shallow valleys in upper parts becoming broader floors and channels downslope. Relief up to 110 m.	Spinifex hummock grasslands are poorly accessible and are generally not preferred by livestock. The system is subject to fairly regular burning. The system has very low erosion hazard.	164	0.50%
Granitic Land System	Depositional surfaces; level wash plains subject to overland sheet flow and with numerous drainage foci (groves of dense vegetation) arranged as arcuate bands transverse to the direction of sheet flow, level plains with gilgai microrelief, minor areas of sand sheet and sandy banks; sparse to very rare drainage tracts subject to more concentrated sheet flow and with occasional shallow channels. Relief less than 10 m.	Mulga shrublands are moderately preferred, and tussock grasslands highly preferred by grazing animals, and are prone to degradation if overgrazed. Wash plains (unit 3) and drainage tracts (unit 6) are moderately susceptible to soil erosion if vegetative cover is depleted.	60	0.20%
Macroy Land System	Depositional surfaces; plains receiving overland sheet flow and with prominent drainage foci (groves) arranged as right angles to direction of flow, broad drainage tracts receiving more concentrated flow, with or without defined channels and with prominent gilgaied drainage foci; minor plains with clay soils and gilgai microrelief, also occasional through going creek channels.	Much of the vegetation on this system is highly preferred by grazing animals and is prone to degradation if overgrazed. Some hardpan wash plains, drainage tracts and groves (units 2, 3 and 4) are moderately susceptible to erosion.	58	0.20%

Land System	Geomorphology	Land Management	Area (ha)	Percentage of Project Area
River Land System	Erosional surfaces; plateaux and mountains - extensive high plateaux, mountains and strike ridges with vertical escarpments and steep scree slopes and more gently inclined lower slopes; moderately spaced dendritic and rectangular tributary drainage patterns of narrow valleys and gorges with narrow drainage floors and channels. Relief up to 450 m.	Much of the system is inaccessible or poorly accessible and is unsuitable for pastoral purposes. The system contains iron ore deposits which are currently being mined and deposits which are likely to be mined in the future. Spinifex is the dominant vegetation and the system is burnt fairly frequently.	6	0.02%
		Total	33040	100%

2.4 SOILS

Tille (2006) described the soil landscapes of Western Australia's arid rangelands and interior at a broad scale. The Atlas of Australian Soils (Northcote *et al.* 1960-1968) describes soil units on a finer scale and nine soils units have been identified within the Project Area, none of which are considered to be restricted (Figure 2.4,Table 2.2).

The Project Area occurs within the Fortescue Province as described by Tille (2006), and is comprised of ten soil landscape zones. The Mulga East and Malay Well tenements primarily occur within the Fortescue Valley Zone (soil landscape zone 284), described as:

- Alluvial plains, hardpan wash plains and sandplains (with stony plains, floodplains and some salt lakes) on alluvial deposits over sedimentary rocks of the Hamersley Basin. Red deep sands, red loamy earths and red/brown non-cracking clays with some red shallow loams and Hard cracking clays (Tille 2006).

The north-eastern corner of the Project Area and southern portion of the proposed rail corridor falls within the Chichester Ranges Zone (soil landscape zone 282), described as:

- Hills and dissected plateaux (with some stony plains) on basalt and sedimentary rocks of the Hamersley Basin. Stony soils with some red shallow loams and hard cracking clays support spinifex grasslands with kanji and snappy gum (and some tussock grasslands) located in the northern Pilbara between Pannawonica and Nullagine (Tille 2006).

The northern portion of the proposed rail corridor lies within the Abydos Plains and Hills Zone (soil landscape zone 283), described as:

- Stony plains (with some hills) on granitic rocks of the Pilbara Craton (East Pilbara Terrane). Deep red sandy duplexes, red shallow loams with stony soils, red sandy earths and red loamy earths support spinifex grasslands with kanji (and some tussock grasslands) located in the northern Pilbara between the Yandeyarra community, Bamboo Springs Station and Marble Bar (Tille 2006).

Table 2.2: Soil units within the Project Area (Northcote *et al.* 1960-1968)

Unit	Description	Proportion of Project Area (ha)	Total area in PIL (ha)
Oc63	Pediplains on granite; more dissected than unit Oc62 and usually occurring as a zone flanking the mainstream courses: chief soils are hard alkaline red soils (Dr2.33) and (Dr2.43). There are more areas of (Um5.11) soils on calcrete (kunkar) than in unit Oc62 and some (Uc5.11) and (Uc1.22) soils occur along creeks	108 (0.3%)	322277
Gf1	Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loams (Um5.51). (Dr2.33) soils occur on lower slopes, with (Uf6.71) and (Ug5.37) on valley floors.	559 (1.6%)	1969690
Oc64	Low stony hills and dissected pediments on granite with occasional basic dykes: the chief soils are hard alkaline red soils (Dr2.33) having shallow stony A horizons. Associated are shallow stony (Uc5.11) soils on steep slopes, (Uc1.22) soils along creek lines, and (Um5.11) soils on patches of calcrete (kunkar)	276 (0.8%)	107823
Ja1	Extensive valley plains largely associated with the Fortescue River: chief soils are earthy clays (Uf6.71) along with some (Ug5.38), (Um5.5), and (Dr2.33) soils. Small areas of calcrete (kunkar) with (Um5.11) soils occur also	19555 (59.1%)	418666
Oc62	Very gently undulating pediplain with low granite outcrops and tors; occasional basic dykes occur as low elongate ridges: chief soils are hard alkaline red soils (Dr2.33) and (Dr2.43) having coarse-textured A horizons up to 18 in. thick. Associated are occasional patches of calcrete (kunkar) with (Um5.11) soils as well as some (Gn2.12) soils	7 (0.02%)	19336
Oc71	Outwash plains with much coarse surface gravel: chief soils are hard alkaline red soils (Dr2.33) but (Uf6.71), (Ug5.38), and (Gn2.12) soils also occur. There are areas of (Gc) soils in proximity to unit Lb12	499 (1.5%)	21348
Oc70	Dissected pediments and low stony hills associated with cherts, jaspilites, and iron ore formations; much coarse surface gravel: chief soils are hard alkaline red soils (Dr2 33) along with some (Dr2.32) and (Um5.52) soils	8255 (24.9%)	78218
MM19	High-level gently undulating plain flanked by areas of basaltic ranges of unit Gfl: chief soils are cracking clays (Ug5.37). Areas of (Uf6.71) and (Dr2.33) soils occur also	209 (0.6%)	25489
Lb12	Valley flats along major drainage lines, associated with limestone and calcareous gravels (kunkar): chief soils are highly calcareous earths (Gc1.12), with minor areas of shallow calcareous loams (Um1.1). Associated are areas of hard red soils (Dr2.33) and some cracking clays (Ug5.37)	3573 (10.8%)	10500
	Total	33040	2973347

2.5 GROUND AND SURFACE WATER VALUES

The Department of the Environment and Energy (DoEE) Protected Matters Search Tool (Department of the Environment and Energy 2018) and the Department of Biodiversity, Conservations and Attractions (DBCA) managed lands and waters database were queried for Ramsar Wetlands, Nationally Important Wetlands, and DBCA managed waters occurring near the Project Area. No Ramsar wetlands occur near the Project Area.

The Fortescue Marsh (WA066), which is a Nationally Important Wetland (Department of the Environment and Energy 2018), is defined by the DBCA's Draft Fortescue Marsh Management Strategy 2018-2024 (DBCA 2018) and located to the east of the Goodiadarrie Hills (Figure 2.5). A section of the lower Fortescue River forms part of the Directory of Important Wetlands in Australia (DIWA)

(previously an Australian Nature Conservation Agency (ANCA)) wetland that occurs in the Project Area and comprises the river, its associated floodplains and claypans.

The Project Area occurs within a section of the Fortescue River that forms part of the Priority 1 (BC Act) Freshwater Claypans of the Fortescue Valley Priority Ecological Community (PEC). Several springs, pools and associated claypans occur within the wider PEC. Two of these occur within the Project Area including Koodjeepindarranna (small claypan) and Gnalka Gnoona (large claypan). The wetlands associated with the Fortescue Valley have very diverse aquatic invertebrate communities and most of the restricted elements of the Pilbara riparian flora (Pinder *et al.* 2017).

The Karijini (Hamersley Range) Gorges (WA067) occur to the immediate south of the Project Area (Figure 2.5). Aerial imagery was also inspected for any groundwater and surface water values (i.e. wetlands) within the Project Area. Excluding bores and watering points for cattle, no permanent water bodies have been identified as persisting within the Project Area.

2.6 DBCA MANAGED LANDS AND WATERS

The Project Area lies to the north of Karijini National Park and to the south of the Mungaroona Range National Park (Figure 1.1).

2.7 ABORIGINAL HERITAGE, RESERVES AND MANAGED LANDS

The management of Aboriginal heritage in Western Australia is governed by the *Aboriginal Heritage Act 1972*. The Act recognises there is significant community interest in preserving and protecting places and objects of Aboriginal heritage as part of State heritage (Department of Mines Industry Regulation and Safety 2019). The northern 18 km portion of the proposed rail corridor falls within the Yandeyarra Reserve (Figure 2.5) which is located within the registered Kariyarra people Native Title claim area. Permission for the survey team to access to the reserve was not granted by the Yandeyarra community at the time of survey.

630000 635000 640000 645000 650000 655000 660000 665000 670000 675000 680000 685000 690000 695000 700000 705000 710000

7580000 7575000 7570000 7565000 7560000 7555000 7550000 7545000 7540000 7535000

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Main Roads

IBRA subregion
- Chichester
- Fortescue
- Hamersley

Chichester

GREAT NORTHERN HIGHWAY

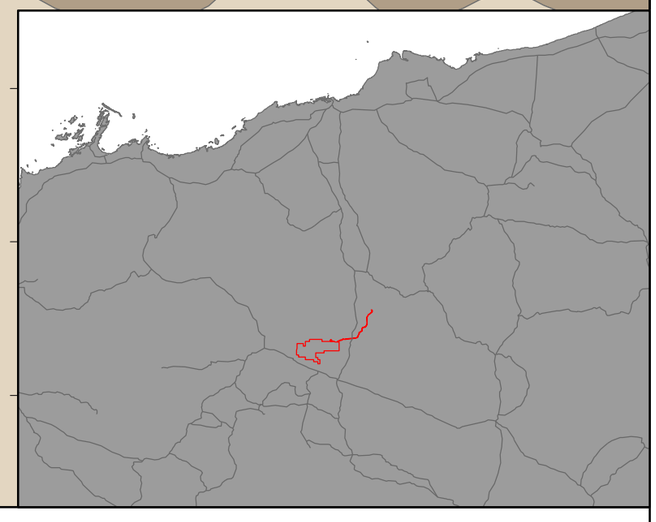
Fortescue

NANUTARRA WITTENOOM ROAD

Hamersley

MUNJINA WITTENOOM ROAD

Hamersley



Project: 1827
Date: 25 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:200,000 @A3

Figure 2.2 IBRA 7 sub-regions

Service Layer Credits:

0 5 10
Kilometers

630000 635000 640000 645000 650000 655000 660000 665000 670000 675000 680000 685000 690000 695000 700000 705000 710000

7580000 7575000 7570000 7565000 7560000 7555000 7550000 7545000 7540000 7535000

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Main Roads

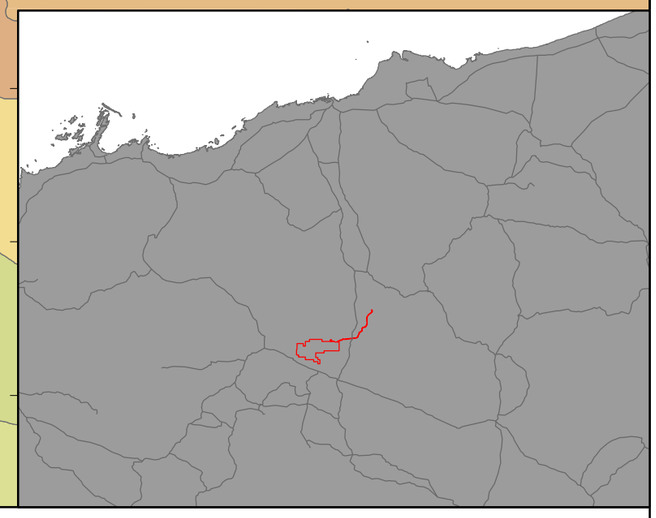
Land system

- Adrian Land System
- Bonney Land System
- Boolgeeda Land System
- Brockman Land System
- Calcrete Land System
- Capricorn Land System
- Christmas Land System
- Coolibah Land System
- Cowra Land System
- Fan Land System
- Granitic Land System
- Hooley Land System
- Jamindie Land System
- Jurrawarrina Land System
- Macroy Land System
- McKay Land System
- Newman Land System
- Platform Land System
- River Land System
- Rocklea Land System
- Urandy Land System
- White Springs Land System
- Wona Land System

GREAT NORTHERN HIGHWAY

NANUTARRA WITTENOOM ROAD

MUNJINA WITTENOOM ROAD



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Project: 1827
Date: 25 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:200,000 @A3

Figure 2.3 Land systems

Service Layer Credits:

0 5 10
Kilometers

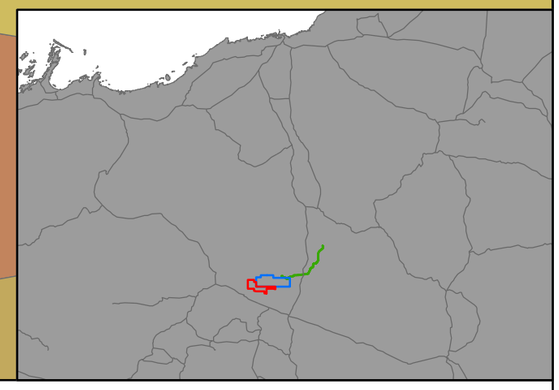
640000 660000 680000 700000

7580000 7560000 7540000

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

Soil unit
- Fa13
- Gf1
- Ja1
- Lb12
- MM17
- MM19
- My55
- Oc62
- Oc63
- Oc64
- Oc70
- Oc71

Oc62 Oc62 Oc62 Oc63 MM17 Oc70 MM19 Gf1 Oc64 MM19 Oc71 Oc70 Lb12 Ja1 My55 Fa13 Lb12



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Project: 1827
Date: 25 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:200,000 @A3

Figure 2.4 Soil units

Service Layer Credits:

0 5 10
Kilometers

650000

700000

7550000

YANDEEYARRA

Wona Land System

Freshwater claypans of the Fortescue Valley

Freshwater claypans of the Fortescue Valley

GREAT NORTHERN HIGHWAY

NANUTARRA WITTENOOM ROAD

Freshwater claypans of the Fortescue Valley

MUNJINA WITTENOOM ROAD

Freshwater claypans of the Fortescue Valley

Brockman Iron cracking clay communities

Freshwater claypans of the Fortescue Valley

Fortescue Marsh

MUNJINA ROY HILL ROAD

BANJIMA DRIVE

Kumina LS

Kumina LS

Wona Land System

Wona Land System

Wona Land System

PORT HEDLAND

POINT SAMSON

BALLA BALLA

KARRATHA

WICKHAM

ROEBOURNE

MALLINA

BAMBOO

MARBLE BAR

NULLAGINE

TOM PRICE

PARABURDOO

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Main Roads
- Threatened and Priority Ecological Communities
- Registered Aboriginal site
- Yandeeyarra Aboriginal Reserve
- Nationally Important Wetlands - Fortescue Valley
- Wittenoom Asbestos Management Area

ecologia ENVIRONMENT

Project: 1757
Date: 30 August 2019
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:300,000 @A3

Figure 2.5 Aboriginal heritage, reverves and managed lands and ground and surface water values.

0 5 10
Kilometers

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

3 METHODOLOGY

3.1 DESKTOP ASSESSMENT

3.1.1 Database Searches

The methodology adopted for the desktop study was consistent with that recommended by the Environmental Protection Authority (2020a). A review of available relevant survey reports in the vicinity of the Project Area was undertaken, as well as searches of mapping resources and databases (Table 3.1) to identify conservation significant species recorded within, or in the vicinity of the Project Area. All results were reviewed based on the likelihood of occurrence of relevant conservation significant species occurring within the Project Area with consideration given to the proximity of previous records, habitat requirements, and landforms.

Relevant conservation significant fauna species assessed as potentially occurring within the Project Area were assigned a likelihood of occurrence rating according to the criteria in Table 3.2. For relevant species, the likelihood of occurrence was determined by investigating the following:

- Fauna habitats likely to exist within the Project Area based on the desktop study;
- Distance of previously recorded conservation significant species based on publicly available records;
- Frequency of occurrence of conservation significant species records; and
- Time passed since conservation significant species were recorded.

Table 3.1: Databases searched for the literature review

Database	Search Details
EPBC Act Protected Matters Database	Records of matters of national significance under the EPBC Act within 40 km of the Project Area
DBCA Threatened and Priority Fauna Database	Records of significant fauna species within 40 km of the Project Area
DBCA NatureMap	All fauna records within 40 km of the Project Area
BirdLife Birdata	Bird records within 40 km of Project Area
Atlas of Living Australia (ALA)	All fauna within 40 km of Project Area

Table 3.2: Criteria used to assess the likelihood of occurrence of significant fauna

Rating	Criterion
Recorded	The species has been recorded within the study area previously or during the current survey.
Likely	The species may occur within the study area as suitable habitat is known to be present and there are existing records very close to the study area (within ca. 10 km).
Possible	The species may occur within the study area as there are existing records in the vicinity of the study area, and suitable habitat is likely to be present; OR The species may occur within the study area as there is insufficient information available to exclude the possibility of occurrence.
Unlikely	The species is unlikely to occur within the study area as suitable habitat is not present or is not likely to be present; OR Suitable habitat is present within the study area, but the taxon/community has not been recorded despite reasonable survey effort.

3.2 FIELD SURVEYS

A level 1 habitat assessment, a two-phase Level 2 vertebrate fauna survey and targeted surveys for conservation significant fauna were conducted to better understand the faunal values within the Project Area. Field surveys were completed during five separate site visits outlined below:

- Level 1 – Fauna habitat assessment: October 8th - 12th 2018
- Phase 1 – Level 2 vertebrate fauna survey: April 4th - 16th 2019
- Phase 1 – Targeted conservation significant fauna survey: July 22nd - 30th 2019
- Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020
- Phase 2 – Targeted conservation significant fauna survey: 29th June - 6th July 2020

The Level 2 surveys were conducted following the period of maximum rainfall for the region as per the EPA Technical Guidance terrestrial fauna surveys (Environmental Protection Authority 2016c). The *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment* (Environmental Protection Authority 2020b) was released in June 2020 and replaces two former Technical Guidance documents: *'Technical Guidance – Sampling methods for terrestrial vertebrate fauna'* (Environmental Protection Authority 2016b) and *'Technical Guidance – Terrestrial fauna surveys'* (Environmental Protection Authority 2016c). Level 1 and Level 2 field surveys were conducted prior to the release of the *Technical Guidance* which now refers to these as Basic and Detailed surveys respectively.

3.2.1 Level 1 Fauna and Fauna Habitat Assessment

A fauna habitat type broadly describes an area of habitat that is distinguishable by its vegetation, soil characteristics, land features and is likely to host a different fauna assemblage to that found in other fauna habitats. Habitat delineation and mapping was based on the interpretation of aerial photography, landforms, habitat site assessments and soil descriptions. The habitat assessment of the Project Area paid particular attention to the likelihood that conservation significance fauna may be present in some habitat types. To ensure survey effort encompassed all fauna habitats present in the Project Area, the following sources of information were used to delineate indicative broad fauna habitats before the Level 1 field survey commenced:

- aerial imagery;
- elevation modelling in Google Earth;
- Beard (1968, 1975, 1979) vegetation mapping; and,
- Land System mapping (van Vreeswyk *et al.* 2004a).

The survey methods for the survey were in accordance with the EPA's Technical Guideline for sampling terrestrial vertebrate fauna for conducting a Level 1 fauna and fauna habitat assessment (Environmental Protection Authority 2016b). Extensive ground truthing of habitat types during subsequent surveys allowed fauna habitat mapping within the Project Area to be further refined.

3.2.2 Level 2 Terrestrial Vertebrate Fauna Assessment

3.2.2.1 Site Selection and Survey Effort

Habitat mapping based on the results of the Level 1 survey indicate eight broad fauna habitat types occur within the Project Area. Three trapping sites were established in each of six broad fauna habitat types identified within the Project Area, totalling 18 sites, with each site trapped for a minimum of seven-nights (Table 3.3). This methodology was replicated in each phase of the survey to ensure consistency and comparison of results. Two habitats, the Claypan and Chenopod/Cracking Clay Floodplains were not trapped as they do not provide suitable niches for vertebrate fauna. Where trap sites were associated within hard substrates which prevented the installation of pitfall traps, a

combination of funnel traps, Elliott traps, cage traps and drift fences were used. This design and effort is considered comparable to that of a pitfall trap line (Environmental Protection Authority 2016b).

Table 3.3: Trap site locations and survey effort

Phase 1						
Site	Habitat Type	Datum	Latitude	Longitude	Nights Open	Total Trap nights
MDS01	Mixed Eucalypt /Mulga Floodplain	GDA94	118.520	-22.149	7	308
MDS02	Calcrete Stony Plain	GDA94	118.520	-22.171	9	346
MDS03	Calcrete Stony Plain	GDA94	118.503	-22.207	7	308
MDS04	Calcrete Stony Plain	GDA94	118.520	-22.165	7	308
MDS05	Mixed Eucalypt /Mulga Floodplain	GDA94	118.469	-22.182	7	308
MDS06	Mixed Eucalypt /Mulga Floodplain	GDA94	118.520	-22.156	7	308
MDS07	Stony Spinifex Plains and Hillslopes	GDA94	118.504	-22.098	8	318
MDS08	Stony Spinifex Plains and Hillslopes	GDA94	118.518	-22.089	8	352
MDS09	Rocky Hills	GDA94	118.556	-22.113	7	288
MDS10	Rocky Hills	GDA94	118.634	-22.136	7	288
MDS11	Drainage Line	GDA94	118.565	-22.120	7	308
MDS12	Drainage Line	GDA94	118.640	-22.112	7	308
MDS13	Drainage Line	GDA94	118.594	-22.127	7	308
MDS14	Stony Spinifex Plains and Hillslopes	GDA94	118.603	-22.134	7	308
MDS15	Rocky Hills	GDA94	118.641	-22.111	7	288
MDS16	Mulga Woodland	GDA94	118.519	-22.118	9	346
MDS17	Mulga Woodland	GDA94	118.551	-22.123	9	346
MDS18	Mulga Woodland	GDA94	118.623	-22.145	7	308
				Total	134	5652
Phase 2						
Site	Habitat Type	Datum	Latitude	Longitude	Nights Open	Total Trap nights
MDPT001	Calcrete Stony Plain	GDA94	118.520	-22.167	9	360
MDPT002	Calcrete Stony Plain	GDA94	118.514	-22.182	9	360
MDPT003	Calcrete Stony Plain	GDA94	118.504	-22.208	8	320
MDPT004	Drainage Line	GDA94	118.567	-22.117	9	360
MDPT005	Drainage Line	GDA94	118.624	-22.143	9	360
MDPT006	Drainage Line	GDA94	118.594	-22.127	9	360
MDPT007	Mulga Woodland	GDA94	118.493	-22.112	8	320
MDPT008	Mulga Woodland	GDA94	118.669	-22.161	9	360
MDPT009	Mulga Woodland	GDA94	118.596	-22.132	9	360
MDPT010	Mixed Eucalypt/ Mulga Floodplain	GDA94	118.519	-22.152	9	360
MDPT011	Mixed Eucalypt/ Mulga Floodplain	GDA94	118.468	-22.183	8	320
MDPT012	Mixed Eucalypt/ Mulga Floodplain	GDA94	118.466	-22.163	8	320
MDPT013	Rocky Hills	GDA94	118.627	-22.127	8	320
MDPT014	Rocky Hills	GDA94	118.512	-22.121	8	320
MDPT015	Rocky Hills	GDA94	118.557	-22.112	8	320
MDPT016	Stony Spinifex Plains and Hillslopes	GDA94	118.517	-22.089	9	360
MDPT017	Stony Spinifex Plains and Hillslopes	GDA94	118.555	-22.110	9	360
MDPT018	Stony Spinifex Plains and Hillslopes	GDA94	118.496	-22.099	8	320
				Total	154	6160
				Grand Total	288	11812

3.2.2.2 Systematic trapping

The Level 2 terrestrial fauna surveys sampled the local fauna using a suite of trapping techniques. Trap lines were established as shown in Figure 3.2 and methodology is described below:

- Pitfall Traps: 20 L bucket and 50 cm long x 15 cm diameter PVC pipe traps (diameter: 150 mm, depth: 700 mm). Each trapping site has two trapping lines, each containing five pitfall traps dug into the ground 5m apart. Each trap line utilises buckets and pipes (alternating) with a 30cm high, 5m long drift fence placed between the pit traps directing fauna towards the trap. This fence extends 5m off the first and last pit trap making the total length of the line 30m. Each trap site therefore contains two lines (roughly 50m apart), both with five pit traps (a total of 10 pit traps) and 30m of drift fence (a total of 60m drift fence).
- Funnel traps: Placed on either side of each fence between each pit trap to capture fauna that do not readily fall into pit traps (eight per line, a total 16 per trapping site). All funnel traps were covered by industrial insulation shades to reduce the likelihood of animals suffering from overheating.
- Elliott traps: Aluminium box traps (10 per trapping site) were baited with 'universal bait' (oats, peanut butter, sardines) to attract and capture smaller mammals and re-baited as necessary at the discretion of the zoologist. All Elliott traps are covered by industrial insulation shades to reduce the likelihood of animals suffering from overheating.
- Cage traps: larger wire-frame box traps, also baited with 'universal bait', to capture medium-sized mammals (two per line, a total of four per trap site). All cage traps are covered by hessian shades to reduce the likelihood of animals suffering from overheating, excess stress from being out in the open and protection from predators.

Traps were cleared within three hours of sunrise, closed during the day, and then reopened in the late afternoon to minimise potential heat stress to captured animals. All traps were removed, and holes were filled following completion of the Level 2 survey.

3.2.2.3 Avifauna Surveys

To survey bird assemblages, 20-minute set-time searches were undertaken at each systematic trapping site by an experienced ornithologist. During each set-time survey, the number of individuals of each species observed was recorded while actively searching similar habitat within a 2-hectare area surrounding the survey site. This approach is in accordance with systematic survey methods recommended by BirdLife Australia and *Technical Guidance: Sampling methods for terrestrial vertebrate fauna* (Environmental Protection Authority 2016b). Survey effort was conducted within three hours of dawn and dusk, which is deemed to be optimal for recording majority of bird species.

Set time surveys were conducted at each systematic trapping site for avifauna on a minimum of two occasions. Opportunistic surveys were conducted at sites considered to potentially support a different avifauna assemblage to systematic trapping locations, with specific focus on areas exhibiting surface water (Figure 3.1). Survey effort for avifauna can be seen in Table 3.4.

Table 3.4: Avifauna survey effort

Survey	Set time surveys	Opportunistic searches
Phase 1 - Level 2 vertebrate fauna survey: April 4th - 16th 2019	70 conducted (1400 minutes)	4 sites
Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020	37 conducted (740 minutes)	15 sites
Total	107 set time surveys (2140 minutes)	19 sites

3.2.2.4 Acoustic Recording Units

SM2BAT (SM2s) and Song Meter 4 (SM4) long term passive acoustic recording units (ARUs) have a high sampling frequency, enabling the full spectrum of bat calls to be recorded without being transformed, allowing greater accuracy and sensitivity. ARUs were placed with the microphone pointed to the sky or at a prospective roost cave and were used to record echolocation calls of bats in the vicinity. ARUs were deployed at each systematic trapping site (Figure 3.1) for a minimum of one night during both phases of the Level 2 terrestrial fauna survey resulting in a total of 36 recording nights (Table 3.6).

3.2.2.5 Nocturnal Spotlighting

Nocturnal spotlighting was conducted from vehicles and on foot to target nocturnal and crepuscular fauna species. Main access tracks were driven on seven nights by four people for a period of one hour totalling 28 hours. Four zoologists conducted spotlighting on foot through rocky habitat totalling 8 hours. In total, 36 hours was spent spotlighting for cryptic nocturnal and crepuscular species during the current Level 2 terrestrial fauna survey (Figure 3.6, Table 3.5).

During the initial survey (*ecologia* 2019), two zoologists conducted an hour long traverse and spotlighting on foot through rocky habitat and 8 hours spotlighting on main access tracks from a vehicle, totalling 10 hours searching for cryptic nocturnal species (Table 3.5).

640000 645000 650000 655000 660000 665000 670000 675000

7560000 7555000 7550000 7545000 7540000

MDS08 MDPT016 MDPT018 MDS07 Opp09 Opp10 Opp15 MDPT007 MDPT017 MDPT015 MDS09 MDPT004 MDS11 MDS16 MDPT014 MDS17 Opp08 MDS12 Opp06 MDS15 Opp04 Opp13 MDPT006 MDS13 MDPT013 Opp12 Opp03 Opp01 Opp05 MDPT009 MDS14 MDS10 MDS18 MDPT005 MDS01 MDPT010 MDS06 Opp07 MDPT008 MDPT012 Opp14 MDS04 Opp02 MDPT001 Opp11 MDS02 MDS05 MDPT011 MDPT002 MDS03 MDPT003

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Systematic trapping site - Phase 1
- Systematic trapping site - Phase 2
- Phase 2 0pportunistic avifauna census transects

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:90,000 @A3

Figure 3.1 Systematic trap site locations and opportunistic bird census transects

0 2.5 5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

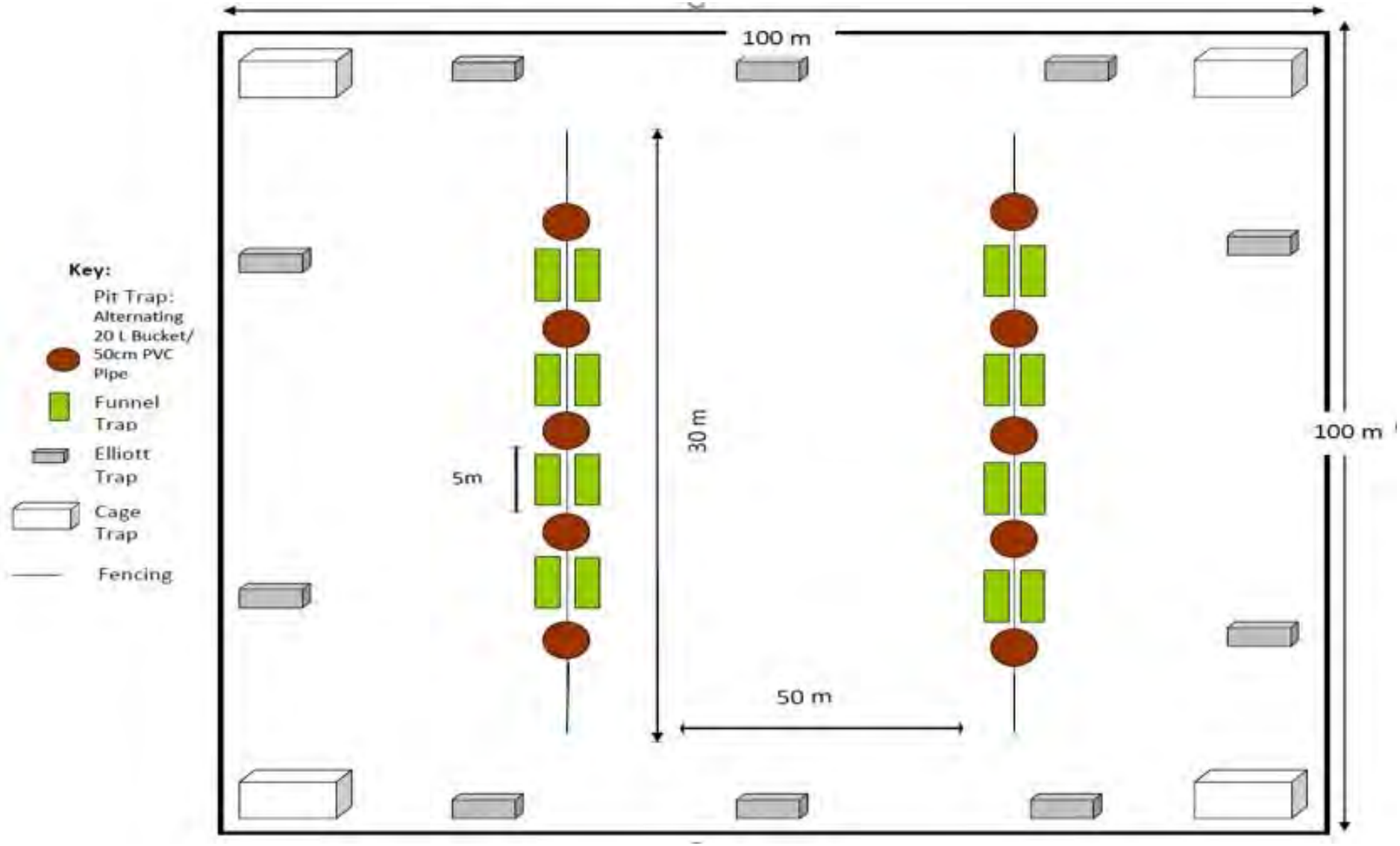


Figure 3.2: Trap site layout

3.2.3 Targeted Conservation Significant Fauna Survey

Fauna species listed as Threatened or Migratory under the EPBC Act are classed as Matters of National Environmental Significance (MNES). Targeted surveys were undertaken for MNES species with the aim of understanding the importance of populations and habitats occurring within the Project Area.

Based on the results of the desktop assessments, habitat assessments and previous surveys, targeted surveys were undertaken for six MNES species including the northern quoll, bilby, Pilbara leaf-nosed bat, ghost bat, Pilbara olive python and night parrot.

Targeted surveys for all species were undertaken in accordance with the following licence, policies and guidelines:

- DBCA Regulation 27 Licence - BA27000030 (Fauna taking for Biological Assessment)
- DBCA Authorisation number TFA 2019-0010 (Authorisation to take or disturb Threatened species)
- EPBC Act referral guideline for the endangered northern quoll (Commonwealth of Australia 2016)
- Survey guidelines for Australia's threatened bats (Department of Sustainability Environment Water Population and Communities 2010)
- Survey guidelines for Australia's threatened reptiles (Department of Sustainability Environment Water Population and Communities 2011b)
- Survey guidelines for Australia's threatened mammals (Department of Sustainability Environment Water Population and Communities 2011a)
- Environmental Factor Guideline: Terrestrial Fauna (Environmental Protection Authority 2016a);
- Technical Guidance: Sampling methods for terrestrial vertebrate fauna (Environmental Protection Authority 2016b); and
- Technical Guidance: Terrestrial Fauna Surveys (Environmental Protection Authority 2016c).

3.2.3.1 Northern quoll (*Dasyurus hallucatus*) (Endangered under EPBC Act and BC Act)

A combination of cage traps, motion sensor cameras, and opportunistic searches to detect dens and scats were employed to detect the presence/absence of northern quolls along with understanding habitat use and population dynamics. To comply with the referral guidelines (Commonwealth of Australia 2016), trapping transects along linear rocky ridgelines in the proposed mine impact area were implemented to achieve optimal coverage of potential habitat.

During the phase 1 targeted survey (*ecologia* 2019), 45 cage traps were set for a period of seven nights, resulting in a total trapping effort of 315 trap nights (Figure 3.3). Traps were cleared within three hours of sunrise each morning and baited with sardines. Camera traps (Reconyx HC500 HyperFire) were deployed at 42 locations with a total trapping effort of 207 trap nights and baiting stations were baited with sardines (Figure 3.3). A total of 12 hours of nocturnal searches were undertaken within suitable habitat with the aid of a Pulser Helion XP28 thermal monocular. Thermal imaging scopes use infra-red light to detect heat signatures emitted by endothermic species such as the northern quoll.

An Unmanned Aerial Vehicle (UAV)/drone was used to identify potential denning and shelter habitat within Rocky Hills over the extent of the Project Area during the phase 2 Level 2 survey in April 2020 (Figure 3.4). The drone covered approximately 107 kms searching for prospective northern quoll habitat. Once suitable habitat was identified 39 motion sensor cameras (Reconyx HC500 HyperFire) were baited with sardines and deployed during the Level 2 survey (April 2020) and retrieved during the targeted survey (July 2020) (Figure 3.3). Each camera recorded for between 101 and 105 nights resulting in a total of 3982 motion sensor camera nights (Table 3.5).

Thirty-six hours was spent spotlighting for northern quolls during targeted searches for cryptic nocturnal species, resulting in an increased survey effort for this species (Figure 3.6). Targeted searches within suitable habitat for secondary sign of northern quolls was undertaken during each phase of this assessment when deploying cameras, bat ARUs and when cave habitat assessments (Table 3.5).

A combined total of 91 sites were surveyed using motion sensor cameras (4237 trap nights), 45 sites using cage traps (315 trap nights), 48 hours of nocturnal searches and 200 hrs of targeted searches were undertaken to target northern quolls (Table 3.5, Figure 3.3).

Table 3.5: Total survey effort for the northern quoll

Survey	Motion sensor cameras	Cage traps	Targeted Searches	Unmanned Aerial Vehicle searches
Phase 1 - Level 2 vertebrate fauna survey: April 4th - 16th 2019	10 sites 48 trap nights	N/A	20 hrs targeted searching	N/A
Phase 1 - Targeted conservation significant fauna survey: July 22nd - 30th 2019	42 Sites 207 trap nights	45 sites 315 trap nights	20 hrs targeted searching, 12 hrs nocturnal searching	N/A
Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020	Cameras deployed at 39 sites	N/A	60 hrs targeted searching	N/A
Phase 2 - Targeted conservation significant fauna survey: 29th June - 6th July 2020	Cameras retrieved from 39 sites 3982 trap nights	N/A	36 hrs nocturnal searches, 100 hrs undertaken during cave habitat assessments (>82 caves assessed)	107 kms of drone flight paths
Total	91 sites 4237 trap nights	45 sites 315 trap nights	48 hrs of nocturnal and 200 hrs of targeted searches (>82 caves assessed)	107 kms of drone flight paths

3.2.3.2 Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara)) (Vulnerable under EPBC Act and BC Act) and ghost bat (*Macroderma gigas*) (Vulnerable under EPBC Act and BC Act)

In addition to echolocation call recordings obtained by ARUs at each systematic trap sites (36 sites), ARUs were deployed at 216 sites (504 recording nights) to record bat calls within the Project Area over five targeted surveys (Figure 3.5, Table 3.6) and the results of these surveys have been addressed in a stand-alone report (Appendix J). ARUs were deployed in habitats known to be important for bat species of significance such as rocky habitats (breakaways, caves, gullies, and gorges), on flight paths (Drainage Lines) and in foraging areas.

To understand how these species utilise suitable habitat within the Project Area, 82 cave habitat assessments were undertaken during the phase 2 targeted survey in June 2020 to evaluate their suitability as diurnal roost caves and review cave morphology, geology and cave conditions (Figure 3.4). A UAV (drone) was used to conduct surveys to identify suitable northern quoll habitat and identify potential cave habitat for the Pilbara leaf-nosed bat and ghost bat (Figure 3.4, Table 3.6).

Suitable caves within these areas with the potential to function as a roost cave, nocturnal refuge or nocturnal feeding cave were assessed and the following parameters were documented:

- Location;
- Assessed ghost bat usage;
- Basic geology;
- Entrance type and dimensions (gathered using a laser measuring device), entrance orientation;
- Cave grouping, insulation from above;
- Cave type (e.g. overhang, adit, crevice, cave with multiple chambers);
- Internal domed chamber, rear passages that may have a roost;
- Internal temperature and relative humidity;
- Local foraging opportunities and distance to disturbance; and
- Cave floorplan and photograph.

Deep caves with ceiling heights of 2.5m or greater, dark recesses and high levels of humidity were classified as potential roost caves for ghost bats (Bat Call 2016). Shallow caves and deep hollow with overhead roof structures higher than 1.5 metres which were assessed as having the capacity to provide protection from inclement weather or predators were classified as potential nocturnal refuges for ghost bats (Bat Call 2016). Nocturnal refuges for this species typically range from five to 15 metres deep and exhibit high humidity and low light conditions (Bat Call 2016).

Deep, complex caves with low light levels and a suitable microclimate were categorised as potential roosts for the Pilbara leaf-nosed bat (Threatened Species Scientific Committee 2016b). This species does not roost in overhangs, as they do not promote the warm, humid microclimates required by this species, therefore these structures were not considered to be potential roosts for the purposes of this survey (Threatened Species Scientific Committee 2016b). Caves with the capacity to shelter Pilbara leaf-nosed bats from inclement weather and predators during nocturnal resting or feeding were classified as nocturnal refuges (Threatened Species Scientific Committee 2016b).

Table 3.6: Total survey effort for the Pilbara leaf-nosed bat and ghost bat.

Survey	Acoustic Recording Unit	Cave habitat assessments	Unmanned Aerial Vehicle searches
Phase 1 - Level 2 vertebrate fauna survey: April 4th - 16th 2019	31 sites 59 recording nights	N/A	N/A
Phase 1 - Targeted conservation significant fauna survey: July 22nd - 30th 2019	57 sites 75 recording nights	N/A	N/A
Targeted Pilbara Leaf-nosed Bat Survey (November 25th - December 2 2019	70 sites 70 recording nights	N/A	N/A
Long-term Pilbara leaf-nosed bat survey December 2019- March 2020	6 Sites 212 recording nights	N/A	N/A
Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020	18 sites 18 recording nights	N/A	107 km of UAV searches
Phase 2 - Targeted conservation significant fauna survey: 29th June - 6th July 2020	42 sites 42 recording nights	81 cave habitat assessments	N/A
Targeted Pilbara Leaf-nosed Bat Survey (October 5th - 9th 2020	28 Sites 28 recording nights	1 cave habitat assessment	N/A

Survey	Acoustic Recording Unit	Cave habitat assessments	Unmanned Aerial Vehicle searches
Total	252 sites, 504 recording nights	82 cave habitat assessments	107 km of flight paths

3.2.3.3 Night parrot (*Pezoporus occidentalis*) (Endangered under EPBC Act and Critically Endangered under BC Act)

The Project Area occurs within a zone classified as a high priority area for the night parrot (Department of Biodiversity Conservation and Attractions 2017). SM2 ARUs were programmed, in accordance with night parrot survey guidance, to record night parrot calls between sunset and sunrise each evening. These surveys were undertaken in the months following significant rainfall events when breeding is more likely to occur and therefore detectability of the species is expected to be higher (Department of Biodiversity Conservation and Attractions 2017).

Three ARUs were programmed to record night parrot calls during the phase 1 Level 2 survey, with two deployed in the Chenopod/Cracking Clay Floodplain and one set amongst long unburnt spinifex within the Stony Spinifex Plain and Hillslope habitat (Figure 3.3).

Prior to undertaking the phase 2 targeted surveys, a detailed assessment of prospective night parrot habitat was undertaken by reviewing high resolution aerial imagery covering the project area and using an UAV to identify areas long unburnt spinifex and potential suitable habitat for this species (Figure 3.4). A total of 33 kms of UAV flights were conducted over clumps of long unburnt spinifex within the Project Area.

Based on current knowledge, broad habitat requirements of the night parrot include areas of old, long-unburnt spinifex (*Triodia* spp.) for roosting and nesting, together with foraging habitats that are likely to include various native grasses and herbs, and may or may not contain shrubs or low trees (Department of Biodiversity Conservation and Attractions 2017). Roosting and nesting sites are in clumps of dense vegetation, primarily old and large spinifex clumps (often >50 years unburnt), especially hummocks that are ring-forming (Department of Biodiversity Conservation and Attractions 2017).

ARUs were set in seven locations (Table 3.7, Figure 3.3) within areas which were considered to support long unburnt spinifex (>50 cm) for a minimum of six nights in accordance with the interim survey guidelines for night parrots (Department of Biodiversity Conservation and Attractions 2017). ARUs were deployed for a combined total of 60 recording nights.

Table 3.7: Night parrot acoustic recording device locations

Site	Survey	Latitude	Longitude	Date opened	Date closed	Effort
NP01	Phase 1	118.4655	-22.1326	6/04/2019	12/04/2019	6 nights
NP02	Phase 1	118.4667	-22.142	6/04/2019	12/04/2019	6 nights
NP03	Phase 1	118.5174	-22.0838	6/04/2019	12/04/2019	6 nights
NPPT01	Phase 2	118.5264	-22.0881	21/04/2020	27/04/2020	6 nights
NPPT02	Phase 2	118.5252	-22.0901	21/04/2020	27/04/2020	6 nights
NPPT03	Phase 2	118.5225	-22.0939	21/04/2020	27/04/2020	6 nights
NPPT04	Phase 2	118.4739	-22.0838	21/04/2020	27/04/2020	6 nights
NPPT05	Phase 2	118.5009	-22.0862	21/04/2020	27/04/2020	6 nights

Site	Survey	Latitude	Longitude	Date opened	Date closed	Effort
NPPT06	Phase 2	118.5183	-22.0854	21/04/2020	27/04/2020	6 nights
NPPT07	Phase 2	118.5539	-22.1105	21/04/2020	27/04/2020	6 nights
					Total	60 nights

3.2.3.4 Bilby (*Macrotis lagotis*) (Vulnerable EPBC Act and BC Act)

Given an historical record of a bilby from the Project Area, a targeted survey was undertaken to confirm the presence/absence of the species within the Project Area. *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises is one of the habitats known to support populations of the bilby within Western Australia (Threatened Species Scientific Committee 2016a). and this habitat type was surveyed extensively with a UAV during the targeted survey

The results of soil assessments undertaken within the Project Area (Mine Earth 2019) were interrogated for suitable substrates for bilby burrows. UAV flights were completed in a linear pattern, with transects separated by no more than 500m (usually between 200 m and 400 m) within Mulga Woodland habitat type to identify potentially suitable habitat and secondary sign (diggings and burrows) (Figure 3.4, Table 3.8).

Table 3.8: Bilby survey effort

Survey	Targeted Searches	Unmanned Aerial Vehicle searches
Level 1 - fauna habitat assessment: October 8th - 12th 2018	42 habitat assessments undertaken	N/A
Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020	N/A	228 km of flight paths
Total	42 habitat assessments undertaken	228 km of flight paths

3.2.3.5 Pilbara olive python (*Liasis olivaceus barroni)* (Vulnerable under EPBC Act and BC Act)

The presence of the Pilbara olive python within the Project Area was confirmed when an individual python was opportunistically recorded at the exploration camp during the initial phase of the Level 2 survey (*ecologia* 2019).

Targeted surveys for cryptic species such as the Pilbara olive python are difficult to effectively conduct. The *Survey Guidelines for Threatened Reptiles* (Department of Sustainability Environment Water Population and Communities 2011b) recommends active searches along rocky gorges and other suitable habitat as the most appropriate survey technique. Suitable habitat for the Pilbara olive python within the Project Area is associated with Rocky Hills (rocky outcrops, breakaways and small gorges) although they have also been recorded in spinifex grasslands and are known to travel large distances, suggesting the species has a large home range (Tutt *et al* 2002).

Targeted searches conducted in rocky habitats for secondary evidence (sloughs and scats) were conducted concurrently with cave habitat assessments, northern quoll targeted searches and deploying bat ARUs. Spotlighting through rocky habitat on foot and nocturnal road spotting for this cryptic nocturnal species was undertaken during the targeted surveys (phase 1 and 2) (Figure 3.6, Table 3.9). Four zoologists conducted spotlighting on foot through suitable rocky habitat for a total of 480 minutes. Nocturnal road spotting was also undertaken on spotlighting for cryptic nocturnal species including the Pilbara olive python during each phase of the surveys for a total of 3840 minutes (Figure 3.6). Camera traps deployed in the Rocky Hills targeting northern quolls were also used to detect

presence of Pilbara olive pythons resulting in greater survey effort for the species (Figure 3.3). Total survey effort for the Pilbara olive python can be seen in Table 3.9.

Table 3.9: Pilbara olive python survey effort

Survey	Motion sensor cameras	Cage traps	Targeted Searches	Unmanned Aerial Vehicle searches
Phase 1 - Level 2 vertebrate fauna survey: April 4th - 16th 2019	10 sites 48 trap nights	N/A	20 hrs targeted searching	N/A
Phase 1 - Targeted conservation significant fauna survey: July 22nd - 30th 2019	42 Sites 207 trap nights	45 sites 315 trap nights	20 hrs targeted searching, 12 hrs nocturnal searching	N/A
Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020	Cameras deployed at 39 sites	N/A	60 hrs targeted searching	N/A
Phase 2 - Targeted conservation significant fauna survey: 29th June - 6th July 2020	Cameras retrieved from 39 sites 3982 trap nights	N/A	36 hrs nocturnal searches, 100 hrs undertaken during cave habitat assessments (>82 caves assessed)	107 kms of drone flight paths
Total	91 sites 4237 trap nights	45 sites 315 trap nights	248 hrs of nocturnal and targeted searches	107 kms of drone flight paths

655000 660000 665000 670000 675000

7560000 7555000 7550000 7545000

NPPT04 TQCT027 TQCT028 TQCT025 NPPT05 NPPT06 NP03 TQCT008 TQCT031 TQCT016 TQCT010 TQCT033 NPPT02 NPPT01 TQCT018 NPPT03

TQCT001 TQCT022 TQCT029 TQCT012 TQCT007 MC32 TQCT003 MC27 TQCT006 TQCT014 NPPT07 CT3 TQCT024 TQCT021 TQCT026 MC29 MC28 TQCT020 MC30 MC31 TQCT004 TQCT015 MC33 MC26 TQCT019 TQCT032

CT4 MC14 MC40 MC41 MC20 MC17 MC21 CT7 CT6 CT5 TQCT038 TQCT039 MC25 MC18 MC42 CT1 MC15 TQCT017 CT2 MC04 MC16 MC34 TQCT036 CT10 MC06 MC22 MC35 MC11 CT9 MC19 MC23 MC39 MC08 MC10 MC38 MC02 MC24 TQCT009 TQCT005 MC13 MC01 TQCT030 TQCT035 TQCT023 MC12 CT8 TQCT037 MC05 MC07 TQCT013 NP01 NP02

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Motion sensor camera - Phase 1
- Motion sensor camera - Phase 2
- Cage trap
- Night Parrot ARU - Phase 1
- Night Parrot ARU - Phase 2

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

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Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:65,000 @A3

Figure 3.3 Targeted motion sensor camera, northern quoll targeted cage trap and night parrot acoustic recording unit locations.

0 1.75 3.5
Kilometers

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650000
655000
660000
665000
670000
675000
7560000
7555000
7550000
7545000

Rocky habitat drone flight log
Night parrot habitat drone flight logs
Bilby habitat drone flight logs

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Figure 3.4 UAV/drone habitat assessment flight logs.

0 2 4
Kilometers

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650000 655000 660000 665000 670000 675000

7550000

7545000

MEC023
MEC077
MEC015
MEC078
MEC017
MEC011
MEC076
MEC020
MEC019
MEC018
MEC022
MEC075
MEC049
MEC003
MEC060
MEC002
MEC001
MEC058
MEC034
MEC007
MEC056
MEC035
MEC065
MEC031
MEC047
MEC044
MEC059
MEC026
MEC009
MEC046
MEC053
MEC010
MEC016
MEC006
MEC008
MEC005
MEC013
MEC073
MEC045
MEC040
MEC014
MEC074
MEC038
MEC036
MEC037
MEC041
MEC048
MEC081

Cave habitat assessment sites
Bat ARU site

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Date: 17 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:70,000 @A3

Figure 3.5 Bat ARU locations and cave habitat assessment sites

0 1.75 3.5
Kilometers

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640000 645000 650000 655000 660000 665000 670000 675000 680000 685000 690000

7570000 7565000 7560000 7555000 7550000 7545000 7540000 7535000

Spotlighting and nocturnal search survey effort
Targeted searches and track logs
Opportunistic avifauna census tracks

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Project: 1828
Date: 30 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:140,000 @A3

Figure 3.6 Targeted searches, avifauna census tracks and nocturnal spotlighting.

0 3.75 7.5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.3 DATA ANALYSIS

3.3.1 Sampling Adequacy and Estimated Species Richness

Sampling adequacy was assessed by extrapolating species accumulation curves (SACs). SACs display the rate at which new species are found within the Project Area in relation to sampling effort and can be extrapolated to provide an estimate of species richness. As sampling effort increases, the rate at which new species are recorded is reduced until the number of species recorded reaches the number present. At the point where there is a minimal increase in species richness with continued sampling effort, the sample size is considered adequate. Four incidence-based coverage estimators (Chao 2, bootstrap, jackknife 1 and jackknife 2) were used to extrapolate species richness for the Project Area using the *vegan* package (Oksanen *et al.* 2017) of R 3.5.2 (R Core Team 2016). Analyses were conducted using the total number of species recorded in both phases of the survey and completed separately for avifauna and trapped animals (ground dwelling mammals, amphibians and reptiles) using 9,999 permutations.

3.3.2 Fauna Assemblage

Analysis of fauna survey data is undertaken to determine potential differences in species composition between the habitat types identified within the Project Area. Patterns among sampling sites were visually assessed by nonmetric multidimensional scaling (NMDS) for each faunal group. NMDS was conducted using square root transformed abundance data and the Bray-Curtis coefficient in *vegan*. 95% confidence intervals of the group (habitat type) centroids were calculated and displayed on the plot as ellipses. A stress value was calculated for the ordination whereby lower values indicate that the configuration of points is a good representation of the actual similarity between sites. Generally, stress values > 0.25 are poor, although they will tend to be greater for larger and more complex data sets.

3.4 ANIMAL ETHICS

The survey was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5 of the *Australian code of practice for the care and use of animals for scientific purposes* (National Health and Medical Research Council 2004). In all cases, fauna species were identified in the field, and not captured or collected during the survey.

3.5 ANALYSIS, TAXONOMY AND NOMENCLATURE

Nomenclature for mammals, birds, reptiles and amphibians within this report is as per *Western Australian Museum Checklist of the Vertebrates of Western Australia* April 2020. *ecologia* consistently check for updates to the checklist and literature to ensure all taxonomy conducted is relevant and current. References used for fauna identification are listed in Table 3.10.

Mr Robert Bullen of Bat Call WA analysed acoustic bat call data collected during the Level 2 survey.

Table 3.10: References for identification

Fauna Group	Reference
Mammals	van Dyck and Strahan (2008b), Van Dyck *et al.* (2013)
Bats	Churchill (1998), Menkhorst and Knight (2011) Van Dyck *et al.* (2013)
Birds	Simpson and Day (2010)
Reptiles	Cogger (2018), Wilson and Swan (2017)
Geckos	Cogger (2018), Wilson and Swan (2017)
Skinks	Cogger (2018), Wilson and Swan (2017)
Dragons	Cogger (2018), Wilson and Swan (2017)
Varanids	Cogger (2018), Wilson and Swan (2017)
Legless Lizards	Cogger (2018), Wilson and Swan (2017)
Snakes	Cogger (2018), Wilson and Swan (2017)

Fauna Group	Reference
Amphibians	Tyler and Doughty (2009), Cogger (2018)

3.6 STUDY TEAM AND LICENCES

The fauna assessments undertaken by *ecologia* were planned, coordinated, executed and reported by those summarised below in Table 3.11. DBCA licences are also provided.

Table 3.11: Study team and licences

Project Staff				
Name	**Qualification**	**Experience**	**Role**	**Project role**
Shaun Grein	B. Sc. Biol.; Grad. Dip. Nat. Resources; MBA	>25 yrs	Managing Director/Principal Scientist	Project management, reporting, QA
Tim McCabe	B.Sc. Env. Biol, Dip Proj Mngment, Cert III Vert Pest Mngment	>12 yrs	Senior Zoologist	Project management, fauna field assessments, reporting
Ed Swinhoe	Masters Vert. Cons, Cert III Vert Pest Mngment	>12 yrs	Senior Zoologist	Field assessments
Jenny Wilcox	B. Sc. Biol and Env. Science	>20 yrs	Ornithologist	Field ornithologist
Tom Clairs	Cert III Conservation Land Management	>5 yrs	Field Assistant	Field assessment
Hassan Abdi	B. Sc Env. Biol	Graduate	Field Assistant	Field assessment
Claudia Buters	B.Sc. Cons. Biol. & Zool.; MWildlifeHth	>5 yrs	Zoologist	Reporting
DBCA Licenses				
Holder	**Type**			**Number**
Tim McCabe	Authorisation to take or disturb Threatened species			TFA 2019-0010
Tim McCabe	Fauna Taking (Biological Assessment) Licence – Regulation 27			BA27000030

3.7 SURVEY LIMITATIONS AND CONSTRAINTS

According to EPA guidelines (Environmental Protection Authority 2016b), terrestrial fauna surveys may be limited by several aspects. An assessment of these aspects regarding the vertebrate fauna surveys is detailed in Table 3.12.

Table 3.12: Statement of limitations for the vertebrate fauna surveys

Constraint	Impact	Comment
Competency and experience of consultants	Nil	All members of the survey team were experienced in fauna identification and undertaking fauna surveys.
Availability of contextual information at a regional and local scale	Nil	Broad scale bioregion, vegetation, land system, and soil, mapping data were available for the Project Area and adequate to provide appropriate contextual information for the Project Area.
Sources of information sources (e.g. historic or recent)	Nil	Comprehensive database records, including conservation significant species, were available and considered adequate.
Scope	Nil	The study scope was well-defined, and surveys were undertaken adequately to satisfy the needs of the scope.
Proportion of fauna identified recorded and/or collected	Nil	Data analysis was undertaken and outlined that adequate survey intensity has been achieved.
Proportion of task achieved, and further work which might be needed	Nil	The assessment was conducted and completed according to an agreed scope.
Timing/weather/season/cycle	Minor	Both phases of the Level 2 surveys were conducted during April (2019 and 2020) following the season of maximum rainfall. Targeted surveys were conducted to comply with specific target species survey guidelines. Surface water was present in the Claypans during both phases due to rainfall events prior to the survey. The two previous “wet seasons” (2017/2018, 2018/2019) in the region have been dry within the Project Area and average summer rains fell over the 2019/2020 season.
Remoteness or access restrictions within the survey area	Negligible	Remoteness and/or access restrictions did not affect results. Limited access along to the northern portion of the proposed Rail corridor within the Yandeyarra Aboriginal Reserve. The western portion of the Malay Well tenement falls within the Wittenoom Asbestos Management Area (WAMA). Access to this area is prohibited and no survey work was undertaken in this area.
Disturbances which may affect results of survey	Nil	Disturbances did not affect results.
Intensity and completeness	Nil	The intensity of trapping effort for both phases of the Level 2 and targeted surveys are considered adequate.

4 RESULTS

4.1 DESKTOP ASSESSMENT

4.1.1 Database Searches

Database searches identified a total of 309 vertebrate fauna species that have been previously recorded within 40 km of the Project Area including 49 mammals (eight introduced), 188 birds, 13 amphibians, 10 fish and 134 reptile species (Appendix F). Birdlife Birdata search results identified 137 species of bird previously recorded within 40 km of the Project Area (Appendix C). Naturemap and Atlas of Living Australia database records are provided in Appendix B and Appendix D respectively and regional fauna records can be seen in Appendix F.

4.1.2 Literature Review

Four fauna surveys have previously been completed within the Project Area. A summary of these surveys is provided in Table 4.1.

Other surveys undertaken within 100 kms of the Project Area include:

- (Bamford 2005a) Bamford Consulting Ecologists. 2005. Fauna Assessment of the Stage B Rail Corridor Re-alignment;
- (Bamford 2005a) Bamford Consulting Ecologists. 2005. Fauna survey of proposed Iron Ore Mine, Cloudbreak;
- (Bamford 2010) Bamford Consulting Ecologists. 2010. Fortescue Metals Group: Targeted Fauna Assessment of the Rail Duplication. 15 December 2010;
- (Biota 2004) Biota Environmental Sciences. 2004. Fauna habitats and fauna assemblage of the proposed FMG Stage A rail corridor;
- (Coffey 2008) Coffey Environments. 2008. Level 2 Terrestrial Vertebrate Fauna Assessment for the Solomon Project;
- (Coffey 2010) Coffey Environments. 2010. Fauna Risk Assessment - Solomon Rail Corridor: Stage 1. Prepared for Fortescue Metals Group;
- (Coffey 2011a) Coffey Environment. 2011a. Targeted Surveys - Northern Quolls and Pilbara Leaf-nosed Bats. Unpublished report for Fortescue Metals Group;
- (Coffey 2011b) Coffey Environments. 2011b. Targeted Surveys - Northern Quolls, Mulgara and Pilbara Olive Pythons at the Solomon Rail Project. Unpublished report for Fortescue Metals Group;
- (Ecoscape 2010a) Ecoscape. 2010a. Solomon Project – Rail Camp Sites 1, 2 and 3: Fauna Assessment. September 2010;
- (Ecoscape 2010b) Ecoscape. 2010b. Solomon Project – Rail Re-alignment: Fauna Assessment. August 2010; and
- (Ecoscape 2010c) Ecoscape. 2010c. Vertebrate Fauna and Fauna Habitat Assessment for the Firetail Project.

Table 4.1: Previous surveys and conservation significant fauna recorded within the Project Area

Reference	Survey Details	Proximity to Project Area	Methods	Broad Fauna Habitat Types	Fauna Recorded	Conservation significant or potential SRE fauna	Comments
ecologia Environment (2009)	Murray's Hill Level 1 Fauna Survey including desktop and reconnaissance survey	Coincides with Project Area	Desktop survey Avifauna census Hand searching for reptiles Spotlighting Anabat detectors Opportunistic sightings	Low spinifex hills Rocky outcrops/breakaways Alluvial plains Floodplains Claypans Creeklines	98 vertebrate taxa: 13 Mammal 64 Bird 21 Reptiles	Conservation significant fauna recorded: western pebble-mound mouse (P4 BC act) Conservation significant fauna with a High likelihood of occurrence: - northern short-tailed mouse (P4 BC act) - peregrine falcon (OS)	Rocky outcrops and breakaways contain larger rocks and crevices providing suitable shelter for rock dwelling species. Within the alluvial plains habitat type the soil consisted primarily of compacted stony clay, resulting in few burrows being observed in these areas, however sandier areas provide potential habitat for the bilby. Claypans of the Fortescue River may provide foraging habitat for numerous waders including the wood sandpiper (EPBC Migratory).
Terrestrial Ecosystems (2012)	Preliminary Vertebrate Fauna Investigation for Murray's Hill project and haul road options	Coincides with Project Area	Desktop survey		No field component	Conservation significant fauna with the potential to occur: - northern quoll (EN EPBC, BC Acts) - mulgara (P4 BC act) - bilby (VU EPBC, BC Act) - Pilbara olive python (VU EPBC, BC Act) - Western pebble-mound mouse (P4 BC act) - ghost bat (VU EPBC, BC Act) - Pilbara leaf-nosed bat (VU EPBC, BC Act) - peregrine falcon (OS) - fork-tailed swift (Migratory) - long-tailed dunnart (P4 BC act) - Gane's blind snake (P1 BC act) - *Ctenotus nigrilineatus* - grey falcon (VU BC Act)	This survey indicated that there was limited survey data collected from the Jamindie land system. It also identified that there is little vertebrate fauna data within the vicinity of the Project Area. The survey also indicated that there is potentially suitable habitat for conservation significant fauna species and targeted surveys will be required.
Terrestrial Ecosystems (2013)	Level 2 fauna survey	Coincides with Project Area	Pitfall trapping Elliott trapping Funnel trapping Avifauna census Systematic searching Targeted searching Camera Trapping Spotlighting SM2BAT+ bat call detectors Opportunistic recording	Open Mulga Woodland Rocky Scree Slopes Rocky Hills	130 vertebrate taxa: 16 Mammals 76 Birds 37 Reptiles 1 Amphibian	Conservation significant fauna recorded: - northern quoll (EN EPBC, BC Acts) - western pebble-mound mouse (P4 BC Act) - grey falcon (VU BC Act) Conservation significant fauna with the potential to occur: - Pilbara olive python(VU EPBC, BC Act) - ghost bat (VU EPBC, BC Act) - *Ctenotus nigrilineatus* (P1 BC act) - Gane's blind snake (P1 BC act) - long-tailed dunnart (P4 BC act) - northern short-tailed mouse (P4 BC act)	Trapping sites selected focussed on the Jamindie land system as limited fauna survey data has been recorded within this lad system. The Pilbara leaf-nosed and ghost bat were not recorded, and no suitable roosting habitat was found for Pilbara leaf-nosed bats, although potential roosting sites were identified for ghost bats. While the fauna habitat in the Project Area was generally not considered suitable for bilbies and brush-tailed mulgara, the rocky hills, gorges and breakaways, as well as creek and riverine habitats support large mature trees containing hollows that provide habitat northern quolls and Pilbara olive pythons. Northern quolls are present in the rocky hills and breakaways in the northern section of the project area and eastern end of the haul road corridor. Western pebble-mound mice are present in the rocky undulating areas.
ecologia Environment (2019)	Mulga East Level 1, Level 2 terrestrial fauna survey and targeted conservation significant fauna surveys	Coincides with Project Area	Pitfall trapping, Elliott trapping Cage trapping Funnel trapping Avifauna census Systematic searching Targeted searching Camera Trapping Spotlighting SM2BAT+ bat call detectors Opportunistic searches	Mulga Woodland Mixed Eucalypt/Mulga Floodplain Rocky Hills Stony Spinifex Plains and Hillslopes Calcrete Stony Plain Chenopod/Cracking Clay Floodplain Drainage Line Claypan	154 vertebrate taxa: 22 Mammal 85 Bird 46 Reptile 1 Amphibian	Conservation significant fauna recorded: - northern quoll (EN EPBC, BC Act) - western pebble-mound mouse (P4 BC act) - ghost bat (VU EPBC and BC Act) - Pilbara leaf-nosed bat (VU EPBC, BC Act) - Pilbara olive python (VU EPBC, BC Act) - common greenshank (Migratory) - wood sandpiper (Migratory) - red-necked stint (Migratory) - Gane's blind snake (P1 BC act) - grey Falcon (VU BC Act)	Rocky outcrops and breakaways contain larger rocks and crevices providing suitable shelter for northern quoll, ghost bat and Pilbara leaf-nosed bat. Three species of conservation significance were recorded at the Priority 1 PEC Gnalka Gnoona Claypan containing surface water. Western pebble-mound mice mounds were recorded in the Stony Plain habitat. No suitable bilby habitat was identified, and no individuals or secondary evidence was recorded. ARUs deployed in prospective night parrot habitat did not record any calls.

4.1.3 Vertebrate Fauna of Conservation Significance

Seventeen vertebrate fauna species of conservation significance were identified from desktop searches as having been previously recorded within 40 km of the Project Area (Table 4.2). Four species, including the northern quoll, bilby, glossy ibis and peregrine falcon have historical records within the Project Area.

The Project Area falls within the high priority area for the night parrot (Department of Biodiversity Conservation and Attractions 2017) and the DBCA recommends surveys for the night parrot are undertaken within areas of suitable habitat where significant disturbances are proposed.

The EPBC Act Protected Matters Report (Appendix E) identified eight Threatened species and nine Migratory species as having the potential to occur within the Project Area. With respect to birds, any listed marine species not known to utilise mainland terrestrial habitats were excluded from the results along with coastal, estuarine, mudflat or mangrove species.

Aside from the species recorded during the survey, the likelihood of occurrence assessment identified three additional species with the potential to occur within the Project Area (Table 4.2). The brush-tailed mulgara was deemed 'Likely' to occur within the northern portion of the proposed rail corridor while the northern short-tailed mouse and fork tailed swift were deemed to have likelihood of occurrence category of 'Possible' and will be discussed further below. One species of mammal, three species of bird, two reptiles and one fish were deemed 'Unlikely' to occur within the Project Area due to a lack of suitable habitat or extremely old records occurring in the vicinity.

Species classed as 'Unlikely' will not be discussed further.

Table 4.2: Conservation significant fauna likelihood of occurrence.

Species	Common name	WA Status	EPBC Status	Latest record	Notes	Likelihood of occurrence Pre-survey	Likelihood of occurrence Post-survey
MAMMALS							
Dasyurus hallucatus	northern quoll	EN	EN	2017	Previously recorded in Project Area. Species recorded during Initial surveys.	**Recorded**	**Recorded**
Dasycercus blythi	brush-tailed mulgara	P4		2016	Recent records in vicinity, limited suitable habitat present within the northern portion of the proposed Rail corridor.	**Possible**	**Likely**
Lagorchestes conspicillatus leichardti	spectacled hare-wallaby (mainland)	P4		NA	Records in vicinity, no suitable habitat present.	**Unlikely**	**Unlikely**
Leggadina lakedownensis	northern short-tailed mouse	P4		2013	Recent records in vicinity, limited suitable habitat present.	**Likely**	**Possible**
Macroderma gigas	ghost bat	VU	VU	2017	Records in vicinity, species recorded during surveys	**Possible**	**Recorded**
Macrotis lagotis	bilby	VU	VU	2017	Multiple records from within vicinity of Project Area. One historical verbal record from the Mulga downs in 2001 within Project Area. No suitable habitat present.	**Recorded (Historical)**	**Unlikely**
Pseudomys chapmani	western pebble-mound mouse	P4		2016	Active mounds recorded within Project Area during previous surveys.	**Recorded**	**Recorded**
Rhinonicteris aurantia	Pilbara leaf-nosed bat	VU	VU	2017	Records in vicinity, species recorded during surveys	**Possible**	**Recorded**
BIRDS							
Apus pacificus	fork-tailed swift	IA	MI	2012	Records from vicinity. May utilise Project Area occasionally as an arid vagrant without using any habitat type in particular.	**Likely**	**Possible**
Calidris ruficollis	red-necked stint	IA	MI	NA	No previous records from database searches, recorded in Claypan during Level 2 survey.	**Unlikely**	**Recorded**
Elanus scriptus	letter-winged kite	P4		2000	Records from the vicinity, has the potential to overfly all habitat types intermittently.	**Possible**	**Unlikely**
Falco hypoleucos	grey falcon	VU		2014	Recorded during reconnaissance survey.	**Recorded**	**Recorded**
Falco peregrinus	peregrine falcon	OS	MI	2014	Historical records in the Project Area, has the potential to overfly all habitat types. Some potentially suitable nesting habitat within the Rocking Hills.	**Recorded (Historical)**	**Recorded (Historical)**
Pandion haliaetus	osprey	IA	MI	2013	Recent records in vicinity may utilise floodplains/claypans in Project Area after rain.	**Possible**	**Unlikely**
Pezoporus occidentalis	night parrot	CR	EN	NA	No records from vicinity, not recorded during Level 2 survey. No long unburnt spinifex rings near chenopod plains habitat present.	**Unlikely**	**Unlikely**
Plegadis falcinellus	glossy ibis	IA	MI	2004	Historical records in the Project Area, may utilise floodplains/claypans after rain.	**Recorded (Historical)**	**Recorded (Historical)**
Tringa glareola	wood sandpiper	IA	MI	2014	Recent records in vicinity, recorded in Gnalka Gnoona Claypan during Level 2 survey.	**Possible**	**Recorded**
Tringa nebularia	common greenshank	IA	MI	2005	Recent records in vicinity, recorded in Claypan during Level 2 survey.	**Possible**	**Recorded**
REPTILES							
Anilios ganei	Gane's blind snake	P1		NA	No previous records within vicinity. Recorded during both phases of Level 2 survey.	**Unlikely**	**Recorded**
Ctenotus nigrilineatus	pin-striped finesnout Ctenotus	P1		2012	Recent records in vicinity, some suitable habitat present, not recorded.	**Likely**	**Unlikely**
Ctenotus uber johnstonei	spotted Ctenotus (Northeast)	P2		2012	Recent records in vicinity, no suitable habitat present.	**Likely**	**Unlikely**
Liasis olivaceus barroni	Pilbara Olive Python	VU	VU	2018	Recent records in vicinity, recorded during Level 2 survey.	**Recorded**	**Recorded**
FISH							
Leiopotherapon aheneus	Fortescue Grunter	P4		2017	Records within the vicinity, no permanent water or suitable habitat found.	**Unlikely**	**Unlikely**

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7550000

Common Name

- Pilbara leaf-nosed bat
- Ghost bat
- Bilby, Dalgyte, Ninu
- Brush-tailed mulgara
- Crest-tailed mulgara
- Northern short-tailed mouse
- Western pebble-mound mouse
- Northern quoll
- Letter-winged kite
- Grey falcon
- Glossy ibis
- Osprey, eastern osprey
- Fork-tailed swift
- Wood sandpiper
- Peregrine falcon
- Pilbara olive python
- Spotted Ctenotus (northeast)
- Fortescue grunter

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Main Roads

GREAT NORTHERN HIGHWAY

NANUTARRA WITTENOOM ROAD

MUNJINA WITTENOOM ROAD

ecologia ENVIRONMENT

Project: 1828
Date: 30 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:250,000 @A3

Figure 4.1 Conservation significant fauna species found within 40 km of the Project Area (DBCA)

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

0 5 10
Kilometers

4.2 FIELD SURVEY

4.2.1 Vertebrate Fauna Habitat Assessment

The 2018 Level 1 fauna and fauna habitat survey identified eight broad habitat types occurring within the Project Area (Table 4.3, Figure 4.2). Fauna habitat types within the Project Area were generally classified as being in 'Good', 'Very Good' or 'Excellent' condition (Appendix H). Habitat mapping has been refined over the course of the two-phase assessment as further exploration and ground truthing within the Project Area occurred (Figure 4.2).

The major threatening processes currently affecting biodiversity within the Project Area are:

- grazing by introduced herbivores;
- clearing of native vegetation;
- fires;
- impacts of introduced predators; and
- weed invasion.

Table 4.3: Fauna habitat types

Broad habitat type	Area		Vegetation description	Habitat description	Representative photos
	Ha	%			
Drainage Line	545.1	1.6	Scattered *Eucalyptus victrix* or *Corymbia hamersleyana* over an open shrubland of *Acacia tumida* and *A. pyrifolia* over hummock and tussock grasses.	The banks provide quality burrowing substrates for monitors while trees and shrub species provide habitat for birds such as honeyeaters and corellas. Drainage lines are of low to moderate conservation value as they provide foraging and dispersal habitat for fauna. Conservation significant species known to utilise drainage lines to forage include Pilbara leaf-nosed bats (Vulnerable) and ghost bats (Vulnerable), while northern quolls (Vulnerable) utilise drainage lines for dispersal and foraging. This habitat is considered widespread in the Pilbara	
Calcrete Stony Plain	2101.5	6.4	Mixed sparse shrubland of *Melaleuca glomerata*, *Eremophila longifolia*, *Acacia* spp., with either *Triodia epactia* hummock grasslands or tussock grasslands of annual *Eragrostis pergracilis*.	Stony orange sandy/clay/loam soils exhibit some outcropping and a moderate percentage of competent rock fragments through the surface soil profile increasing with depth. These substrates permit shallow burrowing by small species but is unsuitable for the deep, extensive burrowing exhibited by species such as the bilby (Vulnerable). Shrubs provide foraging and nesting habitat for bird species. Calcrete Stony Plains support pygmy monitors, kalutas, desert mouse, Pilbara ningaui and multiple species of geckos and skinks. This habitat is widespread in the Pilbara and offers minimal refugia for species of conservation significance.	
Rocky Hills	3057.9	9.2	Isolated *Eucalyptus leucophloia* and/or *Corymbia hamersleyana* over sparse shrubland of mixed *Acacia* spp., *Grevillea wickhamii*, *Hakea lorea* and over open *Triodia* sp. hummock grassland.	The Rocky Hills provides quality refugia, shelter and caves for conservation significant species. Ridgelines, boulders, crevices and caves provide shelter, denning and roosting habitat for species including northern quolls (Vulnerable), Pilbara leaf-nosed bats (Vulnerable), ghost bats (Vulnerable), Pilbara olive pythons (Vulnerable), Rothschild's rock wallaby, rock rats, monitor lizards and *Pseudantichinus* sp. Rocky Hills are considered common and widespread throughout the Pilbara.	
Mulga Woodland	9788.6	29.6	Open woodland of *Acacia aneura, A. xiphophylla* with isolated *A. pruinocarpa* over *Acacia* spp., *Eremophila* spp., *Dodonaea petiolaris* and *Hakea* sp. over sparse soft grasses or *Triodia* hummock grasslands.	Compacted alluvial loamy clay soils with occasional surface stones are generally not favourable for burrowing species with few burrows recorded during the surveys. Dead wood, peeling bark, stumps and leaf litter provide shelter for marsupials, monitors, geckos and skinks. The Mulga Woodland has been disturbed by exploration activities (clearing tracks and drill pads) and evidence of grazing by cattle is present. Regionally this habitat type is generally well represented although it is of low value to conservation significant fauna except for the Gane's blind snake (Priority 1).	

