



Appendix 3: Vertebrate Fauna Assessment: North Star Junction Renewable Energy Infrastructure Project

**NORTH STAR
JUNCTION WEST
DETAILED TERRESTRIAL
VERTEBRATE FAUNA
ASSESSMENT**

PREPARED FOR: FORTESCUE



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EXECUTIVE SUMMARY

Fortescue Limited's (Fortescue) decarbonisation pathway to achieve carbon neutrality across existing and future operations by 2030 is focused on addressing Fortescue's largest sources of emissions, which are stationary power and mining fleet. Fortescue is assessing potential renewable energy generation sites as part of Fortescue's commitment to decarbonise its mining operations.

Spectrum Ecology & Spatial (Spectrum) was engaged to undertake a desktop assessment and a two-phase detailed and targeted vertebrate fauna assessment of the North Star Junction Generation Hub (Survey Area) to support environmental approvals for the potential development of the project.

Spectrum Ecology & Spatial (Spectrum) was engaged to undertake a desktop assessment and a two-phase detailed and targeted vertebrate fauna assessment to support environmental approvals for the potential development of the project.

To provide regional context for the assessment of the terrestrial fauna values within the Survey Area, a desktop assessment was completed. The desktop assessment identified a total of 352 vertebrate fauna consisting of 46 mammals (including nine introduced), 169 bird, 128 reptile, and nine amphibian species that have previously been recorded in the region.

A total of 123 vertebrate fauna species were recorded during both phases of the survey. This included 12 species of native non-volant mammals, eight (or nine due to ambiguous calls) species of bats, five introduced mammals, 54 bird species, 42 reptiles and two amphibians.

Six species of significant fauna were recorded from the Survey Area during the survey:

- Northern Quoll (*Dasyurus hallucatus*, EPBC Act & BC Act; Endangered);
- Bilby (*Macrotis lagotis*, EPBC Act & BC Act; Vulnerable);
- Pilbara Leaf-nosed Bat (*Rhinonictis aurantia*, EPBC Act & BC Act; Vulnerable);
- Grey Falcon (*Falco hypoleucos*, EPBC Act & BC Act; Vulnerable);
- Brush-tailed Mulgara (*Dasyercus blythi*, DBCA; Priority 4); and
- Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA Priority 4 – secondary evidence only).

One additional species was previously recorded from the Survey Area:

- Ghost Bat (*Macroderma gigas*, EPBC Act & BC Act Vulnerable).

A further seven species (one mammal, four birds, two reptiles) were assessed to have a medium to high likelihood of occurrence based on previous regional records and the habitat types present within the Survey Area.

A total of five fauna habitat types were recorded from the Survey Area, these include (Fortescue habitat names in brackets):

- Spinifex Sand Plain (Plain (sand));
- Spinifex Rocky Plain (Plain (stony/gibber));
- Major Drainage Line (Drainage Line/River/Creek (major));
- Minor Drainage Line (Drainage Line/River/Creek (minor)); and
- Granite Domes and Boulder Piles (Granite Outcrops (boulder piles)).

The most common fauna habitat at the Survey Area is Spinifex Sand Plain habitat (91.5%) followed by Granite Domes and Boulder Piles (2.7%). All habitat types are common in the Pilbara region. The Granite Domes and Boulder Piles, and the Major and Minor Drainage Lines have the highest value for significant fauna (Northern Quoll, Bilby, Pilbara Leaf-nosed Bat, Ghost Bat, Brush-tailed Mulgara, Grey Falcon, Pilbara Olive Python, and Migratory Birds) followed by the Spinifex Sand Plain (Bilby, Brush-tailed Mulgara and Spectacled Hare-wallaby).

1. INTRODUCTION

1.1. Project Background

Fortescue Limited's (Fortescue) decarbonisation pathway to achieve carbon neutrality across existing and future operations by 2030 is focused on addressing Fortescue's largest sources of emissions, which are stationary power and mining fleet. Fortescue is making significant investment in renewable power generation that is supported by battery storage, to replace existing stationary diesel and reducing the amount of gas-fired power generating facilities.

Fortescue is assessing potential renewable energy generation sites as part of Fortescue's commitment to decarbonise its mining operations.

Fortescue is constructing the North Star Junction Generation Hub in the Pilbara region of Western Australia (WA). The North Star Junction West (NSJW) Project is being considered as part of the portfolio of solar projects that will generate renewable energy to power Fortescue's operations and meet their decarbonisation targets by 2027.

Fortescue engaged Spectrum Ecology & Spatial (Spectrum) to undertake a two-phase detailed and targeted vertebrate fauna assessment of the NSJW Project (herein referred to as the Survey Area). The Survey Area covers 4,532.9 hectares (ha) and is located approximately 25 km west of Fortescue's Iron Bridge operation and 120 km south of Port Hedland (Map 1.1).

1.2. Project Scope

The project objective was to undertake a detailed vertebrate fauna assessment of the Survey Area (NSJW Project) to support environmental approvals.

The scope of work for this project included:

- Desktop assessment of the Study Area (Survey Area plus 50 km buffer);
- Detailed terrestrial fauna survey for vertebrates; and
- Targeted terrestrial vertebrate fauna survey for significant species.

Throughout this report, areas will be referred to as per the below:

- Survey Area (NSJW Project; area to be surveyed as provided by Fortescue); and
- Study Area (desktop study area; Survey Area plus 50 km buffer).

1.3. Legislation & Guidelines

Fauna in Western Australia are protected by various legislation, including (see Appendix A):

- *Biodiversity Conservation Act 2016* (WA, BC Act);
- *Environmental Protection Act 1986* (WA, EP Act); and
- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth, EPBC Act).

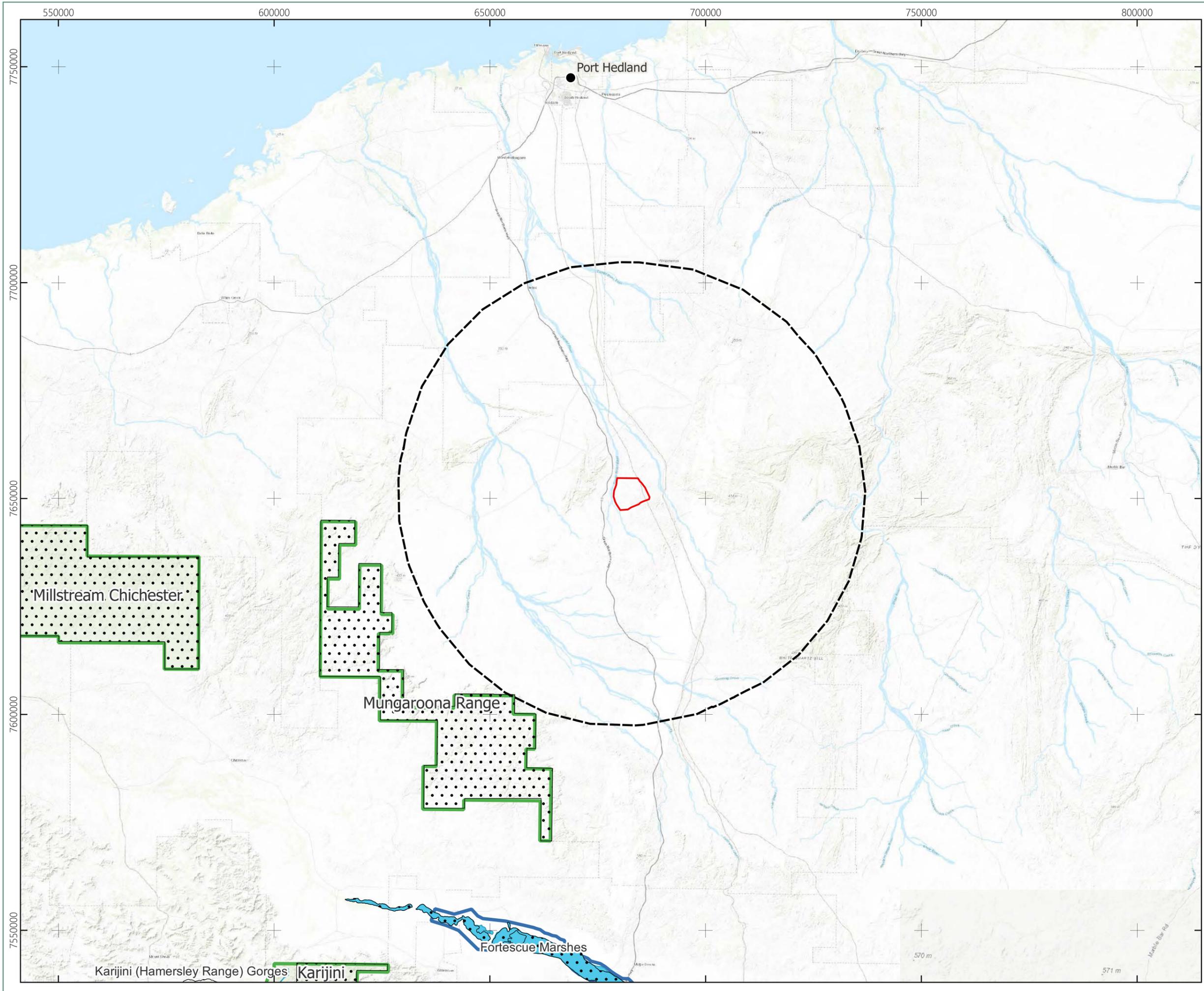
The survey was compliant with survey guidelines, as outlined in:

- Environmental Protection Authority (EPA) – Environmental Factor Guideline. Terrestrial Fauna (EPA, 2016);
- EPA Technical Guidance Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020);

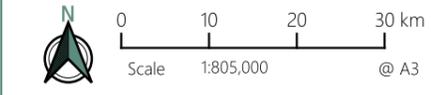
- Terrestrial Vertebrate Fauna Assessment Guidelines 100-GU-EN-0006 (Fortescue, 2014); and
- Environmental Datasets – Data Governance 100-GU-EN-0020_Rev1 (Fortescue, 2019); and
- Geographic Information Systems and Raw Data Guidelines 100-GU-EN-0009_Rev2 (Fortescue Metals Group, 2021b).

In addition to the above, species-specific guidelines were also accessed:

- Survey guidelines for Australia’s threatened mammals (Department of Sustainability Environment Water Population and Communities (DSEWPaC), 2011a);
- Survey guidelines for Australia’s threatened birds (Department of the Environment Water Heritage and the Arts (DEWHA), 2010c);
- Survey guidelines for Australia’s threatened bats (DEWHA, 2010a);
- Survey guidelines for Australia’s threatened reptiles (DSEWPaC, 2011b);
- EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus* (Department of the Environment (DoE), 2016);
- Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity Conservation and Attractions (DBCA), 2017); and
- Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia (Department of Parks and Wildlife (DPAW), 2017).



- Legend**
- Survey Area
 - NSJW Study Area (50km Buffer)
 - Environmentally Sensitive Areas
 - Directory of Important Wetlands - Fortescue Marsh
 - RAMSAR - Fortescue Marsh - Proposed Addition
 - Nature Reserve / National Park Boundary



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre

Spectrum
Ecology & Wildlife

Author: GF Approved: AH Date: 26-09-2023

Location of the NSJW Survey Area, Study Area and Significant Lands

NSJW Fauna Assessment

MAP

1.1

1.4. Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia into regions based on dominant landscape, climate, lithology, geology, landform and vegetation (Thackway and Cresswell, 1995a).

The Study Area is in the Pilbara Craton IBRA Bioregion (Figure 1.1). The climate is classified semi-desert-tropical with very hot summers and mild or warm winters with 9 to 11 months of dry weather annually and a mean average rainfall of between 250–350 mm each year (Kendrick, 2001a). The bioregion is geologically complex with great mineral wealth and is also biologically special. There are high levels of species endemism and species-rich ecosystems including persisting populations of threatened species (McKenzie, May and McKenna, 2003).

The Pilbara Craton is made up of four sub regions; the Chichester, Fortescue Plains, Hamersley and Roebourne. The Study Area is in the central Pilbara within the Chichester subregion (Figure 1.1). The Chichester subregion is characterised by undulating Archaean granite and basalt plains with significant areas of basaltic ranges (Kendrick, 2001a; McKenzie, May and McKenna, 2003). The plains of this subregion support hummock grasslands characterised by shrub steppe of *Acacia pyrifolia* over *Triodia pungens*. The ranges are dominated by *Eucalyptus leucophloia* tree steppes (Kendrick, 2001a; McKenzie, May and McKenna, 2003).

