TURNER RIVER SOLAR HUB PROJECT

TARGETED BILBY SURVEY

PREPARED FOR: FORTESCUE

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EXECUTIVE SUMMARY

Pilbara Energy (Generation) Pty Ltd (PEG), a wholly owned subsidiary of Fortescue Ltd (Fortescue), is proposing to develop a renewable energy hub, the Turner River Solar Hub (TRSH) (the project), comprising of solar generation and a 220 kV transmission line connecting to Fortescue's existing power network in the Pilbara region of Western Australia (WA).

The TRSH is located approximately 25 kilometres (km) west of Iron Bridge and 120 km south of Port Hedland. This project now includes an area known as the North Star Junction West (NSJW) project (4,532.9 hectares [ha]). The project includes two development envelopes (DE) known as the TRSH northern and TRSH southern (Map 1.1). The TRSH southern DE was formally known as the North Star Junction West (NSJW) project (4,532.9 hectares [ha]).

Spectrum Ecology & Spatial (Spectrum) completed a two-phase detailed and targeted vertebrate fauna assessment of the NSJW project (TRSH southern DE) in 2023 (Spectrum, 2025b). In addition, Fortescue's annual Fauna Monitoring Program (2012-2024) includes some monitoring sites located within the Project area. During the above assessment, Spectrum confirmed the presence (individual captured and scats) of the Bilby (*Macrotis lagotis*), a significant species listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Vulnerable) and WA's *Biodiversity Conservation Act 2016* (BC Act, Vulnerable) at the NSJW project (TRSH southern DE).

Fortescue engaged Spectrum to undertake a targeted survey for the Bilby (*Macrotis lagotis*, EPBC Act and BC Act, Vulnerable) within and between the two TRSH DEs (the Survey Area).

The distribution of the Bilby was predicted using an occurrence-based (presence-background) species distribution model (SDM) approach. The SDM extent covered an area of 178,231 km^2, encompassing the entire Pilbara Interim Biogeographic Regionalisation for Australia (IBRA) region. Thirty-seven environmental variables were selected to represent the habitat preferences of the Bilby and predict potential occurrence within the SDM Study Area. The SDM results were expressed as two outputs; the median probability of occurrence as a percentage across the area of interest and the probability of occurrence categorised into three likelihood ranks: "Low", "Medium", and "High".

Targeted searches for the Bilby were completed that aligned with the 2-hectare plot technique as defined in the Bilby survey guidelines (DBCA, 2017). The searches included looking for Bilby evidence (tracks, scats, diggings, and burrows) in line with Southgate et al. (2019), for approximately 50 person minutes at each site. Overall, 62 plots targeting the Bilby were completed, equating to 65.8 person-hours of active searching and 130.4 km traversed within and surrounding the Survey Area.

The literature review identified 24 previous surveys and monitoring programs that have been undertaken in the desktop Study Area (50 km buffer around the Survey Area), with 17 located within 10 km. Of these 17, 12 overlap the Survey Area and eight completed targeted searches for the Bilby.

The Bilby was previously recorded in the Survey Area by Spectrum (2025b), with a female Bilby captured in a cage and multiple burrows, diggings, tracks and scats recorded. The DBCA Fauna Database returned 397 Bilby records within the Study Area, while Fortescue's Internal Database returned 364, which included 12 records from within the Survey Area. These records were from Fortescue's Annual Fauna Monitoring Program and two previous surveys. An additional nine records are located within 2 km of the Survey Area. Of the 17 regional surveys completed within 10 km of the Survey Area, 12 recorded the Bilby, which includes the three previously mentioned surveys and monitoring.

The final SDM model achieved a very high performance with an AUC of 0.941, which indicates the model was highly efficient at measuring presences and pseudo-absences. Amongst the 37 environmental variables tested, 12 variables were the most influential when explaining the distribution of Bilbies, with the type of land system and soil environmental variables contributing most to the model. The environmental variable with the highest gain when used in isolation is soils, which appears to be the most important variable for the species. A total of 6,948 97.4%) of the Survey Area was assigned a Medium or High probability rank.

Seven broad fauna habitat types were present at the Survey Area: Plain (sand), Plain (stony/gibber), Drainage Line/River/Creek (major), Drainage Line/River/Creek (minor), Granite Outcrops (boulder piles), Granite Outcrops (flat domes), and Hills/Ranges/Plateaux. Of these habitats, the most suitable for the Bilby is the Plain (sand) which comprises (87.9%) of the Survey Area, followed by two drainage lines (major and minor). These three are considered critical habitat for the Bilby as they contain suitable burrowing substrate and plant species, including *Acacia stellaticeps*, *A. bivenosa*, *A. colei* and *Senna notabilis*, whose root systems contain invertebrate larvae that the Bilby use as a food resource. The remaining habitats are considered supporting with the Plain (stony/gibber), likely used the most frequently for foraging and dispersal. The habitats present are not restricted to the Survey Area and continue across the surrounding Abydos Plain. As the Bilby is highly mobile and forages over vast areas, Bilbies may expand into other parts of the critical habitats mapped within the Survey Area.