Broad habitat type	Area		Vegetation description	Habitat description	Representative photos
	Ha	%			
Chenopod/Cracking Clay Floodplain	460.8	1.4	Sparse chenopod shrubland of *Sclerolaena trigona, S. bicornis, S. densiflora* over low tussock grasses of *Eragrostis xerophila* on a substrate of cracking clays.	This habitat type exhibits little to no leaf litter and woody debris providing few niches for trappable fauna such as marsupials and reptiles. Due to the condition of this habitat type it is considered low value to species of conservation significance. This habitat type is not considered widespread in the Pilbara.	
Stony Spinifex Plains and Hillslopes	8573.3	26	Isolated *Eucalyptus leucophloia* over sparse shrubland of mixed *Acacia* spp. over open spinifex hummock grassland. The *Triodia* hummocks found are generally small and few isolated long unburnt patches are present.	Coarse stony red clay soils provide habitat for the western pebble-mound mouse (Priority 4) which has been recorded multiple times during surveys conducted within the Project Area. The substrates and vegetation present support termitaria which are a known refuge for vertebrate fauna. Stony Spinifex Plains and Hillslopes are considered as low value offering minimal refugia to species of conservation significance. However, the northern quoll, Pilbara leaf-nosed bat and ghost bat are known to forage in these areas. Stony Spinifex Plains and Hillslopes are widespread in the Pilbara.	
Mixed Eucalypt/Mulga Floodplain	8119.4	24.6	Isolated to dense *Eucalyptus victrix* and *Acacia distans* over scattered understory over low grasses.	Some open areas are associated with scattered tall trees with grasses and woody debris around the base and expanses of red sandy/clay soils in between. Woody debris is present, and the large mature trees provide large hollows for nesting and shelter. This habitat type is considered widespread within the Fortescue valley and is of low value to species of conservation significance as it does not provide significant refugia to sustain any permanent populations. The northern quoll (Vulnerable) is known to inhabit woody areas and may infrequently utilise shelter in large trees and hollows as they traverse the landscape.	
Claypan	393.1	1.2	Supporting very few isolated trees and little ground vegetation due to seasonal inundation.	This habitat type is considered to have high conservation value due to its importance as habitat for water birds, including migratory species, and aquatic invertebrates. This habitat forms part of the Priority 1 (PEC) Freshwater Claypans of the Fortescue Valley.	

640000 645000 650000 655000 660000 665000 670000 675000

7560000 7555000 7550000 7545000 7540000

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

ecologia ENVIRONMENT

Project: 1828
Date: 17 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:90,000 @A3

Figure 4.2a Fauna habitat mapping

0 2.5 5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

665000 670000 675000 680000 685000 690000 695000 700000 705000

7580000 7575000 7570000 7565000 7560000 7555000

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary
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- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

ecologia ENVIRONMENT

Project: 1828
Date: 17 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:110,000 @A3

Figure 4.2b Fauna habitat mapping - Rail Corridor

0 3 6
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.2.2 Level 2 Terrestrial Vertebrate Fauna Assessment

A total of 153 species were recorded during the phase 2 Level 2 survey including 16 mammals (10 ground dwelling species and six bats), 57 reptiles, 78 birds and two amphibians.

Cumulatively, a total of 201 species were recorded across both Level 2 survey phases including 26 mammal species (four introduced), 103 birds, 70 reptiles and two amphibians (Appendix F-H). Species recorded accounted for 65% of the 309 species identified during the desktop assessment as occurring within the vicinity of the Project Area (Appendix H).

4.2.2.1 Mammals

The 26 mammal species recorded within the Project Area includes 12 species of native ground dwelling mammals, 10 species of bat and four introduced mammals (Appendix H). Ground dwelling mammal species recorded account for 41% of regional mammal species identified in database searches. Bat species recorded account for 83% of regional bat species identified in database searches. Site by species matrix can be seen in Appendix F and G.

Ground dwelling mammal species recorded include five carnivorous marsupials (Dasyuridae), euro and red kangaroo (Macropodidae), echidna (Tachyglossidae), four rodents (Muridae) and four introduced mammals (cat, wild dog/dingo, fox and cattle).

Bat species recorded included three species of sheathtail bats (Emballonuridae), the ghost bat (Megadermatidae), northern freetail bat (Molossidae), Pilbara leaf-nosed bat (Hipposideridae) and four species of evening bats (Vespertilionidae).

Three species recorded during the phase 1 survey were not recorded during phase 2 (i.e. northern quoll, yellow-bellied sheath-tailed bat and fox) and three species recorded during phase 2 were not recorded during phase 1 (i.e. western pebble-mound mouse, desert mouse and Woolley's pseudantechinus).

Four mammal species of conservation significance were recorded including the northern quoll, western pebble mound mouse, the Pilbara leaf-nosed bat and the ghost bat (Section 4.4).

4.2.2.2 Avifauna

The 103 avifauna species were recorded within the Project Area represents 54% of the regional bird species identified from database searches (Appendix H). Eighty-five bird species were recorded during phase 1 and 78 in phase 2 (Appendix F and G). Thirteen species recorded in phase 1 were not recorded in phase 2 and 24 species recorded in the phase 2 were not recorded during phase 1.

The family Meliphagidae (honeyeaters) was the most diverse group with nine species followed by the Accipitridae family (raptors) which accounted for six species, including the wedge-tailed eagle and the Anatidae family (five species).

Four species of conservation significance were recorded including the grey falcon (Vulnerable BC Act), common greenshank (Migratory), red-necked stint (Migratory) and wood sandpiper (Migratory).

4.2.2.3 Reptiles

The 70 species of reptile were recorded within the Project Area represent 52% of regional reptile species identified from database searches (Appendix H). A total of 46 species were recorded during phase 1 and 57 species in phase 2 (Appendix F and G). Thirteen of the species recorded during phase

1 were not recorded in phase 2 and 24 species recorded in phase 2 were not recorded during phase 1 (Appendix F).

Reptile species recorded include one turtle (Chelidae), 16 geckos (nine Diplodactylidae, six Gekkonidae and one Carphodactylidae), five legless lizards (Pygopodidae), 19 skinks (Scincidae), four dragons (Agamidae), seven monitors (Varanidae), five blind snakes (Typhlopidae), four pythons (Pythonidae) and nine venomous snakes (Elapidae). One additional reptile species (*Varanus hamersleyensis*) was recorded on camera traps at two sites (TQCT005 and TQCT035) during the targeted survey.

Two species of conservation significance, the Gane's blind snake (Priority 1 BC Act) and Pilbara olive python (Vulnerable EPBC Act and BC Act) were recorded from the Project Area (Section 4.4).

4.2.2.4 Amphibians

Two amphibian species (*Cyclorana maini* and *Litoria rubella*) were recorded within the Project Area representing 15% of regional amphibian species identified in database searches (Appendix H).

Significant rainfall was recorded in the months prior to the phase 2 survey resulting to favourable conditions for amphibians. Small pools of surface water were present in some drainage lines and tadpoles were observed. Two amphibian species (*Cyclorana maini* and *Litoria rubella*) in the Pelodryadidae family were recorded in Drainage Lines (Appendix G). Foraging around pools of water and analysis of tadpoles failed to record additional species of frogs. The phase 1 survey failed to record any amphibians in traps despite 44mm of rainfall two weeks prior to the survey; however, *Litoria rubella* was recorded opportunistically around camp.

No amphibians of conservation significance were recorded during any survey phases.

4.2.2.5 Introduced Species

Three introduced mammalian predators have been recorded within the Project Area including the cat, wild dog/dingo and red fox (Figure 4.3). Cats were recorded on camera traps at 14 locations, foxes at six locations and wild dogs/dingoes have been recorded at 12 locations. Wild dogs/ dingoes have been recorded in multiple habitat types down on the floodplain and up in the Rocky Hills. Cats and foxes are classed as declared pests under the Biosecurity and Agriculture Management Act 2007 and appear to have an affinity for Rocky Hills habitat occupying the same niches as the northern quoll.

As Mulga Downs is an active pastoral lease, cattle were observed regularly during the surveys.

645000 650000 655000 660000 665000 670000 675000

7560000 7555000 7550000 7545000 7540000

Introduced predator
- Wild dog/ dingo
- Cat
- Fox

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

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Project: 1828
Date: 17 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:90,000 @A3

Figure 4.3 Introduced predators recorded within the Project Area.

0 2.5 5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.3 DATA ANALYSIS

Trapped vertebrates: Mammals, Reptiles and Amphibians

The extrapolated species richness of the Project Area using the Chao, jackknife 1, jackknife 2, and bootstrap estimators was 83, 84, 93, and 75 species respectively. Observed species richness was 66, representing between 71% and 88% of the extrapolated species richness. Predicted species accumulation curves of the four estimators showed accumulation of new species tending towards zero (asymptote) by 36 sites (Figure 4.4). Additional site-based survey effort may therefore have resulted in a marginally increased number of trapped species recorded at sites; however, an additional 32 species were recorded opportunistically. Therefore, for the purposes of this survey, vertebrate fauna trapping effort is considered adequate.

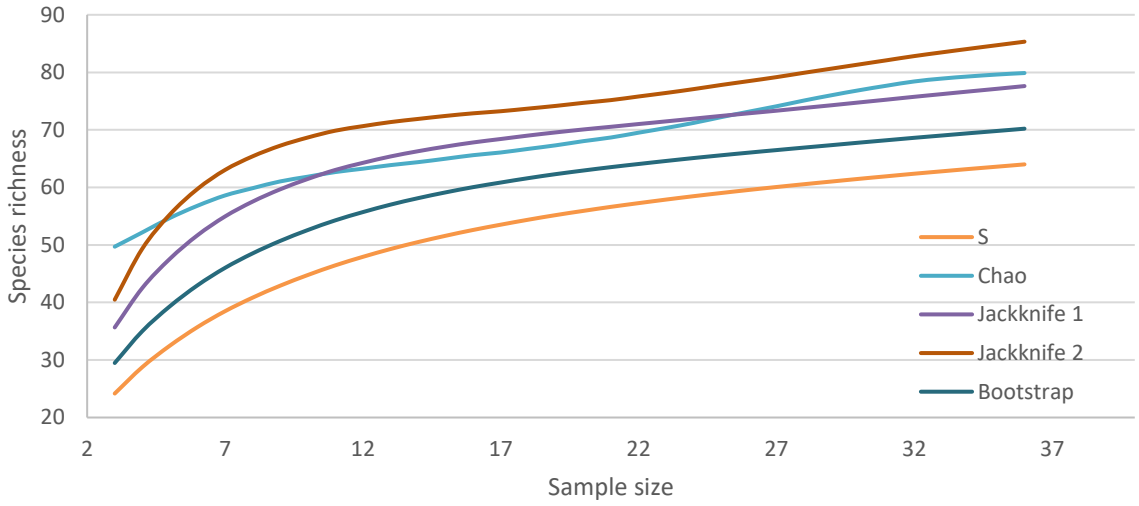


Figure 4.4: Predicted species accumulation curves for four estimators (Chao, jackknife 1, jackknife 2 and bootstrap) and observed species richness (S) with upper and lower 95% confidence intervals.

A visual assessment of the trapped vertebrate data using NMDS (Figure 4.5) suggested that Calcrete Stony Plains (CSP), Rocky Hills (RH) and Mixed Eucalypt Mulga Floodplain (MEMF) have a different fauna assemblage to other habitat types and that similarities exist between remaining habitat types. A stress value of 0.156 was calculated for the ordination, indicating that the configuration of points is a good representation of the actual similarity between sites.

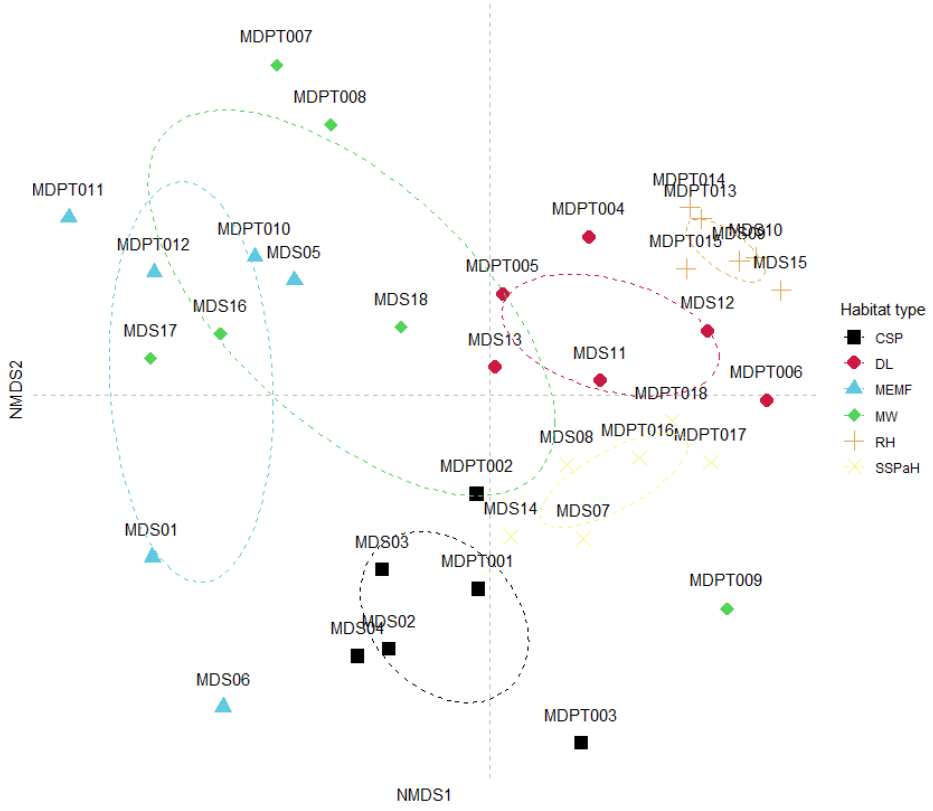


Figure 4.5: First two dimensions of NMDS ordination of survey sites based on Bray-Curtis dissimilarity (stress = 0.11). Ellipses indicate 95% confidence intervals of group centroids.

Avifauna

The extrapolated species richness of the Project Area using the Chao, jackknife 1, jackknife 2, and bootstrap estimators was 80, 77, 85 and 70 species, respectively. The observed species richness was 64, representing between 75% and 91% of the extrapolated species richness. Predicted species accumulation curves of the four estimators showed accumulation of new species not tending towards zero (asymptote) by 36 sites (Figure 4.6). Additional site-based survey effort may therefore have resulted in a larger number of bird species recorded at sites; however, an additional 39 species were recorded opportunistically. For the purposes of this survey, the avifauna sampling effort expended is considered adequate.

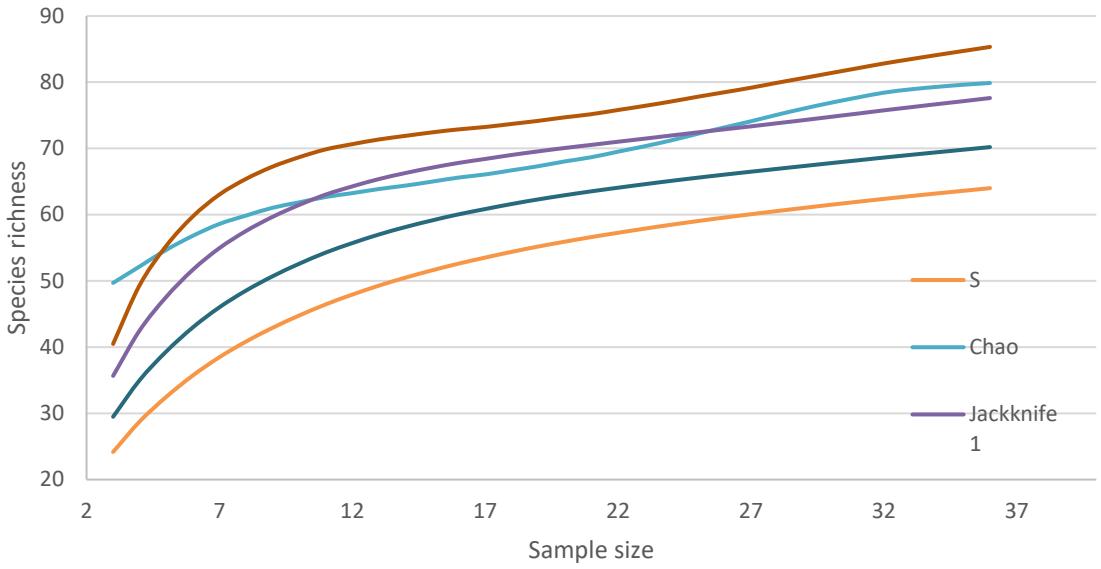


Figure 4.6: Predicted species accumulation curves for four estimators (bootstrap, Chao, jackknife 1 and jackknife 2) and observed species richness (S) with upper and lower 95% confidence intervals.

A visual assessment of the data using NMDS (Figure 4.7) suggested that this reflects differences in avifaunal assemblages between habitat types Calcrete Stony Plain (CSP), Mixed Eucalypt Mulga Floodplain (MEMF), and the remaining habitat types together (Drainage Line (DL), Mulga Woodland (MW), Rocky Hills (RH) and Spinifex Stony Plains and Hillslopes (SSPaH)). A stress value of 0.254 was calculated for the ordination, indicating that this configuration of points is a poor representation of the actual similarity between sites.

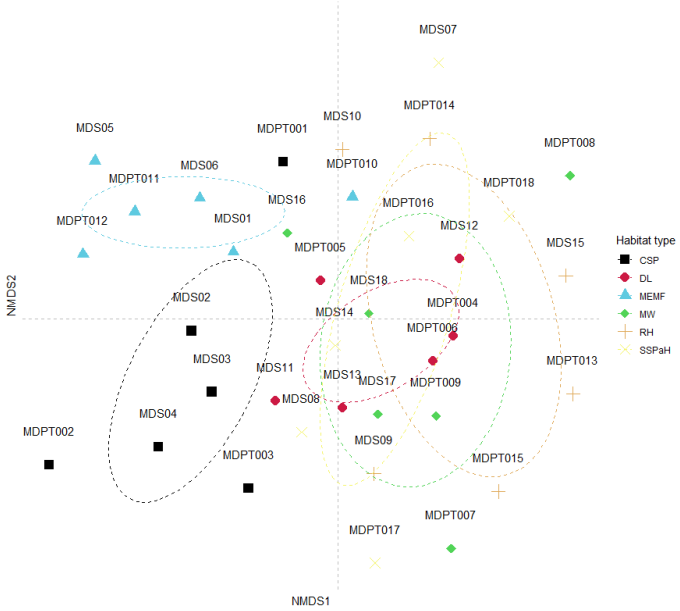


Figure 4.7: First two dimensions of NMDS ordination of survey sites based on Bray-Curtis dissimilarity (stress = 0.11). Ellipses indicate 95% confidence intervals of group centroids.

4.4 VERTEBRATE FAUNA OF CONSERVATION SIGNIFICANCE

Vertebrate fauna of conservation significance are species that have been adequately surveyed and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such (BC Act). Ten species of conservation significance were recorded during the two-phase assessment and three historical DBCA records have been identified within Project Area.

Ten species of conservation significance have been recorded during the two-phase assessment include:

- northern quoll (*Dasyurus hallucatus*) (Endangered EPBC and BC Act);
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (Vulnerable EPBC Act and BC Act);
- ghost bat (*Macroderma gigas*) (Vulnerable EPBC Act and BC Act);
- western pebble-mound mouse (*Pseudomys chapmani*) (Priority 4 BC Act);
- Pilbara olive python (*Liasis olivaceus barroni*) (Vulnerable EPBC Act and BC Act);
- Gane's blind snake (*Anilios ganei*) (Priority 1 BC Act);
- common greenshank (*Tringa nebularia*) (Migratory EPBC and BC Act);
- wood sandpiper (*Tringa glareola*) (Migratory EPBC and BC Act);
- red-necked stint (*Calidris ruficollis*) (Migratory EPBC and BC Act); and
- grey falcon (*Falco hypoleucos*) (Vulnerable BC Act).

Species listed as threatened or migratory under the EPBC Act that have been confirmed to occur within the Project Area or deemed likely to occur are considered MNES (Department of the Environment 2013) and are discussed in detail in Section 5.3.

Historical records of the glossy ibis and peregrine falcon have been identified within the Project Area from database searches; however, neither of these species were recorded during the surveys. Although the glossy ibis was not recorded during either phase of the survey, this species may intermittently visit inundated Claypan habitat within the Project Area. Similarly, the peregrine falcon is a highly mobile species which may intermittently utilise breakaways within Rocky Hills and large trees in the Mixed Eucalypt/Mulga Floodplain provide potential nesting habitat for this species.

The brush-tailed mulgara (Priority 4 BC Act) is considered likely to occur within the northern portion of the proposed rail corridor based on previous records from FMG's Hamersley rail line surveys. This species is considered unlikely to occur within the Mulga East and Malay Wells tenements as it was not recorded during either phase of the survey and no suitable habitat was identified.

Although not recorded during either phase of the survey, the fork-tailed swift (Migratory EPBC and BC Act) and northern short-tailed mouse (Priority 4 BC Act) were assessed as possibly occurring within the Project Area.

Bilby (*Macrotis lagotis*) (Vulnerable EPBC Act and BC Act)

Given the historical 2001 record of a bilby within the Project Area, a targeted survey for the species was undertaken to determine its presence or absence within the Mulga Woodlands habitat type. *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises were identified as one of the habitats known to support populations of the bilby within Western Australia (Threatened Species Scientific Committee 2016a).

A soil assessment of the Project Area (Mine Earth 2019) was interrogated for presence of suitable bilby burrowing substrates and a UAV was flown in transects over Mulga Woodlands to search for secondary signs (burrows and diggings) or suitable habitat within the Project Area. A total of 228 kms of UAV flights and associated videoing were completed within the Mulga Woodland habitat.

No suitable habitat was identified, and no primary sightings or secondary signs were recorded within the Project Area during habitat assessments, UAV video or nocturnal spotlighting activities.

Night parrot (*Pezoporus occidentalis*) (Endangered under EPBC Act and Critically Endangered under BC Act)

The Project Area falls within the high priority area for occurrence of night parrot and a detailed night parrot habitat assessment was undertaken. Two ARUs were deployed in the Chenopod/Cracking Clay Floodplain and one in long unburnt spinifex within the Stony Spinifex Plain and Hillslope habitat for six nights (total of 18 recording nights) during the phase 1 survey. No night parrot calls were recorded during the phase 1 survey.

Additional interrogation of aerial imagery was undertaken prior to the phase 2 survey and UAV flights were undertaken when in the field to further identify areas of long unburnt spinifex and potential night parrot habitat within the Project Area. During the phase 2 survey, 33 kms of UAV flights were undertaken and ARUs were deployed in seven locations identified as the most prospective habitat for night parrots and set to record for six nights as recommended by the interim survey guidelines for night parrots (Department of Biodiversity Conservation and Attractions 2017). A total of 42 recording nights were completed during the phase 2 survey.

No night parrot calls were recorded during either phase of the survey and it is unlikely that this species occurs within the Project Area despite considerable survey effort being undertaken. There are no historical records of this species within 40km of the Project Area. Long unburnt spinifex is patchily distributed in the Project Area and restricted to the Stony Spinifex Plains and Hillslopes in the north-east of the Project Area. Potential foraging (chenopod) habitat is considered negligible as the area has been degraded as a result of long-term grazing pressure by cattle.

4.4.1 Conservation Significant Species Recorded in the Project Area

4.4.1.1 Northern quoll (*Dasyurus hallucatus*) (Endangered under EPBC Act and BC Act)

The phase 1 targeted survey undertaken in June 2019 captured two quolls (one male, one female) in cage traps on six occasions (Figure 4.8). Northern quolls triggered cameras on 58 occasions from nine visits at six locations (Figure 5.1). Spot patterns were used to identify individual quolls using photographs taken by remote cameras as outlined by (Hohnen *et al.* 2013). After analysing the images, three individual quolls were identified.

Despite considerable survey effort across majority of suitable rocky habitats in the phase 2 targeted survey conducted in 2020, no northern quolls were detected on camera traps at 39 locations and no individuals were observed whilst undertaking nocturnal spotlighting activities. Three quoll scats were recorded while setting up/retrieving cameras and undertaking cave habitat assessments (Figure 5.1).

Total survey effort for this species was extensive and included 107 km UAV searches in suitable rocky hills habitat, 45 cage trap locations (315 trap nights) 91 motion sensor camera sites (4237 recording nights), 48 person hours of nocturnal spotlighting and 200 person hours targeted searches (>82 caves assessed) (Table 3.5).

The northern quoll is a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.



Female northern quoll captured at sites C31 and C38



Male northern quoll captured at sites C38, C6, C21 and C27



Site MC06



Site MC08



Site MC10



Site MC12



Site MC17



Site MC31

Figure 4.8:Northern quolls recorded

4.4.1.2 Pilbara leaf-nosed bat (*Rhinonicteris aurantia* (Pilbara)) (Vulnerable under EPBC Act and BC Act)

Five targeted surveys for the Pilbara leaf-nosed bat have been undertaken within the Project Area and results indicate that a permanent diurnal roost and small permanent colony, comprised of as few as ten bats, is present within the Project Area (Figure 5.2). Extensive survey effort has been conducted targeting this species including 82 cave habitat assessments, ARUs were deployed at 252 sites (for a total of 504 recording nights) and 107 kms of UAV searches (Table 3.6). Pilbara leaf-nosed bats have been recorded at 102 locations and results have been addressed in a stand-alone report (Appendix J).

Pilbara leaf-nosed bat calls were recorded within eight minutes of civil twilight indicating bats roosted within the area that day. To locate the potential roost, survey effort was targeted in a valley in the east of the Project Area and cave habitat assessments were undertaken to identify potentially suitable roosting habitat. Call activity recorded in all seasons within the target valley indicated permanent presence within the Project Area and this valley coinciding with Gullies (Priority 2) foraging habitat has been considered as critical foraging habitat for this species.

Eighty-two caves were evaluated during the targeted survey. Of these, 73 were identified as potential nocturnal refuges and 44 as supporting structure suitable to be used as a potential diurnal roost site. In total 45 caves within the target areas have been surveyed using ARUs including 28 caves considered as potential roost sites and 17 potential nocturnal refuges. Calls were recorded at 21 of the caves surveyed and were classified as nocturnal refuges or as sites of occasional visitation. Nocturnal refuges are defined as caves (overhangs excluded) occupied or entered at night for resting, feeding or other purposes with perching not a requirement and are not considered critical habitat but are important for persistence in a local area (Threatened Species Scientific Committee 2016b). The remaining 16 caves considered as potential roost sites are located outside of target areas and have not been surveyed.

The Pilbara leaf-nosed bat is a MNES (Department of the Environment 2013) and is discussed in further detail in Section 5.3 and Appendix J.

4.4.1.3 Ghost bat (*Macroderma gigas*) (Vulnerable under EPBC Act and BC Act)

A single ghost bat call was recorded during the initial Level 2 terrestrial fauna survey (*ecologia* 2019), indicating the presence of this species within the Project Area. Two ghost bat middens comprising of scat and feeding debris were recorded at two caves (MEC001 and MEC030) during the cave habitat assessment conducted in June 2020 (Figure 4.9, Figure 5.3). Of the 82 caves assessed during the targeted survey, six were assessed as being potentially suitable for ghost bats to roost in and 24 were identified as being potential nocturnal refuges for ghost bats. Of the six caves identified as potential ghost bat roosts, no ghost bats were observed, and four caves have previously been surveyed with ARUs and did not record any ghost bat calls.

Survey effort conducted to target this species includes 82 cave habitat assessments, ARUs deployed at 252 sites (504 recording nights) and 107 kms of UAV searches.

The ghost bat is considered a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.



Ghost bat midden at MEC030



Ghost bat midden at MEC001

Figure 4.9: Ghost middens recorded during cave habitat assessments

4.4.1.4 Pilbara olive python (*Liasis olivaceus barroni)* (Vulnerable under EPBC Act and BC Act)

A single Pilbara olive python was opportunistically recorded from the Mulga East camp during the phase 1 survey (*ecologia* 2019) confirming the presence of this species within the Project Area (Figure 5.3). As the Pilbara olive python habitat requirements overlaps the northern quoll, Pilbara leaf-nosed bat and ghost bat, active searches for the species were undertaken concurrently with the other targeted surveys. No Pilbara olive pythons or secondary signs of this species were recorded during targeted searches.

The Pilbara olive python is a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.

4.4.1.5 Western pebble-mound mouse (*Pseudomys chapmani*) (Priority 4 BC Act)

The western pebble-mound mouse constructs distinctive mounds of pebbles around their burrows (Anstee *et al.* 1997). The species is patchily distributed in the Pilbara, but is known to have a preference for hilly and/or rocky landscapes (Anstee and Armstrong 2001; Ford and Johnson 2007). When first described, it was considered that the range and abundance of this species had decreased dramatically. Since that time however, it has been recorded on numerous occasions (usually associated with mining development surveys in the Pilbara), and is widespread in the bioregion. Its status has subsequently been downgraded from Schedule 1 under the WC Act to Priority 4 under the BC Act.

Although habitat requirements for this species do not overlap with any MNES species targeted during this survey, suitable habitat (Stony Spinifex Plain and Hillslopes) for this species was noted during targeted surveys and opportunistic observations of this species were recorded. No specialised techniques were employed to target this species and no additional survey effort was expended.

Twenty-eight (13 active, 15 inactive) western pebble-mound mouse mounds were recorded in the Project Area and the locations of these mounds are shown in Figure 4.10. Stony Spinifex Plains and Hillslopes and Rocky Hills in the Project Area provide stones of a suitable size for the western pebble-mound mouse to construct mounds and this habitat is considered common and widespread at a local and regional scale.

Database searches show that a total of 120 records have previously been identified within 40 km of the Project Area (Figure 4.1) and species is known to occupy suitable habitat within the Project Area. The western pebble-mound mouse has previously been recorded within the Project Area and Terrestrial Ecosystems (2013) recorded 15 mounds and *ecologia* (2009) also recorded active and inactive mounds (locations unknown). Furthermore, Maia recorded 27 mounds in 2013 and 15 mounds in 2013 while undertaking vegetation surveys (Figure 4.10).

4.4.1.6 Gane's blind snake (*Anilios ganei*) (Priority 1 BC Act)

Very little is known about this elusive blind snake due to its fossorial lifestyle. Blind snakes are exclusively insectivorous, and like other members of their genus and probably burrow into social insect colonies to feed on termites and ants, as well as their eggs and pupae (Wilson and Swan 2017). An elongate and moderately stout bodied species does not appear to be particularly closely related to any other species in the genus (Aplin 1998). Four individual Gane's blind snakes were recorded from two sites (MDS014, MDS018) in phase 1 and on one occasion during phase 2 at site MDPT017 (Figure 4.10). This species was recorded within Mulga Woodlands and Stony Spinifex Plains and Hillslopes habitat types. No records of this species were identified within 40 km of the Project Area according to DBCA database search results.

4.4.1.7 Grey falcon (*Falco hypoleucos*) (Vulnerable under BC Act)

The grey falcon is a poorly-known endemic of inland Australia that has a very broad but scattered distribution that includes the Pilbara bioregion (Garnett *et al.* 2011). The species is a resident or nomadic visitor to inland parts and occurs in lightly wooded riverine plains. The species often nests in eucalypts along watercourses and has been recorded from both River red gum (*Eucalyptus camaldulensis*) and coolabah (*Eucalyptus coolabah*) (Garnett *et al.* 2011).

This species was recorded during the October 2018 Level 1 survey (Figure 4.10) and has previously been recorded eight times within 40 km of the Project Area (Figure 4.1). Grey falcons have the potential to overfly all habitat types within the Project Area and the Mixed Eucalypt/Mulga Floodplain provides potential nesting habitat. This species was not recorded during the phase 2 surveys.

4.4.1.8 Common greenshank (*Tringa nebularia*) (Migratory EPBC Act and BC Act)

This species was recorded on three separate occasions utilising the surface water in the PEC Gnalka Gnoona Claypan during the phase 1 avifauna survey (*ecologia* 2019). This species was not recorded during the current Level 2 avifauna survey. Two observations of this species have been previously recorded within 40 km of the Project Area (Figure 4.1).

The common greenshank is a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.7.

4.4.1.9 Wood sandpiper (*Tringa glareola*) (Migratory EPBC Act and BC Act)

The wood sandpiper was recorded during the phase 1 avifauna survey (*ecologia* 2019) within the PEC Gnalka Gnoona Claypan. This species was not recorded during the current Level 2 avifauna survey. Database searches identified three records of this species within 40 km of the Project Area (Figure 4.1).

The common greenshank is a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.7.

4.4.1.10 Red-necked stint (*Calidris ruficollis*) (Migratory EPBC Act and BC Act)

A total of eight red-necked stints were recorded within the PEC Gnalka Gnoona Claypan on two separate occasions during the phase 1 avifauna survey (*ecologia* 2019). This species was not recorded during the current Level 2 avifauna survey and no database records were identified within 40 km of the Project Area.

The common greenshank is a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.7.

4.4.1.11 Glossy ibis (*Plegadis falcinellus*) (Migratory EPBC Act and BC Act)

Two records of this species were identified by database searches within 40 km of the Project Area including one historical record from within the Project Area at the PEC Gnalka Gnoona Claypan in 2004 (Figure 4.1). Although this species was not recorded within the Project Area during this two-phase survey it is considered likely to utilise surface water within the Claypan habitat when inundated.

The common greenshank is a MNES (Department of the Environment 2013) and is discussed in detail in Section 5.3.7.

4.4.1.12 Peregrine falcon (*Falco peregrinus*) (Other Specially Protected fauna BC Act)

This species is widespread in Australia but requires specific nesting sites. It does not build a nest but requires cliffs, rocky outcrops, or large tree hollows (Johnstone and Storr 1998). Suitable breeding habitat has the potential to occur in the Project Area in the form of tree hollows and breakaways; however, due to its widespread movements, the species may also overfly all habitats of the Project Area intermittently. Peregrine falcons feed almost entirely on birds, especially ducks, parrots, and pigeons.

This species has previously been recorded 12 times within 40 km of the Project Area (Figure 4.1) and was recorded in 2003 within the Project Area. Breakaways within Rocky Hills and large trees in the Mixed Eucalypt/Mulga Floodplain provide potential nesting habitat for this species. This species was not recorded within the Project Area while undertaking any of the surveys.

4.4.2 Conservation significant species Likely to occur in the Project Area

4.4.2.1 Brush-tailed mulgara (*Dasycercus blythi*) (Priority 4 BC Act)

The brush-tailed mulgara is a significant mesopredator in arid Australia occupying both sand plain and gibber plain habitats, the latter being a new habitat for the species (Pavey *et al.* 2011). This species displays home ranges that overlap between sexes encompassing both mature spinifex and open regrowth (Koertner *et al.* 2007). Growing between 120-165 mm and weighing up to 110 grams, the brush-tailed mulgara exhibits a preference for burrowing in sandy substrates within spinifex grasslands (van Dyck and Strahan 2008b).

No sign of this species was recorded within the Project Area during either survey phase nor were any signs of this species recorded by Terrestrial Ecosystems (2013). Coffey (2011b) captured three individuals during a targeted survey of FMG's Hamersley line rail corridor east of the Great Northern Highway in Drainage Line habitat and database searches identified 45 individuals previously recorded within 40 km of the Project Area (Figure 4.1), with the majority of records occurring north of the Chichester Ranges.

No suitable habitat for this species is present within the Malay Wells and Mulga East tenements and it is considered unlikely to be found in these areas. However, it is likely that this species occurs in the

northern portion of the rail corridor given the results of Coffey (2011b). Coffey (2011b) completed a targeted survey for the brush-tailed mulgara in an area immediately adjacent to the proposed rail corridor and recorded three brush-tailed mulgaras within comparable habitat. This species was not recorded during the surveys; however, due to restricted access to the northern portion of the rail corridor the presence of this species in the proposed rail corridor cannot be ruled out.

4.4.3 Conservation significant species Possibly occurring in the Project Area

4.4.3.1 Northern short-tailed mouse (*Leggadina lakedownensis*) (Priority 4 BC Act)

The northern short-tailed mouse is a small (50-85 mm snout vent length) rodent occupying a diverse range of semiarid habitats including spinifex and tussock grasslands, samphire and sedge lands, *Acacia* shrublands and stony ranges with most habitats being seasonally inundated on red or white sandy clay soils (van Dyck and Strahan 2008b).

Eighteen records were identified from within 40 km of the Project Area. This species was not recorded within the Project Area during any of the surveys conducted by *ecologia* within the Project Area. Although this species was not recorded, it has been given a likelihood of occurrence rating of 'Possible' on basis of presence of suitable habitat.

4.4.3.2 Fork-tailed swift (*Apus pacificus*) (Migratory EPBC and BC Act)

The fork-tailed swift is a migratory, almost exclusively aerial species that, in its non-breeding area in Australia, is independent of terrestrial habitats. The fork-tailed swift migrates to Australia from its breeding areas in Siberia in October and returns by the end of April (Higgins 1999). They forage along the edge of low-pressure systems which help lift insect prey and assists in flight.

The fork-tailed swift has been recorded 41 times within a 40 km radius of the Project Area and has the potential (Possible) to overfly the entire Project Area without specifically utilising any particular habitat present.

650000 655000 660000 665000 670000 675000 680000

7555000

7550000

7545000

7540000

Common name
- Gane's blind snake
- Grey falcon
- Western pebble-mound mouse active mound
- Western pebble-mound mouse inactive mound

Historical western pebble-mound mouse mound
- Maia 2012/2013
- Terrestrial ecosystems 2012

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Project: 1828
Date: 17 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:80,000 @A3

Figure 4.10 Conservation significant fauna (excluding MNES) recorded within the Project Area.

0 2 4
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4.4.4 Cave Habitat Assessments

Cave habitat assessments were undertaken to evaluate potential ghost bat and Pilbara leaf-nosed bat roost caves within the Project Area and review cave morphology, geology and cave conditions to narrow down the list of potential ghost bat maternity and/or Pilbara leaf-nosed bat roost caves. Habitat assessments were undertaken for 82 caves within the Project Area which were identified as potential roost and feeding caves for Pilbara leaf-nosed bats and ghost bats (Figure 4.11).

Two caves were identified as nocturnal ghost bat feeding caves (MEC030 and MEC001) based on the presence of ghost bat scat and feeding debris (bird feathers) within the cave. Microbats were observed at five caves (MEC001, MEC045, MEC052, MEC054 and MEC082); however, ghost bats and Pilbara leaf-nosed bats were not visually observed during the survey. The results of cave habitat assessments are summarised in Table 4.4 and full cave habitat assessment site sheets are provided in Appendix I.

Table 4.4: Summary of cave habitat assessments

Cave ID	Echolocation call patterns indicate cave is unlikely to be used as a roost	Potential ghost bat roost	Potential ghost bat nocturnal refuge	Potential Pilbara leaf-nosed bat roost	Potential Pilbara leaf-nosed bat nocturnal refuge	Microbats present	Unlikely to be used
MEC001		x	x	x	x	x	
MEC002	x			x	x		
MEC003	x				x		
MEC004			x		x		
MEC005					x		
MEC006			x		x		
MEC007	x		x		x		
MEC008	x				x		
MEC009				x	x		
MEC010	x			x			
MEC011				x	x		
MEC012	x		x	x	x		
MEC013				x	x		
MEC014				x			
MEC015			x		x		
MEC016	x			x	x		
MEC017					x		
MEC018			x	x	x		
MEC019				x	x		
MEC020	x			x			
MEC021					x		
MEC022			x		x		
MEC023					x		
MEC024			x		x		
MEC025	x			x			
MEC026				x	x		
MEC027			x		x		
MEC028							x
MEC029							x
MEC030			x		x		

Cave ID	Echolocation call patterns indicate cave is unlikely to be used as a roost	Potential ghost bat roost	Potential ghost bat nocturnal refuge	Potential Pilbara leaf-nosed bat roost	Potential Pilbara leaf-nosed bat nocturnal refuge	Microbats present	Unlikely to be used
MEC031					x		
MEC032				x			
MEC033	x				x		
MEC034				x	x		
MEC035			x		x		
MEC036	x		x		x		
MEC037	x	x	x	x	x		
MEC038	x				x		
MEC039	x	x	x	x	x		
MEC040				x	x		
MEC041	x		x		x		
MEC042	x		x		x		
MEC043	x				x		
MEC044			x		x		
MEC045				x	x	x	
MEC046	x			x	x		
MEC047	x				x		
MEC048	x			x	x		
MEC049				x	x		
MEC050	x				x		
MEC051					x		
MEC052				x	x	x	
MEC053				x	x		
MEC054				x	x	x	
MEC055				x	x		
MEC056					x		
MEC057				x	x		
MEC058				x	x		
MEC059				x	x		
MEC060					x		
MEC061					x		
MEC062			x		x		
MEC063	x		x		x		
MEC064	x				x		
MEC065	x				x		
MEC066	x			x	x		
MEC067					x		
MEC068	x		x		x		
MEC069	x	x	x	x	x		
MEC070					x		
MEC071	x			x	x		
MEC072				x			
MEC073	x			x	x		
MEC074	x			x	x		
MEC075		x	x	x	x		

Cave ID	Echolocation call patterns indicate cave is unlikely to be used as a roost	Potential ghost bat roost	Potential ghost bat nocturnal refuge	Potential Pilbara leaf-nosed bat roost	Potential Pilbara leaf-nosed bat nocturnal refuge	Microbats present	Unlikely to be used
MEC076				**x**	**x**		
MEC077				**x**	**x**		
MEC078				**x**	**x**		
MEC079	**x**	**x**	**x**	**x**	**x**		
MEC080	**x**			**x**	**x**		
MEC081	**x**			**x**			
MEC082	**x**		**x**	**x**	**x**	**x**	

668000 668500 669000 669500 670000

7554000 7553500 7553000 7552500 7552000 7551500 7551000 7550500 7550000 7549500 7549000 7548500 7548000 7547500 7547000 7546500 7546000 7545500 7545000 7544500 7544000 7543500 7543000 7542500 7542000 7541500 7541000 7540500 7540000

MEC063
MEC062 MEC060
MEC061
MEC049
MEC003
MEC035
MEC034
MEC002
MEC051
MEC050
MEC046 MEC047
MEC082
MEC065
MEC007 MEC033
MEC031
MEC032
MEC067
MEC066
MEC053
MEC052
MEC069
MEC068
MEC027
MEC030 MEC021
MEC009 MEC070
MEC029
MEC010 MEC025
MEC016
MEC012
MEC071
MEC072 MEC013
MEC008
MEC014
MEC040
MEC073
MEC039
MEC074
MEC079
MEC037
MEC043 MEC038
MEC042 MEC036
MEC041
MEC064 MEC080
MEC048
MEC081

650000 660000 670000

7560000 7550000 7540000

Map reference

Cave habitat type

- Potential roost site (PLnB)
- Potential roost site and potential nocturnal shelter (PLnB only)
- Potential roost site and potential nocturnal shelter (PLnB/GB)
- Potential roost site (PLnB) and potential nocturnal shelter (PLnB/GB)
- Potential nocturnal shelter only (PLnB)
- Potential nocturnal shelter only (PLnB/GB)
- Unlikely to be used for either shelter or roosting by either species
- Rocky habitat drone flight log

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

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Project: 1828
Date: 24 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:10,000 @A3

Figure 4.11a: Cave habitat assessment sites and suitability for Pilbara leaf-nosed bats and ghost bats.

0 0.075 0.15 0.3 0.45
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

664000
665000
640000
650000
660000
670000
680000
7554000
7553000

Enlargement 1

MEC077
MEC015
MEC078
MEC024
MEC076
MEC017
MEC011
MEC018
MEC022
MEC019
MEC020
MEC075

MEC023
Enlargement 1
Enlargement 2

Enlargement 2

MEC004
MEC054
MEC001
MEC044
MEC055
MEC058
MEC059
MEC057
MEC053MEC052
MEC006
MEC005
MEC045

0 100 200 Meters
1:10,000

Cave habitat type

- Potential roost site (PLnB)
- Potential roost site and potential nocturnal shelter (PLnB only)
- Potential roost site and potential nocturnal shelter (PLnB/GB)
- Potential roost site (PLnB) and potential nocturnal shelter (PLnB/GB)
- Potential nocturnal shelter only (PLnB)
- Potential nocturnal shelter only (PLnB/GB)
- Unlikely to be used for either shelter or roosting by either species

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

TEN_HAN_Tenements

Tenement Boundary

- Malay Wells E 4702117
- Mulga East R 4700012
- Mulga Downs Rail Corridor

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Project: 1828
Date: 24 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:225,606 @A3

Figure 4.11b: Cave habitat assessment sites and suitability for Pilbara leaf-nosed bats and ghost bats.

0 5 10
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5 DISCUSSION

In their assessment of development proposals, the EPA's broad objective for the terrestrial fauna factor is to protect biological diversity and maintain ecological integrity (Environmental Protection Authority 2016a). Accordingly, the aim of this assessment was to determine vertebrate fauna species assemblages and habitats present or likely to be present to enable an impact assessment to be completed and management actions to be identified.

5.1 FAUNA HABITAT ASSESSMENT

Eight broad fauna habitat types were identified within the Project Area. Other than the Claypan (PEC) and Chenopod/Cracking Clay Floodplain habitat types, the remaining habitats identified are not restricted to the Project Area and are considered widespread at both local and regional scales.

The Rocky Hills and Claypan habitats were assessed to be of high conservation value to species of conservation significance. Critical habitat relating to MNES are outlined in detail in Section 5.3 below.

Breakaways, gorges and gullies within the Rocky Hills habitat type provide caves, denning and foraging habitat considered to be critical habitat for the survival of northern quolls, Pilbara leaf-nosed bats and ghost bats. From a regional perspective, the Rocky Hills habitat type, containing breakaways and caves, is a common feature of the Pilbara, particularly within the Chichester and Hamersley Ranges.

The PEC Claypan is subject to inundation after significant rainfall events and provides foraging habitat for waterfowl and wading species. This habitat type is not considered locally or regionally common and has significant value to fauna, especially when inundated with water. Three migratory wading species (the common greenshank, red-necked stint and the wood sandpiper) were recorded foraging in the surface water present in the PEC Claypan during the initial Level 2 survey (*ecologia* 2019).

The Stony Spinifex Plains and Hillslopes habitat types provide stones of a suitable size for the western pebble-mound mouse to construct mounds and this species has been recorded within the Project Area. This habitat type is considered common and widespread at a local and regional scale.

The Drainage Line habitat within the Mulga East and Malay Wells tenements is generally considered small and common at a local and regional scale. However, drainage lines are significantly larger in the northern portion of the proposed rail corridor, and database search results indicate potentially suitable habitat to support bilbies and brush-tailed mulgara is present. UAV flight surveys and ground truthing results did not detect suitable bilby habitat within the Mulga East and Malay Wells tenements.

Comparisons of trapped fauna (reptiles, amphibians and mammals) from both survey phases using NMDS, showed that the Calcrete Stony Plains (CSP), Rocky Hills (RH) and Mixed Eucalypt Mulga Floodplain (MEMF) support a different fauna assemblage to other habitat types, with similarities existing between the remaining habitat types.

A visual assessment of systematic avifauna observations from both survey phases using NMDS suggested Calcrete Stony Plain (CSP) and Mixed Eucalypt Mulga Floodplain (MEMF) supported different avifauna assemblages to other habitat types and the remaining habitat types exhibited similarities in avifauna composition (Drainage Line (DL), Mulga Woodland (MW), Rocky Hills (RH) and Spinifex Stony Plains and Hillslopes (SSPaH)).

The Level 1 fauna habitat assessment indicated that habitat condition ratings within the Project Area vary from 'Good' to 'Excellent' with the Chenopod/Cracking Clay Floodplain and some areas of Mixed Eucalypt Mulga Floodplain allocated a lower rating of 'Good' due to degradation associated with long term cattle grazing. The Mulga Downs Station has been an operational pastoral lease for over 100 years and fauna habitats within the Project Area, particularly those in the vicinity of cattle holding yards and the station homestead, have experienced extensive grazing pressures.

5.2 TERRESTRIAL VERTEBRATE FAUNA

Of the 309 vertebrate fauna species assessed as potentially occurring within the Project Area, 201 species (65%) were recorded during the two-phase survey including 26 mammal species (four introduced), 103 birds, 70 reptiles and two amphibians. Phase 2 recorded 46 species that were not recorded in phase 1 including three mammals, 18 birds, 24 reptiles and one amphibian. Phase 1 recorded three mammals, 23 birds and 13 reptile species which were not recorded in phase 2.

The number of reptile and amphibian species recorded during phase 1 (47) and phase 2 (57) compares favourably with other single phase fauna surveys conducted in the region (28 to 59) (Bamford (2005b), *ecologia* (2008), Terrestrial Ecosystems (2013)). Similarly, the number of mammal species recorded in phase 1 (23) and phase 2 (22) is comparable with other single phase surveys in the area (16-23) (Bamford (2005b), *ecologia* (2008), Terrestrial Ecosystems (2013)). The mammal species assemblage (16 species) recorded by Terrestrial Ecosystems (2013) was considerably lower than recorded during the current survey and Terrestrial Ecosystems (2013) noted that the number of small mammals caught was very low compared to other surveys conducted in the Abydos Plain (How and Cooper 2002, Thompson and Thompson 2008a) and elsewhere in the Pilbara. The number of bird species recorded during phase 1 (85) and phase 2 (78) is consistent with comparable single phase surveys in the area (77 to 93) (Bamford (2005b), *ecologia* (2008), Terrestrial Ecosystems (2013)).

Data analysis indicated trapping survey effort was considered adequate for the two survey phases with trapped vertebrates (66 species) representing between 71% and 88% of the extrapolated species richness and avifauna (64 species) representing between 75% and 91% of the extrapolated species richness when SAC analysis was completed. Opportunistically recorded species significantly increase species richness observed within the Project Area accounting for an additional 32 reptiles/mammals, and an additional 39 bird species.

Three species of introduced predators were recorded (cats, wild dogs/dingoes and foxes). Cats and foxes are declared pests and are known predators of conservation significant fauna species including the northern quoll and western pebble-mound mouse. Both species were recorded occupying similar habitat in the Rocky Hills to that utilised by the northern quoll. The red fox (*Vulpes vulpes*) recorded during phase 1 is additional to the mammals provided by DBCA NatureMap indicating that the range for this species is extending further north into the Pilbara and arid zone of Australia.

European cattle were recorded during both phases of the survey and the associated long-term grazing pressure from introduced herbivores has resulted in a lower habitat quality rating given to vegetation surrounding the homestead and stockyards within the Project Area.

5.3 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Species listed as threatened or migratory under the EPBC Act recorded within or have been deemed likely to occur within the Project Area are considered MNES according to Department of the Environment (2013). Significant impacts to MNES are considered by Department of the Environment (2013) as impacts which are important, notable or of consequence having regard to its context or intensity.

For MNES, habitat critical to the survival of a species and important populations is considered important. According to Department of the Environment (2013), critical habitat to the survival of a species refers to areas that are necessary:

- for activities such as foraging, breeding, roosting or dispersal;
- for the long-term maintenance of the species;
- to maintain genetic diversity and long-term evolutionary development; or
- for the reintroduction of populations or recovery of the species.

Similarly, Department of the Environment (2013) outlines important populations necessary for a species' long-term survival and recovery, which may include:

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

More specific critical habitat criteria and definitions surrounding important populations have been outlined in specific government documents for the northern quoll (Commonwealth of Australia 2016) and Pilbara leaf-nosed bat (Threatened Species Scientific Committee 2016b).

Four MNES species listed as threatened (EPBC Act) and three MNES migratory species have been recorded in the Project Area:

- Northern quoll (*Dasyurus hallucatus*) (Endangered EPBC and BC Act);
- Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (Vulnerable EPBC Act and BC Act);
- Ghost bat (*Macroderma gigas*) (Vulnerable EPBC Act and BC Act);
- Pilbara olive python (*Liasis olivaceus barroni*) (Vulnerable EPBC Act and BC Act);
- Common greenshank (*Tringa nebularia*) (Migratory EPBC and BC Act);
- Wood sandpiper (*Tringa glareola*) (Migratory EPBC and BC Act); and
- Red-necked stint (*Calidris ruficollis*) (Migratory EPBC and BC Act);

The bilby and glossy ibis have previously been recorded within the Project Area and the Project Area falls within the high priority area for the Night Parrot. These species are discussed in further detail below.

5.3.1 Northern quoll (Endangered EPBC and BC Act)

The northern quoll's range once extended contiguously across the north of Australia but is now restricted to six separate land units including the Pilbara (Department of the Environment 2019). The Pilbara is regarded as the stronghold population for the species given that the cane toad is not expected to make its way across the desert into parts of the Pilbara (Woinarski *et al.* 2014). Preferred habitat for the northern quoll is rocky escarpments, but it also inhabits riverine habitats (Woinarski *et al.* 2014). Rocky habitats with rock crevices and caves support higher densities of northern quoll (van Dyck and Strahan 2008a; Woinarski *et al.* 2014). Predominantly inhabiting dissected rocky escarpments, a male quoll can have a home range of more than 100 ha while a female occupies territories of up to 35 ha (van Dyck and Strahan 2008b).

This species is predominantly nocturnal but may be observed during the day during the breeding season and on overcast days (Oakwood 2008). Northern quolls are opportunistic omnivores and feed primarily on small vertebrates (mammals, amphibians and reptiles), invertebrates and soft fruits (Oakwood 2008). Breeding occurs once per year, with juveniles deposited in dens once they reach eight to nine weeks of age and can no longer fit in the females pouch (Oakwood 2008). Northern quolls are the smallest of the Australian quolls and are the largest mammal species in the world to undergo male die-off events following the breeding season (Oakwood 2008). Lifespan of females in the wild is typically less than three years, with most females only surviving a single breeding season (Oakwood 2008).

According to the DoEE northern quoll referral guidelines (Commonwealth of Australia 2016), a low-density population is characterised by infrequent captures of one or two individuals confined to one or two traps or where no trapping has identified a northern quoll, but latrine evidence remains. A high density population may be characterised by numerous camera triggers by multiple individuals across multiple cameras and/or traps on the site (Commonwealth of Australia 2016).

Two northern quolls (one male and one female) were captured in cage traps and three individuals were captured on motion sensor camera traps at six locations within Rocky Hills during the phase 1 targeted

survey. After analysing data including location, time and date of captures combined with spot pattern identification, a low-density population occurs within the broader Rocky Hills habitat in the northern and north eastern portions of the Project Area. After extensively surveying rocky habitats for northern quolls during both survey phases, it has been determined that a low-density population is present and confined to the north eastern portion of the Project Area (Figure 5.1). The Project Area received below average rainfall for the two seasons (2017-2019) prior to the phase 1 targeted survey and above average rainfall prior to the phase 2 targeted survey. Multiple seasons of below average rainfall may potentially impact the size of the population and it is possible that the population may increase/recover under favourable conditions.

Northern quoll populations considered important for the long-term survival of the species occur in habitats that are free of cane toads and unlikely to support cane toads upon arrival eg. granite habitats in WA, populations surrounded by desert and without permanent water (Commonwealth of Australia 2016). The northern quoll population within the Project Area occurs in habitats that are currently free of cane toads and are unlikely to support any future cane toad invasion due to a lack of water. No natural permanent water sources were recorded within the Project Area and therefore, the population recorded is considered important for the long-term survival of this species.

Habitat critical to the survival of this species applicable to the Project Area includes rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines or treed creek lines (Commonwealth of Australia 2016). Within the Rocky Hills habitat, breakaway, gorge and gully habitat (237 ha total) was defined and is considered habitat critical to the survival of this species (Figure 5.1). These micro-habitats provide shelter for breeding, refuge from fire/predation and potential poisoning from cane toads in the future (Commonwealth of Australia 2016). No major dispersal habitat for northern quolls such as major drainage lines are found within Mulga East or Malay Wells tenements; however, the northern portion of the proposed rail corridor crosses two major drainage lines which have the potential to be utilised by northern quolls for dispersal.

Foraging habitat is recognised to be any land comprising predominantly native vegetation in the immediate area (i.e. within 1 km) of shelter habitat or land comprising predominately native vegetation that is connected to shelter habitat within the range of the species (Commonwealth of Australia 2016). It is therefore considered possible for quolls to utilise any habitat type (all habitat types are comprised of native vegetation) for foraging within 1 km of breakaway, gorge and gully habitat.

The most common cause of adult mortality (excluding post-reproduction die-off) is predation by dingoes, foxes, feral cats, snakes, owls and kites (Maxwell *et al.* 1996; Oakwood 2008). The main threats to the northern quoll as outlined in the national recovery plan (Hill and Ward 2010) include; cane toads, feral predators, inappropriate fire regimes, habitat degradation, weeds, disease, hunting and persecution, and population isolation. The main threats to the northern quoll applicable to the Project Area are feral predators (cat, fox and wild dog/dingo) and loss of habitat. Feral predators were recorded occupying the same Rocky Hills habitat as where northern quoll was recorded from. The northern quoll national recovery plan (Hill and Ward 2010) recommends implementing best-practice techniques for feral predator control at sites with remnant northern quoll populations and potential refuge habitats. There is some evidence to suggest that the presence of a healthy dingo population in an area has positive impacts on the local native mammal populations through suppression of feral predator numbers (Hill and Ward 2010).

655000 660000 665000 670000 675000

7560000 7555000 7550000 7545000

Ecologia 2019/2020
- Phase 1 - Northern quoll
- Phase 2 - Northern quoll scat

Terrestrial ecosystems 2012
- Northern quoll
- Northern quoll scat

Core critical habitat
- Breakaway, gully, gorge

Broad fauna habitat
- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Project: 1828
Date: 17 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:65,000 @A3

Figure 5.1 Northern quoll records and critical habitat.

0 1.75 3.5
Kilometers

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5.3.2 Pilbara leaf-nosed bat (Vulnerable EPBC Act and BC Act)

This small insectivorous bat occurs throughout the Pilbara and adjacent upper Gascoyne regions of Western Australia (Threatened Species Scientific Committee 2016b). The species was listed as Vulnerable in April 2001 because it had undergone a substantial reduction in numbers, its geographic distribution is precarious for its survival (being limited to the Pilbara), and the estimated total number of mature individuals is limited, and the number is likely to continue to decline. The Pilbara leaf-nosed bat has very restrictive habitat requirements, including caves and disused mines with hot to very hot and humid roost sites at 28° to 32° C with 96% to 100% relative humidity (Armstrong 2001; Churchill 2008). During the Pilbara winter dry months, preceding the heavy rains of summer, Pilbara leaf-nosed bat colonies are thought to contract to the deepest mines and caves that maintain microclimates suitable for roosting (Armstrong 2001; van Dyck and Strahan 2008a; Bullen and McKenzie 2011). During the hotter wetter and more humid summer months, the species has a greater ability to disperse through the landscape. The Pilbara leaf-nosed bat has been observed foraging in a variety of habitats- *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the creeks (Department of the Environment 2020). This species are most commonly encountered over small pools of water in rocky gullies and gorges (Department of the Environment 2020).

Given the deficiency of information around what habitats are required to sustain a roosting colony, it is often difficult to definitively define critical foraging habitat of the Pilbara leaf-nosed bat (Threatened Species Scientific Committee 2016b). Foraging habitats, as outlined by Threatened Species Scientific Committee (2016b), that are considered to be important for sustaining a nearby Pilbara leaf-nosed bat colony include five habitat categories (Priority 1-5)(Table 5.1). The Project Area was assessed as supporting Gullies (Priority 2), Rocky Outcrop (Priority 3), and open grassland and woodland (Priority 5) foraging habitat (Table 5.1, Figure 5.2). Rocky Hills and Drainage Lines within the Newman land system supports Priority 2 and Priority 3 foraging habitat while Drainage Lines (not within Newman land system) and Stony Spinifex Plains and Hillslopes support Priority 5 foraging habitat. These habitat types are considered widespread in the Project Area and in a regional context. Regular detections in all seasons within the target valley indicate that the creek line is a preferred commuting and foraging area and is considered critical foraging habitat (Table 5.1, Figure 5.2).

Table 5.1: Pilbara leaf-nosed bat foraging habitat

Pilbara leaf-nosed bat foraging habitat category	Area (hectares)	% of Project Area
Gorges with pools (Priority 1)—watercourses through upland areas bounded by sheer rock walls for parts of their length, often containing pools that remain for weeks or months, sites of relatively large biomass production, sometimes containing caves.	N/A	N/A
Gullies (Priority 2)—primary drainage with limited riparian development in upland rocky habitats, sometimes containing small pools that may last for weeks, with less biomass production than Priority 1 gorge habitat.	331.7 ha (151.7 ha considered critical foraging habitat)	1.20%
Rocky outcrop (Priority 3)—areas of exposed rock at the top of rocky outcrop and mesa hills that contain caves and overhangs, and boulder piles in the granite terrains.	237.4 ha	0.71%
Major watercourses (Priority 4)—riparian vegetation on flat land plus the main gravelly or sandy channel of the riverbed, sometimes containing pools that persist for weeks or months, and generally supporting higher productivity of biomass than the surrounding habitats.	N/A	N/A

Pilbara leaf-nosed bat foraging habitat category	Area (hectares)	% of Project Area
Open grassland and woodland (Priority 5)—dominated by *Triodia,* on lowland plains, colluvial slopes and hilltops.	11632.4 ha	35.20%

Pilbara leaf-nosed bat echolocation calls were recorded at 102 locations within the Project Area with the earliest calls recorded at two creek line sites eight minutes after the end of civil twilight, indicating bats roosted nearby that day (Appendix J). Call times recorded at cave entrances within target areas (Table 5.2) did not strongly suggest diurnal roosting and consequently the entrance sheeting method to confirm diurnal occupancy was not undertaken. Data gathered to date indicates that some of the surveyed caves may function as nocturnal refuges or as sites of occasional visitation, and year-round presence of this species has been clearly demonstrated indicating a diurnal roost in the vicinity. However, extensive searches for caves within the target valley and call times analysed from cave entrances indicate that the caves surveyed are highly unlikely to be utilised as diurnal roosts. The creek line and caves within the valley that were targeted have consistently recorded Pilbara leaf-nosed bat activity of the over all seasons indicating these habitats are regularly utilised for foraging and dispersal.

The long-term ARU detector deployed at MEC016 between December 2019 and March 2020 (for a total of 79 nights) recorded low activity (10 or less calls) on most nights with relatively high levels of activity recorded on three nights. On two occasions, with specific reference to 16 February 2020, activity recorded very close to the beginning of CT may suggest diurnal roosting or the presence of a diurnal roost in the vicinity (Specialised Zoological 2021). The patterns recorded at MEC016 are not suggestive of long-term consistent diurnal roosting and are more consistent with that of a nocturnal refuge; however, whether this cave is also used as a transitory roost cannot be determined from recordings alone. The application of the entrance sheeting method to confirm diurnal occupancy at this cave is unlikely to provide helpful information unless it happened by chance that the effort coincided with an uncommon roosting event (Specialised Zoological 2021). Nocturnal refuges are caves occupied or entered by Pilbara leaf-nosed bats at night for resting, feeding or other purposes and are not considered critical habitat, but are important for local level population persistence (Threatened Species Scientific Committee 2016b).

The population of Pilbara leaf-nosed bats recorded consistently within the Project Area is considered important as the Pilbara and the upper Gascoyne represent a single interbreeding population with individuals showing evidence of genetic divergence from those further north (Threatened Species Scientific Committee 2016b). The nearest confirmed Pilbara leaf-nosed bat diurnal roosts within the central/western roost group are at Koodaideri ~75 kms to the south east, and south of Millstream in the Hamersley Ranges (~160 kms) (Bat Call WA 2020). The Mt Webber roost located approximately 80 km to the north and represents the nearest roost in the east Pilbara roost group (Bat Call WA 2020).

Table 5.2: Caves surveyed, and call times recorded.

Cave ID	Site name	Easting	Northing	Number PLnb calls detected	Time of first call after dusk CT	Time of last call before dawn CT	Time +/- CT
MEC002	BD43	669313.3	7553694.0	0			
MEC002	MEC002	669310.2	7553693.5	0			
MEC007	BD41	668731.7	7553584.0	0			
MEC008	BD10	668905.4	7552848.0	2	8:59:00 PM	11:32:00 PM	Midnight
MEC009	MEC009	668573.8	7553165.6	0			
MEC010	BD12	668632.0	7553172.0	5	~21:00	~03:30	Midnight
MEC010	DP002	668632.5	7553169.0	1		3:38:00 AM	CT-80
MEC012	BD07	668764.4	7552995.0	27	6:29:00 PM	10:25:00 PM	CT + 21
MEC012	DP010	668783.5	7552989.0	0			

Cave ID	Site name	Easting	Northing	Number PLnb calls detected	Time of first call after dusk CT	Time of last call before dawn CT	Time +/- CT
MEC012	MEC012	668769.9	7552990.3	18	11:47	4:08:00 AM	CT -70
MEC013	MEC013	668832.7	7552939.5	0			
MEC014	MEC014	668909.6	7552841.1	0			
MEC016	BD17	668782.5	7553001.0	34	8:51:00 PM	1:42:00 AM	Midnight
MEC016	DP015	668789.2	7553006.0	75	7:31:00 PM	4:05:00 AM	CT+32-45
MEC016	MEC016 long-term	668783.9	7553003.1	>700			CT+25-0
MEC016	MEC016	668783.9	7553003.1	5	00:38	4:07:00 AM	CT -71
MEC021	MEC021	668580.3	7553177.2	0			
MEC025	BD13	668679.3	7553106.0	13	8:54:00 PM	10:51:00 PM	Midnight
MEC026 left entrance	MEC026 left entrance	668537.4	7553208.8	0			
MEC026 right entrance	MEC026 right entrance	668537.4	7553208.8	0			
MEC030	BD24	668400.3	7553173.0	2	12:03:00 AM	12:03:00 AM	Midnight
MEC031	BD31	668666.8	7553391.0	1	7:38:00 PM		CT + 90
MEC032	MEC032	668661.9	7553402.2	0			
MEC033	BD42	668738.1	7553604.0	0			
MEC036	BD55	668731.2	7552394.0	0			
MEC037	BD54	668687.6	7552476.0	1	3:29:00 AM		Midnight
MEC039	MEC039	668952.2	7552713.3	0			
MEC040	MEC040	668230.5	7552738.7	0			
MEC041	BD48	668758.6	7552381.0	0			
MEC041	PLBT018	668761.2	7552381.0	1		12:26:00 AM	Midnight
MEC042	BD53	668746.3	7552392.0	3	9:50:00 PM	1:12:00 AM	Midnight
MEC043	PLBT007	668696.8	7552423.0	0			
MEC046	BD47	669388.8	7553596.0	1	11:38:00 PM		Midnight
MEC047	BD04	669388.8	7553596.0	0			
MEC048	PLBT026	668646.7	7552175.0	1	9:22:00 PM		Midnight
MEC050	BD39	669294.0	7553661.0	0			
MEC052	MEC052	670322.3	7553365.6	0			
MEC053	MEC053	670322.3	7553365.6	0			
MEC063	BD49	668829.6	7554008.0	13	8:46:00 PM	5:06:00 AM	CT -70
MEC064	LT03	668553.0	7552282.0	0			
MEC065	BD38	668644.0	7553591.0	0			
MEC066	BD32	668646.5	7553334.0	4	8:22:00 PM	12:38:00 AM	Midnight
MEC067	MEC067	668479.2	7553290.2	0			
MEC068	BD21	668558.3	7553259.0	0			
MEC068	BD29	668545.6	7553255.0	2	11:26:00 PM	12:22:00 AM	Midnight
MEC069	BD23	668589.7	7553257.0	29	9:30:00 PM	3:31:00 AM	Midnight
MEC069	MEC069	668587.9	7553258.1	4	11:27	4:06:00 AM	CT -72
MEC070	BD11	668608.0	7553156.0	4	8:54:00 PM	10:41:00 PM	Midnight
MEC071	BD09	668757.3	7552947.0	0			
MEC071	MEC071	668750.6	7552953.9	0			
MEC072	MEC072	668780.5	7552925.1	0			
MEC073	BD02	668944.7	7552774.0	0			
MEC073	PLBT037	668936.6	7552774.0	0			

Cave ID	Site name	Easting	Northing	Number PLnb calls detected	Time of first call after dusk CT	Time of last call before dawn CT	Time +/- CT
MEC074	BD03	668988.9	7552656.0	0			
MEC074	PLBT036	668993.1	7552662.0	28	10:50:00 PM	11:05:00 PM	Midnight
MEC074	MEC074	668993.1	7552662.0	0			
MEC079	BD56	668651.2	7552508.0	0			
MEC079	PLBT027	668651.5	7552509.0	5	8:22:00 PM		Midnight
MEC080	PLBT010	668744.4	7552283.0	1	11:21:00 PM		Midnight
MEC081	PLBT042	668789.5	7551155.0	3	6:20:00 PM		CT +22
MEC082	MEC082	669462.5	7553534.8	0			

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+ Pilbara leaf-nosed bat record

Forgaing habitat categories

- Gullies (Priority 2) and regularly utilised critical foraging habitat
- Gullies (Priority 2) foraging habitat
- Rocky Outcrop (Priority 3) foraging habitat
- Open Grassland and Woodland (Priority 5) foraging habitat

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

ecologia ENVIRONMENT

Project: 1828
Date: 17 Novembert 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:65,000 @A3

Figure 5.2: Pilbara leaf-nosed bat foraging habitat and critical foraging habitat.

0 1.75 3.5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5.3.3 Ghost bat (Vulnerable EPBC Act and BC Act)

The ghost bat is the largest Microchiroptera bat in Australia, is strictly carnivorous and captures its prey mainly on the ground before returning to an established feeding site to devour its catch (van Dyck and Strahan 2008b). The ghost bat has a patchy but widespread distribution across northern Australia. Preferred roosting habitat in the Pilbara includes caves beneath bluffs of low, rounded hills composed of Marra Mamba geology, and granite rock piles (Woinarski *et al.* 2012). Ghost bats have also been known to roost in large colonies within sandstone caves, under boulder piles and in abandoned mines (Churchill 1998). Ghost bats disperse widely during the non-breeding season but require warm caves with high relative humidity (80%) for rearing their young (Toop 1985). These maternity caves are uncommon with only eleven recorded in the Pilbara region (three natural caves and eight mines) (Armstrong and Anstee 2000). During daylight hours, ghost bats roost in large caves, mines or deep rock fissures (van Dyck and Strahan 2008b). In some parts of its range, the ghost bat shares roosts with the Pilbara leaf-nosed bat, Finlayson's cave bat (*Vespadelus finlayson*), common heath-tailed bat (*Taphozous georgianus*), and possibly Hill's sheath-tailed bat (*Taphozous hilli*) (Department of the Environment 2020). Ghost bats are known to move between a number of caves seasonally or as dictated by weather conditions (Hutson *et al.* 2001) and disperse widely when not breeding but concentrate in a relatively few roost sites when breeding (Threatened Species Scientific Committee 2016c).

Ghost bats are surface foragers ambushing prey either on the ground or in the air (Woinarski et al. 2012). Hunting behaviour within foraging areas consisted of observing and locating prey from stationary vantage points with brief flights to catch prey before intermittently changing vantage point (Tidemann *et al.* 1985). No studies have been undertaken to accurately define foraging habitat within the Pilbara.

A single ghost bat call was recorded during the initial survey (*ecologia* 2019) indicating the presence of this species within the Project Area. The Department of the Environment (2020) states that surveying for the ghost bat simultaneously with surveys for the Pilbara leaf-nosed bat can simplify strategies and reduce costs. To this end, survey effort undertaken for ghost bats included recording echolocation calls using ARUs at 252 sites (504 recording nights), 82 cave habitat assessments and 107 kms of UAV flights. No ghost bats were observed or recorded, and no additional calls of ghost bats have been recorded. Of the caves assessed, 82 cave habitat assessments were undertaken and six were potentially suitable for ghost bats to roost in and 24 were identified as potential nocturnal refuges for ghost bats (Table 4.4, Figure 4.11).

Although they were not observed during the cave assessment, ghost bat middens, comprising scat and feeding debris, were recorded at two caves (MEC001 and MEC030)(Figure 5.3) indicating the intermittent utilisation of caves within the Project Area, particularly while feeding. As this species is known to travel distances greater than 15 km a night to forage, it is likely that ghost bats utilise habitats within the Project Area whilst foraging and feeding. There is anecdotal evidence of a known roost occurring approximately 20 km south of the Project Area across the Fortescue Valley near Wittenoom in the Hamersley Ranges (Bob Bullen *pers. comm*). After extensive survey effort, it is considered unlikely that a permanent ghost bat roost occurs within the Project Area. Previous acoustic surveys conducted to target the Pilbara leaf-nosed bat were analysed for ghost bat calls and the absence of calls indicates that a ghost bat maternity roost is unlikely to occur within the Project Area.

Critical habitat for this species within the Project Area overlaps with the northern quoll and Pilbara olive python in the form of breakaway, gorge and gully habitat (Figure 5.3) within the Rocky Hills. This species has the potential to forage in all habitat types within the Project Area. Armstrong and Anstee (2000) suggested that ghost bats occur in small groups within the Hamersley Ranges and may move about in a local area, possibly in response to disturbance, microclimate or social factors.

Roosting ghost bats are easily disturbed and may abandon their roost site if they are disturbed (Threatened Species Scientific Committee 2016c). Key threatening processes include habitat loss and degradation associated with mining exploration and activities (Threatened Species Scientific Committee 2016c). Other threats include collisions with barbed wire fences, destruction of old mine adits which house nursery roosts, disease, poisoning by cane toad consumption and competition with foxes and cats for prey (Threatened Species Scientific Committee 2016c).

5.3.4 Pilbara olive python (Vulnerable EPBC Act and BC Act)

One of Australia's largest snakes, the Pilbara olive python is restricted to gorges, rocky habitats and escarpments of the Pilbara (Wilson and Swan 2017). Bush and Maryan (2011) noted that Pilbara olive pythons have been observed from locations some distance from water sources including granite outcrops, elevated mesas and spinifex plains on stony ground, preferring to shelter in caves, crevices and beneath large boulders. Pilbara olive pythons have been known to eat prey as large as rock wallabies and the Pilbara subspecies is larger and can grow up to 6.5 m in length (Wilson and Swan 2017). Two distinct populations of the Pilbara olive python exist (not including the northern subspecies *L. olivaceus olivaceus*) with one isolated around Mt Augustus in the Gascoyne, and the other occurring across a vast area from the Burrup Peninsula, Ord Ranges and Meentheena south to Nanutarra and Newman (Storr *et al.* 2002).

Population size estimates are difficult due to the Pilbara olive python's cryptic nature and lack of reliable trapping or census techniques (DEWHA 2008). The main threats to this subspecies come from predation by feral cats and foxes, particularly of juveniles, competition with foxes for food, and destruction of habitat (Pearson 2006).

Within the Project Area, suitable habitat for the Pilbara olive python is associated with the Rocky Hills (rocky outcrops, breakaways and small gorges) (Figure 5.3) although it has also been known to inhabit spinifex grasslands and travel large distances, suggesting the species has a large home range (Tutt *et al* 2002). The Project Area does not contain deep gorges or permanent sources of water considered as preferred habitat by the Threatened Species Scientific Committee (2008).

One Pilbara olive python was opportunistically recorded at the Mulga East camp. However, despite considerable survey effort for the species, no additional Pilbara olive pythons were recorded, and it is considered unlikely to be present in high numbers within the Project Area.

Of the 15 records of the species within 40 km of the Project Area, the most recent, in 2018, occurred at Fortescue's Solomon mine (40 km west). This species has also been recorded 13 km south of Malay Well in Wittenoom Gorge in 2013, 10 km north of Mulga East in 2013 and in the Chichester Ranges 7 km north west of the proposed rail corridor in 2012. The distribution of this species to the south, west, north and north-east of the Project Area indicates this species occurs widely across the broader landscape and is not restricted to specialised habitats within the Project Area.

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Ghost Bat
Pilbara Olive Python

Core critical habitat
Breakaway, gully, gorge

Broad fauna habitat
Mulga Woodland
Mixed Eucalypt/ Mulga Floodplain
Stony Spinifex Plains and Hillslopes
Calcrete Stony Plain
Rocky Hills
Drainage Line
Chenopod/ Cracking Clay Floodplain
Claypan

Tenement Boundary
Mulga East R 47/0012
Malay Wells E 47/2117
Mulga Downs Rail Corridor

ecologia ENVIRONMENT

Project: 1828
Date: 30 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:61,922 @A3

Figure 5.3 Pilbara olive python and ghost bat records and critical habitat.

0 1.5 3
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5.3.5 Bilby (*Macrotis lagotis*) (Vulnerable EPBC Act and BC Act)

Bilbies occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils which are typically sandy, for burrow excavation. The bilby suffered a sudden and widespread population crash in the early 20th Century and is now confined to the driest and least fertile parts of its former range and its distribution is negatively correlated with that of the fox.