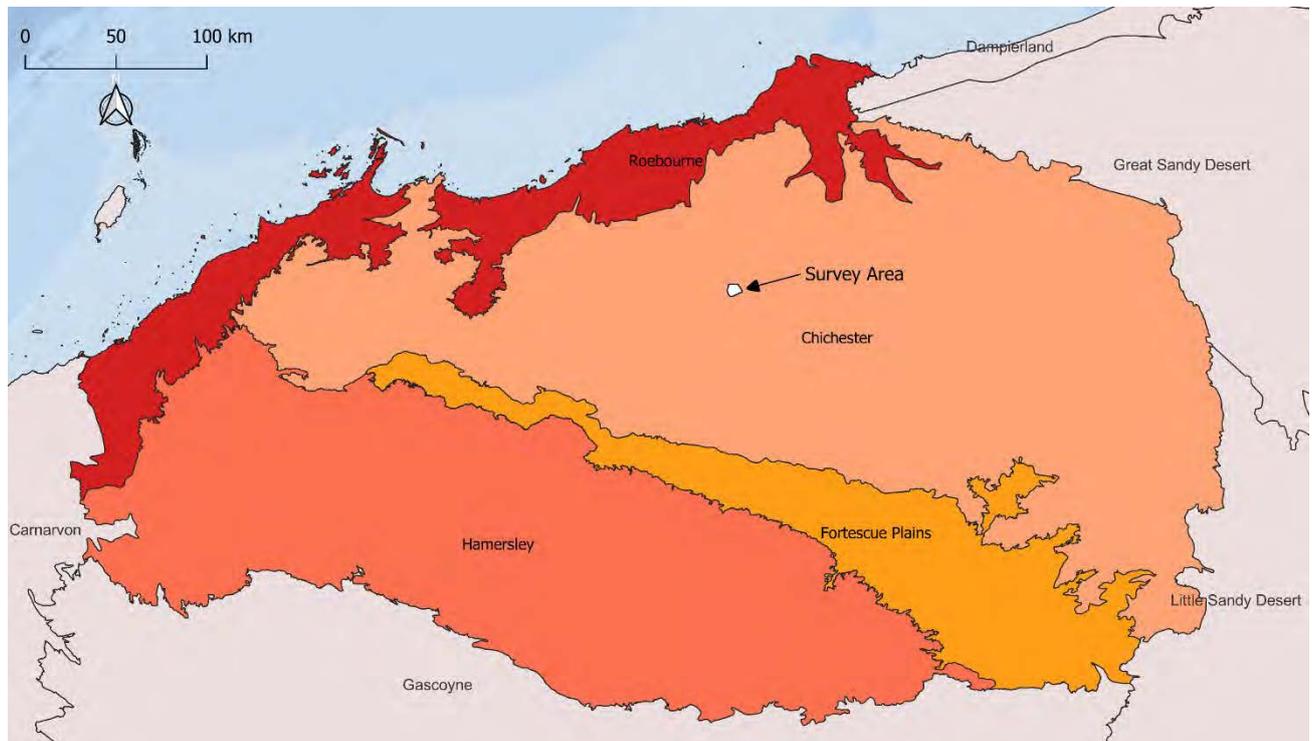


Figure 1.1: IBRA Classification

1.5. Climate

The climate of the Pilbara bioregion is classified as tropical, arid to semi-arid, with a median annual rainfall of 300 mm. Rainfall for the region can be variable, falling mainly in summer cyclonic events from December to February (Thackway and Cresswell, 1995b).

Two broad climatic zones occur across the Pilbara region. Semi-desert tropical climatic conditions occur in coastal areas, as well as some higher-rainfall inland areas, which experience 9-11 months of dry weather, with hot humid summers and warm winters. Dry desert climatic conditions occur across the remaining inland areas, which typically experience higher temperatures and lower rainfall, with hot dry summers and mild winters with up to 12 months of dry weather (Leighton, 2004). The Study Area is located within the dry inland area.

Annual rainfall is highly variable but generally follows an inland-to-coastal and southern-to-northern increasing trend (Leighton, 2004). The driest months are in spring (September to October), with tropical cyclones and local thunderstorms producing much of the summer and early autumn rainfall (Mckenzie, Van Leeuwen and Pinder, 2009). Winter rainfall is also highly variable, generally decreasing from the coast through to inland areas (Leighton, 2004).

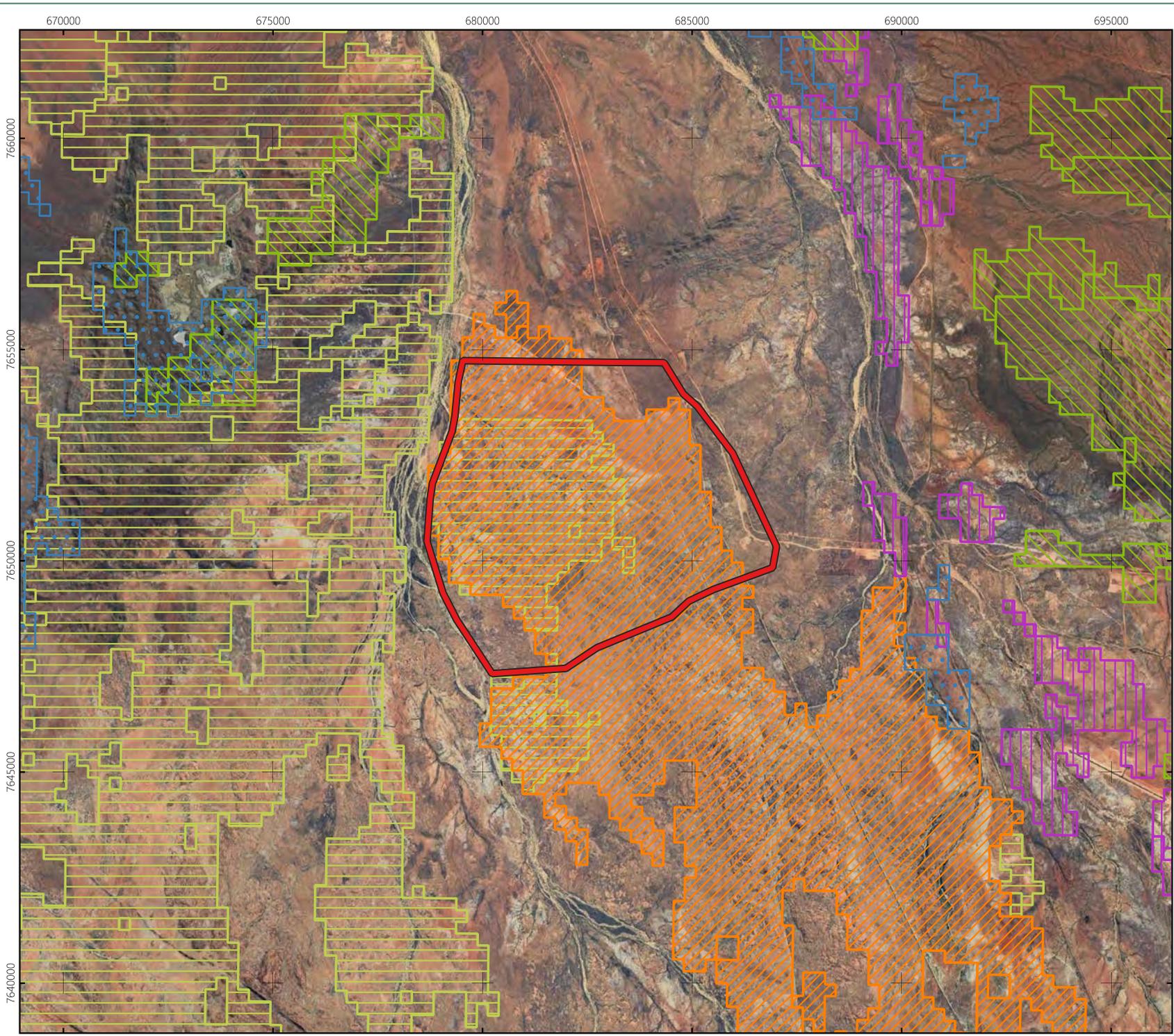
Monthly maximum temperatures in the Pilbara region range from an average of 25°C in July to 37°C in January, while minimum temperatures range between 12°C in July and 25°C in January (Mckenzie, Van Leeuwen and Pinder, 2009). According to the Köppen-Geiger climate classification, the Study Area has a hot desert climate (Class BWh) (Peel, Finlayson and McMahon, 2007). This classification includes arid regions where annual evaporation exceeds annual precipitation, and have a mean annual temperature $\geq 18^\circ\text{C}$.

1.6. Disturbance History

The dominant current and historical land uses across the Pilbara region involves grazing of native pasture, conservation, crown reserves, mining leases, and Aboriginal lands and reserves. Historically, pastoralism has been the most significant land use within the Pilbara. Since the 1960's mining, predominantly iron ore, has become a significant land use with much of the Pilbara now under mining tenure (Kendrick, 2001b).

1.7. Fire History

The fire history of the Survey Area for the five years (2018 to 2023) prior to the assessment was assessed using North Australia and Rangelands Fire Information (NAFI) (Charles Darwin University, 2023). Two fires have impacted the Survey Area during this period. In 2021, 37% or 1,656.6 ha of the Survey Area was burnt, while in 2022, 79% (3,589 ha) of the Survey Area was impacted by fire, which also included the same area as the 2021 fire (Charles Darwin University, 2023). However, it is likely the actual burnt area is less as NAFI uses satellite imagery to map fire scars, which has an accuracy of 85-90% (Charles Darwin University, 2023). Map 1.2 displays the fire history over the past five years.

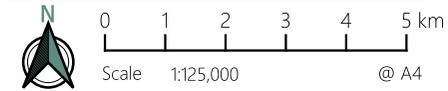


Legend

 Survey Area

NAFI Fire History

-  2017
-  2018
-  2019
-  2020
-  2021
-  2022



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre



Author: EM

Date: 29-01-2024

Fire History

NSJW Project

MAP

Prepared for
Fortescue

1.2

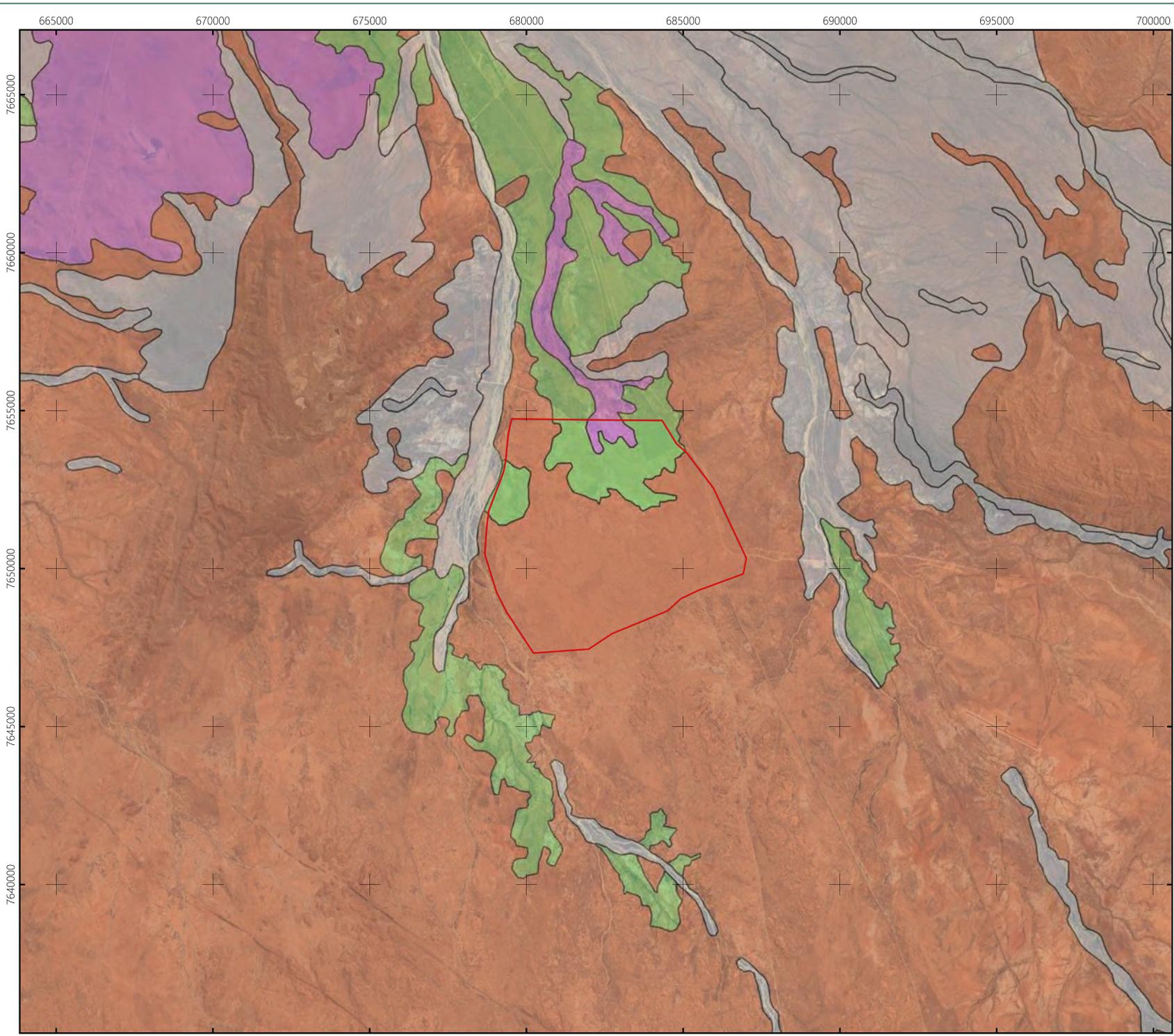
1.8. Geology

The geology of Western Australia has been mapped at a scale of 1:50,000, 1:100,000, 1:250,000, and 1:500,000. The Study Area occurs in the central west of the 1:500,000 scale geological mapping (DMIRS, 2020), which is the finest-scale digital mapping available for the area mapped to the state extent.

Geological mapping was completed within the Survey Area, recording three units, as listed in Table 1.1 and mapped on Map 1.3. Two units cover most of the Survey Area, with X-PIP accounting for 77% and R-PIP representing 21%. All units are well represented elsewhere in WA.