Confirmed presence of Bilby was recorded from three sites: WDG_37, WDG_38 and MR GB AS41, with all three sites located near an area of known Bilby occurrence previously recorded by Spectrum (2025b). Site WDG_38 was separated from the main area of Bilby activity by a road and other infrastructure. All three sites are located within two of the critical habitats, Plain (sand) and Drainage Line/River/Creek (minor). Fresh diggings, scats and burrows were recorded, with site WDG_38 confirmed as the present location of the Bilby (at the time of the survey). The Bilby is likely crossing the road regularly to move between its burrows and foraging areas. Scat samples collected were sent for DNA analysis, which showed only one individual to be present, which is likely the female captured during the previous survey. Potential, unconfirmed evidence was recorded elsewhere, in the form of old and ambiguous diggings.

Based on the previous surveys and evidence, it's likely that Bilbies have been inhabiting the area surrounding these sites for some time. Additional Bilbies could be occupying areas adjacent to the Survey Area, which aligns with previous records located to the north of the Survey Area.

Forty non-target species were recorded during the survey, including three significant species:

- Brush-tailed Mulgara (*Dasycercus blythi*, DBCA Priority 4 [P4]), – likely burrows and diggings;
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*, DBCA P4) – potential tracks; and
- Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA P4) – one active mound.

1. INTRODUCTION

1.1. Project Background

Pilbara Energy (Generation) Pty Ltd (PEG), a wholly owned subsidiary of Fortescue Ltd (Fortescue), is proposing to develop a renewable energy hub, the Turner River Solar Hub (TRSH) (the project), comprising of solar generation and a 220 kV transmission line connecting to Fortescue's existing power network in the Pilbara region of Western Australia (WA).

The TRSH is located approximately 25 kilometres (km) west of Iron Bridge and 120 km south of Port Hedland. This project now includes an area known as the North Star Junction West (NSJW) project (4,532.9 hectares [ha]). The project includes two development envelopes (DE) known as the TRSH northern and TRSH southern (Map 1.1). The TRSH southern DE was formally known as the North Star Junction West (NSJW) project (4,532.9 hectares [ha]).

Spectrum Ecology & Spatial (Spectrum) completed a two-phase detailed and targeted vertebrate fauna assessment of the NSJW project (TRSH southern DE) in 2023 (Spectrum, 2025b). In addition, Spectrum completes Fortescue's annual Fauna Monitoring Program, with some monitoring sites located within the NSJW project area (Spectrum, 2019, 2020b, 2021, 2022, Spectrum, 2023, 2024, 2025a).

Spectrum recorded confirmed presence (individual captured and scats) of the Bilby (*Macrotis lagotis*), a significant species listed under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act, Vulnerable) and WA's *Biodiversity Conservation Act 2016* (BC Act, Vulnerable) at the NSJW project (TRSH southern DE) (Spectrum, 2025b).

1.2. Project Scope

Fortescue engaged Spectrum to undertake a targeted survey for the Bilby (*Macrotis lagotis*, EPBC Act and BC Act, Vulnerable) within and between the two TRSH DEs which covers 7,135.4 ha (herein referred to as the Survey Area, see Map 1.1).

The scope of work for this project included the following:

- Completion of Species Distribution Modelling (SDM) for the Bilby (*Macrotis lagotis;* EPBC Act & BC Act, Vulnerable) in the Pilbara Craton Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion; and
- Conducting a targeted significant fauna survey for the Bilby within the Survey Area (4,532.9 ha).

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

- Survey Area (Turner River Solar Hub; area to be surveyed as provided by Fortescue); and
- Study Area (desktop Study Area; Survey Area plus 50 km buffer).

1.3. Legislation & Guidelines

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

- BC Act, WA;
- EP Act, WA; and
- EPBC Act, Commonwealth.

The targeted Bilby 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) (EPA, 2020);
- Terrestrial Vertebrate Fauna Assessment Guidelines 100-GU-EN-0006 (Fortescue, 2014);
- Environmental Datasets – Data Governance 100-GU-EN-0020 (Fortescue, 2012);
- Geographic Information Systems and Raw Data Guidelines 100-GU-EN-0009 (Fortescue, 2011); and
- Environmental Document Standard Terminology 100-GU-EN-0002 (Fortescue, 2010).

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

- Survey guidelines for Australia's threatened mammals (Department of Sustainability Environment Water Population and Communities, 2011); and
- Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (Department of Biodiversity Conservation and Attractions, 2017).

1.3.1. Significant Fauna Definitions

Significant fauna 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.

The Bilby is considered to be a significant species as it has been identified as a Threatened species under both the EPBC Act and BC Act (Vulnerable).