The bilby is an omnivorous burrowing marsupial. It is generally solitary, strictly nocturnal and can breed throughout the year (Southgate 1990). An individual bilby may have over a dozen regularly used burrows which are used as shelter during the day and rest at night (Southgate 1990). One of the three major vegetation types outlined in the national recovery plan for the bilby (Pavey 2006) is hummock grassland growing on sand plains and dunes, drainage systems, salt lake systems and other alluvial areas.

Seventy bilby records were identified from database searches within 40 km of the Project Area and one anecdotal, verbal record (2001) exists from within the Project Area (Mulga Downs homestead). The verbal record lacks some credibility as the associated data indicates the record locality is 'Telfer' and site are listed as 'Mulga Downs Station', which covers a relatively large range.

Most database records are from rail corridor surveys conducted by FMG, BHP and Roy Hill and occur near the northern tip of the proposed project rail corridor. As access to this area was limited, surveys were not conducted within these areas. The nearest record of this species is from 2015 approximately 4 km north of the proposed rail corridor. It is considered possible that this species will occur within the Drainage Line habitat in the northern portion of the rail corridor.

Despite considerable survey effort, no suitable habitat for bilbies was identified within the Project Area nor was any evidence (primary or secondary) of this species recorded during any previous surveys conducted by *ecologia*. Furthermore, (Terrestrial Ecosystems 2013) did not record burrows, scats or diggings and stated that the Project Area was generally unsuitable for bilbies. Therefore, it is considered unlikely that bilbies occur within the Project Area. The presence of cats, foxes and wild dogs/dingoes, which are known predators of the bilby (Pavey 2006), further decreases the likelihood of bilbies occurring within the Project Area. Fox presence is negatively correlated with the presence of greater bilbies (Southgate 1990).

5.3.6 Night parrot (*Pezoporus occidentalis*) (Endangered EPBC Act and Critically Endangered BC Act)

The Project Area occurs within the classified "high priority area" for occurrence of the night parrot (Department of Biodiversity Conservation and Attractions 2017). Interrogation of aerial imagery and UAV video footage identified small patches of sparsely distributed long unburnt spinifex that is considered suitable habitat for the night parrot. These areas are confined to the north east of the Project Area.

Additionally, ARUs were deployed in seven locations within the long unburnt spinifex for a minimum of six nights, with three ARUs also deployed within the Chenopod/Cracking Clay Floodplain and Stony Spinifex Plains and Hillslopes habitat types during the initial targeted survey (*ecologia* 2019).

Although potentially suitable foraging habitat for night parrots is found in Chenopod/Cracking Clay Floodplains, it is unlikely that this habitat is utilised due to degradation from long-term overgrazing and trampling by cattle.

Night parrot calls were not recorded during either survey phase and this species is considered unlikely to occur within the Project Area.

5.3.7 Migratory species

5.3.7.1 Common greenshank (*Tringa nebularia*) (Migratory EPBC Act and BC Act)

The common greenshank is a large, pale, nervous wader with a medium-long slightly upturned bill growing to between 30 and 34 cm (Pizzey *et al.* 2013). This migratory bird breeds in northern Europe, north Asia and winters in southern areas including Australia where it inhabits shallow freshwaters (river pools, lakes, claypans, lagoons, swamps) and salt water (estuaries, mangroves, lakes, reef flats) (Johnstone and Storr 1998). This species is highly mobile and tends to be found around any open body of water including pools in Drainage Lines after rain.

This highly mobile species was recorded on three separate occasions utilising the surface water in the PEC Gnalka Gnoona Claypan during the phase 1 avifauna survey (Figure 5.4) and is considered likely to be an infrequent visitor to the Claypans within the Project Area when inundated after rainfall.

5.3.7.2 Wood sandpiper (*Tringa glareola*) (Migratory EPBC Act and BC Act)

This species is of a similar size and has similar habits to the common greenshank. The wood sandpiper is migratory bird that breeds in northern Europe, north Asia and winters in southern areas including Australia where it inhabits shallow freshwaters (river pools, lakes, claypans, lagoons, swamps) and is less likely to occur in salty or brackish waters (Johnstone and Storr 1998). This species is highly mobile and tends to be found around any open body of water including pools in drainage lines after rain.

Database searches identified three records of this species within 40 km of the Project Area (Figure 4.1). The wood sandpiper was recorded during the phase 1 survey within the PEC Gnalka Gnoona Claypan (Figure 5.4) and is considered likely to be an infrequent visitor to the Claypans when inundated after rainfall.

5.3.7.3 Red-necked stint (*Calidris ruficollis*) (Migratory EPBC Act and BC Act)

Breeding in arctic Siberia and northern Alaska, this small (13-16cm) wading species is an abundant summer migrant to coastal and inland Australia (Pizzey *et al.* 2013). This species is a common to very common visitor on most coasts, coastal plains and larger west-coast islands and is considered rare to moderately common to the interior usually in small flocks (Johnstone and Storr 1998). Red-necked stints frequent a variety of habitats including tidal mudflats, saltmarshes, sandy and shelly beaches, and coastal and inland saline or freshwater wetlands (Pizzey *et al.* 2013).

A total of eight red-necked stints were recorded within the PEC Gnalka Gnoona Claypan on two separate occasions during the phase 1 avifauna survey (Figure 5.4). It is considered likely that this species will be an infrequent visitor to the Claypan within the Project Area when inundated. Although not previously recorded within the database search area, this species is highly mobile and is known to inhabit inland water bodies after rain.

5.3.7.4 Glossy ibis (*Plegadis falcinellus*) (Migratory EPBC Act and BC Act)

The glossy ibis is a small dark ibis with rich purplish brown, glossed bronze or green feathers with a distinctive white line bordering facial skin (Pizzey *et al.* 2013). Habitat preferences include well-vegetated wetlands, wet pastures, rice fields, floodwaters, floodplains and brackish or occasionally saline wetlands (Pizzey *et al.* 2013). Known to visit well-watered flatlands and adjacent flats to freshwater lakes this species is a casual or vagrant in drier and hillier parts of Western Australia (Johnstone and Storr 1998).

Two records of this species were identified by database searches within 40 km of the Project Area including one historical record from within the Project Area at the PEC Gnalka Gnoona Claypan in 2004 (Figure 4.1). Although this species was not recorded within the Project Area during this survey, it is likely to be an infrequent visitor to the Claypan within the Project Area when inundated.

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Migratory species
- common greenshank
- red-necked stint
- wood sandpiper
- glossy ibis

Critical habitat
- Claypan

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Project: 1828
Date: 30 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:50,000 @A3

Figure 5.4 Migratory species locations and critical habitat.

0 1.25 2.5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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7 APPENDICES

APPENDIX A DEFINITIONS

Significant Terrestrial Fauna

According to EPA Factor Guideline: Terrestrial Fauna (Environmental Protection Authority 2016a), terrestrial fauna may be considered significant for a number of reasons including, but not restricted to:

- Being identified as a Threatened or Priority species;
- Species with restricted distribution;
- Degree of historical impact from threatening processes; and
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

Additionally, as described in EPA Guidance (Environmental Protection Authority 2016c) terrestrial fauna may be considered significant for the following reasons:

- Species is protected by international agreement or treaty (i.e. migratory fauna);
- Species is a short-range endemic;
- Species has declining populations or distribution;
- Species is at the extreme of its range, or is part of an outlying population; and
- Species is undescribed.

Fauna habitats may be significant if they provide habitat important to the life history of a significant species, i.e. breeding, feeding and roosting or aggregation areas, or where they are unique or isolated habitats, for example wetlands, in the landscape or region (Environmental Protection Authority 2016c).

Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia)

At the Commonwealth level, Threatened Fauna are protected under Section 178 of the EPBC Act, which may list species as: extinct, extinct in the wild, critically endangered, endangered, vulnerable, and conservation dependent. In addition, under sections 209 and 248 of the Act, some migratory and marine species are protected under international agreements. EPBC Act conservation code definitions can be found in below.

Biodiversity Conservation Act 2016 (Western Australia)

At a state level, fauna species are protected under the BC Act. Threatened, Extinct and Specially Protected fauna are species which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such. BC Act conservation code definitions can be found below.

Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act* 2016 (BC Act).

Specially protected fauna under section 13(1) of the BC Act are species that meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Priority Fauna (DBCA)

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or

other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations. Priority conservation code definitions can be found below.

Threatened Fauna Categories (EPBC Act)

Code	Definition
EX	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
EW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CR	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
EN	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
VU	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, the species is the focus of a specific conservation programme, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Threatened Fauna Categories (BC Act)

Category	Code	Definition	Schedule
Critically Endangered	CR	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines." Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.	**Schedule 1**
Endangered	EN	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.	**Schedule 2**
Vulnerable	VU	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.	**Schedule 3**

Category	Code	Definition	Schedule
Extinct species	EX	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act). Published as presumed extinct under schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.	**Schedule 4**
Extinct in the wild species	EW	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).	Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
Migratory	MI	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.	**Schedule 5**
Species of special conservation interest (conservation dependent fauna)	CD	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.	**Schedule 6**
Other specially protected species	OS	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.	**Schedule 7**

Definition of codes for Priority Fauna (BC Act)

Code	Definition
P1: Priority One	**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.
P2: Priority Two	**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.
P3: Priority Three	**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.
P4: Priority Four	**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.

APPENDIX B NATUREMAP DATABASE SEARCH RESULTS

NatureMap
Mapping Western Australia's biodiversity

Amphibian NatureMap Species Report

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Amphibians
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Species Group	Species	Records
Amphibian	5	198
TOTAL	**5**	**198**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25375	*Cyclorana maini (Sheep Frog)*			
2.	25376	*Cyclorana platycephala (Water-holding Frog)*			
3.	25392	*Litoria rubella (Little Red Tree Frog)*			
4.	25432	*Pseudophryne douglasi (Gorge Toadlet)*			
5.	41428	*Uperoleia saxatilis (Pilbara Toadlet)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

Amphibian NatureMap Species Report

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Amphibians
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Area (ha)		502569.66
Taxa:	Naturalised	0
	Native	5
Endemics:		0
Families:		2
Genera:		4
Conservation Status:	-	5
MS Status:	-	5
Rank:	-	5

Top Ten Families

		Species	Records
1.	Hylidae	3	178
2.	Myobatrachidae	2	20

Top Ten Genera

		Species	Records
1.	*Cyclorana*	2	158
2.	*Pseudophryne*	1	6
3.	*Litoria*	1	20
4.	*Uperoleia*	1	14

[1]Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

Reptile NatureMap Species List

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Reptiles
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Species Group	Species	Records
Reptile	105	1479
TOTAL	**105**	**1479**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Reptile					
1.	25332	*Acanthophis wellsi (Pilbara Death Adder)*			
2.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
3.	25318	*Antaresia perthensis (Pygmy Python)*			
4.	25448	*Antaresia stimsoni (Stimson's Python)*			
5.	25241	*Antaresia stimsoni subsp. stimsoni (Stimson's Python)*			
6.	25320	*Aspidites melanocephalus (Black-headed Python)*			
7.	25331	*Brachyurophis approximans (North-western Shovel-nosed Snake)*			
8.	25015	*Carlia munda (Shaded-litter Rainbow Skink)*			
9.	25017	*Carlia triacantha (Desert Rainbow Skink)*			
10.	24919	*Crenadactylus ocellatus subsp. horni (Clawless Gecko)*			
11.	30893	*Cryptoblepharus buchananii*			
12.	30892	*Cryptoblepharus ustulatus*			
13.	25458	*Ctenophorus caudicinctus (Ring-tailed Dragon)*			
14.	24865	*Ctenophorus caudicinctus subsp. caudicinctus (Ring-tailed Dragon)*			
15.	25459	*Ctenophorus isolepis (Crested Dragon, Military Dragon)*			
16.	24876	*Ctenophorus isolepis subsp. isolepis (Crested Dragon, Military Dragon)*			
17.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
18.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
19.	25036	*Ctenotus duricola*			
20.	25462	*Ctenotus grandis*			
21.	25041	*Ctenotus grandis subsp. grandis*			
22.	25044	*Ctenotus hanloni*			
23.	25045	*Ctenotus helenae*			
24.	25052	*Ctenotus leonhardii*			
25.	25463	*Ctenotus pantherinus (Leopard Ctenotus)*			
26.	25064	*Ctenotus pantherinus subsp. ocellifer (Leopard Ctenotus)*			
27.	25070	*Ctenotus robustus*			
28.	25072	*Ctenotus rubicundus*			
29.	25071	*Ctenotus rutilans*			
30.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
31.	25465	*Ctenotus uber (Spotted Ctenotus)*			
32.	25081	*Ctenotus uber subsp. johnstonei (Spotted Ctenotus (northeast), Spotted Skink (Balgo, NE WA))*		P2	
33.	25466	*Cyclodomorphus melanops (Slender Blue-tongue)*			
34.	25090	*Cyclodomorphus melanops subsp. melanops (Slender Blue-tongue)*			
35.	24997	*Delma butleri*			
36.	25001	*Delma nasuta*			
37.	25002	*Delma pax*			
38.	25004	*Delma tincta*			
39.	25468	*Demansia psammophis (Yellow-faced Whipsnake)*			
40.	25295	*Demansia psammophis subsp. cupreiceps (Yellow-faced Whipsnake)*			
41.	25297	*Demansia rufescens (Rufous Whipsnake)*			
42.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
43.	41404	*Diplodactylus galaxias (Northern Pilbara Beak-faced Gecko)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
44.	24937	*Diplodactylus mitchelli*			
45.	24940	*Diplodactylus pulcher*			
46.	24944	*Diplodactylus savagei (Southern Pilbara Beak-faced Gecko)*			
47.	30909	*Diporiphora amphiboluroides (Mulga Dragon)*			
48.	25092	*Egernia depressa (Southern Pygmy Spiny-tailed Skink)*			
49.	25094	*Egernia formosa*			
50.	25109	*Eremiascincus richardsonii (Broad-banded Sand Swimmer)*			
51.	25301	*Furina ornata (Moon Snake)*			
52.	24956	*Gehyra pilbara*			
53.	24958	*Gehyra punctata*			
54.	24959	*Gehyra variegata*			
55.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
56.		*Heteronotia sp.*			
57.	25135	*Lerista flammicauda*			
58.	30929	*Lerista jacksoni*			
59.	25155	*Lerista muelleri*			
60.	30925	*Lerista verhmens*			
61.	25183	*Lerista zietzi*			
62.	25005	*Lialis burtonis*			
63.	25238	*Liasis olivaceus subsp. barroni (Pilbara Olive Python)*		T	
64.	30933	*Lucasium stenodactylum*			
65.	30934	*Lucasium wombeyi*			
66.	25184	*Menetia greyii*			
67.	25491	*Menetia surda*			
68.	25187	*Menetia surda subsp. surda*			
69.	25193	*Morethia ruficauda subsp. exquisita*			
70.	25498	*Nephrurus wheeleri*			
71.	24972	*Nephrurus wheeleri subsp. cinctus*			
72.	25499	*Notoscincus ornatus*			
73.	25197	*Notoscincus ornatus subsp. ornatus*			
74.	24976	*Oedura marmorata (Marbled Velvet Gecko)*			
75.	25254	*Parasuta monachus*			
76.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
77.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
78.	24908	*Pogona minor subsp. mitchelli (Dwarf Bearded Dragon)*			
79.	25199	*Proablepharus reginae*			
80.	25261	*Pseudechis australis (Mulga Snake)*			
81.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
82.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
83.	25264	*Pseudonaja nuchalis (Gwardar, Northern Brown Snake)*			
84.	25009	*Pygopus nigriceps*			
85.	24982	*Rhynchoedura ornata (Western Beaked Gecko)*			
86.	24923	*Strophurus assimilis (Goldfields Spiny-tailed Gecko)*			
87.	24932	*Strophurus jeanae*			
88.	24949	*Strophurus wellingtonae*			
89.	25269	*Suta fasciata (Rosen's Snake)*			
90.	25307	*Suta punctata (Spotted Snake)*			
91.	25202	*Tiliqua multifasciata (Central Blue-tongue)*			
92.	30814	*Tympanocryptis cephalus (Pebble Dragon)*			
93.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
94.	25210	*Varanus brevicauda (Short-tailed Pygmy Monitor)*			
95.	30825	*Varanus bushi (Pilbara Mulga Monitor)*			
96.	25211	*Varanus caudolineatus*			
97.	25212	*Varanus eremius (Pygmy Desert Monitor)*			
98.	25216	*Varanus giganteus (Perentie)*			
99.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
100.	25524	*Varanus panoptes (Yellow-spotted Monitor)*			
101.	25223	*Varanus panoptes subsp. rubidus*			
102.	25224	*Varanus pilbarensis (Pilbara Rock Monitor, Northern Pilbara Rock Goanna)*			
103.	25526	*Varanus tristis (Racehorse Monitor)*			
104.	25227	*Varanus tristis subsp. tristis (Racehorse Monitor)*			
105.	25311	*Vermicella snelli*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

Reptile NatureMap Species Stats Report

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Reptiles
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Area (ha)		502569.66
Taxa:	Naturalised	0
	Native	105
Endemics:		0
Families:		9
Genera:		42
Conservation Status:	-	103
	T	1
	2	1
MS Status:	-	105
Rank:	-	87
	subsp.	18

Top Ten Families

		Species	Records
1.	Scincidae	36	451
2.	Elapidae	14	75
3.	Diplodactylidae	13	360
4.	Agamidae	12	296
5.	Varanidae	12	98
6.	Pygopodidae	6	14
7.	Gekkonidae	5	164
8.	Boidae	5	11
9.	Carphodactylidae	2	10

Top Ten Genera

		Species	Records
1.	*Ctenotus*	14	277
2.	*Varanus*	12	98
3.	*Ctenophorus*	6	242
4.	*Diplodactylus*	5	188
5.	*Lerista*	5	46
6.	*Delma*	4	8
7.	*Pogona*	3	16
8.	*Menetia*	3	36
9.	*Pseudonaja*	3	16
10.	*Antaresia*	3	6

[1] Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

Birds NatureMap Species Stats Report

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Birds
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Area (ha)		502569.66
Taxa:	Naturalised	0
	Native	159
Endemics:		0
Families:		52
Genera:		113
Conservation Status:	-	153
	IA	3
	4	2
	S	1
MS Status:	-	159
Rank:	-	149
	subsp.	10

Top Ten Families

		Species	Records
1.	Accipitridae	14	187
2.	Anatidae	10	54
3.	Psittacidae	10	361
4.	Ardeidae	7	51
5.	Acanthizidae	7	307
6.	Meliphagidae	7	416
7.	Phalacrocoracidae	6	27
8.	Rallidae	6	14
9.	Maluridae	6	195
10.	Falconidae	5	98

Top Ten Genera

		Species	Records
1.	*Phalacrocorax*	5	18
2.	*Falco*	5	98
3.	*Acanthiza*	4	51
4.	*Cacatua*	4	119
5.	*Cracticus*	3	219
6.	*Elanus*	3	16
7.	*Ardea*	3	28
8.	*Malurus*	3	190
9.	*Anas*	3	28
10.	*Artamus*	3	152

[1]Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

Birds NatureMap Species List

Created By Tim McCabe on 25/09/2018

Current Names Only Yes
Core Datasets Only Yes
Species Group Birds
Method 'By Circle'
Centre 118° 30' 32" E,22° 10' 01" S
Buffer 40km
Group By Species Group

Species Group	Species	Records
Bird	159	4526
TOTAL	**159**	**4526**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Bird					
1.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
2.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
3.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
4.	24264	*Acanthiza robustirostris (Slaty-backed Thornbill)*			
5.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
6.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
7.	25536	*Accipiter fasciatus (Brown Goshawk)*			
8.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
9.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
10.	25647	*Amytornis striatus (Striated Grasswren)*			
11.	24539	*Amytornis striatus subsp. striatus (Striated Grasswren (inland))*		P4	
12.	24312	*Anas gracilis (Grey Teal)*			
13.	24315	*Anas rhynchotis (Australasian Shoveler)*			
14.	24316	*Anas superciliosa (Pacific Black Duck)*			
15.	47414	*Anhinga novaehollandiae (Australasian Darter)*			
16.	25670	*Anthus australis (Australian Pipit)*			
17.	25554	*Apus pacificus (Fork-tailed Swift, Pacific Swift)*		IA	
18.	24285	*Aquila audax (Wedge-tailed Eagle)*			
19.	41324	*Ardea modesta (great egret, white egret)*			
20.	24340	*Ardea novaehollandiae (White-faced Heron)*			
21.	24341	*Ardea pacifica (White-necked Heron)*			
22.	24610	*Ardeotis australis (Australian Bustard)*			
23.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
24.	24355	*Artamus minor (Little Woodswallow)*			
25.	24356	*Artamus personatus (Masked Woodswallow)*			
26.	24318	*Aythya australis (Hardhead)*			
27.		*Barnardius zonarius*			
28.	24359	*Burhinus grallarius (Bush Stone-curlew)*			
29.	25715	*Cacatua roseicapilla (Galah)*			
30.	24725	*Cacatua roseicapilla subsp. assimilis (Galah)*			
31.	24726	*Cacatua roseicapilla subsp. roseicapilla (Galah)*			
32.	25716	*Cacatua sanguinea (Little Corella)*			
33.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
34.	25600	*Centropus phasianinus (Pheasant Coucal)*			
35.	24564	*Certhionyx variegatus (Pied Honeyeater)*			
36.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
37.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
38.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
39.	25580	*Cinclosoma castaneothorax (Chestnut-breasted Quail-thrush)*			
40.	24288	*Circus approximans (Swamp Harrier)*			
41.	24289	*Circus assimilis (Spotted Harrier)*			
42.	25581	*Climacteris affinis (White-browed Treecreeper)*			
43.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
44.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
45.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
46.	24416	*Corvus bennetti (Little Crow)*			
47.	25593	*Corvus orru (Torresian Crow)*			
48.	24671	*Coturnix pectoralis (Stubble Quail)*			
49.	25701	*Coturnix ypsilophora (Brown Quail)*			
50.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
51.	25595	*Cracticus tibicen (Australian Magpie)*			
52.	25596	*Cracticus torquatus (Grey Butcherbird)*			
53.	24322	*Cygnus atratus (Black Swan)*			
54.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
55.	24325	*Dendrocygna eytoni (Plumed Whistling Duck)*			
56.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
57.	24470	*Dromaius novaehollandiae (Emu)*			
58.		*Egretta garzetta*			
59.		*Egretta novaehollandiae*			
60.		*Elanus axillaris*			
61.	25540	*Elanus caeruleus (Black-shouldered Kite)*			
62.	24291	*Elanus scriptus (Letter-winged Kite)*		P4	
63.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
64.	24631	*Emblema pictum (Painted Finch)*			
65.		*Eolophus roseicapillus*			
66.	25578	*Ephippiorhynchus asiaticus (Black-necked Stork)*			
67.	24387	*Ephippiorhynchus asiaticus subsp. australis (Black-necked Stork)*			
68.	24570	*Epthianura tricolor (Crimson Chat)*			
69.	24837	*Eremiornis carteri (Spinifex-bird)*			
70.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
71.	24368	*Eurostopodus argus (Spotted Nightjar)*			
72.	25621	*Falco berigora (Brown Falcon)*			
73.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
74.	25623	*Falco longipennis (Australian Hobby)*			
75.	24474	*Falco longipennis subsp. longipennis (Australian Hobby)*			
76.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
77.	25727	*Fulica atra (Eurasian Coot)*			
78.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
79.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
80.	47954	*Gelochelidon nilotica (Gull-billed Tern)*		IA	
81.	24401	*Geopelia cuneata (Diamond Dove)*			
82.	25585	*Geopelia striata (Zebra Dove)*			
83.	24404	*Geophaps plumifera (Spinifex Pigeon)*			
84.	25530	*Gerygone fusca (Western Gerygone)*			
85.	24443	*Grallina cyanoleuca (Magpie-lark)*			
86.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
87.	24295	*Haliastur sphenurus (Whistling Kite)*			
88.	24297	*Hamirostra melanosternon (Black-breasted Buzzard)*			
89.	47965	*Hieraaetus morphnoides (Little Eagle)*			
90.	25734	*Himantopus himantopus (Black-winged Stilt)*			
91.	24491	*Hirundo neoxena (Welcome Swallow)*			
92.	25562	*Ixobrychus flavicollis (Black Bittern)*			
93.	24367	*Lalage tricolor (White-winged Triller)*			
94.	25661	*Lichmera indistincta (Brown Honeyeater)*			
95.		*Lophoictinia isura*			
96.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
97.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
98.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
99.	25654	*Malurus splendens (Splendid Fairy-wren)*			
100.	24583	*Manorina flavigula (Yellow-throated Miner)*			
101.	47997	*Melanodryas cucullata (Hooded Robin)*			
102.	25665	*Melithreptus gularis (Black-chinned Honeyeater)*			
103.	24736	*Melopsittacus undulatus (Budgerigar)*			
104.	24598	*Merops ornatus (Rainbow Bee-eater)*			
105.		*Microcarbo melanoleucos*			
106.	25542	*Milvus migrans (Black Kite)*			
107.	25545	*Mirafra javanica (Horsfield's Bushlark, Singing Bushlark)*			
108.	25685	*Neochmia ruficauda (Star Finch)*			
109.		*Neopsephotus bourkii*			
110.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
111.	24742	*Nymphicus hollandicus (Cockatiel)*			
112.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
113.	24618	*Oreoica gutturalis (Crested Bellbird)*			
114.	25680	*Pachycephala rufiventris (Rufous Whistler)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
115.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
116.	25682	*Pardalotus striatus (Striated Pardalote)*			
117.	24628	*Pardalotus striatus subsp. murchisoni (Striated Pardalote)*			
118.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
119.	48060	*Petrochelidon ariel (Fairy Martin)*			
120.	48061	*Petrochelidon nigricans (Tree Martin)*			
121.	24659	*Petroica goodenovii (Red-capped Robin)*			
122.	25697	*Phalacrocorax carbo (Great Cormorant)*			
123.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
124.	24666	*Phalacrocorax melanoleucos subsp. melanoleucos (Little Pied Cormorant)*			
125.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
126.	25699	*Phalacrocorax varius (Pied Cormorant)*			
127.	24409	*Phaps chalcoptera (Common Bronzewing)*			
128.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
129.	24842	*Platalea regia (Royal Spoonbill)*			
130.	24748	*Platycercus varius (Mulga Parrot)*			
131.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
132.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
133.	25703	*Podargus strigoides (Tawny Frogmouth)*			
134.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
135.	24683	*Pomatostomus superciliosus (White-browed Babbler)*			
136.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			
137.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
138.	24771	*Porzana tabuensis (Spotless Crake)*			
139.	24390	*Psophodes occidentalis (Western Wedgebill, Chiming Wedgebill)*			
140.		*Ptilonorhynchus guttatus*			
141.	24757	*Ptilonorhynchus maculatus subsp. guttatus (Western Bowerbird)*			
142.	42344	*Purnella albifrons (White-fronted Honeyeater)*			
143.	24278	*Pyrrholaemus brunneus (Redthroat)*			
144.	48096	*Rhipidura albiscapa (Grey Fantail)*			
145.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
146.	30948	*Smicrornis brevirostris (Weebill)*			
147.	25643	*Sterna hybrida (Whiskered Tern)*			
148.	24329	*Stictonetta naevosa (Freckled Duck)*			
149.	25656	*Stipiturus ruficeps (Rufous-crowned Emu-wren)*			
150.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
151.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
152.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
153.	30870	*Taeniopygia guttata (Zebra Finch)*			
154.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
155.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
156.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
157.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
158.	24851	*Turnix velox (Little Button-quail)*			
159.	25577	*Vanellus miles (Masked Lapwing)*			

Conservation Codes
T - Rare or likely to become extinct
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IA - Protected under international agreement
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3 - Priority 3
4 - Priority 4
5 - Priority 5

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NatureMap
Mapping Western Australia's biodiversity

Mammals NatureMap Species List

Created By Tim McCabe on 25/09/2018

Current Names Only Yes
Core Datasets Only Yes
Species Group Mammals
Method 'By Circle'
Centre 118° 30' 32" E,22° 10' 01" S
Buffer 40km
Group By Species Group

Species Group	Species	Records
Mammal	33	480
TOTAL	**33**	**480**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Mammal					
1.	24251	*Bos taurus (European Cattle)*	Y		
2.	24254	*Camelus dromedarius (Dromedary, Camel)*	Y		
3.	25454	*Canis lupus (Dog, Dingo)*	Y		
4.	24039	*Canis lupus subsp. dingo (Dingo)*	Y		
5.	24181	*Chaerephon jobensis (Greater Northern Freetail-bat, Northern Mastiff Bat)*			
6.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
7.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
8.	24093	*Dasyurus hallucatus (Northern Quoll)*		T	
9.	24041	*Felis catus (Cat)*	Y		
10.	24217	*Leggadina lakedownensis (Northern Short-tailed Mouse, Lakeland Downs Mouse, Kerakenga)*		P4	
11.	24180	*Macroderma gigas (Ghost Bat)*		T	
12.	25489	*Macropus robustus (Euro, Biggada)*			
13.	24135	*Macropus robustus subsp. erubescens (Euro, Biggada)*			
14.	24136	*Macropus rufus (Red Kangaroo, Marlu)*			
15.	24168	*Macrotis lagotis (Bilby, Dalgyte, Ninu)*		T	
16.	24223	*Mus musculus (House Mouse)*	Y		
17.	24095	*Ningaui timealeyi (Pilbara Ningaui)*			
18.	48027	*Nyctophilus geoffroyi subsp. geoffroyi (Lesser Long-eared Bat)*			
19.	24144	*Petrogale rothschildi (Rothschild's Rock-wallaby)*			
20.	24101	*Planigale ingrami (Long-tailed Planigale)*			
21.	24233	*Pseudomys chapmani (Western Pebble-mound Mouse, Ngadji)*		P4	
22.	24234	*Pseudomys delicatulus (Delicate Mouse)*			
23.	24235	*Pseudomys desertor (Desert Mouse)*			
24.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
25.	24172	*Pteropus alecto (Black Flying-fox)*			
26.	24174	*Saccolaimus flaviventris (Yellow-bellied Sheath-tailed Bat)*			
27.	24200	*Scotorepens greyii (Little Broad-nosed Bat)*			
28.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
29.	24175	*Taphozous georgianus (Common Sheath-tailed Bat)*			
30.	24176	*Taphozous hilli (Hill's Sheathtail-bat)*			
31.	24157	*Trichosurus vulpecula subsp. arnhemensis (northern brushtail possum (Kimberley))*		T	
32.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
33.	24248	*Zyzomys argurus (Common Rock-rat)*			

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NatureMap
Mapping Western Australia's biodiversity

Mammals NatureMap Species Stats Report

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Mammals
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Area (ha)		502569.66
Taxa:	Naturalised	6
	Native	27
Endemics:		0
Families:		14
Genera:		26
Conservation Status:	-	27
	T	4
	4	2
MS Status:	-	33
Rank:	-	29
	subsp.	4

Top Ten Families

		Species	Records
1.	Muridae	7	118
2.	Dasyuridae	5	169
3.	Vespertilionidae	4	42
4.	Macropodidae	4	51
5.	Emballonuridae	3	25
6.	Canidae	2	4
7.	Felidae	1	14
8.	Phalangeridae	1	4
9.	Bovidae	1	26
10.	Molossidae	1	8

Top Ten Genera

		Species	Records
1.	*Pseudomys*	4	87
2.	*Macropus*	3	45
3.	*Taphozous*	2	20
4.	*Canis*	2	4
5.	*Vespadelus*	1	19
6.	*Macroderma*	1	2
7.	*Zyzomys*	1	6
8.	*Dasyurus*	1	106
9.	*Ningaui*	1	13
10.	*Dasykaluta*	1	34

[1]Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

FishNatureMap Species List

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Fish
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Species Group	Species	Records
Fish	7	43
TOTAL	**7**	**43**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Fish					
1.		*Amniataba percoides*			
2.		*Glossogobius giuris*			
3.	34042	*Leiopotherapon aheneus (Fortescue Grunter)*		P4	
4.		*Leiopotherapon unicolor*			
5.		*Melanotaenia australis*			
6.		*Nematalosa erebi*			
7.		*Neosilurus hyrtlii*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Fish NatureMap Stats Report

Created By Tim McCabe on 25/09/2018

Current Names Only	Yes
Core Datasets Only	Yes
Species Group	Fish
Method	'By Circle'
Centre	118° 30' 32" E,22° 10' 01" S
Buffer	40km
Group By	Species Group

Area (ha)		502569.66
Taxa:	Naturalised	0
	Native	7
Endemics:		0
Families:		5
Genera:		6
Conservation Status:	-	6
	4	1
MS Status:	-	7
Rank:	-	7

Top Ten Families

		Species	Records
1.	Terapontidae	3	27
2.	Plotosidae	1	5
3.	Gobiidae	1	2
4.	Clupeidae	1	2
5.	Melanotaeniidae	1	7

Top Ten Genera

		Species	Records
1.	*Leiopotherapon*	2	25
2.	*Amniataba*	1	2
3.	*Melanotaenia*	1	7
4.	*Nematalosa*	1	2
5.	*Neosilurus*	1	5
6.	*Glossogobius*	1	2

[1]Endemic To Query Area

Name ID	Species	Conservation Status

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

APPENDIX C BIRDLIFE BIRDATA SEARCH RESULTS

Birdata Species List

Emu
Dromaius novaehollandiae
8 (2.56%)

Plumed Whistling-Duck
Dendrocygna eytoni
5 (1.60%)

Pink-eared Duck
Malacorhynchus membranaceus
3 (0.96%)

Black Swan
Cygnus atratus
3 (0.96%)

Australian Shelduck
Tadorna tadornoides
1 (0.32%)

Hardhead
Aythya australis
5 (1.60%)

Pacific Black Duck
Anas superciliosa
1 (0.32%)

Grey Teal
Anas gracilis
11 (3.53%)

Freckled Duck
Stictonetta naevosa
1 (0.32%)

Stubble Quail
Coturnix pectoralis
1 (0.32%)

Brown Quail
Synoicus ypsilophora
2 (0.64%)

Australasian Grebe
Tachybaptus novaehollandiae
4 (1.28%)

Hoary-headed Grebe
Poliocephalus poliocephalus
3 (0.96%)

Spinifex Pigeon
Geophaps plumifera
21 (6.73%)

Common Bronzewing
Phaps chalcoptera
19 (6.09%)

Flock Bronzewing
Phaps histrionica
1 (0.32%)

Crested Pigeon
Ocyphaps lophotes
71 (22.76%)

Diamond Dove
Geopelia cuneata
82 (26.28%)

Peaceful Dove
Geopelia placida
5 (1.60%)

Pheasant Coucal
Centropus phasianinus
1 (0.32%)

Horsfield's Bronze-Cuckoo
Chalcites basalis
11 (3.53%)

Pallid Cuckoo
Heteroscenes pallidus
27 (8.65%)

Australian Bustard
Ardeotis australis
19 (6.09%)

Tawny Frogmouth
Podargus strigoides
3 (0.96%)

Spotted Nightjar
Eurostopodus argus
13 (4.17%)

Australian Owlet-nightjar
Aegotheles cristatus
8 (2.56%)

Black-tailed Native-hen
Tribonyx ventralis
1 (0.32%)

Eurasian Coot
Fulica atra
3 (0.96%)

Bush Stone-curlew
Burhinus grallarius
2 (0.64%)

Red-necked Avocet
Recurvirostra novaehollandiae
1 (0.32%)

Black-winged Stilt
Himantopus leucocephalus
1 (0.32%)

Red-capped Plover
Charadrius ruficapillus
4 (1.28%)

Black-fronted Dotterel
Elseyornis melanops
9 (2.88%)

Little Button-quail
Turnix velox
29 (9.29%)

Caspian Tern
Hydroprogne caspia
1 (0.32%)

Whiskered Tern
Chlidonias hybrida
1 (0.32%)

Australian Pelican
Pelecanus conspicillatus
9 (2.88%)

White-necked Heron
Ardea pacifica
7 (2.24%)

Great Egret
Ardea alba
5 (1.60%)

White-faced Heron
Egretta novaehollandiae
5 (1.60%)

Straw-necked Ibis
Threskiornis spinicollis
11 (3.53%)

Glossy Ibis
Plegadis falcinellus
1 (0.32%)

Little Pied Cormorant
Microcarbo melanoleucos
1 (0.32%)

Little Black Cormorant
Phalacrocorax sulcirostris
5 (1.60%)

Australasian Darter
Anhinga novaehollandiae
4 (1.28%)

Black-shouldered Kite
Elanus axillaris
3 (0.96%)

Black-breasted Buzzard
Hamirostra melanosternon
4 (1.28%)

Square-tailed Kite
Lophoictinia isura
3 (0.96%)

Wedge-tailed Eagle
Aquila audax
21 (6.73%)

Little Eagle
Hieraaetus morphnoides
6 (1.92%)

Swamp Harrier
Circus approximans
3 (0.96%)

Spotted Harrier
Circus assimilis
20 (6.41%)

Brown Goshawk
Accipiter fasciatus
6 (1.92%)

Collared Sparrowhawk
Accipiter cirrocephalus
9 (2.88%)

White-bellied Sea-Eagle
Haliaeetus leucogaster
2 (0.64%)

Whistling Kite
Haliastur sphenurus
52 (16.67%)

Black Kite
Milvus migrans
10 (3.21%)

Barn Owl
Tyto alba
3 (0.96%)

Southern Boobook
Ninox boobook
2 (0.64%)

Rainbow Bee-eater
Merops ornatus
27 (8.65%)

Sacred Kingfisher
Todiramphus sanctus
5 (1.60%)

Red-backed Kingfisher
Todiramphus pyrrhopygius
34 (10.90%)

Blue-winged Kookaburra
Dacelo leachii
9 (2.88%)

Nankeen Kestrel
Falco cenchroides
28 (8.97%)

Australian Hobby
Falco longipennis
11 (3.53%)

Brown Falcon
Falco berigora
39 (12.50%)

Peregrine Falcon
Falco peregrinus
3 (0.96%)

Cockatiel
Nymphicus hollandicus
31 (9.94%)

Galah
Eolophus roseicapilla
65 (20.83%)

Little Corella
Cacatua sanguinea
27 (8.65%)

Mulga Parrot
Psephotellus varius
1 (0.32%)

Australian Ringneck
Barnardius zonarius
30 (9.62%)

Bourke's Parrot
Neopsephotus bourkii
13 (4.17%)

Budgerigar
Melopsittacus undulatus
74 (23.72%)

Western Bowerbird
Ptilonorhynchus guttatus
18 (5.77%)

Variegated Fairy-wren
Malurus lamberti
49 (15.71%)

White-winged Fairy-wren
Malurus leucopterus
30 (9.62%)

Rufous-crowned Emu-wren
Stipiturus ruficeps
2 (0.64%)

Striated Grasswren
Amytornis striatus
1 (0.32%)

Black Honeyeater
Sugomel niger
6 (1.92%)

Brown Honeyeater
Lichmera indistincta
35 (11.22%)

Black-chinned Honeyeater
Melithreptus gularis
5 (1.60%)

Pied Honeyeater
Certhionyx variegatus
7 (2.24%)

Crimson Chat
Epthianura tricolor
39 (12.50%)

Orange Chat
Epthianura aurifrons
4 (1.28%)

Spiny-cheeked Honeyeater
Acanthagenys rufogularis
54 (17.31%)

Singing Honeyeater
Gavicalis virescens
103 (33.01%)

Grey-headed Honeyeater
Ptilotula keartlandi
28 (8.97%)

Grey-fronted Honeyeater
Ptilotula plumula
1 (0.32%)

White-plumed Honeyeater
Ptilotula penicillata
52 (16.67%)

White-fronted Honeyeater
Purnella albifrons
2 (0.64%)

Yellow-throated Miner
Manorina flavigula
94 (30.13%)

Red-browed Pardalote
Pardalotus rubricatus
24 (7.69%)

Striated Pardalote
Pardalotus striatus
14 (4.49%)

Western Gerygone
Gerygone fusca
14 (4.49%)

Weebill
Smicrornis brevirostris
54 (17.31%)

Inland Thornbill
Acanthiza apicalis
6 (1.92%)

Slaty-backed Thornbill
Acanthiza robustirostris
2 (0.64%)

Chestnut-rumped Thornbill
Acanthiza uropygialis
37 (11.86%)

Grey-crowned Babbler
Pomatostomus temporalis
23 (7.37%)

White-browed Babbler
Pomatostomus superciliosus
20 (6.41%)

Varied Sittella
Daphoenositta chrysoptera
3 (0.96%)

Ground Cuckoo-shrike
Coracina maxima
1 (0.32%)

Black-faced Cuckoo-shrike
Coracina novaehollandiae
61 (19.55%)

White-winged Triller
Lalage tricolor
53 (16.99%)

Rufous Whistler
Pachycephala rufiventris
84 (26.92%)

Grey Shrike-thrush
Colluricincla harmonica
26 (8.33%)

Crested Bellbird
Oreoica gutturalis
39 (12.50%)

Chiming Wedgebill
Psophodes occidentalis
1 (0.32%)

Australian Magpie
Gymnorhina tibicen
10 (3.21%)

Pied Butcherbird
Cracticus nigrogularis
60 (19.23%)

Grey Butcherbird
Cracticus torquatus
19 (6.09%)

Masked Woodswallow
Artamus personatus
7 (2.24%)

Black-faced Woodswallow
Artamus cinereus
69 (22.12%)

Little Woodswallow
Artamus minor
18 (5.77%)

Willie Wagtail
Rhipidura leucophrys
109 (34.94%)

Grey Fantail
Rhipidura fuliginosa
1 (0.32%)

Torresian Crow
Corvus orru
54 (17.31%)

Little Crow
Corvus bennetti
13 (4.17%)

Magpie-lark
Grallina cyanoleuca
53 (16.99%)

Red-capped Robin
Petroica goodenovii
29 (9.29%)

Hooded Robin
Melanodryas cucullata
28 (8.97%)

Mistletoebird
Dicaeum hirundinaceum
20 (6.41%)

Painted Finch
Emblema pictum
16 (5.13%)

Star Finch
Neochmia ruficauda
2 (0.64%)

Zebra Finch
Taeniopygia guttata
124 (39.74%)

Australasian Pipit
Anthus novaeseelandiae
20 (6.41%)

Grey Wagtail
Motacilla cinerea
1 (0.32%)

Horsfield's Bushlark
Mirafra javanica
20 (6.41%)

Brown Songlark
Cincloramphus cruralis
26 (8.33%)

Rufous Songlark
Cincloramphus mathewsi
38 (12.18%)

Spinifexbird
Poodytes carteri
9 (2.88%)

Australian Reed-Warbler
Acrocephalus australis
3 (0.96%)

Fairy Martin
Petrochelidon ariel
16 (5.13%)

Tree Martin
Petrochelidon nigricans
5 (1.60%)

Welcome Swallow
Hirundo neoxena
2 (0.64%)

Crow & Raven spp
5 (1.60%)

APPENDIX D ATLAS OF LIVING AUSTRALIA SEARCH RESULTS

Class		Order	Family	Genus	*Species Name*	Vernacular Name
ACTINOPTERYGII	Fish	ATHERINIFORMES	ATHERINIDAE	Craterocephalus	*Craterocephalus cuneiceps*	Deep Hardyhead
ACTINOPTERYGII	Fish	CLUPEIFORMES	CLUPEIDAE	Nematalosa	*Nematalosa erebi*	Bony Bream
ACTINOPTERYGII	Fish	PERCIFORMES	ELEOTRIDAE	Hypseleotris	*Hypseleotris aurea*	Golden Carp Gudgeon
ACTINOPTERYGII	Fish	PERCIFORMES	GOBIIDAE	Glossogobius	*Glossogobius giuris*	Tank Goby
ACTINOPTERYGII	Fish	ATHERINIFORMES	MELANOTAENIIDAE	Melanotaenia	*Melanotaenia australis*	Western Rainbowfish
ACTINOPTERYGII	Fish	SILURIFORMES	PLOTOSIDAE	Neosilurus	*Neosilurus hyrtlii*	Hyrtl's Catfish
ACTINOPTERYGII	Fish	PERCIFORMES	TERAPONTIDAE	Leiopotherapon	*Leiopotherapon unicolor*	Spangled Perch
ACTINOPTERYGII	Fish	PERCIFORMES	TERAPONTIDAE	Leiopotherapon	*Leiopotherapon aheneus*	Fortescue Grunter
ACTINOPTERYGII	Fish	PERCIFORMES	TERAPONTIDAE	Amniataba	*Amniataba percoides*	Barred Grunter
ACTINOPTERYGII	Fish	PERCIFORMES	TERAPONTIDAE	Hephaestus	*Hephaestus jenkinsi*	Western Sooty Grunter
AMPHIBIA	AMPHIBIA	ANURA	HYLIDAE	Litoria	*Litoria rubella*	Little Red Tree Frog
AMPHIBIA	AMPHIBIA	ANURA	HYLIDAE	Cyclorana	*Cyclorana maini*	Main's Frog
AMPHIBIA	AMPHIBIA	ANURA	HYLIDAE	Cyclorana	*Cyclorana australis*	Giant Frog
AMPHIBIA	AMPHIBIA	ANURA	LIMNODYNASTIDAE	Platyplectrum	*Platyplectrum spenceri*	Spencer's Frog
AMPHIBIA	AMPHIBIA	ANURA	LIMNODYNASTIDAE	Notaden	*Notaden nichollsi*	Desert Spadefoot
AMPHIBIA	AMPHIBIA	ANURA	LIMNODYNASTIDAE	Neobatrachus	*Neobatrachus aquilonius*	Northern Burrowing Frog
AMPHIBIA	AMPHIBIA	ANURA	LIMNODYNASTIDAE	Neobatrachus	*Neobatrachus sutor*	Shoemaker Frog
AMPHIBIA	AMPHIBIA	ANURA	MYOBATRACHIDAE	Uperoleia	*Uperoleia saxatilis*	Pilbara Toadlet
AMPHIBIA	AMPHIBIA	ANURA	MYOBATRACHIDAE	Uperoleia	*Uperoleia glandulosa*	Glandular Toadlet
AMPHIBIA	AMPHIBIA	ANURA	MYOBATRACHIDAE	Pseudophryne	*Pseudophryne douglasi*	Douglas's Toadlet
AMPHIBIA	AMPHIBIA	ANURA	MYOBATRACHIDAE	Uperoleia	*Uperoleia russelli*	Russell's Toadlet
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Smicrornis	*Smicrornis brevirostris*	Weebill
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Gerygone	*Gerygone fusca*	Western Gerygone
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Acanthiza	*Acanthiza (Geobasileus) uropygialis*	Chestnut-Rumped Thornbill
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Acanthiza	*Acanthiza (Acanthiza) apicalis*	Inland Thornbill
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Acanthiza	*Acanthiza (Milligania) robustirostris*	Slaty-Backed Thornbill
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Acanthiza	*Acanthiza (Geobasileus) chrysorrhoa*	Yellow-Rumped Thornbill
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Pyrrholaemus	*Pyrrholaemus brunneus*	Redthroat

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	PASSERIFORMES	ACANTHIZIDAE	Calamanthus	*Calamanthus campestris*	Rufous Fieldwren
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Haliastur	*Haliastur sphenurus*	Whistling Kite
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Aquila	*Aquila (Uroaetus) audax*	Wedge-Tailed Eagle
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Circus	*Circus assimilis*	Spotted Harrier
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Elanus	*Elanus axillaris*	Black-Shouldered Kite
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Milvus	*Milvus migrans*	Black Kite
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Accipiter	*Accipiter (Leucospiza) fasciatus*	Brown Goshawk
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Accipiter	*Accipiter (Paraspizias) cirrocephalus*	Collared Sparrowhawk
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Hieraaetus	*Hieraaetus (Hieraaetus) morphnoides*	Little Eagle
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Elanus	*Elanus scriptus*	Letter-Winged Kite
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Lophoictinia	*Lophoictinia isura*	Square-Tailed Kite
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Circus	*Circus approximans*	Swamp Harrier
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Hamirostra	*Hamirostra melanosternon*	Black-Breasted Buzzard
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Pandion	*Pandion cristatus*	Eastern Osprey
AVES	Birds	FALCONIFORMES	ACCIPITRIDAE	Haliaeetus	*Haliaeetus (Pontoaetus) leucogaster*	White-Bellied Sea-Eagle
AVES	Birds	PASSERIFORMES	ACROCEPHALIDAE	Acrocephalus	*Acrocephalus (Acrocephalus) australis*	Australian Reed Warbler
AVES	Birds	APODIFORMES	AEGOTHELIDAE	Aegotheles	*Aegotheles (Aegotheles) cristatus*	Australian Owlet-Nightjar
AVES	Birds	PASSERIFORMES	ALAUDIDAE	Mirafra	*Mirafra (Mirafra) javanica*	Horsfield's Bushlark
AVES	Birds	CORACIIFORMES	ALCEDINIDAE	Todiramphus	*Todiramphus (Cyanalcyon) pyrrhopygius*	Red-Backed Kingfisher
AVES	Birds	CORACIIFORMES	ALCEDINIDAE	Dacelo	*Dacelo (Dacelo) leachii*	Blue-Winged Kookaburra
AVES	Birds	CORACIIFORMES	ALCEDINIDAE	Todiramphus	*Todiramphus (Todiramphus) sanctus*	Sacred Kingfisher
AVES	Birds	ANSERIFORMES	ANATIDAE	Anas	*Anas (Anas) superciliosa*	Pacific Black Duck
AVES	Birds	ANSERIFORMES	ANATIDAE	Anas	*Anas (Nettion) gracilis*	Grey Teal
AVES	Birds	ANSERIFORMES	ANATIDAE	Chenonetta	*Chenonetta jubata*	Australian Wood Duck
AVES	Birds	ANSERIFORMES	ANATIDAE	Malacorhynchus	*Malacorhynchus membranaceus*	Pink-Eared Duck
AVES	Birds	ANSERIFORMES	ANATIDAE	Aythya	*Aythya (Nyroca) australis*	Hardhead
AVES	Birds	ANSERIFORMES	ANATIDAE	Stictonetta	*Stictonetta naevosa*	Freckled Duck
AVES	Birds	ANSERIFORMES	ANATIDAE	Cygnus	*Cygnus (Chenopis) atratus*	Black Swan

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	ANSERIFORMES	ANATIDAE	Dendrocygna	*Dendrocygna (Leptotarsis) eytoni*	Plumed Whistling-Duck
AVES	Birds	ANSERIFORMES	ANATIDAE	Tadorna	*Tadorna (Casarca) tadornoides*	Australian Shelduck
AVES	Birds	ANSERIFORMES	ANATIDAE	Dendrocygna	*Dendrocygna (Dendrocygna) arcuata*	Wandering Whistling-Duck
AVES	Birds	PELECANIFORMES	ANHINGIDAE	Anhinga	*Anhinga novaehollandiae*	Australasian Darter
AVES	Birds	APODIFORMES	APODIDAE	Apus	*Apus (Apus) pacificus*	Fork-Tailed Swift
AVES	Birds	CICONIIFORMES	ARDEIDAE	Ardea	*Ardea (Ardea) pacifica*	White-Necked Heron
AVES	Birds	CICONIIFORMES	ARDEIDAE	Egretta	*Egretta novaehollandiae*	White-Faced Heron
AVES	Birds	CICONIIFORMES	ARDEIDAE	Nycticorax	*Nycticorax caledonicus*	Nankeen Night-Heron
AVES	Birds	CICONIIFORMES	ARDEIDAE	Ardea	*Ardea (Casmerodius) modesta*	Eastern Great Egret
AVES	Birds	CICONIIFORMES	ARDEIDAE	Egretta	*Egretta garzetta*	Little Egret
AVES	Birds	CICONIIFORMES	ARDEIDAE	Ardea	*Ardea alba*	Baluun
AVES	Birds	CICONIIFORMES	ARDEIDAE	Ixobrychus	*Ixobrychus flavicollis*	Black Bittern
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Cracticus	*Cracticus nigrogularis*	Pied Butcherbird
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Artamus	*Artamus (Angroyan) cinereus*	Black-Faced Woodswallow
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Gymnorhina	*Gymnorhina tibicen*	Australian Magpie
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Artamus	*Artamus (Angroyan) minor*	Little Woodswallow
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Artamus	*Artamus (Campbellornis) personatus*	Masked Woodswallow
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Cracticus	*Cracticus torquatus*	Grey Butcherbird
AVES	Birds	PASSERIFORMES	ARTAMIDAE	Artamus	*Artamus (Artamus) leucorynchus*	White-Breasted Woodswallow
AVES	Birds	CHARADRIIFORMES	BURHINIDAE	Burhinus	*Burhinus (Burhinus) grallarius*	Bush Stone-Curlew
AVES	Birds	PSITTACIFORMES	CACATUIDAE	Cacatua	*Cacatua (Licmetis) sanguinea*	Little Corella
AVES	Birds	PSITTACIFORMES	CACATUIDAE	Eolophus	*Eolophus roseicapilla*	Galah
AVES	Birds	PSITTACIFORMES	CACATUIDAE	Nymphicus	*Nymphicus hollandicus*	Cockatiel
AVES	Birds	PASSERIFORMES	CAMPEPHAGIDAE	Coracina	*Coracina (Coracina) novaehollandiae*	Black-Faced Cuckoo-Shrike
AVES	Birds	PASSERIFORMES	CAMPEPHAGIDAE	Lalage	*Lalage (Lalage) sueurii*	White-Winged Triller
AVES	Birds	PASSERIFORMES	CAMPEPHAGIDAE	Coracina	*Coracina (Pteropodocys) maxima*	Ground Cuckoo-Shrike
AVES	Birds	CAPRIMULGIFORMES	CAPRIMULGIDAE	Eurostopodus	*Eurostopodus (Eurostopodus) argus*	Spotted Nightjar
AVES	Birds	STRUTHIONIFORMES	CASUARIIDAE	Dromaius	*Dromaius novaehollandiae*	Emu

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	CUCULIFORMES	CENTROPODIDAE	Centropus	*Centropus (Polophilus) phasianinus*	Pheasant Coucal
AVES	Birds	CHARADRIIFORMES	CHARADRIIDAE	Elseyornis	*Elseyornis melanops*	Black-Fronted Dotterel
AVES	Birds	CHARADRIIFORMES	CHARADRIIDAE	Erythrogonys	*Erythrogonys cinctus*	Red-Kneed Dotterel
AVES	Birds	CHARADRIIFORMES	CHARADRIIDAE	Charadrius	*Charadrius (Charadrius) ruficapillus*	Red-Capped Dotterel
AVES	Birds	CHARADRIIFORMES	CHARADRIIDAE	Charadrius	*Charadrius (Eupoda) veredus*	Oriental Plover
AVES	Birds	CHARADRIIFORMES	CHARADRIIDAE	Vanellus	*Vanellus (Lobipluvia) miles*	Masked Lapwing
AVES	Birds	CHARADRIIFORMES	CHARADRIIDAE	Vanellus	*Vanellus (Lobivanellus) tricolor*	Banded Lapwing
AVES	Birds	CICONIIFORMES	CICONIIDAE	Ephippiorhynchus	*Ephippiorhynchus (Ephippiorhynchus) asiaticus*	Black-Necked Stork
AVES	Birds	PASSERIFORMES	CISTICOLIDAE	Cisticola	*Cisticola (Cisticola) exilis*	Golden-Headed Cisticola
AVES	Birds	PASSERIFORMES	CLIMACTERIDAE	Climacteris	*Climacteris (Climacteris) melanura*	Black-Tailed Treecreeper
AVES	Birds	COLUMBIFORMES	COLUMBIDAE	Geophaps	*Geophaps (Lophophaps) plumifera*	Spinifex Pigeon
AVES	Birds	COLUMBIFORMES	COLUMBIDAE	Geopelia	*Geopelia cuneata*	Diamond Dove
AVES	Birds	COLUMBIFORMES	COLUMBIDAE	Ocyphaps	*Ocyphaps lophotes*	Crested Pigeon
AVES	Birds	COLUMBIFORMES	COLUMBIDAE	Phaps	*Phaps (Phaps) chalcoptera*	Common Bronzewing
AVES	Birds	COLUMBIFORMES	COLUMBIDAE	Geopelia	*Geopelia striata*	Peaceful Dove
AVES	Birds	COLUMBIFORMES	COLUMBIDAE	Phaps	*Phaps (Histriophaps) histrionica*	Flock Bronzewing
AVES	Birds	PASSERIFORMES	CORVIDAE	Corvus	*Corvus orru*	Torresian Crow
AVES	Birds	PASSERIFORMES	CORVIDAE	Corvus	*Corvus bennetti*	Little Crow
AVES	Birds	CUCULIFORMES	CUCULIDAE	Cacomantis	*Cacomantis (Vidgenia) pallidus*	Pallid Cuckoo
AVES	Birds	CUCULIFORMES	CUCULIDAE	Chalcites	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
AVES	Birds	CUCULIFORMES	CUCULIDAE	Chalcites	*Chalcites osculans*	Black-Eared Cuckoo
AVES	Birds	PASSERIFORMES	ESTRILDIDAE	Taeniopygia	*Taeniopygia guttata*	Zebra Finch
AVES	Birds	PASSERIFORMES	ESTRILDIDAE	Emblema	*Emblema pictum*	Painted Finch
AVES	Birds	PASSERIFORMES	ESTRILDIDAE	Neochmia	*Neochmia (Neochmia) ruficauda*	Star Finch
AVES	Birds	FALCONIFORMES	FALCONIDAE	Falco	*Falco (Tinnunculus) cenchroides*	Nankeen Kestrel
AVES	Birds	FALCONIFORMES	FALCONIDAE	Falco	*Falco (Ieracidea) berigora*	Brown Falcon
AVES	Birds	FALCONIFORMES	FALCONIDAE	Falco	*Falco (Falco) longipennis*	Australian Hobby
AVES	Birds	FALCONIFORMES	FALCONIDAE	Falco	*Falco (Hierofalco) peregrinus*	Peregrine Falcon

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	FALCONIFORMES	FALCONIDAE	Falco	*Falco (Hierofalco) hypoleucos*	Grey Falcon
AVES	Birds	CHARADRIIFORMES	GLAREOLIDAE	Glareola	*Glareola (Glareola) maldivarum*	Oriental Pratincole
AVES	Birds	CHARADRIIFORMES	HAEMATOPODIDAE	Haematopus	*Haematopus longirostris*	Pied Oystercatcher
AVES	Birds	PASSERIFORMES	HIRUNDINIDAE	Petrochelidon	*Petrochelidon (Petrochelidon) ariel*	Fairy Martin
AVES	Birds	PASSERIFORMES	HIRUNDINIDAE	Petrochelidon	*Petrochelidon (Hylochelidon) nigricans*	Tree Martin
AVES	Birds	PASSERIFORMES	HIRUNDINIDAE	Hirundo	*Hirundo (Hirundo) neoxena*	Welcome Swallow
AVES	Birds	PASSERIFORMES	HIRUNDINIDAE	Cheramoeca	*Cheramoeca leucosterna*	White-Backed Swallow
AVES	Birds	CHARADRIIFORMES	LARIDAE	Sternula	*Sternula albifrons*	Little Tern
AVES	Birds	CHARADRIIFORMES	LARIDAE	Gelochelidon	*Gelochelidon nilotica*	Gull-Billed Tern
AVES	Birds	CHARADRIIFORMES	LARIDAE	Hydroprogne	*Hydroprogne caspia*	Caspian Tern
AVES	Birds	CHARADRIIFORMES	LARIDAE	Chlidonias	*Chlidonias (Pelodes) hybrida*	Whiskered Tern
AVES	Birds	PASSERIFORMES	MALURIDAE	Malurus	*Malurus (Leggeornis) lamberti*	Variegated Fairy-Wren
AVES	Birds	PASSERIFORMES	MALURIDAE	Malurus	*Malurus (Musciparus) leucopterus*	White-Winged Fairy-Wren
AVES	Birds	PASSERIFORMES	MALURIDAE	Amytornis	*Amytornis (Magnamytis) striatus*	Striated Grasswren
AVES	Birds	PASSERIFORMES	MALURIDAE	Malurus	*Malurus (Leggeornis) assimilis*	
AVES	Birds	PASSERIFORMES	MALURIDAE	Stipiturus	*Stipiturus ruficeps*	Rufous-Crowned Emu-Wren
AVES	Birds	PASSERIFORMES	MALURIDAE	Malurus	*Malurus (Malurus) splendens*	Splendid Fairy-Wren
AVES	Birds	PASSERIFORMES	MEGALURIDAE	Cincloramphus	*Cincloramphus (Maclennania) mathewsi*	Rufous Songlark
AVES	Birds	PASSERIFORMES	MEGALURIDAE	Eremiornis	*Eremiornis carteri*	Spinifexbird
AVES	Birds	PASSERIFORMES	MEGALURIDAE	Cincloramphus	*Cincloramphus (Cincloramphus) cruralis*	Brown Songlark
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Manorina	*Manorina (Myzantha) flavigula*	Yellow-Throated Miner
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Ptilotula	*Ptilotula penicillata*	White-Plumed Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Ptilotula	*Ptilotula keartlandi*	Grey-Headed Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Lichmera	*Lichmera (Lichmera) indistincta*	Brown Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Gavicalis	*Gavicalis virescens*	Singing Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Acanthagenys	*Acanthagenys rufogularis*	Spiny-Cheeked Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Epthianura	*Epthianura (Parepthianura) tricolor*	Crimson Chat
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Melithreptus	*Melithreptus (Eidopsarus) gularis*	Black-Chinned Honeyeater

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Certhionyx	*Certhionyx (Certhionyx) variegatus*	Pied Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Conopophila	*Conopophila (Lacustroica) whitei*	Grey Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Sugomel	*Sugomel niger*	Black Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Purnella	*Purnella albifrons*	White-Fronted Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Ptilotula	*Ptilotula plumula*	Grey-Fronted Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Epthianura	*Epthianura (Aurepthianura) aurifrons*	Orange Chat
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Melithreptus	*Melithreptus (Eidopsarus) validirostris*	Strong-Billed Honeyeater
AVES	Birds	PASSERIFORMES	MELIPHAGIDAE	Entomyzon	*Entomyzon cyanotis*	Blue-Faced Honeyeater
AVES	Birds	CORACIIFORMES	MEROPIDAE	Merops	*Merops (Merops) ornatus*	Rainbow Bee-Eater
AVES	Birds	PASSERIFORMES	MONARCHIDAE	Grallina	*Grallina cyanoleuca*	Magpie-Lark
AVES	Birds	PASSERIFORMES	MOTACILLIDAE	Anthus	*Anthus (Anthus) novaeseelandiae*	Australian Pipit
AVES	Birds	PASSERIFORMES	NECTARINIIDAE	Dicaeum	*Dicaeum (Dicaeum) hirundinaceum*	Mistletoebird
AVES	Birds	PASSERIFORMES	NEOSITTIDAE	Daphoenositta	*Daphoenositta (Neositta) chrysoptera*	Varied Sittella
AVES	Birds	PASSERIFORMES	OREOIDIDAE	Oreoica	*Oreoica gutturalis*	Crested Bellbird
AVES	Birds	GRUIFORMES	OTIDIDAE	Ardeotis	*Ardeotis australis*	Australian Bustard
AVES	Birds	PASSERIFORMES	PACHYCEPHALIDAE	Pachycephala	*Pachycephala (Alisterornis) rufiventris*	Rufous Whistler
AVES	Birds	PASSERIFORMES	PACHYCEPHALIDAE	Colluricincla	*Colluricincla (Colluricincla) harmonica*	Grey Shrike-Thrush
AVES	Birds	PASSERIFORMES	PARDALOTIDAE	Pardalotus	*Pardalotus (Pardalotinus) striatus*	Striated Pardalote
AVES	Birds	PASSERIFORMES	PARDALOTIDAE	Pardalotus	*Pardalotus (Pardalotinus) rubricatus*	Red-Browed Pardalote
AVES	Birds	PELECANIFORMES	PELECANIDAE	Pelecanus	*Pelecanus conspicillatus*	Australian Pelican
AVES	Birds	PASSERIFORMES	PETROICIDAE	Melanodryas	*Melanodryas (Melanodryas) cucullata*	Hooded Robin
AVES	Birds	PASSERIFORMES	PETROICIDAE	Petroica	*Petroica (Petroica) goodenovii*	Red-Capped Robin
AVES	Birds	PASSERIFORMES	PETROICIDAE	Microeca	*Microeca (Microeca) fascinans*	Jacky Winter
AVES	Birds	PELECANIFORMES	PHALACROCORACIDAE	Microcarbo	*Microcarbo melanoleucos*	Little Pied Cormorant
AVES	Birds	PELECANIFORMES	PHALACROCORACIDAE	Phalacrocorax	*Phalacrocorax (Phalacrocorax) sulcirostris*	Little Black Cormorant
AVES	Birds	PELECANIFORMES	PHALACROCORACIDAE	Phalacrocorax	*Phalacrocorax (Phalacrocorax) varius*	Pied Cormorant
AVES	Birds	PELECANIFORMES	PHALACROCORACIDAE	Phalacrocorax	*Phalacrocorax (Phalacrocorax) carbo*	Great Cormorant
AVES	Birds	PELECANIFORMES	PHALACROCORACIDAE	Phalacrocorax	*Phalacrocorax melanoleucos*	Birribangga

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	PELECANIFORMES	PHALACROCORACIDAE	Phalacrocorax	*Phalacrocorax melanoleucos*	Little Pied Cormorant
AVES	Birds	GALLIFORMES	PHASIANIDAE	Coturnix	*Coturnix (Synoicus) ypsilophora*	Brown Quail
AVES	Birds	GALLIFORMES	PHASIANIDAE	Coturnix	*Coturnix (Coturnix) pectoralis*	Stubble Quail
AVES	Birds	CAPRIMULGIFORMES	PODARGIDAE	Podargus	*Podargus strigoides*	Tawny Frogmouth
AVES	Birds	PODICIPEDIFORMES	PODICIPEDIDAE	Tachybaptus	*Tachybaptus novaehollandiae*	Australasian Grebe
AVES	Birds	PODICIPEDIFORMES	PODICIPEDIDAE	Poliocephalus	*Poliocephalus poliocephalus*	Hoary-Headed Grebe
AVES	Birds	PASSERIFORMES	POMATOSTOMIDAE	Pomatostomus	*Pomatostomus (Pomatostomus) temporalis*	Grey-Crowned Babbler
AVES	Birds	PASSERIFORMES	POMATOSTOMIDAE	Pomatostomus	*Pomatostomus (Morganornis) superciliosus*	White-Browed Babbler
AVES	Birds	PSITTACIFORMES	PSITTACIDAE	Barnardius	*Barnardius zonarius*	Australian Ringneck
AVES	Birds	PSITTACIFORMES	PSITTACIDAE	Melopsittacus	*Melopsittacus undulatus*	Budgerigar
AVES	Birds	PSITTACIFORMES	PSITTACIDAE	Neopsephotus	*Neopsephotus bourkii*	Bourke's Parrot
AVES	Birds	PSITTACIFORMES	PSITTACIDAE	Neophema	*Neophema (Neonanodes) elegans*	Elegant Parrot
AVES	Birds	PSITTACIFORMES	PSITTACIDAE	Psephotus	*Psephotus (Psephotus) varius*	Mulga Parrot
AVES	Birds	PASSERIFORMES	PSOPHODIDAE	Psophodes	*Psophodes (Sphenostoma) occidentalis*	Chiming Wedgebill
AVES	Birds	PASSERIFORMES	PTILONORHYNCHIDAE	Ptilonorhynchus	*Ptilonorhynchus guttatus*	Western Bowerbird
AVES	Birds	PASSERIFORMES	PTILONORHYNCHIDAE	Ptilonorhynchus	*Ptilonorhynchus maculatus*	Spotted Bowerbird
AVES	Birds	GRUIFORMES	RALLIDAE	Fulica	*Fulica atra*	Eurasian Coot
AVES	Birds	GRUIFORMES	RALLIDAE	Porzana	*Porzana (Porzana) tabuensis*	Spotless Crake
AVES	Birds	GRUIFORMES	RALLIDAE	Tribonyx	*Tribonyx ventralis*	Black-Tailed Native-Hen
AVES	Birds	GRUIFORMES	RALLIDAE	Gallirallus	*Gallirallus philippensis*	
AVES	Birds	GRUIFORMES	RALLIDAE	Porphyrio	*Porphyrio (Porphyrio) porphyrio*	Purple Swamphen
AVES	Birds	CHARADRIIFORMES	RECURVIROSTRIDAE	Himantopus	*Himantopus himantopus*	Pied Stilt
AVES	Birds	CHARADRIIFORMES	RECURVIROSTRIDAE	Recurvirostra	*Recurvirostra novaehollandiae*	Red-Necked Avocet
AVES	Birds	PASSERIFORMES	RHIPIDURIDAE	Rhipidura	*Rhipidura (Sauloprocta) leucophrys*	Willie Wagtail
AVES	Birds	PASSERIFORMES	RHIPIDURIDAE	Rhipidura	*Rhipidura (Rhipidura) albiscapa*	Grey Fantail
AVES	Birds	PASSERIFORMES	RHIPIDURIDAE	Rhipidura	*Rhipidura (Howeavis) rufifrons*	Rufous Fantail
AVES	Birds	CHARADRIIFORMES	SCOLOPACIDAE	Tringa	*Tringa (Rhyacophilus) glareola*	Wood Sandpiper
AVES	Birds	CHARADRIIFORMES	SCOLOPACIDAE	Tringa	*Tringa (Glottis) nebularia*	Greenshank

Class		Order	Family	Genus	*Species Name*	Vernacular Name
AVES	Birds	CHARADRIIFORMES	SCOLOPACIDAE	Calidris	*Calidris (Erolia) acuminata*	Sharp-Tailed Sandpiper
AVES	Birds	CHARADRIIFORMES	SCOLOPACIDAE	Actitis	*Actitis hypoleucos*	Common Sandpiper
AVES	Birds	CHARADRIIFORMES	SCOLOPACIDAE	Tringa	*Tringa (Rhyacophilus) stagnatilis*	Marsh Sandpiper
AVES	Birds	CHARADRIIFORMES	SCOLOPACIDAE	Calidris	*Calidris (Ereunetes) ruficollis*	Red-Necked Stint
AVES	Birds	STRIGIFORMES	STRIGIDAE	Ninox	*Ninox (Ninox) novaeseelandiae*	Southern Boobook
AVES	Birds	STRIGIFORMES	STRIGIDAE	Ninox	*Ninox (Hieracoglaux) connivens*	Barking Owl
AVES	Birds	CICONIIFORMES	THRESKIORNITHIDAE	Threskiornis	*Threskiornis spinicollis*	Straw-Necked Ibis
AVES	Birds	CICONIIFORMES	THRESKIORNITHIDAE	Platalea	*Platalea (Platibis) flavipes*	Yellow-Billed Spoonbill
AVES	Birds	CICONIIFORMES	THRESKIORNITHIDAE	Platalea	*Platalea (Platalea) regia*	Royal Spoonbill
AVES	Birds	CICONIIFORMES	THRESKIORNITHIDAE	Threskiornis	*Threskiornis moluccus*	Australian White Ibis
AVES	Birds	CICONIIFORMES	THRESKIORNITHIDAE	Plegadis	*Plegadis falcinellus*	Glossy Ibis
AVES	Birds	TURNICIFORMES	TURNICIDAE	Turnix	*Turnix (Alphaturnia) velox*	Little Button-Quail
AVES	Birds	STRIGIFORMES	TYTONIDAE	Tyto	*Tyto (Tyto) javanica*	Eastern Barn Owl
AVES	Birds	STRIGIFORMES	TYTONIDAE	Tyto	*Tyto alba*	Barn Owl
MAMMALIA	Mammals	CARNIVORA	CANIDAE	Canis	*Canis familiaris*	Dingo
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Dasykaluta	*Dasykaluta rosamondae*	Little Red Kaluta
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Ningaui	*Ningaui timealeyi*	Pilbara Ningaui
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Dasyurus	*Dasyurus hallucatus*	Digul
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Pseudantechinus	*Pseudantechinus macdonnellensis*	Fat-Tailed Pseudantechinus
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Sminthopsis	*Sminthopsis macroura*	Stripe-Faced Dunnart
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Sminthopsis	*Sminthopsis youngsoni*	Lesser Hairy-Footed Dunnart
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Pseudantechinus	*Pseudantechinus woolleyae*	Woolley's Pseudantechinus
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Sminthopsis	*Sminthopsis ooldea*	Ooldea Dunnart
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Ningaui	*Ningaui ridei*	Wongai Ningaui
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Dasycercus	*Dasycercus blythi*	Brush-Tailed Mulgara
MAMMALIA	Mammals	DASYUROMORPHIA	DASYURIDAE	Sminthopsis	*Sminthopsis longicaudata*	Long-Tailed Dunnart
MAMMALIA	Mammals	CHIROPTERA	EMBALLONURIDAE	Taphozous	*Taphozous georgianus*	Common Sheathtail-Bat
MAMMALIA	Mammals	CHIROPTERA	EMBALLONURIDAE	Taphozous	*Taphozous hilli*	Hill's Sheathtail-Bat

Class		Order	Family	Genus	*Species Name*	Vernacular Name
MAMMALIA	Mammals	CHIROPTERA	EMBALLONURIDAE	Saccolaimus	*Saccolaimus flaviventris*	Yellow-Bellied Sheathtail-Bat
MAMMALIA	Mammals	PERISSODACTYLA	EQUIDAE	Equus	*Equus africanus*	
MAMMALIA	Mammals	CARNIVORA	FELIDAE	Felis	*Felis catus*	Cat
MAMMALIA	Mammals	DIPROTODONTIA	MACROPODIDAE	Osphranter	*Osphranter robustus*	Common Wallaroo
MAMMALIA	Mammals	DIPROTODONTIA	MACROPODIDAE	Petrogale	*Petrogale rothschildi*	Rothschild's Rock-Wallaby
MAMMALIA	Mammals	DIPROTODONTIA	MACROPODIDAE	Osphranter	*Osphranter rufus*	Red Kangaroo
MAMMALIA	Mammals	DIPROTODONTIA	MACROPODIDAE	Lagorchestes	*Lagorchestes conspicillatus*	Spectacled Hare-Wallaby
MAMMALIA	Mammals	CHIROPTERA	MEGADERMATIDAE	Macroderma	*Macroderma gigas*	Ghost Bat
MAMMALIA	Mammals	CHIROPTERA	MOLOSSIDAE	Chaerephon	*Chaerephon jobensis*	Northern Mastiff Bat
MAMMALIA	Mammals	CHIROPTERA	MOLOSSIDAE	Austronomus	*Austronomus australis*	White-Striped Freetail-Bat
MAMMALIA	Mammals	CHIROPTERA	MOLOSSIDAE	Ozimops	*Ozimops lumsdenae*	Northern Free-Tailed Bat
MAMMALIA	Mammals	RODENTIA	MURIDAE	Pseudomys	*Pseudomys hermannsburgensis*	Sandy Inland Mouse
MAMMALIA	Mammals	RODENTIA	MURIDAE	Zyzomys	*Zyzomys argurus*	Common Rock-Rat
MAMMALIA	Mammals	RODENTIA	MURIDAE	Mus	*Mus musculus*	House Mouse
MAMMALIA	Mammals	RODENTIA	MURIDAE	Pseudomys	*Pseudomys desertor*	Desert Mouse
MAMMALIA	Mammals	RODENTIA	MURIDAE	Pseudomys	*Pseudomys chapmani*	Pebble-Mound Mouse
MAMMALIA	Mammals	RODENTIA	MURIDAE	Leggadina	*Leggadina lakedownensis*	Lakeland Downs Mouse
MAMMALIA	Mammals	RODENTIA	MURIDAE	Pseudomys	*Pseudomys delicatulus*	Delicate Mouse
MAMMALIA	Mammals	DIPROTODONTIA	PHALANGERIDAE	Trichosurus	*Trichosurus vulpecula*	Common Brushtail Possum
MAMMALIA	Mammals	CHIROPTERA	PTEROPODIDAE	Pteropus	*Pteropus alecto*	Black Flying-Fox
MAMMALIA	Mammals	CHIROPTERA	PTEROPODIDAE	Pteropus	*Pteropus poliocephalus*	Grey-Headed Flying-Fox
MAMMALIA	Mammals	CHIROPTERA	RHINONYCTERIDAE	Rhinonicteris	*Rhinonicteris aurantia*	Orange Leaf-Nosed Bat
MAMMALIA	Mammals	MONOTREMATA	TACHYGLOSSIDAE	Tachyglossus	*Tachyglossus aculeatus*	Short-Beaked Echidna
MAMMALIA	Mammals	PERAMELEMORPHIA	THYLACOMYIDAE	Macrotis	*Macrotis lagotis*	Bilby
MAMMALIA	Mammals	CHIROPTERA	VESPERTILIONIDAE	Vespadelus	*Vespadelus finlaysoni*	Finlayson's Cave Bat
MAMMALIA	Mammals	CHIROPTERA	VESPERTILIONIDAE	Scotorepens	*Scotorepens greyii*	Little Broad-Nosed Bat
MAMMALIA	Mammals	CHIROPTERA	VESPERTILIONIDAE	Chalinolobus	*Chalinolobus gouldii*	Gould's Wattled Bat
MAMMALIA	Mammals	CHIROPTERA	VESPERTILIONIDAE	Nyctophilus	*Nyctophilus geoffroyi*	Lesser Long-Eared Bat