Table 1.1: Surface Geology

Unit Name	Unit Code	Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	Total Pilbara Extent (ha)	% of Pilbara Extent Within Survey Area
X-PIP	Exposed Unit, PIP	Exposed bedrock	3,486.7	76.9	14,267,483	8,412,584	0.04
R-PIP	Residual or relict unit, PIP	Residual or relict unit; undivided	944.4	20.8	355,639	298,866	0.32
W-PIP	Sheetwash unit, PIP	Clay, silt and sand in distal sheetwash fan and slope deposits; local ferruginous pisoliths and gravel	101.8	2.3	3,786,925	1,200,060	0.01
Total			4,532.9	100			



Legend

- Survey Area
- Geological Unit Code**
- _R-PIP
- _W-PIP
- _X-PIP
- Unit Not in Survey Area

0 1 2 3 4 km
 Scale 1:167,107.788394 @ A4
Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre



Author: GF Date: 05-02-2024

Surface Geology (1:500,000)

NSJW Project

Prepared for
Fortescue

MAP
1.3

1.9. Beard Vegetation Mapping

Pre-European vegetation mapping was originally undertaken by John Beard (Beard *et al.*, 2013) at various scales across the state and has since been updated to be consistent with the National Vegetation Information System (NVIS) descriptions at a scale of 1:250,000 (Department of Primary Industries and Regional Development, 2019). State-wide vegetation statistics are available from 2018 for these associations, which lists pre-European extent, current extent, area in DBCA managed lands and is a useful tool to determine if a vegetation association is rare or otherwise significant (Department of Biodiversity Conservation and Attractions, 2019a).

One vegetation sub-association (SA) has been mapped within the Survey Area, SA93.4 (Table 1.2, Map 1.4). Over 99% of the pre-European vegetation extent remains for this SA.

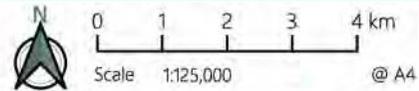
Table 1.2: Beard Vegetation Sub-Associations

SA	NVIS Level V Description	Area in Survey Area (ha)	% of Survey Area	Pre-European Extent WA (ha)	Current Extent WA (ha)	Current Pilbara Extent WA (ha)	% Remaining	% of Current WA Extent in Survey Area	% Current Pilbara Extent in Survey Area
93.4	<i>Grevillea pyramidalis</i> , <i>Hakea lorea</i> , <i>Senna</i> sp., <i>Grevillea wickhamii</i> tall sparse shrubland.	4,532.9	100	2,481,889	2,478,504	2,477,408	99.8	0.2	0.2



Legend

- Survey Area
- Beard Vegetation Sub-Associations
- 93.4
- Sub-Association not in Survey Area



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre



Author: GF Date: 13-06-2023

**Beard Vegetation
 Sub-Associations**

NSJW Project

MAP

Prepared for
 Fortescue

1.4

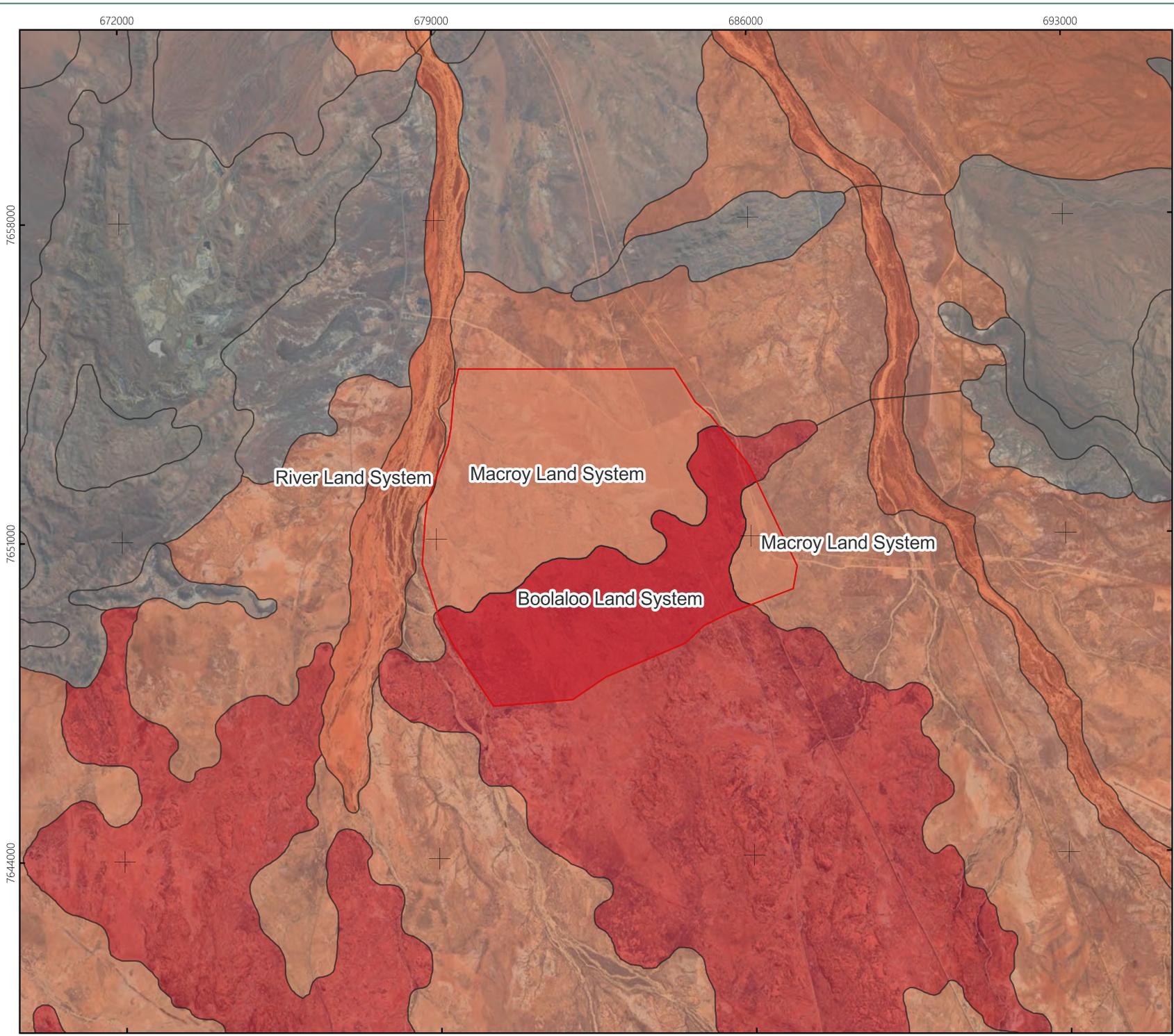
1.10. Land Systems

The land systems of Western Australia have been mapped at a scale of 1:250,000 (DAFWA 2016).

A total of three land systems were mapped across the Survey Area, two of which are dominant: Macroy (60.6%) and Boolaloo (39.3%). The dominant land systems encompass stony plains, granite hills and spinifex grasslands. The remaining River land system encompasses less than 0.1% of the Survey Area. All land systems are well represented in the region with the Survey Area covering less than 1 % of the land systems extent in WA (Table 1.3; Map 1.5).

Table 1.3: Land Systems

Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	% of Total Extent within Survey Area
Boolaloo Land System: Granite hills, domes, tor fields and sandy plains supporting spinifex grasslands with scattered shrubs.	1,783.5	39.3	247,383	0.7
Macroy Land System: Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	2,748.1	60.6	1,330,647	0.2
River Land System: Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	1.3	<0.1	481,994	<0.01
Total	4,532.9	100		



Legend

- Survey Area
- Land Systems**
- Boolaloo Land System
- Macroy Land System
- River Land System
- Land System not in Survey Area

0 1 2 3 4 km
 Scale 1:125,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre

Author: GF Date: 05-02-2024

Land Systems

NSJW Project

1.11. Significant Lands

Significant lands include conservation estates, Environmentally Sensitive Areas (ESAs) and wetlands listed on the Australian Wetlands Database, with further detailed information in sections 1.11.1 to 1.11.3. One significant land is located in the Study Area: Mungaroona Nature Reserve, located approximately 40 km south-west of the Survey Area. It is listed in Table 1.4, shown on Map 1.1 and described in the following sections.

Table 1.4: Significant Lands within the Study Area

Reserve Name (Protected Area ID)	Distance and Direction from Survey Area
Conservation Estate & ESAs	
Mungaroona Range Nature Reserve	40 km SW

1.11.1. Conservation Estate

The Western Australian conservation estate includes land and waters vested in the Conservation and Parks Commission under the *Conservation and Land Management Act 1984*. The conservation estate is generally managed by the Department of Biodiversity, Conservation and Attractions (DBCA) to protect Western Australia's biodiversity and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DCCEEW, 2022). The Mungaroona Range Nature Reserve occurs within the Study Area (Table 1.4, Map 1.1).

1.11.2. Environmentally Sensitive Areas

Environmentally Sensitive Areas are defined by the Department of Water and Environmental Regulation (DWER, 2019) as:

- A defined wetland and the area within 50 m of a wetland;
- The area covered by vegetation within 50 m of Threatened flora, to the extent to which the vegetation is continuous with the vegetation in which the Threatened flora is located;
- The area covered by a Threatened Ecological Community (TEC);
- A Bush Forever site;
- Areas covered by the Gngara Mound Crown Land Policy and Western Swamp Tortoise Policy; and
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including South-west Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy.

One ESA is located within the Study Area, the Mungaroona Range Nature Reserve (Table 1.4, Map 1.1).

1.11.3. Australian Wetlands Database

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare, or unique, or wetlands that are considered of international importance (DBCA, 2017, 2018; DCCEEW, 2023).

No nationally significant wetlands, including Ramsar wetlands, were mapped within the Study Area. The closest wetland of national significance is the Fortescue Marsh, located approximately 100 km south of the Survey Area (Table 1.4, Map 1.1).

2. METHODS

2.1. Desktop Assessment

A desktop review of relevant and available biological data sources of the Study Area was undertaken prior to the field survey, to assess the fauna likely to occur across the Survey Area. The desktop assessment of the Study Area included searches of biological databases, a literature review of previously conducted assessments and likelihood of occurrence of significant species (Table 2.1, Map 1.1).

2.1.1. Biological Database Searches

The following databases were searched and incorporated into the desktop assessment (Table 2.1).

Table 2.1: Summary of Database Searches

Data Source	Custodian	Details	Buffer
Commonwealth Protected Matters Search Tool (PMST)	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Date: 04/04/2023	50 km
Threatened Fauna Database	Department of Biodiversity Conservation and Attraction (DBCA)	Date: 4/05/2023 Reference: 7635	50 km
NatureMap	DBCA	Date: 13/06/2023	50 km
Atlas of Living Australia	National Research Infrastructure for Australia (NCRIS) / Commonwealth Scientific and Industrial Research Organisation (CSIRO) / Global Biodiversity Information Facility (GBIF)	Date: 04/04/2023	50 km
Fortescue Internal Database	Fortescue	Date: 14/04/2023	40 km

2.1.2. Literature Review

Previously conducted vertebrate fauna assessments or monitoring programs within the Study Area were reviewed to analyse fauna assemblages and determine occurrence of significant species. Reports were incorporated if they were provided by the client, publicly available, or within our fauna database. The 33 reports incorporated into the desktop assessment are listed in Table 2.2 and shown on Map 2.1.

Twelve of the previous surveys or monitoring programs in the region overlap with the Survey Area:

- Fortescue Fauna Monitoring from 2013 to 2023 (ecologia Environment (ecologia), 2014b, 2014a, 2014d, 2015a, 2015b; Ecoscape (Australia, Ecoscape), 2015, 2016c, 2016b, 2017a, 2018; Spectrum, 2019, 2020a, 2021, 2022, 2023a, 2024);
- North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360 Environmental (360), 2023);
- North Star Junction Flora and Fauna Assessments (Ecoscape, 2021);
- Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a);