550000
600000
650000
700000
750000
800000
7750000
7700000
7650000
7600000
7550000

Port Hedland

Millstream Chichester

Mungaroona Range

Fortescue Marshes

Karijini

570 m

571 m

Legend

- Survey Area
- Study Area (50 km Buffer)
- Turner River Solar Hub Southern Development Envelope
- Turner River Solar Hub Northern Development Envelope
- Directory of Important Wetlands - Fortescue Marsh
- Nature Reserve / National Park Boundary

N

0 10 20 30 km

Scale 1:805,000 @ A3

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

Spectrum

Author: EM

Date: 30-01-2025

Location of the Survey Area

Turner River Solar Hub Project

MAP 1.1

Prepared for Fortescue

2. EXISTING INFORMATION

2.1. 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 Survey Area is in the Pilbara Craton IBRA Bioregion (Figure 2.1). 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 subregions: the Chichester, Fortescue Plains, Hamersley and Roebourne. The Survey Area is located in the central Pilbara within the Chichester subregion (Figure 2.1). 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).

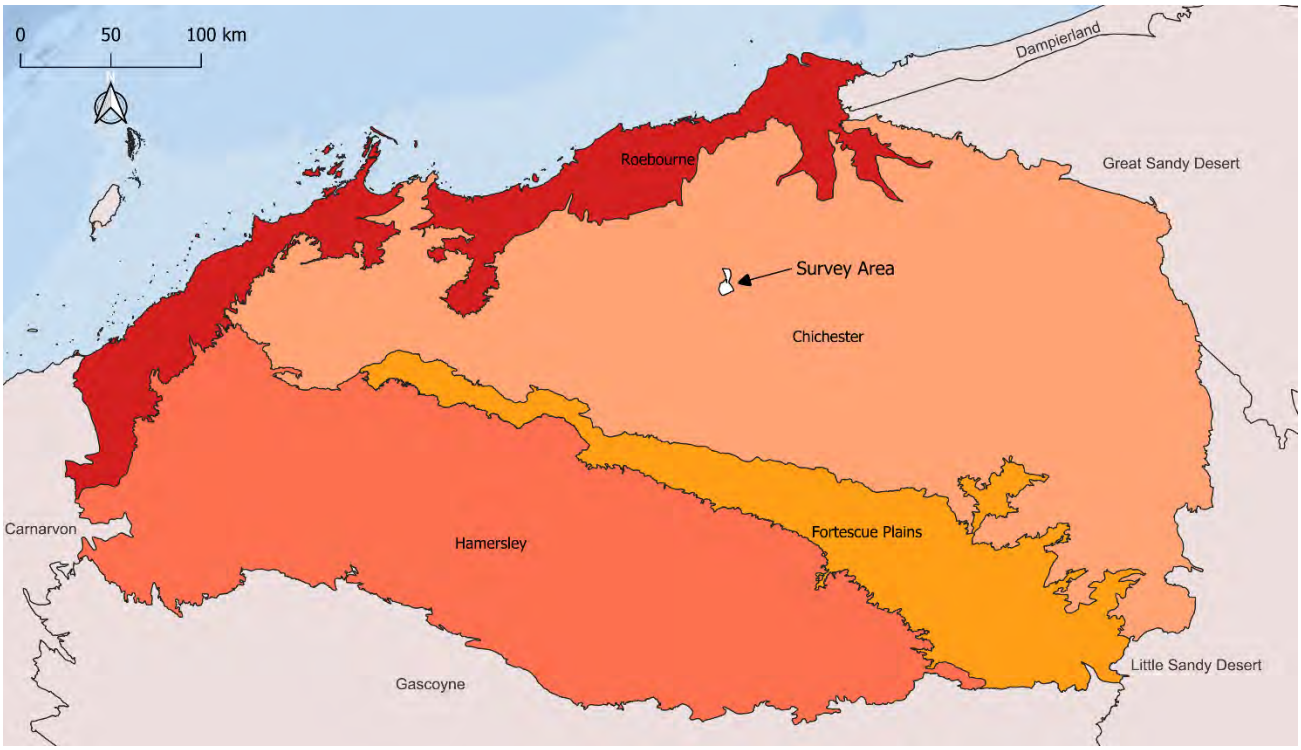


Figure 2.1: IBRA Classification

2.2. 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 Survey 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 ≥18°C.