Class		Order	Family	Genus	*Species Name*	Vernacular Name
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Ctenophorus	*Ctenophorus caudicinctus*	Ring-Tailed Dragon
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Ctenophorus	*Ctenophorus isolepis*	Central Military Dragon
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Ctenophorus	*Ctenophorus nuchalis*	Central Netted Dragon
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Ctenophorus	*Ctenophorus reticulatus*	Western Netted Dragon
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Diporiphora	*Diporiphora amphiboluroides*	Mulga Dragon
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Diporiphora	*Diporiphora valens*	Pilbara Two-Line Dragon
REPTILIA	Reptiles	SQUAMATA	AGAMIDAE	Diporiphora	*Diporiphora vescus*	Northern Pilbara Tree Dragon

APPENDIX E EPBC PROTECTED MATTERS SEARCH TOOL (40 KM BUFFER)

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

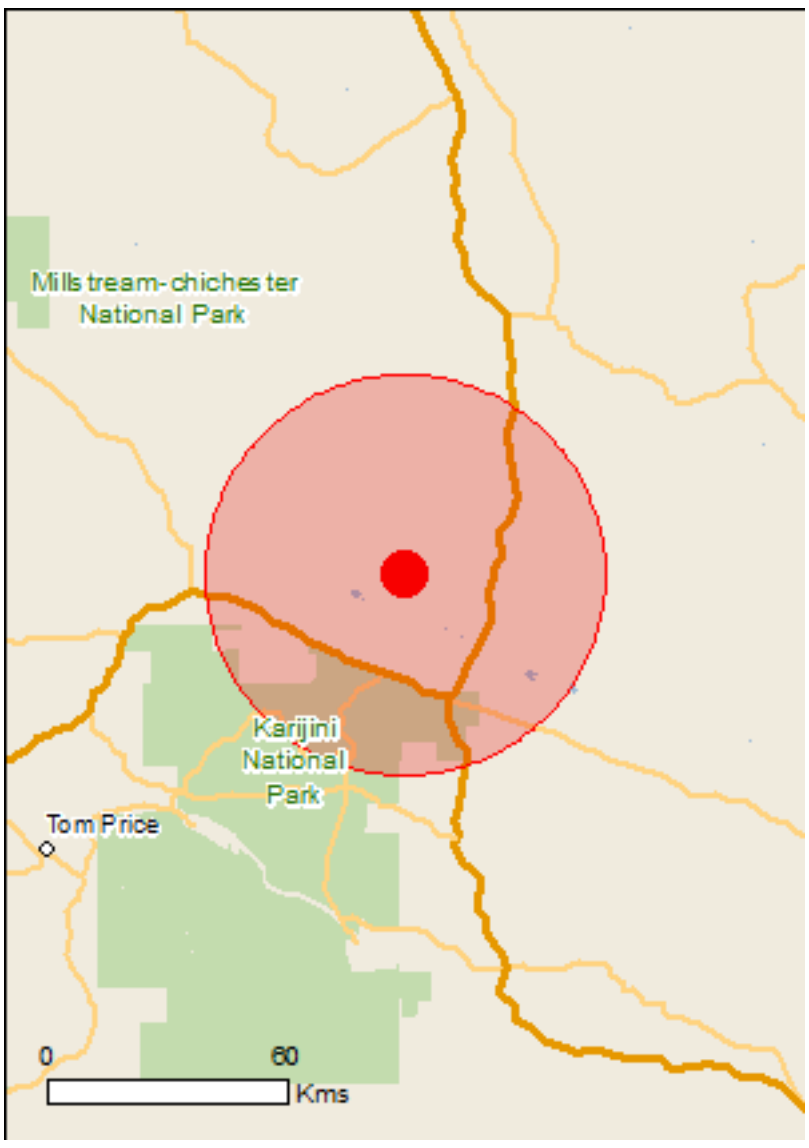
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 30/10/18 17:38:36

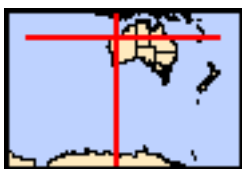
Summary
Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 50.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	8
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	9
Nationally Important Wetlands:	2
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Rostratula australis		
Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus		
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Liasis olivaceus barroni		
Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Karijini	WA
Mungaroona Range	WA

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Fortescue Marshes	WA
Karijini (Hamersley Range) Gorges	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-22.11935 118.59046

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX F PHASE 1 SITE BY SPECIES MATRIX

Phase 1 site by species matrix – Ground dwelling mammals

Family and species	Common name	Site																			
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	Opportunistic	Total
TACHYGLOSSIDAE																					
Tachyglossus aculeatus	Echidna																			x	x
DASYURIDAE																					
Dasykaluta rosamondae	Kaluta		1	4	6			5	1												17
Dasyurus hallucatus	Northern Quoll																			x	x
Ningaui timealeyi	Pilbara Ningaui		2	1					2												5
Sminthopsis macroura	Strip-faced Dunnart	1				1								2			1	2			7
MACROPODIDAE																					
Osphranter robustus	Euro																			x	**x**
Osphranter rufus	Red Kangaroo																			x	**x**
MURIDAE																					
Pseudomys desertor	Desert mouse				1			3													4
Zyzomys argurus	Common Rock Rat									1			2			4					7
FELIDAE																					
**Felis catus*	Cat																			x	x
BOVIDAE																					
**Bos taurus*	Cattle																			x	x
CANIDAE																					
**Canis familiaris*	Dog/Dingo																			x	x
**Vulpes vulpes*	Red Fox																			x	x
	Total number of records	**1**	**3**	**5**	**7**	**1**	**0**	**8**	**3**	**1**	**0**	**0**	**2**	**2**	**0**	**4**	**1**	**2**	**0**	**8**	**40**
	Total number of species	**1**	**2**	**2**	**2**	**1**	**0**	**2**	**2**	**1**	**0**	**0**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**8**	**13**

Phase 1 site by species matrix – Avifauna

Family and species	Common name	Site																					
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	BOS01	BOS02	BOS03	BOS04	Total
DROMAIIDAE																								
Dromaius novaehollandiae	Emu		1																					**1**
ANATIDAE																								
Stictonetta naevosa	Freckled Duck																			1				**1**
Malacorhynchus membranaceus	Pink-eared Duck																			27				**27**
Anas gracilis	Grey Teal																			45				**45**
ARDEIDAE																								
Ardea pacifica	White-necked Heron																			1				**1**

Family and species	Common name	Site																						
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	BOS01	BOS02	BOS03	BOS04	Total
Ardea modesta	Great Egret																			1				**1**
ACCIPITRIDAE																								
Hieraaetus morphnoides	Little Eagle							1																**1**
Aquila audax	Wedge-tailed Eagle																			1				**1**
Accipiter fasciatus	Brown Goshawk						1				1													**2**
Circus assimilis	Spotted Harrier				1															1				**2**
Milvus migrans	Black Kite																			15				**15**
Haliastur sphenurus	Whistling Kite			1		3	1													44				**49**
TURNICIDAE																								
Turnix velox	Little Button-quail		1																					**1**
RECURVIROSTRIDAE																								
Cladorhynchus leucocephalus	Black-winged Stilt																			73				**73**
Recurvirostra novaehollandiae	Red-necked Avocet																			4				**4**
CHARADRIIDAE																								
Erythrogonys cinctus	Red-kneed Dotterel																			18				**18**
Charadrius ruficapillus	Red-capped Plover																			58				**58**
Elseyornis melanops	Black-fronted Dotterel																			33				**33**
SCOLOPACIDAE																								
Tringa nebularia	Common Greenshank																			6				**6**
Tringa glareola	Wood Sandpiper																			2				**2**
Calidris ruficollis	Red-necked Stint																			8				**8**
COLUMBIDAE																								
Phaps chalcoptera	Common Bronzewing	1									1			2			4							**8**
Ocyphaps lophotes	Crested Pigeon	22		2		4	15				6	4			1		1			7				**62**
Geopelia cuneata	Diamond Dove	13					3					1												**17**
Geopelia striata	Peaceful Dove	6				3										1			1					**11**
CUCULIDAE																								
Chrysococcyx basalis	Horsfield's Bronze-cuckoo			1	1							1												**3**
Chrysococcyx osculans	Black-eared Cuckoo					1																		**1**
Cacomantis pallidus	Pallid Cuckoo													1										**1**
TYTONIDAE																								
Tyto javanica	Eastern Barn Owl						1																	**1**
MEROPIDAE																								
Merops ornatus	Rainbow Bee-eater	3				5		3			1		1	1	1				4	17		4		**40**
FALCONIDAE																								
Falco cenchroides	Nankeen Kestrel							1					1									1		**3**
Falco berigora	Brown Falcon		1	2					1			1		1						1	1			**8**
Falco subniger	Black Falcon																			1				**1**
CACATUIDAE																								

Family and species	Common name	Site																						
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	BOS01	BOS02	BOS03	BOS04	Total
Cacatua roseicapilla	Galah	5	5		14	8	9		2			9								22			8	**82**
Cacatua sanguinea	Little Corella													40									30	**70**
Nymphicus hollandicus	Cockatiel				4	1														8				**13**
PSITTACIDAE																								
Platycercus zonarius	Australian Ringneck	5																				5		**10**
Neophema bourkii	Bourke's Parrot	10		2																				**12**
Melopsittacus undulatus	Budgerigar																					23		**23**
PTILONORHYNCHIDAE																								
Ptilonorhynchus nuchalis	Great Bowerbird		1			1								1			2		1				1	**7**
CLIMACTERIDAE																								
Climacteris melanurus	Black-tailed Treecreeper	2				7	2														3			**14**
MALURIDAE																								
Malurus lamberti	Variegated Fairywren	3	3				4	3			2		9		3	2	1							**30**
Malurus leucopterus	White-winged Fairy-wren		3	11	5															3			7	**29**
Amytornis striatus whitei	Rufous Grasswren				2																			**2**
MELIPHAGIDAE																								
Lichmera indistincta	Brown Honeyeater								1							1								**2**
Epthianura tricolor	Crimson Chat	1				1			1											1				**4**
Epthianura aurifrons	Orange Chat																						2	**2**
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	2		4						6		2		2	2		1	4	1					**24**
Manorina flavigula	Yellow-throated Miner			6		1			1	1			1	2			4	1	1	3		3	1	**25**
Purnella albifrons	White-fronted Honeyeater																			10				**10**
Gavicalis virescens	Singing Honeyeater	1	4	4	1			5	11			10	4	4	4			4	2					**54**
Ptilotula keartlandi	Grey-headed Honeyeater												1			2								**3**
Ptilotula penicillata	White-plumed Honeyeater	72	4	3	3	12	5		2		4	2	2		4		4		7		8	5		**137**
PARDALOTIDAE																								
Pardalotus rubricatus	Red-browed Pardalote	1									1		2											**4**
ACANTHIZIDAE																								
Smicrornis brevirostris	Weebill						3								2				2					**7**
Acanthiza uropygialis	Chestnut-rumped Thornbill																4	6	2					**12**
Acanthiza robustirostris	Slaty-backed Thornbill										5						5	4	2					**16**
POMATOSTOMIDAE																								
Pomatostomus temporalis	Grey-crowned Babbler	6				13	5										1			5	5			**35**
Pomatostomus superciliosus	White-browed Babbler											4		2				2						**8**
ARTAMIDAE																								
Artamus cinereus	Black-faced Woodswallow	17		152	7	7	1		16										1			3		**204**
CRACTICIDAE																								
Cracticus nigrogularis	Pied Butcherbird	2					1			1				1			2							**7**
CAMPEPHAGIDAE																								

Family and species	Common name	Site																						
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	BOS01	BOS02	BOS03	BOS04	Total
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1		1			1						1			3					3	1		**11**
Lalage tricolor	White-winged Triller				1	1																		**2**
OREOICIDAE																								
Oreoica gutturalis	Crested Bellbird	6	2	1	2		2		2	2	4	5		3	3		4	4	2					**42**
PACHYCEPHALIDAE																								
Pachycephala rufiventris	Rufous Whistler	2					2		1			6		5	4			3	2					**25**
Colluricincla harmonica	Grey Shrike-thrush											1		1	2									**4**
RHIPIDURIDAE																								
Rhipidura leucophrys	Willie Wagtail	2		1			1			1	4		1	4		1	2	1	2	1				**21**
MONARCHIDAE																								
Grallina cyanoleuca	Magpie-lark	6				4	2										2			10	3			**27**
CORVIDAE																								
Corvus orru	Torresian Crow				2				1	2		1	1	2	1	1		1						**12**
Corvus bennetti	Little Crow	5	3		3	2				1				1	1			1		3			2	**22**
PETROICIDAE																								
Melanodryas cucullata	Hooded Robin										2													**2**
ALAUDIDAE																								
Mirafra javanica	Horsfield's Bushlark																			2			1	**3**
HIRUNDINIDAE																								
Petrochelidon nigricans	Tree Martin		2			17	2													2				**23**
ESTRILDIDAE																								
Taeniopygia guttata	Zebra Finch	54	2	16		3	4	2	5		12	4	2			2	6		5			12		**129**
	Total number of records	**248**	**32**	**207**	**46**	**94**	**65**	**15**	**44**	**14**	**43**	**51**	**26**	**73**	**28**	**13**	**43**	**31**	**35**	**434**	**23**	**57**	**52**	**1674**
	Total number of species	**25**	**13**	**15**	**13**	**19**	**20**	**6**	**12**	**7**	**12**	**14**	**12**	**17**	**12**	**8**	**15**	**11**	**15**	**33**	**6**	**9**	**8**	**74**

Phase 1 site by species matrix – Reptiles

Family and species	Common name	Site																			
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	Opportunistic	Total
CARPHODACTYLIDAE																					
Nephrurus wheeleri cinctus	Banded Knob-tail													1			3				**4**
DIPLODACTYLIDAE																					
Diplodactylus conspicillatus	Fat-tailed Diplodactylus		1		4																**5**
Diplodactylus laevis	Desert Fat-tailed Gecko		6	3	6		4														**19**
Diplodactylus pulcher	Fine-faced Gecko																2				**2**
Diplodactylus savagei	Savage's Gecko												1	1							**2**
Lucasium stenodactylum	Steindachner's Ground Gecko	1			3			2	1												**7**

Family and species	Common name	Site																			
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	Opportunistic	Total
Lucasium wombeyi	Pilbara Ground Gecko								3					4	2						**9**
GEKKONIDAE																					
Gehyra variegata	Tree Dtella			2		10								1			4	3	2		**22**
Gehyra punctata																				x	**x**
Heteronotia binoei	Bynoe's Pricky Gecko					1		2	2	2	3		1	1					1		**13**
PYGOPODIDAE																					
Delma desmosa															1						**1**
Delma nasuta	Sharp-snouted Delma							1	1												**2**
Lialis burtonis	Burton's legless lizard								1			2									**3**
Pygopus nigriceps	Western Hooded Scaly-foot											1					1				**2**
AGAMIDAE																					
Ctenophorus caudicinctus	Ring-tailed Dragon											3									**3**
Gowidon longirostris	Long-nosed Dragon																			x	**x**
SCINCIDAE																					
Carlia triacantha	Desert Rainbow-skink	2	5	4	4		2	3	2			7		6	2				2		**39**
Ctenotus grandis	Grand ctenotus											1	3		3						**7**
Ctenotus helenae	Clay-soil Ctenotus								1						1						**2**
Ctenotus pantherinus	Leopard Skink		7	8	3			9	7						1						**35**
Ctenotus saxatilis	Stony-soil Ctenotus							3	8	16	5	15	16	7	1	8			1		**80**
Ctenotus schomburgkii	Barred Wedgesnout Ctenotus		2		1																**3**
Cyclodomorphus melanops	Spinifex Slender Blue-tongue							1	1												**2**
Egernia cygnitos	Western Pilbara Spiny-tailed Skink									1	1										**2**
Eremiascincus richardsonii	Broad-banded Sand-swimmer	2				1															**3**
Menetia greyii	Common Dwarf Skink				1										1			1	2		**5**
Morethia ruficauda	Lined Firetail Skink		1						1					4							**6**
Proablepharus reginae	Western Soil-crevice Skink		1	1	2																**4**
Tiliqua multifasciata	Centralian Blue-tongued Lizard		1	2																	**3**
TYPHLOPIDAE																					
Anilios ganei	Gan's blind snake														2				2		**4**
Anilios grypus	Long-beaked Bind Snake		2					1	1												**4**
Anilios hamatus	Pale-headed Blind Snake	1			1							1		1				1			**5**
VARANIDAE																					
Varanus acanthurus	Ridge-tailed monitor									3	1				2						**6**
Varanus brevicauda	Pygmy monitor				1			1	1												**3**
Varanus eremius	Pygmy desert monitor		1		1																**2**
Varanus giganteus	Perentie																			x	**x**
Varanus panoptes	Yellow-spotted Monitor																			x	**x**
PYTHONIDAE																					

Family and species	Common name	Site																			
		MDS01	MDS02	MDS03	MDS04	MDS05	MDS06	MDS07	MDS08	MDS09	MDS10	MDS11	MDS12	MDS13	MDS14	MDS15	MDS16	MDS17	MDS18	Opportunistic	Total
Antaresia perthensis	Pygmy python									1											**1**
Antaresia stimsoni	Stimson's python							1													**1**
Aspidites melanocephalus	Black-headed Python																			x	**x**
Liasis olivaceus barroni	Olive Python (Pilbara subspecies)																			x	**x**
ELAPIDAE																					
Brachyurophis approximans	north-western Shovel-nosed Snake			1				3	1			1	3	2	1	1					**13**
Demansia psammophis cupreiceps	Yellow-faced Whipsnake			1									1								**2**
Pseudechis australis	Mulga Snake		1															1			**2**
Pseudonaja mengdeni	Gwardar											1									**1**
Pseudonaja modesta	Ringed Brown Snake																			x	**x**
	Total number of records	**6**	**28**	**22**	**27**	**12**	**6**	**27**	**31**	**23**	**10**	**32**	**25**	**28**	**17**	**9**	**10**	**6**	**10**	**x**	**329**
	Total number of species	**4**	**11**	**8**	**11**	**3**	**2**	**11**	**14**	**5**	**4**	**9**	**6**	**10**	**11**	**2**	**4**	**4**	**6**	**7**	**46**

APPENDIX G PHASE 2 SITE BY SPECIES MATRIX

Phase 2 site by species matrix – Bats

FAMILY and Species	Common name	Site																	
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	Total
EMBALLONURIDAE																				
Taphozous spp.			x			x						x			x		x			**5**
MOLOSSIDAE																				
Chaerephon jobensis	greater northern free-tailed bat	x	x	x		x	x			x		x	x		x		x	x	x	**12**
VESPERTILIONIDAE																				
Chalinolobus gouldii	Gould's wattled bat	x	x	x		x	x		x	x	x	x	x	x	x		x	x	x	**15**
Nyctophilus geoffroyi	lesser long-eared bat						x													**1**
Scotorepens greyii	little broad-nosed bat	x	x	x		x	x			x	x	x	x	x	x			x	x	**13**
Vespadelus finlaysoni	Finlayson's cave bat			x		x	x		x	x	x	x		x	x		x			**10**
Total number of species		**3**	**4**	**4**	**0**	**5**	**5**	**0**	**2**	**4**	**3**	**5**	**3**	**3**	**5**	**0**	**4**	**3**	**3**	**6**

Phase 2 site by species matrix – Ground dwelling mammals.

FAMILY and Species	Common Name	Site																			
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	Opportunistic	Grand Total
DASYURIDAE																					
Dasykaluta rosamondae	Kaluta	1	3							1							3	2			**10**
Ningaui timealeyi	Pilbara Ningaui					2					1					1	1				**5**
Sminthopsis macroura	Froggatt's Stripe-faced Dunnart			1																	**1**
MACROPODIDAE																					
Osphranter robustus	Euro																			x	**2**
Osphranter rufus	Red Kangaroo											2								x	**4**
MURIDAE																					
Pseudomys chapmani	Western Pebble-mound Mouse																			x	
Pseudomys desertor	Desert Mouse						1														**1**
Pseudomys hermannsburgensis	Sandy Inland Mouse											1									**1**
CANIDAE																					
Canis familiaris	Dingo/Dog							1												x	**3**
BOVIDAE																					
Bos taurus	European Cattle																			x	**8**
Total number of records		**1**	**3**	**1**	**0**	**2**	**1**	**1**	**0**	**1**	**1**	**3**	**0**	**0**	**0**	**1**	**4**	**2**	**0**	**27**	**48**
Total number of species		**1**	**1**	**1**	**0**	**1**	**1**	**1**	**0**	**1**	**1**	**2**	**0**	**0**	**0**	**1**	**2**	**1**	**0**	**5**	**10**

Phase 2 Site by species matrix – Avifauna

FAMILY and Species	Common Name	Site																																					
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	No site	Opp01	Opp02	Opp03	Opp04	Opp05	Opp06	Opp07	Opp08	Opp09	Opp10	Opp11	Opp12	Opp13	Opp14	Opp15	Total
DROMAIIDAE																																							
Dromaius novaehollandiae	Emu	1																		5									1								**7**
ANATIDAE																																							
Dendrocygna eytoni	Plumed Whistling Duck																						61															**61**
Malacorhynchus membranaceus	Pink-eared Duck																				2		11															**13**
Anas superciliosa	Pacific Black Duck																						12															**12**
Anas gracilis	Grey Teal																				14		35															**49**
PHASIANIDAE																																							
Coturnix ypsilophora	Brown Quail																															2						**2**
THRESKIORNITHIDAE																																							
Threskiornis spinicollis	Straw-necked Ibis																						51															**51**
Platalea flavipes	Yellow-billed Spoonbill																						5															**5**
ARDEIDAE																																							
Ardea pacifica	White-necked Heron																						4															**4**
Ardea modesta	Great Egret																						2															**2**
Ardea novaehollandiae	White-faced Heron																						3															**3**
ANHINGIDAE																																							
Anhinga novaehollandiae	Australasian Darter																						2															**2**
ACCIPITRIDAE																																							
Aquila audax	Wedge-tailed Eagle																			3																		**3**
Accipiter fasciatus	Brown Goshawk												1										1					1				1		1				**5**
Circus assimilis	Spotted Harrier																															1						**1**
Milvus migrans	Black Kite																			1																		**1**
Haliastur sphenurus	Whistling Kite											2									1	1	1									1	1		1			**8**
TURNICIDAE																																							
Turnix velox	Little Buttonquail										1																								1			**2**
CHARADRIIDAE																																							
Elseyornis melanops	Black-fronted Dotterel																						11															**11**
COLUMBIDAE																																							
Ocyphaps lophotes	Crested Pigeon	2			13		1				1	1	1				1				1	1	1			1						1	1		1		**27**
Geophaps plumifera	Spinifex Pigeon				5																												1				**6**
Geopelia cuneata	Diamond Dove		1		2	3				1	4	2		1							1	1	1					1			1		1	1			**21**

FAMILY and Species	Common Name	Site																																		
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	No site	Opp01	Opp02	Opp03	Opp04	Opp05	Opp06	Opp07	Opp08	Opp09	Opp10	Opp11	Opp12	Opp13	Opp14	Opp15	Total
Geopelia striata	Peaceful Dove											1									1	1	1	1							1	1				**7**
CUCULIDAE																																				
Chrysococcyx osculans	Black-eared Cuckoo																1																			**1**
CAPRIMULGIDAE																																				
Eurostopodus argus	Spotted Nightjar																			1							1									**2**
AEGOTHELIDAE																																				
Aegotheles cristatus	Australian Owlet-nightjar							1																							1					**2**
ALCEDINIDAE																																				
Dacelo leachii	Blue-winged Kookaburra																			2																**2**
Todiramphus sanctus	Sacred Kingfisher																				1		1									1				**3**
Todiramphus pyrrhopygius	Red-backed Kingfisher																							1							1					**2**
MEROPIDAE																																				
Merops ornatus	Rainbow Bee-eater										1			1							1		1			1					1					**6**
FALCONIDAE																																				
Falco berigora	Brown Falcon			2														2				1	1													**6**
CACATUIDAE																																				
Cacatua roseicapilla	Galah		4			2						4	23							2		1	1													**37**
Nymphicus hollandicus	Cockatiel	3		11	5	3						2									1	1									1	1		1		**29**
PSITTACIDAE																																				
Platycercus zonarius	Australian Ringneck					6																	1				1				1	1	1			**11**
Neophema bourkii	Bourke's Parrot	2																																		**2**
Melopsittacus undulatus	Budgerigar	1		11							1	5			4						1	1	1	1		1	1						1		**29**
PTILONORHYNCHIDAE																																				
Ptilonorhynchus maculatus	Western Bowerbird																															1				**1**
CLIMACTERIDAE																																				
Climacteris melanurus	Black-tailed Treecreeper											2	4									1	1	1									1			**10**
MALURIDAE																																				
Malurus lamberti	Variegated Fairywren	7			3	5	1		3		6				3				10	3		1				1		1	1			1	1		**47**
Malurus leucopterus	White-winged Fairywren	3	2																						1										**6**
MELIPHAGIDAE																																				
Lichmera indistincta	Brown Honeyeater				5	1	4																				1					1				**12**

FAMILY and Species	Common Name	Site																																			
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	No site	Opp01	Opp02	Opp03	Opp04	Opp05	Opp06	Opp07	Opp08	Opp09	Opp10	Opp11	Opp12	Opp13	Opp14	Opp15	Total
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			1	1	1	3	1		1																1									**9**
Manorina flavigula	Yellow-throated Miner																	2													1				**3**
Purnella albifrons	White-fronted Honeyeater				2		1			2																										**5**
Gavicalis virescens	Singing Honeyeater	1	1	3	2	2	3	1		1					2	1	4	1	3							1	1	1	1	1	1			1	1	**33**
Ptilotula keartlandi	Grey-headed Honeyeater				1									3		1												1								**6**
Ptilotula penicillata	White-plumed Honeyeater					8					2	5	3		1						1	1	1	1		1		1			1	1	1	1		**29**
PARDALOTIDAE																																					
Pardalotus rubricatus	Red-browed Pardalote				1		1			1									1									1					1			**6**
ACANTHIZIDAE																																					
Smicrornis brevirostris	Weebill														4			2		5											1		1			**13**
Acanthiza uropygialis	Chestnut-rumped Thornbill							3	4	3																1		1								**12**
Acanthiza robustirostris	Slaty-backed Thornbill																																		1	**1**
POMATOSTOMIDAE																																					
Pomatostomus temporalis	Grey-crowned Babbler											5																			1					**6**
Pomatostomus superciliosus	White-browed Babbler									3																1										**4**
PSOPHODIDAE																																					
Cinclosoma marginatum	Western Quail-thrush																									1										**1**
ARTAMIDAE																																					
Artamus personatus	Masked Woodswallow															25																				**25**
Artamus cinereus	Black-faced Woodswallow		5	5		1					2							4				1	1			1					1	1	1		**23**
CRACTICIDAE																																					
Cracticus torquatus	Grey Butcherbird					1		2	1										1																	**5**
Cracticus nigrogularis	Pied Butcherbird				2																										1					**3**
Cracticus tibicen	Australian Magpie																2																			**2**
CAMPEPHAGIDAE																																					
Coracina novaehollandiae	Black-faced Cuckoo-shrike					4						3	1										1			1					1					**11**
Lalage tricolor	White-winged Triller																					1												1		**2**
OREOICIDAE																																					
Oreoica gutturalis	Crested Bellbird	1		1	1	1	1			1	1	2	2	2		1	1			1	1	1	1				1	1						1		**22**

FAMILY and Species	Common Name	Site																																					
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	No site	Opp01	Opp02	Opp03	Opp04	Opp05	Opp06	Opp07	Opp08	Opp09	Opp10	Opp11	Opp12	Opp13	Opp14	Opp15	Total
PACHYCEPHALIDAE																																							
Pachycephala rufiventris	Rufous Whistler				1	2	2	1	2	2	1															1	1	1		1				1	**16**
Colluricincla harmonica	Grey Shrikethrush												2																							**2**
RHIPIDURIDAE																																							
Rhipidura leucophrys	Willie Wagtail				1	2			1		2				1		1		2		1		1			1	1	1		1	1	1	1	1		**20**
MONARCHIDAE																																							
Grallina cyanoleuca	Magpie-lark											2									1	1	1								1					**6**
CORVIDAE																																							
Corvus orru	Torresian Crow							1								1		1					1									1	1	1		**7**
PETROICIDAE																																							
Melanodryas cucullata	Hooded Robin																			2											1					**3**
Petroica goodenovii	Red-capped Robin																										1				1					**2**
ALAUDIDAE																																							
Mirafra javanica	Horsfield's Bushlark		3																						1											**4**
HIRUNDINIDAE																																							
Petrochelidon nigricans	Tree Martin											4	2										1												1		**8**
LOCUSTELLIDAE																																							
Poodytes carteri	Spinifexbird													1		1	2	1	2											1					1	**9**
Cincloramphus cruralis	Brown Songlark		1																																	**1**
Cincloramphus mathewsi	Rufous Songlark																				1		1									1				**3**
ESTRILDIDAE																																							
Emblema pictum	Painted Finch				4		1							1		4		4		1						1		1				1				**18**
Neochmia ruficauda	Star Finch																														2					**2**
Taeniopygia guttata	Zebra Finch	6	4			6	4	1		1	4	2	2		1			3		2	1	1	1		1						1	1	1	1		**44**
MOTACILLIDAE																																							
Anthus australis	Australian Pipit																			1											1		1			**3**
Total number of records		**27**	**21**	**34**	**49**	**48**	**22**	**11**	**11**	**16**	**26**	**42**	**41**	**9**	**16**	**34**	**12**	**20**	**19**	**29**	**30**	**16**	**219**	**5**	**3**	**9**	**12**	**12**	**5**	**4**	**15**	**25**	**15**	**18**	**5**	**880**
Total number of species		**10**	**8**	**7**	**16**	**16**	**11**	**8**	**5**	**10**	**12**	**15**	**10**	**6**	**7**	**7**	**7**	**9**	**6**	**13**	**16**	**16**	**33**	**5**	**3**	**9**	**12**	**12**	**5**	**4**	**15**	**23**	**15**	**18**	**5**	**78**

Phase2 site by species matrix – Reptiles

FAMILY and *Species*	Common Name	Site																			
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	Opportunistic	Total
CHELIDAE																					
Chelidonia steindacherii	Steindachner's Turtle																			1	**1**
CARPHODACTYLIDAE																					
Nephrurus cinctus	Northern Banded Knob-tailed Gecko		1																		**1**
DIPLODACTYLIDAE																					
Diplodactylus galaxias	Northern Pilbara Beak-faced Gecko					1								5				1	1		**8**
Diplodactylus laevis	Desert Fat-tailed Gecko	15	4																		**19**
Diplodactylus pulcher									1												**1**
Lucasium wombeyi		1	3		3												1				**8**
Oedura fimbria	Western Marbled Velvet Gecko																			1	**1**
Rhynchoedura ornata	Western Beaked Gecko	1		1									1								**3**
GEKKONIDAE																					
Gehyra macra	Large Pilbara rock gehyra																			1	**1**
Gehyra micra	Small Pilbara spotted rock gehyra													2	2						**4**
Gehyra variegata	Variegated gehyra					5		1	3		8	6	6								**29**
Heteronotia binoei	Bynoe's Gecko		1			4	10			1				1	1	1	3	6			**28**
Heteronotia spelea	Pilbara Cave Gecko																			1	**1**
PYGOPODIDAE																					
Delma tincta										1											**1**
Lialis burtonis	Burton's Snake-lizard	1	1		1	1													1		**5**
Pygopus nigriceps	Western Hooded Scaly-foot						1			1								1			**3**
AGAMIDAE																					
Ctenophorus caudicinctus	Western Ring-tailed Dragon						1												2	x	**5**
Ctenophorus isolepis	Yellowy Military Dragon		2																		**2**
Gowidon longirostris	Long-nosed Dragon				3																**3**
Pogona minor																				1	**1**
SCINCIDAE																					
Carlia munda			2			1		1	1		1						3		1		**10**
Carlia triacantha		2	4								1										**7**
Cryptoblepharus buchananii											1										**1**
Ctenotus grandis				1	3		1			1							1	1	2		**10**
Ctenotus hanloni			1																		**1**
Ctenotus helenae		2															1				**3**
Ctenotus pantherinus	Leopard Ctenotus	10	4	3		2				2							5	1	3		**30**
Ctenotus saxatilis	Rock Ctenotus	2	4		23	8	13							11	8	10	11	5	13		**108**
Ctenotus schomburgkii		1	2																		**3**
Cyclodomorphus melanops	Spinifex Slender Blue-tongue						1										1	1			**3**
Egernia formosa					1																**1**
Eremiascincus richardsonii	Broad-banded Sand Swimmer										2										**2**
Lerista jacksoni						1														1	**2**
Lerista muelleri													2								**2**
Menetia greyii						2					3		3							1	**9**
Morethia ruficauda					1											1					**2**

FAMILY and *Species*	Common Name	Site																				
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	Opportunistic	Total
Tiliqua multifasciata	Central Blue-tongue																			1	**1**
VARANIDAE																					
Varanus acanthurus	Spiny-tailed Monitor				2	1			1	1				2	3						**10**
Varanus brevicauda	Short-tailed Pygmy Monitor			1													1		1		**3**
Varanus giganteus	Perentie																			x	**3**
Varanus hamersleyensis	Southern Pilbara Rock Goanna																			x	
Varanus panoptes	Yellow-spotted Monitor																			x	**1**
Varanus tristis	Black-headed Monitor								1						1						**2**
TYPHLOPIDAE																					
Anilios ammodytes	Pilbara Blind Snake									1							1				**2**
Anilios ganei	Gane's Blind Snake																	1			**1**
Anilios grypus	Northern Beaked Blind Snake		2																1		**3**
Anilios pilbarensis	Pilbara Hook-snouted Blind Snake	1																			**1**
PYTHONIDAE																					
Antaresia perthensis	Pygmy Python																			1	**1**
Aspidites melanocephalus	Black-headed Python																			1	**1**
ELAPIDAE																					
Acanthophis wellsi	Pilbara Death Adder																			1	**1**
Demansia psammophis	Yellow-faced Whipsnake	1	1		3																**5**
Parasuta monachus	Monk Snake		3		1				1		1										**6**
Pseudechis australis	Mulga Snake											1									**1**
Pseudonaja mengdeni	Western Brown Snake	1			2		2												1		**6**
Pseudonaja modesta	Ringed Brown Snake						1													1	**2**
Suta fasciata	Rosen's Snake			1																	**1**
Vermicella snelli	Pilbara Bandy Bandy									1											**1**
Total number of records		**39**	**35**	**7**	**43**	**26**	**30**	**2**	**8**	**9**	**17**	**7**	**12**	**21**	**15**	**12**	**28**	**17**	**26**	**18**	**381**
Total number of species		**13**	**15**	**5**	**11**	**10**	**8**	**2**	**6**	**8**	**7**	**2**	**4**	**5**	**5**	**3**	**10**	**8**	**10**	**15**	**56**

Phase 2 site by species matrix – Amphibians

FAMILY and Species	Common Name	Site																			
		MDPT001	MDPT002	MDPT003	MDPT004	MDPT005	MDPT006	MDPT007	MDPT008	MDPT009	MDPT010	MDPT011	MDPT012	MDPT013	MDPT014	MDPT015	MDPT016	MDPT017	MDPT018	Opportunistic	Total
PELODRYADIDAE																					
Litoria rubella	Little Red Tree Frog						1														**1**
Cyclorana maini	Sheep Frog				2																**2**
Total number of records		**0**	**0**	**0**	**2**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**
Total number of species		**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**

APPENDIX H REGIONAL FAUNA RECORDS

Mammals

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Van Dyck and Strahan (2008)	Cloudbreak (Bamford Consulting 2005)	Kurrajura -Cowra (*ecologia* 2007)	Solomon Rail (Coffey Environments 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Rail (Coffey Environments 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
TACHYGLOSSIDAE																	
Tachyglossus aculeatus	Echidna					x	x	x					x			x	x
DASYURIDAE																	
Dasycercus blythi	Brush-tailed Mulgara	P4				x	x							x			
Dasykaluta rosamondae	Kaluta			x		x	x	x	x	x	x		x	x		x	x
Dasyurus hallucatus	Northern Quoll	EN	EN	x	x	x	x			x			x	x	x	x	
Ningaui ridei	Wongai Ningaui					x											
Ningaui timealeyi	Pilbara Ningaui			x		x	x	x		x	x		x		x	x	x
Planigale sp.	Pilbara Planigale sp. (undescribed)			x				x		x	x		x		x		
Pseudantechinus macdonnellensis	Fat-Tailed Pseudantechinus					x											
Pseudantechinus woolleyae	Woolley's Pseudantechinus					x	x										x
Sminthopsis longicaudata	Long-Tailed Dunnart	P4				x											
Sminthopsis macroura	Froggatt's Stripe-faced Dunnart			x		x	x	x		x	x		x		x	x	x
Sminthopsis ooldea	Ooldea Dunnart					x	x										
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					x	x										
THYLACOMIDAE																	
Macrotis lagotis	Greater Bilby	VU	VU	x	x	x		x									
PHALANGERIDAE																	
Trichosurus vulpecula	Common Brushtail Possum			x		x							x				
MACROPODIDAE																	
Osphranter robustus	Euro			x		x	x	x	x		x		x			x	x
Osphranter rufus	Red Kangaroo			x		x	x	x	x			x				x	x
Petrogale rothschildi	Rothschild's Rock-wallaby			x		x	x		x								
Lagorchestes conspicillatus eichardti	Spectacled Hare-Wallaby	P4				x											
EMBALLONURIDAE																	
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat			x		x	x		x	x	x		x		x	x	
Taphozous georgianus	Common Sheath-tailed Bat			x		x	x		x	x	x		x		x	P?	P?
Taphozous hilli	Hill's Sheath-tailed Bat			x		x	x									P?	P?
MEGADERMATIDAE																	
Macroderma gigas	Ghost Bat	VU	VU	x	x	x	x		P?		x					x	x
MOLOSSIDAE																	

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Van Dyck and Strahan (2008)	Cloudbreak (Bamford Consulting 2005)	Kurrajura -Cowra (*ecologia* 2007)	Solomon Rail (Coffey Environments 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Rail (Coffey Environments 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
Austronomus australis	White-striped Free-tailed Bat					x	x	x									
Chaerephon jobensis	Northern Freetail Bat			x		x	x	x	x	x	x				x	x	x
Ozimops lumsdenae	Northern Free-Tailed Bat					x											
HIPPOSIDERIDAE																	
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU			x	x	x									x	
VESPERTILIONIDAE																	
Chalinolobus gouldii	Gould's Wattled Bat			x		x	x	x	x	x	x		x		x	x	x
Nyctophilus geoffroyi	Lesser Long-eared Bat			x		x	x	x		P?						x	x
Scotorepens greyii	Little Broad-nosed Bat			x		x	x	x	x	x	x		x		x	x	x
Vespadelus finlaysoni	Finlayson's Cave Bat			x		x	x	x	x	x	x		x		x	x	x
MURIDAE																	
Leggadina lakedownensis	Northern Short-tailed Mouse	P4		x	x	x	x				x						
**Mus musculus*	House Mouse			x		x	x	x		x					x		
Notomys alexis	Spinifex Hopping-mouse						x		x		x						
Pseudomys chapmani	Western Pebble-mound Mouse	P4		x	x	x	x	x			x						x
Pseudomys delicatulus	Delicate Mouse			x		x	x										
Pseudomys desertor	Desert Mouse			x		x	x	x		x	x	x		x	x		x
Pseudomys hermannsburgensis	Sandy Inland Mouse			x		x	x			x	x	x			x	x	x
Zyzomys argurus	Common Rock Rat			x		x	x	x		x	x	x			x	x	x
PTEROPODIDAE																	
Pteropus alecto	Black Flying-Fox			x		x											
Pteropus poliocephalus	Grey-Headed Flying-Fox					x											
LEPORIDAE																	
**Oryctolagus cuniculus*	Rabbit						x		x		x						
EQUIDAE																	
**Equus asinus*	Donkey					x	x	x									
**Equus caballus*	Horse						x	x									
CAMELIDAE																	
**Camelus dromedarius*	Camel			x			x	x									
FELIDAE																	
**Felis catus*	Cat			x		x	x	x	x		x		x	x		x	x
BOVIDAE																	

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Van Dyck and Strahan (2008)	Cloudbreak (Bamford Consulting 2005)	Kurrajura -Cowra (*ecologia* 2007)	Solomon Rail (Coffey Environments 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Rail (Coffey Environments 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
**Bos taurus*	Cattle			x			x				x			x		x	x
CANIDAE																	
**Canis familiaris*	Dog/Dingo					x	x	x			x	x		x		x	x
**Vulpes vulpes*	Red Fox															x	
Total number of species				**30**	**6**	**42**	**38**	**23**	**14**	**16**	**22**	**5**	**14**	**7**	**14**	**23**	**22**

Reptiles

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Cogger (2018)	Cloudbreak (Bamford Consulting 2005)	Kurrajura-Cowra (*ecologia* 2007)	Solomon Mine (Coffey 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Mine (Coffey 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
CHELUIDAE																	
Chelodina steindachneri	Steindachner's Turtle					x	x	x									x
DIPLODACTYLIDAE																	
Nephrurus levis	Smooth Knob-tailed Gecko					x	x										
Nephrurus cinctus (formerly *Nephrurus wheeleri*)	Banded Knob-tailed Gecko			x		x	x			x	x	x	x		x	x	x
Underwoodisaurus milii	Southern Barking Gecko												x				
Underwoodisaurus seorsus	Pilbara Barking Gecko	P2				x											
Crenadactylus ocellatus	Clawless gecko					x	x										
Crenadactylus pilbarensis	Pilbara Clawless Gecko					x											
Diplodactylus bilybara	Western Fat-Tailed Gecko					x											
Diplodactylus conspicillatus	Fat-tailed Gecko			x		x	x	x		x					x	x	
Diplodactylus galaxias				x		x											x
Diplodactylus laevis						x										x	x
Diplodactylus mitchelli				x		x	x										
Diplodactylus pulcher				x											x	x	x
Diplodactylus savagei				x		x	x			x	x		x		x	x	
Lucasium stenodactylum	Sand-plain Gecko			x		x	x		x		x	x			x	x	
Lucasium wombeyi				x		x	x			x	x		x		x	x	x
Oedura fimbria	Marbled Velvet Gecko			x		x	x				x		x				x
Rhynchoedura ornata	Beaked Gecko			x		x	x		x		x				x		x
Strophurus assimilis				x													
Strophurus elderi	Jewelled Gecko					x	x			x	x						
Strophurus jeanae				x		x	x			x							
Strophurus ciliaris						x											
Strophurus strophurus	Western Spiny-tailed Gecko						x										
Strophurus wellingtonae				x		x	x		x	x	x	x	x				
GEKKONIDAE																	
Gehyra crypta	Western Cryptic Gehyra					x											
Gehyra incognita	Northern Pilbara Cryptic Gehyra					x											
Gehyra pilbara				x		x	x			x							
Gehyra punctata				x		x	x			x	x	x	x			x	

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Cogger (2018)	Cloudbreak (Bamford Consulting 2005)	Kurrajura-Cowra (*ecologia* 2007)	Solomon Mine (Coffey 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Mine (Coffey 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
Gehyra macra																	x
Gehyra micra						x											x
Gehyra montium	Centralian Dtella					x											
Gehyra variegata	Variegated gehyra			x		x	x	x	x	x	x	x	x		x	x	x
Heteronotia binoei	Bynoe's Gecko			x		x	x	x		x	x	x	x		x	x	x
Heteronotia spelea	Desert Cave Gecko					x	x	x			x						x
PYGOPODIDAE																	
Delma butleri				x		x	x										
Delma elegans						x	x			x	x						
Delma desmosa							x									x	
Delma nasuta	Long-nosed Delma			x		x	x			x	x		x			x	
Delma pax				x		x	x			x	x		x				
Delma tincta				x		x	x				x						x
Lialis burtonis	Burton's Snake-lizard			x		x	x	x		x	x	x	x			x	x
Pygopus nigriceps	Western Hooded Scaly-foot			x		x	x			x	x	x	x			x	x
AGAMIDAE																	
Diporiphora amphiboluroides	Mulga Dragon			x		x	x				x						
Diporiphora valens	Southern Pilbara Tree Dragon					x											
Diporiphora vescus	Northern Pilbara Tree Dragon					x											
Ctenophorus caudicinctus	Western Ring-tailed Dragon			x		x	x	x	x	x	x	x	x		x	x	x
Ctenophorus isolepis	Yellowy Military Dragon			x		x	x		x	x	x				x		x
Ctenophorus nuchalis	Central Netted Dragon			x		x	x	x			x						
Ctenophorus reticulatus	Western Netted Dragon			x		x	x	x			x				x		
Gowidon longirostris	Long-nosed Dragon			x		x	x	x		x	x	x	x		x	x	x
Pogona minor	Western Bearded Dragon			x		x	x			x	x	x	x		x		x
Tympanocryptis cephalus	Coastal Pebble-mimic Dragon			x		x	x				x						
Tympanocryptis fortescuensis	Fortescue pebble-mimic dragon					x											
SCINCIDAE																	
Carlia munda				x		x	x	x		x	x		x		x		x
Carlia triacantha				x		x	x			x			x			x	x
Cryptoblepharus buchananii				x		x	x								x		x
Cryptoblepharus ustulatus				x		x	x	x			x		x				

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
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Ctenotus ariadnae	Ariadna's Ctenotus					x											
Ctenotus duricola				x		x	x			x	x		x				
Ctenotus grandis				x		x	x			x	x					x	x
Ctenotus hanloni				x													x
Ctenotus helenae				x		x	x			x	x	x	x		x	x	x
Ctenotus inornatus	Bar-Shouldered Ctenotus					x											
Ctenotus leonhardii				x		x	x			x							
Ctenotus nigrilineatus	Pin-striped finesnout Ctenotus	P1			x	x											
Ctenotus pantherinus	Leopard Ctenotus			x		x	x	x		x	x		x		x	x	x
Ctenotus robustus				x		x											
Ctenotus rubicundus				x		x	x	x			x		x				
Ctenotus rutilans				x		x				x							
Ctenotus saxatilis	Rock Ctenotus			x			x	x		x	x	x	x		x	x	x
Ctenotus schomburgkii						x	x									x	x
Ctenotus serventyi						x	x										
Ctenotus uber				x	x	x	x		x		x						
Cyclodomorphus melanops	Spinifex Slender Blue-tongue			x		x	x	x		x	x	x	x			x	x
Egernia cygnitos						x	x									x	
Egernia depressa	Pygmy Spiny-tailed Skink			x			x					x					
Egernia epsisolus	Eastern Pilbara Spiny-tailed Skink					x											
Egernia formosa				x		x	x			x							x
Eremiascincus musivus	Mosaic Desert Skink					x											
Egernia pilbarensis						x	x										
Eremiascincus pallidus	Western Narrow-banded Skink					x	x			x							
Eremiascincus richardsonii	Broad-banded Sand Swimmer			x		x	x									x	x
Eremiascincus rubiginosus	Rusty Skink					x											
Lerista bipes						x	x										
Lerista chalybura (Lerista zietzi)				x		x	x			x			x				
Lerista flammicauda				x		x	x										
Lerista jacksoni				x		x	x						x				x
Lerista labialis	Southern Sandslider					x											
Lerista muelleri				x		x	x	x			x				x		x

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
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Lerista timida						x											
Lerista verhmens				x		x				x							
Liopholis striata	Night Skink					x											
Menetia greyii				x		x	x	x		x	x	x	x			x	x
Menetia surda				x		x	x										
Morethia ruficauda				x		x	x	x		x	x		x			x	x
Notoscincus butleri		P4					x			x							
Notoscincus ornatus				x		x	x										
Proablepharus reginae				x		x	x			x	x					x	
Tiliqua multifasciata	Centralian Blue-tongue			x		x	x	x		x	x		x		x	x	x
VARANIDAE																	
Varanus acanthurus	Spiny-tailed Monitor			x		x	x	x		x	x	x	x		x	x	x
Varanus brevicauda	Short-tailed Pygmy Monitor			x		x	x	x		x					x	x	x
Varanus bushi	Pilbara Mulga Goanna			x		x	x			x	x		x		x		
Varanus caudolineatus	Stripe-tailed Monitor			x		x	x	x			x		x				
Varanus eremius	Pygmy Desert Monitor			x		x	x			x	x					x	
Varanus giganteus	Perentie			x		x	x						x			x	x
Varanus hamersleyensis	Southern Pilbara Rock Goanna					x											x
Varanus gouldii	Gould's Goanna			x		x	x										
Varanus panoptes	Yellow-spotted Monitor			x		x	x	x		x	x		x	x		x	x
Varanus pilbarensis	Pilbara Rock Monitor			x		x	x										
Varanus tristis	Black-headed Monitor			x		x	x	x		x	x		x		x		x
TYPHLOPIDAE																	
Anilios ammodytes						x	x	x		x	x				x		x
Anilios ganei	Beaked Blind Snake	P1			x	x						x				x	x
Anilios grypus						x	x	x		x	x		x			x	x
Anilios hamatus						x	x									x	
Anilios pilbarensis	Pilbara Blind Snake					x	x			x		x	x				x
BOIDAE																	
Antaresia perthensis	Pygmy Python			x		x	x					x	x			x	x
Antaresia stimsoni	Stimson's Python			x		x	x			x	x		x			x	
Aspidites melanocephalus	Black-headed Python			x		x	x				x					x	x

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
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Liasis olivaceus barroni	Olive Python (Pilbara subspecies)	VU	VU	x	x	x	x						x			x	
ELAPIDAE																	
Acanthophis wellsi	Pilbara Death Adder			x		x	x				x	x	x				x
Brachyurophis approximans	North-western Shovel-nosed Snake			x		x	x			x	x	x	x		x	x	
Brachyurophis fasciolatus						x											
Demansia psammophis	Yellow-faced Whipsnake			x		x	x			x	x		x		x	x	x
Demansia rufescens	Rufous Whipsnake			x		x	x			x	x		x				
Furina ornata	Moon Snake			x		x	x			x		x	x		x		
Parasuta monachus	Monk Snake			x		x	x			x		x					x
Pseudechis australis	Mulga Snake			x		x	x			x	x	x	x		x	x	x
Pseudonaja mengdeni	Gwardar			x		x	x						x		x	x	x
Pseudonaja modesta	Ringed Brown Snake			x		x	x			x	x				x	x	x
Pseudonaja nuchalis				x			x			x	x	x					
Simoselaps bertholdi	Jan's Banded Snake					x											
Suta fasciata	Rosen's Snake			x		x	x			x		x					x
Suta punctata	Little Spotted Snake			x		x	x										
Vermicella snelli	Pilbara Band Bandy			x		x	x					x					x
Total number of species				**88**	**4**	**123**	**100**	**27**	**7**	**58**	**58**	**28**	**48**	**1**	**32**	**46**	**57**

Birds

FAMILY and Species	Common Name	Conservation Status		Database Searches				Reference text	Previous surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Birdata	Johnstone and Storr (1998, 2004)	Cloudbreak (Bamford Consulting 2005)	Kurrajura-Cowra (ecologia 2007)	Solomon Rail (Coffey Environments 2008)	Chichester Deviation (ecologia 2008b)	Roy Hill (ecologia 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Rail (Coffey Environments 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
DROMAIIDAE																		
Dromaius novaehollandiae	Emu			x		x	x	x	x		x	x			x	x	x	
ANATIDAE																		
Dendrocygna eytoni	Plumed Whistling Duck			x		x										x		x
Dendrocygna arcuata	Wandering Whistling Duck					x												
Cygnus atratus	Black Swan			x		x	x	x	x									
Stictonetta naevosa	Freckled Duck			x		x	x										x	
Tadorna tadornoides	Australian Shelduck			x		x	x		x									
Malacorhynchus membranaceus	Pink-eared Duck			x		x	x	x	x								x	x
Chenonetta jubata	Australian Wood Duck			x		x	x											
Anas superciliosa	Pacific Black Duck			x		x	x	x	x		x	x						x
Anas rhynchotis	Australasian Shoveler			x														
Anas gracilis	Grey Teal			x		x	x		x							x	x	x
Aythya australis	Hardhead			x		x	x	x										
PHASIANIDAE																		
Coturnix pectoralis	Stubble Quail			x		x					x			x				
Coturnix ypsilophora	Brown Quail			x		x		x	x		x	x		x		x		x
PODICIPEDIDAE																		
Tachybaptus novaehollandiae	Australasian Grebe			x		x	x	x				x						
Poliocephalus poliocephalus	Hoary-headed Grebe			x		x												
CICONIIDAE																		
Ephippiorhynchus asiaticus	Black-necked Stork			x		x	x	x										
THRESKIORNITHIDAE																		
Threskiornis moluccus	Australian White Ibis					x												
Threskiornis spinicollis	Straw-necked Ibis			x		x	x	x	x								x	x
Plegadis falcinellus	Glossy Ibis	IA	MI	x	x	x												
Platalea regia	Royal Spoonbill			x		x	x	x									x	
Platalea flavipes	Yellow-billed Spoonbill			x		x	x	x										x
ARDEIDAE																		
Ixobrychus flavicollis	Black Bittern			x		x												
Nycticorax caledonicus	Nankeen Night Heron			x		x	x	x										

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Ardea pacifica	White-necked Heron			x		x	x	x	x								x	x
Ardea modesta	Great Egret			x		x											x	x
Ardea novaehollandiae	White-faced Heron			x		x	x	x	x			x	x			x		x
Ardea garzetta	Little Egret			x		x	x	x										
PELECANIDAE																		
Pelecanus conspicillatus	Australian Pelican			x		x	x	x										
PHALACROCORACIDAE																		
Phalacrocorax melanoleucos	Little Pied Cormorant			x		x	x	x			x			x				
Phalacrocorax sulcirostris	Little Black Cormorant			x		x	x	x										
Phalacrocorax varius	Pied Cormorant			x		x												
Phalacrocorax carbo	Great Cormorant			x		x	x	x										
ANHINGIDAE																		
Anhinga novaehollandiae	Australasian Darter			x		x	x											x
PANDIONIDAE																		
Pandion haliaetus	Osprey				x	x												
ACCIPITRIDAE																		
Elanus caeruleus	Black-shouldered Kite			x		x	x			x	x	x				x		
Elanus scriptus	Letter-winged Kite	P4		x	x	x												
Hamirostra isura	Square-tailed Kite			x		x	x					x				x		
Hamirostra melanosternon	Black-breasted Buzzard			x		x		x		x								
Hieraaetus morphnoides	Little Eagle			x		x	x	x	x			x					x	
Aquila audax	Wedge-tailed Eagle			x		x	x	x	x	x		x				x	x	x
Accipiter fasciatus	Brown Goshawk			x		x	x	x		x	x	x		x		x	x	x
Accipiter cirrocephalus	Collared Sparrowhawk			x		x		x	x		x			x				
Circus approximans	Swamp Harrier			x		x	x	x										
Circus assimilis	Spotted Harrier			x		x	x	x	x			x				x	x	x
Milvus migrans	Black Kite			x		x	x	x	x	x						x	x	x
Haliastur sphenurus	Whistling Kite			x		x	x	x	x	x	x	x				x	x	x
Haliaeetus leucogaster	White-bellied Sea-Eagle			x		x	x	x										
OTIDIDAE																		
Ardeotis australis	Australian Bustard			x	x	x	x	x	x	x		x	x			x	x	
RALLIDAE																		

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Gallirallus philippensis	Buff-banded Rail			x		x												
Porzana tabuensis	Spotless Crake			x		x						x						
Porphyrio porphyrio	Purple Swamphen			x		x												
Tribonyx ventralis	Black-tailed Native-hen			x		x	x		x							x		
Fulica atra	Eurasian Coot			x		x	x	x										
TURNICIDAE																		
Turnix velox	Little Button-quail			x		x	x	x	x	x	x	x		x	x	x	x	x
BURHINIDAE																		
Burhinus grallarius	Bush Stone-curlew			x	x	x	x	x				x		x		x		
RECURVIROSTRIDAE																		
Haematopus longirostris	Pied Oystercatcher					x												
Himantopus himantopus	Black-winged Stilt			x		x		x									x	
Recurvirostra novaehollandiae	Red-necked Avocet					x											x	
CHARADRIIDAE																		
Vanellus tricolor	Banded Lapwing					x												
Vanellus miles	Masked Lapwing			x		x												
Erythrogonys cinctus	Red-kneed Dotterel			x		x	x	x	x								x	
Charadrius ruficapillus	Red-capped Plover			x		x											x	
Charadrius veredus	Oriental Plover	IA	MI			x												
Elseyornis melanops	Black-fronted Dotterel			x		x	x	x	x			x					x	x
SCOLOPACIDAE																		
Tringa nstagnatilis	Marsh Sandpiper					x												
Tringa nebularia	Common Greenshank	IA	MI			x											x	
Tringa glareola	Wood Sandpiper	IA	MI			x		x				x					x	
Actitis hypoleucos	Common Sandpiper	IA	MI			x												
Calidris ruficollis	Red-necked Stint	IA	MI			x											x	
Calidris acuminata	Sharp-tailed Sandpiper	IA	MI			x												
GLAREOLIDAE																		
Glareola maldivarum	Oriental Pratincole	IA	MI			x												
LARIDAE																		
Sterna nilotica	Gull-billed Tern			x		x		x										
Sterna caspia	Casapian Tern					x												

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Sterna albifrons	Little Tern					x		x										
Sterna hybrida	Whiskered Tern			x		x		x										
COLUMBIDAE																		
Phaps chalcoptera	Common Bronzewing			x		x	x	x	x		x	x	x	x		x	x	
Phaps histrionica	Flock Bronzewing					x												
Ocyphaps lophotes	Crested Pigeon			x		x	x	x	x	x	x	x	x	x		x	x	x
Geophaps plumifera	Spinifex Pigeon			x		x	x	x		x	x	x		x			x	x
Geopelia cuneata	Diamond Dove			x		x	x	x	x	x	x	x	x	x		x	x	x
Geopelia striata	Peaceful Dove			x		x		x			x	x		x		x	x	x
CUCULIDAE																		
Centropus phasianinus	Pheasant Coucal			x		x	x				x	x		x				
Chrysococcyx basalis	Horsfield's Bronze Cuckoo			x		x	x	x	x		x	x	x	x			x	
Chrysococcyx osculans	Black-eared Cuckoo					x											x	x
Cacomantis pallidus	Pallid Cuckoo			x		x		x	x		x	x		x			x	
TYTONIDAE																		
Tyto javanica	Easter Barn Owl					x		x	x			x				x	x	
STRIGIDAE																		
Ninox connivens	Barking Owl					x		x										
Ninox boobook	Southern Boobook					x		x	x			x		x		x	x	
PODARGIDAE																		
Podargus strigoides	Tawny Frogmouth			x		x	x	x	x			x		x		x		
EUROSTOPODIDAE																		
Eurostopodus argus	Spotted Nightjar			x		x	x	x	x			x	x	x		x		x
AEGOTHELIDAE																		
Aegotheles cristatus	Australian Owlet-nightjar			x		x	x	x	x			x	x	x		x	x	x
APODIDAE																		
Apus pacificus	Fork-tailed Swift	IA	MI	x		x		x				x						
HALCYONIDAE																		
Dacelo leachii	Blue-winged Kookaburra			x		x	x	x	x		x	x		x				x
Todiramphus sanctus	Sacred Kingfisher			x		x	x	x			x	x		x		x		x
Todiramphus pyrrhopygius	Red-backed Kingfisher			x		x		x	x			x		x		x	x	x
MEROPIDAE																		

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Merops ornatus	Rainbow Bee-eater			x		x	x	x	x		x	x	x	x			x	x
FALCONIDAE																		
Falco cenchroides	Nankeen Kestrel			x		x	x	x	x	x	x	x	x	x		x	x	
Falco longipennis	Australian Hobby			x		x	x	x	x							x		
Falco berigora	Brown Falcon			x		x	x	x	x	x	x	x	x	x		x	x	x
Falco hypoleucos	Grey Falcon	VU		x	x	x		x	x			x				x	x	
Falco subniger	Black Falcon							x									x	
Falco peregrinus	Peregrine Falcon	OS		x	x	x	x	x	x									
CACATUIDAE																		
Cacatua roseicapilla	Galah			x		x		x	x	x		x		x		x	x	x
Cacatua sanguinea	Little Corella			x		x	x	x	x	x	x	x		x			x	
Nymphicus hollandicus	Cockatiel			x		x	x	x	x	x	x	x		x		x	x	x
PSITTACIDAE																		
Platycercus zonarius	Australian Ringneck			x		x	x	x	x	x	x	x	x	x		x	x	x
Platycercus varius	Mulga Parrot			x		x												
Neophema bourkii	Bourke's Parrot			x		x	x	x	x							x	x	x
Neophema elegans	Elegant Parrot					x		x										
Melopsittacus undulatus	Budgerigar			x		x	x	x	x	x	x	x	x	x		x	x	x
Pezoporus occidentalis	Night Parrot	CR	EN					x	x									
PTILONORHYNCHIDAE																		
Ptilonorhynchus maculatus	Western Bowerbird			x		x	x	x		x	x	x		x		x	x	x
CLIMACTERIDAE																		
Climacteris affinis	White-browed Treecreeper			x														
Climacteris melanurus	Black-tailed Treecreeper			x		x		x			x							x
MALURIDAE																		
Malurus lamberti	Variegated Fairy-wren			x		x	x	x	x	x	x	x	x	x		x	x	x
Malurus splendens	Splendid Fairy-wren			x		x												
Malurus leucopterus	White-winged Fairy-wren			x		x	x	x	x	x	x	x				x	x	x
Stipiturus ruficeps	Rufous-crowned Emu-wren			x		x		x	x									
Amytornis striatus	Striated Grasswren			x		x		x			x			x			x	
MELIPHAGIDAE																		
Sugomel niger	Black Honeyeater					x	x	x								x		

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Certhionyx variegatus	Pied Honeyeater			x		x	x	x					x					
Lichmera indistincta	Brown Honeyeater			x		x	x	x	x		x	x		x		x	x	x
Melithreptus cyanotis	Blue-faced Honeyeater					x												
Melithreptus gularis	Black-chinned Honeyeater			x		x	x	x	x		x	x		x				
Epthianura tricolor	Crimson Chat			x		x	x	x				x	x			x	x	
Epthianura aurifrons	Orange Chat					x			x								x	
Lacustroica whitei	Grey Honeyeater					x	x	x				x						
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			x		x	x	x	x	x	x	x	x	x		x	x	x
Manorina flavigula	Yellow-throated Miner			x		x	x	x	x	x	x	x		x		x	x	x
Purnella albifrons	White-fronted Honeyeater			x		x	x	x									x	x
Gavicalis virescens	Singing Honeyeater					x		x	x	x	x	x	x	x		x	x	x
Ptilotula keartlandi	Grey-headed Honeyeater					x		x	x		x	x		x		x	x	x
Ptilotula plumula	Grey-fronted Honeyeater					x			x									
Ptilotula penicillata	White-plumed Honeyeater			x		x		x	x	x	x	x		x		x	x	x
PARDALOTIDAE																		
Pardalotus rubricatus	Red-browed Pardalote			x		x	x	x		x	x	x		x		x	x	x
Pardalotus striatus	Striated Pardalote			x		x	x	x	x		x	x	x	x				
ACANTHIZIDAE																		
Calamanthus campestris	Rufous Fieldwren					x												
Pyrrholaemus brunneus	Redthroat			x		x												
Smicrornis brevirostris	Weebill			x		x	x	x	x	x	x	x	x	x		x	x	x
Gerygone fusca	Western Gerygone			x		x	x	x	x		x	x	x	x				
Acanthiza apicalis	Inland Thornbill			x		x						x						
Acanthiza uropygialis	Chestnut-rumped Thornbill			x		x	x	x	x			x	x			x	x	x
Acanthiza chrysorrhoa	Yellow-rumped Thornbill			x		x								x				
Acanthiza robustirostris	Slaty-backed Thornbill			x		x	x	x	x			x				x	x	x
Aphelocephala leucopsis	Southern Whiteface								x									
POMATOSTOMIDAE																		
Pomatostomus temporalis	Grey-crowned Babbler			x		x	x	x	x		x	x		x		x	x	x
Pomatostomus superciliosus	White-browed Babbler			x		x	x		x			x	x			x	x	x
PSOPHODIDAE																		
Psophodes occidentalis	Chiming Wedgebill			x		x		x					x					

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Cinclosoma marginatum	Western Quail-thrush																	x
ARTAMIDAE																		
Artamus leucorynchus	White-breasted Woodswallow					x												
Artamus personatus	Masked Woodswallow			x		x	x	x								x		x
Artamus cinereus	Black-faced Woodswallow			x		x	x	x	x	x	x	x	x	x		x	x	x
Artamus minor	Little Woodswallow			x		x	x	x		x	x	x		x		x	x	x
CRACTICIDAE																		
Cracticus torquatus	Grey Butcherbird			x		x	x	x	x	x	x	x	x	x		x		x
Cracticus nigrogularis	Pied Butcherbird			x		x	x	x	x	x	x	x		x		x	x	x
Cracticus tibicen	Australian Magpie			x		x		x	x	x	x	x				x		x
CAMPEPHAGIDAE																		
Coracina maxima	Ground Cuckoo-shrike			x		x		x	x			x		x				
Coracina novaehollandiae	Black-faced Cuckoo-shrike			x		x	x	x	x	x	x	x	x	x		x	x	x
Lalage tricolor	White-winged Triller			x		x		x	x		x	x		x		x	x	x
NEOSITTIDAE																		
Daphoenositta chrysoptera	Varied Sittella					x		x	x		x							
OREOICIDAE																		
Oreoica gutturalis	Crested Bellbird			x		x	x	x	x	x	x	x	x	x		x	x	x
PACHYCEPHALIDAE																		
Pachycephala rufiventris	Rufous Whistler			x		x	x	x	x	x	x	x	x	x		x	x	x
Colluricincla harmonica	Grey Shrike-thrush			x		x	x	x	x	x	x	x	x			x	x	x
RHIPIDURIDAE																		
Rhipidura leucophrys	Willie Wagtail			x		x	x	x	x	x	x	x		x		x	x	x
Rhipidura albiscapa	Grey Fantail			x		x		x	x									
MONARCHIDAE																		
Grallina cyanoleuca	Magpie-Lark			x		x	x	x	x	x	x	x		x		x	x	x
CORVIDAE																		
Corvus orru	Torresian Crow			x		x	x	x	x	x	x	x	x	x		x	x	x
Corvus bennetti	Little Crow			x		x	x	x	x			x	x	x			x	
PETROICIDAE																		
Melanodryas cucullata	Hooded Robin			x		x		x	x		x	x		x		x	x	x
Microeca fascinans	Jacky Winter					x												

FAMILY and Species	Common Name	Conservation Status		Database Searches				Reference text	Previous surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Birdata	Johnstone and Storr (1998, 2004)	Cloudbreak (Bamford Consulting 2005)	Kurrajura-Cowra (ecologia 2007)	Solomon Rail (Coffey Environments 2008)	Chichester Deviation (ecologia 2008b)	Roy Hill (ecologia 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Rail (Coffey Environments 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
Petroica goodenovii	Red-capped Robin			x		x	x	x	x			x	x			x		x
ALAUDIDAE																		
Mirafra javanica	Horsfield's Bushlark			x		x	x	x	x	x		x					x	x
HIRUNDINIDAE																		
Cheramoeca leucosterna	White-backed Swallow					x												
Hirundo neoxena	Welcome Swallow			x		x	x					x						
Petrochelidon ariel	Fairy Martin			x		x	x	x	x	x		x				x		
Petrochelidon nigricans	Tree Martin			x		x	x	x		x	x	x				x	x	x
ACROCEPHALIDAE																		
Acrocephalus australis	Australian Reed-warbler			x		x	x	x				x						
MEGALURIDAE																		
Poodytes carteri	Spinifexbird			x		x		x	x		x	x		x		x	x	x
Cincloramphus cruralis	Brown Songlark					x		x	x									x
Cincloramphus mathewsi	Rufous Songlark					x		x			x	x				x	x	x
CISTICOLIDAE																		
Cisticola exilis	Golden-headed Cisticola					x												
NECTARINIDAE																		
Dicaeum hirundinaceum	Mistletoebird			x		x	x	x	x		x			x		x		
ESTRILDIDAE																		
Emblema pictum	Painted Finch			x		x	x	x	x		x	x	x	x		x		x
Neochmia ruficauda	Star Finch			x	x	x	x	x	x			x						x
Taeniopygia guttata	Zebra Finch			x		x	x	x	x	x	x	x	x	x		x	x	x
Lonchura castaneothorax	Chestnut-breasted Mannikin			x														
MOTACILLIDAE																		
Anthus australis	Australian Pipit			x		x	x	x	x			x	x			x	x	x
Total number of species				**147**	**8**	**181**	**105**	**130**	**93**	**43**	**65**	**93**	**36**	**64**	**2**	**77**	**85**	**78**

Amphibians

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		EPBC	WC Act	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Tyler *et al.* (1994)	Cloudbreak (Bamford Consulting 2005)	Kurrajura-Cowra (*ecologia* 2007)	Solomon Mine (Coffey 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Mine (Coffey 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
HYLIDAE																	
Cyclorana australis	Giant Frog					x											
Cyclorana maini	Main's Frog			x		x	x			x		x					x
Cyclorana platycephala	Water-holding Frog)			x													
Litoria rubella	Desert Tree Frog			x		x	x	x		x	x				x	x	x
LIMNODYNASTIDAE																	
Platyplectrum spenceri	Spencer's Frog					x											
Notaden nichollsi	Desert Spadefoot					x											
Neobatrachus aquilonius	Northern Burrowing Frog					x											
Neobatrachus sutor	Shoemaker Frog					x											
MYOBATRACHIDAE																	
Limnodynastes spenceri	Spencer's Frog						x										
Pseudophryne douglasi	Douglas Toad			x		x	x										
Uperoleia glandulosa	Glandular Toadlet					x	x										
Uperoleia russelli	Russell's Toadlet					x	x			x							
Uperoleia saxatilis	Pilbara Toadlet			x		x											
Total number of species				**5**	**0**	**11**	**6**	**1**	**0**	**3**	**1**	**1**	**0**	**0**	**1**	**1**	**2**

Fish

FAMILY and *Species*	Common Name	Conservation Status		Database searches			Reference Guide	Previous Surveys								This Survey Phase 1 & Phase 2	
		BC Act	EPBC Act	DBCA Naturemap	DBCA Threatened Fauna Database	Atlas of Living Australia	Allen et al. 2002	Cloudbreak (Bamford Consulting 2005)	Kurrajura-Cowra (*ecologia* 2007)	Solomon Mine (Coffey 2008)	Chichester Deviation (*ecologia* 2008b)	Roy Hill (*ecologia* 2009)	Firetail Project (Ecoscape & Coffey 2010)	Solomon Mine (Coffey 2011)	Mulga Downs (Terrestrial Ecosystems 2013)	Mulga East Phase 1 (ecologia 2019)	Mulga East Phase 2 (ecologia 2020)
CLUPEIDAE																	
Nematalosa erebi	Bony Bream			x		x	x										
PLOTOSIDAE																	
Neosilurus hyrtlii	Hyrtl's Catfish			x		x	x						x				
ATHERINIDAE																	
Craterocephalus cuneiceps	Deep Hardyhead					x	x										
MELANOTAENIIDAE																	
Melanotaenia australis	Western Rainbowfish			x		x	x						x				
TERAPONTIDAE																	
Leiopotherapon unicolor	Spangled Perch			x		x	x						x				
Leiopotherapon aheneus	Fortescue Grunter	P4		x		x	x										
Amniataba percoides	Barred Grunter			x		x	x										
Hephaestus jenkinsi	Western Sooty Grunter					x											
GOBIIDAE																	
Glossogobius giuris	Tank Goby			x		x											
ELEOTRIDAE																	
Hypseleotris aurea	Golden Carp Gudgeon	P2				x											
Total number of species				**7**	**0**	**10**	**7**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**

APPENDIX I FAUNA HABITAT SITE ASSESSMENT SHEETS

Site	Landform		Condition	Habitat
HA1	Floodplain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	15		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	80		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	None		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing	Cattle		
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	Yes		
	Tree Hollows (>10cm)			



Vegetation			
Stratum	**Form**	**Height**	**Description**
Upper	Tree	<10m	Open woodland
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	Tussock grass land / sedgeland / herbland

Site	Landform		Condition	Habitat
HA2	Floodplain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplain with open eucalypts and mulga woodland over isolated shrubs over tussock grasses			
% Ground Cover	Bare Soil	50		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	None		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**
	Woody Debris	Low (< 10%)	Upper	Tree
	Grazing	Cattle		
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Moderate		
	Large trees present	Yes	Ground	Grasses
	Tree Hollows (>10cm)	>10cm		



Height	**Description**
<10m	Open woodland
<2m	Isolated low shrubs
0.5m	Open tussock grassland / sedgeland / herbland

Site	Landform		Condition	Habitat
HA3	Undulating Plain		Very Good	Calcrete Stony Plain
Description	Stony Plain with isolated trees and shrubs over triodia hummock grasslands			
% Ground Cover	Bare Soil	20		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	75		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris		Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Isolated shrubs
	Burrowing Suitability	Moderate				
	Large trees present	No	Ground	Grasses	0.75m	Hummock grassland
	Tree Hollows (>10cm)					

Site	Landform		Condition	Habitat
HA4	Floodplain		Good	Claypan
Description	Floodplain subject to inundation after rains.			
% Ground Cover	Bare Soil	90		
	Litter			
	Canopy Cover			
	Understorey			
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	None		
Soil	Type	Clay		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence		**Stratum**	**Form** / **Height** / **Description**
	Woody Debris	Low (< 10%)	Upper	Tree / <10m / Tall isolated tress
	Grazing			
	Rock Crevices		Middle	Shrubs / <2m /
	Burrowing Suitability	Low		
	Large trees present		Ground	Grasses / 0.5m / Isolated tussock grasses sedges herbs and samphire
	Tree Hollows (>10cm)			

Site	Landform		Condition	Habitat
HA5	Plain		Good	Mulga Woodland
Description	Isolated Eucaypts with low calcrete platforms and plains supporting shrubby hard spinifex grasslands.			
% Ground Cover	Bare Soil	30		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	60		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Open shrubland
	Burrowing Suitability	Moderate				
	Large trees present	Yes	Ground	Grasses	0.5m	Tussock grassland / sedgeland / herbland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA6	Floodplain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	30		
	Litter	Low (< 10%)		
	Canopy Cover	10		
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	No Evidence		
	Woody Debris	Moderate (10-40%)		
	Grazing	Cattle		
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		



Vegetation			
Stratum	**Form**	**Height**	**Description**
Upper	Tree	<10m	Open Woodland
Middle	Shrubs	<2m	Tall shrubs
Ground	Grasses	0.5m	Open tussock grassland / sedgeland / herbland

Site	Landform		Condition	Habitat
HA7	Creek/Drainage Line		Degraded	Drainage Line
Description	Creekline with tall trees and high presence of cattle and weeds			
% Ground Cover	Bare Soil	50		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	40		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Sand		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Moderate (10-40%)	Upper	Tree	<10m	Tall trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Isolated shrubs
	Burrowing Suitability	Moderate				
	Large trees present	Yes	Ground	Grasses	0.5m	Open tussock and hummock grasses
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA8	Creek/Drainage Line		Very Good	Drainage Line
Description	Stony creekline with scattered trees over open shrubland over hummock and tussock grasses and herbs.			
% Ground Cover	Bare Soil	40		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	40		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Sand		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Isolated tall trees
Middle	Shrubs	<2m	Open Shrubland
Ground	Grasses	0.5m	Open tussock grassland/ sedgeland/ herbs and hummock grasses

Site	Landform		Condition	Habitat
HA9	Floodplain		Very Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplains subject to inundation with isolated tall trees and tussock grasses surrounded by cracking clays.			
% Ground Cover	Bare Soil	80		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	15		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones			
Soil	Type	Clay		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated tell trees
	Grazing					
	Rock Crevices		Middle	Shrubs		
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Isolated tussock grass land / sedgeland / herbland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA10	Low Hill		Very Good	Rocky Hills
Description	Low rocky hills with isolated eucalypts over acacias over open triodia hummock grassland.			
% Ground Cover	Bare Soil	10		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	70		
Rocks	No exposed rock			
	<20% exposed rock	X		
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Rocks		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	> 5 Years		
	Woody Debris			
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)			



Vegetation			
Stratum	**Form**	**Height**	**Description**
Upper	Tree	<10m	Isolated trees
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	Hummock grassland