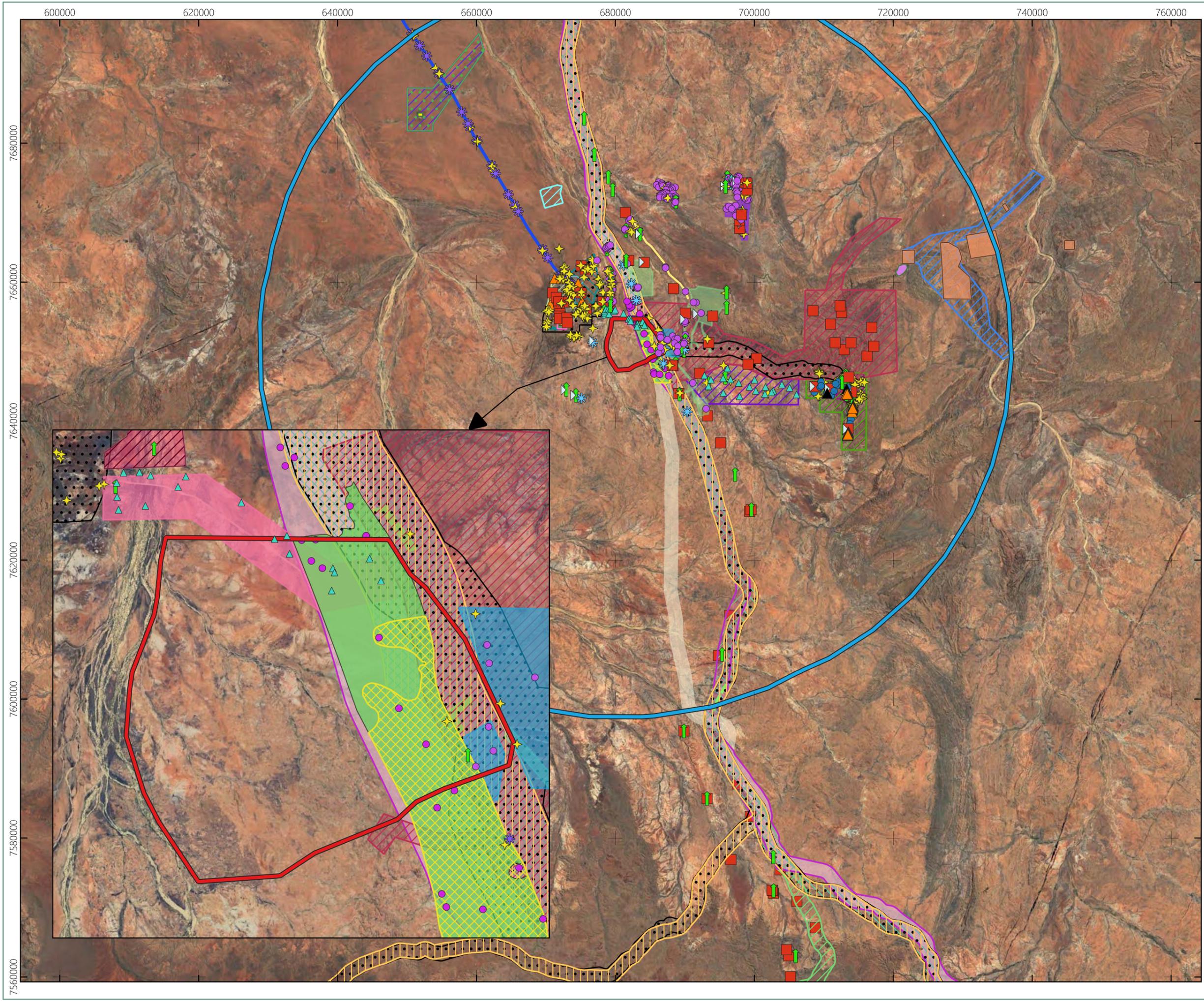
- Pilbara Transmission Project Terrestrial Fauna Desktop (Spectrum, 2018);
- North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a);
- North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b);
- Targeted Fauna Assessment of the Rail Duplication (Bamford Consulting Ecologists (Bamford, 2010);
- Significant Vertebrate Fauna of Roy Hill Infrastructure Corridor (Terrestrial Ecosystems (TE), 2011);
- Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009);
- Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA Environmental (ATA), 2007); and
- Fortescue Stage A Rail (Biota Environmental Sciences (Biota), 2004).

Table 2.2: Previously Conducted Biological Assessments

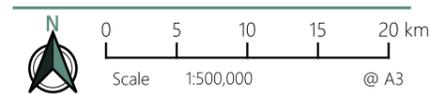
Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Fortescue Fauna Monitoring (ecologia, 2014b, 2014a, 2014d, 2015a, 2015b; Ecoscape, 2015, 2016c, 2016b, 2017a, 2018; Spectrum, 2019, 2020a, 2021; 2022, 2023a, 2024)	Significant fauna monitoring	2013-2023	Partially in Survey Area
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360 Environmental (360), 2023)	Detailed and targeted – vertebrate fauna & SRE – single phase	March 2022	Partially in Survey Area
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	Basic – vertebrate fauna	May 2021	Partially in Survey Area
Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a)	Targeted – vertebrate fauna	September 2019	Partially in Survey Area
Pilbara Transmission Project Terrestrial Fauna Desktop (Spectrum, 2018)	Desktop – vertebrate fauna & SRE	October 2018	Partially in Survey Area
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	Detailed and targeted – vertebrate fauna	Mar-Apr, Jul & Oct-Nov 2011	Partially in Survey Area
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	Basic – vertebrate fauna	May 2012	Partially in Survey Area
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	Basic – vertebrate fauna	August 2015	5.3 km W
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	Basic – vertebrate fauna	August 2014	1.5 km N
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	Targeted – vertebrate fauna	November 2010	Partially in Survey Area
Conservation Significant Vertebrate Fauna Species Habitat Assessment: Roy Hill Rail (TE, 2011)	Basic & targeted – vertebrate fauna	January – February 2011	Partially in Survey Area
Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009)	Targeted – vertebrate fauna	June 2009	Partially in Survey Area
Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA, 2007)	Targeted & basic – vertebrate fauna	June to September 2006 (9 phases)	Partially in Survey Area
Fortescue Stage A Rail (Biota, 2004)	Detailed – vertebrate fauna	March – April 2004	Partially in Survey Area
Wodgina Lithium Project: Level 2 Vertebrate Fauna (Western Wildlife (WW), 2020)	Detailed – vertebrate fauna	April 2019 & October 2019	1.6 km W
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	Basic – vertebrate fauna	July 2020	2.7 km E

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	Basic & targeted – vertebrate fauna	July 2018	3.6 km NW
Hercules Project: Terrestrial Fauna (Outback Ecology Services (Outback), 2012)*	Detailed & targeted – vertebrate fauna (single phase only)	March 2011	6.5 km W
Wodgina DSO Project: Terrestrial Fauna (Outback, 2009)	Detailed and targeted vertebrate fauna	April-May 2009 & July-August 2009	5.6 km W
Wodgina DSO Project: Northern Quoll Annual Monitoring (Baseline Survey) (Outback, 2010)	Targeted – vertebrate fauna	February 2010	4.9 km W
Wodgina DSO Project Quarterly Bat Monitoring Program (Outback, 2011a)	Targeted – vertebrate fauna	March 2011	5.5 km W
Wodgina Gas Pipeline Targeted Fauna Survey (360, 2018)	Targeted – vertebrate fauna & SRE	June 2018	7.3 km NW
Pilgangoora Baseline Vertebrate Fauna (360, 2016)	Detailed – vertebrate fauna (single phase only)	March 2016	23.8 km NE
E45/2287 Infill Pilgangoora Project Flora & Fauna (Animal Plant Mineral (APM), 2023)	Targeted – vertebrate fauna	March 2023	29.5 km NE
P1000 Pilgangoora Project Flora & Fauna (APM, 2024)	Targeted – vertebrate fauna	September-October 2023	34.3 km NE
Glacier Valley and South Star Fauna Surveys (GHD, 2020)	Targeted – vertebrate fauna	May 2018 – February 2019	21 km E
Glacier Valley Terrestrial Vertebrate Fauna (Spectrum, 2021b)	Detailed – vertebrate fauna	May – October 2020	21 km E
Abydos DSO Project: Terrestrial Vertebrate Fauna Baseline Survey (Outback, 2011b)	Detailed – vertebrate fauna	May – September 2010	35.2 km E
Conservation Significant Bats Sulphur Springs, Pilbara (Molhar, 2007)	Targeted – vertebrate fauna	June 2007	36.4 km E
Mt Dove DSO Project: Northern Quoll Monitoring (MWH, 2015)	Targeted – vertebrate fauna	July – August 2015	37.4 km NW
Mt Dove DSO Project: Vertebrate Fauna (Outback, 2011c)	Detailed – vertebrate fauna	May – September 2010	37.4 km NW
Mt Dove Drilling Exploration Bat Monitoring (Outback, 2011d)	Targeted – vertebrate fauna	January 2011	39.9 km NW
Panorama Project Area: Baseline Fauna (Bamford, 2001)	Detailed – vertebrate fauna	June – September 2001	37.1 km E

Note: * - these reports were only accessed via Western Wildlife (2020) and Stantec (2018) reports, so have limited information



- Legend**
- Survey Area
 - Study Area
 - Previous Surveys Completed in Vicinity
 - 360 (2016)
 - 360 (2018a)
 - 360 (2018b)
 - 360 (2023)
 - APM (2023)
 - APM (2024)
 - ATA (2007)
 - Bamford (2001)
 - Bamford (2010)
 - Biota (2004)
 - Ecologia (2012a)
 - Ecologia (2012b)
 - Ecologia (2014c)
 - Ecologia (2015c)
 - Ecoscape (2009)
 - Ecoscape (2020a)
 - Ecoscape (2020b)
 - Ecoscape (2021)
 - GHD (2020)
 - Molhar (2007)
 - MWH (2015)
 - Outback Ecology (2009)
 - Outback Ecology (2010)
 - Outback Ecology (2011a)
 - Outback Ecology (2011b)
 - Outback Ecology (2011c)
 - Outback Ecology (2011d)
 - Outback Ecology (2012)
 - Spectrum (2018)
 - Spectrum (2021)
 - Stantec (2018)
 - Terrestrial Ecosystems (2011)
 - Western Wildlife (2020)
- Survey Site Types**
- Systematic trapping
 - ↑ Bat Recorder
 - ★ Motion Camera
 - Habitat Assessment
 - ▲ Targeted Search
 - ▷ Targeted Bird Survey
 - ✱ Targeted Bilby Search
 - ✱ Bilby Monitoring
 - ▲ Targeted Pilbara Olive Python
 - ▲ Northern Quoll Trap Location
 - Opportunistic Site
- Targeted Search Areas**
- Terrestrial Ecosystems (2011) - Bilby & Brush-tailed Mulgara
 - Terrestrial Ecosystems (2011) - Northern Quoll
 - Bamford (2010) - Northern Quoll, Bilby, Pilbara Olive Python



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre



Author: EM Date: 27-11-2024

Previous Surveys in the Vicinity

NSJW Project

MAP

Prepared for Fortescue

2.1

2.1.3. Likelihood of Occurrence of Significant Fauna

The following information was collated for each significant fauna taxon identified during the desktop assessment:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of habitat requirements;
- Description of previous records including age of record (historical database records considered not accurate were excluded if required); and
- Distance of record to the Survey Area.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 2.3. This included assessing the presence of appropriate habitats within the Survey Area using geology, vegetation mapping, and/or aerial imagery.

Table 2.3: Likelihood of Occurrence Criteria

Likelihood	Fauna
Recorded	Species recorded within the Survey Area within the previous 10 years.
High	Species recorded within the Survey Area, more than 10 years ago; or Species recorded within 20 km of the Survey Area and suitable habitat occurs in the Survey Area. Species is easily detectable using standard survey methods.
Medium	Species recorded within the Survey Area, more than 20 years ago; or Species recorded within 40 km of the Survey Area and suitable habitat occurs; or Suitable habitat exists in the Survey Area, but species records are infrequent, or species is not easily detectable using standard survey methods.
Low	Species rarely or not recorded within 50 km of the Survey Area and suitable habitat does not occur within the Survey Area; or Suitable habitat occurs in the Survey Area, but species has not been recorded for more than 50 years.
Very Low	Species not recorded within 50 km despite multiple recent surveys. Suitable habitat does not occur within the Survey Area. Species considered locally extinct.

Note: The species' biology, detectability and frequency of records are considered in the likelihood assessment (e.g. an elusive species that is very rarely recorded may be rated more likely to occur than a species that is easily detectable).

2.2. Survey Timing & Survey Personnel

2.2.1. Survey Timing

The first phase of surveying was completed from the 15-25 May 2023, with the motion camera set-up survey completed from the 21 to 22 August 2023 and the second phase from the 27 September - 6 October 2023. The Survey Area is located within the Eremaean Botanical Province as described by Beard (1980). Technical Guidance (EPA, 2020a) recommends terrestrial fauna surveys in this region be completed between September to April (the period of highest reptile activity), preferably immediately after rain events (rain season) to coincide with peak amphibian and bird activity. There is no recommendation on survey timing for mammals.

The proposed survey timing for targeted significant fauna followed relevant species-specific guidelines (DBCA, 2017; DSEWPC, 2011b, 2011a; DoE, 2016; DEWHA, 2010a, 2010b) in particular those for EPBC Act listed species such as the Northern Quoll and threatened bat species which are known from the Study Area. The preferred timing for the terrestrial fauna assessments relevant to this project are:

- Surveys for Northern Quoll can be completed any time of the year using non-invasive techniques such as motion cameras.
- Threatened bat species can be surveyed at any time; however, the population contracts to areas around roost caves during the cooler dry season and then expands out during the warmer wet season.
- Pilbara Olive Python can be surveyed at any time; however, they are considered to be more active in the warmer wet season, and move to rocky areas with suitable caves and crevices during the cooler dry season.
- The Bilby can be surveyed at any time of the year using non-invasive techniques such as targeted searches for secondary evidence.

Survey timing is also a significant factor when considering animal welfare. The survey should be completed at a time when the target fauna groups are active and detectable but not during a time of year when extreme weather events are likely. High temperatures and flooding can lead directly to fauna stress and/ or death or indirectly by restricting access to trapping sites. Traps were closed after morning check and reopened in the late afternoon when temperatures to minimise impacts by heat to trapped fauna.

2.2.2. Climatic Conditions

Monthly climate data was sourced from the two nearest Bureau of Meteorology (BOM) stations with data, Indee #4016 and Marble Bar #4106, located approximately 48 km north and 98 km west of the Survey Area, respectively (BOM, 2023). Only monthly and long-term rainfall data was available from Indee which opened in 1909, while Marble Bar station data commenced in 2000. Rainfall recorded 12 months prior to the survey, median monthly rainfall, and temperature are presented in Figure 2.1.