2.3. Disturbance History

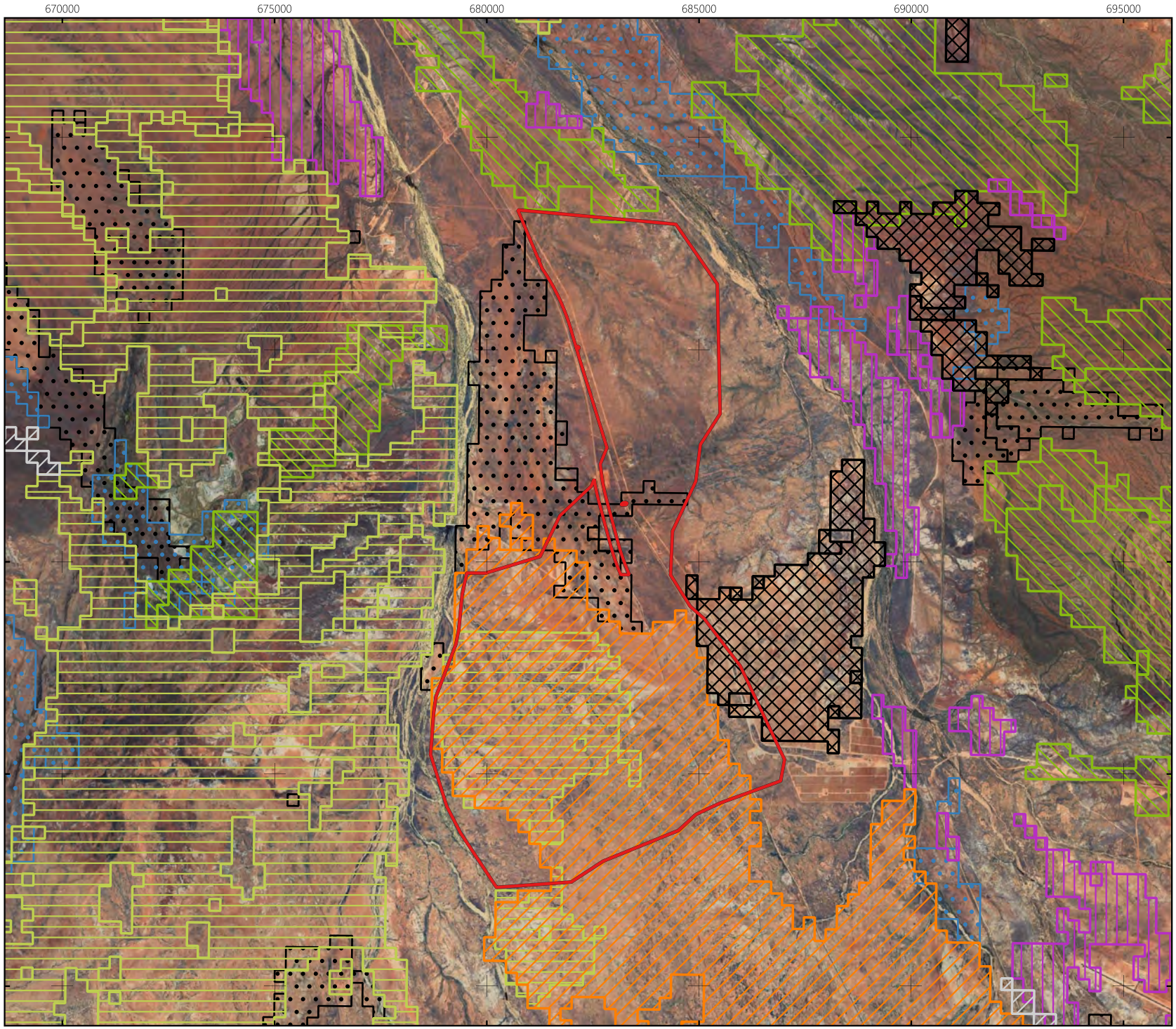
The dominant current and historical land uses across the Pilbara region involves grazing of native pasture, conservation, crown reserves, mining leases, and Aboriginal lands and reserves. Historically, pastoralism has been the most significant land use within the Pilbara. Since the 1960's mining, predominantly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

2.4. Fire History

The fire history of the Survey Area for the eight years (2018 to August 2024) prior to the assessment was assessed using North Australia and Rangelands Fire Information (NAFI) (Charles Darwin University, 2023). Five fires have impacted the Survey Area during this period and are detailed in Table 2.1 and shown on Map 2.1. The highest impact from fire was recorded in 2022, with over half (51.5% or 3,675.4 ha) of the Survey Area burnt, followed by 2021 fires, with 22.8% (1,627.9 ha) burnt, which also included the same area as the 2022 fire. The recent fire in 2024 impacted 7.5 ha or 0.1% of the south-eastern portion of the Survey Area, which was not burnt during the 2021 or 2022 fires. NAFI utilises satellite imagery to map fire scars with an accuracy ranging from 85% to 90%. Therefore, the fire data presented in Table 2.1 and Map 2.1, might be subject to some degree of variation.