Site	Landform		Condition	Habitat
HA11	Creek/Drainage Line		Very Good	Stony Spinifex Plains and Hillslopes
Description	Drainage line supporting tall open acacia shrublands over triodia hummock grasses.			
% Ground Cover	Bare Soil	10		
	Litter	Moderate (10-40%)		
	Canopy Cover			
	Understorey	70		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present			
	Tree Hollows (>10cm)			



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Isolated tress
Middle	Shrubs	<2m	Tall open shrubland
Ground	Grasses	0.5m	Open hummock grassland

Site	Landform		Condition	Habitat
HA12	Mesa		Very Good	Rocky Hills
Description	Rocky hills with crevices supporting isolated eucalypts over acacias over open triodia hummock grassland.			
% Ground Cover	Bare Soil	30		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	70		
Rocks	No exposed rock			
	<20% exposed rock			
	20-50% exposed rock	X		
	>50% exposed rock			
	Boulders / Rocks %	30		
	Surface Stones	Rocks		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices	Moderate (10-40%)		
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)			



Vegetation			
Stratum	**Form**	**Height**	**Description**
Upper	Tree	<10m	Scattered tall trees
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	Open hummock grassland

Site	Landform		Condition	Habitat
HA13	Plain		Very Good	Mulga Woodland
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	60		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	30		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	> 5 Years		
	Woody Debris	Moderate (10-40%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Open woodland
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	tussock grasses/ sedges / herbs

Site	Landform		Condition	Habitat
HA14	Plain		Very Good	Mulga Woodland
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	40		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**
	Woody Debris	Moderate (10-40%)	Upper	Tree
	Grazing			
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Moderate		
	Large trees present	Yes	Ground	Grasses
	Tree Hollows (>10cm)	>10cm		



Height	Description
<10m	Open Woodland
<2m	Isolated shrubs
0.5m	Hummock and tussock grasses/ sedges / herbs

Site	Landform		Condition	Habitat
HA15	Hill		Very Good	Rocky Hills
Description	Low rocky hills with isolated eucalypts over acacias over open triodia hummock grassland.			
% Ground Cover	Bare Soil	30		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	70		
Rocks	No exposed rock	X		
	<20% exposed rock	X		
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	2-5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Isolated shrubs
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Triodia hummock grasslands
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA16	Creek/Drainage Line		Very Good	Drainage Line
Description	Stony drainage line with scattered trees over open shrubland over hummock and tussock grasses and herbs.			
% Ground Cover	Bare Soil	40		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Open Shrubland
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.75m	Hummock grassland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA17	Floodplain		Good	Chenopod/ Cracking Clay Floodplain
Description	Chenopod floodplains on gilgaid cracking clays			
% Ground Cover	Bare Soil	50		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones			
Soil	Type	Clay		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree		
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Open chenopod shrubland
	Burrowing Suitability	Low				
	Large trees present		Ground	Grasses	0.5m	Sparse tussock grass land / sedgeland / herbland
	Tree Hollows (>10cm)					

Site	Landform		Condition	Habitat
HA18	Creek/Drainage Line		Degraded	Drainage Line
Description	Degraded drainage line due to high cattle use with tall eucalypts over isolated shrubs over hummock and tussock grasses			
% Ground Cover	Bare Soil	50		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	40		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones			
Soil	Type	Clay		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Open woodland
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Isolated shrubs
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Hummock and tussock grasses
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA19	Plain		Very Good	Mulga Woodland
Description	Mulga woodland with isolated shrubs over tussock grasses			
% Ground Cover	Bare Soil	70		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	20		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Moderate (10-40%)	Upper	Tree	<10m	Open woodland
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Isolated shrubs
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Tussock grasses / sedgeland / herbland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA20	Gorge		Very Good	Rocky Hills
Description	Rocky breakaway/ gorge with multiple rocky crevices and caves with bats and geckoes found.			
% Ground Cover	Bare Soil	20		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	60		
Rocks	No exposed rock			
	<20% exposed rock			
	20-50% exposed rock	X		
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Boulders (>250mm)		
Soil	Type	Clay loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices	Moderate (10-40%)		
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		

Stratum	Form	Height	Description
Upper	Tree	<10m	Scattered tall trees
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	Triodia hummock grassland

Site	Landform		Condition	Habitat
HA21	Creek/Drainage Line		Very Good	Drainage Line
Description	Stony drainage line with scattered trees over open shrubland over hummock and tussock grasses and herbs.			
% Ground Cover	Bare Soil	10		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Sand		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	2-5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Moderate (10-40%)	Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Open shrubland
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Hummock and Tussock grassland / sedgeland / herbland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA22	Floodplain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	55		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	20		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	None		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts			
	Fire Presence	No Evidence		
	Woody Debris	Low (< 10%)		
	Grazing	Cattle		
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Open Woodland
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	Very open tussock grassland / sedgeland / herbland

Site	Landform		Condition	Habitat
HA23	Floodplain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplain isolated low trees and shrubland over sparse tussock grasses.			
% Ground Cover	Bare Soil	85		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	5		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**
	Woody Debris	Low (< 10%)	Upper	Tree
	Grazing	Cattle		
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Low		
	Large trees present	No	Ground	Grasses
	Tree Hollows (>10cm)			



Height	**Description**
<10m	Isolated low trees
<2m	Isolated shrubs
0.5m	Open tussock and hummock grasses

Site	Landform		Condition	Habitat
HA24	Plain		Very Good	Calcrete Stony Plain
Description	Mixed acacia shrubland over triodia hummock grasslands.			
% Ground Cover	Bare Soil	15		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	80		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Stony		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**
	Woody Debris	Low (< 10%)	Upper	Tree
	Grazing			
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Moderate		
	Large trees present	No	Ground	Grasses
	Tree Hollows (>10cm)	None		

Height	Description
<10m	Isolated tall trees
<2m	Open Shrubland
0.5m	Triodia Hummock grassland

Site	Landform		Condition	Habitat
HA25	Creek/Drainage Line		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Edge of Fortescue river			
% Ground Cover	Bare Soil	10		
	Litter	Moderate (10-40%)		
	Canopy Cover	25		
	Understorey	60		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	None		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts	Creekline	**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**
	Woody Debris	Moderate (10-40%)	Upper	Tree
	Grazing	Cattle		
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Low		
	Large trees present	Yes	Ground	Grasses
	Tree Hollows (>10cm)	>10cm		

Height	**Description**
<10m	Tall open woodland
<2m	Scattered low shrubs
0.5m	Tussock grass land/ sedgeland/ herbland

Site	Landform		Condition	Habitat
HA26	Plain		Excellent	Calcrete Stony Plain
Description	Eucalypts over low acacia shrubland over triodia hummock grasslands.			
% Ground Cover	Bare Soil	5		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	80		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts	Sheet runoff		
	Fire Presence	No Evidence		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	No		
	Tree Hollows (>10cm)	>10cm		



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Open woodland
Middle	Shrubs	<2m	Isolated low shrubland
Ground	Grasses	0.5m	Hummock grassland

Site	Landform		Condition	Habitat
HA27	Plain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplain with open eucalypts and mulga woodland over isolated shrubs over tussock grasses			
% Ground Cover	Bare Soil	10		
	Litter	Moderate (10-40%)		
	Canopy Cover	5		
	Understorey	75		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Open woodland
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Isolated low shrubs
	Burrowing Suitability	Moderate				
	Large trees present	Yes	Ground	Grasses	0.5m	Open tussock grassland / sedgeland / herbland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA28	Undulating Plain		Good	Calcrete Stony Plain
Description	Isolated Eucaypts with low calcrete platforms and plains supporting shrubby hard spinifex grasslands.			
% Ground Cover	Bare Soil	5		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	55		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Clay loam		
	Colour	Brown		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	1-2 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated tall trees
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Open shrubland
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Hummock and tussock grass land / sedgeland / herbland
	Tree Hollows (>10cm)	None				

Site	Landform		Condition	Habitat
HA29	Undulating Plain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplain with open eucalypts and mulga woodland over isolated shrubs over tussock grasses			
% Ground Cover	Bare Soil	10		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	20		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts	Minor Drainage	**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**
	Woody Debris	Moderate (10-40%)	Upper	Tree
	Grazing	Cattle		
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Low		
	Large trees present	Yes	Ground	Grasses
	Tree Hollows (>10cm)	>10cm		

Height	**Description**
<10m	Open woodland
<2m	Tall open shrubs
0.5m	Open tussock grassland / sedgeland / herbland

Site	Landform		Condition	Habitat
HA30	Plain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplain with open eucalypt and mulga woodland over isolated tall shrubs over tussock grasses			
% Ground Cover	Bare Soil	5		
	Litter	Low (< 10%)		
	Canopy Cover	10		
	Understorey	90		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Open Woodland
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Isolated tall shrubs
	Burrowing Suitability	Moderate				
	Large trees present	Yes	Ground	Grasses	0.75m	Open tussock grassland / sedgeland / herbland
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA31	Plain		Good	Calcrete Stony Plain
Description	Calcrete stony plain with tall isolated shrubs over tussock grasses.			
% Ground Cover	Bare Soil	10		
	Litter	Moderate (10-40%)		
	Canopy Cover	30		
	Understorey	20		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence		**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Moderate (10-40%)	Upper	Tree	<10m	Isolated trees
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Tall shrubs
	Burrowing Suitability	Low				
	Large trees present	No	Ground	Grasses	0.5m	Very open tussock grass land / sedgeland / herbland
	Tree Hollows (>10cm)					

Site	Landform		Condition	Habitat
HA32	Floodplain		Good	Mulga Woodland
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	10		
	Litter	Low (< 10%)		
	Canopy Cover	30		
	Understorey	10		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts	Sheet runoff		
	Fire Presence			
	Woody Debris	Moderate (10-40%)		
	Grazing	Cattle		
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	Yes		
	Tree Hollows (>10cm)			



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Woodland
Middle	Shrubs	<2m	Open shrubland
Ground	Grasses	0.5m	Tussock grass land / sedgeland / herbland

Site	Landform		Condition	Habitat
HA33	Floodplain		Good	Mixed Eucalypt/ Mulga Floodplain
Description	Floodplain with open eucalypts and mulga woodland over isolated shrubs over tussock grasses			
% Ground Cover	Bare Soil	80		
	Litter	Low (< 10%)		
	Canopy Cover	10		
	Understorey	20		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	None		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts	Pooling		
	Fire Presence	No Evidence		
	Woody Debris	Low (< 10%)		
	Grazing	Cattle		
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Open woodland
Middle	Shrubs	<2m	Isolated tall shrubs
Ground	Grasses	0.5m	Open tussock grassland / sedgeland / herbland

Site	Landform		Condition	Habitat
HA34	Floodplain		Good	Chenopod/ Cracking Clay Floodplains
Description	Chenopod floodplains on gilgaid cracking clays			
% Ground Cover	Bare Soil	50		
	Litter	Moderate (10-40%)		
	Canopy Cover			
	Understorey	70		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts	Pooling		
	Fire Presence	No Evidence		
	Woody Debris	Low (< 10%)		
	Grazing	Cattle		
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	No		
	Tree Hollows (>10cm)			



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	
Middle	Shrubs	<2m	Chenopod floodplains
Ground	Grasses	0.75m	Hummock grassland

Site	Landform		Condition	Habitat
HA35	Plain		Good	Mulga Woodland
Description	Mulga woodland with open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	25		
	Litter	Moderate (10-40%)		
	Canopy Cover	20		
	Understorey	20		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**
	Woody Debris	Moderate (10-40%)	Upper	Tree
	Grazing	Cattle		
	Rock Crevices		Middle	Shrubs
	Burrowing Suitability	Low		
	Large trees present	Yes	Ground	Grasses
	Tree Hollows (>10cm)			

Height	**Description**
<10m	Open woodland
<2m	Tall open shrubland
0.5m	Very open tussock grass land / sedgeland / herbland

Site	Landform		Condition	Habitat
HA36	Low Hill		Excellent	Stony Spinifex Plains and Hillslopes
Description	Low rocky hills with isolated eucalypts and corymbias over acacia shrublands over triodia hummock grasslands.			
% Ground Cover	Bare Soil	45		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Stony		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		

Stratum	Form	Height	Description
Upper	Tree	<10m	Isolated trees
Middle	Shrubs	<2m	Low shrubland
Ground	Grasses	0.5m	Mid-dense Hummock grasslands

Site	Landform		Condition	Habitat
HA37	Low Hill		Excellent	Stony Spinifex Plains and Hillslopes
Description	Isolated trees and tall shrubs over stony triodia hummock grasslands.			
% Ground Cover	Bare Soil	45		
	Litter	Low (< 10%)		
	Canopy Cover	5		
	Understorey	65		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Stony		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Low shrubland
	Burrowing Suitability	Low				
	Large trees present	Yes	Ground	Grasses	0.5m	Triodia hummock grasslands
	Tree Hollows (>10cm)	>10cm				

Site	Landform		Condition	Habitat
HA38	Plain		Good	Mulga Woodland
Description	Mulga woodland with tall open shrubland over tussock grasses.			
% Ground Cover	Bare Soil	30		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	45		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	No Evidence	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris	Low (< 10%)	Upper	Tree	<10m	Isolated Low trees
	Grazing	Cattle				
	Rock Crevices		Middle	Shrubs	<2m	Tall shrubland
	Burrowing Suitability	Low				
	Large trees present	No	Ground	Grasses	0.5m	Open tussock grassland / sedgeland / herbland
	Tree Hollows (>10cm)					

Site	Landform		Condition	Habitat
HA39	Undulating Plain		Very Good	Stony Spinifex Plains and Hillslopes
Description	Stony Plain with isolated trees and shrubs over triodia hummock grasslands some termitaria present.			
% Ground Cover	Bare Soil	20		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	75		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts		**Vegetation**	
	Fire Presence	> 5 Years	**Stratum**	**Form**	**Height**	**Description**
	Woody Debris		Upper	Tree	<10m	Isolated trees
	Grazing					
	Rock Crevices		Middle	Shrubs	<2m	Isolated shrubs
	Burrowing Suitability	Moderate				
	Large trees present	No	Ground	Grasses	0.75m	Triodia hummock grassland
	Tree Hollows (>10cm)					

Site	Landform		Condition	Habitat
HA40	Low Hill		Very Good	Stony Spinifex Plains and Hillslopes
Description	Stony Plain with isolated trees and shrubs over triodia hummock grasslands some termitaria present.			
% Ground Cover	Bare Soil	40		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	75		
Rocks	No exposed rock			
	<20% exposed rock	X		
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Cobbles (51-250mm)		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts	Scouring		
	Fire Presence	> 5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Isolated trees
Middle	Shrubs	<2m	Isolated shrubs
Ground	Grasses	0.5m	Triodia hummock grassland

Site	Landform		Condition	Habitat
HA41	Undulating Plain		Good	Mulga Woodland
Description	Recently burnt mulga woodland with isolated trees and shrubs over triodia hummock grasses.			
% Ground Cover	Bare Soil	30		
	Litter	Low (< 10%)		
	Canopy Cover			
	Understorey	50		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Sandy loam		
	Colour	Red		
Habitat Features	Water Impacts			
	Fire Presence	2-5 Years		
	Woody Debris	Low (< 10%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Low		
	Large trees present	No		
	Tree Hollows (>10cm)			



Vegetation

Stratum	Form	Height	Description
Upper	Tree	<10m	Isolated trees
Middle	Shrubs	<2m	Isolated shrubs
Ground	Grasses	0.5m	Triodia hummock grassland

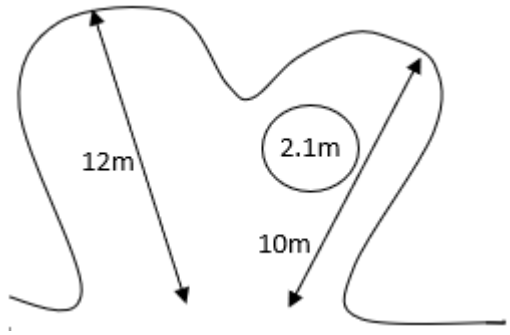
Site	Landform		Condition	Habitat
HA42	Plain		Good	Mulga Woodland
Description	Stony Plain with isolated trees and shrubs over triodia hummock grasslands.			
% Ground Cover	Bare Soil	35		
	Litter	Low (< 10%)		
	Canopy Cover	15		
	Understorey	40		
Rocks	No exposed rock	X		
	<20% exposed rock			
	20-50% exposed rock			
	>50% exposed rock			
	Boulders / Rocks %			
	Surface Stones	Pebbles (0-50mm)		
Soil	Type	Clay loam		
	Colour	Orange		
Habitat Features	Water Impacts			
	Fire Presence	No Evidence		
	Woody Debris	Moderate (10-40%)		
	Grazing			
	Rock Crevices			
	Burrowing Suitability	Moderate		
	Large trees present	Yes		
	Tree Hollows (>10cm)	>10cm		

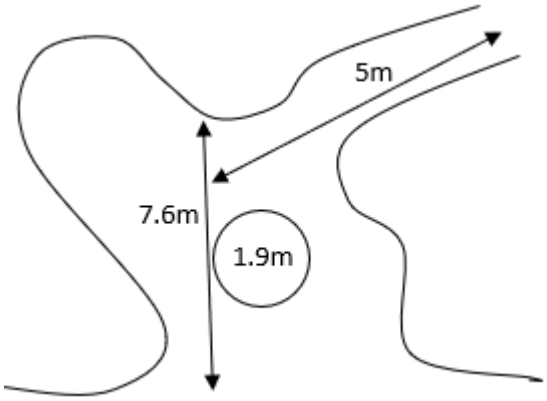


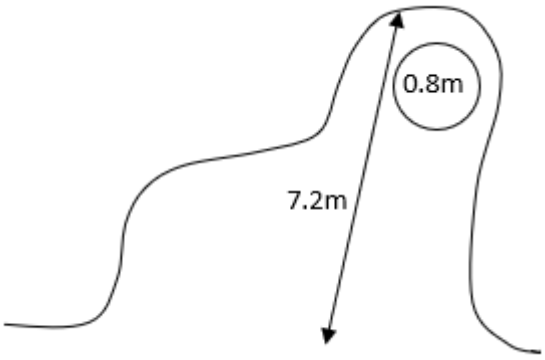
Vegetation

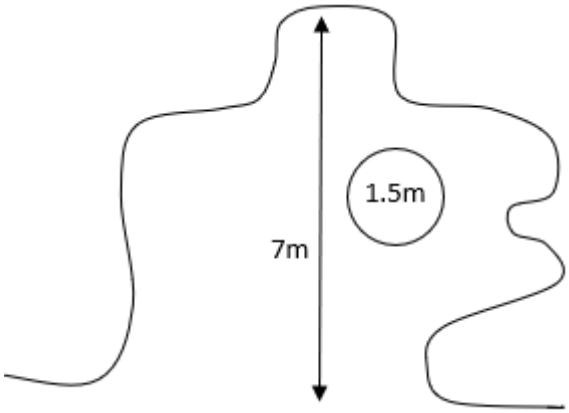
Stratum	Form	Height	Description
Upper	Tree	<10m	Isolated trees
Middle	Shrubs	<2m	Isolated tall shrubs
Ground	Grasses	0.5m	Open tussock grassland / sedgeland / herbland

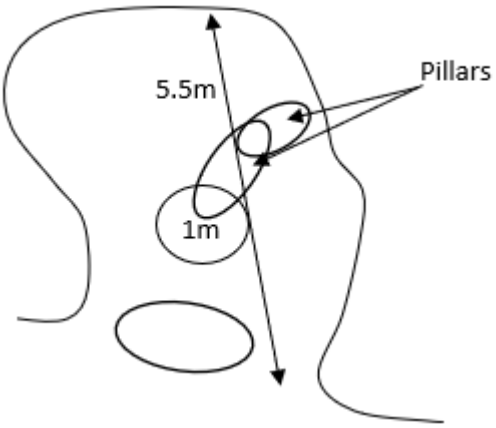
APPENDIX J CAVE HABITAT ASSESSMENTS

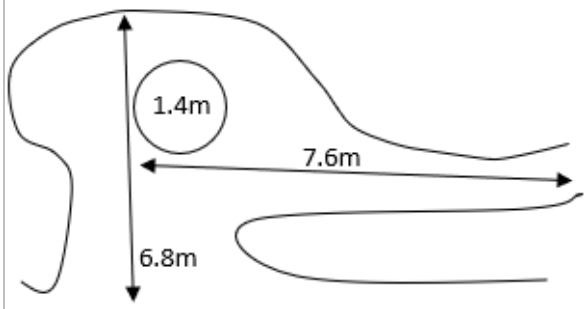
Cave ID: MEC001	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Yes, feeding debris and scats found	670749E 7553843S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.2 x 0.9	South
Cave Grouping:	**Insulation from surface above:**
Multiple caves on ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Nocturnal feeding- Internal dome with bird feathers and ghost bat scats underneath. Potential PLnB and GB shelter. Potential PLnB roost (humid microclimate, microbats observed roosting).	Yes- 2.1m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None seen- possible	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	Kilometres
Cave Floorplan and Photo	
	

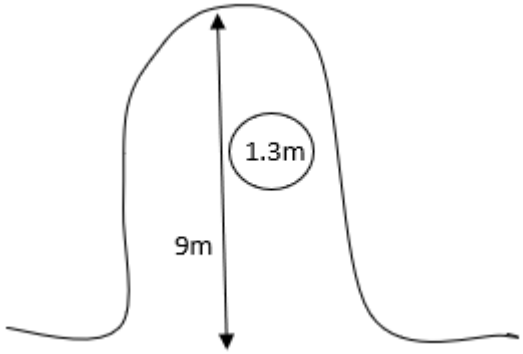
Cave ID: MEC002	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669311E 7553694S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.7 x 1.3	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential PLnB and GB shelter (domed chamber >1.5m). Potential PLnB roost	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient- warm deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	300m to road
Cave Floorplan and Photo	
	

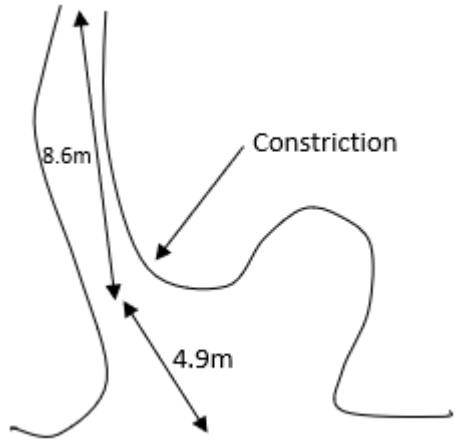
Cave ID: MEC003	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669456E 7553955S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.6 x 0.9	South
Cave Grouping:	**Insulation from surface above:**
Loose grouping at end of small valley ridgeline	Mid landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential PLnB nocturnal shelter/refuge	No- very low
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	400m to road
Cave Floorplan and Photo	
	

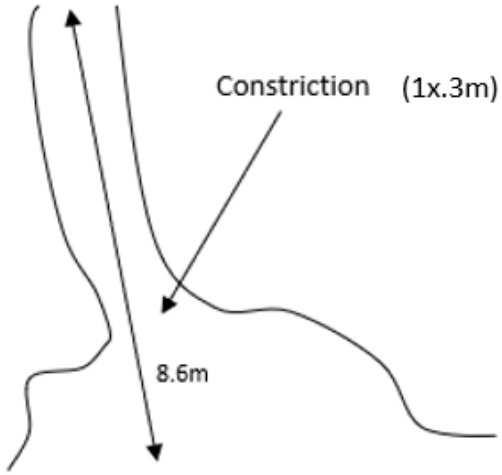
Cave ID: MEC004	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670704E 7553921S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.3 x 1.4	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB). Domed chamber 1.5m tall	Small – 1.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hills with Spinifex, Drainage Line	Kilometres to disturbance
Cave Floorplan and Photo	
	

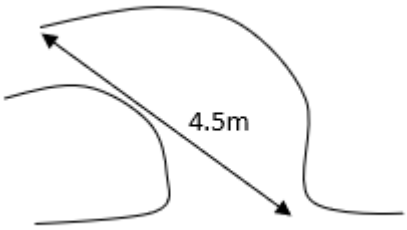
Cave ID: MEC005	**Date**: 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670882E 7553178S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances – 1.3 x 1.0 - 1.4 x 0.7	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential PLnB nocturnal shelter– low, deep cave	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possibly	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	Kilometres
Cave Floorplan and Photo	
	

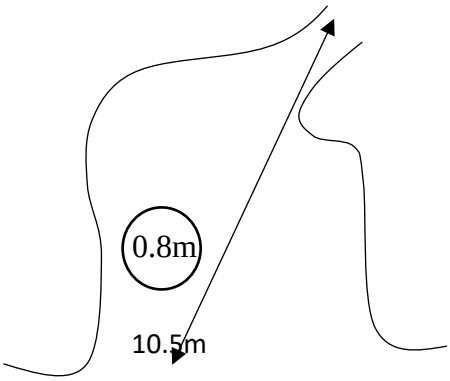
Cave ID: MEC006	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670677E 7553374S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single - 5.8 x 1.8	North East
Cave Grouping:	**Insulation from surface above:**
Loose grouping at end of valley in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – large open space
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	Kilometres
Cave Floorplan and Photo	
	

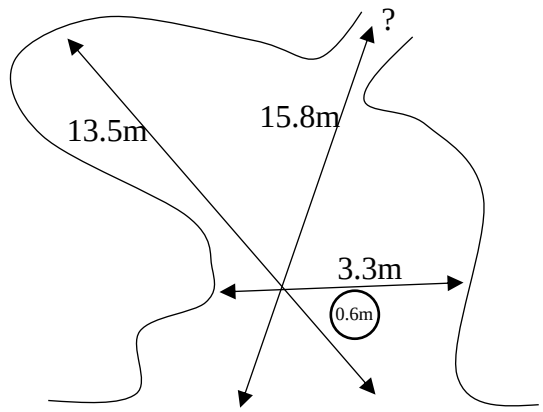
Cave ID: MEC007	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668730E 7553581S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.1 x 2.2	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB and GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line and Rocky Hills with Spinifex	300m to Drill Line
Cave Floorplan and Photo	
	

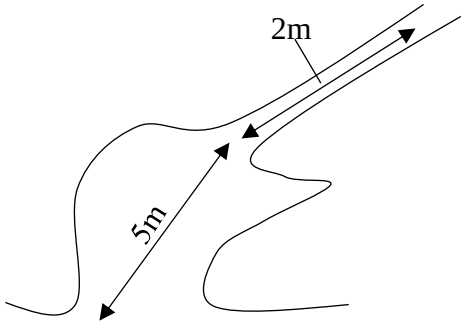
Cave ID: MEC008	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668900E 7552845S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.8 x 1.0	North-east
Cave Grouping:	**Insulation from surface above:**
Loose grouping in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely to be a PLnB roost due to light levels deep in cave and air flow	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – internal temperature unknown. Light was seen deep in cave. Potentially allowing airflow & not likely to harbour humid conditions
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

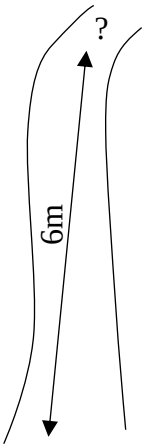
Cave ID: MEC009	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668582E 7553142S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.7	North-east
Cave Grouping:	**Insulation from surface above:**
Big, broken boulders along ridgeline. Entrance down behind a large boulder. Cave very long and low	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

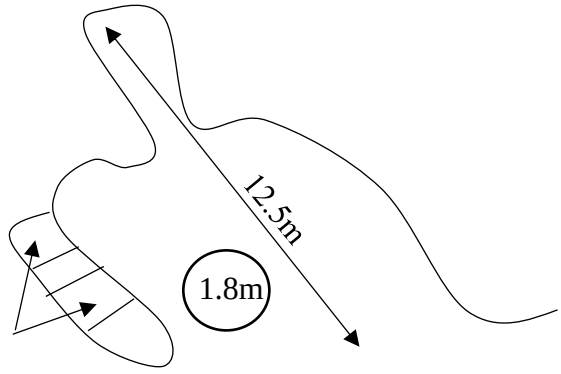
Cave ID: MEC010	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668631E 7553169S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.3 x 0.5	North
Cave Grouping:	**Insulation from surface above:**
Grouping of caves and cracks along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost	None seen
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

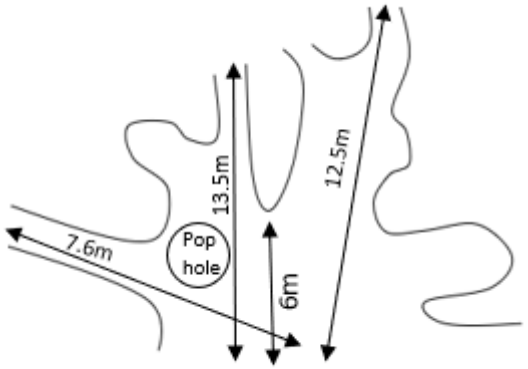
Cave ID: MEC011	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664104E 7553907S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.7 x 1.0	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes – 1 rear passage	Ambient in main chamber – rear passage unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

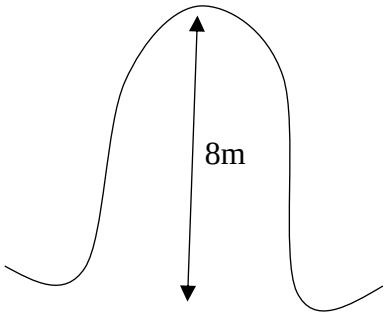
Cave ID: MEC012	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668770E 7552990S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.3 x 1.5	South-east
Cave Grouping:	**Insulation from surface above:**
Multiple deep caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB), potential roost site (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – rear passage unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	No photo

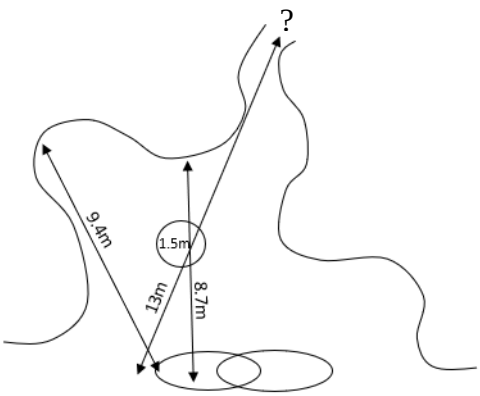
Cave ID: MEC013	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668833E 7552939S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.8 x 1.0	North
Cave Grouping:	**Insulation from surface above:**
Single cave in small ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes – very small constriction	Ambient main chamber – passage unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to Drill Line
Cave Floorplan and Photo	
	

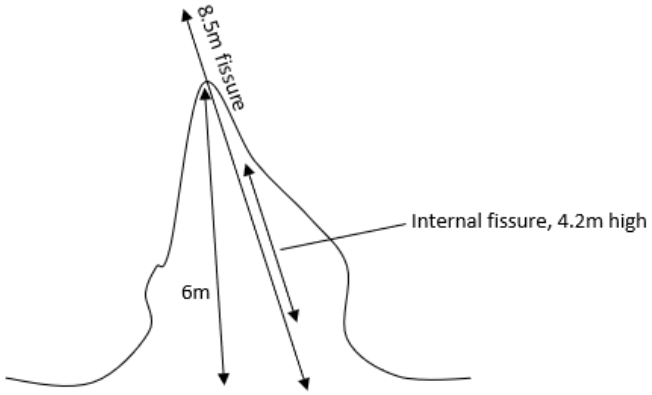
Cave ID: MEC014	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668910E 7552841S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.7 x 0.7	East
Cave Grouping:	**Insulation from surface above:**
Singular – loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Present	Ambient → humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

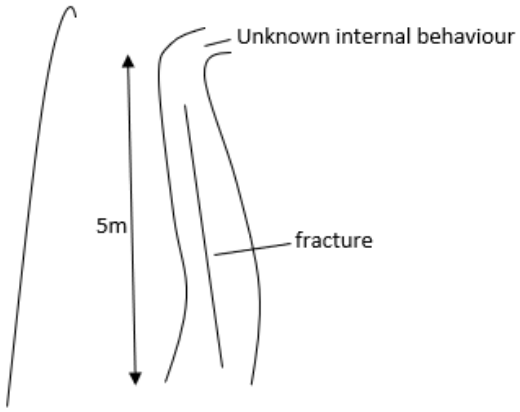
Cave ID: MEC015	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664141E 7554343S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
3 entrances – 2 partially blocked Single main – 6.1 x 1.7	South
Cave Grouping:	**Insulation from surface above:**
Singular	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Nocturnal shelter only (GB/PLnB). Unlikely to be a roost due to airflow and low humidity	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient, two small entrances blocked by rocks let airflow through
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres
Cave Floorplan and Photo	
 2 small entrances blocked by rocks which lets airflow through	

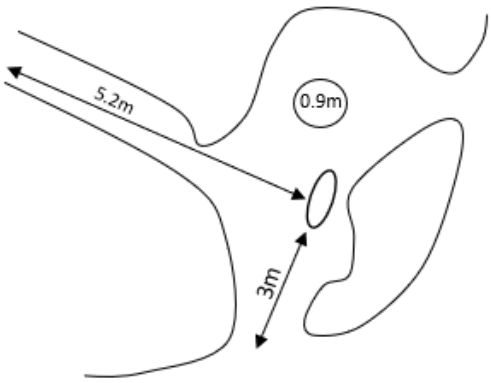
Cave ID: MEC016	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668802E 7553006S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single entrance – 7.5 x 2.0m	South
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site. PLnBs have been recorded using this cave as a diurnal refuge. Pop hole in main chamber.	Not obvious – possible in rear of cave
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient- unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

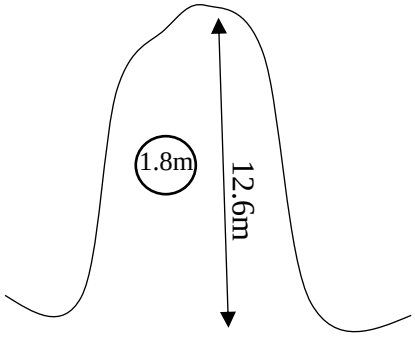
Cave ID: MEC017	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664093E 7553977S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.7 x 0.8	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Nil	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

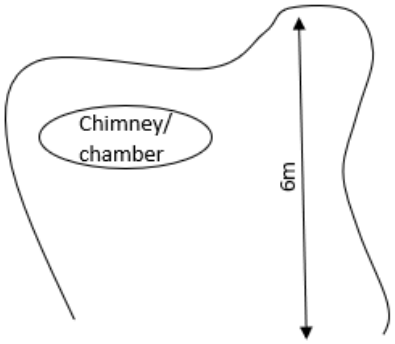
Cave ID: MEC018	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	663708E 7553862S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: North – 1.5 x 0.8 South – 3.7 x 0.9	East
Cave Grouping:	**Insulation from surface above:**
Single	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB), potential roost site (PLnB)	Small – 1.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Present	Warm – unknown deep
Local foraging opportunities:	**Current distance to disturbance:**
Stony Plains, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

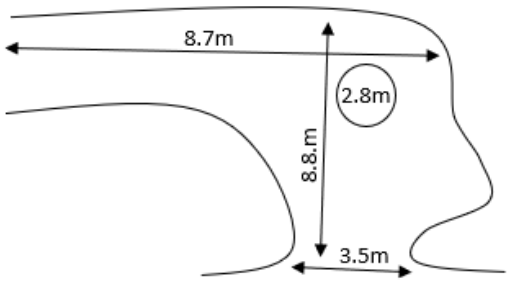
Cave ID: MEC019	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Possible/ Unlikely	664342E 7553779S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.0 x 0.6m	North West
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves- 2 levels, bottom level	Bottom of ridgeline
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter/roost (PLnB)	Internal fissure/crack
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Unlikely	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	No photo

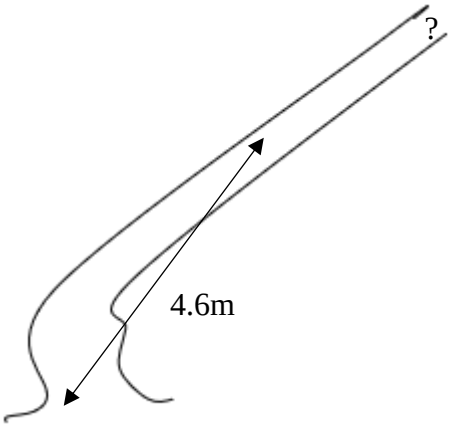
Cave ID: MEC020	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664316E 7553783S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.3 x 1.0	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	Possible
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Lines
Cave Floorplan and Photo	
	No photo

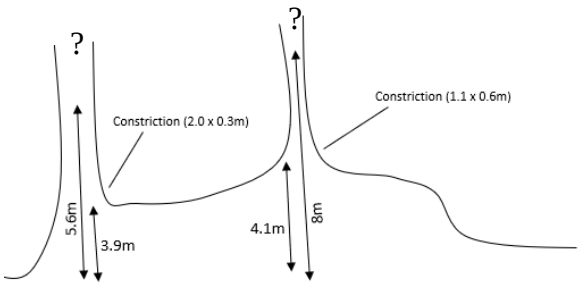
Cave ID: MEC021	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668581E 7553177S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: North – 2.0 x 1.0 South – 3.7 x 1.2	East
Cave Grouping:	**Insulation from surface above:**
Multiple caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely to be a potential roost due to ambient temperature	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m
Cave Floorplan and Photo	
	

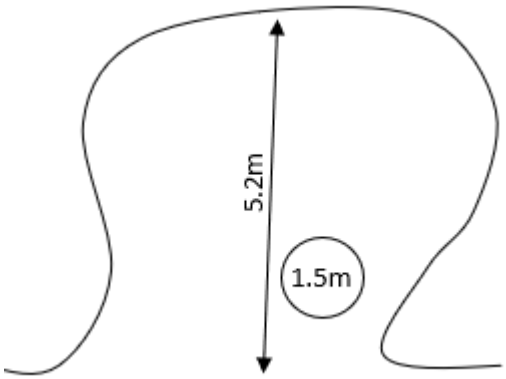
Cave ID: MEC022	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664277E 7553778S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.8 x 2.3	North-west
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	Not present
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Nil	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to drill lines
Cave Floorplan and Photo	
	

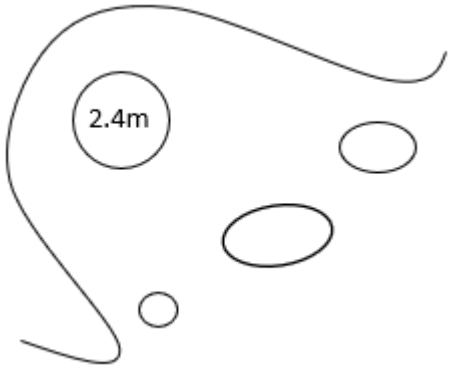
Cave ID: MEC023	**Date:** 30/6/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	653577E 7557013S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 1.3	North-northwest
Cave Grouping:	**Insulation from surface above:**
Ridgeline of small caves	Thick with one small access pipe
Cave Type & roost suitability:	**Internal domed chamber:**
Wide, low ceiling, chimney to outside, Potential nocturnal shelter	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Very good, creek line in close proximity	400m
Cave Floorplan and Photo	
	No Photo

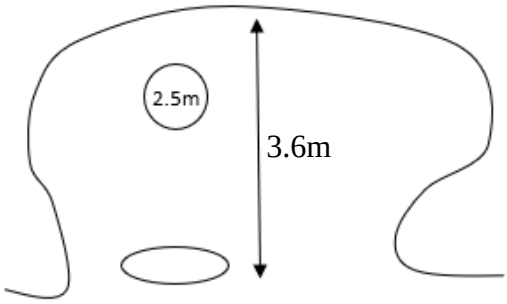
Cave ID: MEC024	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664115E 7554057S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: North – 3.5 x 2.0 South- 3.4 x 2.5	North entrance – South-east South entrance - South
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter only (PLnB/GB) – no roosting as lots of air movement through cave resulting in low humidity	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient temperature, lots of airflow
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

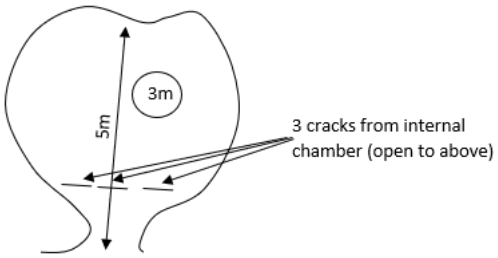
Cave ID: MEC025	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668670E 7553131S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.0 x 0.6	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient-unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

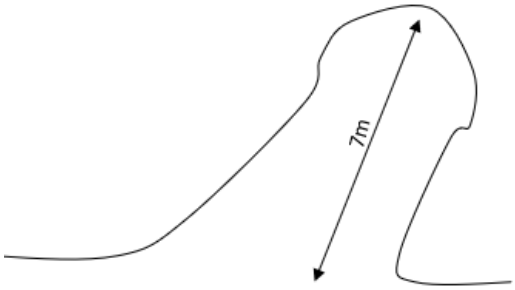
Cave ID: MEC026	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668537E 7553209S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single large open entrance – 14.0 x 1.8	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes - 2	Ambient – unknown in passages
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

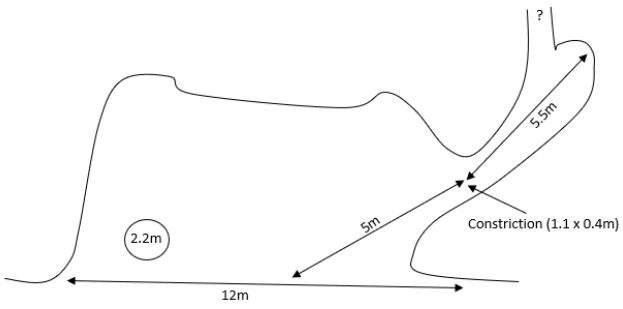
Cave ID: MEC027	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668470E 7553203S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.7 x 1.6	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Not present	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

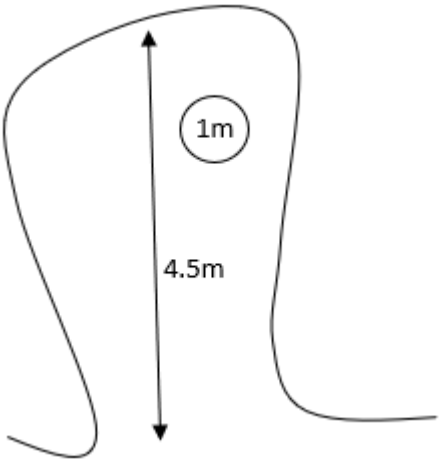
Cave ID: MEC028	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668427E 7553200S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Main single – 3.4 x 3.1	North-west
Cave Grouping:	**Insulation from surface above:**
Multiple caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Unlikely to be used for shelter as not very deep and very open. Cave not suitable for roosting due to open nature and ambient temperature	Yes – cave very open
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

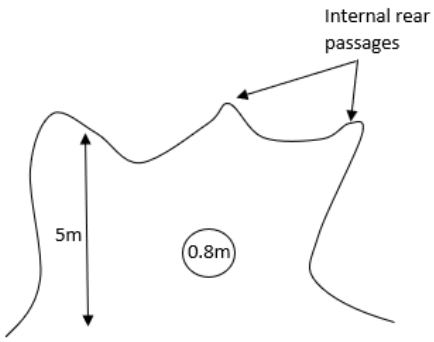
Cave ID: MEC029	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668407E 7553187S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.2 x 2.2	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Not likely to be suitable for roosting as not very deep and very open. No roosting likely due to open nature and low humidity.	Yes – cave very open
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

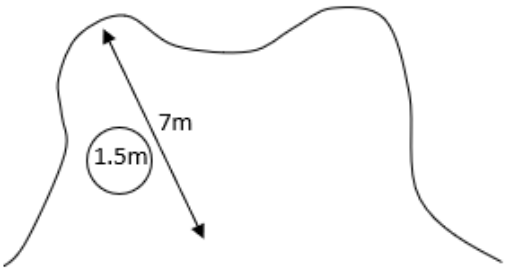
Cave ID: MEC030	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Yes, feeding debris and scats found	668403E 7553178S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Main – 0.9 x 0.8	
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Nocturnal GB feeding cave. Unlikely to be a roost due to airflow through cracks in chamber ceiling, reducing humidity	Yes - 3m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient. Three cracks from internal chamber open to above allowing airflow.
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

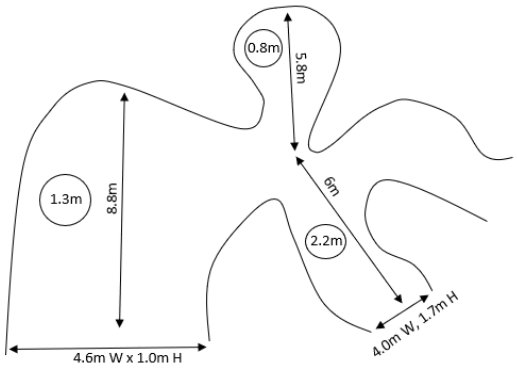
Cave ID: MEC031	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668651E 7553387S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.6 x 1.2	North-east
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to Drill Line
Cave Floorplan and Photo	
	

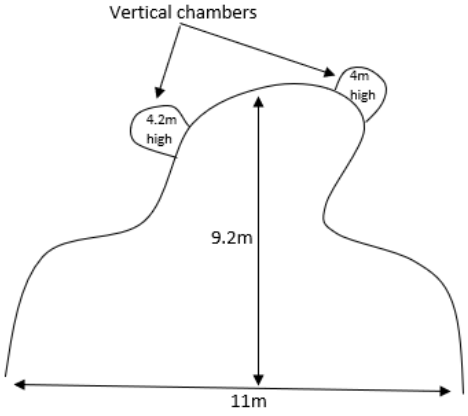
Cave ID: MEC032	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668662E 7553402S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 12.0 x 2.1	East
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Lower part of ridge
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possibly	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to Drill Line
Cave Floorplan and Photo	
	

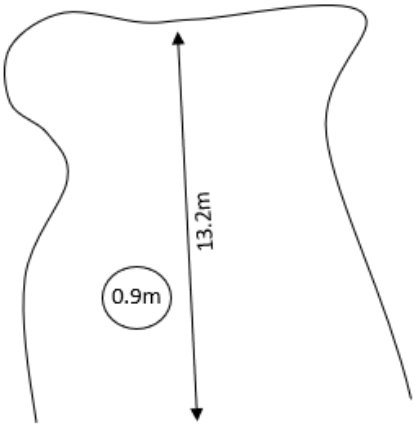
Cave ID: MEC033	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668737E 7553601S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.0 x 0.6	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping in small valley ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	Small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with spinifex	300m to Drill Line
Cave Floorplan and Photo	
	

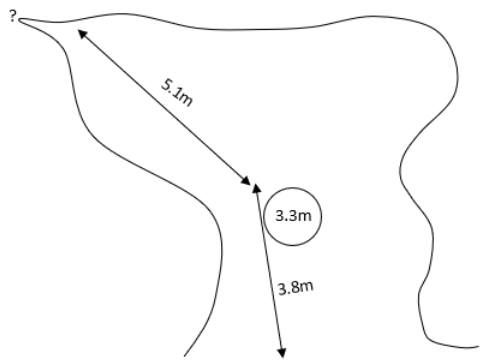
Cave ID: MEC034	**Date:** 2/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	667761E 7553600S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.8	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping in small valley ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site in rear passages (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Present	Ambient, unknown in passages
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hills with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

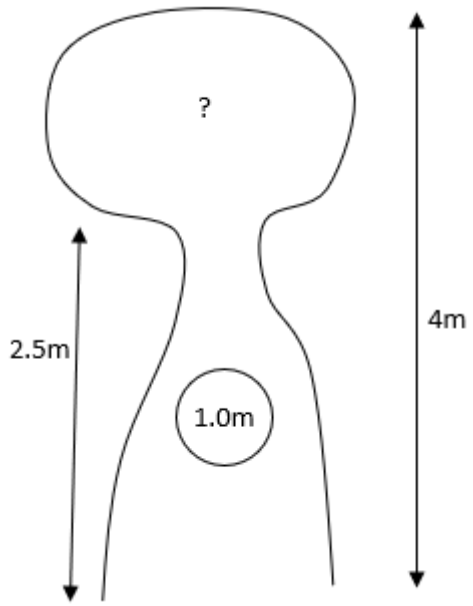
Cave ID: MEC035	**Date:** 2/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	667760E 7553667S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 1.8	South
Cave Grouping:	**Insulation from surface above:**
Single	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hills with Spinifex	Kilometres. Long distance away from Drill Pads
Cave Floorplan and Photo	
	

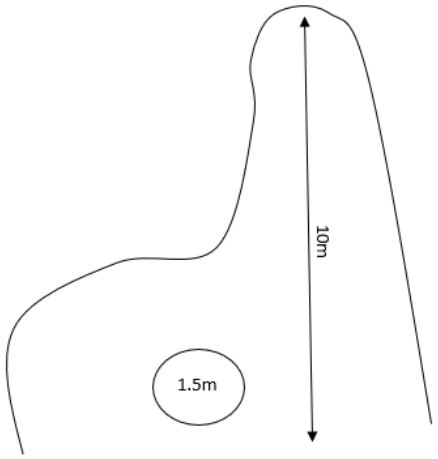
Cave ID: MEC036	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668732E 7552393S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
3 entrance Entrance 1 – 4.6 x 1.0 Entrance 2 – 4.0 x 1.7	North-east
Cave Grouping:	**Insulation from surface above:**
Multiple on ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Open cave with deep chambers, Potential nocturnal shelter (GB/PLnB), unlikely roost due to lack of humidity and airflow	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	100m from Drill Lines
Cave Floorplan and Photo	
	

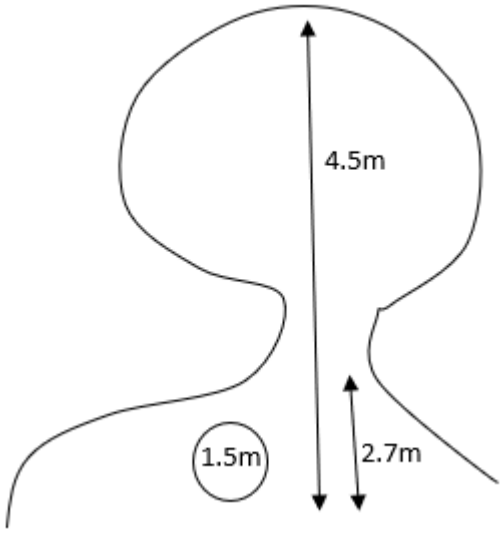
Cave ID: MEC037	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Possibly suitable	668690E 7552471S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 11.0 x 3.0	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Open with two vertical chambers Potential nocturnal shelter (GB/PLnB), potential roost site in back chambers (GB/PLnB)	Two vertical chambers with deep cracks
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Two rear chambers	Ambient- temp in chambers unknown
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	100m from Drill Lines
Cave Floorplan and Photo	
	

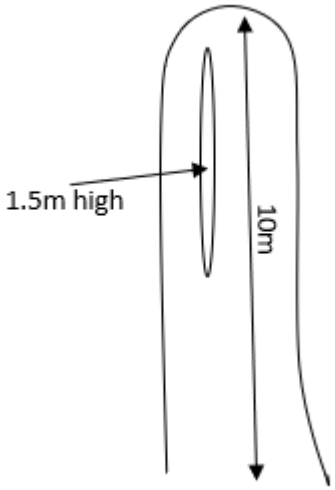
Cave ID: MEC038	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668825E 7552434S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.3 x 0.5	South
Cave Grouping:	**Insulation from surface above:**
Mid-slope ridge	Mid ridge
Cave Type & roost suitability:	**Internal domed chamber:**
Overhang with low roof through cave, Potential nocturnal shelter (PLnB only)	Possible
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	200m from Drill Lines
Cave Floorplan and Photo	
	

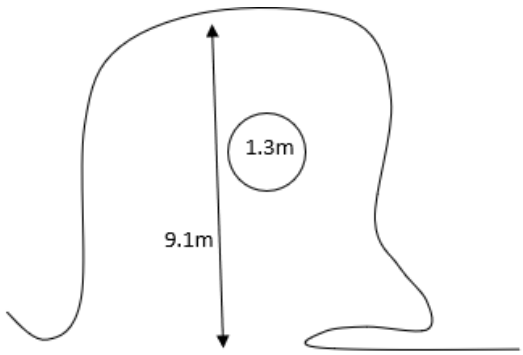
Cave ID: MEC039	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Possible	668952E 7552713S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.1 x 1.1	East
Cave Grouping:	**Insulation from surface above:**
Single in ridge	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Single entrance split in 2 by a single rock, Potential nocturnal shelter (GB/PLnB), potential roost site (GB/PLnB)	Yes - 3
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes – small entrance	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	200m
Cave Floorplan and Photo	
	

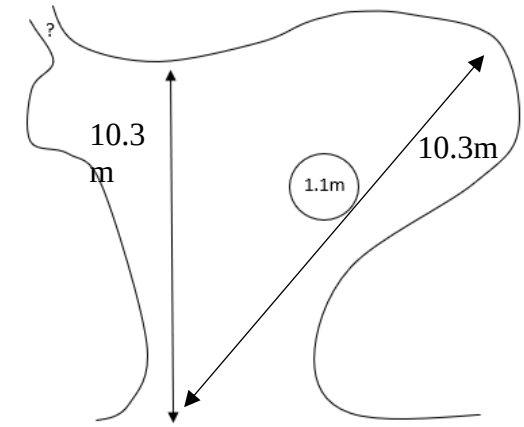
Cave ID: MEC040	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668739E 7552289S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.0 x 0.5	South
Cave Grouping:	**Insulation from surface above:**
Loose grouping/ridgeline of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Small cave with constriction and possible chamber, potential nocturnal shelter (PLnB), potential roost site (PLnB)	Possible internal chamber after 2.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Hot and humid
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	Drill Lines in close proximity
Cave Floorplan and Photo	
	

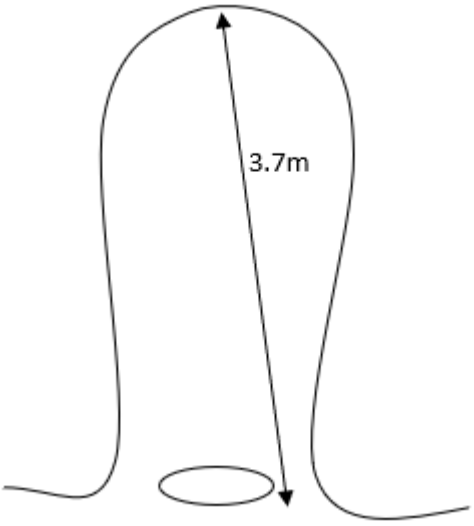
Cave ID: MEC041	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668758E 7552382S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 8.0 x 1.4	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of significant caves	Mid-slope
Cave Type & roost suitability:	**Internal domed chamber:**
Open cave with possible chamber, Potential nocturnal shelter (PLnB/GB)	Possible after 5 m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	Drill Lines in close proximity
Cave Floorplan and Photo	
	

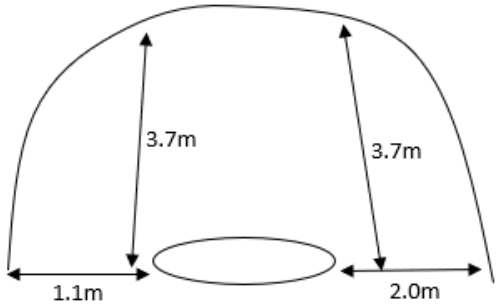
Cave ID: MEC042	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668743E 7552389S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.8 x 1.5	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of significant caves	Mid-slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	Yes – approximately 2.5m L x 2.0m W x 2.0m H
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	Drill Lines in close proximity
Cave Floorplan and Photo	
	

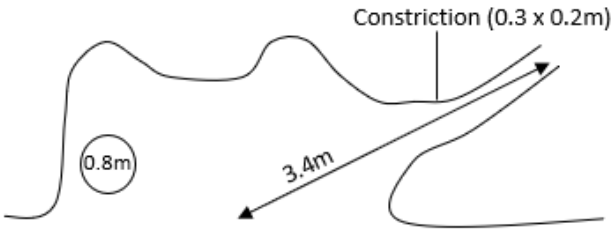
Cave ID: MEC043	**Date:** 30/6/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668697E 7552423S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.5 x 1.4	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely roost due to ambient temperature	Present with small chamber/cracks
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Lines
Cave Floorplan and Photo	
	

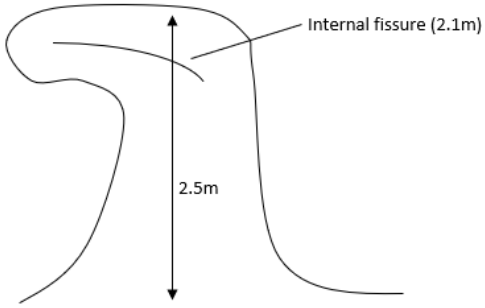
Cave ID: MEC044	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670767E 7553847S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.3 x 1.6	South
Cave Grouping:	**Insulation from surface above:**
Multiple large caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres
Cave Floorplan and Photo	
	

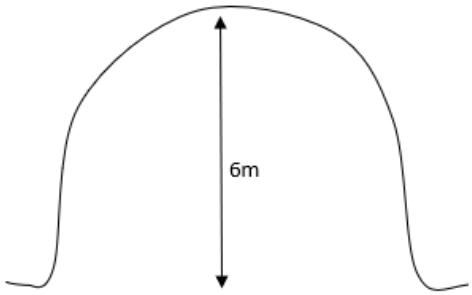
Cave ID: MEC045	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670925E 7553107S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.1 x 1.0	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter/potential roosting (small bats present on inspection)- PLnB only	Yes – 1.1m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Warm/humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Lines
Cave Floorplan and Photo	
	

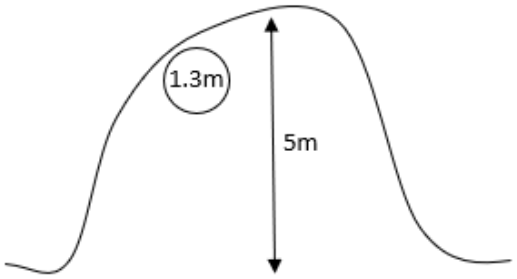
Cave ID: MEC046	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669396E 7553603S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 0.6 x 0.5 2- 0.5 x 0.4	West
Cave Grouping:	**Insulation from surface above:**
Group of small caves	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – rear unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

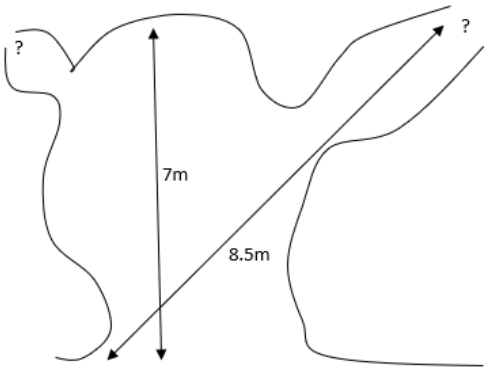
Cave ID: MEC047	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669396E 7553603S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 1.1 x 0.7 2- 2.0 x 0.7	West
Cave Grouping:	**Insulation from surface above:**
Group of small caves	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

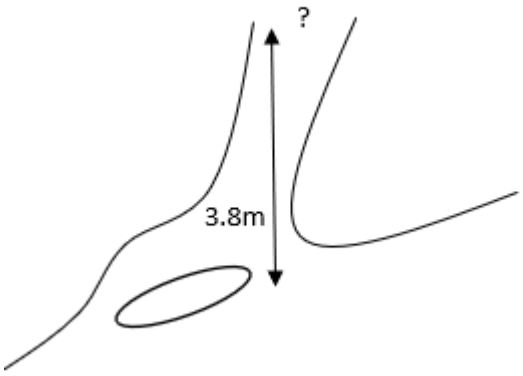
Cave ID: MEC048	**Date:** 30/6/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668646E 7552180S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.3 x 0.7	North
Cave Grouping:	**Insulation from surface above:**
Isolated cave in small ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Small internal passage	Ambient – unknown beyond constriction
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	50m to Drill Line
Cave Floorplan and Photo	
	No photo

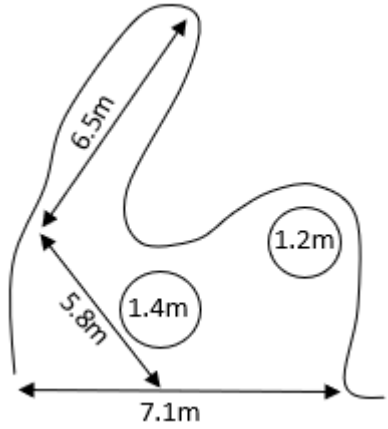
Cave ID: MEC049	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669392E 7554034S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.5 x 0.7	South
Cave Grouping:	**Insulation from surface above:**
Very loose grouping of caves on ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost in internal fissure (PLnB only)	Yes – 2.1m internal fissure
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to road
Cave Floorplan and Photo	
	

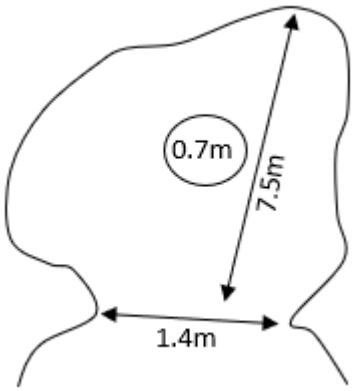
Cave ID: MEC050	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669293E 7553661S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 9.0 x 0.9	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	No – low, open cave
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

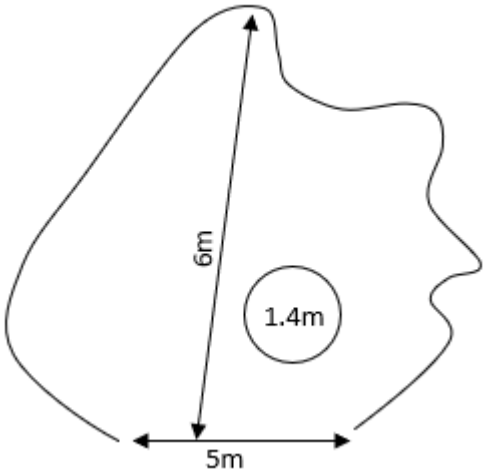
Cave ID: MEC051	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669299E 7553679S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 0.8	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping of shallow caves on ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter – low, open overhang (PLnB)	Yes - small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

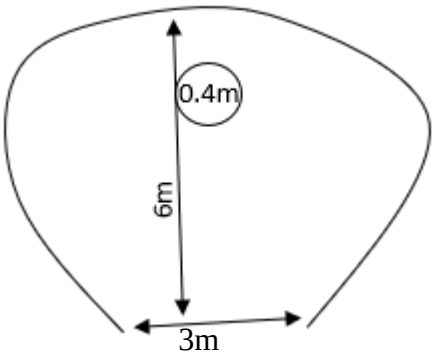
Cave ID: MEC052	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670322E 7553366S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.3 x 1.1	North-west
Cave Grouping:	**Insulation from surface above:**
Several caves in small ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (microbats witnessed in cave)- PLnB only	Not seen
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hill with Spinifex	Kilometres to road
Cave Floorplan and Photo	
	

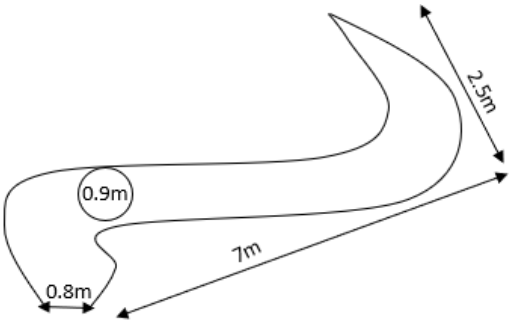
Cave ID: MEC053	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670322E 7553366S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 1.5 x 1.0 2- 1.0 x 0.9	North-west
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	Not seen
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hill with Spinifex	Kilometres to road
Cave Floorplan and Photo	
	

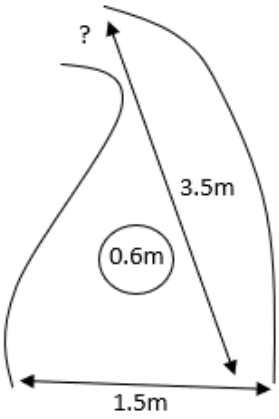
Cave ID: MEC054	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670754E 7553854S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 7.0 x 1.1	South
Cave Grouping:	**Insulation from surface above:**
Ridge of good caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (microbats witnessed in cave) – PLnB only	Yes – internal chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

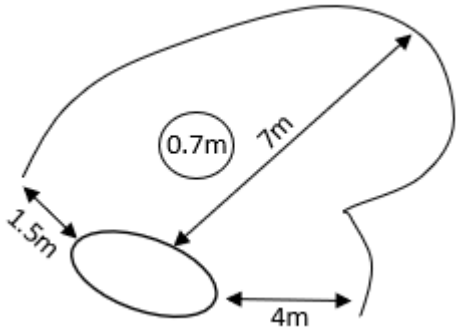
Cave ID: MEC055	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670771E 7553853S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.4 x 0.3	South
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope – rock, spinifex etc.
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	Yes – internal chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

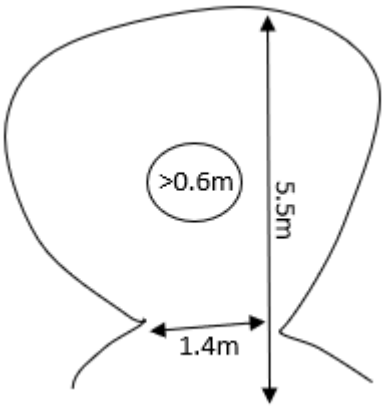
Cave ID: MEC056	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670809E 7553866
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.0 x 1.2	South-southeast
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter only - PLnB	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

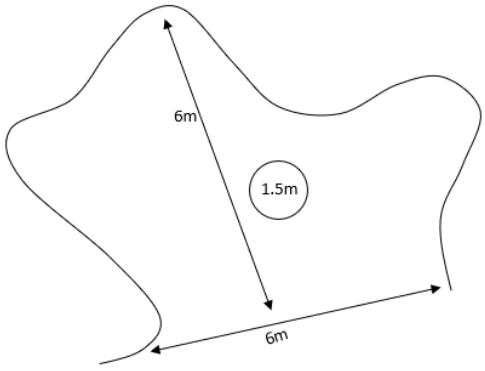
Cave ID: MEC057	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670731E 7553556S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.3	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of minor caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

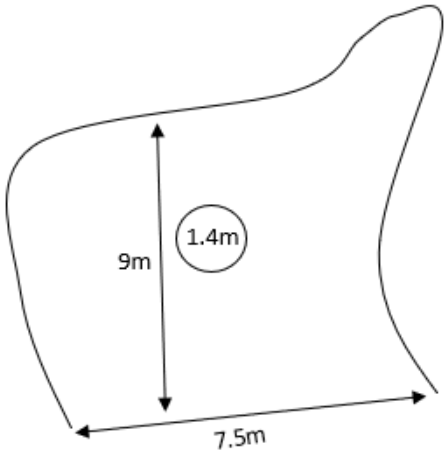
Cave ID: MEC058	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	671980E 7553879S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.8 x 0.8	East
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

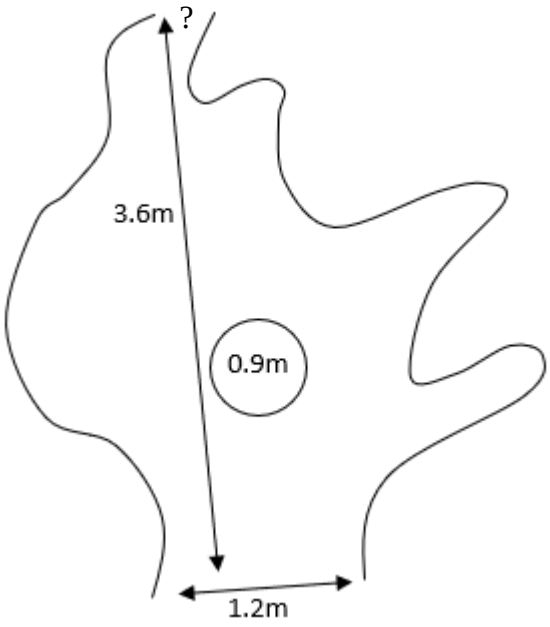
Cave ID: MEC059	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	671974E 7553892S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.5 x 0.6	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Top of slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	Unlikely
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

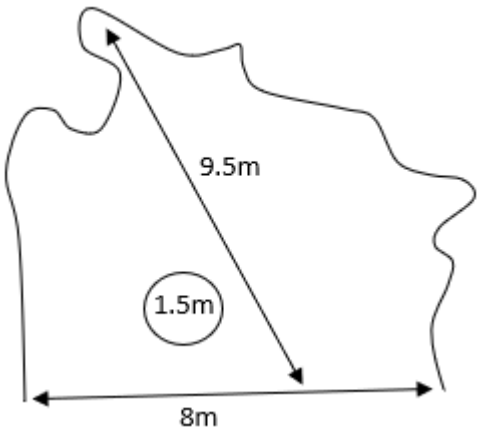
Cave ID: MEC060	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668851E 7553947
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 4.0 x 0.4 2 – 1.5 x 0.4	North
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Overhang. Potential nocturnal shelter- PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

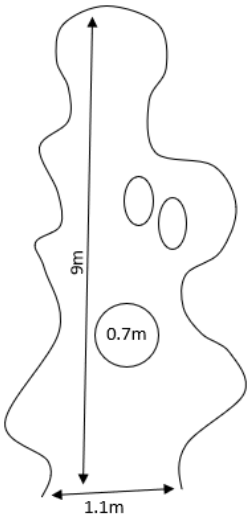
Cave ID: MEC061	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668851E 7553932S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.4 x 0.3	North-east
Cave Grouping:	**Insulation from surface above:**
Ridgeline of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB only)	Present – internal chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

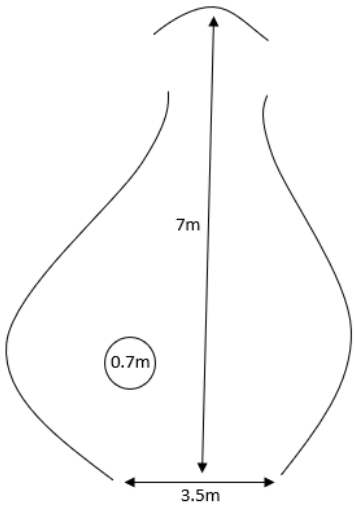
Cave ID: MEC062	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668826E 7553946S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 1.5	North-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

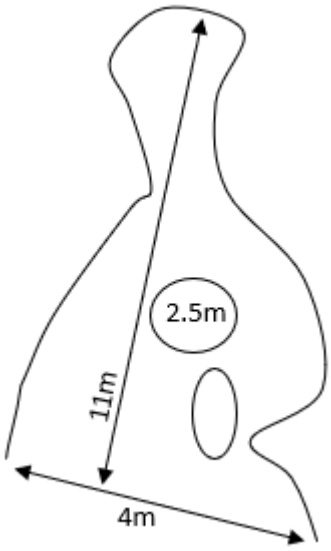
Cave ID: MEC063	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668828E 7554009S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 7.5 x 1.5	East-southeast
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

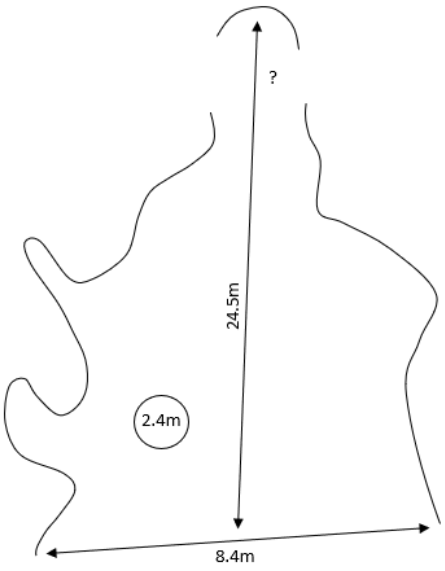
Cave ID: MEC064	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668553E 7552286S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.2 x 0.9	South
Cave Grouping:	**Insulation from surface above:**
Single cave	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely roost due to ambient temp	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Unlikely	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	20m
Cave Floorplan and Photo	
	

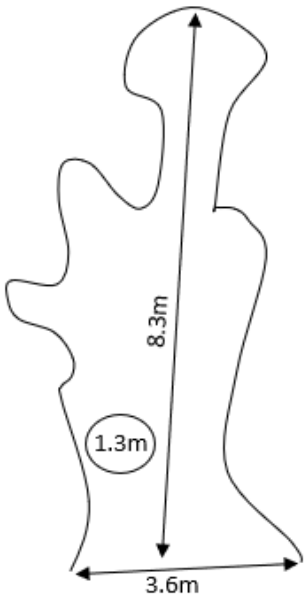
Cave ID: MEC065	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668642E 7553592S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 8.0 x 1.5	South
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, low overhang (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Unlikely	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	400m
Cave Floorplan and Photo	
	

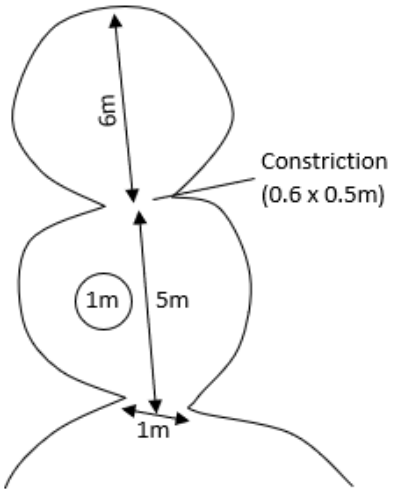
Cave ID: MEC066	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668644E 7553331S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.1 x 0.7	East
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB)	Small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m
Cave Floorplan and Photo	
	

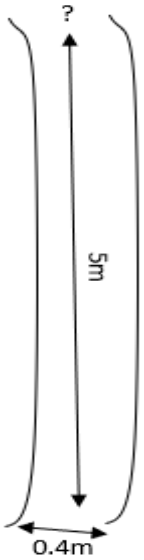
Cave ID: MEC067	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668464E 7553325S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.5 x 0.7	South-east
Cave Grouping:	**Insulation from surface above:**
Several good caves	Mid-upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, low overhang (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	150m
Cave Floorplan and Photo	
	

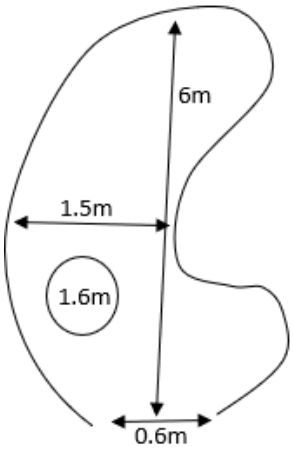
Cave ID: MEC068	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668555E 7553260S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.0 x 4.0	South
Cave Grouping:	**Insulation from surface above:**
Ridge of good caves	Mid - upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB). Not potential roost due to ambient temperature	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	75m
Cave Floorplan and Photo	
	

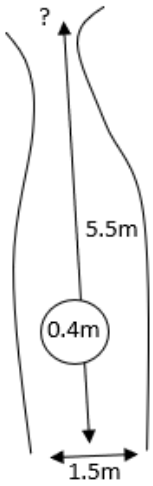
Cave ID: MEC069	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668587E 7553258S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 8.5 x 2.4	South
Cave Grouping:	**Insulation from surface above:**
Ridge of good caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Multiple chambers– Potential nocturnal shelter and potential roost site (GB/PLnB)	Small chambers
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	50m
Cave Floorplan and Photo	
	

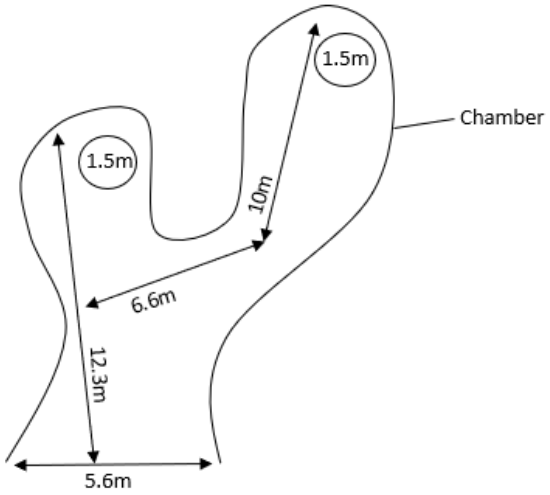
Cave ID: MEC070	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	6688616E 7553160S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.6 x 1.3	Northwest
Cave Grouping:	**Insulation from surface above:**
Ridgeline of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB only)	Small chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m
Cave Floorplan and Photo	
	

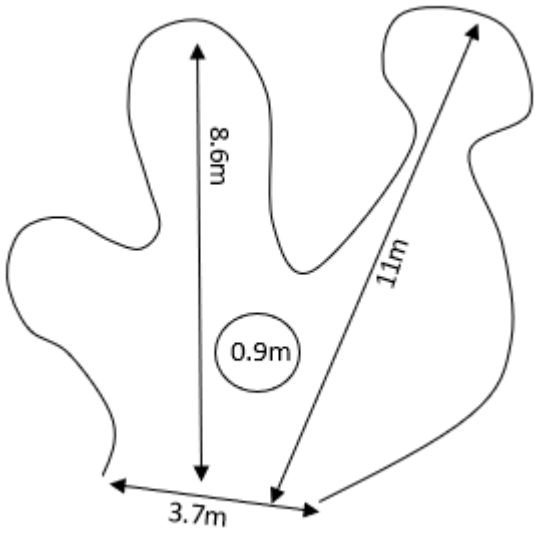
Cave ID: MEC071	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668750E 7552954S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.0 x 0.3	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Yes - 2
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	500m
Cave Floorplan and Photo	
	

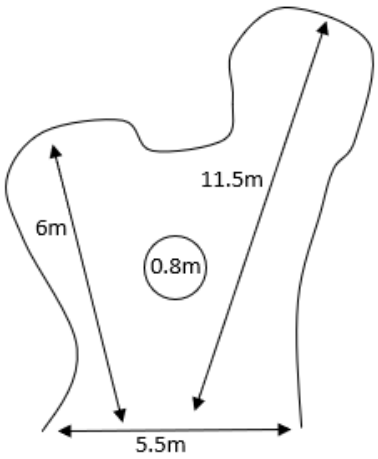
Cave ID: MEC072	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668701E 7552925S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.4 x 0.25	North
Cave Grouping:	**Insulation from surface above:**
Solo/valley of caves	Mid- upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB only	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Unknown deeper, ambient at entrance
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m
Cave Floorplan and Photo	
	

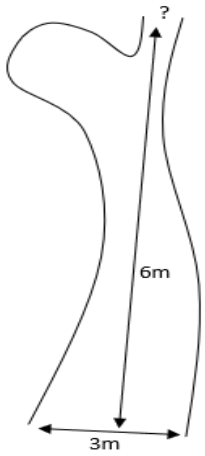
Cave ID: MEC073	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668944E 7552779S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.6 x 0.4	North-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Small entrance with chamber. Potential nocturnal shelter, potential roost site (PLnB only)	Small with cracks
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	400m
Cave Floorplan and Photo	
	

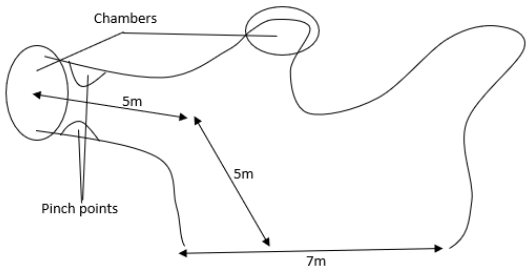
Cave ID: MEC074	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668994E 7552657S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single, small low entrance – 1.5 x 0.4	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Possible
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Relative – unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	400m
Cave Floorplan and Photo	
	

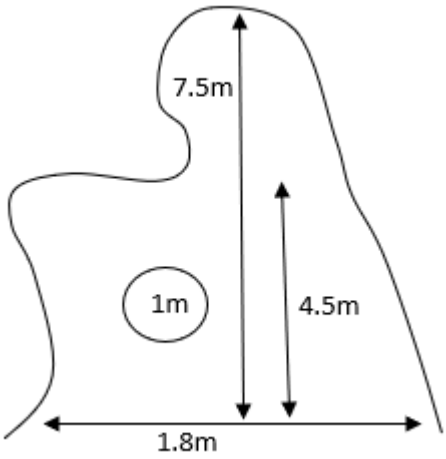
Cave ID: MEC075	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664774E 7553720S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single wide, low entrance– 5.6 x 1.3	East
Cave Grouping:	**Insulation from surface above:**
Valley of small caves	>5 metres, mid to upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Long with two chambers, potential nocturnal shelter, potential roost site (GB/PLnB)	Yes - two
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	0.5 – 1 kilometre
Cave Floorplan and Photo	
	

Cave ID: MEC076	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	665245E 7554058
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single low, wide entrance – 3.7 x 1.0	South-southeast
Cave Grouping:	**Insulation from surface above:**
Gully of caves	5m of rock
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	No photo

Cave ID: MEC077	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	665359E 7554512S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.5 x 0.8	North-west
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	5m of rock
Cave Type & roost suitability:	**Internal domed chamber:**
Low, wide cave with possible passage Potential nocturnal shelter, potential roost site (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Approximately 1.5km
Cave Floorplan and Photo	
	

Cave ID: MEC078	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664943E 7554286S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.7	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of caves	Rock, spinifex, >3 metres
Cave Type & roost suitability:	**Internal domed chamber:**
Tunnel with low roof (approximately 0.5m high) Potential nocturnal shelter, potential roost site (PLnB only)	Unlikely
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient at entrance- unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Approximately 1.5km
Cave Floorplan and Photo	
	

Cave ID: MEC079	**Date:** 2/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668660E 7552520S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 7.0 x 1.5	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of quality caves	2-10 feet
Cave Type & roost suitability:	**Internal domed chamber:**
Wide, low entrance with two narrow passages Potential nocturnal shelter, potential roost site (GB/PLnB)	Yes - two small chambers
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes - three	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	150m
Cave Floorplan and Photo	
	

Cave ID: MEC080	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668743E 7552286S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single entrance behind boulders – 1.8 x 0.75	South
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves and shelter	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Small cave with low roof Potential nocturnal shelter, potential roost site, no calls recorded (PLnB only)	Possibly deep internal dome after 4.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Potentially a rear passage	Hot
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Lines
Cave Floorplan and Photo	
	

Cave ID: MEC081	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
No	668789E 7551154S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.3 x 0.4	West
Cave Grouping:	**Insulation from surface above:**
Single opening in small breakaway	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Small entrance with unknown internal dimensions, potential roost site, no PLnB calls recorded close to CT	Unsure
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None seen- possible	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	50m to drill line
Cave Floorplan and Photo	
No floorplan	

APPENDIX K TARGETED PILBARA LEAF-NOSED BAT ASSESSMENT REPORT

JANUARY 2021



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management and monitoring solutions
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ENVIRONMENT

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MULGA EAST PILBARA LEAF-NOSED BAT ASSESSMENT

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Document Status						
Rev.	**Author(s)**	**Reviewer**	**Date**	**Approved for Issue**		
				Name	**Distributed To**	**Date**
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1	T. McCabe, C. Buters	S. Grein	25/01/2021	S Grein	R Duckworth	25/01/2021

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EXECUTIVE SUMMARY

ecologia confirmed the presence of the Pilbara leaf-nosed bat within the Project Area during Phase 1 of the Level 2 assessment conducted in April 2019. These recordings initiated the requirement for targeted surveys, with the primary objective of determining the type and location(s) of potential Pilbara leaf-nosed bat roost sites and to better understand population dynamics and habitat use within the Project Area. A total of five targeted surveys have been completed assessing 216 sites (468 recording nights) using ultrasonic acoustic recording units.