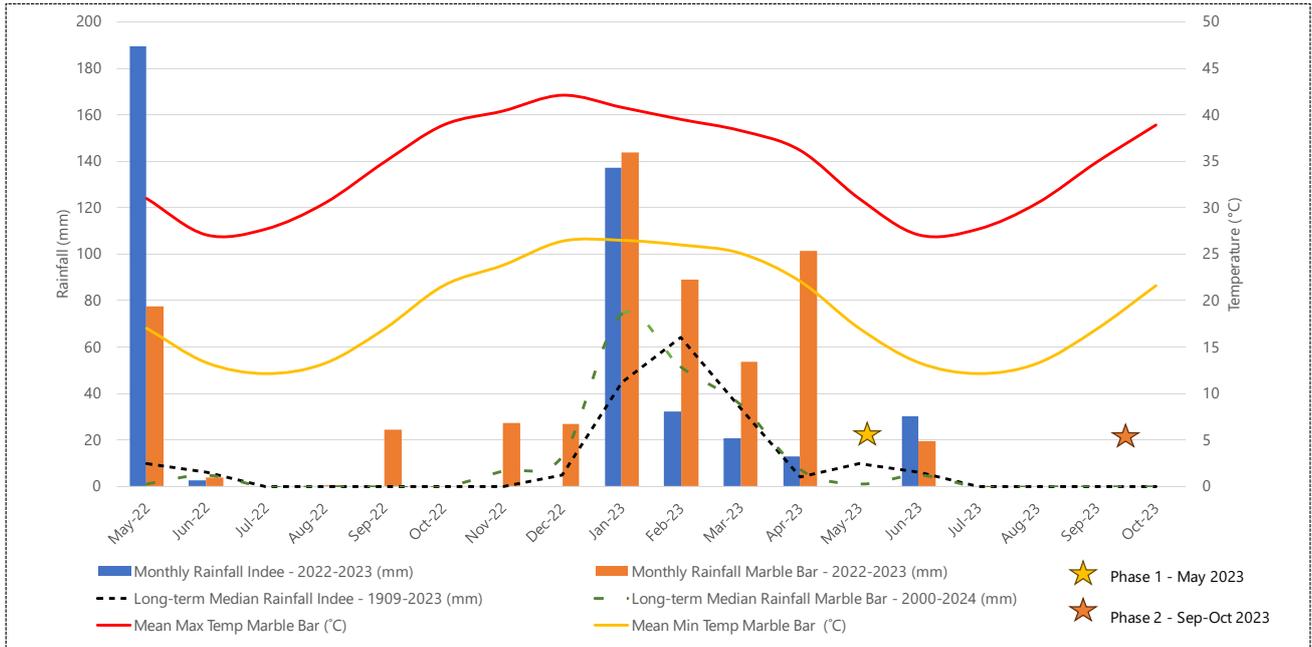


Figure 2.1: Mean Temperature, Rainfall 12 Months Prior to Surveys & Median Long-term Rainfall

The following rainfall was recorded at Indee (#4016) and Marble Bar (#4106) 12 months prior to the survey:

- In the 12 months preceding the Phase 1 survey (May 2022 to April 2023), 395.2 mm of rainfall was recorded at Indee, 227.3 mm higher than the sum of the long-term annual median of 167.9 mm. While, 548.6 mm of rainfall was recorded at Marble Bar, 354.1 mm higher than the sum of the long-term annual median of 194.5 mm. In 2022, the wet season occurred later than usual, with Indee and Marble Bar recording 189.6 mm and 77.6 mm of rainfall in May, respectively. While the 2023 wet season was more typical for the Survey Area with significant rainfall recorded in January 2023 at Indee (137 mm) and Marble Bar (143.6 mm). Additionally, Marble Bar received more than twice Indee’s rainfall during the 2023 wet season period (November 2022 to April 2023) with 442.2 mm and 203.1 mm recorded, respectively.
- During the three months preceding the Phase 1 field survey (February 2023 – April 2023), only 66.1 mm of rainfall was recorded from Indee, 35.9 mm lower than the sum of the long-term annual median for the same three months (102 mm). However, significant rainfall occurred one month prior, with January 2023 recording 137 mm. Conversely, for the same period, Marble Bar recorded 244. mm of rainfall, 94.3 mm higher than the sum of the long-term annual median for the same three months (244.4 mm) with similar significant rainfall in January 2023 (143.6 mm).
- Rainfall between the two survey phases (May 2023 to September 2023) was above the long-term median for both stations (Indee: 16.1 mm and Marble Bar: 6.2 mm), with Indee recording 30 mm and Marble Bar receiving less rain with 19.4 mm.

During Phase 1 in May 2023, the maximum daily temperatures were generally below the long-term mean max temperature for Marble Bar in May (31°C), with only day three of the survey reaching slightly above that (31.1°C). The average maximum temperature experienced during the survey was 28.5°C. The minimum temperatures experienced during Phase 1 of the survey were similarly below the long-term mean minimum temperature in May (17°C) with an average of 13.3°C. The lowest minimum temperature was experienced on Day 10 of the survey, where it only reached 9.8°C. However, during Phase 2, the maximum temperatures were well above the long-term mean for both September (30.5°C) and October (34.9°C), with an average of 40.1°C. The lowest temperature experience was 37.5°C, with a high of 41.9°C. Likewise, the minimum

temperatures were also above the long-term mean for both months (13.2°C and 16.9°C, respectively), with an average of 20.8°C. No rainfall was recorded during any of the survey phases.

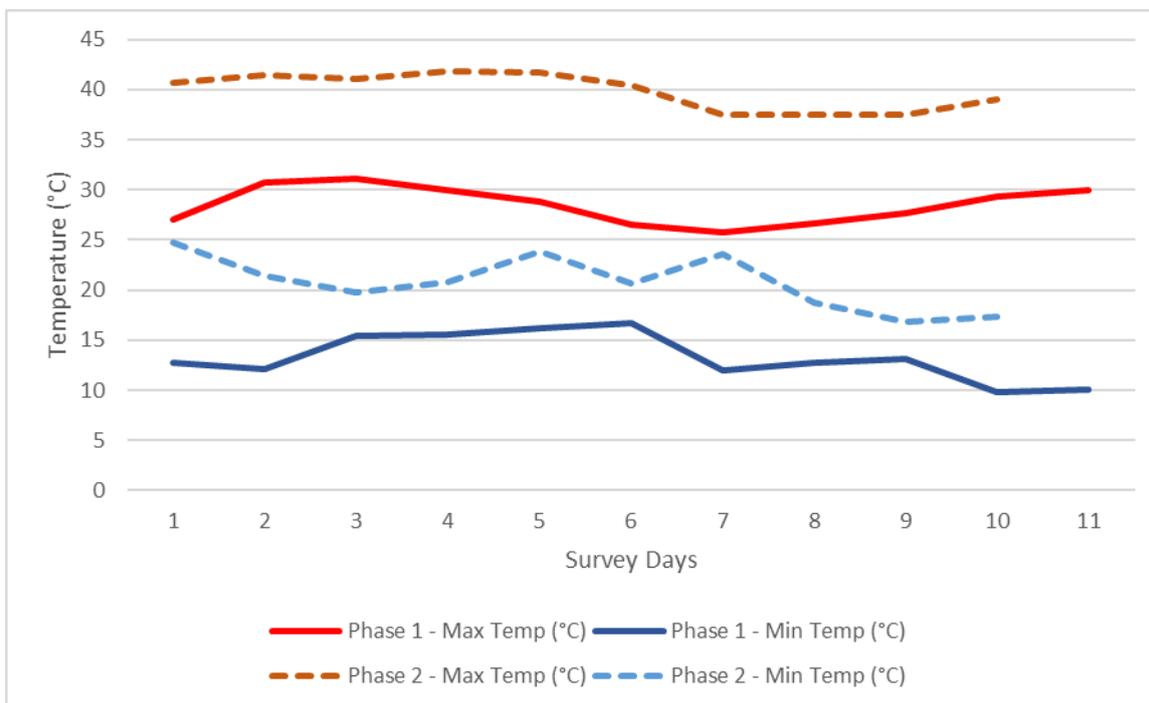


Figure 2.2: Phase 1 & 2 Survey Maximum & Minimum Temperatures

2.2.3. Survey Permits & Personnel

The survey was completed under DBCA Regulation 27 licence number BA27000842 and Section 40 of the BC Act authorisation number TFA2223-0261.

The field personnel details are presented in Table 2.4, along with Dr Kyle Armstrong of Specialised Zoological, who completed the bat call analysis.

Table 2.4: Project Staff

Name	Position	Qualification	Consulting/Relevant Experience*	Tasks
Astrid Heidrich	Principal Zoologist	MSc.	15	Report writing, report review, field survey (phase 1)
Erica MacIntyre	Senior Zoologist	BSc.	10	Report writing, project management, field survey (phase 1 and 2)
Melinda Henderson	Senior Zoologist	B.Sc. Hons	5	Field survey (phase 2)
Georgia Ford	Zoologist	BSc, MSc.	5	Report writing, field survey (phase 1)
Steven Spragg	Zoologist, Ornithologist	BSc.	1 (10 years ornithology)	Field survey (phase 1)
Louise Ridgeway	Zoologist	BSc.	5	Field survey (phase 2)
Karis Waterson	Zoologist	BSc.	<1	Field survey (phase 2)
Joel Wilson	Zoologist	MSc (Res.)	4	Statistical analysis
Kyle Armstrong	Bat Call Analysis	BSc, PhD. Zool.	>20	Bat call analysis

2.3. Field Methods & Sampling Effort

2.3.1. Determination of Survey Design

The desktop assessment identified 33 previous surveys of relevance, which includes the ongoing fauna monitoring for Fortescue. Of these, 12 were completed partly within the Survey Area, nine were within 10 km (Table 2.5) and the remaining 12 were completed in the wider region (60 km or less; section 2.1.2). Following this review and prior to the development of the survey methods, an assessment was undertaken of factors likely to influence the design and intensity of the field survey. This assessment followed the EPA Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020a).

Of the 12 surveys that partially overlap the Survey Area, five were conducted recently, while the remaining seven are over 12 years old. Notably, the three detailed surveys did not include any trap sites within the Survey Area boundary. A recent detailed survey was completed 1.6 km to the west in 2019, although some of the habitats present differed from those in the Survey Area. Consequently, it was determined that a detailed fauna survey and targeted survey for significant fauna was required. These surveys and other factors that may influence survey design are detailed in Table 2.6.

The survey effort of fauna assessments completed within or adjacent to (within 10 km) of the Survey Area are listed in Table 2.5.

Table 2.5: Previous Survey Effort & Timing within 10 km of the Survey Area

Source ^a	Survey Type	Survey Timing	Distance from Survey Area	Site Type								
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted NQ Trapping / Search	Targeted Bilby Search	Targeted POP Search	Bird Survey	Motion Camera	Bat Recorder / Targeted Search
Fortescue Fauna Monitoring 2013-2023 (ecologia, 2014b, 2014a, 2014c, 2015a, 2015b; Ecoscape, 2015, 2016c, 2016b, 2017a, 2018; Spectrum, 2020, 2021, 2022, 2023a, 2024b)	Significant fauna monitoring	2013-2023	Partially in Survey Area		-	-	-	8 x Bilby 2 ha search sites within 10 km	-	4 x transects within 10 km	1 MC in culvert x 30-90 days in Survey Area (annually since 2013) 2 MCs in culvert x 30-90 days within 10 km (annually since 2013)	1 site (85 recorder nights) in Survey Area (annually since 2012) 6 x bat recorders (392 nights) within 10 km (annually since 2012)
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360, 2023)	Detailed and targeted – vertebrate fauna & SRE – single phase	March 2022	Partially in Survey Area	7 x trapping grids	16	Completed	-	5 x 6 km transects searching for burrows, diggings, scats and tracks	Active searches at each trap site for all significant fauna	One hour at each trapping site Targeted Night Parrot x 2 acoustic recorders (14 nights)	4 sites x 10 cameras (210 trap nights)	6 x recorders (44 nights)
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	Basic – vertebrate fauna	May 2021	Partially in Survey Area	-	15	Completed	-	-	-	-	5 motion cameras	1 bat recorder
Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a)	Targeted – vertebrate fauna	September 2019	Partially in Survey Area	-	-	Completed	Searches in granite boulder piles	Searches in alluvial plains in association with creek lines	-	-	-	-
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	Detailed and targeted – vertebrate fauna	Mar-Apr, Jul & Oct-Nov 2011	Partially in Survey Area	16 x trapping grids	Completed for habitat mapping	Completed	3825 trap nights 129.5 hours of active searches 52 camera nights	3 hours searching sandy plains	125.5 hours active searches 52 camera nights	6 x 20 min at each trapping site (total 62 hours)	14 sites (total 156 hours)	682.5 hours of recordings and 11 hours of cave searches
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	Basic – vertebrate fauna	May 2012	Partially in Survey Area	-	Completed for habitat mapping	Completed	Active searches at each site for all significant fauna	Active searches at each site for all significant fauna	Active searches at each site for all significant fauna	20 min x 18 sites	-	-
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	Basic – vertebrate fauna	August 2015	5.3 km W	-	Completed for habitat mapping	-	19 hours active searches for all significant fauna	19 hours active searches for all significant fauna	19 hours active searches for all significant fauna	1 hour x 19 sites	13 sites (208 hours total)	-
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	Basic – vertebrate fauna	August 2014	1.5 km N	-	10	Completed	Searches in suitable den habitat (rocky habitats)	Searches in sandy spinifex plains	Searches along drainage lines and rocky areas	-	8 x motion cameras at 8 sites (approx. 40 hours each, total 334 hours & 47 mins)	6 bat recorders at 6 sites (12 hrs 47 min effort each site)
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	Targeted – vertebrate fauna	November 2010	Partially in Survey Area	-	-	-	Searches for scats around granite outcrops	Searches for burrows, diggings and tracks in sandy habitats	Searches for individuals, skins, scats around rock outcrops	-	-	-
Conservation Significant Vertebrate Fauna Species Habitat Assessment: Roy Hill Rail (TE, 2011)	Basic & targeted – vertebrate fauna	January – February 2011	Partially in Survey Area	-	7 x in Survey Area, 30 x within 10 km	-	Searches in suitable habitat	Searches suitable habitat, also searches for Brush-tailed Mulgara	-	-	-	-
Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009)	Targeted – vertebrate fauna	June 2009	Partially in Survey Area	-	-	Completed	Searches in suitable habitat	Searches in suitable habitat	Searches in suitable habitat	-	-	-
Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA, 2007)	Targeted & basic – vertebrate fauna	June to September 2006 (9 phases)	Partially in Survey Area	-	Completed for habitat mapping	Completed	Grid searches in suitable habitat	Grid searches in suitable habitat	Grid searches in suitable habitat	-	-	-