Table 2.1: Previous Fires Impacting the Survey Area

Fire Year	Extent within Survey Area (ha)	% of Survey Area
2024	157.7	2.2%
2022	3,675.4	51.5%
2021	1,627.9	22.8%
2019	7.5	0.1%
2017	432.3	6.1%



Legend

- Survey Area

NAFI Fire History

- 2017
- 2018
- 2019
- 2020
- 2021
- 2022
- 2023
- 2024 to 19 Aug

N

0 1 2 3 4 5 km

Scale 1:125,000 @ A4

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

Spectrum

Author: EM

Date: 30-01-2025

Fire History

Turner River Solar Hub Project

MAP 2.1

Prepared for Fortescue

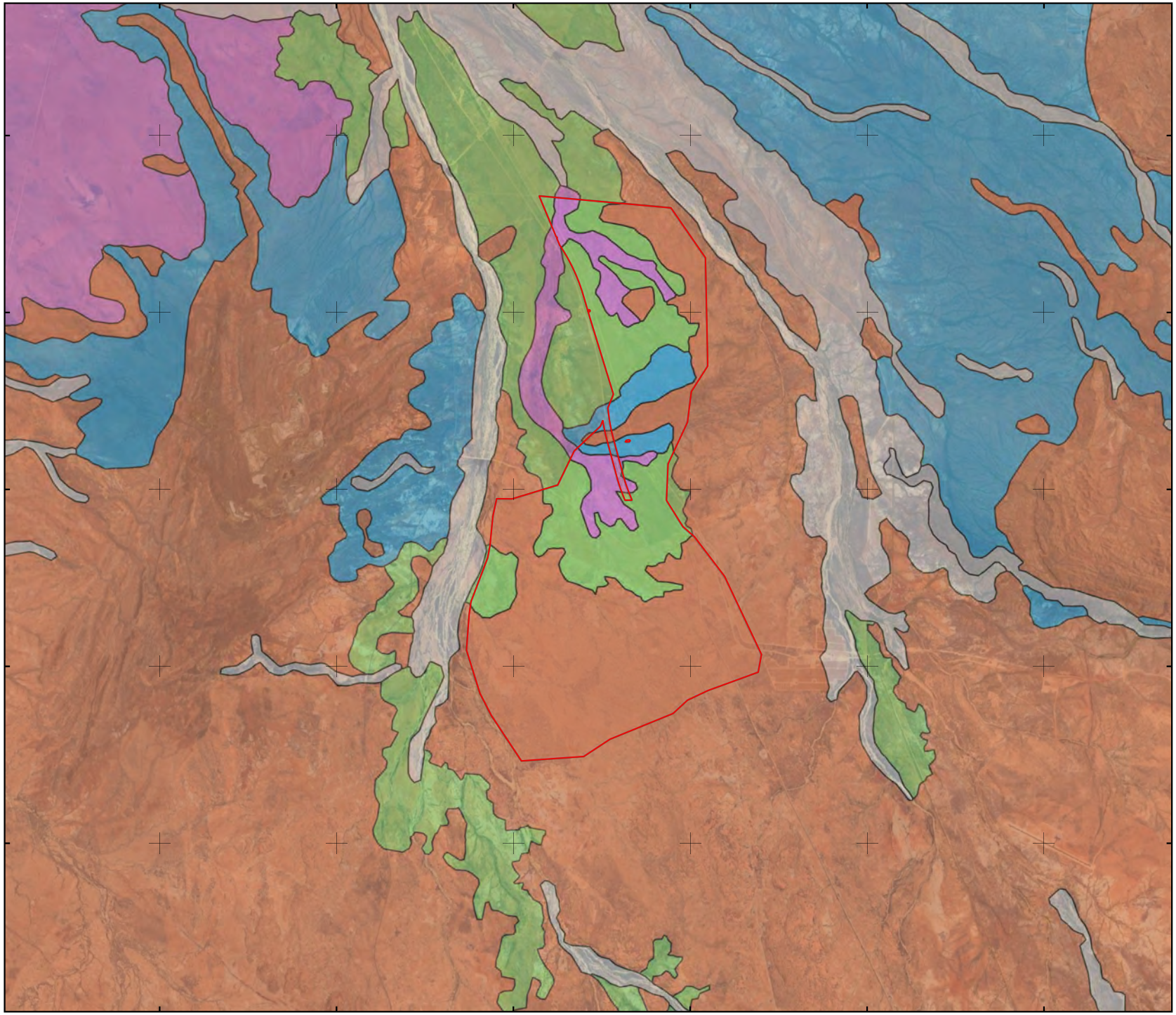
2.5. Geology

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 four units, as listed in Table 2.2 and mapped on Map 2.2. Two units cover most of the Survey Area (86.8%), with X-PIP accounting for 59.1% and R-PIP representing 27.7%. All units are well represented elsewhere in WA, except R-PIP of which 84% occurs in the Pilbara IBRA region.