A valley where calls were consistently recorded was identified as the most likely to support a roost. Extensive survey effort, including analysis of aerial imagery, video from unmanned aerial vehicle (UAV) flights and targeted searches on foot to ground-truth results was undertaken within this valley to identify suitable rocky habitats. Eighty-two cave habitat assessments were completed within the Project Area to evaluate potential roost cave candidates and to assess cave architecture, geology and climatic conditions to better define potential roost locations.

A total of 45 caves within the target valley were surveyed for at least one night. Call times indicated that it is unlikely any of these caves are used as either permanent diurnal (Priority 1) or non-permanent breeding roosts (Priority 2). Nocturnal Pilbara leaf-nosed bat activity was recorded at 21 caves, with call times indicating that these caves are used as nocturnal refuges or as sites of occasional visitation rather than diurnal roosts. As call times recorded at cave entrances within target areas did not indicate diurnal roosting by Pilbara leaf-nosed bats, cave entrance sheeting to confirm diurnal occupancy was not undertaken.

Cave MEC016 was the site of a long-term detector and activity patterns were not consistent with diurnal roosting or breeding activity; however, on 16 February 2020, call activity close to civil twilight suggested potential diurnal roosting or the presence of a diurnal roost in the vicinity. Entrance sheeting would have unambiguously determined whether this cave met the definition of a transitory roost; however, this is a rare occurrence, and it is not possible to predict when such instances occur.

The Project Area was assessed as supporting Gullies (Priority 2), Rocky Outcrop (Priority 3), and Open Grassland and Woodland (Priority 5) foraging habitat. Rocky Hills and Drainage Lines within the Newman land system supports Priority 2 and Priority 3 foraging habitat while Drainage Lines (not within Newman land system) and Stony Spinifex Plains and Hillslopes support Priority 5 foraging habitat.

Pilbara leaf-nosed bat calls were recorded consistently across all surveys and seasons indicating year-round use of habitats within the Project Area. No observations recorded during these surveys suggest the presence of a permanent diurnal roost (Priority 1) or a non-permanent breeding roost (Priority 2) within the Project Area; however, the year-round presence and call times recorded indicate that it is likely a diurnal roost occurs in the vicinity of the Project Area.

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1 INTRODUCTION

1.1 PROJECT BACKGROUND

Hancock Prospecting Pty Ltd (HPPL) is seeking to develop the Mulga East Iron Ore Project 'the Project Area'). In order to meet the Environmental Protection Authority's (EPA) environmental objectives for the environmental factor "*Terrestrial Fauna*" (Environmental Protection Authority 2016a), Ecologia Environmental Consultants (*ecologia*) was commissioned by Strategen-JBS&G, on behalf of HPPL, to conduct a Level 1 fauna habitat assessment, a baseline Level 2 vertebrate fauna survey and targeted conservation significant fauna surveys of the Project Area which is comprised of the following tenements: Mulga East (R 47/0012), Malay Wells (E 47/2117) tenements and proposed Rail corridor (E45/380, L45/381, L45/382 and L45/447 with E47/2044, E45/3593) (Figure 1.1). Initial Level 2 surveys indicated the Commonwealth *Environmental Protection and Biodiversity Conservation* (EPBC) *Act* (1999) and state *Biodiversity Conservation* (BC) Act (2016) Vulnerable listed Pilbara leaf-nosed bat was present in the area and targeted surveys were undertaken to better understand habitat use and to determine if Pilbara leaf-nosed bat roost sites occur within the Mulga East Project Area.

Numerous Pilbara leaf-nosed bat calls were recorded during Phase 1 of the Level 2 survey conducted in April 2019 and again during targeted surveys conducted in July 2019, confirming the continued presence of this species within the Project Area. This report outlines the results of targeted Pilbara leaf-nosed bat surveys completed, cave habitat assessments and a consolidation of all Pilbara leaf-nosed bat surveys conducted within the Project Area.

The Project Area is located wholly within the Mulga Downs pastoral lease and includes the HPPL exploration tenements Mulga East (R47/0012) and Malay Well (E47/2117). An associated proposed 50 km rail extending from the Roy Hill Iron Ore rail line to the Project Area lies partially within the Mulga Downs Pastoral station, vacant Crown Land and other reserves. The nearest key landscape features include the Karijini National Park which is 15 km to the south-west and the Fortescue Marsh (Figure 1.1), the western portion of which is approximately 60 km east of the Mulga East exploration camp.

The proposed Project, which is subject to ongoing studies, is likely to include the following infrastructure:

- A series of open cut mine pits;
- On site ore processing plant, waste rock landforms, waste fine storage area (or tailings storage facility);
- Mine infrastructure including rail load out facility, workshops, access and service roads, accommodation camp and airport; and
- A rail spur of approximately 50 km in length from the site to the existing Roy Hill Iron Ore rail line.

1.2 SURVEY OBJECTIVES

The Environmental Protection Authority's (EPA) environmental objectives for the factors *Terrestrial Fauna* (Environmental Protection Authority 2016a) are: "To protect terrestrial fauna so that biological diversity and ecological integrity are maintained." In this context, 'ecological integrity' is the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements. The surveys are intended for use as a supporting document for the environmental impact assessment of the proposal, which has been referred under Section 38 of the *Environmental Protection Act* 1986 (EP Act). The project is also being assessed as a controlled action under the terms of the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), and the document provides technical support and data to inform those assessments. To this end, the following activities were undertaken as part of this assessment:

- Targeted surveys to determine the location(s) of Pilbara leaf-nosed bat roost sites;

- Gain an understanding of population dynamics and critical habitat;
- Consolidation of all Pilbara leaf-nosed bat surveys within the Project Area; and
- Cave habitat assessments to map and rank the importance of cave habitat present within the Project Area.

1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The survey was designed and undertaken to comply with the following guidance documents:

- Environmental Factor Guideline: Terrestrial Fauna (Environmental Protection Authority 2016a);
- Technical Guidance: Sampling methods for terrestrial vertebrate fauna (Environmental Protection Authority 2016b);
- Technical Guidance: Terrestrial Fauna Surveys (Environmental Protection Authority 2016c);
- Survey Guidelines for Australia's Threatened Bats (Department of Sustainability Environment Water Population and Communities 2010);
- Survey Guidelines for Australia's Threatened Mammals (Department of Sustainability Environment Water Population and Communities 2011);
- Conservation Advice for *Rhinonicteris aurantius* (Pilbara form) (Pilbara Leaf-nosed Bat) (Threatened Species Scientific Committee 2016); and
- Species Profiles and Threats Database for *Rhinonicteris aurantius* (Pilbara form) (Pilbara Leaf-nosed Bat) (Department of the Environment 2020).

1.4 ANALYSIS, TAXONOMY AND NOMENCLATURE

Nomenclature for bat species within this report is according to the *Western Australian Museum Checklist of the Vertebrates of Western Australia* November 2020.

Mr Robert Bullen of Bat Call WA analysed all acoustic bat call data collected during the targeted Pilbara leaf-nosed bat surveys. Mr Robert Bullen also provided summary reports of his findings and expert advice throughout assessment process (Appendix B, C, D). Dr Kyle Armstrong provided analysis and additional interpretation of data (Appendix E).

1.5 STUDY TEAM AND LICENCES

The fauna assessments undertaken by *ecologia* were planned, coordinated, executed and reported by those summarised below in Table 1.1. DBCA licences are also provided.

Table 1.1: Study team and licences.

Project Staff				
Name	**Qualification**	**Experience**	**Role**	**Project role**
Shaun Grein	B. Sc. Biol.; Grad. Dip. Nat. Resources; MBA	>25 yrs	Managing Director/Principal Scientist	Project management, QA
Tim McCabe	B.Sc. Env. Biol, Dip Proj Management, Cert III Vert Pest Management	>12 yrs	Senior Zoologist	Project management, fauna field assessment, reporting
Ed Swinhoe	Masters Vert. Cons, Cert III Vert Pest Management	>12 yrs	Senior Zoologist	Fauna field assessment
Tom Clairs	Cert III Conservation Land Management	>5 yrs	Field Zoologist	Fauna field assessment
Claudia Buters	B.Sc Cons. Biol. & Zool.; M.WildlifeHth	>5 yrs	Zoologist	Reporting
DBCA Licenses				
Holder	**Type**			**Number**
Tim McCabe	Authorisation to take or disturb Threatened species			TFA 2019-0010
Tim McCabe	Fauna Taking (Biological Assessment) Licence – Regulation 27			BA27000030

1.6 PILBARA LEAF-NOSED BAT (*Rhinonicteris aurantius)* PROFILE

The Pilbara leaf-nosed bat is the Pilbara form of the orange leaf-nosed bat (*Rhinonicteris aurantia*) and is listed as Vulnerable. While it is considered a separate form, formal reclassification has been hampered by the small size of the Pilbara population which appear morphologically similar to the northern form (Armstrong 2008).

This small, insectivorous bat occurs throughout the Pilbara and adjacent upper Gascoyne regions of Western Australia (Threatened Species Scientific Committee 2016). The species was listed as Vulnerable in Western Australia in April 2001 as it had undergone a substantial reduction in numbers, its geographic distribution is precarious for its survival (being limited to the Pilbara), and the estimated total number of mature individuals is limited and the number is likely to continue to decline (Threatened Species Scientific Committee 2016).

The Pilbara leaf-nosed bat has specific and very restrictive roost requirements including caves, adits and disused mines with hot to very hot (28-32°C) and humid (96-100%) microclimates (Armstrong 2001; Churchill 2008). Individuals rapidly dehydrate and die within a short period of time if removed from their roost (Bat Call 2016). During the dry season, prior to the heavy summer rains, Pilbara leaf-nosed bat colonies are believed to contract to the deepest mines and caves that maintain microclimates suitable for roosting (Armstrong 2001; van Dyck and Strahan 2008a; Bullen and McKenzie 2011). At least 10 caves and underground mine sites have been confirmed as permanent diurnal roost locations (Priority 1) and in some cases these roosts also function as breeding sites (Threatened Species Scientific Committee 2016).

Underground refuges used by the Pilbara leaf-nosed bat can be classified into one of the following standard categories:

- **permanent diurnal roosts (Priority 1)**—occupied year-round and likely the focus for some part of the 9-month breeding cycle; considered as critical habitat that is essential for the daily survival of the Pilbara leaf-nosed bat.

- **non-permanent breeding roosts (Priority 2)**—evidence of usage during some part of the 9-month breeding cycle (July–March), but not occupied year-round; considered as critical habitat that is essential for both the daily and long-term survival of the Pilbara leaf-nosed bat.

- **transitory diurnal roosts (Priority 3)**—occupied for part of the year only, outside the breeding season (i.e. April–June), and which could facilitate long distance dispersal in the region; considered as critical habitat that is essential for both the daily and long-term survival of the Pilbara leaf-nosed bat.

- **nocturnal refuge (Priority 4)**—occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Excludes overhangs. Not considered critical habitat but are important for persistence in a local area.

Pilbara leaf-nosed bats have been observed foraging in a variety of habitats including spinifex hummock grasslands covering low rolling hills and shallow gullies, black soil grasslands, open savannah woodland, tall open forest and monsoon rainforest (Churchill *et al.* 2008). The Pilbara leaf-nosed bat is commonly encountered over small pools of water in rocky gullies and gorges (Department of the Environment 2020). Foraging areas may range up to 20 km away from a diurnal roost (Bat Call 2016). Given the lack of understanding around which habitats are required to sustain a roosting colony, it is difficult to define critical foraging habitat of the Pilbara leaf-nosed bat (Threatened Species Scientific Committee 2016). According to the Conservation Advice for the Pilbara leaf-nosed bat, foraging habitats are categorised as follows:

- **Gorges with pools (Priority 1)**—watercourses through upland areas bounded by sheer rock walls for parts of their length, often containing pools that remain for weeks or months, sites of relatively large biomass production, sometimes containing caves;
- **Gullies (Priority 2)**—primary drainage with limited riparian development in upland rocky habitats, sometimes containing small pools that may last for weeks, with less biomass production than Priority 1 gorge habitat;
- **Rocky outcrop (Priority 3)**—areas of exposed rock at the top of rocky outcrop and mesa hills that contain caves and overhangs, and boulder piles in the granite terrains;
- **Major watercourses (Priority 4)**—riparian vegetation on flat land plus the main gravelly or sandy channel of the riverbed, sometimes containing pools that persist for weeks or months, and generally supporting higher productivity of biomass than the surrounding habitats;
- **Open grassland and woodland (Priority 5**)—dominated by *Triodia,* on lowland plains, colluvial slopes and hilltops.

At dusk, Pilbara leaf-nosed bats emerge from their roosting sites to forage in gorges, small gullies and large watercourses for insects (van Dyck and Strahan 2008b). The Pilbara leaf-nosed bat is a highly acrobatic flyer which is capable of intercepting prey in the air (McKenzie and Bullen 2009)

This species is highly susceptible to disturbances and will abandon roost caves when startled (Threatened Species Scientific Committee 2016). Colonies in mines in the eastern Pilbara are subject to several pressures, including human visitation, and the collapse and flooding of disused mines and exploration activities by mining companies (Armstrong 2008; Threatened Species Scientific Committee 2016).

The nearest known Pilbara leaf-nosed bat roost locations are at Koodaideri, approximately 70 km to the south-east of Mulga East and to the south of Millstream approximately 150 km west of the Project Area in the Hamersley Ranges. The Mt Webber roost which is approximately 80 km to the north-east of the Project Area.

500000 550000 600000 650000 700000 750000 800000 850000

7650000 7600000 7550000 7500000 7450000

Millstream Chichester National Park

Millstream Pools

MILLSTREAM YARRALOOLA ROAD

ROEBOURNE WITTENOOM ROAD

Mungaroona Range Nature Reserve

PORT HEDLAND WITTENOOM ROAD

HILLSIDE MARBLE BAR ROAD

RIPON HILLS ROAD

HILLSIDE WOODSTOCK ROAD

SKULL SPRINGS ROAD

BONNEY DOWNS HILLSIDE ROAD

MARBLE BAR ROAD

BONNEY DOWNS NOREENA ROAD

MOUNT BROCKMAN ROAD

TOM PRICE RAILWAY ROAD

HAMERSLEY ROAD

MUNJINA WITTENOOM ROAD

Fortescue Marshes

HAMERSLEY MOUNT BRUCE ROAD

BANJIMA DRIVE

Karijini (Hamersley Range) Gorges

NOREENA ROY HILL ROAD

KARIJINI DRIVE

Mt. Bruce coolibah-lignum flats

MARANDOO ROAD

NANUTARRA WITTENOOM ROAD

TOM PRICE NORTH ROAD

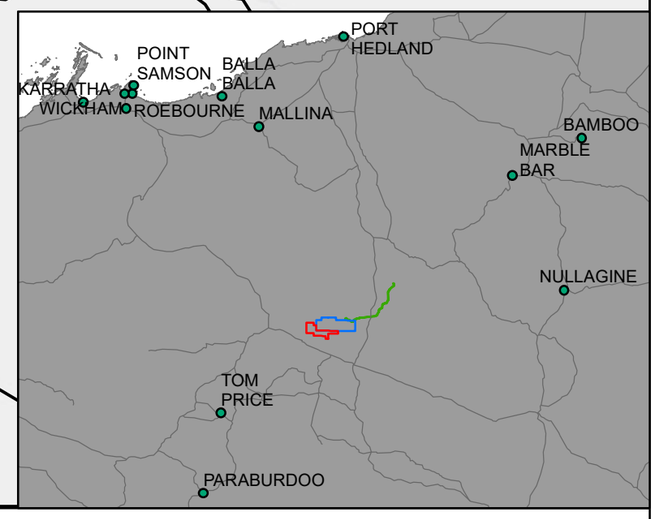
GREAT NORTHERN HIGHWAY

MUNJINA ROY HILL ROAD

JUNA DOWNS ROAD

Karijini National Park

PARABURDOO TOM PRICE ROAD



Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor
- Main Roads
- Nationally Important Wetlands
- DBCA managed lands
- Wittenoom Asbestos Management Area

ecologia ENVIRONMENT

Project: 1757
Date: 30 August 2019
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:1,000,000@A3

Figure 1.1 Project Area

0 25 50
Kilometers

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

2 METHODOLOGY

The survey guidelines for Australia's threatened bat species (Department of Sustainability Environment Water Population and Communities 2010) presents recommended guidelines for efficient and effective survey of the Pilbara leaf-nosed bat. Some of these approaches are now outdated for various reasons, so a revised summary in the Species Profiles and Threats Database provided by Department of the Environment (2020) includes the following six steps:

1. Pre-survey considerations;
2. Determining presence in a locality;
3. Determining roost occupancy;
4. Cave/mine searches;
5. Determination of a roost site in an area; and
6. Survey effort.

2.1 PRE-SURVEY CONSIDERATIONS

A fauna habitat type broadly describes an area of habitat that is distinguishable by its vegetation, soil characteristics and land features, and is likely to host a different fauna assemblage to that found in other fauna habitats. Vertebrate fauna habitat delineation and mapping was based on interpretation of aerial photography and landforms, site habitat site assessments, soil descriptions and ground truthing. For the Mulga East Pilbara leaf-nosed bat assessment, particular attention was given to habitat types which were assessed as likely to be occupied or utilised by the Pilbara leaf-nosed bat. To identify suitable habitat within the Project Area, the following sources of information were used to delineate important habitat for the Pilbara leaf-nosed bat:

- aerial imagery;
- elevation modelling in Google Earth;
- Beard (1968, 1975, 1979) vegetation mapping; and,
- Land system mapping (van Vreeswyk *et al.* 2004).

2.2 DETERMINING PRESENCE IN LOCALITY

In April 2019, a Level 2 terrestrial vertebrate fauna survey was undertaken, and acoustic recording units (ARUs) were deployed to identify bat species present within the Project Area. Bat detectors (SM2's/SM4's) were placed at each of the 18 systematic trapping site and at a further 13 locations within rocky habitats (Figure 2.1). The Pilbara leaf-nosed bat was recorded at five locations prompting further field surveys to understand habitat use within the Project Area.

2.3 DETERMINING ROOST OCCUPANCY

In addition to echolocation call recordings obtained by ARUs at each systematic trap site during the two-phase vertebrate fauna assessment (36 sites), ARUs were deployed at 216 sites to target Pilbara leaf-nosed bats within the Project Area over five targeted surveys (Table 2.1, Figure 2.1, Appendix A).

ARUs were placed in cave entrances to determine occupancy with a total of 45 caves surveyed within target areas. A list of caves surveyed using ARUs and Pilbara leaf-nosed bat call times recorded can be seen in Table 3.3. The entrance sheeting method to confirm diurnal roosting was not undertaken as suspected diurnal roosts were not identified using call times as an indicator.

Table 2.1: Summary of bat ARU sites and detections of Pilbara leaf-nosed bats.

Survey	Sites	Sites with PLnB calls detected
April 2019	31	5
July 2019*	57	31
November 2019*	70	43
Dec 2019 -March 2020*	6	4
April 2020	18	0
July 2020*	42	13
October 2020*	28	6
Total	**252**	**102**

* Denotes targeted survey

2.4 CAVE/MINE SEARCHES

To better understand Pilbara leaf-nosed bat habitat use within the Project Area, cave habitat assessments were undertaken over eight days between 29th June and 6th July 2020. An additional cave was also identified and assessed during the October 2020 targeted survey. Cave habitat assessments were undertaken to evaluate potential roost cave candidates and review cave architecture, geology and cave climatic conditions in order to better define potential roost locations. Cave roost suitability was assessed by evaluating the cave characteristics outlined below and caves were classified as potential roosts, potential nocturnal refuges or unsuitable for use by the Pilbara leaf-nosed bat. Cave habitat assessments were undertaken concurrently with targeted searches for significant fauna including the northern quoll, ghost bat and Pilbara olive python.

Caves identified as having the potential to be suitable as a roost cave or nocturnal refuge for the Pilbara leaf-nosed bat were assessed, and the following parameters were documented:

- Location;
- Basic geology;
- Entrance type and dimensions (gathered using a laser measuring device), entrance orientation;
- Cave grouping, insulation from above;
- Cave type (e.g. overhang, adit, crevice, cave with multiple chambers);
- Internal domed chamber, rear passages that may have a roost;
- Internal temperature and relative humidity;
- Local foraging opportunities and distance to disturbance; and
- Cave floorplan and photograph.

Deep, complex caves with low light levels and a suitable microclimate were categorised as potential Pilbara leaf-nosed bat roost cave (Threatened Species Scientific Committee 2016). Pilbara leaf-nosed bats do not roost in overhangs which don't provide the warm, humid microclimates required by this species, and as a consequence these structures were not considered potential roosts (Threatened Species Scientific Committee 2016). Caves assessed as having the capacity to shelter Pilbara leaf-nosed bats from inclement weather and predators during nocturnal resting or feeding were classified as nocturnal refuges (Threatened Species Scientific Committee 2016).

Cave habitat assessments were completed for 82 caves within the Project Area identified as having the potential to act as nocturnal refuge, or potential roost cave for the Pilbara leaf-nosed bat and ghost bat (Figure 3.2).

2.5 DETERMINATION OF A ROOST SITE IN AN AREA

Of the 82 caves assessed as potentially supporting roosts or acting as potential nocturnal refuges, 45 have been surveyed using ARUs. The remaining caves not surveyed were either located outside target areas or not considered likely to support a roost due to unsuitable cave characteristics. Call times analysed by Bat Call WA indicated the potential origin of Pilbara leaf-nosed bats within the Project Area was in an area where survey effort was concentrated, and caves surveyed using ARUs were focused on this valley. It was considered likely that the suspected roost was inside the main target valley (Bat Call WA 2019a) and none of the potentially suitable caves further afield were surveyed using ARUs. As no suspected roost caves were identified in target areas using echolocation call times recorded close to dawn or dusk CT as an indicator, entrance sheeting was not undertaken to determine roost occupancy.

A list of caves surveyed using ARUs and Pilbara leaf-nosed bat call times recorded can be seen in Table 3.2 and Table 3.3.

2.6 SURVEY EFFORT

Total survey effort to locate the roost has been extensive including 107 km of UAV flights, 82 cave habitat assessments, targeted surveys using ARUs at 216 locations (504 recording nights) and targeted searches on foot (Figure 2.1, Table 2.2). Due to the considerable survey effort undertaken, all breakaway and rocky habitat within the Project Area has been identified and it is considered unlikely suitable roosting habitat for this species has not been identified; however, due to the terrain and size of the Project Area, the possibility of a cave or adit being overlooked remains.

Extensive ground truthing of suitable habitat on foot within the Project Area has allowed Pilbara leaf-nosed bat habitat within the Project Area to be further refined (Table 3.1, Figure 3.2).

Table 2.2: Total survey effort for the Pilbara leaf-nosed bat and ghost bat.

Survey	Acoustic Recording Unit	Cave habitat assessments	Unmanned Aerial Vehicle searches
Phase 1 - Level 2 vertebrate fauna survey: April 4th - 16th 2019	31 sites 59 recording nights	N/A	N/A
Phase 1 - Targeted conservation significant fauna survey: July 22nd - 30th 2019	57 sites 75 recording nights	N/A	N/A
Targeted Pilbara Leaf-nosed Bat Survey (November 25th - December 2 2019	70 sites 70 recording nights	N/A	N/A
Long-term Pilbara leaf-nosed bat survey December 2019- March 2020	6 Sites 212 recording nights	N/A	N/A
Phase 2 – Level 2 vertebrate fauna assessment: 14th - 27th April 2020	18 sites 18 recording nights	N/A	107 km
Phase 2 - Targeted conservation significant fauna survey: 29th June - 6th July 2020	42 sites 42 recording nights	81	N/A
Targeted Pilbara Leaf-nosed Bat Survey (October 5th - 9th 2020	28 Sites 28 recording nights	1	N/A
Total	252 sites, 504 recording nights	82	107 km

645000 650000 655000 660000 665000 670000 675000

7560000 7555000 7550000 7545000 7540000

ARU survey site
Survey effort
UAV survey effort

Tenement Boundary

Mulga East R 47/0012
Malay Wells E 47/2117
Mulga Downs Rail Corridor

ecologia ENVIRONMENT

Project: 1828
Date: 17 Novembert 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:93,867 @A3

Figure 2.1: Acoustic recording unit survey locations and survey effort.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 2.5 5
Kilometers

3 RESULTS

3.1 PILBARA LEAF-NOSED BAT HABITAT ASSESSMENT

Habitat considered critical for the survival of the Pilbara leaf-nosed bat includes permanent diurnal roosts (Priority 1), non-permanent breeding roosts (Priority 2) and transitory diurnal roosts (Priority 3) (Threatened Species Scientific Committee 2016). No confirmed critical habitat for this species has been identified within the Project Area. Rocky outcrops found within the Rocky Hills habitat type provide caves and overhangs that may be utilised by Pilbara leaf-nosed bats as nocturnal refuges (Priority 4) and sites of occasional visitation which is not classed as critical habitat but is important for persistence in a local area (Threatened Species Scientific Committee 2016).

Drainage Lines within the Newman land system are found in upland rocky habitats and sometimes contain small pools that may last for weeks after rain. This corresponds with the Gullies (Priority 2) foraging habitat as outlined by Threatened Species Scientific Committee (2016).

Rocky outcrops comprised of exposed rock and mesa hills containing caves and overhangs with open grassland and woodland dominated by *Triodia*, on lowland plains, colluvial slopes and hilltops are considered Priority 3 foraging habitat for Pilbara leaf-nosed bats (Threatened Species Scientific Committee 2016). These features are present within the Rocky Hills and Spinifex Stony Plains and Hillslopes habitat types across the Project Area (Table 3.1, Figure 3.1). Drainage Lines are known to be utilised for dispersal and foraging (Bob Bullen pers. comm). From a regional perspective, the Rocky Hills, containing breakaways and caves, is a common feature of the Pilbara, particularly within the Chichester and Hamersley Ranges. Spinifex Stony Plains and Hillslopes and Drainage Lines are common and widespread across the Pilbara.

Given the ambiguity around habitat requirements for sustaining a roosting colony, it is difficult to definitively define the critical foraging habitat of the Pilbara leaf-nosed bat (Threatened Species Scientific Committee 2016). Based on the priority foraging criteria outlined by the Threatened Species Scientific Committee (2016), the Project Area was assessed as supporting Priority 2 (Primary drainage with limited riparian development in upland rocky habitats, sometimes containing small pools), Priority 3 (rocky outcrop areas of exposed rock at the top of rocky outcrop and mesa hills that contain caves and overhangs) and Priority 5 (open grassland and woodland dominated by *Triodia*, on lowland plains, colluvial slopes and hilltops) foraging habitat (Table 3.1, Figure 3.1). Rocky Hills supports Priority 3 foraging habitat while Drainage Lines and Stony Spinifex Plains and Hillslopes support Priority 5 foraging habitat (Table 3.1, Figure 3.1).

Call activity has been recorded in all seasons within the targeted valley during the surveys indicating the year-long presence of Pilbara leaf-nosed bats (Table 3.1, Figure 3.1).

No permanent or semi-permanent watercourses or springs occur within the Project Area.

Table 3.1: Pilbara leaf-nosed bat foraging habitat.

Pilbara leaf-nosed bat foraging habitat category	Area (hectares)	% of Project Area
Gorges with pools (Priority 1)—watercourses through upland areas bounded by sheer rock walls for parts of their length, often containing pools that remain for weeks or months, sites of relatively large biomass production, sometimes containing caves.	N/A	N/A
Gullies (Priority 2)—primary drainage with limited riparian development in upland rocky habitats, sometimes containing small pools that may last for weeks, with less biomass production than Priority 1 gorge habitat.	331.7 ha (151.7 ha considered critical foraging habitat)	1.20%
Rocky outcrop (Priority 3)—areas of exposed rock at the top of rocky outcrop and mesa hills that contain caves and overhangs, and boulder piles in the granite terrains.	237.4 ha	0.71%
Major watercourses (Priority 4)—riparian vegetation on flat land plus the main gravelly or sandy channel of the river bed, sometimes containing pools that persist for weeks or months, and generally supporting higher productivity of biomass than the surrounding habitats.	N/A	N/A
Open grassland and woodland (Priority 5)—dominated by *Triodia,* on lowland plains, colluvial slopes and hilltops.	11632.4 ha	35.20%

655000 660000 665000 670000 675000

7555000

7550000

7545000

+ Pilbara leaf-nosed bat record

Forgaing habitat categories

- Gullies (Priority 2) and regularly utilised critical foraging habitat
- Gullies (Priority 2) foraging habitat
- Rocky Outcrop (Priority 3) foraging habitat
- Open Grassland and Woodland (Priority 5) foraging habitat

Tenement Boundary

- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

ecologia ENVIRONMENT

Project: 1828
Date: 17 Novembert 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:65,000 @A3

Figure 3.1: Pilbara leaf-nosed bat foraging habitat and critical foraging habitat.

0 1.75 3.5
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.2 CAVE HABITAT ASSESSMENT

Cave habitat assessments were completed for 82 caves within the Project Area identified as having the potential to act as nocturnal refuge, or potential roost caves for the Pilbara leaf-nosed bat and ghost bat (Figure 3.2). In total, 73 caves were assessed as potential nocturnal refuges for Pilbara leaf-nosed bats and 44 caves were assessed as providing potential roosting opportunities for Pilbara leaf-nosed bats. Microbats were observed at five caves (MEC001, MEC045, MEC052, MEC054 and MEC082); however, no Pilbara leaf-nosed bat were observed in any cave during the survey. The results of these assessments are summarised in Table 3.2 and full cave habitat assessments are provided in Appendix F.

Table 3.2: Summary of cave habitat assessments.

Cave ID	ARU surveyed; call patterns indicate these caves are unlikely to be used as a diurnal roost	Potential ghost bat roost	Potential Pilbara leaf-nosed bat roost	Cave unsuitable for roosting	Potential ghost bat nocturnal refuge	Potential Pilbara leaf-nosed bat nocturnal refuge	Microbats present
MEC001		x	x		x	x	x
MEC002	x		x			x	
MEC003	x			x		x	
MEC004				x	x	x	
MEC005				x		x	
MEC006				x	x	x	
MEC007	x			x	x	x	
MEC008	x			x		x	
MEC009	x		x			x	
MEC010	x		x				
MEC011			x			x	
MEC012	x		x		x	x	
MEC013	x		x			x	
MEC014	x		x				
MEC015				x	x	x	
MEC016	x		x			x	
MEC017				x		x	
MEC018			x		x	x	
MEC019			x			x	
MEC020	x		x				
MEC021	x			x		x	
MEC022				x	x	x	
MEC023				x		x	
MEC024				x	x	x	
MEC025	x		x				
MEC026	x		x			x	
MEC027				x	x	x	
MEC028				x			
MEC029				x			
MEC030				x	x	x	

Cave ID	ARU surveyed; call patterns indicate these caves are unlikely to be used as a diurnal roost	Potential ghost bat roost	Potential Pilbara leaf-nosed bat roost	Cave unsuitable for roosting	Potential ghost bat nocturnal refuge	Potential Pilbara leaf-nosed bat nocturnal refuge	Microbats present
MEC031				x		x	
MEC032	x		x				
MEC033	x			x		x	
MEC034			x			x	
MEC035				x	x	x	
MEC036	x			x	x	x	
MEC037	x	x	x		x	x	
MEC038	x			x		x	
MEC039	x	x	x		x	x	
MEC040	x		x			x	
MEC041	x			x	x	x	
MEC042	x			x	x	x	
MEC043	x			x		x	
MEC044				x	x	x	
MEC045			x			x	x
MEC046	x		x			x	
MEC047	x			x		x	
MEC048	x		x			x	
MEC049			x			x	
MEC050	x			x		x	
MEC051				x		x	
MEC052	x		x			x	x
MEC053	x		x			x	
MEC054			x			x	x
MEC055			x			x	
MEC056				x		x	
MEC057			x			x	
MEC058			x			x	
MEC059			x			x	
MEC060				x		x	
MEC061				x		x	
MEC062				x	x	x	

Cave ID	ARU surveyed; call patterns indicate these caves are unlikely to be used as a diurnal roost	Potential ghost bat roost	Potential Pilbara leaf-nosed bat roost	Cave unsuitable for roosting	Potential ghost bat nocturnal refuge	Potential Pilbara leaf-nosed bat nocturnal refuge	Microbats present
MEC063	x			x	x	x	
MEC064	x			x		x	
MEC065	x			x		x	
MEC066	x		x			x	
MEC067	x			x		x	
MEC068	x			x	x	x	
MEC069	x	x	x		x	x	
MEC070				x		x	
MEC071	x		x			x	
MEC072	x		x				
MEC073	x		x			x	
MEC074	x		x			x	
MEC075		x	x		x	x	
MEC076			x			x	
MEC077			x			x	
MEC078			x			x	
MEC079	x	x	x		x	x	
MEC080	x		x			x	
MEC081	x		x				
MEC082	x		x		x	x	x

668000 668500 669000 669500 670000

7554000 7553500 7553000 7552500 7552000 7551500

MEC063
MEC062 MEC060
MEC061
MEC049
MEC003
MEC035
MEC034
MEC065
MEC007 MEC033
MEC002
MEC050
MEC051
MEC046 MEC047
MEC082
MEC031
MEC032
MEC067
MEC066
MEC053
MEC052
MEC068 MEC069
MEC026
MEC028
MEC021
MEC030 MEC027
MEC029
MEC070
MEC010
MEC025
MEC016
MEC012
MEC071 MEC072
MEC013
MEC008
MEC014
MEC040
MEC073
MEC039
MEC074
MEC079
MEC037
MEC043 MEC038
MEC042 MEC036
MEC041
MEC064
MEC080
MEC048
MEC081

640000 650000 660000 670000

7560000 7561000 7550000 7540000 7550500

Map reference

Cave habitat type

- Potential roost site (PLnB)
- Potential roost site and potential nocturnal shelter (PLnB only)
- Potential roost site and potential nocturnal shelter (PLnB/GB)
- Potential roost site (PLnB) and potential nocturnal shelter (PLnB/GB)
- Potential nocturnal shelter only (PLnB)
- Potential nocturnal shelter only (PLnB/GB)
- Unlikely to be used for either shelter or roosting by either species

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

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Project: 1824
Date: 24 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:10,000 @A3

Figure 3.2a: Cave habitat assessment sites and suitability for Pilbara leaf-nosed bats within the main target valley.

0 0.075 0.15 0.3 0.45
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

664000
665000
640000
650000
660000
670000
680000
7554000
7553000

Enlargement 1

MEC077
MEC015
MEC078
MEC024
MEC076
MEC017
MEC011
MEC018
MEC022
MEC019
MEC020
MEC075

MEC023
Enlargement 1
Enlargement 2

Enlargement 2

MEC004
MEC054
MEC001
MEC044
MEC055
MEC058
MEC059
MEC057
MEC053MEC052
MEC006
MEC005
MEC045

0 100 200 Meters
1:10,000

Cave habitat type

- Potential roost site (PLnB)
- Potential roost site and potential nocturnal shelter (PLnB only)
- Potential roost site and potential nocturnal shelter (PLnB/GB)
- Potential roost site (PLnB) and potential nocturnal shelter (PLnB/GB)
- Potential nocturnal shelter only (PLnB)
- Potential nocturnal shelter only (PLnB/GB)
- Unlikely to be used for either shelter or roosting by either species

Broad fauna habitat

- Mulga Woodland
- Mixed Eucalypt/ Mulga Floodplain
- Stony Spinifex Plains and Hillslopes
- Calcrete Stony Plain
- Rocky Hills
- Drainage Line
- Chenopod/ Cracking Clay Floodplain
- Claypan

Tenement Boundary

- Malay Wells E 4702117
- Mulga East R 4700012
- Mulga Downs Rail Corridor

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Project: 1824
Date: 24 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:225,606 @A3

Figure 3.2b: Cave habitat assessment sites and suitability for Pilbara leaf-nosed bats in outlier areas.

0 5 10
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

3.3 PILBARA LEAF-NOSED BAT SURVEYS

After the initial recording of Pilbara leaf-nosed bat calls within the Project Area during the Phase 1 Level 2 terrestrial fauna survey in April 2019 (Figure 3.3), a further five surveys have been undertaken to determine the location(s) of a roost site and confirm permanence of occupancy and habitat use within the Project Area. A total of 252 sites (504 recording nights) were surveyed and 102 sites were recorded Pilbara leaf-nosed bat calls (Appendix A). The preliminary desktop assessment identified the Pilbara leaf-nosed bat as being likely to occur although previous Level 2 surveys conducted within the Project Area (Terrestrial Ecosystems 2013) failed to record the presence of this species.

During the April 2019 survey, site MDARU07 recorded a call of the Pilbara leaf-nosed bat eight minutes after dusk civil twilight indicating a diurnal roost was likely to be in the vicinity of this site.

A targeted survey was undertaken in June 2019 concurrently with targeted surveys for other significant fauna species. ARUs were deployed at cave entrances and along suspected flight paths in 57 locations for a minimum of one night (75 recording nights) with survey effort concentrated in the valley near MDARU07 (Figure 3.4). A total of 225 Pilbara leaf-nosed bat calls were detected from 31 sites and call times close to CT supported the possibility of a diurnal roost within the Project Area (Figure 3.4).

A targeted Pilbara leaf-nosed bat survey was undertaken in November 2019 with the aim of determining the nature (e.g. transitory or permanent) and location(s) of the potential roost site. ARUs were deployed for one night at the entrance of caves (70 sites) and within an adjacent creek line to determine foraging habitat, flight path directions (i.e. north or south) and therefore, determine the most likely location of the potential roost (Figure 3.5). A total of 212 Pilbara leaf-nosed bat calls were recorded at 43 sites (Figure 3.5). The earliest call detected was at site DP038 (eight minutes after dusk CT) located in a creek bed which was surrounded by several sites where calls were detected within 20 and 30 minutes of CT. Call times again indicated continued usage of the valley by Pilbara leaf-nosed bats for foraging and dispersal which again suggested the possibility of a roost within the Project Area. Cave MEC016 recorded multiple calls in both the July 2019 and November 2019 surveys and is considered as a regular nocturnal refuge used by this species.

Following the November targeted survey, five long-term bat detectors were deployed between the 17th of December 2019 and 15th of January 2020 within a likely roost target areas as indicated by Mr Bob Bullen of Bat Call WA (Bat Call WA 2019b). Fifteen calls were recorded at three sites with one site (LT05) recording one call at 20 minutes after dusk CT and one call 20 minutes before dawn CT (Figure 3.6).

An additional long-term bat detector was deployed between December 2019 and February 2020 at a cave (MEC016) (Figure 3.6) known to be frequented regularly by Pilbara leaf-nosed bats to determine presence/absence of this species within the Project Area over the breeding period and provide clarity on the potential roost type; transitory roost (Priority 3), non-permanent breeding roost (Priority 2) or permanent roost (Priority 1) within the Project Area. Over the 79 recording nights, call sequences of Pilbara leaf-nosed bats were relatively low with 10 or fewer calls recorded on most nights with the exception of three nights when relatively high levels of activity were recorded. Two peaks of activity were recorded soon after dusk CT which may be indicative of diurnal roosting. Activity very close to dusk CT was recorded on February 16, 2020 and suggesting either diurnal roosting or the presence of a diurnal roost in the vicinity (Specialised Zoological 2021). These nightly call patterns recorded at MEC016 are not consistent with long-term diurnal roosting or breeding activity and are more consistent with use of the site as a nocturnal refuge (Specialised Zoological 2021).

A targeted survey was undertaken concurrently with the Phase 2 surveys in June/July 2020 to conduct cave habitat assessments and obtain additional call data from prospective caves. ARUs were deployed at 42 sites including the entrances of potentially suitable roost caves and along potential flight paths within a target area identified by Bat Call WA (2020) (Figure 3.7). Calls were recorded at 13 sites and activity indicated the caves are unlikely to be utilised as diurnal roosts (Figure 3.7). Cave habitat

assessments were also undertaken during this survey identified a number of caves outside of the target area that had not been surveyed with potential of being used as roosts.

To obtain call data from prospective caves identified during the June/July 2020 cave habitat assessments and ensure all potential roost caves within target areas had been comprehensively surveyed, an additional targeted survey was conducted in October 2020. ARUs were deployed at the entrances of eight caves that had not previously been surveyed and an additional 20 sites that included resurveying some caves. Pilbara leaf-nosed bats were recorded at six sites confirming the continued presence of Pilbara leaf-nosed bats within the Project Area (Figure 3.8). However, the pattern of calls were not consistent with roost caves and it is considered unlikely that any of the caves surveyed are used for diurnal roosting.

Eighty-two caves were evaluated during the targeted survey (Figure 3.2), of which 73 were identified as potential nocturnal refuges and 44 having architectural structure suitable for potential diurnal roost sites. In total 45 caves within the target areas have been surveyed using ARUs including 28 caves considered as potential roost sites and 17 potential nocturnal refuges (Table 3.3). Twenty-one of the caves surveyed recorded call times during the night and were identified as nocturnal refuges or as sites of occasional visitation (Table 3.3). Nocturnal refuges are defined as caves (overhangs excluded) occupied or entered at night for resting, feeding or other purposes with perching not a requirement and are not considered critical habitat but are important for persistence in a local area (Threatened Species Scientific Committee 2016). It is considered unlikely that any of the caves surveyed are used for diurnal roosting.

Sixteen caves with the potential to be used as a diurnal roost are located outside of the target valley deemed most likely to support the Pilbara leaf-nosed bat colony and are yet to be surveyed (Table 3.2).

Table 3.3: Caves surveyed, and call times recorded.

Cave ID	Site name	Easting	Northing	Number PLnb calls detected	Time of first call after dusk CT	Time of last call before dawn CT	Time +/- CT
MEC002	BD43	669313.3	7553694.0	0			
MEC002	MEC002	669310.2	7553693.5	0			
MEC007	BD41	668731.7	7553584.0	0			
MEC008	BD10	668905.4	7552848.0	2	8:59:00 PM	11:32:00 PM	Midnight
MEC009	MEC009	668573.8	7553165.6	0			
MEC010	BD12	668632.0	7553172.0	5	~21:00	~03:30	Midnight
MEC010	DP002	668632.5	7553169.0	1		3:38:00 AM	CT-80
MEC012	BD07	668764.4	7552995.0	27	6:29:00 PM	10:25:00 PM	CT + 21
MEC012	DP010	668783.5	7552989.0	0			
MEC012	MEC012	668769.9	7552990.3	18	11:47	4:08:00 AM	CT -70
MEC013	MEC013	668832.7	7552939.5	0			
MEC014	MEC014	668909.6	7552841.1	0			
MEC016	BD17	668782.5	7553001.0	34	8:51:00 PM	1:42:00 AM	Midnight
MEC016	DP015	668789.2	7553006.0	75	7:31:00 PM	4:05:00 AM	CT+32-45
MEC016	MEC016 long-term	668783.9	7553003.1	>700			CT+25-0
MEC016	MEC016	668783.9	7553003.1	5	00:38	4:07:00 AM	CT -71
MEC021	MEC021	668580.3	7553177.2	0			
MEC025	BD13	668679.3	7553106.0	13	8:54:00 PM	10:51:00 PM	Midnight
MEC026 left entrance	MEC026 left entrance	668537.4	7553208.8	0			

Cave ID	Site name	Easting	Northing	Number PLnb calls detected	Time of first call after dusk CT	Time of last call before dawn CT	Time +/- CT
MEC026 right entrance	MEC026 right entrance	668537.4	7553208.8	0			
MEC030	BD24	668400.3	7553173.0	2	12:03:00 AM	12:03:00 AM	Midnight
MEC031	BD31	668666.8	7553391.0	1	7:38:00 PM		CT + 90
MEC032	MEC032	668661.9	7553402.2	0			
MEC033	BD42	668738.1	7553604.0	0			
MEC036	BD55	668731.2	7552394.0	0			
MEC037	BD54	668687.6	7552476.0	1	3:29:00 AM		Midnight
MEC039	MEC039	668952.2	7552713.3	0			
MEC040	MEC040	668230.5	7552738.7	0			
MEC041	BD48	668758.6	7552381.0	0			
MEC041	PLBT018	668761.2	7552381.0	1		12:26:00 AM	Midnight
MEC042	BD53	668746.3	7552392.0	3	9:50:00 PM	1:12:00 AM	Midnight
MEC043	PLBT007	668696.8	7552423.0	0			
MEC046	BD47	669388.8	7553596.0	1	11:38:00 PM		Midnight
MEC047	BD04	669388.8	7553596.0	0			
MEC048	PLBT026	668646.7	7552175.0	1	9:22:00 PM		Midnight
MEC050	BD39	669294.0	7553661.0	0			
MEC052	MEC052	670322.3	7553365.6	0			
MEC053	MEC053	670322.3	7553365.6	0			
MEC063	BD49	668829.6	7554008.0	13	8:46:00 PM	5:06:00 AM	CT -70
MEC064	LT03	668553.0	7552282.0	0			
MEC065	BD38	668644.0	7553591.0	0			
MEC066	BD32	668646.5	7553334.0	4	8:22:00 PM	12:38:00 AM	Midnight
MEC067	MEC067	668479.2	7553290.2	0			
MEC068	BD21	668558.3	7553259.0	0			
MEC068	BD29	668545.6	7553255.0	2	11:26:00 PM	12:22:00 AM	Midnight
MEC069	BD23	668589.7	7553257.0	29	9:30:00 PM	3:31:00 AM	Midnight
MEC069	MEC069	668587.9	7553258.1	4	11:27	4:06:00 AM	CT -72
MEC070	BD11	668608.0	7553156.0	4	8:54:00 PM	10:41:00 PM	Midnight
MEC071	BD09	668757.3	7552947.0	0			
MEC071	MEC071	668750.6	7552953.9	0			
MEC072	MEC072	668780.5	7552925.1	0			
MEC073	BD02	668944.7	7552774.0	0			
MEC073	PLBT037	668936.6	7552774.0	0			
MEC074	BD03	668988.9	7552656.0	0			
MEC074	PLBT036	668993.1	7552662.0	28	10:50:00 PM	11:05:00 PM	Midnight
MEC074	MEC074	668993.1	7552662.0	0			
MEC079	BD56	668651.2	7552508.0	0			
MEC079	PLBT027	668651.5	7552509.0	5	8:22:00 PM		Midnight
MEC080	PLBT010	668744.4	7552283.0	1	11:21:00 PM		Midnight
MEC081	PLBT042	668789.5	7551155.0	3	6:20:00 PM		CT +22
MEC082	MEC082	669462.5	7553534.8	0			

650000
655000
660000
665000
670000
7555000
7550000
7545000
CT+8-16

Bat ARU
- No calls recorded
- PLnB calls recorded

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

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Project: 1824
Date: 25 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:64,792 @A3

Figure 3.3 ARU locations and bat call data from the Level 2 terrestrial fauna survey (April 2019). Orange symbol denotes call within 100 minutes of Civel Twilight.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

0 1.75 3.5
Kilometers

665000
670000
7555000
CT -70 minutes
CT -41 minutes
CT + 55 minutes
CT + 90 minutes
CT + 100 minutes
CT + 21 minutes
640000
650000
660000
670000
7560000
7550000
7540000
Map reference
Bat ARU
No calls recorded
PLnB calls recorded
Tenement Boundary
Mulga East R 47/0012
Malay Wells E 47/2117
Mulga Downs Rail Corridor
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Project: 1824
Date: 25 August 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:23,091 @A3
Figure 3.4 ARU locations and bat call data from the Phase 1 targeted survey (July 2019). Orange triangles denote calls within 100 minutes of Civil Twighlight.
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
0 0.5 1
Kilometers

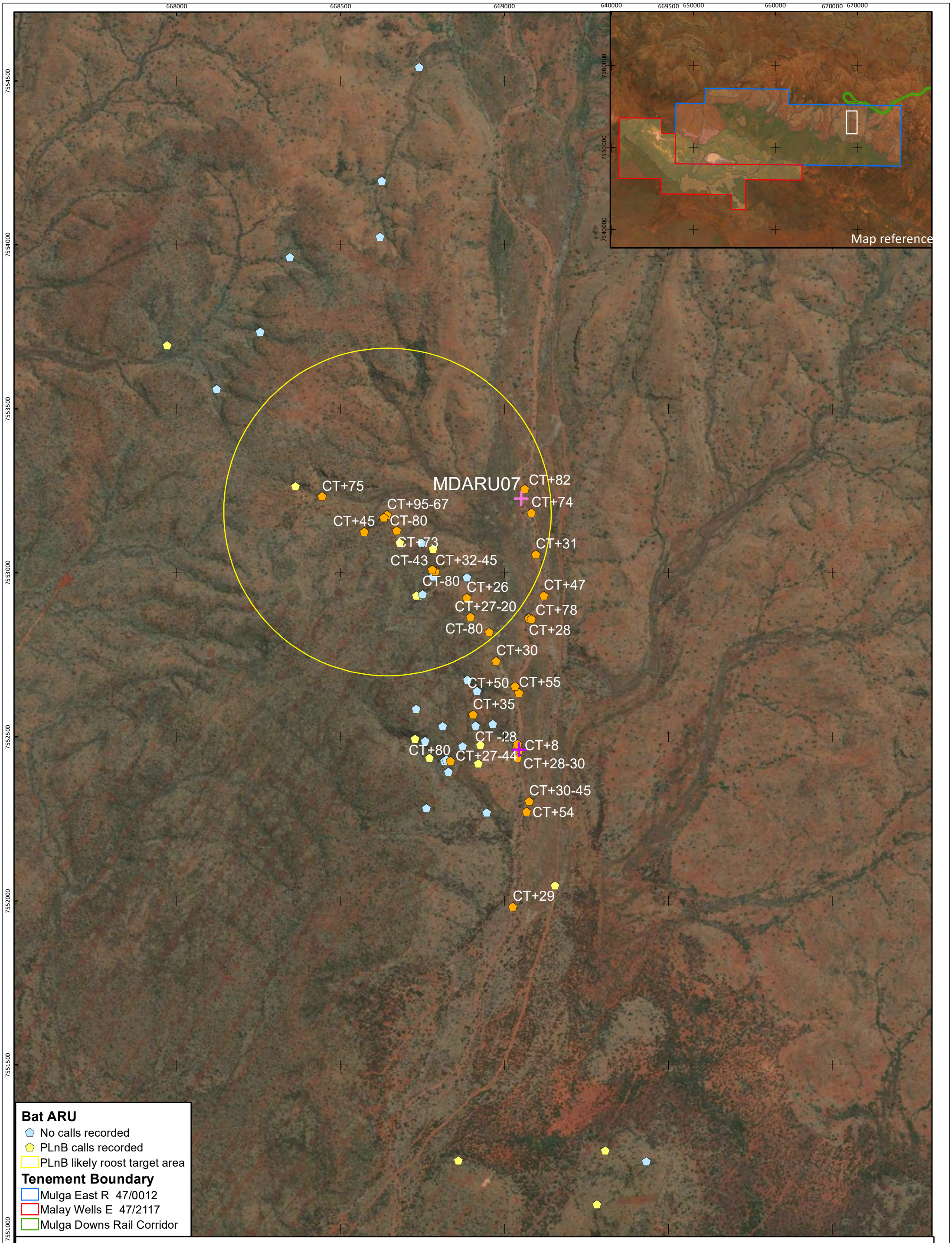


Figure 3.5 ARU locations, call data and likely roost location (yellow circle) from the targeted Pilbara leaf-nosed bat survey (November 2019). Orange symbols denote calls within 100 minutes of CT. DP038 and MDARU07 indicate earliest recorded calls at 8 minutes after CT.

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Date: 25 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:10,000 @A3

0 0.075 0.15 0.3 0.45
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

668500
669000
669500
7553000
7552500
7552000
7551500
MDARU07
CT+25-0
DP038
CT+20-20
640000
650000
660000
670000
7560000
7550000
7540000
Map reference

Bat ARU
- LT01 - PLnB calls recorded
- LT02 - No calls recorded
- LT03 - No calls recorded
- LT04 - PLnB calls recorded
- LT05 - PLnB calls recorded
- MEC016 long-term
- Likley roost target area

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

Figure 3.6 ARU locations, call data and likely roost location (Yellow circle) from long-term bat detectors (December 2019- March 2020). Orange symbols denote calls within 100 minutes of CT. DP038 and MDARU07 indicate earliest recorded calls at 8 minutes after CT.

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Project: 1824
Date: 25 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:5,000 @A3

0 0.0425 0.085 0.17 0.255
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

668500
669000
7552500
7552000
7551500
CT +45 -20
DP038
CT+35
CT -40
CT +22
640000
650000
660000
670000
7560000
7550000
7540000
Map reference

Bat ARU
- No call recorded
- PLnB calls recorded
- Likley roost target area

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

Figure 3.7 ARU locations, call data and likely roost location (Yellow circle) from targeted survey (July 2020). Orange symbols denote calls within 100 minutes of CT. DP038 indicate earliest recorded calls at 8 minutes after CT.

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Project: 1824
Date: 25 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:4,627 @A3

0 0.04 0.08 0.16 0.24
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

668000 668500 669000 669500 670000 670500

7554000 7553500 7553000 7552500 7552000 7551500 7551000 7550500

CT -72

CT -70

CT -71

DP038

640000 650000 660000 670000

7560000 7550000 7540000

Map reference

Bat ARU
- No calls
- PLnB calls recorded
- Northern possible roost location
- Southern possible roost location

Tenement Boundary
- Mulga East R 47/0012
- Malay Wells E 47/2117
- Mulga Downs Rail Corridor

Figure 3.8 ARU locations, call data and likely roost location (Yellow circle) from targeted survey (October 2020).
Orange symbols denote calls within 100 minutes of CT. DP038 indicate earliest recorded calls at 8 minutes after CT.

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Project: 1824
Date: 25 November 2020
Author: TM
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Absolute Scale: 1:10,000 @A3

0 0.075 0.15 0.3 0.45
Kilometers

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

4 DISCUSSION

Significant survey effort has been expended to locate a diurnal roost(s) for the Pilbara leaf-nosed bat within the Project Area using ultrasonic acoustic recording units, targeted searches, UAV flights and cave habitat assessments. All rocky ridgelines identified as likely to contain caves suitable for roosting were traversed on foot and caves observed were assessed on their potential to be used as a roosting site. Due to the nature of the terrain and the size of the Project Area the possibility remains a concealed cave or adit was not identified. However, it is unlikely caves or adits within the target areas have been overlooked as these areas have been extensively surveyed.

The long-term detector deployed at MEC016 recorded activity patterns consistent with that of a nocturnal refuge; however, whether this cave is also used as a transitory roost cannot be determined from recordings alone. The sheeting of caves entrances to confirm diurnal occupancy at this cave is unlikely to provide useful information unless the timing of sheeting coincided with an uncommon roosting event (Specialised Zoological 2021).

The earliest calls recorded from the Project Area were eight minutes after the end of civil twilight at two sites in the creek line indicating bats roosted nearby that day. Call times recorded at cave entrances within target areas did not strongly suggest diurnal roosting and the cave entrance sheeting to confirm diurnal occupancy was not undertaken. Data gathered to date indicates that some surveyed caves function as nocturnal refuges or simply as sites of occasional visitation and the year-round presence of this species indicates that a diurnal roost occurs in the vicinity of the Project Area. The creek line and caves within the valley targeted have consistently recorded Pilbara leaf-nosed bat activity over all seasons indicating these habitats are regularly utilised for foraging and dispersal.

Survey effort using ARUs was concentrated in the valley considered to most likely to support a roost and no direct evidence of a permanent diurnal roost (Priority 1) or non-permanent breeding roost (Priority 2) has been recorded after extensive survey effort. Some caves may occasionally be used as a transitory roost, but this would need to be confirmed using an appropriate method (i.e. entrance sheeting).

This leaves the possibility of a permanent diurnal roost being located elsewhere and it is considered likely this is outside the Project Area; however, its location is speculative (Specialised Zoological 2021).

5 REFERENCES

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6 APPENDICES

APPENDIX A PILBARA LEAF-NOSED BAT CALLS RECORDED

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
MDARU01	652617.6	7549074.4	April 2019	No	0			
MDARU02	669338.1	7553598.7	April 2019	No	0			
MDARU03	651376.2	7554899.8	April 2019	No	0			
MDARU04	668657.0	7552211.7	April 2019	No	0			
MDARU05	646731.4	7550794.4	April 2019	No	0			
MDARU06	650144.7	7554484.4	April 2019	No	0			
MDARU07	669051.0	7553226.8	April 2019	Yes	Yes			CT+8-16
MDARU08	670527.8	7549811.4	April 2019	Yes	Yes			Midnight
MDARU09	659980.9	7554500.3	April 2019	No	0			
MDARU10	668688.3	7553484.6	April 2019	No	0			
MDARU11	668922.5	7552634.4	April 2019	No	0			
MDARU12	668743.9	7552455.8	April 2019	Yes	Yes			Midnight
MDARU13	668675.0	7552494.1	April 2019	No	0			
MDARU14	656693.1	7549882.5	April 2019	No	0			
MDARU15	661398.8	7553022.8	April 2019	No	0			
MDARU16	669148.7	7553903.2	April 2019	Yes	Yes			CT+3hr
MDARU17	664432.7	7552211.6	April 2019	No	0			
MDARU18	665278.3	7551455.6	April 2019	No	0			
MDARU19	669283.4	7553941.6	April 2019	No	0			
MDARU20	656652.2	7553319.5	April 2019	No	0			
MDARU21	659944.6	7552718.9	April 2019	No	0			
MDARU22	667321.5	7550246.2	April 2019	Yes	Yes			CT+100
MDARU23	656669.3	7547514.8	April 2019	No	0			
MDARU24	654879.8	7543509.8	April 2019	No	0			
MDARU25	656714.2	7548082.7	April 2019	No	0			
MDARU26	651421.3	7546322.2	April 2019	No	0			
MDARU27	656699.0	7549133.7	April 2019	No	0			
MDARU28	655123.6	7555618.6	April 2019	No	0			
MDARU29	656614.2	7556588.4	April 2019	No	0			
MDARU30	660542.2	7553870.0	April 2019	No	0			
MDARU31	656881.2	7555134.2	April 2019	No	0			
BD01	669343.2	7553967.0	July 2019	No	0			
BD02	668944.7	7552774.0	July 2019	No	0			
BD03	668988.9	7552656.0	July 2019	No	0			
BD04	669388.8	7553596.0	July 2019	No	0			
BD05	669459.6	7553947.0	July 2019	No	0			
BD06	668945.3	7552705.0	July 2019	Yes	10	10:08:00 PM	10:09:00 PM	Midnight
BD07	668764.4	7552995.0	July 2019	Yes	27	6:29:00 PM	10:25:00 PM	CT + 21
BD08	669063.6	7553251.0	July 2019	Yes	1	7:46:00 PM		CT + 100

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
BD09	668757.3	7552947.0	July 2019	No	0			
BD10	668905.4	7552848.0	July 2019	Yes	2	8:59:00 PM	11:32:00 PM	Midnight
BD11	668608.0	7553156.0	July 2019	Yes	4	8:54:00 PM	10:41:00 PM	Midnight
BD12	668632.0	7553172.0	July 2019	Yes	5	~21:00	~03:30	Midnight
BD13	668679.3	7553106.0	July 2019	Yes	13	8:54:00 PM	10:51:00 PM	Midnight
BD14	668734.9	7553093.0	July 2019	Yes	4	9:12:00 PM	10:51:00 PM	Midnight
BD15	668783.5	7553076.0	July 2019	Yes	8	8:55:00 PM	11:41:00 PM	Midnight
BD16	668537.2	7553202.0	July 2019	Yes	2	9:45:00 PM	10:30:00 PM	Midnight
BD17	668782.5	7553001.0	July 2019	Yes	34	8:51:00 PM	1:42:00 AM	Midnight
BD18	668374.7	7553174.0	July 2019	No	0			
BD19	668615.9	7553230.0	July 2019	No	0			
BD20	668588.0	7553137.0	July 2019	No	0			
BD21	668558.3	7553259.0	July 2019	No	0			
BD22	668608.6	7553259.0	July 2019	Yes	37	9:15:00 PM	3:31:00 AM	Midnight
BD23	668589.7	7553257.0	July 2019	Yes	29	9:30:00 PM	3:31:00 AM	Midnight
BD24	668400.3	7553173.0	July 2019	Yes	2	12:03:00 AM	12:03:00 AM	Midnight
BD25	669459.1	7551019.0	July 2019	No	0			
BD26	668401.0	7553264.0	July 2019	Yes	2	12:04:00 AM	12:04:00 AM	Midnight
BD27	668760.2	7553552.0	July 2019	Yes	2	7:03:00 PM	2:35:00 AM	CT + 55
BD28	668685.2	7553365.0	July 2019	Yes	2	9:39:00 PM	11:18:00 PM	
BD29	668545.6	7553255.0	July 2019	Yes	2	11:26:00 PM	12:22:00 AM	Midnight
BD30	668418.6	7553285.0	July 2019	Yes	1	12:21:00 AM		Midnight
BD31	668666.8	7553391.0	July 2019	Yes	1	7:38:00 PM		CT + 90
BD32	668646.5	7553334.0	July 2019	Yes	4	8:22:00 PM	12:38:00 AM	Midnight
BD33	668582.5	7553577.0	July 2019	No	0			
BD34	668617.0	7553509.0	July 2019	Yes	2	12:12:00 AM	5:38:00 AM	CT -41
BD35	668578.6	7553565.0	July 2019	Yes	2	12:12:00 AM	12:12:00 AM	Midnight
BD36	668587.2	7553606.0	July 2019	No	0			
BD37	670527.1	7549810.0	July 2019	No	0			
BD38	668644.0	7553591.0	July 2019	No	0			
BD39	669294.0	7553661.0	July 2019	No	0			
BD40	669328.1	7555335.0	July 2019	No	0			

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
BD41	668731.7	7553584.0	July 2019	No	0			
BD42	668738.1	7553604.0	July 2019	No	0			
BD43	669313.3	7553694.0	July 2019	No	0			
BD44	668746.6	7553525.0	July 2019	Yes	5	9:14:00 PM	12:18:00 AM	Midnight
BD45	664554.6	7553565.0	July 2019	No	0			
BD46	664243.4	7553870.0	July 2019	No	0			
BD47	669388.8	7553596.0	July 2019	Yes	1	11:38:00 PM		Midnight
BD48	668758.6	7552381.0	July 2019	No	0			
BD49	668829.6	7554008.0	July 2019	Yes	13	8:46:00 PM	5:06:00 AM	CT -70
BD50	669315.8	7553708.0	July 2019	Yes	1	9:43:00 PM		
BD51	670784.3	7555260.0	July 2019	No	0			
BD52	669318.5	7553718.0	July 2019	Yes	3	9:41:00 PM	9:41:00 PM	Midnight
BD53	668746.3	7552392.0	July 2019	Yes	3	9:50:00 PM	1:12:00 AM	Midnight
BD54	668687.6	7552476.0	July 2019	Yes	1	3:29:00 AM		Midnight
BD55	668731.2	7552394.0	July 2019	No	0			
BD56	668651.2	7552508.0	July 2019	No	0			
BD57	668721.7	7552408.0	July 2019	Yes	2	3:33:00 AM	3:33:00 AM	Midnight
DP001	668641.5	7553177.0	November 2019	Yes	4	8:53:00 PM	3:49:00 AM	CT+95-67
DP002	668632.5	7553169.0	November 2019	Yes	1		3:38:00 AM	CT-80
DP003	668121.7	7553561.0	November 2019	No	0			
DP004	667971.0	7553695.0	November 2019	Yes	1	10:07:00 PM		Midnight
DP005	668254.9	7553735.0	November 2019	No	0			
DP006	668345.4	7553963.0	November 2019	No	0			
DP007	668620.6	7554025.0	November 2019	No	0			
DP008	668626.0	7554195.0	November 2019	No	0			
DP009	668739.8	7554542.0	November 2019	No	0			
DP010	668783.5	7552989.0	November 2019	No	0			
DP011	668362.8	7553265.0	November 2019	Yes	3	10:14:00 PM		Midnight
DP012	668443.5	7553233.0	November 2019	Yes	3	8:13:00 PM		CT+75
DP013	668671.3	7553129.0	November 2019	Yes	3	8:11:00 PM	3:27:00 AM	CT+73
DP014	668680.9	7553093.0	November 2019	Yes	4	10:21:00 PM	3:38:00 AM	Midnight

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
DP015	668789.2	7553006.0	November 2019	Yes	75	7:31:00 PM	4:05:00 AM	CT+32-45
DP016	668780.0	7553011.0	November 2019	No	0			
DP017	668738.0	7552931.0	November 2019	Yes	6	9:56:00 PM		Midnight
DP018	668731.4	7552931.0	November 2019	Yes	6	9:59:00 PM		Midnight
DP019	668750.6	7552935.0	November 2019	No	0			
DP020	669082.4	7553184.0	November 2019	Yes	9	8:13:00 PM	2:17:00 AM	CT+74
DP021	668782.7	7553074.0	November 2019	Yes	2		1:30:00 AM	Midnight
DP022	668746.7	7553092.0	November 2019	No	0			
DP023	668572.3	7553126.0	November 2019	Yes	1	7:44:00 PM		CT+45
DP024	668780.0	7553011.0	November 2019	Yes	2		4:06:00 AM	CT-43
DP025	668885.6	7552987.0	November 2019	No	0			
DP026	668884.8	7552924.0	November 2019	Yes	1	7:25:00 PM		CT+26
DP027	668896.6	7552866.0	November 2019	Yes	2	7:26:00 PM	4:29:00 AM	CT+27-20
DP028	669074.6	7552862.0	November 2019	Yes	4	7:27:00 PM		CT+28
DP029	669095.5	7553056.0	November 2019	Yes	2	7:30:00 PM	12:48:00 AM	CT+31
DP030	669062.0	7553256.0	November 2019	Yes	1	8:22:00 PM		CT+82
DP031	668780.0	7553011.0	November 2019	Yes	3	11:05:00 PM	3:33:00 AM	CT-80
DP032	668953.1	7552819.0	November 2019	Yes	2		3:34:00 AM	CT-80
DP033	668974.6	7552731.0	November 2019	Yes	3	7:30:00 PM	2:58:00 AM	CT+30
DP034	669044.2	7552635.0	November 2019	Yes	1	7:54:00 PM		CT+55
DP035	668916.4	7552640.0	November 2019	No	0			
DP036	668887.1	7552674.0	November 2019	No	0			
DP037	668912.2	7552534.0	November 2019	No	0			
DP038	669043.6	7552460.0	November 2019	Yes	7	7:08:00 PM	3:39:00 AM	CT+8
DP039	669075.0	7552304.0	November 2019	Yes	2	7:30:00 PM	4:06:00 AM	CT+30-45
DP040	669081.8	7552860.0	November 2019	Yes	1	8:18:00 PM		CT+78
DP041	668903.9	7552568.0	November 2019	Yes	1	7:36:00 PM		CT+35
DP042	668964.6	7552540.0	November 2019	No	0			

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
DP043	668920.5	7552420.0	November 2019	Yes	1		1:18:00 AM	Midnight
DP044	668829.3	7552394.0	November 2019	No	0			
DP045	668822.8	7552431.0	November 2019	No	0			
DP046	668771.1	7552437.0	November 2019	Yes	1		2:06:00 AM	Midnight
DP047	668727.6	7552494.0	November 2019	Yes	1		2:07:00 AM	Midnight
DP048	668946.1	7552269.0	November 2019	No	0			
DP049	668762.0	7552283.0	November 2019	No	0			
DP050	669038.0	7552469.0	November 2019	Yes	6	11:05:00 PM	4:23:00 AM	CT -28
DP051	668758.2	7552487.0	November 2019	No	0			
DP052	668836.1	7552427.0	November 2019	Yes	1	8:22:00 PM		CT+80
DP053	668822.8	7552431.0	November 2019	No	0			
DP054	668816.8	7552427.0	November 2019	No	0			
DP055	668822.8	7552431.0	November 2019	No	0			
DP056	668811.0	7552532.0	November 2019	No	0			
DP057	668730.5	7552586.0	November 2019	No	0			
DP058	668871.8	7552472.0	November 2019	No	0			
DP059	668926.3	7552476.0	November 2019	Yes	2		2:28:00 AM	Midnight
DP060	669039.6	7552436.0	November 2019	Yes	17	7:29:00 PM	4:19:00 AM	CT+28-30
DP061	669067.8	7552272.0	November 2019	Yes	1	7:55:00 PM		CT+54
DP062	669039.8	7552479.0	November 2019	Yes	12	7:28:00 PM	4:05:00 AM	CT+27-44
DP063	669032.5	7552654.0	November 2019	Yes	4	7:52:00 PM	1:40:00 AM	CT+50
DP064	669120.5	7552931.0	November 2019	Yes	2	7:48:00 PM	1:38:00 AM	CT+47
DP065	669025.3	7551983.0	November 2019	Yes	5	7:30:00 PM		CT+29
DP066	669154.2	7552047.0	November 2019	Yes	2		2:12:00 AM	Midnight
DP067	668859.4	7551208.0	November 2019	Yes	1	9:51:00 PM		Midnight
DP068	669281.8	7551075.0	November 2019	Yes	5		2:11:00 AM	Midnight
DP069	669433.0	7551206.0	November 2019	No	0			
DP070	669307.7	7551239.0	November 2019	Yes	1	11:35:00 PM		Midnight

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
LT01	668672.0	7552214.0	Dec 2019 - Jan 2020	Yes	Yes			
LT02	668585.0	7552242.0	Dec 2019 - Jan 2020	No	0			
LT03	668553.0	7552282.0	Dec 2019 - Jan 2020	No	0			
LT04	668773.0	7552182.0	Dec 2019 - Jan 2020	Yes	Yes			
LT05	668750.0	7552290.0	Dec 2019 - Jan 2020	Yes	Yes	12:00:00 AM		CT+20-20
MEC016 long-term	668783.9	7553003.1	Dec 2019 - March 2020	Yes	Yes			CT+25-0
PLBT001	669068.6	7552305.0	July 2020	No	0			
PLBT002	669040.0	7552484.0	July 2020	No	0			
PLBT003	669012.8	7552615.0	July 2020	Yes	1	11:34:00 PM		Midnight
PLBT004	668786.6	7552299.0	July 2020	No	0			
PLBT005	669024.7	7552028.0	July 2020	No	0			
PLBT006	668517.1	7552326.0	July 2020	No	0			
PLBT007	668696.8	7552423.0	July 2020	No	0			
PLBT008	668646.6	7552180.0	July 2020	No	0			
PLBT009	668747.3	7552262.0	July 2020	No	0			
PLBT010	668744.4	7552283.0	July 2020	Yes	1	11:21:00 PM		Midnight
PLBT011	668892.2	7552449.0	July 2020	No	0			
PLBT012	668848.1	7552377.0	July 2020	Yes	1	7:51:00 PM		Midnight
PLBT013	669042.4	7552459.0	July 2020	Yes	7	6:42:00 PM	6:00:00 AM	CT +45 -20
PLBT014	668796.8	7552445.0	July 2020	Yes	3	6:32:00 PM		CT+35
PLBT015	668821.1	7552433.0	July 2020	No	0			
PLBT016	668757.0	7552491.0	July 2020	No	0			
PLBT017	668697.6	7552492.8	July 2020	No	0			
PLBT018	668761.2	7552381.0	July 2020	Yes	1		12:26:00 AM	Midnight
PLBT019	668724.3	7552403.0	July 2020	Yes	6		5:43:00 AM	CT -40
PLBT020	668734.1	7552390.0	July 2020	No	0			
PLBT021	668708.0	7552411.0	July 2020	No	0			
PLBT022	668696.7	7552270.0	July 2020	No	0			
PLBT023	668623.6	7552275.0	July 2020	No	0			
PLBT024	668517.5	7552276.0	July 2020	No	0			
PLBT025	668698.6	7552168.0	July 2020	No	0			
PLBT026	668646.7	7552175.0	July 2020	Yes	1	9:22:00 PM		Midnight
PLBT027	668651.5	7552509.0	July 2020	Yes	5	8:22:00 PM		Midnight

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
PLBT028	668685.8	7552355.0	July 2020	No	0			
PLBT029	668611.8	7552344.0	July 2020	No	0			
PLBT030	668782.4	7552041.0	July 2020	No	0			
PLBT031	668677.0	7552001.0	July 2020	No	0			
PLBT032	668695.8	7552109.0	July 2020	No	0			
PLBT033	668606.1	7552059.0	July 2020	No	0			
PLBT034	668840.8	7552123.0	July 2020	No	0			
PLBT035	668897.2	7552561.0	July 2020	Yes	1	11:49:00 PM		Midnight
PLBT036	668993.1	7552662.0	July 2020	Yes	28	10:50:00 PM	11:05:00 PM	Midnight
PLBT037	668936.6	7552774.0	July 2020	No	0			
PLBT038	668730.9	7551951.0	July 2020	No	0			
PLBT039	668716.2	7551854.0	July 2020	No	0			
PLBT040	668614.2	7551850.0	July 2020	No	0			
PLBT041	668523.2	7551831.0	July 2020	Yes	1	7:52:00 PM		Midnight
PLBT042	668789.5	7551155.0	July 2020	Yes	3	6:20:00 PM		CT +22
MDOT001	669508.5639	7553528.286	October 2020	No	0			
MDOT002	669476.9553	7553534.827	October 2020	No	0			
MDOT003	668684.2197	7552516.989	October 2020	No	0			
MDOT004	669352.2045	7551116.21	October 2020	No	0			
MDOT005	669384.5616	7551180.2	October 2020	Yes	1	21:32		Midnight
MDOT006	669439.933	7551196.541	October 2020	No	0			
MDOT007	668520.8026	7553199.86	October 2020	Yes	1	00:48		Midnight
MDOT008	668521.2893	7553196.866	October 2020	Yes	3	23:36	2:41:00 AM	Midnight
MEC002	669310.1783	7553693.541	October 2020	No	0			
MEC009	668573.777	7553165.627	October 2020	No	0			
MEC012	668769.8924	7552990.335	October 2020	Yes	18	11:47	4:08:00 AM	CT -70
MEC013	668832.6929	7552939.502	October 2020	No	0			
MEC014	668909.6309	7552841.115	October 2020	No	0			
MEC016	668783.9099	7553003.095	October 2020	Yes	5	00:38	4:07:00 AM	CT -71
MEC021	668580.3009	7553177.187	October 2020	No	0			
MEC026 left entrance	668537.4076	7553208.759	October 2020	No	0			

Name	Easting	Northing	Survey	PLnB call detected	Number PLNb calls detected	Time first call after dusk	Time last call before dawn	Civil Twighlight
MEC026 right entrance	668537.4076	7553208.759	October 2020	No	0			
MEC032	668661.8506	7553402.204	October 2020	No	0			
MEC039	668952.2126	7552713.314	October 2020	No	0			
MEC040	668230.4664	7552738.677	October 2020	No	0			
MEC052	670322.3315	7553365.558	October 2020	No	0			
MEC053	670322.3315	7553365.558	October 2020	No	0			
MEC067	668479.163	7553290.227	October 2020	No	0			
MEC069	668587.8638	7553258.087	October 2020	Yes	4	11:27	4:06:00 AM	CT -72
MEC071	668750.5873	7552953.918	October 2020	No	0			
MEC072	668780.5193	7552925.064	October 2020	No	0			
MEC074	668993.075	7552661.993	October 2020	No	0			
MEC082	669462.5117	7553534.76	October 2020	No	0			

APPENDIX B BAT CALL WA REPORT #1 (APRIL & JULY 2019)

Tim McCabe
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18 August 2019.