Source [^]	Survey Type	Survey Timing	Distance from Survey Area	Site Type								
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted NQ Trapping / Search	Targeted Bilby Search	Targeted POP Search	Bird Survey	Motion Camera	Bat Recorder / Targeted Search
Fortescue Stage A Rail (Biota, 2004)	Detailed – vertebrate fauna	March – April 2004	Partially in Survey Area	3 x trapping grids (Hope Downs)	-	Completed	Active searches in suitable habitat	Active searches in suitable habitat	Active searches in suitable habitat	37 surveys at 18 sites (24.67 hours)	-	1 x within 10 km
Wodgina Lithium Project: Level 2 Vertebrate Fauna (WW, 2020)	Detailed – vertebrate fauna	April 2019 & October 2019	1.6 km W	6 x trapping grids	Completed for habitat mapping	Completed	2 x trap sites (20 Elliott traps) April 2019 only	-	-	6 x 20 min at each site Targeted Night Parrot x 4 acoustic recorders	82 at 40 sites (208 trap nights)	At each trap site plus additional 20 sites
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	Basic – vertebrate fauna	July 2020	2.9 km E	-	Completed for habitat mapping	Completed	23 x 30 min searches across 1 ha	23 x 30 min searches across 1 ha	23 x 30 min searches across 1 ha	2 acoustic recorders (8 nights total)	10 cameras	3 bat recorders (12 nights)
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	Basic & targeted – vertebrate fauna	July 2018	3.6 km NW	-	54	-	Searches in suitable habitat	Searches in suitable habitat	Searches in suitable habitat	-	32	6 x recorders & searches in suitable habitat
Wodgina Hercules Project: Terrestrial Fauna* (Outback, 2012)	Detailed & targeted – vertebrate	March 2011 (1 phase only)	6.5 km W	4 x trapping grids	Completed*	Completed*	Completed*	-	Completed*	Completed*	-	Completed*
Wodgina DSO Project: Terrestrial Fauna* (Outback, 2009)	Detailed and targeted vertebrate fauna	April-May 2009 & July-August 2009	5.6 km W	6 x trapping grids	Completed*	Completed*	Completed*	-	Completed*	Completed*	-	Completed*
Wodgina DSO Project: Northern Quoll Annual Monitoring (Baseline Survey) (Outback, 2010)	Targeted – vertebrate fauna	February 2010	4.9 km W	-	-	-	8 sites x 20 Elliott traps (1,120 trap nights)	-	-	-	-	-
Wodgina DSO Project Quarterly Bat Monitoring Program (Outback, 2011a)	Targeted – vertebrate fauna	March 2011	5.5 km W	-	-	-	-	-	-	-	4 x at 4 cave entrances	9 x bat recorders from 1-4 nights
Wodgina Gas Pipeline Targeted Fauna Survey (360, 2018)	Targeted – vertebrate fauna & SRE	June 2018	6.1 km NW	-	-	-	46 x 2 ha searches total for all significant fauna	46 x 2 ha searches total for all significant fauna (specifically targeting Bilby)	-	-	12 units for 36 trap nights	-

Note: * - these reports were only accessed via Western Wildlife (2020) and Stantec (2018) reports, so have limited information of survey effort for some site types. [^]Desktop reports were excluded from table.

Table 2.6: Factors Likely to Influence Survey Design

Factor	Relevance
Bioregion – level of existing survey/knowledge of the region and associated ability to predict accurately.	The Pilbara region has been extensively surveyed over the past decade with a general expansion in the detailed knowledge of the vertebrate faunal assemblages that occur in the region. The data is adequate to predict fauna assemblages and the likelihood of occurrence of significant species.
Landform special characteristics/specific fauna/specific context of the landform characteristics and their distribution and rarity in the region.	The landforms of the Survey Area are typical of the region and consist of sand plains, granite outcropping and drainage lines. All landforms are considered common throughout the surrounding region.
Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present.	The Pilbara region is considered arid, and most fauna life cycles are significantly influenced by rainfall. Population increases, the influx of nomadic species and the onset of breeding activity is directly affected by rainfall in many taxa. Temperature also influences activity levels, with reptiles and amphibians being most active during warm wet periods.
Level of existing knowledge and results of previous regional sampling (e.g. species accumulation curves, species/area curves).	The results of 20 vertebrate fauna surveys were available to provide regional context to the current assessment. Four previous surveys have been completed within the Survey Area, with an additional seven within 10 km of the Survey Area, including four detailed vertebrate trapping surveys. A comprehensive detailed survey (2 phases), and targeted significant fauna survey have been completed in 2019, from 1.6 km to the west for Wodgina. Regional and local knowledge for the area is detailed, highly comparable and available for inclusion.
Number of different habitats or degree of similarity between habitats within a study area.	Five fauna habitat types were expected and identified based on staff experience with the region, previous habitat mapping, land systems and vegetation units. Additional areas considered cleared or disturbed were also identified.
Climatic constraints (e.g. temperature or rainfall that preclude certain sampling methods).	The Pilbara region experiences hot summers with occasional cyclonic rain events, followed by warm winters with little rain although rainfall is considered to be highly unpredictable. Field surveys are generally conducted in Autumn (wet/post-wet season) and Spring (dry season) to avoid climatic events that may preclude sampling. Above the median rainfall was recorded prior to the surveys which made conditions optimal. However, there was a large fire that burnt approximately 79% of the Survey Area in 2022 (prior to phase 1), which may have impacted the fauna assemblage of the Survey Area. Phase 2 of the survey experienced high temperatures, so traps were closed during the day and reopened in the afternoon, which may have limited diurnal reptile captures. Nocturnal species captures are not likely impacted. Extensive regional data offset any potential survey gaps experienced.
Sensitivity of the environment to the proposed activities.	The Survey Area contains habitat types which are well represented in the surrounding region. However, granite outcrops provide habitat for a range of significant fauna and other species. Prior assessments completed as part of the Wodgina project, North Star project, Glacier Valley project, and rail infrastructure projects provided broad baseline knowledge of the area.
Size, shape, and location of the proposed activities.	The Survey Area is located approximately 120 km south of Port Hedland and 25 km west of Iron Bridge. The Survey Area encompasses 4,532.9 ha.
Scale and impact of the proposal.	The proposal will include clearing of land for solar panel installation.

2.3.2. Terrestrial Fauna Survey Techniques

Spectrum conducted a two-phase detailed fauna assessment and targeted significant fauna survey. The details of the survey phases including dates, time frame and number of staff is outlined in Table 2.7.

Table 2.7: Survey Phase Details

Survey Phase	Dates	Time Frame (Days)	No. of Zoologists*
Phase 1	15 - 25 May 2023	11	4
Motion Camera Installation	21 - 22 August 2023	2	2
Phase 2	27 September - 6 October 2023	10	4

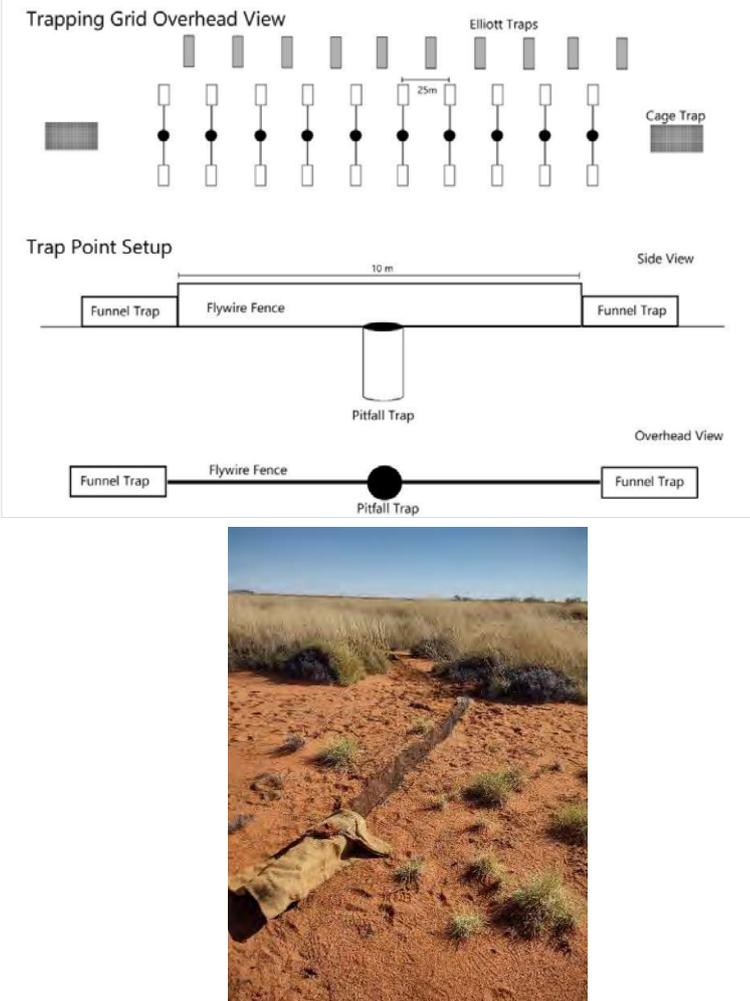
Note: * = See Table 2.4 for staff details

The approach of the survey was to describe and map the terrestrial fauna habitats across the Survey Area and complete systematic trapping and targeted searches to describe the vertebrate fauna assemblages, particularly any significant fauna identified as likely to be present.

Survey techniques used during the survey are outlined in Table 2.8.

Table 2.8: Fauna Survey Techniques

Technique	Application & Purpose	Target Group
Opportunistic / Basic Site	<p>Information collected at each site included some, or all of the following:</p> <ul style="list-style-type: none"> • Site code, date, location, zoologist; • A photograph; • Vegetation condition and disturbances (including fire); • Landform including; slope, soil, rock type, aspect; • Vegetation community type and density; and • Fauna present. 	<ul style="list-style-type: none"> • Habitat Assessment • Mammals • Reptiles • Birds • Amphibians • Significant Fauna
Systematic Trapping Site	<ul style="list-style-type: none"> • Pitfall: 5 x 20 L bucket and 5 x 50 cm PVC pipe pitfall traps, dug into the ground to act as pitfall traps. A 10 m long, 30 cm high fence was also installed, passing across the top of each pit to direct fauna into it. • Funnel traps: placed at the ends of each fence to capture fauna that are not readily caught in pitfall traps (20 per trapping grid). All funnel traps were covered with shades to reduce the likelihood of animals suffering from overheating. • Elliott traps: aluminium box traps were baited with 'universal bait' to attract and capture smaller mammals (10 per trapping grid) and re-baited as required. All Elliott traps were covered by 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 trapping grid) and re-baited as required. All cage traps were covered by shades to reduce the likelihood of animals suffering from overheating. <p>Layout of a trap site and a single trap line is shown below. Traps were left open for seven nights.</p>	<ul style="list-style-type: none"> • Habitat Assessment • Mammals (small sized non-volant) • Reptiles • Amphibians • Significant Fauna

Technique	Application & Purpose	Target Group
		
<p>Targeted Trapping Site – Satellite Sites</p>	<p>Two sites (S01 & S03) located in granite outcropping consisted of:</p> <ul style="list-style-type: none"> • 5 x cage traps (as per above) (Phase 1 & 2); • 5 x motion cameras (Phase 1 only); • One ultrasonic bat recorder (Phase 1 & 2); and • Traps were left open for four trap nights. <p>One site (S02) located in drainage line habitat consisted of:</p> <ul style="list-style-type: none"> • 5 x motion cameras (Phase 1 & 2); and • One ultrasonic bat recorder (Phase 1 & 2). 	<ul style="list-style-type: none"> • Mammals • Significant Fauna
<p>Systematic Bird Surveys</p>	<p>Area searches (30-minute set-time searches of 2 ha areas) were used to document the bird assemblage present at each of the systematic fauna trapping sites. Four searches per phase were completed (total of eight 30 min surveys). During each area search an ornithologist recorded the number of individuals of each species observed while actively searching similar habitat within a 2 ha area surrounding the trapping site. Survey effort was concentrated within three hours of dawn or dusk, as these times are considered optimal for recording most bird species.</p>	<ul style="list-style-type: none"> • Birds • Significant Fauna
<p>Mapping Note</p>	<p>Note taken with the location and fauna habitat present. Might have included photographs or descriptions.</p>	<ul style="list-style-type: none"> • Habitat Assessment
<p>Opportunistic Sampling</p>	<p>Fauna species not recorded through other sampling methods were opportunistically sampled as encountered in the Survey Area. Opportunistic sampling also included recording locations of significant and introduced species.</p>	<ul style="list-style-type: none"> • Mammals • Reptiles • Birds

Technique	Application & Purpose	Target Group
		<ul style="list-style-type: none"> Amphibians Significant Fauna
Targeted Sampling	Areas likely to support significant fauna were targeted during the survey, using techniques such as motion cameras, bat recorders, and searches for secondary evidence, with further details provided in Table 2.10. Areas were selected based on existing records from previous surveys, database searches, geology, aerial imagery, and vegetation mapping.	<ul style="list-style-type: none"> Significant Fauna
Motion Cameras	Motion sensitive cameras capable of recording both normal (day) and infra-red (night) images were deployed in areas of interest, such as near permanent water or in gorges, to record cryptic or targeted species not normally recorded by other survey methods. In addition, suitable habitat for significant fauna likely to occur were targeted to determine their presence or absence. Motion Cameras were baited with non-food reward baits (cotton rope soaked in fish oil).	<ul style="list-style-type: none"> Mammals Reptiles Birds Significant Fauna
Passive[^] Ultrasonic Recording Units (PUR)	Bat echolocation calls were recorded using Wildlife Acoustics SM4BAT ultrasonic recorders. The PUR devices record the full spectrum of calls allowing greater accuracy and sensitivity when identifying bat species. Each PUR device was programmed to record from 30 minutes pre-dusk to 30 minutes post-dawn for each night and deployed for a minimum of three nights.	<ul style="list-style-type: none"> Bats

Note: [^] Passive is the automatic recording of echolocation calls without an observer present.