Table 2.2: 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	4,217.0	59.1	14,351,074	8,412,613	0.05
R-PIP	Residual or relict unit, PIP	Residual or relict unit; undivided	1,973.1	27.7	355,640	298,866	0.66
W-PIP	Sheetwash unit, PIP	Clay, silt and sand in distal sheetwash fan and slope deposits; local ferruginous pisoliths and gravel	562.8	7.9	3,809,878	1,200,066	0.05
C-PIP	Colluvial unit, PIP	Colluvium derived from different rock types; includes gravel, sand, silt and clay	382.5	5.4	2,737,565	1,218,680	0.03
		Total	7,135.4	100			



Legend

Survey Area

Geological Unit Code

- X-PIP
- R-PIP
- W-PIP
- C-PIP
- Unit Not in Survey Area

N

0 1 2 3 4 km

Scale 1:150,000 @ A4

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

Spectrum Geology + Spatial

Author: EM

Date: 30-01-2025

Surface Geology (1:500,000)

Turner River Solar Hub Project

MAP 2.2

Prepared for Fortescue

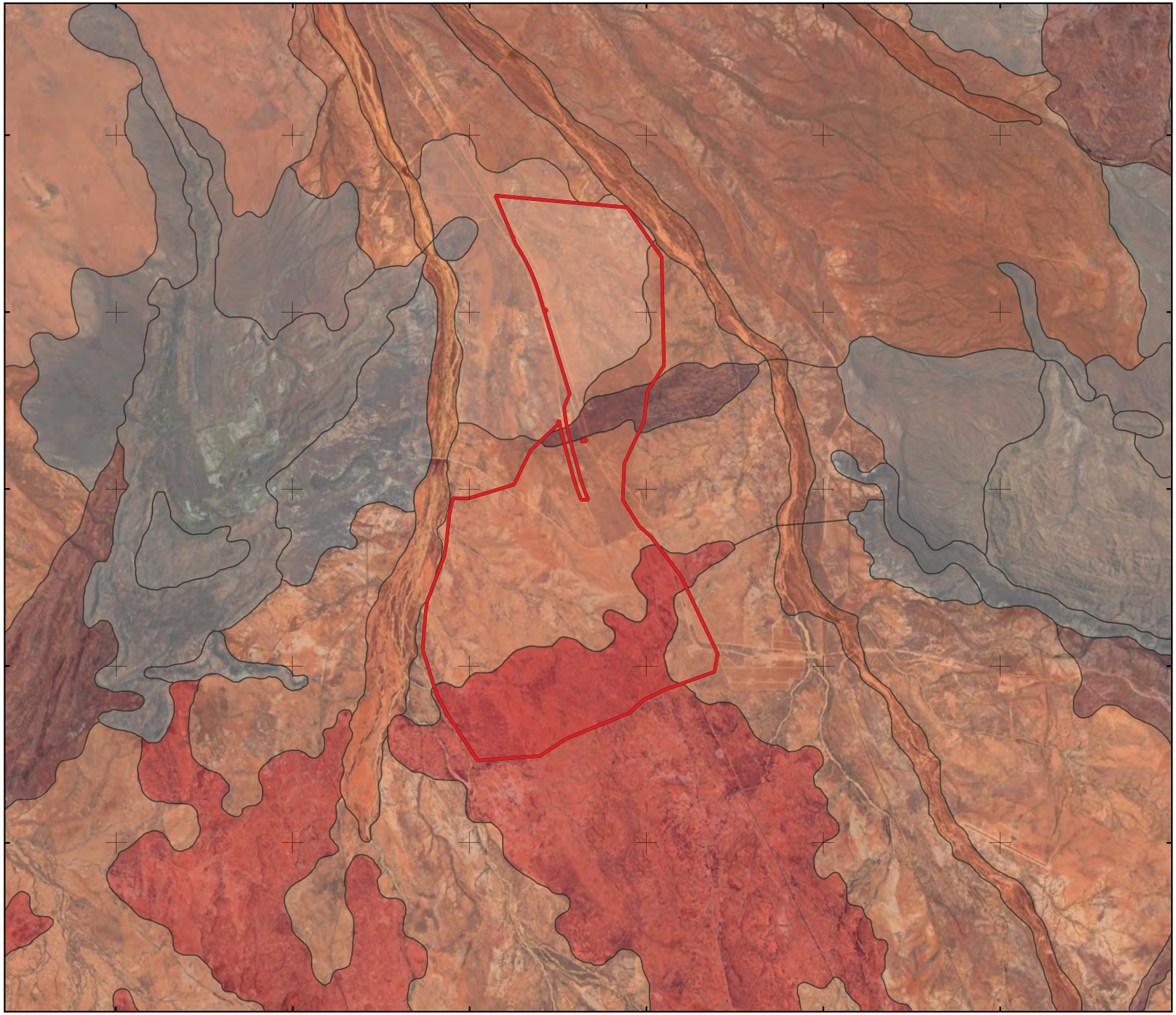
2.6. Land Systems

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

A total of five land systems were mapped across the Survey Area, three of which are dominant and account for 96.8%: Macroy (49.9%), Boolaloo (25.0%) and Uaroo (21.9%). The dominant land systems encompass stony and sandy plains, granite hills and spinifex grasslands. The two remaining land systems, Talga and River, encompasses 3.2% and less than 0.01% of the Survey Area, respectively. All land systems are well represented in the region with the Survey Area covering less than 1% of the land systems extent in the Pilbara (Table 1.3; Map 2.3).