Mulga East Bat Survey – Report #1.

A team of zoologists from Ecologia visited Mulga East in April 2019 and carried out an ultrasonic survey for bats. During this survey a series of calls of the Pilbara leaf-nosed bat (*Rhinonicteris aurantia*, PLNb) were detected at locations and timings that indicated that a diurnal roost was present in the vicinity of a creek bed site at 50K 699100 7553250, figure 1, where calls were detected within a few minutes of dusk and dawn civil twilight (CT). In addition, a single call from a Ghost bat (*Macroderma gigas*, PGb) was recorded 12 km south-west of this site at MD56 (50K 656695 7549133). Both species are listed under both federal and state legislation as Vulnerable species. Subsequently, the Ecologia team returned in July and completed a targeted survey. The recordings from 75 nights were subsequently supplied to R. Bullen of Bat Call for analysis and reporting.

Results

In July, a large number of PLNb calls were detected at a series of sites, and over multiple nights, that confirm the presence of a diurnal roost, Table 1 and figures 2 and 3. PLNb calls were detected on each night of the survey and a series of calls were detected under 100 minutes from dusk and dawn CT. Also noted is that no PLNb calls were detected in July at sites more distant to the north, south and west, figure 2. The spread of call times and the number of calls detected each night suggests that the colony was small in July compared to other Pilbara colonies and may have been as few as 10 bats. Also, the pattern of calls detected is insufficient to positively identify the cave that houses the colonies diurnal roost. The earliest call detected was at ‘BD07 but the latest calls were at ‘BD34 and ‘BD49. The roost may be in, or immediately adjacent to, one of these within the valley, but also may be within one of the valleys immediately to the west of the circle.

No PGb were detected during the targeted survey

Recommendation

The July results confirm the presence of a PLNb diurnal roost however they are insufficient to positively locate the roost or confirm its size or permanence.

Therefore, to address the roost permanence and location, the recommendation is to complete a second targeted survey in the early wet season, October to December, and include the valleys to the west.



Figure 1. Diagram showing detection of PLNb calls in April 2019, orange pins, and the likely location of the diurnal roost cave indicated, green circle.

Table 1. Results of targeted PLNb survey, July 2019

Site	Easting	Northing	Nights	PLNb calls detected	Time of first call	Time of last call	Remarks
BD01	669343.2	7553967	22 July	0			
BD02	668944.7	7552774	22 July	0			
BD03	668988.9	7552656	22 July	0			
BD04	669388.8	7553596	22 July	0			
BD05	669459.6	7553947	22 July	0			
BD06	668945.3	7552705	22 July	10	22:08	22:09	
BD07	668764.4	7552995	22 July	27	18:29	22:25	First call at CT + 21 minutes
BD08	669063.6	7553251	22-27 July	1	19:46		First call at CT + 100 minutes
BD09	668757.3	7552947	22 July	0			
BD10	668905.4	7552848	22 July	2	20:59	23:32	
BD11	668608	7553156	23 July	4	20:54	22:41	
BD12	668632	7553172	22-23 July	5	~21:00	~03:30	Time estimated as clock set incorrectly
BD13	668679.3	7553106	23 July	13	20:54	22:51	
BD14	668734.9	7553093	23 July	4	21:12	22:51	
BD15	668783.5	7553076	23 July	8	20:55	23:41	

Site	Easting	Northing	Nights	PLNb calls detected	Time of first call	Time of last call	Remarks
BD16	668537.2	7553202	23 July	2	21:45	22:30	
BD17	668782.5	7553001	23 July	34	20:51	01:42	
BD18	668374.7	7553174	23-24 July	0			
BD19	668615.9	7553230	23-24 July	0			
BD20	668588	7553137	24 July	0			
BD21	668558.3	7553259	24-25 July	0			
BD22	668608.6	7553259	24 July	37	21:15	03:31	
BD23	668589.7	7553257	24 July	29	21:30	03:31	
BD24	668400.3	7553173	24 July	2	00:03	00:03	
BD25	669459.1	7551019	24-25 July	0			
BD26	668401	7553264	24 July	2	00:04	00:04	
BD27	668760.2	7553552	25-26 July	2	19:03	02:35	First call at CT + 55 minutes
BD28	668685.2	7553365	25 July	2	21:39	23:18	
BD29	668545.6	7553255	25 July	2	23:26	00:22	
BD30	668418.6	7553285	25 July	1	00:21		
BD31	668666.8	7553391	25-26 July	1	19:38		First call at CT + 90 minutes
BD32	668646.5	7553334	25-26 July	4	20:22	00:38	
BD33	668582.5	7553577	26 July	0			
BD34	668617	7553509	26 July	2	00:12	05:38	Last call at CT -41 minutes
BD35	668578.6	7553565	26 July	2	00:12	00:12	
BD36	668587.2	7553606	26 July	0			
BD37	670527.1	7549810	25-27 July	0			
BD38	668644	7553591	26 July	0			
BD39	669294	7553661	27 July	0			
BD40	669328.1	7555335	27 July	0			
BD41	668731.7	7553584	27 July	0			
BD42	668738.1	7553604	27 July	0			
BD43	669313.3	7553694	27 July	0			
BD44	668746.6	7553525	27 July	5	21:14	00:18	
BD45	664554.6	7553565	27-29 July	0			
BD46	664243.4	7553870	27-29 July	0			
BD47	669388.8	7553596	28 July	1	23:38		
BD48	668758.6	7552381	28 July	0			
BD49	668829.6	7554008	28-29 July	13	20:46	05:06	Last call at CT -70 minutes
BD50	669315.8	7553708	28 July	1	21:43		
BD51	670784.3	7555260	28-29 July	0			
BD52	669318.5	7553718	28 July	3	21:41	21:41	
BD53	668746.3	7552392	28 July	3	21:50	01:12	
BD54	668687.6	7552476	29 July	1	03:29		
BD55	668731.2	7552394	29 July	0			
BD56	668651.2	7552508	29 July	0			
BD57	668721.7	7552408	29 July	2	03:33	03:33	

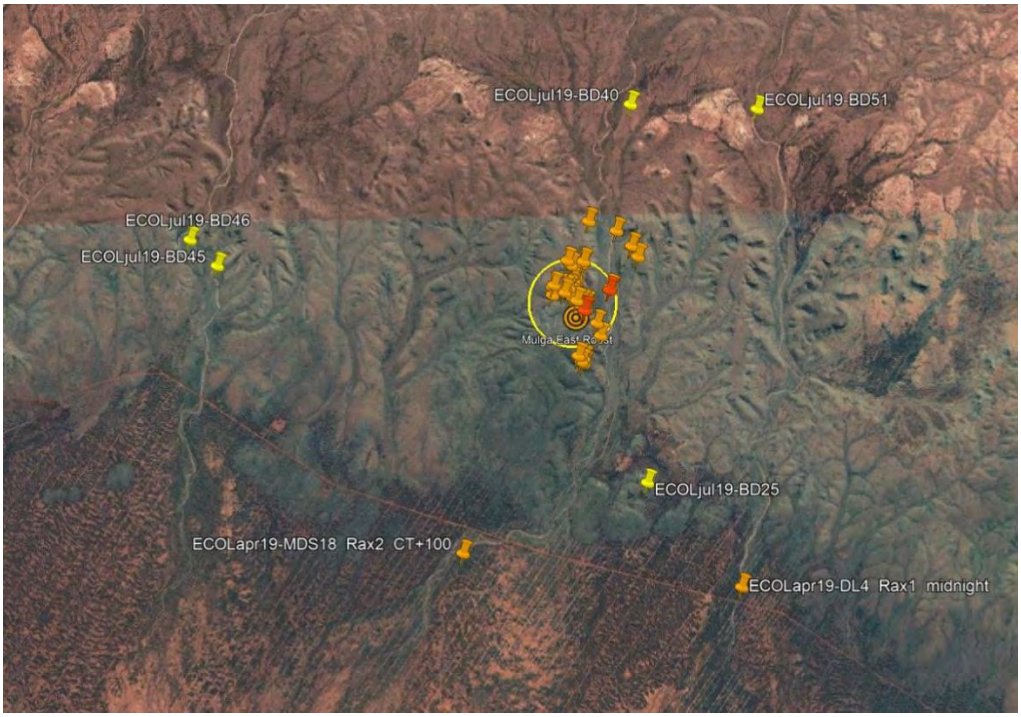


Figure 2. Diagram showing detection of PLNb calls in April and July 2019, orange pins, and the likely location of the diurnal roost cave indicated, yellow circle. The two sites with calls under 30 minutes from CT have burnt orange pins. The yellow pins indicate sites with no PLNb calls detected

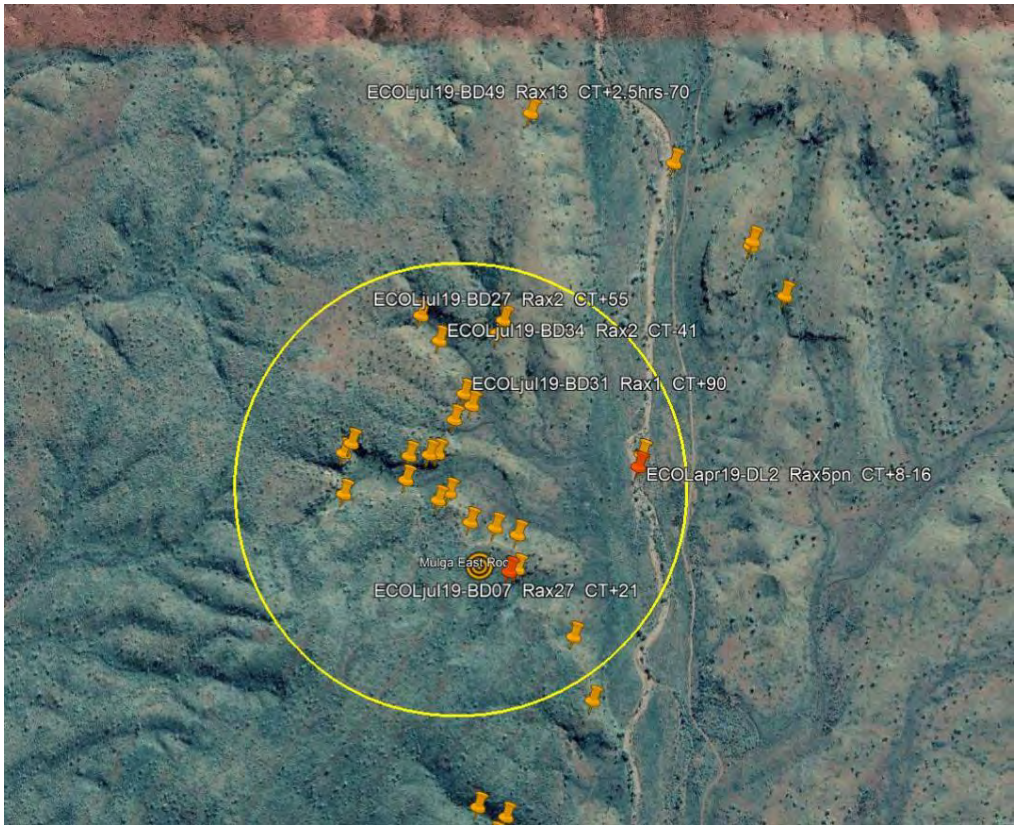


Figure 3. Detail showing PLNb calls in April and July 2019 and the likely location of the diurnal roost cave, yellow circle. The two sites with calls under 30 minutes from CT have burnt orange pins.

Yours sincerely



Robert Bullen
Managing Director and Principal Ecologist

APPENDIX C BAT CALL WA REPORT #2 (NOVEMBER 2019)

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10 December 2019.

Mulga East Bat Survey – Report #2.

During previous surveys at Mulga East, a series of calls of the Pilbara leaf-nosed bat (*Rhinonicteris aurantia*, PLNb) were detected by Ecologia that indicated that a diurnal PLNb roost was located in the study area and that it may be permanent. The Ecologia team returned in November 2019 and continued a targeted survey. The recordings from 70 sites were subsequently supplied to Bat Call for analysis and reporting.

Results

In November, a number of PLNb calls were detected at a series of sites, and over multiple nights, that confirm the presence of a diurnal roost, Table 1. PLNb calls were detected on each night of the survey and a series of calls were detected under 90 minutes from dusk or dawn civil twilight (CT). The spread of call times and the number of calls detected each night confirms the earlier conclusion that the colony is small compared to other Pilbara colonies and may have been as few as 10 bats. Also, the pattern of calls detected is insufficient to positively identify the cave that houses the diurnal roost. The earliest call detected was at DP038 at CT+8 minutes. This site is on a creek bed and is surrounded by a several sites where calls were detected between 20 and 30 minutes of CT over multiple nights, figure 1. These data suggest that the roost may be in a gully immediately to the south-west of this point as the areas to the west and north-west of this point have been searched and the areas to the east appear unsuitable. The most probable location is given by a probability circle in figure 1

No PGb were detected during the targeted survey

Recommendation

The November results confirm the presence of a PLNb diurnal roost and, together with the earlier results from April and July, indicate permanence. However, they are insufficient to positively confirm permanence throughout the breeding period of late December to March.

Therefore, to address the breeding season presence, the recommendation is to install a detector in a suitable location that has been shown to be a regular foraging site (e.g. cave DP015) and record continuously from mid-December to early March. Further, given the proximity of the resource evaluation drilling patterns, it is important to quickly identify and quarantine the diurnal roost cave in accordance with TSSC (2016).

Table 1. Results of targeted PLNb survey, November 2019.

Site	Easting	Northing	PLNb calls detected	Time of first call after dusk	Time of last call before dawn	Time differential of the first and/or last call from civil twilight, when the number of minutes is less than 90
DP001	668641.5	7553177	4	20:53	03:49	CT+95-67
DP002	668632.5	7553169	1		03:38	CT-80
DP003	668121.7	7553561	0			
DP004	667971	7553695	1	22:07		
DP005	668254.9	7553735	0			
DP006	668345.4	7553963	0			
DP007	668620.6	7554025	0			
DP008	668626	7554195	0			
DP009	668739.8	7554542	0			
DP010	668783.5	7552989	0			
DP011	668362.8	7553265	3	22:14		
DP012	668443.5	7553233	3	20:13		CT+75
DP013	668671.3	7553129	3	20:11	03:27	CT+73
DP014	668680.9	7553093	4	22:21	03:38	
DP015	668789.2	7553006	75	19:31	04:05	CT+32-45
DP016	668780	7553011	0			
DP017	668738	7552931	6	21:56		
DP018	668731.4	7552931	6	21:59		
DP019	668750.6	7552935	0			
DP020	669082.4	7553184	9	20:13	02:17	CT+74
DP021	668782.7	7553074	2		01:30	
DP022	668746.7	7553092	0			
DP023	668572.3	7553126	1	19:44		CT+45
DP024	668780	7553011	2		04:06	CT-43
DP025	668885.6	7552987	0			
DP026	668884.8	7552924	1	19:25		CT+26
DP027	668896.6	7552866	2	19:26	04:29	CT+27-20
DP028	669074.6	7552862	4	19:27		CT+28
DP029	669095.5	7553056	2	19:30	00:48	CT+31
DP030	669062	7553256	1	20:22		CT+82
DP031	668780	7553011	3	23:05	03:33	CT-80
DP032	668953.1	7552819	2		03:34	CT-80
DP033	668974.6	7552731	3	19:30	02:58	CT+30
DP034	669044.2	7552635	1	19:54		CT+55
DP035	668916.4	7552640	0			
DP036	668887.1	7552674	0			
DP037	668912.2	7552534	0			
DP038	669043.6	7552460	7	19:08	03:39	CT+8
DP039	669075	7552304	2	19:30	04:06	CT+30-45
DP040	669081.8	7552860	1	20:18		CT+78

Site	Easting	Northing	PLNb calls detected	Time of first call after dusk	Time of last call before dawn	Time differential of the first and/or last call from civil twilight, when the number of minutes is less than 90
DP041	668903.9	7552568	1	19:36		CT+35
DP042	668964.6	7552540	0			
DP043	668920.5	7552420	1		01:18	
DP044	668829.3	7552394	0			
DP045	668822.8	7552431	0			
DP046	668771.1	7552437	1		02:06	
DP047	668727.6	7552494	1		02:07	
DP048	668946.1	7552269	0			
DP049	668762	7552283	0			
DP050	669038	7552469	6	23:05	04:23	CT
DP051	668758.2	7552487	0			
DP052	668836.1	7552427	1	20:22		CT+80
DP053	668822.8	7552431	0			
DP054	668816.8	7552427	0			
DP055	668822.8	7552431	0			
DP056	668811	7552532	0			
DP057	668730.5	7552586	0			
DP058	668871.8	7552472	0			
DP059	668926.3	7552476	2		02:28	
DP060	669039.6	7552436	17	19:29	04:19	CT+28-30
DP061	669067.8	7552272	1	19:55		CT+54
DP062	669039.8	7552479	12	19:28	04:05	CT+27-44
DP063	669032.5	7552654	4	19:52	01:40	CT+50
DP064	669120.5	7552931	2	19:48	01:38	CT+47
DP065	669025.3	7551983	5	19:30		CT+29
DP066	669154.2	7552047	2		02:12	
DP067	668859.4	7551208	1	21:51		
DP068	669281.8	7551075	5		02:11	
DP069	669433	7551206	0			
DP070	669307.7	7551239	1	23:35		

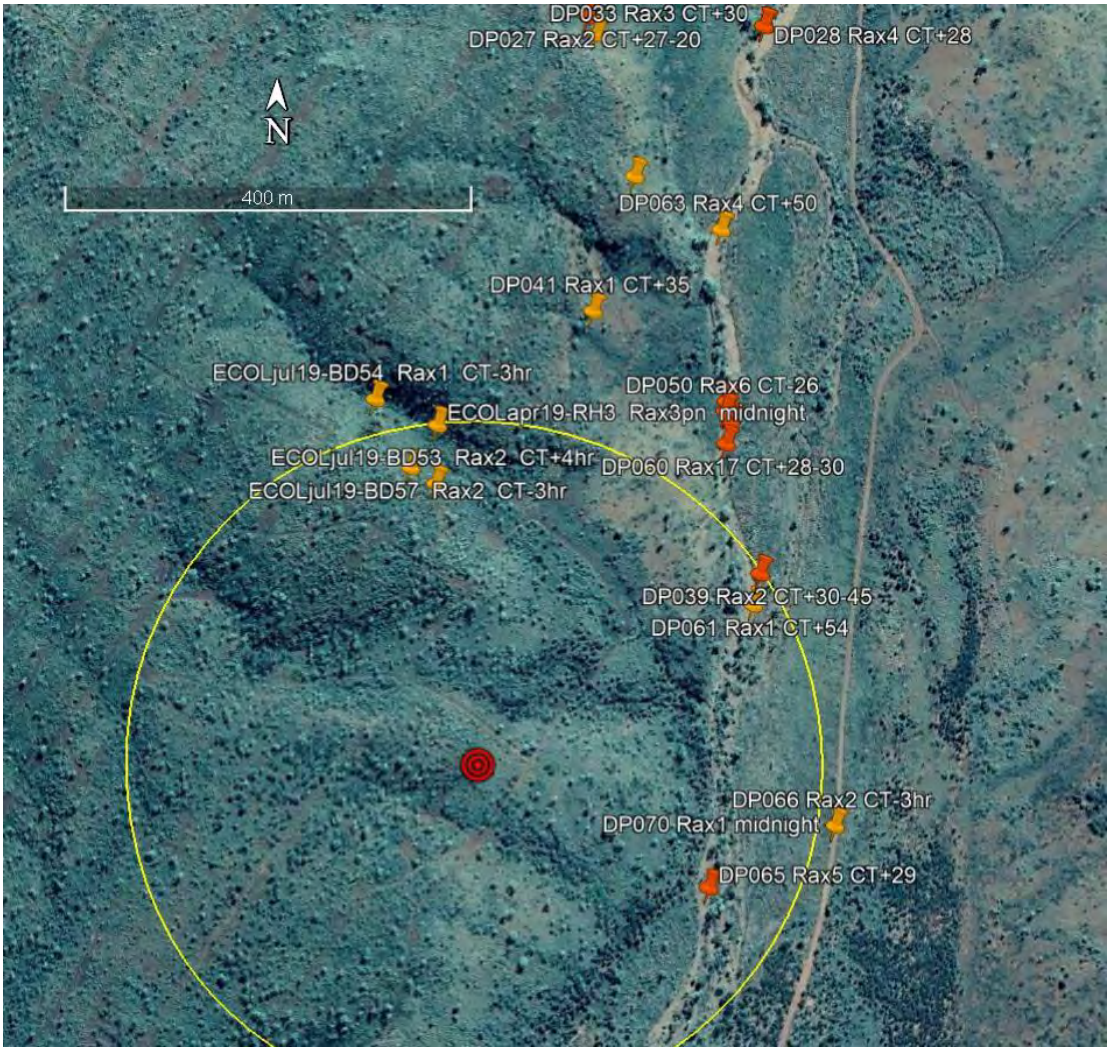


Figure 1. Diagram showing a cluster of PLNb calls in November 2019, orange pins, and the possible location of the diurnal roost cave, green circle. The burnt orange pins are sites where calls inside 30 minutes from Civil Twilight were detected. The earliest call was detected at site DP038 that is adjacent to sites DP-050 and '060.

Yours sincerely



Robert Bullen
Managing Director and Principal Ecologist

Threatened Species Scientific Committee, TSSC (2016). Conservation Advice: *Rhinonicteris aurantia* (Pilbara form), Pilbara Leaf-nosed Bat. Canberra, Australian Capital Territory:

APPENDIX D BAT CALL WA REPORT #3 (JUNE/JULY 2020)

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20 August 2020.

Mulga East Bat Survey – Report #3.

During previous surveys at Mulga East, a series of calls of the Pilbara leaf-nosed bat (*Rhinonicteris aurantia*, PLNb) were detected by Ecologia that indicated a diurnal PLNb roost was located in the study area and that it may be permanent. The Ecologia team continued work at the site in July 2020 with a targeted survey designed to locate the roost cave. The recordings from 42 sites were subsequently supplied to Bat Call for analysis and reporting.

July 2020 Survey Results

A number of PLNb calls were detected at a series of sites, and over multiple nights, that confirm the continued presence of a diurnal roost, Table 1, Figure 1. PLNb calls were detected on each night of the survey and a small number of calls were detected under 90 minutes from dusk or dawn civil twilight (CT). The spread of call times and the number of calls detected confirms the earlier conclusion that the colony persists but is small compared to other Pilbara colonies and may have been as few as 10 bats. However, the pattern of calls detected in July alone is insufficient to positively identify the cave that houses the diurnal roost. The earliest calls detected was at PLBT013 at dawn CT -20 minutes and PLBT042 at CT-20 minutes. Both sites are on a creek line that runs north to south through the study area. They are surrounded by several sites where calls have been detected. These data are consistent with the data collected previously at nearby sites. Further discussion of the combined survey results to date follow below.

No Pilbara Ghost bats were detected during the targeted survey.

Table 1. Results of targeted PLNb survey, November 2019.

Site	Easting	Northing	PLNb calls detected	Time of first call after dusk	Time of last call before dawn	Time differential of the first and/or last call from civil twilight, when the number of minutes is less than 90
PLBT001	669068.6	7552305	0			
PLBT002	669040	7552484	0			
PLBT003	669012.8	7552615	1	23:34		
PLBT004	668786.6	7552299	0			
PLBT005	669024.7	7552028	0			
PLBT006	668517.1	7552326	0			
PLBT007	668696.8	7552423	0			
PLBT008	668646.6	7552180	0			
PLBT009	668747.3	7552262	0			
PLBT010	668744.4	7552283	1	23:21		
PLBT011	668892.2	7552449	0			
PLBT012	668848.1	7552377	1	19:51		
PLBT013	669042.4	7552459	7	18:42	06:00	CT +45 -20
PLBT014	668796.8	7552445	3	18:32		CT+35
PLBT015	668821.1	7552433	0			
PLBT016	668757.0	7552491	0			
PLBT017	668697.6	7552492.8	0			
PLBT018	668761.2	7552381	1		00:26	
PLBT019	668724.3	7552403	6		05:43	CT -40
PLBT020	668734.1	7552390	0			
PLBT021	668708	7552411	0			
PLBT022	668696.7	7552270	0			
PLBT023	668623.6	7552275	0			
PLBT024	668517.5	7552276	0			
PLBT025	668698.6	7552168	0			
PLBT026	668646.7	7552175	1	21:22		
PLBT027	668651.5	7552509	5	20:22		
PLBT028	668685.8	7552355	0			
PLBT029	668611.8	7552344	0			
PLBT030	668782.4	7552041	0			
PLBT031	668677	7552001	0			
PLBT032	668695.8	7552109	0			
PLBT033	668606.1	7552059	0			
PLBT034	668840.8	7552123	0			
PLBT035	668897.2	7552561	1	23:49		
PLBT036	668993.1	7552662	28	22:50	23:05	
PLBT037	668936.6	7552774	0			
PLBT038	668730.9	7551951	0			
PLBT039	668716.2	7551854	0			
PLBT040	668614.2	7551850	0			
PLBT041	668523.2	7551831	1	19:52		
PLBT042	668789.5	7551155	3	18:20		CT +22

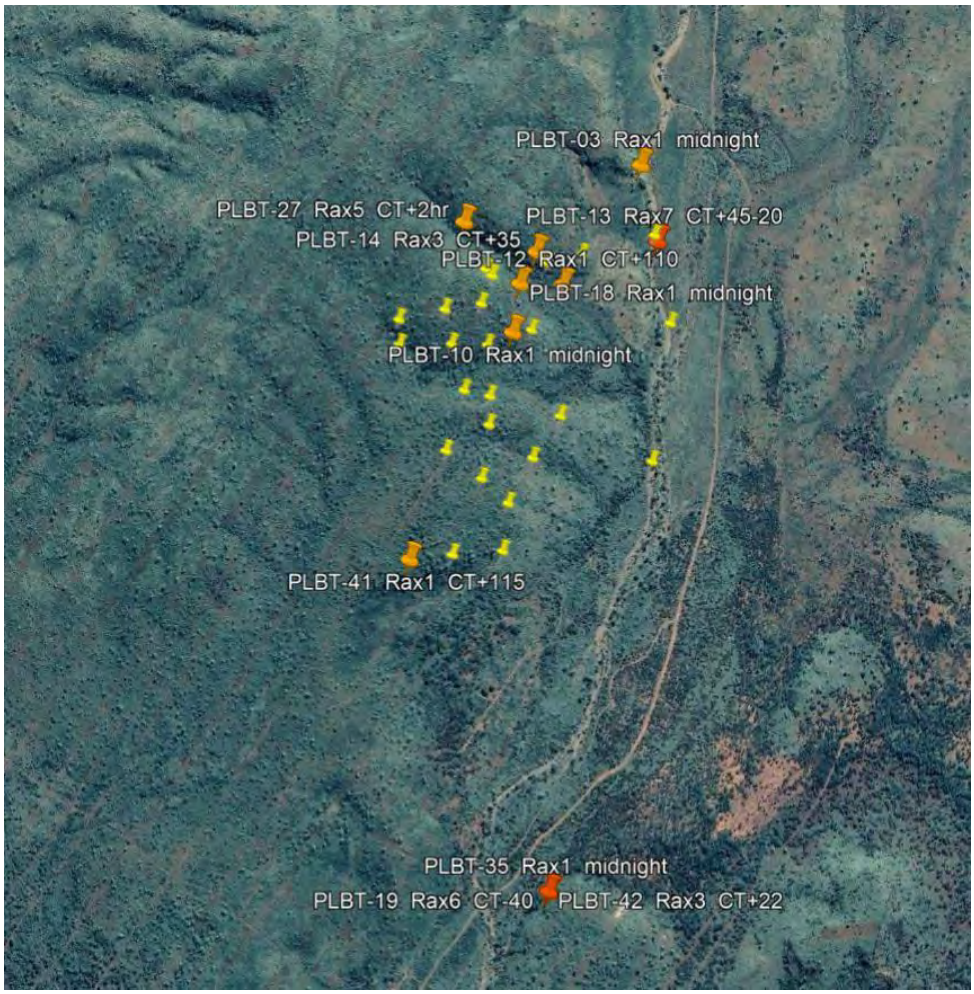


Figure 1. Diagram showing a cluster of PLNb calls in July 2020, orange pins. The burnt orange pins are sites where calls inside 30 minutes from Civil Twilight were detected.

Combined results of the surveys between April 2019 and July 2020

The results to date show that the PLNb roost is located in an area adjacent to a one-kilometer length of an unnamed creek, a tributary of the Fortescue River. The presence of this diurnal roost is confirmed by a series of calls at cave entrances and along the creek bed with timings close to dusk and dawn Civil Twilight, and together with the earlier results from April 2019, July 2019 and November-December 2019, indicate permanence, and therefore presumed maternity cave status (TSSC 2016). However, to date there has not been a site that gives the pattern of call numbers and call timings consistent with the roost cave. The shortest times from CT are at two sites that are 750 m apart, both in the creek bed (DL02 in April 2019 and DP038 in November 2019) and have calls recorded at eight minutes after CT. The pattern of call detections is consistent with the roost being in a gully immediately adjacent to these points but to date extensive searching has not successfully identified the roost. Three caves (BD-07 in July 2019, DP-07 in November 2019 and LT-05 in December 2019) have calls recorded at 20 minutes from

CT. Also, regular detections have shown that the creek line immediately to the east of these sites to be a preferred commuting and foraging area for the bats from the colony.

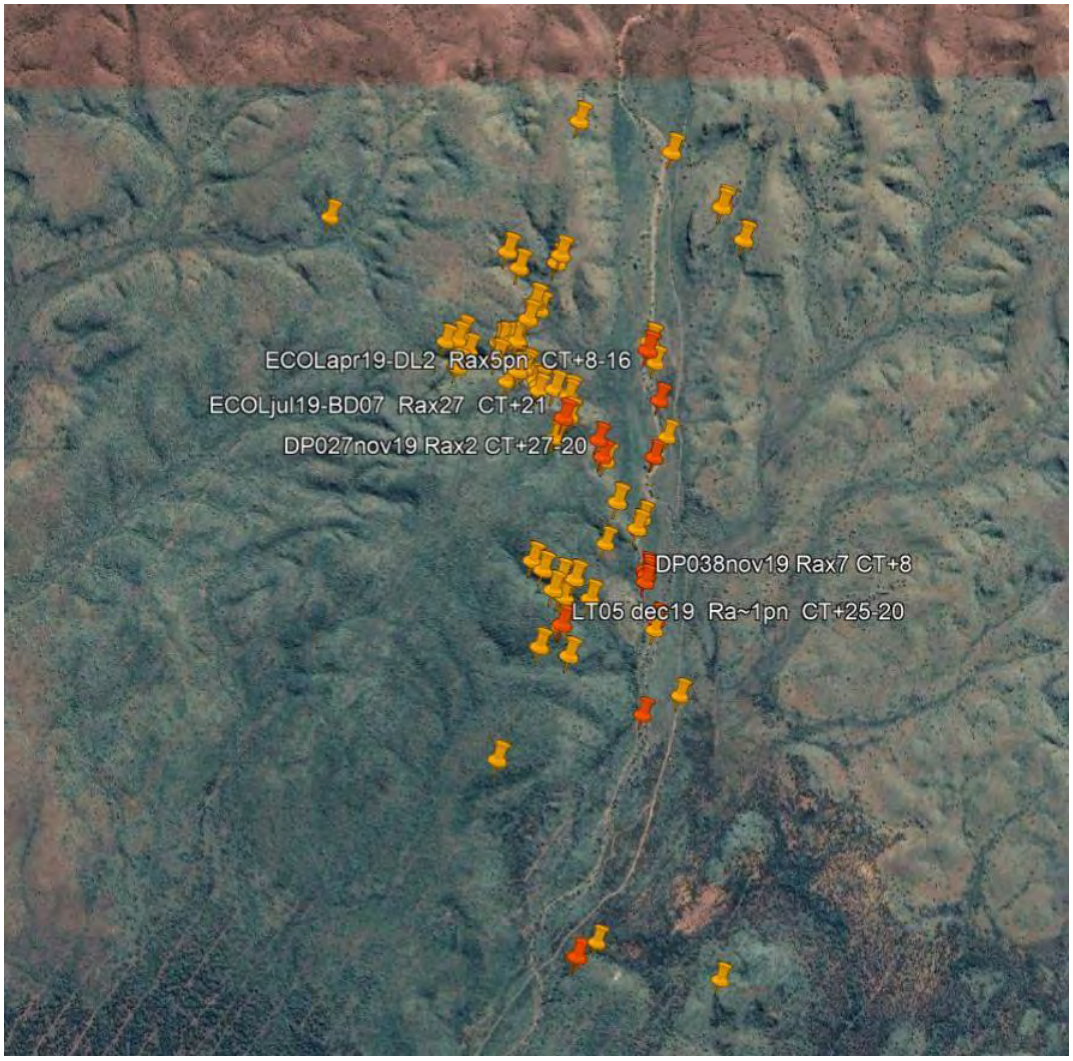


Figure 2. Diagram showing all detections of PLNb calls at Mulga East to date. The burnt orange pins are sites where calls inside 30 minutes from Civil Twilight were detected.

Importance of the Roost

There are two factors that determine the importance of this roost and confirm it as a Category 1 roost (TSSC 2016) that is defined as critical habitat that is of national significance.

1. It has been shown to be a permanently occupied diurnal roost by the results from April 2019 to July 2020.
2. Its location is in the Chichester Range to the north of the Fortescue River basin. This is the only known permanent roost in this district. Further it lies midway between the two groupings of permanent roosts, the central/western Hamersley Range group and the East Pilbara group, figure3, that are separated by approximately 100 km across the Fortescue Basin. This distance is beyond the typical maximum nightly foraging range (approximately 30 km, Bullen 2013) for the species. In this location, it provides the only convenient path for gene flow between the two roost concentrations.

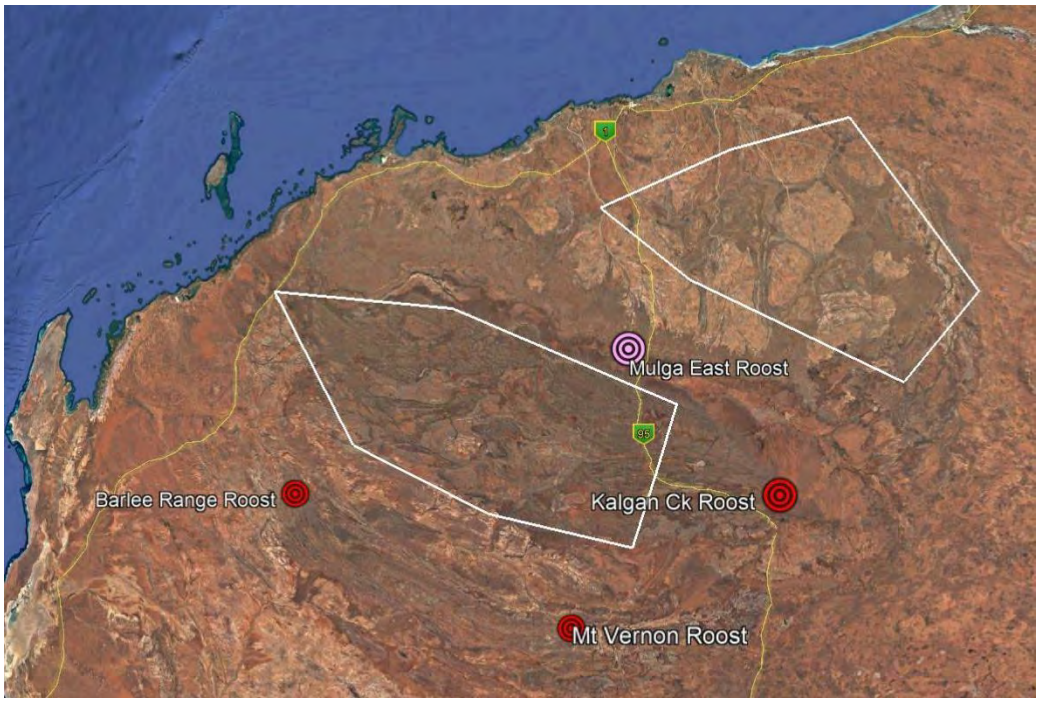


Figure 4. Diagram showing the location of the Mulga East Roost in relation to the other known PLNb permanent roosts. The white polygons surround the two concentrations of PLNb roosts, the Hamersley Range and the East Pilbara groups. Three outlier roosts are shown in red.

Recommendation

Based on the pattern of calls detected to date, the roost is most likely located in a gully immediately to the west of Unnamed Creek, however, the area immediately to the east of the creek cannot be completely ruled out as yet. The area adjacent to the creek is expected, but not yet confirmed, to become a part of the proponents mine impact area. To protect it, the following recommendations are made.

1. Until the roost is located, an exclusion zone comprising two overlapping circles of 500 m radius is recommended, figure 4. These circles are centered on sites DP026 (668885 7552925) and LT05 (668750 7552290). These zones also protect the length of creek line nearby the roost that has proven to be a regular commuting and foraging area and a small area to the east of the creek.
2. A further targeted echolocation-based survey should be carried out as soon as possible to assess every remaining cave entrance within the circles that have not been instrumented to date. This shall also assess any likely caves immediately to the east of the circles. Should this targeted survey be unsuccessful in locating the roost cave, then it should be repeated in March of 2021 following the expected recruitment of pups in the new year.
3. Once found, the recommended exclusion area is to be modified to in accordance with the confirmed location of the roost and its proximity to the projects impact area.

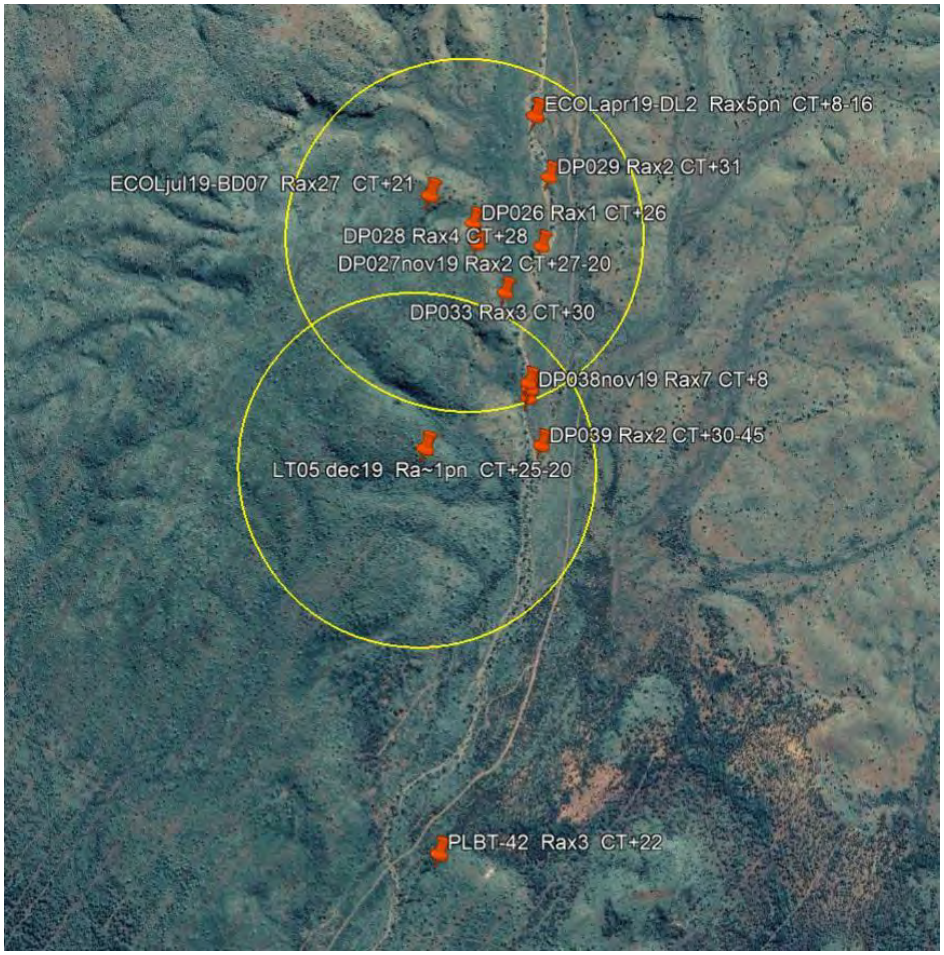


Figure 4. Diagram showing all detections of PLNb calls at Mulga East with timings of 30 minutes or less from CT. The yellow circles indicate a recommended exclusion zone surrounding the likely location of the PLNb roost cave.

Yours sincerely



Robert Bullen
Managing Director and Principal Ecologist

Bullen, R. (2013). Pilbara leaf-nosed bat, *Rhinonicteris aurantia*: Summary of current data on distribution, energetics and threats. Presentation made to Western Australian Department of Environment and Conservation workshop on Pilbara leaf-nosed bats, 25 June 2013

Threatened Species Scientific Committee, TSSC (2016). Conservation Advice: *Rhinonicteris aurantia* (Pilbara form), Pilbara Leaf-nosed Bat. Canberra, Australian Capital Territory:

APPENDIX E SPECIALISED ZOOLOGICAL MULGA EAST PILBARA LEAF-NOSED BAT REPORT

Specialised Zoological

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15 January 2021

Review of the report on the Pilbara Leaf-nosed Bat
for Hancock Prospecting Pty Ltd's Mulga East project

Dear Shaun,

Thank you for seeking my advice on your survey programme for the Pilbara leaf-nosed Bat *Rhinonicteris aurantia* for Hancock Prospecting Pty Ltd's Mulga East project. I have reviewed the report you forwarded: 'Rev0_1824_HPPL_Mulga_East_PLnB_assessment.pdf'. I provide here comments that address the scope of your enquiry:

1. Is there a Pilbara Leaf-nosed Bat maternity roost within the survey/project area?
2. If there is, where, in your opinion, is the most likely location of the roost?

My comments are made on the basis of my experience since 1996 of conducting academic research on Pilbara bats of conservation significance, and participation in many (perhaps several hundred) consultancy projects involving the Pilbara Leaf-nosed Bat. My Curriculum Vitae can be made available separately if required.

Please note that this letter of advice is not intended for the public domain, unless it is included as an appendix in a larger report to the client and/or Government.

Sincerely,

Dr Kyle Armstrong
Zoologist

A typical approach to surveying for the presence of the Pilbara Leaf-nosed Bat

The risk of development projects to the Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* is considered in most terrestrial environmental impact assessments conducted in the Pilbara region. To support this, the Commonwealth Government has provided several resources that detail expectations around surveys, and that also provide helpful information for assessments (DEWHA 2010; TSSC 2016; DAWE 2020). Given these resources, and my previous experience, I would expect to see the steps detailed in **Table 1**.

Table 1. Ordered steps undertaken for a typical consideration of the presence of the Pilbara Leaf-nosed Bat as part of the environmental impact assessment process.

Step	Detail
1	**Background review of habitats and past records**. A desktop assessment of the likelihood of presence of cave-roosting bats of conservation significance. This would consider the topography and geology in the project area, and make statements about whether the area would be likely to contain caves, especially relatively deep structures that this species prefers (Armstrong 2001). Areas of rocky outcrop would be highlighted for follow-up inspection in a field survey. The review would also consider past records of the species in the same area and nearby.
2	**Field survey to assess general presence of the species in the project area**. This would have a focus on areas where they might be detected foraging (gullies, gorges, watercourses at all scales), and at the entrance of caves that might function as roosts (as distinct from overhangs, where the back of the structure is visible from the entrance and in twilight/daylight; roosts as defined by the TSSC 2016).
3	**Assessment of nightly activity patterns at potential roost caves**. A summary of patterns based on bat detector recordings at cave entrances with an initial assessment of how the species might use the cave. This is based on two observations: 1. The time of detection relative to the end of civil twilight after sunset; and time of detection relative to the beginning of civil twilight before dawn; and 2. The pattern of activity over the entire night, with peaks of activity soon after sunset and prior to dawn indicating the possible presence of a diurnal roost. Greater attention (more survey nights) should be given to caves with the highest levels of activity and detections close to twilight periods.
4	**Assessing potential for future acoustics-based monitoring**. A summary of patterns at foraging sites away from cave entrances that might be helpful for future monitoring of general presence in the project area if long-term monitoring is required. These are cave entrances that have been visited by the species, and also gullies and pools where activity is documented to be relatively high.

5	**Searches for roosts, and confirmation of daytime occupancy**. Concurrent and/or follow up survey work is required to search for caves in the project that might function as roosts, especially if earlier surveys detect the species. A critical part of this is to make an assessment that allows sites used as nocturnal refuges to be distinguished unambiguously from those that are used as diurnal roosts. The Conservation Advice for the species (TSSC 2016) contains definitions that help a decision to be made about roost type, and the document "Survey guidelines for Australia's threatened bats" (DEWHA 2010) outlines a low-impact method that can be used for this (also referred to in TSSC 2016 and DAWE 2020). This is the 'entrance barricade' or 'entrance sheeting' method. This method, which is conducted at a cave entrance, allows an unambiguous determination of whether the Pilbara Leaf-nosed Bat is present inside during the day, because it can distinguish individuals that might visit the cave at night after emerging from another structure soon after sunset. A combination of video and acoustic recordings can also be used (DAWE 2020) but there can be a possibility of misinterpretation if several bats are present at the time the first Pilbara Leaf-nosed Bat emerges, or if placement of devices results in missed detections. For a third party to have confidence in the results, and given the cost implications of an incorrect determination, the entrance sheeting method can be considered superior.
6	**Assessment of seasonal presence to establish roost type (*sensu* TSSC 2016)**. Consideration should be given to a follow up survey in a different season to establish whether there is year-round presence of the species in the project area. This will contribute to defining transitory diurnal roosts and distinguish them from permanent diurnal roosts and non-permanent breeding roosts (*sensu* TSSC 2016). Of particular relevance is whether the species is present and can be associated with a particular cave site at some stage during the breeding cycle. The breeding cycle includes mating, times when females are pregnant, parturition (birth) and the time until young are weaned. While any cave that provides refuge for this physiologically fragile species at any time of the year is important, presence during one of the stages of breeding can elevate the importance of a site, especially if diurnal presence can be confirmed unambiguously.
7	**Further follow up characterisation work**. This might be required if a diurnal roost that would be impacted negatively by the proposed development is confirmed within a project area. This would typically involve characterisation of the structure itself and how it is used by the colony, including a definition of the size of the structure, measurement of roost chamber conditions (if the chamber is accessible when bats are absent), and a robust estimation of colony size based on video recordings (not acoustic recordings). Local movements in and out of the project area, or amongst known roosts, are sometimes relevant, as is any evidence that breeding might be occurring at sites within the project area. The nature of characterisation work can be dependent on the situation.

If this process has been followed, but no diurnal roosts have been confirmed to exist in the project area despite an appropriate amount of effort, adequate exploration for caves, and the application of suitable methods (steps 1–6), then it could be concluded that the project is not likely to have a significant impact on the species, given the importance of roost sites that is highlighted in the Conservation Advice (TSSC 2016).

Review of the Ecologia report

To meet the provided scope and derive an opinion about whether a roost used for breeding purposes exists in the project area, and where diurnal roosts might be, I read through the report 'Rev0_1824_HPPL_Mulga_East_PLnB_assessment.pdf', including the appendices that contained the three reports by Bat Call WA Pty Ltd.

The effort can be summarised as follows:

1. Phase 1 Level 2 terrestrial fauna survey with bat detectors April 2019
2. Phase 1 Targeted bat detector survey in July 2019
3. Targeted bat detector survey in November 2019
4. Long-term bat detector recordings 17 December 2019 to 22 March 2020
5. Targeted bat detector survey in July 2020
6. Targeted bat detector survey in October 2020 (not included in Ecologia Environment 2020)

The total number of recording sites is 206 (plus 28 sites from October 2020 not presented in Ecologia Environment 2020). Each recording site was sampled once, with apparently no repeat of sampling at the same sites among surveys. The Pilbara Leaf-nosed Bat was detected at 96 of these sites (pre-October 2020; **Table 2**).

The work presented in the compiled report is comprehensive and mostly consistent with the steps outlined in **Table 1** (and thus DEWHA 2010; TSSC 2016; DAWE 2020), though there are several issues originating with the reports Bat Call WA (2019a,b, 2020)—commentary on these was beyond the scope of this review, but has been provided separately.

Table 2. Summary of Bat detector sites and detections of the Pilbara Leaf-nosed Bat ('Ra'). **This survey was not reported in Ecologia Environment (2020), however recordings were provided to me for inspection.

Survey	Sites	Sites with Ra
1. April 2019	31	5
2. July 2019	57	31
3. November 2019	70	43
4. December 2019 to March 2020	6	4
5. July 2020	42	13
**6. October 2020	28	6
Total	**234**	**102**

Assessment against the steps

Step	Detail
1	**Background review of habitats and past records**. This information was presented, which guided the placement of bat detectors, the explorations for caves that might contain roost sites, and consideration of potential foraging areas that were classified according to categories in the TSSC (2016). Reference to the previous survey by Terrestrial Ecosystems (2013) was made, which did not record the species. Search areas based on rocky outcrop were not explicitly presented (e.g., as polygonal areas on a map), but field-based search effort to locate caves and assess them as potential roosts was well documented (see Step 2 for further details). Work to complete this step appears satisfactory.
2	**Field survey to assess general presence of the species in the project area**. The Phase 1 Level 2 terrestrial fauna survey with bat detectors conducted in April 2019 identified an area in the eastern part of the project area where the Pilbara Leaf-nosed Bat was present (detected at five recording sites). This prompted a further five field surveys (**Table 2**), four of which are presented in Ecologia Environment (2020). These surveys specifically targeted caves as potential roost sites, as well as other sites that helped to define areas where the species foraged. This significant level of effort is mapped and summarised here in **Figures 1** and **2**. The various tables in Ecologia Environment (2020) do not indicate which recording sites were at cave entrances. Significant effort was made to document the caves in the project area, with the raw observations presented in the appendix of Ecologia Environment (2020). The comprehensive level of survey effort to locate roost sites was mapped (Table 2.7 in Ecologia Environment 2020), and it appears that most surveys were confined to the eastern edge of one particular upland area (see also **Figures 1** and **2** in the present report). Further clarification was provided to me by Ecologia Environment, who described the western side as “a rolling hill with no caves”. In addition, extensive searches for caves were completed both east and west of the creek. Work to complete this step appears satisfactory.
3	**Assessment of nightly activity patterns at potential roost caves**. The recordings made with bat detectors were summarised in tables in Ecologia Environment (2020). The interpretation of how caves might be used by the species, and where a diurnal roost might be located was based on the first and last times of detection relative to civil twilight (which I interpret to mean the end of civil twilight after sunset, or the beginning of civil twilight before dawn). No activity patterns were presented, though Bat Call WA (2020) does make mention of the possibility that this was undertaken. An assessment of diurnal occupancy of putative roosts consistent with the entrance screening methods described in DEWHA 2010, TSSC 2016 and DAWE (2020) was not undertaken. Ecologia Environment supplied the original call recordings from all six surveys (**Table 2**) for me to inspect. The information on times of first and last detection, and number of call sequences presented for each recording site is accurate and adequate.

	However, I saw value in re-analysing the WAV files collected from one of the long-term recording sites (MEC016) where a bat detector was set to record between 17 December 2019 and 18 March 2020. This site was reported to have "100s" of call sequences by Ecologia Environment (2020: Table 2.4), though with most nightly totals not exceeding 10 call sequences. I was forwarded a brief informal email from R. Bullen to Ecologia Environment that summarised the outcome of the analysis of recordings from site MEC016 (and sites LT01–LT05). This contained a plot and an interpretation stating "This confirms that there is a roost with a very small number of PLNb using it diurnally right through the wet season". Given that this site appeared to have relatively high activity, it seemed prudent to re-analyse that dataset, and check Bullen's interpretation. The results are summarised in the present report in the following section: *Summary of activity at MEC016*. Work to complete this step could have been extended to further analysis and formal presentation of the activity patterns at site MEC016 as a minimum. This would have allowed a decision to be made on whether the entrance screening method for confirming diurnal occupancy of a cave would have provided further confidence in the designation of a roost type consistent with the definitions in the TSSC (2016).
4	**Assessing potential for future acoustics-based monitoring**. Many detections of the Pilbara Leaf-nosed Bat were made at cave entrances, though the species was also detected along a major watercourse to the east of these caves (**Figure 2**). Caves with the highest levels of activity (especially MEC016) and these sites in the watercourse would be good candidate sites if long term monitoring was required. Note that I am not explicitly recommending monitoring here, just commenting on whether candidate sites are present. Work to complete this step appears satisfactory.
5	**Searches for roosts, and confirmation of daytime occupancy**. Confirmation of diurnal occupancy was not undertaken. Upon querying this, I was advised that: "No caves with a suspected diurnal roost [were] identified to warrant the use of sheeting. Once a cave of interest was identified and to confirm diurnal presence, sheeting would [have] been undertaken." While information on some of the caves examined was provided in the appendix of Ecologia Environment (2020), the best judges of whether to conduct the entrance screening method based on an examination from the entrance are the people that observed the structures directly in the field. Following that, consideration of both times of first and last detection, plus the pattern of nightly visitation based on numbers of calls can also guide whether to follow up with a confirmation of diurnal occupancy. I have provided further thoughts about the applicability of the entrance screening method for determining diurnal occupancy below in the section *Summary of activity at MEC016*. This site had the highest level of activity of the species, and is therefore the greatest candidate of all structures examined for a diurnal roost of some type.
6	**Assessment of seasonal presence to establish roost type (*sensu* TSSC 2016)**. The comprehensiveness of bat detector surveys established that the Pilbara Leaf-nosed Bat is present in the project area throughout the year.

	Work to complete this step appears satisfactory.
7	**Further follow up characterisation work**. Since no specific cave in the project area was suggested to function as a diurnal roost (only nocturnal refuges; *sensu* TSSC 2016), this precludes further characterisation work.

Summary of activity at MEC016

Re-analysis of the recordings made between 17 December 2019 and 18 March 2020 at cave entrance MEC016 allows the following interpretations to be made:

1. **Presence of peaks of activity**. The activity patterns across each of the 79 nights, as derived from a tally of the number of WAV files containing an echolocation call sequence of the Pilbara Leaf-nosed Bat in 30 minute periods, show only two peaks of activity soon after sunset that can sometimes indicate diurnal roosting (**Figure 3—Upper**). For the remaining 77 nights, there were no such peaks. The nightly patterns are not consistent with long-term, consistent diurnal roosting, or breeding activity. The patterns are more consistent with a nocturnal refuge (*sensu* TSSC 2016). A confirmation of absence during the day would require application of the entrance sheeting method (DEWHA 2010; TSSC 2016; DAWE 2020).

2. **Number and consistency of nights with relatively high activity**. The nightly total number of call sequences of the Pilbara Leaf-nosed Bat was relatively low on most of the 79 nights, with relatively high levels of activity on only three nights (**Figure 3—Lower**). This pattern is not consistent with long-term, consistent diurnal roosting, or breeding activity.

3. **Overall levels of activity**. The recordings for most of those 79 nights contained 10 or fewer call sequences per night (**Figure 4**). This level of nightly activity is not typical of long-term, consistent diurnal roosting, or breeding activity.

4. **Summarised overview of activity patterns and levels**. To provide clarity on when the Pilbara Leaf-nosed Bat was detected relative to sunset/sunrise and civil set/civil rise times, I summarised the nightly activity for the whole period in a single plot (**Figure 5**). No calls were detected in the periods between sunset and the end of civil twilight, or between the beginning of civil twilight and sunrise. There were no peaks of activity in periods of darkness just after the end of civil twilight after sunset, or just before the start of civil twilight before dawn. Overall the patterns in **Figure 5** are not consistent with long-term, consistent diurnal roosting, or breeding activity. However, activity very close to the beginning of civil twilight on 16 February 2020 could suggest either diurnal roosting or the presence of a diurnal roost not far away. In this case, the entrance sheeting method would have provided an unambiguous determination of whether this cave met the definition of a transitory diurnal roost (*sensu* TSSC 2016), however this was a rare occurrence, and there is no way to predict when such instances occur.

Summary comments

1. **Level of search effort**. There has been a significant amount of effort given to locating a diurnal roost of the Pilbara Leaf-nosed Bat using bat detectors and by documenting the caves present in the project area. All areas of rocky outcrop within the project area appear to have been assessed for the presence of caves that might function as diurnal roosts. However, it falls to Ecologia Environment to present sufficient evidence for whether all caves in the project area have been found and assessed.

2. **Assessment of cave MEC016**. It appears that the cave at recording site MEC016 had the greatest potential to be a diurnal roost of the Pilbara Leaf-nosed Bat. Overall, the activity patterns from cave site MEC016 that are presented in **Figures 3–5** help with the interpretation of how this particular structure might be used by the species. The activity patterns are not suggestive of long-term, consistent diurnal roosting, or breeding activity; and instead are consistent with use of the site as a nocturnal refuge, at least during the period of recording.

3. **Consideration of the application of the entrance sheeting method at cave MEC016**. Whether the cave at MEC016 is also used a transitory roost cannot be determined unambiguously from the recordings. The application of the entrance sheeting method to confirm diurnal occupancy at this cave would probably not have provided any further helpful information, unless it happened by chance that the effort coincided with an uncommon roosting event.

4. **Other cave sites**. None of the other caves had times of first/last detection relative to the end and start of civil twilight, or total numbers of call sequences detected, that are strongly suggestive of diurnal roosting. It is only by longer term bat detector recordings and the application of the entrance sheeting method that diurnal occupancy would be confirmed. However, if one of these caves functions as a transient diurnal roost, then chance will play a role in whether diurnal roosting will actually be observed using the entrance sheeting method. The best current interpretation is that they function as nocturnal refuges or simply as sites for occasional visitation.

5. **Comments on supporting work**. In addition to the comments made in the present document, I provided further extensive critical comment on the contents of the reports from Bat Call WA (2019a,b, 2020). There are serious shortcomings in all three reports, and details have been provided to Ecologia for their consideration, but they are beyond the scope of the present review.

6. **The likelihood of presence of a type of diurnal roost**. If there has indeed been an exhaustive search for caves in the project area, then the total weight of evidence does not support the presence of a permanent diurnal roost or non-permanent breeding roost within the areas surveyed. It might suggest the presence of a transitory diurnal roost, but this would need to be demonstrated.

Explicit comment to the scope of this analysis

1. Is there a Pilbara Leaf-nosed Bat maternity roost within the survey/project area?

From the evidence I have been able to consider here, there is no observation that suggests either a permanent diurnal roost or non-permanent breeding roost within the project area.

However, there is clearly year-round presence of the species, and visitation at cave entrances that suggests a diurnal roost is not far away.

For the caves visited by the Pilbara Leaf-nosed Bat at night in the project area, the best current interpretation is that they function as nocturnal refuges or simply as sites for occasional visitation.

They might function as transitory diurnal roosts on some occasions, but this would need to be demonstrated with an appropriate method.

The comments above assume that exhaustive searches for caves have been completed. This perspective would obviously need revision if further effort at any one of the caves in the project area visited at night by the species demonstrates evidence of diurnal roosting. But even the confirmation of a transitory diurnal roost within the project area leaves open the possibility of another permanent diurnal roost somewhere else nearby.

2. If there is, where, in your opinion, is the most likely location of the roost?

Given that there is no direct evidence of a permanent diurnal roost or non-permanent breeding roost within the project area, answering this question becomes optional. However, hopefully I can provide a useful perspective below.

It is more likely that the closest diurnal roost is located outside the project area. Its location is a subject for speculation only. The ironstone habitats of the Hamersley Range on the southern side of the Fortescue Valley, where deep caves might occur, are at least 30 km away. While this species has been observed or inferred to range ten or more kilometres from a diurnal roost while out foraging at night, it seems unlikely that bats could reach the Mulga East project area from the Hamersley Range within a few minutes of the end of civil twilight. Thus, it is more likely that one or more diurnal roosts are closer, north of the Fortescue Valley.

References

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URL: http://www.environment.gov.au/biodiversity/threatened/species/pubs/82790-conservation-advice-10032016.pdf.

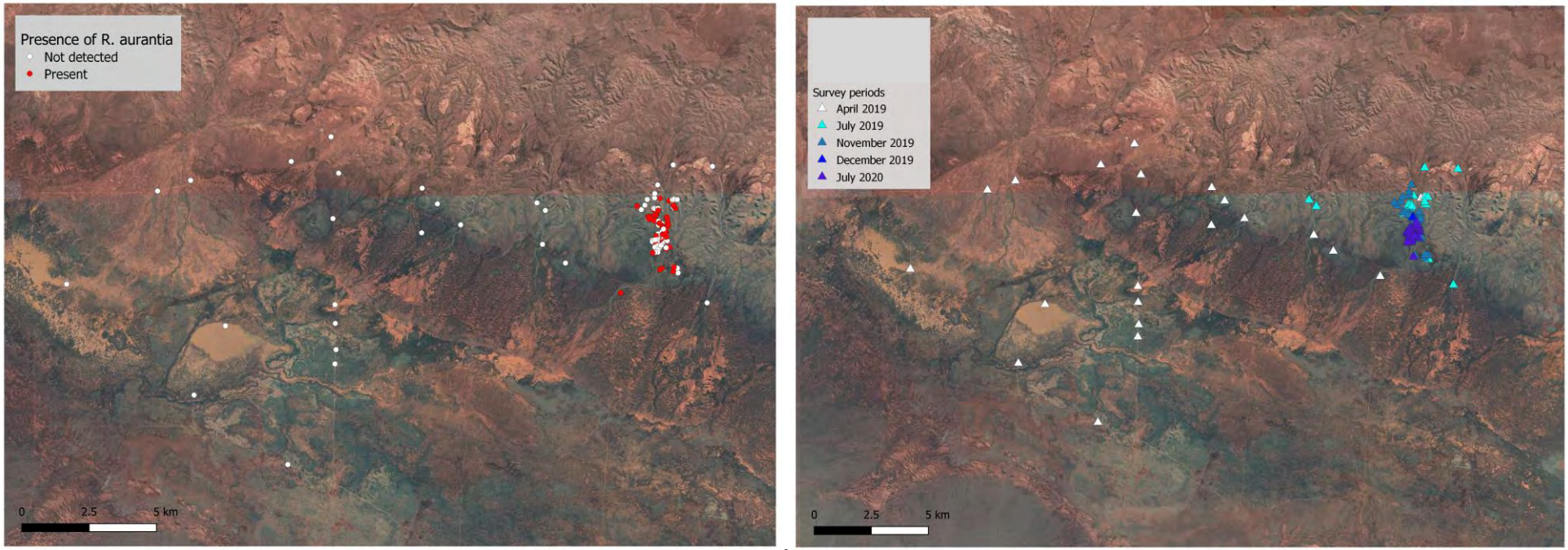
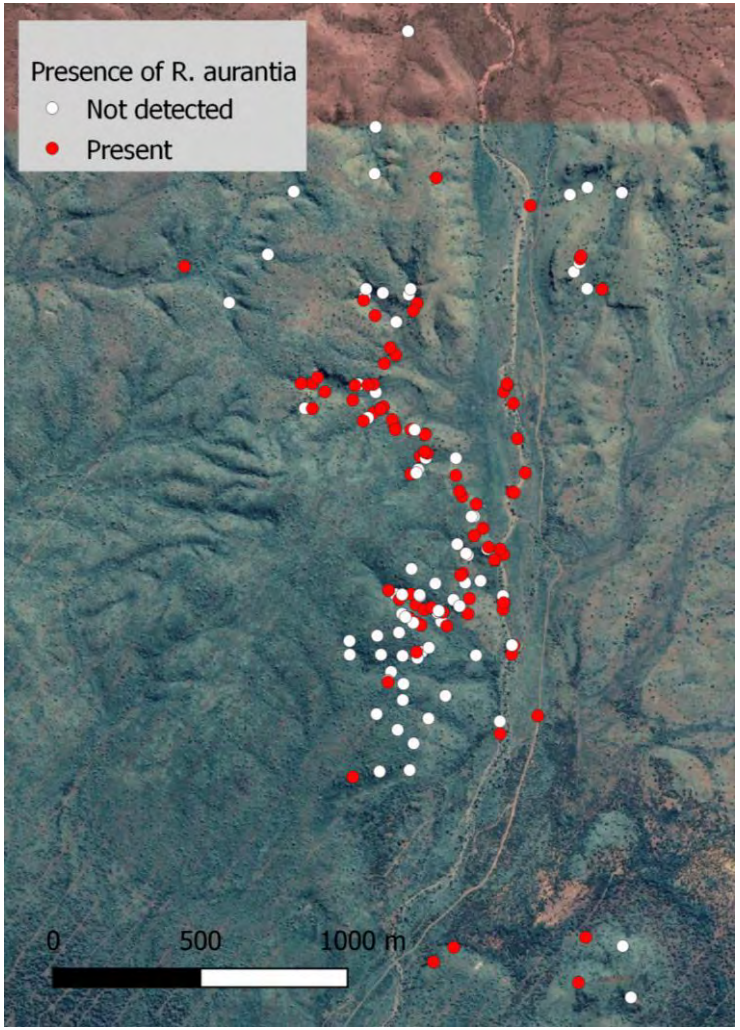


Figure 1. L**eft**: Distribution of records of the Pilbara Leaf-nosed Bat across the entire area studied; **Right**: The focus of the different surveys across the entire area studied.



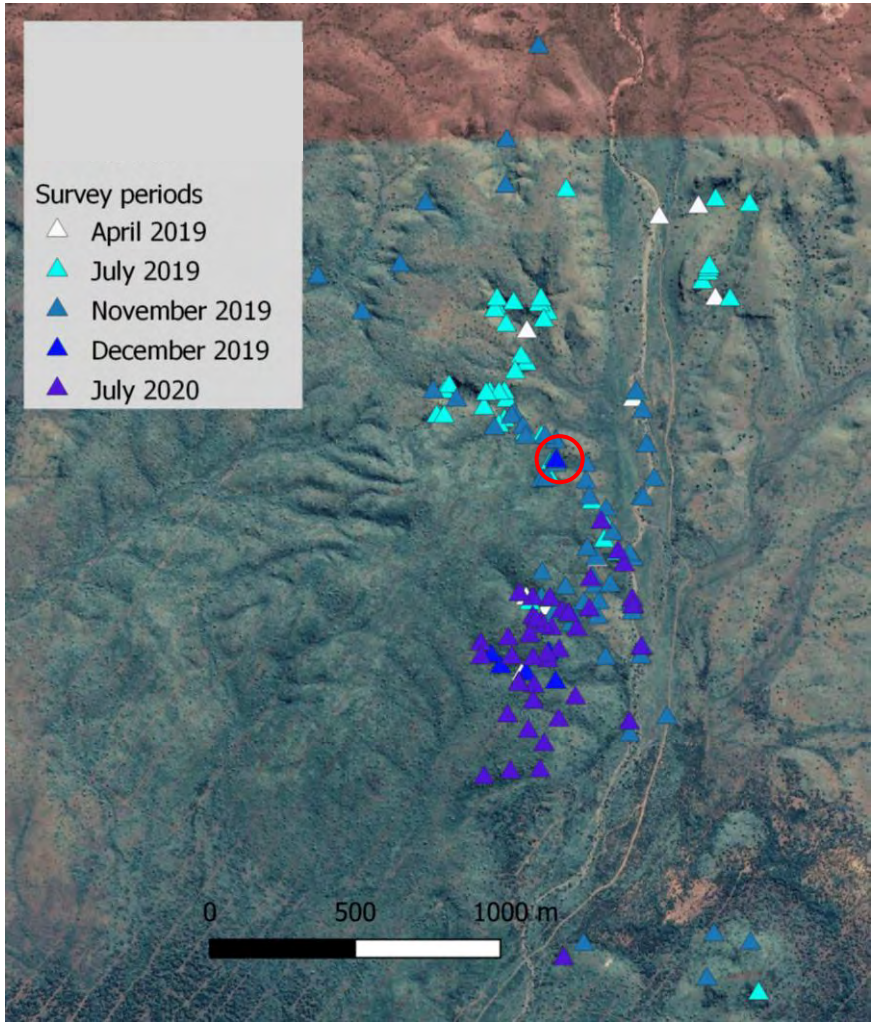


Figure 2. Detail of eastern part of the study area where most of the survey effort was concentrated. **Left**: Records of the Pilbara Leaf-nosed Bat; **Right**: The focus of the various surveys. The red circle shows the location of the cave MEC016 that had the greatest level of recorded activity between December 2019 and March 2020.

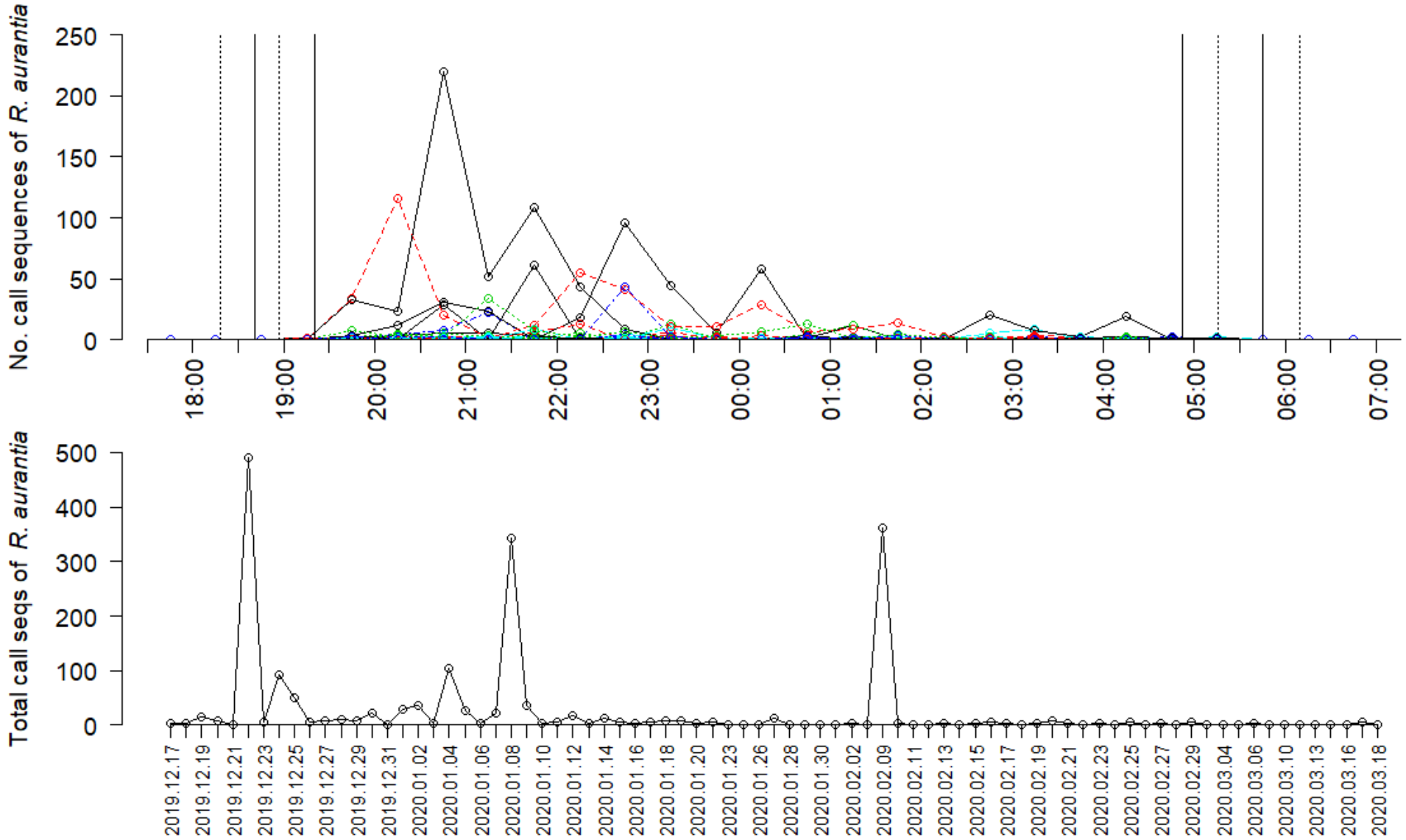


Figure 3. **Upper**: Activity patterns from 79 recording nights at MEC016 between 17 December 2019 and 18 March 2020, with the number of passes totalled in 30 minute periods, and overlaid upon each other (dotted lines show the range of sunset/sunrise times; solid lines show the range of civil set/civil rise times); **Lower**: nightly total number of call sequences of the Pilbara Leaf-nosed Bat at MEC016.