2.3.2.1. Survey Effort

Five systematic detailed vertebrate fauna trapping sites were surveyed over two phases. Each site was open for seven nights. In addition, two targeted trapping satellite sites were surveyed for four nights during each phase of the survey. A minimum of four 30-minute systematic bird surveys were completed at each of the trapping sites during both phases of the vertebrate fauna survey.

Ultrasonic Acoustic recordings were completed at each trapping site for at least four nights during both phases of the survey. Three additional bat survey sites (satellite sites) were surveyed for a minimum of four nights each during Phase 1, and at least three nights during Phase 2. Five motion cameras were deployed at each of the three satellite sites for four nights during Phase 1.

During Phase 1, a total of 15 motion cameras were deployed at the three satellite sites for four nights, with an additional 15 cameras set up at other areas of interest (e.g. Bilby and Mulgara burrows). This included two long-term motion cameras deployed for 32 days at an active Bilby burrow at site NS01. A separate motion camera installation survey was completed in August 2023, and nine motion camera sites were set up consisting of five motion cameras each, except for one site with only four. These cameras were deployed for 44-45 days. A further five cameras were deployed during Phase 2 at one satellite site.

A total of 43 habitat assessments were completed at trap and satellite sites, motion camera sites, targeted search sites and an additional four sites.

A summary of the survey effort completed during the current survey at the Survey Area is detailed in Table 2.9.

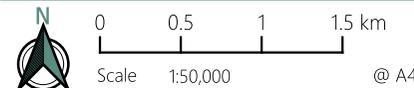
Table 2.9: Survey Effort Completed

Survey		Phase 1	MC Install	Phase 2	Total
Survey Timing		May 2023	Aug 2023	Sep-Oct 2023	-
Person Days		44	4	40	88
Trap Nights	Pit Trap	350		350	700
	Funnel Trap	700		700	1400
	Elliott Trap	350		350	700
	Cage Trap	70		70	140
	Satellite Site – Cage Traps	40		40	80
Survey Effort (hrs)	Diurnal Searches	76.02		19	95.02
	Bird Surveys	10		10	20
	Bat Recorders	410		370	160
	Motion Cameras	4,200	49,080	600	53,880



Legend

- Survey Area
- Bat recorder
- Grey Falcon Check
- ◆ Habitat Assessment
- Motion Camera
- Systematic Trapping
- ◆ Targeted Active Search



Coordinate System: GDA 1994 MGA Zone 50
 Projection: Universal Transverse Mercator
 Units: Metre



Author: EM Date: 02-02-2024

Survey Site Locations

NSJW Project

MAP
2.2

Prepared for
 Fortescue

2.3.2.2. Targeted Survey – Significant Fauna

An initial desktop assessment was completed, which identified 28 species listed under the EPBC Act, gazetted under the BC Act or listed under the DBCA Priority fauna categories. These were specifically targeted using the field survey techniques as listed in Table 2.10 which follow the Threatened Species guidelines (where applicable).

Table 2.10: Significant Species – Targeted Survey Methods

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Mammals				
Northern Quoll <i>Dasyurus hallucatus</i>	EN	EN	-	<ul style="list-style-type: none"> Habitat assessment Searches for secondary evidence (8 hours across 2 sites) Cages in Granite Outcropping habitat (80 trap nights at 2 sites) 60 motion cameras at 12 sites from 4 - 45 nights (45,312 hours recording)
Pilbara Leaf-nosed Bat <i>Rhinonictis aurantia</i> Pilbara Form	VU	VU	-	<ul style="list-style-type: none"> Habitat assessment Ultrasonic Recorders (78 nights at 8 sites)
Ghost Bat <i>Macroderma gigas</i>	VU	VU	-	<ul style="list-style-type: none"> Habitat assessment Ultrasonic Recorders (78 nights at 8 sites)
Bilby <i>Macrotis lagotis</i>	VU	VU	-	<ul style="list-style-type: none"> Habitat assessment Searches for secondary evidence (45.5 hours at 11 sites) 22 motion cameras at 3 sites from 3 - 45 nights (5,448 hours recording)
Long-tailed Dunnart <i>Antechinomys longicaudatus</i>	-	-	P4	<ul style="list-style-type: none"> Habitat assessment
Brush-tailed Mulgara <i>Dasyercus blythi</i>	-	-	P4	<ul style="list-style-type: none"> Habitat assessment Searches for secondary evidence (45.5 hours at 11 sites) 21 motion cameras from 3 - 5 nights (2,112 hours recording)
Spectacled Hare-wallaby <i>Lagorchestes conspicillatus leichardti</i>	-	-	P4	<ul style="list-style-type: none"> Habitat assessment Searches for secondary evidence (4 hours at 1 site) seven motion cameras from 3 to 5 nights (600 hours recording)
Short-tailed Mouse <i>Leggadina lakedownensis</i>	-	-	P4	<ul style="list-style-type: none"> Habitat assessment Trapping grids in suitable habitat (pitfalls – 700 trap nights and Elliott traps – 700 trap nights, at five sites)
Western Pebble-mound Mouse <i>Pseudomys chapmani</i>	-	-	P4	<ul style="list-style-type: none"> Habitat assessment Searches for secondary evidence (5 hours at 2 sites) eight motion cameras at 1 site for 2 - 45 nights (4,512 hours recording)
Birds				
Night Parrot <i>Pezoporus occidentalis</i>	EN	CR	-	<ul style="list-style-type: none"> Habitat assessment

Species	Conservation Status			Survey Method
	EPBC Act	BC Act	DBCA	
Grey Falcon <i>Falco hypoleucos</i>	VU	VU	-	<ul style="list-style-type: none"> Habitat assessment Bird surveys across variety of habitats (20 hours at 5 sites) Targeted searches in suitable habitat (30.2 hours at 14 sites)
Pacific Swift <i>Apus pacificus</i>	MI	MI	-	<ul style="list-style-type: none"> Habitat assessment Bird surveys across variety of habitats (20 hours at 5 sites) Opportunistic searches in suitable habitat (30.2 hours at 14 sites)
Peregrine Falcon <i>Falco peregrinus</i>		OS	-	<ul style="list-style-type: none"> Habitat assessment Bird surveys in suitable habitat (20 hours at 5 sites) Targeted searches in suitable habitat (30.2 hours at 14 sites)
Migratory shorebirds	CR, MI	CR, MI	-	<ul style="list-style-type: none"> Habitat assessment Bird surveys in suitable habitat (8 hours at 1 site) Targeted searches in suitable habitat (5 hours at 2 sites)
Reptiles				
Pilbara Olive Python <i>Liasis olivaceus barroni</i>	VU	VU	-	<ul style="list-style-type: none"> Habitat assessment Targeted searches in suitable habitat (26 hours at 6 sites)
Pin-striped Finesnout Ctenotus <i>Ctenotus nigrilineatus</i>	-	-	P1	<ul style="list-style-type: none"> Habitat assessment Targeted searches suitable habitat (26 hours at 6 sites) Trapping grids in suitable habitat (pitfalls – 700 trap nights at five sites)
Gane's Blindsnake <i>Anilius ganei</i>		-	P1	<ul style="list-style-type: none"> Habitat assessment Trapping grids in suitable habitat (pitfalls – 700 trap nights at five sites)

2.3.3. Animal Ethics

This survey has approval under the Western Australian Ethics Committee scientific licence number: WAEC-22-07-74. Any disturbance of animals by the various capture or sampling methods involved, followed the state and federal legislations and guidelines listed in section Appendix A. The survey methods also followed the DBCA Standard Operating Procedures (SOPs) listed below (Department of Biodiversity Conservation and Attractions, 2019b):

- Aluminium Box Traps for Capture of Terrestrial Vertebrates;
- Cage Traps for Live Capture of Terrestrial Vertebrates;
- Dry Pitfall Trapping for Vertebrates;
- Funnel Trapping for Terrestrial Fauna;
- Animal Handling and Restraint using Soft Containment;
- Hand Capture of Wildlife;
- Hand Restraint of Wildlife; and
- Transport and Temporary Holding of Wildlife.

Vertebrate fauna taxa were only handled as required for the purposes of species identification.

2.4. Reporting & Data Analysis

2.4.1. Fauna Taxonomy & Nomenclature

Nomenclature for mammals, reptiles and amphibians followed the Western Australian Museum Checklist of the Vertebrates of Western Australia (November 2024). Nomenclature for birds follows the IOC World Bird List (Gill, Donsker and Rasmussen, 2023). Fauna species identifications were completed based on information provided in references listed in Table 2.11.

Table 2.11: Species Identification References

Fauna	Survey Techniques
Mammals	Churchill (2009); Menkhorst and Knight (2010); Van Dyck, Gynther and Baker (2013)
Birds	Menkhorst <i>et al.</i> (2019a); Simpson and Day (2017); Gill, Donsker and Rasmussen (2023)
Reptiles & Amphibians	Wilson and Swan (2017a); Cogger (2014); Tyler and Doughty (2009)

2.4.2. Bat Call Analysis

The raw bat call data was recorded in full spectrum WAV format using Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at 30 minutes prior to sunset and off, 30 minutes after sunrise). The data was downloaded and sent to Kyle Armstrong (Specialised Zoological), where it was processed and analysed to identify all bat species present, but with a focus on the two significant bat species; the Ghost Bat (*Macroderma gigas*) and the Pilbara Leaf-nosed Bat (*Rhinionictis aurantia*).

A multi-step acoustic analysis procedure developed to process large full spectrum echolocation recording datasets from insectivorous bats (Armstrong, Broken-Brow, *et al.*, 2021; Armstrong, Clarke, *et al.*, 2021) was applied to the recordings made on the survey. Firstly, the WAV files were scanned for bat echolocation calls using several parameter sets in the software SCAN'R version 1.8.3 (Binary Acoustic Technology), which also provides measurements (SCAN'R parameters) from each putative bat pulse. The outputs were then used to determine if putative bat pulses measured in SCAN'R could be identified to species. This was done using a custom [R] language application that performed three tasks:

- undertook a Discriminant Function Analysis on training data from representative calls from bat species in the Pilbara region;
- from the measurements of each putative bat pulse from SCAN'R, calculated values for the first two Discriminant Functions that could separate the echolocation call types derived from the analysis of training data, and plotted these resulting coordinates over ellipses representing one standard deviation of the variation for the defined call types; and
- facilitated an inspection in a spectrogram of multiple examples of each call type for each recording night by opening the original WAV files containing pulses of interest in Adobe Audition version 23.1.

Species were identified based on information in Armstrong and Coles (2007), McKenzie and Bullen (2009) and Kyle Armstrong's own unpublished material. Nomenclature in the report and data follows Jackson and Groves (2015).

Pilbara leaf-nosed Bat: Echolocation calls are distinctive, having a CF-FM (constant frequency - frequency modulated) structure, and with a characteristic frequency between 117 and 125 kHz (DAWE 2020a). The mean characteristic frequency of the loudest (second) emitted harmonic is 121 kHz in the Pilbara, which is around 6 kHz higher than in the northern distribution of the species. Each pulse consists of a constant frequency tone of c. 8 milliseconds duration, followed by a very brief broadband downwards sweep through

c. 20 kHz (Armstrong and Coles, 2007). It is possible to identify the species unambiguously from good quality echolocation calls.