Table 2.3: Land Systems

Description	Area in Survey Area (ha)	% of Survey Area	Total WA Extent (ha)	% of Total Extent within Survey Area	Total Pilbara Extent (ha)	% of Pilbara Extent Within Survey Area
Boolaloo Land System: Granite hills, domes, tor fields and sandy plains supporting spinifex grasslands with scattered shrubs.	1,783.5	25.0	247,383	0.7	238,382	0.8
Macroy Land System: Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	3,558.6	49.9	1,332,648	0.3	1,330,647	0.3
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	595,308	<0.01	481,994	<0.1
Talga Land System: Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	229.4	3.2	212,465	0.1	202,285	0.1
Uaroo Land System: Broad sandy plains, pebbly plains and drainage tracts supporting hard and soft spinifex hummock grasslands with scattered acacia shrubs.	1,562.6	21.9	1,381,842	0.1	987,003	0.2
Total	7,135.4	100				



Legend

Survey Area

Land Systems

- Boolaloo Land System
- Macroy Land System
- River Land System
- Talga Land System
- Uaroo Land System
- Land System not in Survey Area

N

0 1 2 3 4 km

Scale 1:150,000 @ A4

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

Spectrum

Author: EM

Date: 30-01-2025

Land Systems

Turner River Solar Hub Project

MAP

Prepared for
Fortescue

2.3

2.7. 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, 2019).

The Survey Area is located within the Abydos Plain, with two vegetation sub-associations (SAs) mapped, SA93.4 and SA626.1 (Table 2.4, Map 2.4). Sub-association 93.4 is dominant and accounts for 94.9% of the Survey Area. Over 99% of the pre-European vegetation extent remains for both SAs.

Table 2.4: Beard Vegetation Sub Associations

SA	Flora 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	Hummock grassland with scattered shrubs or mallee *Triodia* spp. *Acacia* spp., *Grevillea* spp. *Eucalyptus* spp.	6,767.7	94.9	2,481,889	2,478,504	2,480,782	99.9	0.3	0.3
626.1	Hummock grassland with sparse shrubs *Triodia* spp. *Acacia* spp.	367.7	5.2	117,724	117,198	117,724	99.6	0.3	0.3

Legend

Survey Area

Beard Vegetation Sub-Associations

93.4

626.1

Sub-Association not in Survey Area

N

0 1 2 3 4 km

Scale 1:150,000 @ A4

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

Spectrum

Author: EM

Date: 30-01-2025

Beard Vegetation Sub-Associations

Turner River Solar Hub Project

MAP 2.4

Prepared for Fortescue

2.8. Significant Species Information

2.8.1. Bilby, *Macrotis lagotis*

Conservation Status: EPBC Act & BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Bilby is a medium-sized marsupial that formerly inhabited the arid and semi-arid zones of 70% of Australia (Department of Environment and Conservation [DEC], 2012). The distribution of this species has contracted to less than 20% of their former range, and the distribution is thought to have further decreased to the north, due to threatening processes (DCCEEW, 2023). The remaining populations occur in the Northern Territory, some isolated areas in south-west Queensland and within central and northern WA (DEC, 2012; Dziminski et al., 2020; Northover et al., 2023).

Within WA, the Bilby populations are limited to the Pilbara, Kimberley and the central desert and rangelands regions. The current Bilby distribution within the Pilbara region encompasses the eastern portion or around 48%. The western boundary of this distribution extends south-east from around 50 km west of Port Hedland to approximately 350 km past Newman (Dziminski, Carpenter and Morris, 2020). However, there are historic or unreliable records in areas to the west and south-west of their current distribution in the Pilbara (Dziminski, Carpenter and Morris, 2020).

The Bilby inhabits a variety of substrate and vegetation types in northern WA from sand plains with low *Acacia* spp. over hummock grasses to Mulga shrubland on loamy-clay soils, and can broadly fit into three landscape types as per the Cramer et al. (2017) conceptual model (Cramer *et al.*, 2017; Northover *et al.*, 2023) which is detailed in Table 2.5.