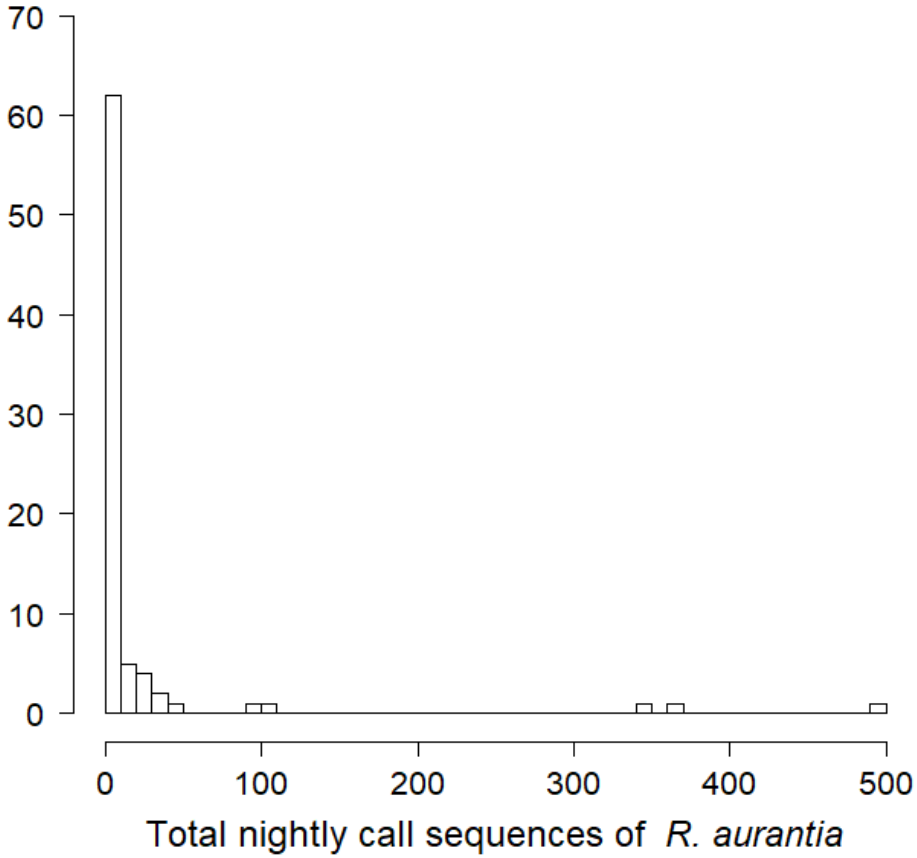


Figure 4. Histogram of the total number of nightly call sequences of the Pilbara Leaf-nosed Bat for the period between 17 December 2019 and 16 March 2020. Most nights had ten or less call sequences of the Pilbara Leaf-nosed Bat.

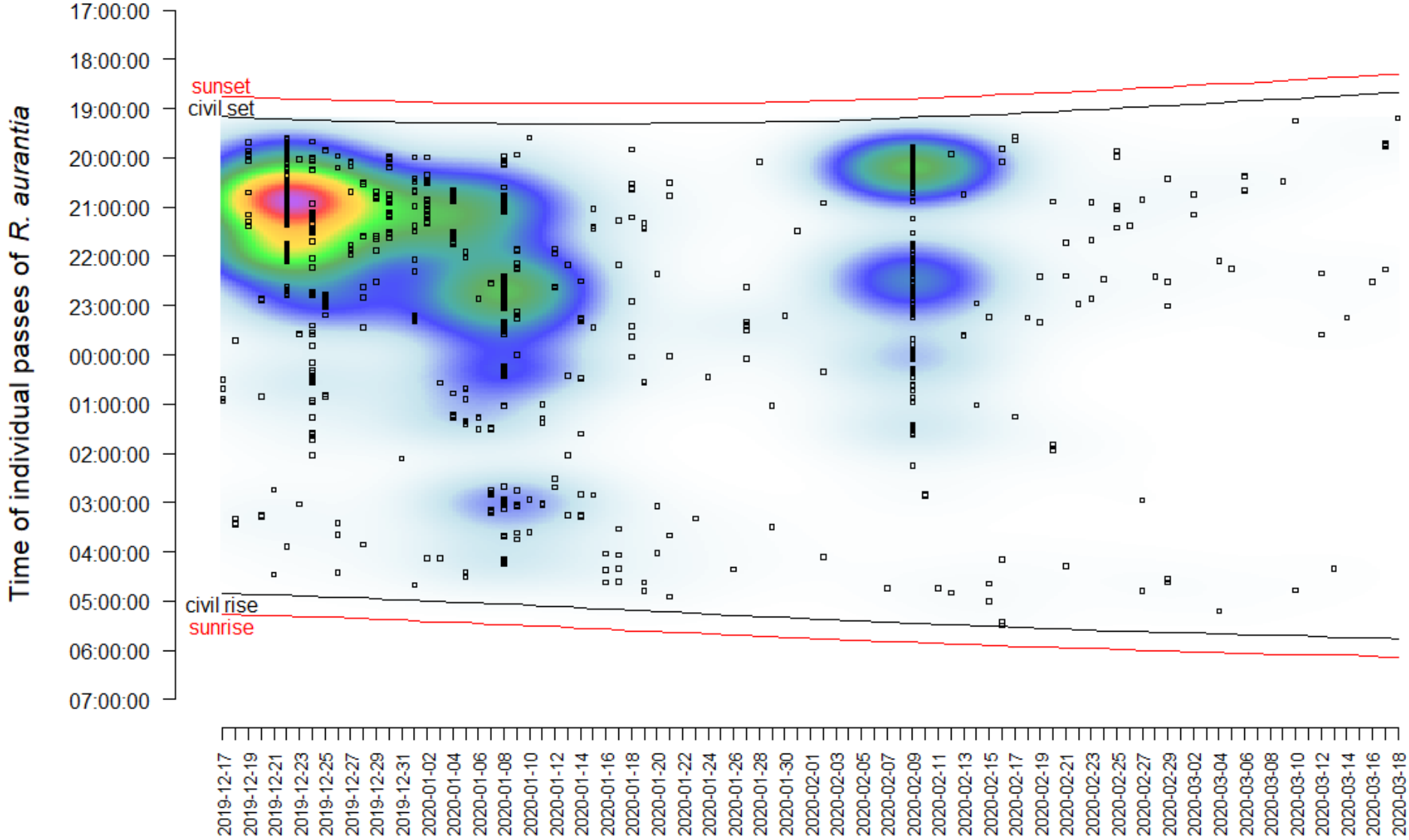
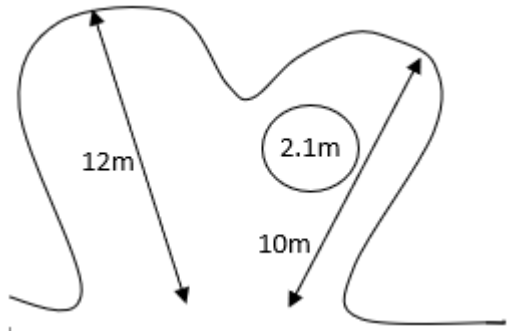
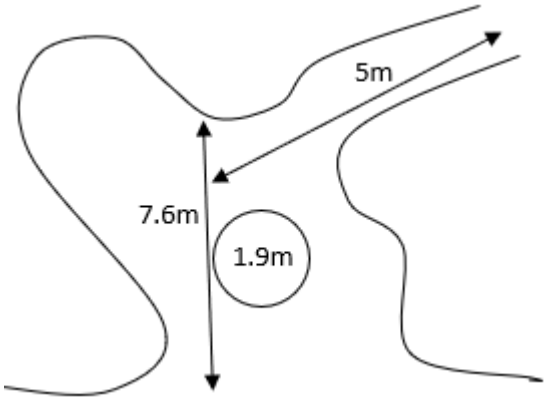
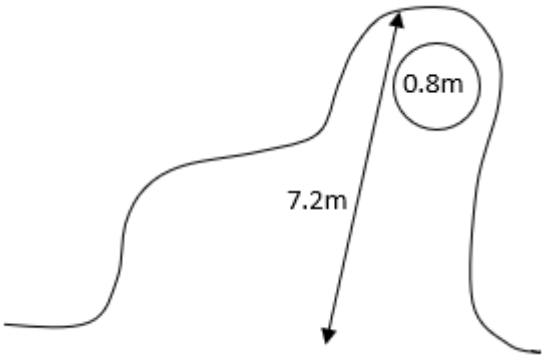


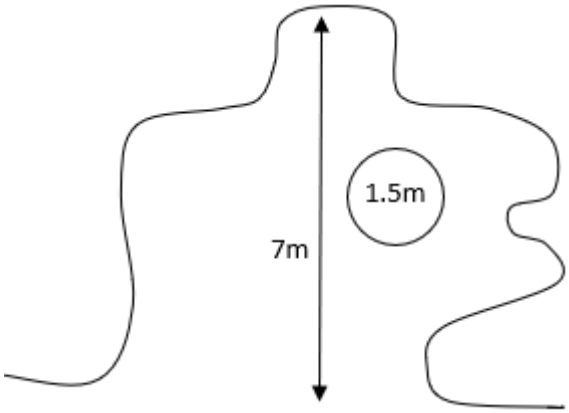
Figure 5. Distribution of times of each pass of the Pilbara Leaf-nosed Bat throughout each night. The colour scale represents the density of passes, with blue colours indicating relatively low numbers and red-purple relatively high numbers. This can be compared against the nightly peaks shown in Figure 3—Lower. The times of sunset/sunrise and civil set/civil rise are plotted to highlight whether activity at the cave entrance occurred between sunset and civil set, and between civil rise and sunrise.

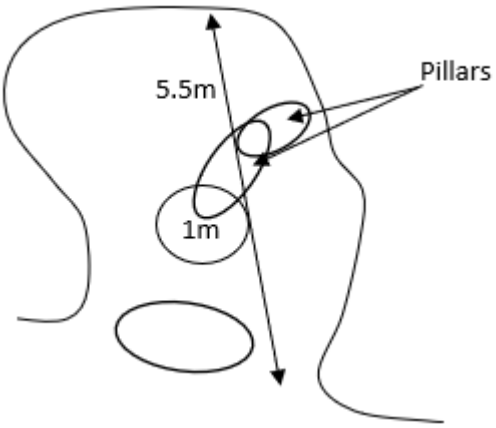
APPENDIX F CAVE HABITAT ASSESSMENTS

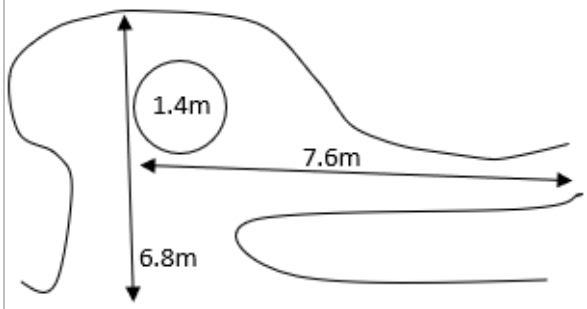
Cave ID: MEC001	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Yes, feeding debris and scats found	670749E 7553843S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.2 x 0.9	South
Cave Grouping:	**Insulation from surface above:**
Multiple caves on ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Nocturnal feeding- Internal dome with bird feathers and ghost bat scats underneath. Potential PLnB and GB shelter. Potential PLnB roost (humid microclimate, microbats observed roosting).	Yes- 2.1m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None seen- possible	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	Kilometres
Cave Floorplan and Photo	
	

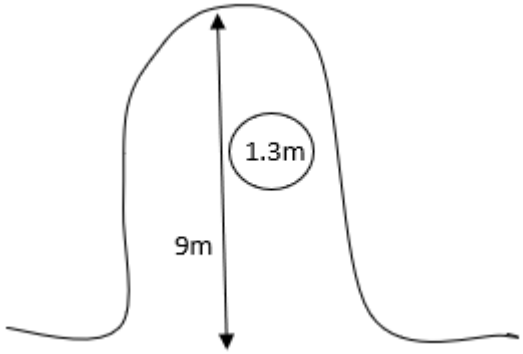
Cave ID: MEC002	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669311E 7553694S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.7 x 1.3	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential PLnB and GB shelter (domed chamber >1.5m). Potential PLnB roost	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient- warm deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	300m to road
Cave Floorplan and Photo	
	

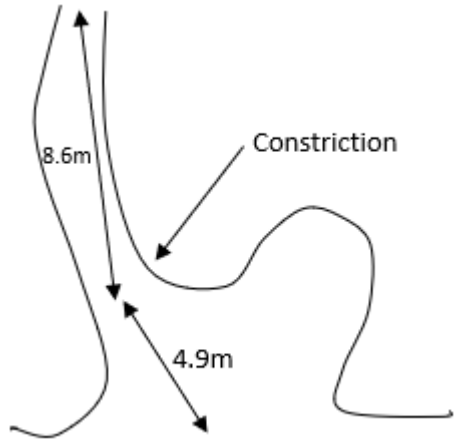
Cave ID: MEC003	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669456E 7553955S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.6 x 0.9	South
Cave Grouping:	**Insulation from surface above:**
Loose grouping at end of small valley ridgeline	Mid landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential PLnB nocturnal shelter/refuge	No- very low
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	400m to road
Cave Floorplan and Photo	
	

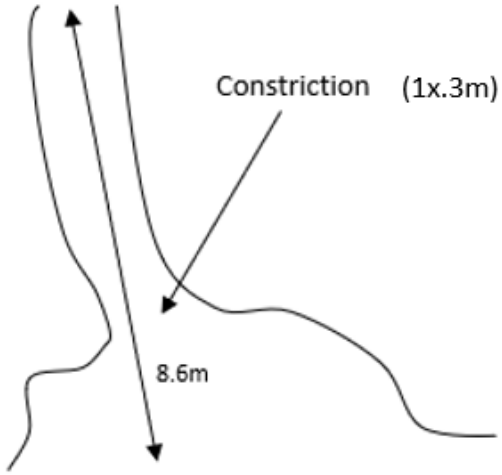
Cave ID: MEC004	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670704E 7553921S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.3 x 1.4	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB). Domed chamber 1.5m tall	Small – 1.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hills with Spinifex, Drainage Line	Kilometres to disturbance
Cave Floorplan and Photo	
	

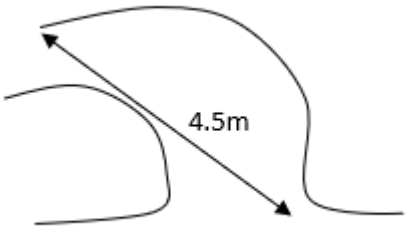
Cave ID: MEC005	**Date**: 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670882E 7553178S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances – 1.3 x 1.0 - 1.4 x 0.7	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential PLnB nocturnal shelter– low, deep cave	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possibly	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	Kilometres
Cave Floorplan and Photo	
	

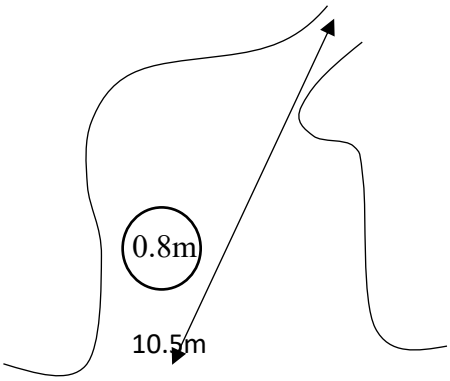
Cave ID: MEC006	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670677E 7553374S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single - 5.8 x 1.8	North East
Cave Grouping:	**Insulation from surface above:**
Loose grouping at end of valley in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – large open space
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	Kilometres
Cave Floorplan and Photo	
	

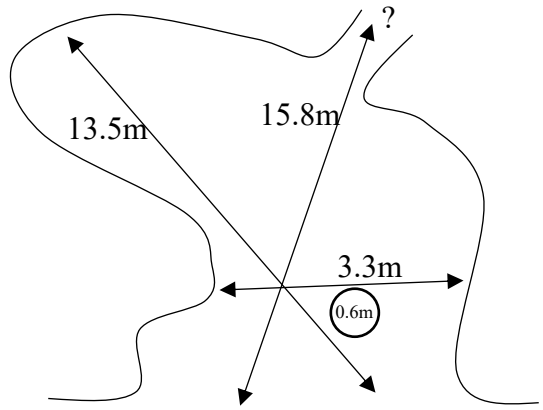
Cave ID: MEC007	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668730E 7553581S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.1 x 2.2	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB and GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line and Rocky Hills with Spinifex	300m to Drill Line
Cave Floorplan and Photo	
	

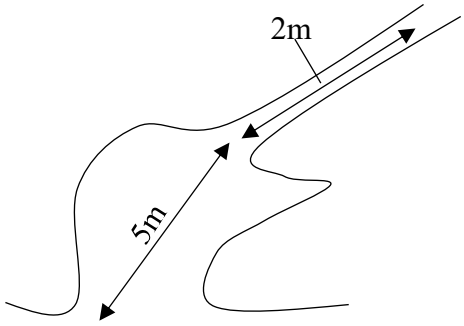
Cave ID: MEC008	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668900E 7552845S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.8 x 1.0	North-east
Cave Grouping:	**Insulation from surface above:**
Loose grouping in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely to be a PLnB roost due to light levels deep in cave and air flow	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – internal temperature unknown. Light was seen deep in cave. Potentially allowing airflow & not likely to harbour humid conditions
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

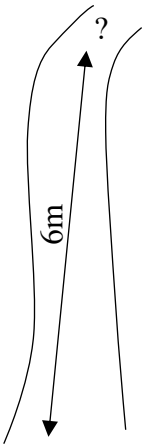
Cave ID: MEC009	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668582E 7553142S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.7	North-east
Cave Grouping:	**Insulation from surface above:**
Big, broken boulders along ridgeline. Entrance down behind a large boulder. Cave very long and low	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

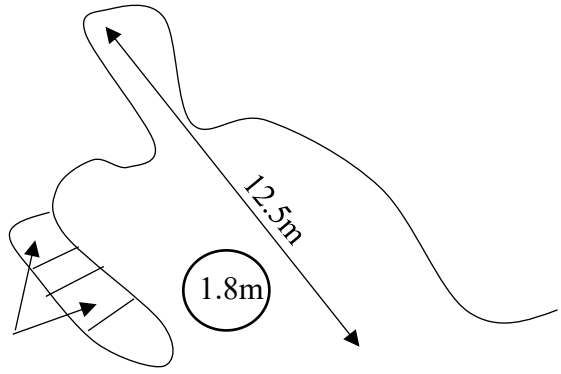
Cave ID: MEC010	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668631E 7553169S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.3 x 0.5	North
Cave Grouping:	**Insulation from surface above:**
Grouping of caves and cracks along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost	None seen
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

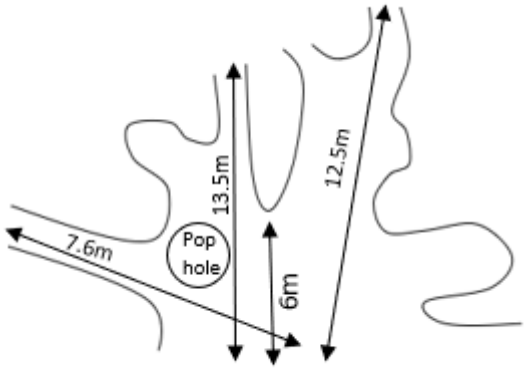
Cave ID: MEC011	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664104E 7553907S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.7 x 1.0	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes – 1 rear passage	Ambient in main chamber – rear passage unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

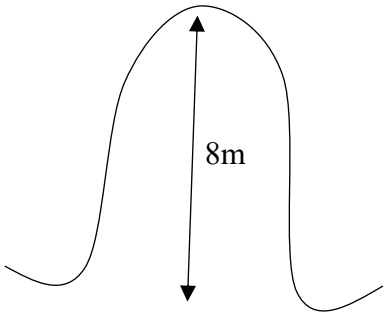
Cave ID: MEC012	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668770E 7552990S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.3 x 1.5	South-east
Cave Grouping:	**Insulation from surface above:**
Multiple deep caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB), potential roost site (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – rear passage unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	No photo

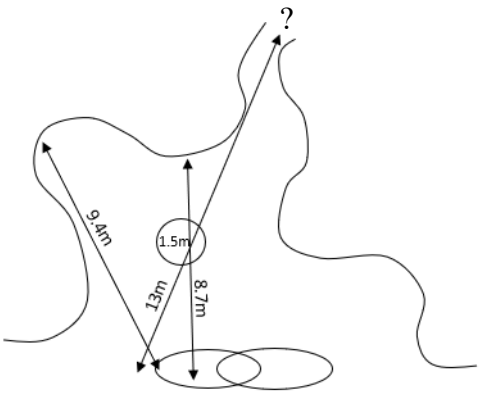
Cave ID: MEC013	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668833E 7552939S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.8 x 1.0	North
Cave Grouping:	**Insulation from surface above:**
Single cave in small ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes – very small constriction	Ambient main chamber – passage unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to Drill Line
Cave Floorplan and Photo	
	

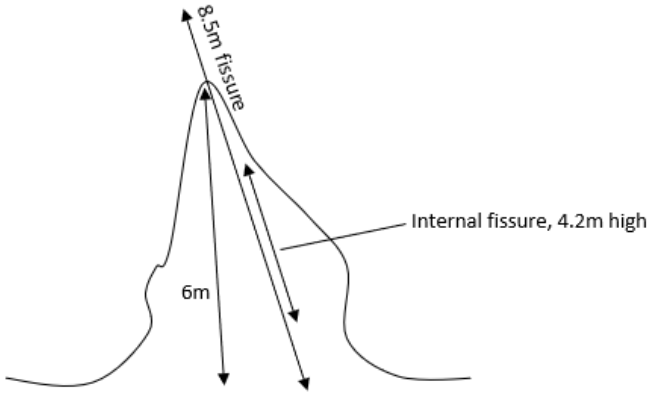
Cave ID: MEC014	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668910E 7552841S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.7 x 0.7	East
Cave Grouping:	**Insulation from surface above:**
Singular – loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Present	Ambient → humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

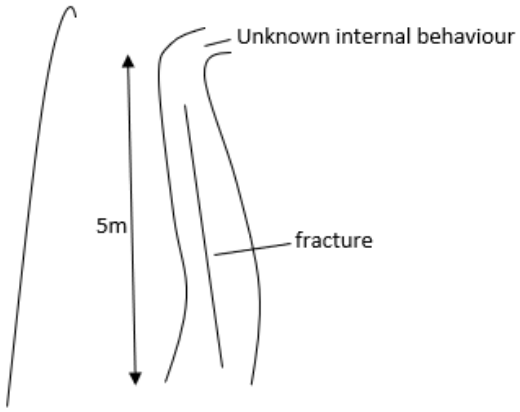
Cave ID: MEC015	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664141E 7554343S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
3 entrances – 2 partially blocked Single main – 6.1 x 1.7	South
Cave Grouping:	**Insulation from surface above:**
Singular	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Nocturnal shelter only (GB/PLnB). Unlikely to be a roost due to airflow and low humidity	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient, two small entrances blocked by rocks let airflow through
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres
Cave Floorplan and Photo	
 2 small entrances blocked by rocks which lets airflow through	

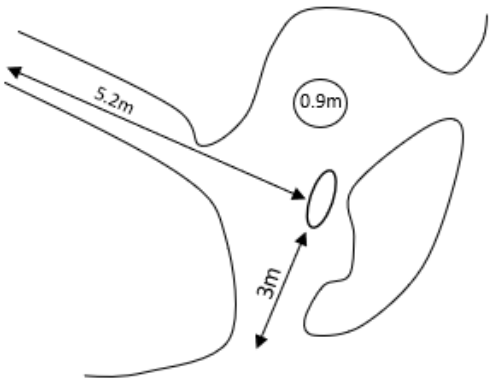
Cave ID: MEC016	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668802E 7553006S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single entrance – 7.5 x 2.0m	South
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site. PLnBs have been recorded using this cave as a diurnal refuge. Pop hole in main chamber.	Not obvious – possible in rear of cave
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient- unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

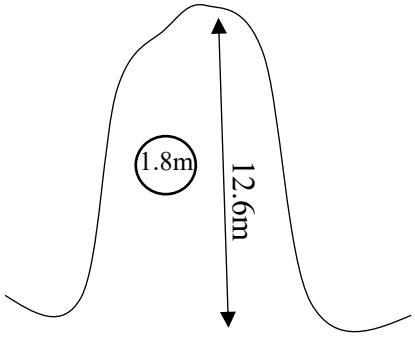
Cave ID: MEC017	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664093E 7553977S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.7 x 0.8	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Nil	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

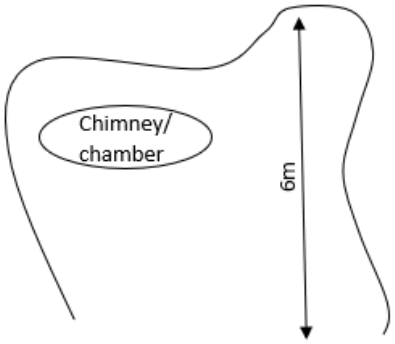
Cave ID: MEC018	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	663708E 7553862S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: North – 1.5 x 0.8 South – 3.7 x 0.9	East
Cave Grouping:	**Insulation from surface above:**
Single	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB), potential roost site (PLnB)	Small – 1.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Present	Warm – unknown deep
Local foraging opportunities:	**Current distance to disturbance:**
Stony Plains, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

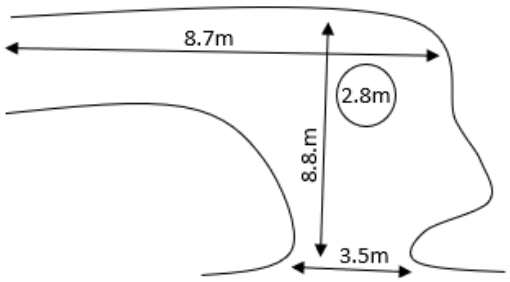
Cave ID: MEC019	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Possible/ Unlikely	664342E 7553779S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.0 x 0.6m	North West
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves- 2 levels, bottom level	Bottom of ridgeline
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter/roost (PLnB)	Internal fissure/crack
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Unlikely	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	No photo

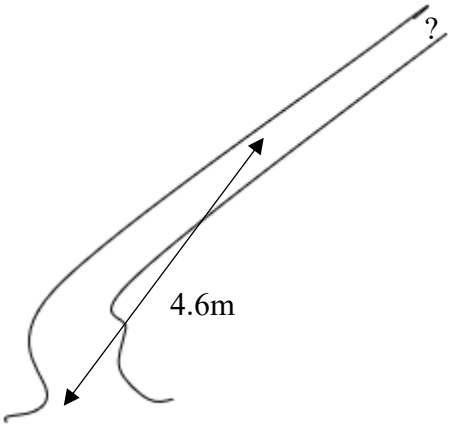
Cave ID: MEC020	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664316E 7553783S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.3 x 1.0	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	Possible
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Lines
Cave Floorplan and Photo	
	No photo

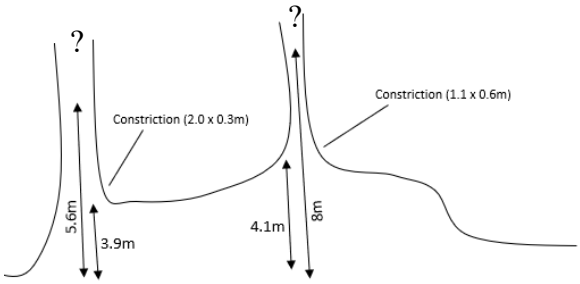
Cave ID: MEC021	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668581E 7553177S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: North – 2.0 x 1.0 South – 3.7 x 1.2	East
Cave Grouping:	**Insulation from surface above:**
Multiple caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely to be a potential roost due to ambient temperature	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m
Cave Floorplan and Photo	
	

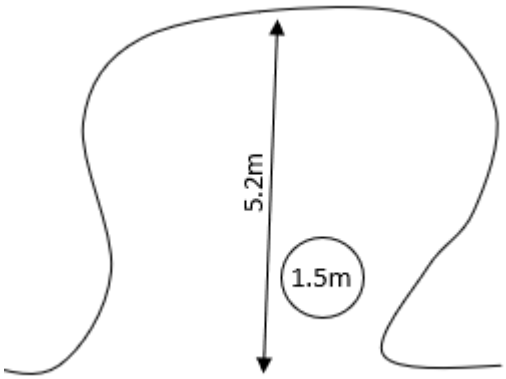
Cave ID: MEC022	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664277E 7553778S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.8 x 2.3	North-west
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	Not present
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Nil	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to drill lines
Cave Floorplan and Photo	
	

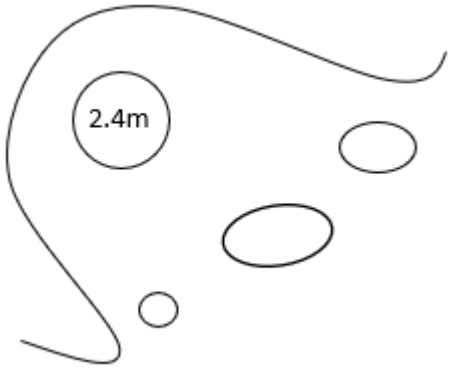
Cave ID: MEC023	**Date:** 30/6/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	653577E 7557013S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 1.3	North-northwest
Cave Grouping:	**Insulation from surface above:**
Ridgeline of small caves	Thick with one small access pipe
Cave Type & roost suitability:	**Internal domed chamber:**
Wide, low ceiling, chimney to outside, Potential nocturnal shelter	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Very good, creek line in close proximity	400m
Cave Floorplan and Photo	
	No Photo

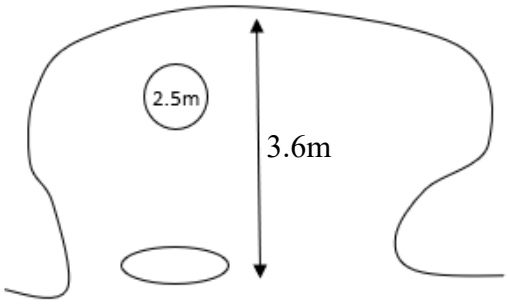
Cave ID: MEC024	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664115E 7554057S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: North – 3.5 x 2.0 South- 3.4 x 2.5	North entrance – South-east South entrance - South
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter only (PLnB/GB) – no roosting as lots of air movement through cave resulting in low humidity	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient temperature, lots of airflow
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

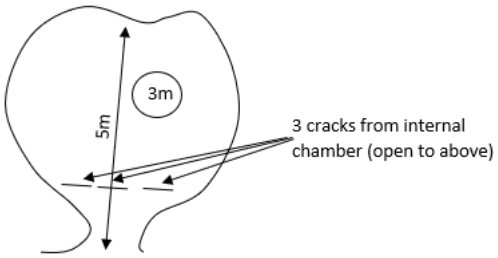
Cave ID: MEC025	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668670E 7553131S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.0 x 0.6	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient-unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

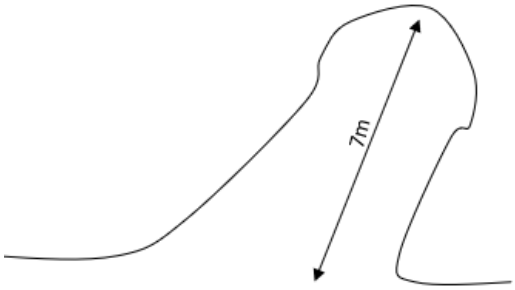
Cave ID: MEC026	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668537E 7553209S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single large open entrance – 14.0 x 1.8	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB)	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes - 2	Ambient – unknown in passages
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

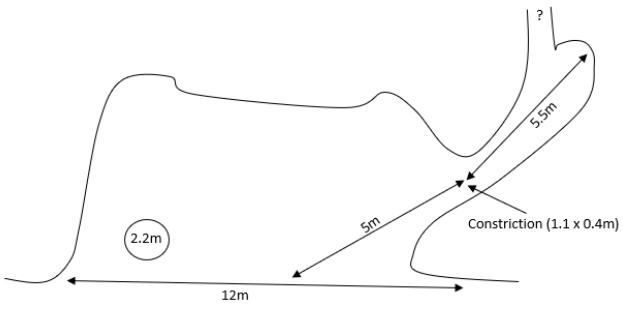
Cave ID: MEC027	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668470E 7553203S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.7 x 1.6	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Not present	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

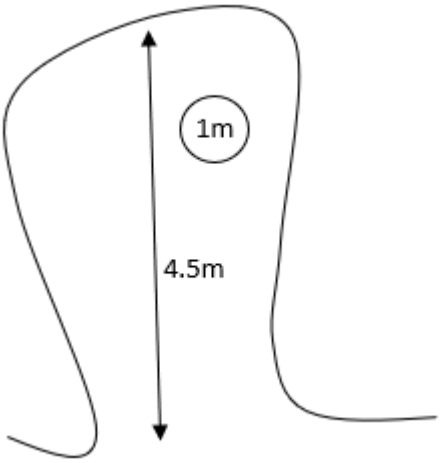
Cave ID: MEC028	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668427E 7553200S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Main single – 3.4 x 3.1	North-west
Cave Grouping:	**Insulation from surface above:**
Multiple caves along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Unlikely to be used for shelter as not very deep and very open. Cave not suitable for roosting due to open nature and ambient temperature	Yes – cave very open
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

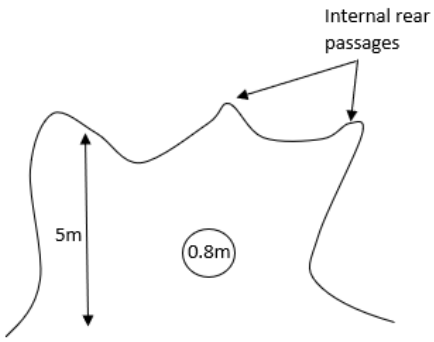
Cave ID: MEC029	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668407E 7553187S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.2 x 2.2	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Not likely to be suitable for roosting as not very deep and very open. No roosting likely due to open nature and low humidity.	Yes – cave very open
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

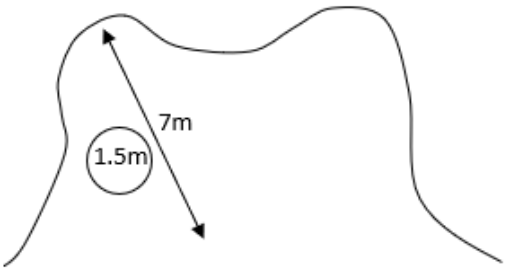
Cave ID: MEC030	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Yes, feeding debris and scats found	668403E 7553178S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Main – 0.9 x 0.8	
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Nocturnal GB feeding cave. Unlikely to be a roost due to airflow through cracks in chamber ceiling, reducing humidity	Yes - 3m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient. Three cracks from internal chamber open to above allowing airflow.
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Line
Cave Floorplan and Photo	
	

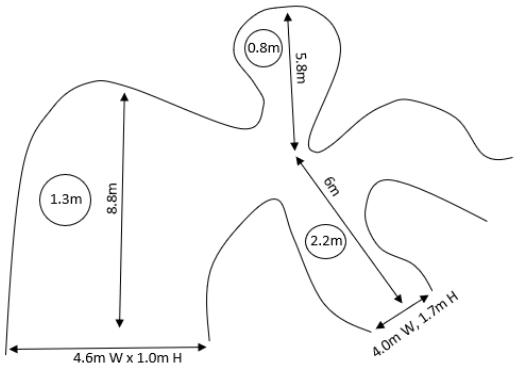
Cave ID: MEC031	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668651E 7553387S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.6 x 1.2	North-east
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to Drill Line
Cave Floorplan and Photo	
	

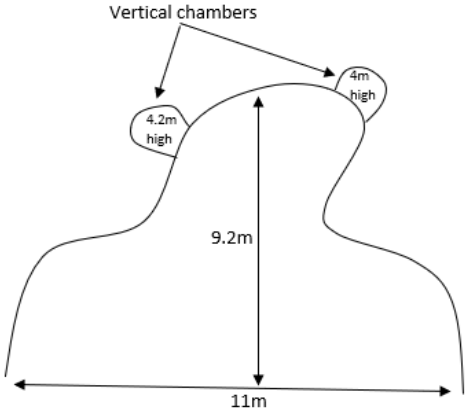
Cave ID: MEC032	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668662E 7553402S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 12.0 x 2.1	East
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Lower part of ridge
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possibly	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to Drill Line
Cave Floorplan and Photo	
	

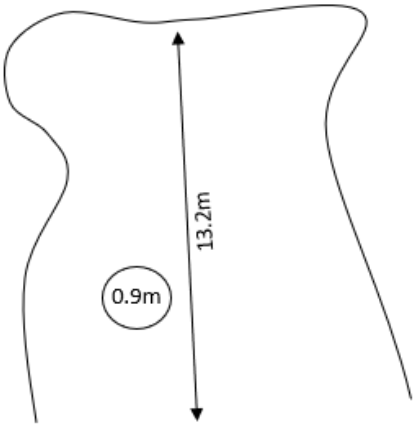
Cave ID: MEC033	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668737E 7553601S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.0 x 0.6	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping in small valley ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	Small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with spinifex	300m to Drill Line
Cave Floorplan and Photo	
	

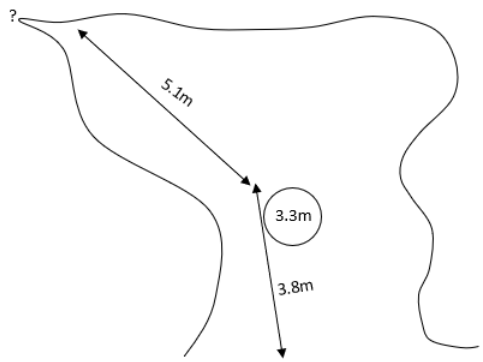
Cave ID: MEC034	**Date:** 2/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	667761E 7553600S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.8	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping in small valley ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site in rear passages (PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Present	Ambient, unknown in passages
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hills with Spinifex	Kilometres to Drill Line
Cave Floorplan and Photo	
	

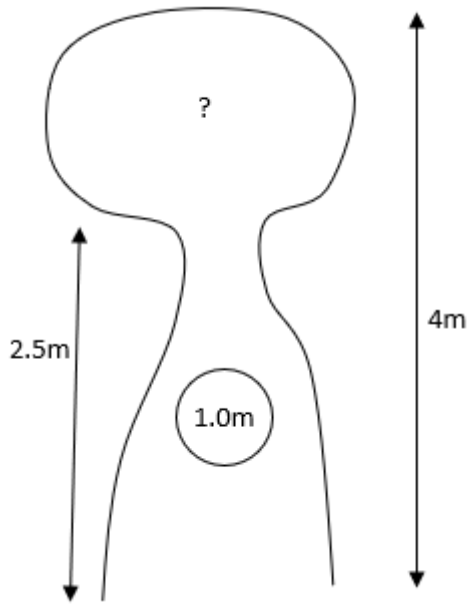
Cave ID: MEC035	**Date:** 2/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	667760E 7553667S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 1.8	South
Cave Grouping:	**Insulation from surface above:**
Single	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hills with Spinifex	Kilometres. Long distance away from Drill Pads
Cave Floorplan and Photo	
	

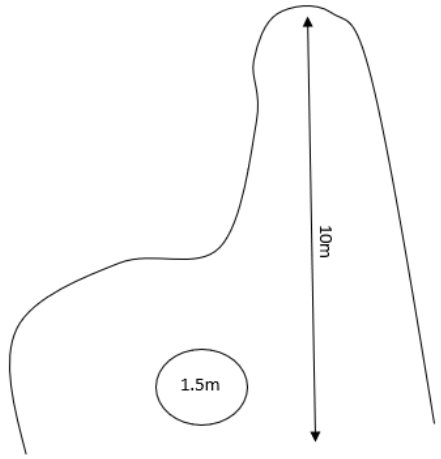
Cave ID: MEC036	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668732E 7552393S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
3 entrance Entrance 1 – 4.6 x 1.0 Entrance 2 – 4.0 x 1.7	North-east
Cave Grouping:	**Insulation from surface above:**
Multiple on ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Open cave with deep chambers, Potential nocturnal shelter (GB/PLnB), unlikely roost due to lack of humidity and airflow	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	100m from Drill Lines
Cave Floorplan and Photo	
	

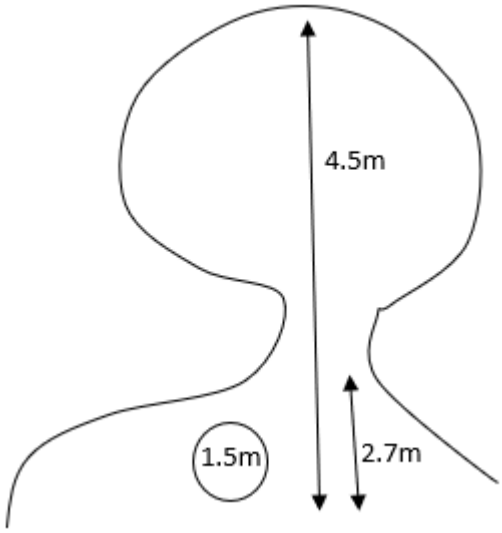
Cave ID: MEC037	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Possibly suitable	668690E 7552471S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 11.0 x 3.0	North
Cave Grouping:	**Insulation from surface above:**
Multiple caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Open with two vertical chambers Potential nocturnal shelter (GB/PLnB), potential roost site in back chambers (GB/PLnB)	Two vertical chambers with deep cracks
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Two rear chambers	Ambient- temp in chambers unknown
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	100m from Drill Lines
Cave Floorplan and Photo	
	

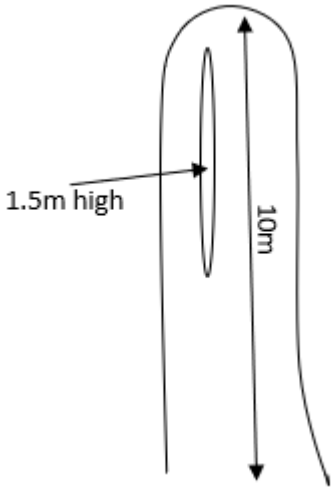
Cave ID: MEC038	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668825E 7552434S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.3 x 0.5	South
Cave Grouping:	**Insulation from surface above:**
Mid-slope ridge	Mid ridge
Cave Type & roost suitability:	**Internal domed chamber:**
Overhang with low roof through cave, Potential nocturnal shelter (PLnB only)	Possible
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	200m from Drill Lines
Cave Floorplan and Photo	
	

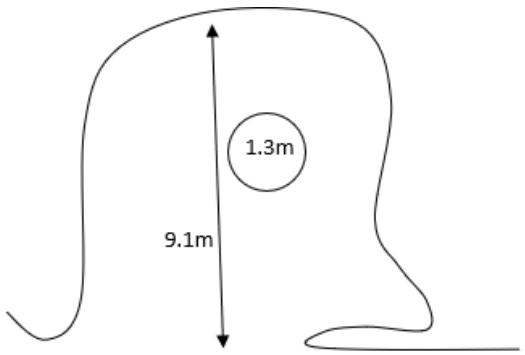
Cave ID: MEC039	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Possible	668952E 7552713S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.1 x 1.1	East
Cave Grouping:	**Insulation from surface above:**
Single in ridge	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Single entrance split in 2 by a single rock, Potential nocturnal shelter (GB/PLnB), potential roost site (GB/PLnB)	Yes - 3
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes – small entrance	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	200m
Cave Floorplan and Photo	
	

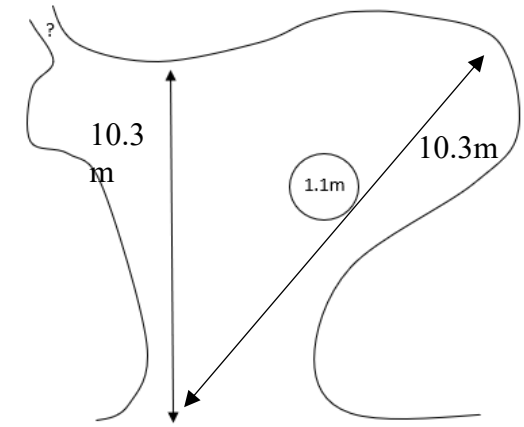
Cave ID: MEC040	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668739E 7552289S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.0 x 0.5	South
Cave Grouping:	**Insulation from surface above:**
Loose grouping/ridgeline of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Small cave with constriction and possible chamber, potential nocturnal shelter (PLnB), potential roost site (PLnB)	Possible internal chamber after 2.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Hot and humid
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	Drill Lines in close proximity
Cave Floorplan and Photo	
	

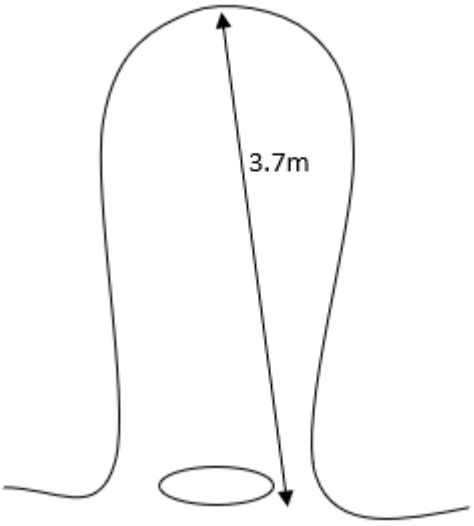
Cave ID: MEC041	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668758E 7552382S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 8.0 x 1.4	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of significant caves	Mid-slope
Cave Type & roost suitability:	**Internal domed chamber:**
Open cave with possible chamber, Potential nocturnal shelter (PLnB/GB)	Possible after 5 m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	Drill Lines in close proximity
Cave Floorplan and Photo	
	

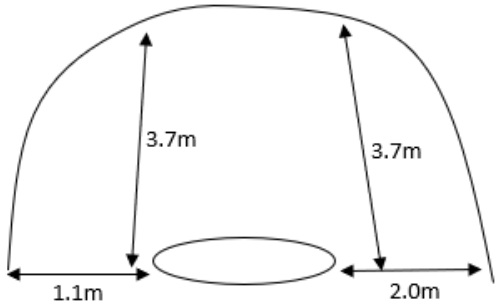
Cave ID: MEC042	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668743E 7552389S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.8 x 1.5	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of significant caves	Mid-slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	Yes – approximately 2.5m L x 2.0m W x 2.0m H
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Moderate Drainage Lines in close proximity	Drill Lines in close proximity
Cave Floorplan and Photo	
	

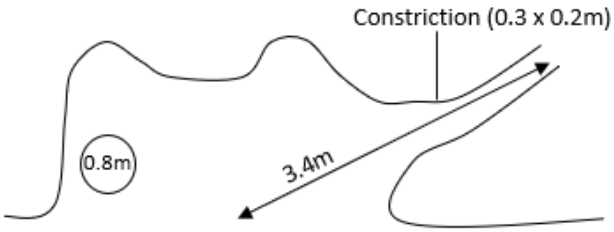
Cave ID: MEC043	**Date:** 30/6/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668697E 7552423S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.5 x 1.4	North
Cave Grouping:	**Insulation from surface above:**
Loose grouping	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely roost due to ambient temperature	Present with small chamber/cracks
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Lines
Cave Floorplan and Photo	
	

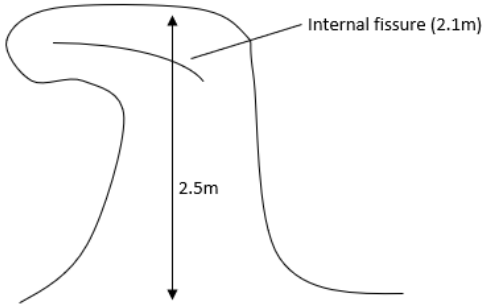
Cave ID: MEC044	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670767E 7553847S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.3 x 1.6	South
Cave Grouping:	**Insulation from surface above:**
Multiple large caves in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB/GB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres
Cave Floorplan and Photo	
	

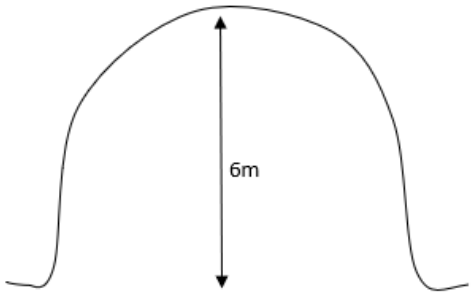
Cave ID: MEC045	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670925E 7553107S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.1 x 1.0	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping in ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter/potential roosting (small bats present on inspection)- PLnB only	Yes – 1.1m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Warm/humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Kilometres to Drill Lines
Cave Floorplan and Photo	
	

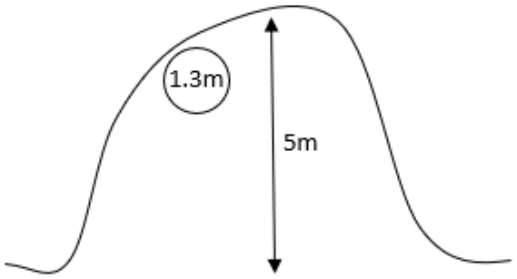
Cave ID: MEC046	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669396E 7553603S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 0.6 x 0.5 2- 0.5 x 0.4	West
Cave Grouping:	**Insulation from surface above:**
Group of small caves	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient – rear unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

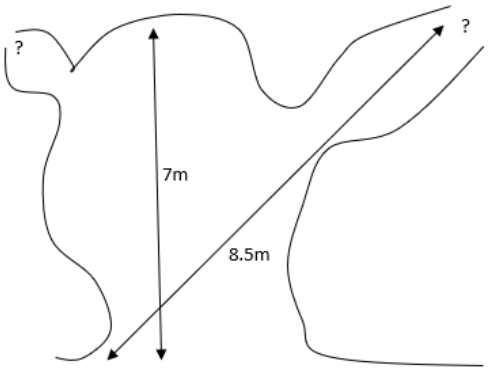
Cave ID: MEC047	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669396E 7553603S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 1.1 x 0.7 2- 2.0 x 0.7	West
Cave Grouping:	**Insulation from surface above:**
Group of small caves	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

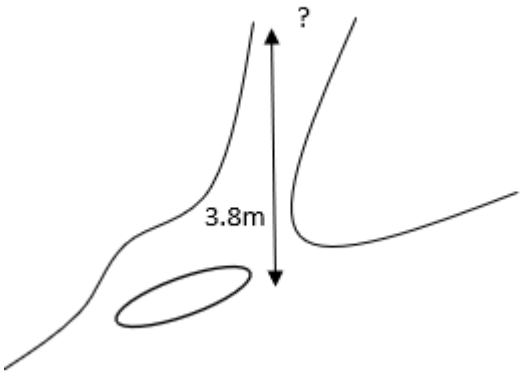
Cave ID: MEC048	**Date:** 30/6/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668646E 7552180S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.3 x 0.7	North
Cave Grouping:	**Insulation from surface above:**
Isolated cave in small ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Small internal passage	Ambient – unknown beyond constriction
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	50m to Drill Line
Cave Floorplan and Photo	
	No photo

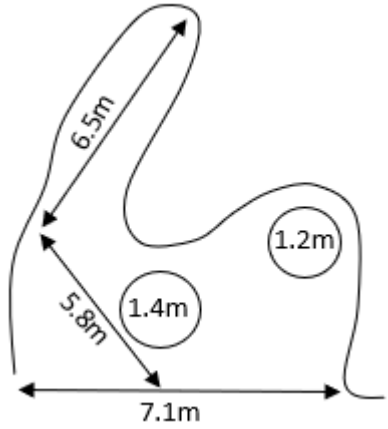
Cave ID: MEC049	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669392E 7554034S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.5 x 0.7	South
Cave Grouping:	**Insulation from surface above:**
Very loose grouping of caves on ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost in internal fissure (PLnB only)	Yes – 2.1m internal fissure
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m to road
Cave Floorplan and Photo	
	

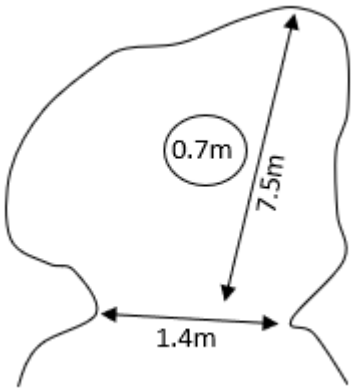
Cave ID: MEC050	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669293E 7553661S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 9.0 x 0.9	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB)	No – low, open cave
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

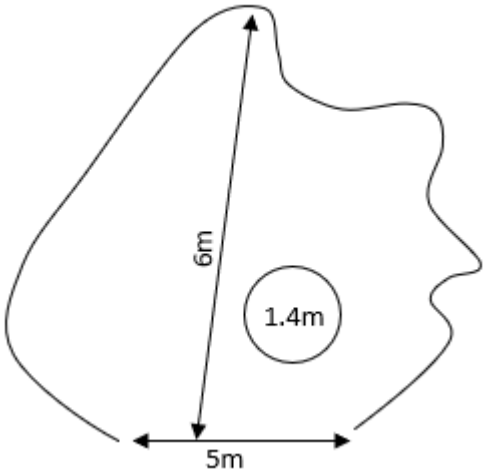
Cave ID: MEC051	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	669299E 7553679S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 0.8	East
Cave Grouping:	**Insulation from surface above:**
Loose grouping of shallow caves on ridge	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter – low, open overhang (PLnB)	Yes - small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m to road
Cave Floorplan and Photo	
	

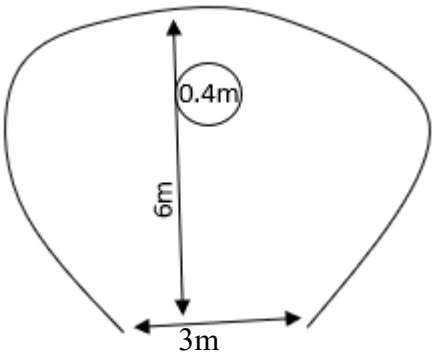
Cave ID: MEC052	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670322E 7553366S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 2.3 x 1.1	North-west
Cave Grouping:	**Insulation from surface above:**
Several caves in small ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (microbats witnessed in cave)- PLnB only	Not seen
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hill with Spinifex	Kilometres to road
Cave Floorplan and Photo	
	

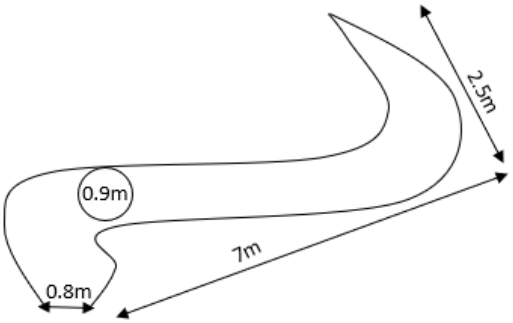
Cave ID: MEC053	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670322E 7553366S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 1.5 x 1.0 2- 1.0 x 0.9	North-west
Cave Grouping:	**Insulation from surface above:**
Loose grouping along ridgeline	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	Not seen
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Warm
Local foraging opportunities:	**Current distance to disturbance:**
Rocky Hill with Spinifex	Kilometres to road
Cave Floorplan and Photo	
	

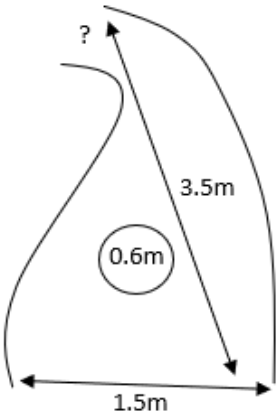
Cave ID: MEC054	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670754E 7553854S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 7.0 x 1.1	South
Cave Grouping:	**Insulation from surface above:**
Ridge of good caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (microbats witnessed in cave) – PLnB only	Yes – internal chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

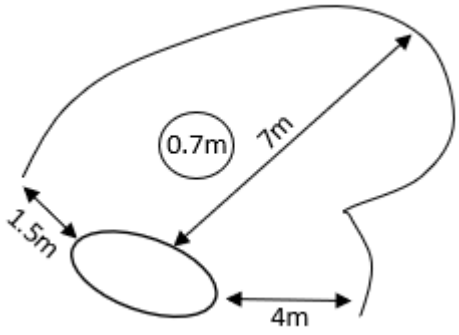
Cave ID: MEC055	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670771E 7553853S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.4 x 0.3	South
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope – rock, spinifex etc.
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	Yes – internal chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

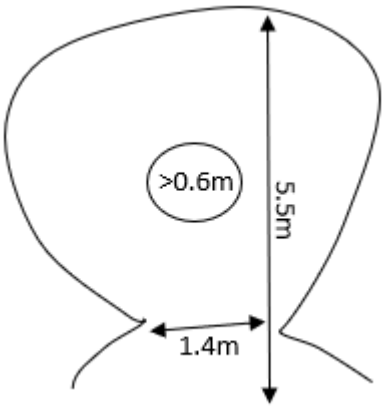
Cave ID: MEC056	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670809E 7553866
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.0 x 1.2	South-southeast
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter only - PLnB	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

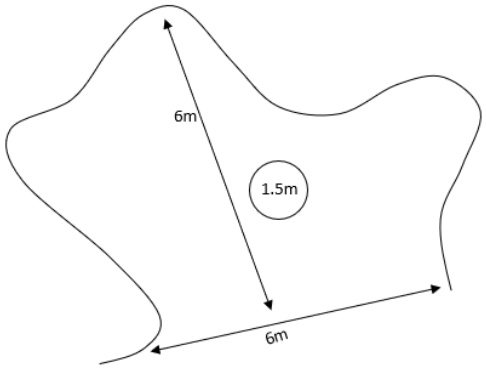
Cave ID: MEC057	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	670731E 7553556S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.3	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of minor caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

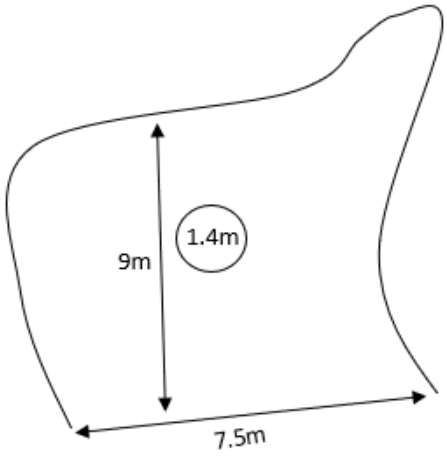
Cave ID: MEC058	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	671980E 7553879S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.8 x 0.8	East
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

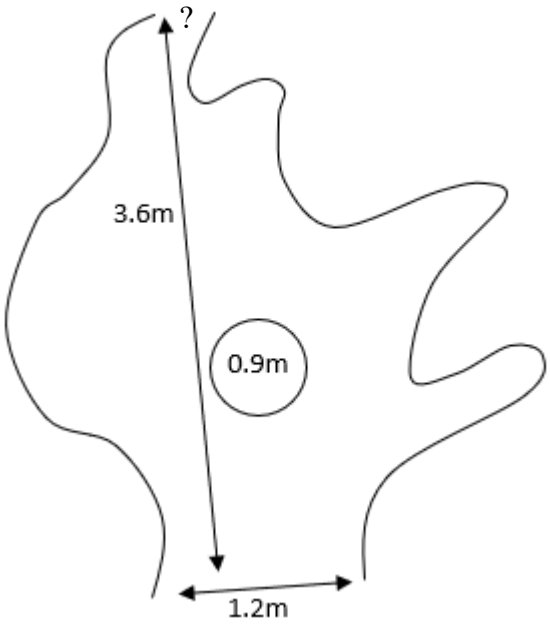
Cave ID: MEC059	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	671974E 7553892S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.5 x 0.6	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Top of slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site – PLnB only	Unlikely
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	

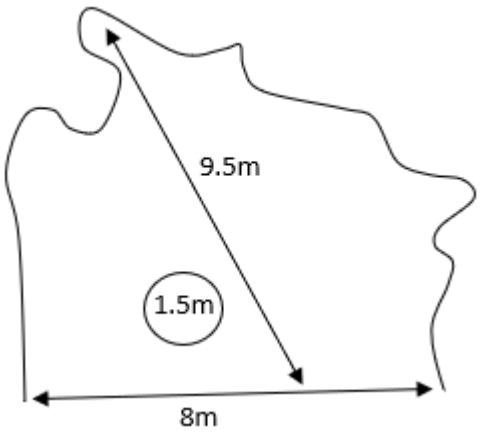
Cave ID: MEC060	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668851E 7553947
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
2 entrances: 1- 4.0 x 0.4 2 – 1.5 x 0.4	North
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Overhang. Potential nocturnal shelter- PLnB only	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

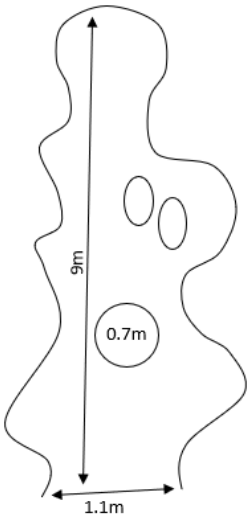
Cave ID: MEC061	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668851E 7553932S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.4 x 0.3	North-east
Cave Grouping:	**Insulation from surface above:**
Ridgeline of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB only)	Present – internal chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

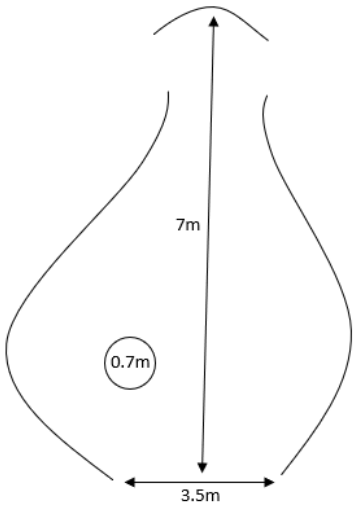
Cave ID: MEC062	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668826E 7553946S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 6.0 x 1.5	North-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

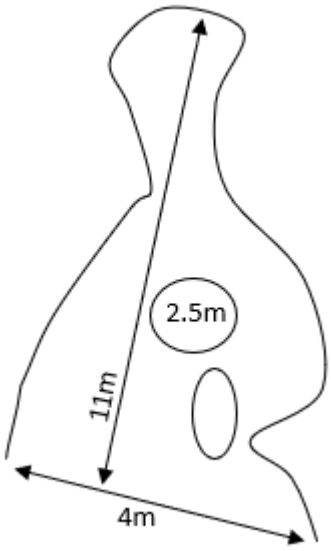
Cave ID: MEC063	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668828E 7554009S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 7.5 x 1.5	East-southeast
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
No	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	300m
Cave Floorplan and Photo	
	

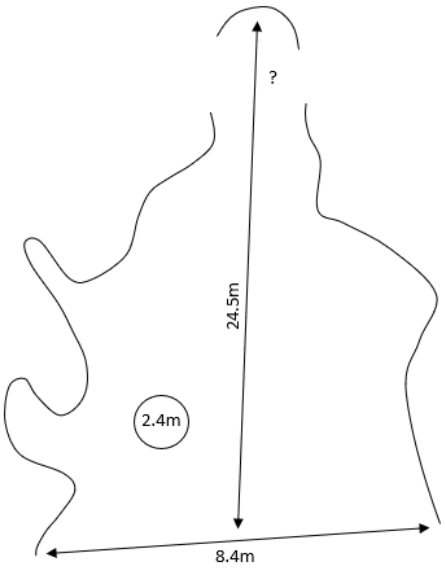
Cave ID: MEC064	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668553E 7552286S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.2 x 0.9	South
Cave Grouping:	**Insulation from surface above:**
Single cave	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB). Unlikely roost due to ambient temp	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Unlikely	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	20m
Cave Floorplan and Photo	
	

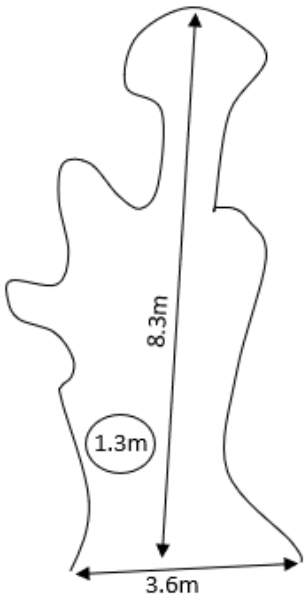
Cave ID: MEC065	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668642E 7553592S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 8.0 x 1.5	South
Cave Grouping:	**Insulation from surface above:**
Ridge of small caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, low overhang (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Unlikely	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	400m
Cave Floorplan and Photo	
	

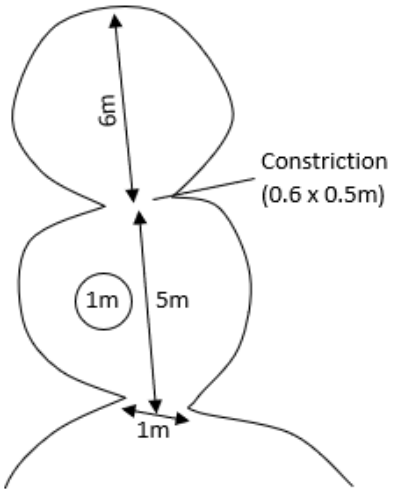
Cave ID: MEC066	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668644E 7553331S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.1 x 0.7	East
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB)	Small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m
Cave Floorplan and Photo	
	

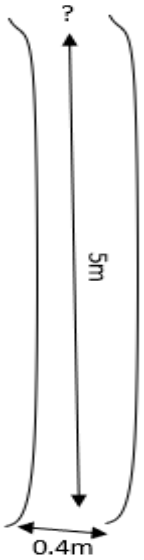
Cave ID: MEC067	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668464E 7553325S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.5 x 0.7	South-east
Cave Grouping:	**Insulation from surface above:**
Several good caves	Mid-upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, low overhang (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	150m
Cave Floorplan and Photo	
	

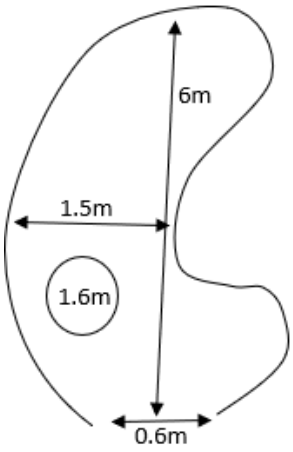
Cave ID: MEC068	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668555E 7553260S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 4.0 x 4.0	South
Cave Grouping:	**Insulation from surface above:**
Ridge of good caves	Mid - upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (GB/PLnB). Not potential roost due to ambient temperature	Yes
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	75m
Cave Floorplan and Photo	
	

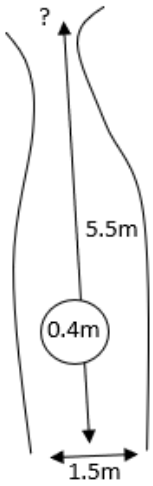
Cave ID: MEC069	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668587E 7553258S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 8.5 x 2.4	South
Cave Grouping:	**Insulation from surface above:**
Ridge of good caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Multiple chambers– Potential nocturnal shelter and potential roost site (GB/PLnB)	Small chambers
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	50m
Cave Floorplan and Photo	
	

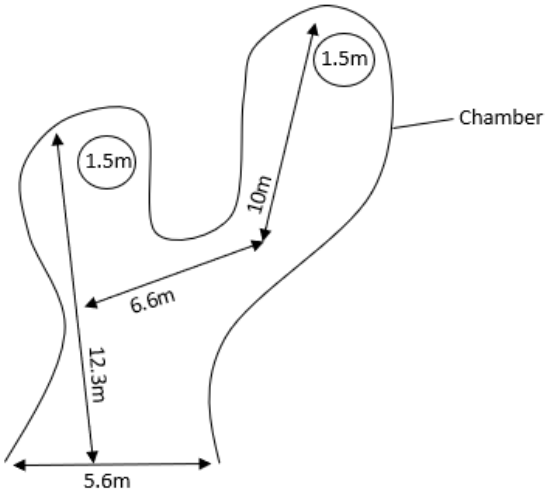
Cave ID: MEC070	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	6688616E 7553160S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.6 x 1.3	Northwest
Cave Grouping:	**Insulation from surface above:**
Ridgeline of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter (PLnB only)	Small chamber
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m
Cave Floorplan and Photo	
	

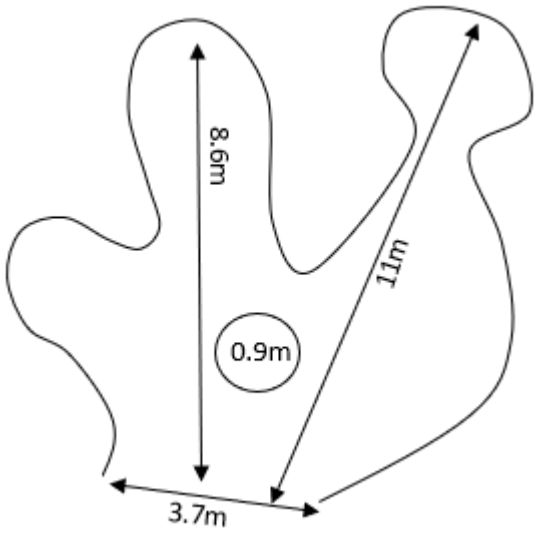
Cave ID: MEC071	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668750E 7552954S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 1.0 x 0.3	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Yes - 2
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	500m
Cave Floorplan and Photo	
	

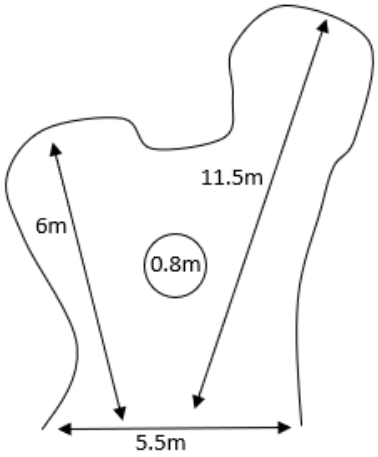
Cave ID: MEC072	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668701E 7552925S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.4 x 0.25	North
Cave Grouping:	**Insulation from surface above:**
Solo/valley of caves	Mid- upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential roost site (PLnB only	Unknown
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Unknown deeper, ambient at entrance
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	200m
Cave Floorplan and Photo	
	

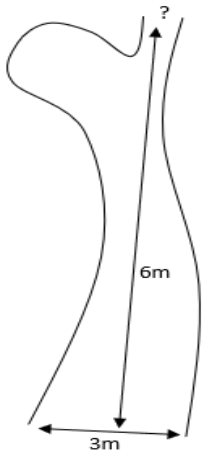
Cave ID: MEC073	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668944E 7552779S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.6 x 0.4	North-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Small entrance with chamber. Potential nocturnal shelter, potential roost site (PLnB only)	Small with cracks
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	400m
Cave Floorplan and Photo	
	

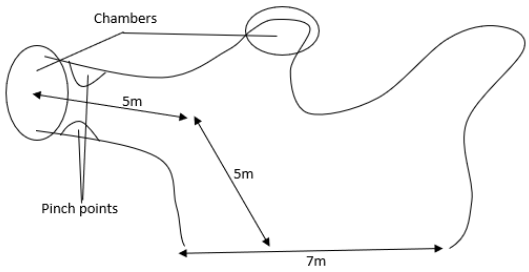
Cave ID: MEC074	**Date:** 4/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668994E 7552657S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single, small low entrance – 1.5 x 0.4	South-east
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Possible
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Relative – unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	400m
Cave Floorplan and Photo	
	

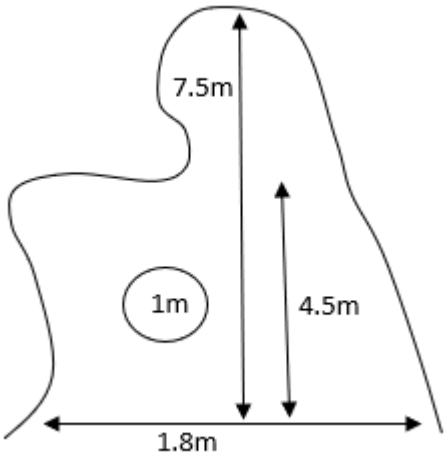
Cave ID: MEC075	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664774E 7553720S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single wide, low entrance– 5.6 x 1.3	East
Cave Grouping:	**Insulation from surface above:**
Valley of small caves	>5 metres, mid to upper slope
Cave Type & roost suitability:	**Internal domed chamber:**
Long with two chambers, potential nocturnal shelter, potential roost site (GB/PLnB)	Yes - two
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	0.5 – 1 kilometre
Cave Floorplan and Photo	
	

Cave ID: MEC076	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	665245E 7554058
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single low, wide entrance – 3.7 x 1.0	South-southeast
Cave Grouping:	**Insulation from surface above:**
Gully of caves	5m of rock
Cave Type & roost suitability:	**Internal domed chamber:**
Potential nocturnal shelter, potential roost site (PLnB only)	Small
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	1 kilometre
Cave Floorplan and Photo	
	No photo

Cave ID: MEC077	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	665359E 7554512S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 5.5 x 0.8	North-west
Cave Grouping:	**Insulation from surface above:**
Ridge of caves	5m of rock
Cave Type & roost suitability:	**Internal domed chamber:**
Low, wide cave with possible passage Potential nocturnal shelter, potential roost site (PLnB only)	No
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient - humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Approximately 1.5km
Cave Floorplan and Photo	
	

Cave ID: MEC078	**Date:** 3/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	664943E 7554286S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 3.0 x 0.7	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of caves	Rock, spinifex, >3 metres
Cave Type & roost suitability:	**Internal domed chamber:**
Tunnel with low roof (approximately 0.5m high) Potential nocturnal shelter, potential roost site (PLnB only)	Unlikely
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Possible	Ambient at entrance- unknown deeper
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	Approximately 1.5km
Cave Floorplan and Photo	
	

Cave ID: MEC079	**Date:** 2/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668660E 7552520S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 7.0 x 1.5	North
Cave Grouping:	**Insulation from surface above:**
Ridgeline of quality caves	2-10 feet
Cave Type & roost suitability:	**Internal domed chamber:**
Wide, low entrance with two narrow passages Potential nocturnal shelter, potential roost site (GB/PLnB)	Yes - two small chambers
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Yes - three	Humid
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	150m
Cave Floorplan and Photo	
	

Cave ID: MEC080	**Date:** 25/4/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
Nil	668743E 7552286S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single entrance behind boulders – 1.8 x 0.75	South
Cave Grouping:	**Insulation from surface above:**
Loose grouping of caves and shelter	Mid slope
Cave Type & roost suitability:	**Internal domed chamber:**
Small cave with low roof Potential nocturnal shelter, potential roost site, no calls recorded (PLnB only)	Possibly deep internal dome after 4.5m
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
Potentially a rear passage	Hot
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hill with Spinifex	100m to Drill Lines
Cave Floorplan and Photo	
	

Cave ID: MEC081	**Date:** 5/7/2020
Assessed Ghost bat usage:	**Coordinates (GDA1994, Zone 50):**
No	668789E 7551154S
Entrance safe or unsafe to approach:	**Basic Geology:**
Yes	Marra Mamba iron formation
Entrance type and dims – WxH (m):	**Entrance Orientation:**
Single – 0.3 x 0.4	West
Cave Grouping:	**Insulation from surface above:**
Single opening in small breakaway	Top of landscape
Cave Type & roost suitability:	**Internal domed chamber:**
Small entrance with unknown internal dimensions, potential roost site, no PLnB calls recorded close to CT	Unsure
Rear passages that may have roosts:	**Internal temp. and relative humidity:**
None seen- possible	Unknown
Local foraging opportunities:	**Current distance to disturbance:**
Creek Line, Rocky Hills with Spinifex	50m to drill line
Cave Floorplan and Photo	
No floorplan	