Ghost Bat: Ghost Bats make several social calls that are audible to humans ('chirps', 'squabbles' and 'twitters' (Kulzer et al., 1984; Guppy, Coles, and Pettigrew, 1985; Pettigrew et al., 1986)). When free flying, echolocation calls are characterised by steep linear frequency modulated pulses at 45-56 kHz, of low intensity and short duration (0.8-2.3 ms) (Guppy, Coles and Pettigrew, 1985). Echolocation calls have up to four harmonics, but most of the strength is in the 2nd or 3rd harmonic (Guppy, Coles, and Pettigrew, 1985). More recently studies (Hanrahan, 2020; Hanrahan *et al.*, 2021) reviewed and revised the social vocalisations of the species as 'chirp-trill', 'squabble' and 'ultrasonic social'.

2.4.3. Fauna Habitat Mapping

Fauna habitat mapping identifies areas of vegetation and land features that are distinguishable from other areas. Typically, each fauna habitat supports a characteristic fauna assemblage that is adapted to the features of the fauna habitat. Fauna habitat types are identified and mapped based on the following information:

- General vegetation type (Department of Primary Industries and Regional Development, 2019);
- Vegetation types mapped within the Survey Area;
- Previous fauna habitat mapping supplied by Fortescue;
- Vegetation structure;
- Landforms;
- Geological units;
- Soil substrate;
- Aerial imagery;
- Fauna assemblage; and
- Field observations.

The fauna habitat was recorded at each fauna site and also opportunistically while traversing the Survey Area.

2.4.4. Habitat Analysis

Fauna habitat mapping enables the categorisation of each survey site into a specific habitat type, and analysis of this data provides insight into how distinct or similar the fauna assemblages in each habitat type are. One method is non-metric multidimensional scaling (non-metric MDS), which is based on a distance matrix computed with a range of distance measures, whereby an algorithm attempts to place the data points in a theoretical two- or three-dimensional coordinate system whilst preserving the ranked differences in terms of their Euclidean distance from others (Oksanen *et al.*, 2022). In this case, the Bray-Curtis similarity algorithm was used because it appropriately quantifies the compositional similarity/dissimilarity between two sites with abundance data.

2.4.5. Survey Adequacy

Survey adequacy can, in part, be assessed by estimating species richness from sample data. Extrapolating Species Accumulation Curves (SACs), fitting parametric models or relative abundance and using non-parametric estimators (Bunge and Fitzpatrick, 1993; Colwell and Coddington, 1994; Gaston, 1996) are three generally accepted methods that achieve this. Rarefaction Curves were used to interpolate and extrapolate the collected species data and graphically illustrate the species richness against the number of individuals encountered (Hsieh, Ma and Chao, 2016). These curves were generated using abundance data and plotted

with a 95% confidence interval. The point where the horizontal asymptote is estimated to be reached, is interpreted to be when no new species are expected to be present.

2.4.6. Significant Fauna Definitions

Significant fauna (Appendix A) can include (EPA, 2016):

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

2.5. Limitations & Constraints

Survey specific limitations and constraints for the fauna assessment of the Survey Area are discussed in Table 2.12. Overall, the assessment was not subject to any limitations or constraints.

Table 2.12: Survey Limitations & Constraints

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Database searches provided detailed information, adequate to guide field survey design and effort for the fauna survey. There were multiple assessments conducted within and in the vicinity of the Survey Area and have been included in the desktop assessment.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	Principal Zoologist Astrid Heidrich and Senior Zoologist Erica MacIntyre have suitable knowledge and experience (over 20 years combined) conducting fauna surveys in the Pilbara region of Western Australia.
Timing/weather/season/cycle.	No	The timing of the two-phase field survey was considered appropriate for a fauna survey conducted in the Pilbara region, where the recommended survey timing is post wet (February to April). The first survey was completed in May 2023 with the second season completed in September/October 2023. Rainfall prior to phase 1 of the survey was above the median rainfall leading to optimal survey conditions. Phase 2 also had above the median rainfall prior to survey, however, temperatures during this survey were above the mean with an average temperature of 41°C experienced.
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	No significant disturbances were recorded at the Survey Area that have affected the results of the fauna assessment. A fire prior to phase 1 of the survey limited the unburnt areas to be surveyed, with approximately 79% of the Survey Area impacted by the fire. This may have offset the optimal survey conditions discussed above. Access tracks were also limited, but the use of the helicopter enabled access to all areas, in particular patches of unburnt habitats.
Remoteness and/or access problems.	No	No access restrictions were experienced during the survey. The use of helicopter during both phases enabled full access.
Fauna Specific		
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	No	Sampling techniques were adequate for all vertebrate fauna species. All fauna groups were sampled, and no survey constraints were experienced.
Proportion of fauna identified, recorded, and/or collected.	No	All vertebrate fauna species encountered were identified in the field by experienced zoologists.

Limitation	Constraint	Comment
The proportion of the task achieved and further work which might be needed.	No	All components of a detailed fauna assessment were completed.
Resources (degree of expertise available in animal identification to taxon level).	No	Fauna resources available were adequate and did not compromise the outcome of the survey.
Intensity (in retrospect, was the intensity adequate).	No	A detailed and targeted fauna assessment was adequate to identify faunal assemblages and fauna habitat present, and significant fauna present or likely to be present within the Survey Area. Targeted searches for significant fauna species were completed within areas of suitable habitat.
Completeness (was the relevant area fully surveyed).	No	All major fauna habitat types were sampled and defined. Habitat types that may host significant fauna species were surveyed.

3. RESULTS & DISCUSSION

3.1. Desktop Assessment

To provide regional context for the assessment of the terrestrial fauna values within the Survey Area, a desktop assessment was completed. The desktop assessment identified a total of 352 vertebrate fauna consisting of 46 mammals (including nine introduced), 169 bird, 128 reptile, and nine amphibian species that have previously been recorded in the region (Table 3.1, Appendix C).

The total of 352 vertebrate fauna species recorded from the regions is significantly higher than the results of any single vertebrate fauna survey completed in the region, including the current survey. This is to be expected, as the desktop draws data from a wide range of sources that were collected over different time periods and seasons. There is also a high likelihood that the desktop assessment will include occurrence data from fauna habitat types that are not present within the Survey Area, such as permanent water sources, rocky gorges/gullies, rocky ridgetops and cracking clays. A suitable example of this is the large number of shorebird and other water bird species reported only by NatureMap. NatureMap also has the potential to record vagrant species and those only present in the region during and/or following significant rainfall events and the resource boom that follows. These records may also come via museum collection trips, public specimen collections/ observations, DBCA surveys, and the DBCA Fauna Survey Returns Database, which includes data from private sources.

The data reported by NatureMap, the DBCA Threatened Fauna Database, Protected Matters Search Tool as well as previous survey reports provide a useful indication of regional vertebrate fauna assemblages. Whilst many species recorded during the desktop assessment have the potential to occur in the Survey Area, the fauna assemblage that typically uses the habitats found within the Survey Area forms a much smaller subset of species. Variations in population distributions and the availability of microhabitats within each area also limit the species that may occur. However, the accumulated data provided by the desktop assessment is invaluable during survey planning to ensure all major fauna assemblages are sampled, and any significant species that may occur are targeted appropriately.

Table 3.1: Total Vertebrate Fauna Species Previously Recorded in the Region

Data Source	Mammals (Native/Introduced)	Birds	Reptiles	Amphibians	Total Vertebrates
Survey Reports					
Fortescue Fauna Monitoring 2019-2023 (Spectrum, 2020, 2021, 2022, 2023a, 2023b)	15/6	22	13	-	56
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360, 2023)	12/4	37	53	3	109
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	9/2	20	7	-	38
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	20/3	80	68	6	177
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	2/4	38	7	-	51
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	5/1	18	12	-	36
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	6/3	28	4	-	41
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	5/0	25	2	-	32
Fortescue Stage A Rail (Biota, 2004)	18/6	84	56	6	170
Wodgina Lithium Project: Level 2 Vertebrate Fauna (WW, 2020)	21/4	75	57	5	162
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	9/2	29	4	-	44
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	16/4	33	4	-	57
Wodgina Hercules Project: Terrestrial Fauna (Outback, 2012)	11/1	39	32	3	86
Wodgina DSO Project: Terrestrial Fauna (Outback, 2009)	17/2	46	24	2	91
Wodgina DSO Project: Northern Quoll Annual Monitoring (Baseline Survey) (Outback, 2010)	2/0	-	8	-	10
Pilgangoora Baseline Vertebrate Fauna (360, 2016)	3/0	27	30	-	60
E45/2287 Infill Pilgangoora Project Flora & Fauna (APM, 2023)	4/2	9	9	1	25
P1000 Pilgangoora Project Flora & Fauna (APM, 2024)	3/2	6	12	1	24
Glacier Valley and South Star Fauna Surveys (GHD, 2020)	13/3	70	28	3	117
Glacier Valley Terrestrial Vertebrate Fauna (Spectrum, 2021b)	11/3	37	32	1	84
Abydos DSO Project: Terrestrial Vertebrate Fauna (Outback, 2011b)	15/3	38	41	3	100
Mt Dove DSO Project: Northern Quoll Monitoring (MWH, 2015)	4/3	2	4	-	13
Mt Dove DSO Project: Vertebrate Fauna (Outback, 2011c)	17/6	40	29	1	93
Panorama Project Area: Baseline Fauna (Bamford, 2001)	18/5	79	28	2	132
Public Databases					
EPBC Act Protected Matters (PMST)	4/0	12	1	-	17
DBCA Threatened Fauna Database	9/0	8	2	-	19
NatureMap	35/8	139	99	9	290
Atlas of Living Australia	25/6	142	85	7	265
Fortescue Internal Database	9/0	11	2	-	22
Total Species	37/9	169	128	9	352

Note: Surveys containing less than 10 species or desktop assessments have been omitted from this table, see Appendix C for further details.

3.1.1.1. Significant Fauna

The desktop assessment identified 28 species of significance (nine mammals, 16 birds and three reptiles) as potentially occurring at the Survey Area based on the database search results (DBCA Threatened Fauna, Fortescue's database, ALA, NatureMap and PMST). Six species have previously been recorded in the Survey Area (Table 3.2):

- Northern Quoll (*Dasyurus hallucatus*, EPBC Act & BC Act Endangered (EN));
- Bilby (*Macrotis lagotis*; EPBC Act & BC Act Vulnerable (VU)) – secondary evidence;
- Pilbara Leaf-nosed Bat (*Rhinonictis aurantia* Pilbara form; EPBC Act & BC Act VU);
- Ghost Bat (*Macroderma gigas*, EPBC Act & BC Act VU);
- Brush-tailed Mulgara (*Dasyercus blythi*, DBCA Priority 4 (P4)); and
- Western Pebble-mound Mouse (*Pseudomys chapmani*; DBCA P4).

In addition, the Grey Falcon (*Falco hypoleucos*; EPBC Act & BC Act Vulnerable) was previously recorded less than 300 m from the Survey Area.

The DBCA Threatened Fauna Database search results and PMST included records of species that have been excluded from the report as per the below details:

- Great Desert Skink (*Liopholis kintorei*; EPBC Act & BC Act Vulnerable) no known Pilbara distribution;
- Four Migratory species have been deemed unlikely to occur far from the coastline and thus outside the Survey Area:
 - Far Eastern Curlew (*Numenius madagascariensis*, EPBC Act & BC Act Critically Endangered);
 - Barn Swallow (*Hirundo rustica*, EPBC Act & BC Act Migratory);
 - Grey Wagtail (*Motacilla cinerea*, EPBC Act & BC Act Migratory); and
 - Eastern Yellow Wagtail (*Motacilla tschutschensis (flava)*, EPBC Act & BC Act Migratory).
- Northern Leaf-nosed Bat (*Hipposideros stenotis*, DBCA Priority 2), no known Pilbara distribution; and
- Spotted Ctenotus (*Ctenotus uber johnstonei*; DBCA Priority 2): single record, however this subspecies is not currently known to occur in the Pilbara region.

The locations of the DBCA Threatened Database and the Fortescue Internal Database (FID) search results are shown on Map 3.1.

Table 3.2: Significant Fauna Potentially Occurring at the Survey Area

Species	Conservation Status			Database Record				No. Surveys Recorded	Previously Recorded in Survey Area
	EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap	FID*		
Mammals									
Northern Quoll <i>Dasyurus hallucatus</i>	EN	EN	-	✓	✓	✓	✓	18	Y
Bilby <i>Macrotis lagotis</i>	VU	VU	-	✓	✓	✓	✓	9	Y
Pilbara Leaf-nosed Bat <i>Rhinonicteris aurantia</i> Pilbara form	VU	VU	-	✓	✓	-	✓	18	Y
Ghost Bat <i>Macroderma gigas</i>	VU	VU	-	✓	✓	✓	✓	10	Y
Long-tailed Dunnart <i>Antechinomys longicaudatus</i>	-	-	P4	-	✓	-	✓	3	N
Brush-tailed Mulgara <i>Dasyercus blythi</i>	-	-	P4	-	✓	✓	✓	10	Y
Spectacled Hare-wallaby <i>Lagorchestes conspicillatus leichardti</i>	-	-	P4	-	✓	✓	✓	2	N
Short-tailed Mouse <i>Leggadina lakedownensis</i>	-	-	P4	-	✓	✓	-	1	N
Western Pebble-mound Mouse <i>Pseudomys chapmani</i>	-	-	P4	-	✓	✓	✓	16	Y
Birds									
Curlew Sandpiper <i>Calidris ferruginea</i>	CR, MI	CR	-	✓	-	-	-	-	N
Night Parrot <i>Pezoporus occidentalis</i>	EN	CR	-	✓	PA	-	-	-	N