Table 2.5: Suitable Habitat Characteristics of the Bilby in the North of WA

Landform	Substrate	Vegetation
Fluvial, includes a variety of drainage lines: • creek lines including upland systems • broad paleodrainage, low-lying and perched systems • calcrete	• sandy to sandy loam soils • alluvial and calcrete • salt channels and lakes	• Low shrubs of *Acacia* spp. and *Melaleuca* spp. over *Cyperus bulbosus. and* hummock grasslands usually with *Triodia basedowii, T. pungens and T. schinzii*
Residual, includes: • Laterite • Silcrete • Stony rises • Uplands • Breakaways • Plateaus • Granitic hills	• sandy to sandy loam soils • red earths usually with lateritic, small gravel, stony matrix	• Low shrubs of *Acacia* spp., including Mulga shrubland (*A. aneura*), over hummock and tussock grasslands
Sand plain and sand dune, includes: • Flat to gently undulating plains • Dune fields • Isolated dunes	• Soil texture ranges from coarse sand to light medium clay • Non-calcareous gradational soils • Duplex soils – red sand, loamy sand plains and dune fields	• Low woodland (<10 m) of *Eucalyptus* and *Acacia* spp. over shrub-steppe communities over *Triodia* hummock grasslands, occasionally with rich understorey; or • Pindan woodland over hummock and tussock grassland (Kimberley)

Where rainfall is higher in northern WA, the Bilby tends to occupy all three landforms, while in the south of WA, they are more restricted to fluvial and residual landforms (Cramer *et al.*, 2017). It is uncertain why the residual landforms are so important, as the substrate tends to be harder and includes less inundated run-

off areas. They also include shrub species such as *Acacia hilliana* that support root-dwelling larvae that the Bilby use for food, so it appears these areas are more suitable for foraging (Cramer *et al.*, 2017). Additionally, it appears that fire may influence the type and availability of food resources and may assist in improving habitat favourability in parts of their range (Cramer *et al.*, 2017; Northover *et al.*, 2023).

Within the Pilbara, some preliminary distribution modelling undertaken by Dziminski and Carpenter (2017) showed that the habitat variables of soil type, depth and elevation are the major variables predicting preferred Bilby habitat. Observations have also shown that in addition to the species requiring a substrate that is suitable for burrowing, such as sand, sandy clay or sandy gravel, the Bilby also has an association with certain stands of *Acacia* species (and other plants) that provide a key food resource as they host root-dwelling larvae (Cramer *et al.*, 2017; Northover *et al.*, 2023). In particular, the Cossidae (moth) larvae appears to be a major food resource for the Bilby (Dziminski and Carpenter, 2017; Southgate *et al.*, 2019). Within the Pilbara, these plant species include:

- *Acacia bivenosa;*
- *A. colei;*
- *A. dictyophleba;*
- *A. hilliana*^
- *A. melleodora;*
- *A. rhodophloia*^
- *A. stellaticeps;*
- *A. trachycarpa* including dwarf variant; and
- *Senna notabilis*.

Note: ^- species occurs in the Pilbara, but observations of Bilby diggings for root dwelling larvae only in Tanami Desert (NT), Central Desert or Gibson Desert IBRA regions (Southgate *et al.*, 2019).

The larvae are extracted from the root systems by the Bilby which is the only known species in the arid and semi-arid areas of Australia that opens the root system in this specific way (Southgate *et al.*, 2019).

The Bilby also consumes a variety of invertebrates such as spiders, beetles, and termites, along with plant materials such as seeds and bulbs. The majority of the food resources for the Bilby are either acquired from the soil surface or by digging (Southgate *et al.*, 2019).

The Bilby is a nocturnal species that shelters during the day in an extensive burrow system of up to 4.5 m in length and 2 m deep, which could spiral down, have side branches, or blocked tunnel entrances (freshly dug soil). Most burrows have a single entrance; however, some can have multiple entrances like rabbit warrens. A single individual may use up to 18 burrows (Moseby et al., 2003; DEC, 2012).

Bilbies are exceedingly mobile and can cover vast distances while foraging (DCCEEW, 2023). The size of the Bilby's home range is estimated to be between 0.18 km^2 and 3.16 km^2 (from Arid Recovery in SA) and is dependent on the location and availability of foraging habitat supporting insects, fungi and vegetation (Pavey, 2006; DCCEEW, 2023). However, their home range in many areas is still not well understood (DCCEEW, 2023). Sudden shifts in spatial distribution can occur, particularly in sandy deserts, in response to changing food availability. Females can display long-term site fidelity whereas males display a roaming behaviour allowing them to mate with multiple females (Pavey, 2006).

Threats:

Some of the key threats to the Bilby include the following (DCCEEW, 2023):

- Predation by Feral Cats, Foxes and Dingoes (Dogs).
- Habitat loss, degradation and fragmentation due to factors such as land clearing, agriculture, mining and infrastructure developments.
- Competition for resources and degradation of habitat from introduced herbivores and domestic livestock.
- Unmanaged fire and unsuitable fire regimes which impact habitat suitability.
- Loss of traditional owner ecological knowledge and land management practices.
- Extinction risks elevated from reduced genetic fitness and population resilience.

Additionally, many of these threats can have significant interactions, such as unmanaged fire and livestock grazing reducing the density of vegetation, facilitating easier capture of prey by predators (DCCEEW, 2023).

3. METHODS

3.1. Desktop Survey

A desktop review of relevant and available biological data sources of the Study Area, specifically for the Bilby, was undertaken prior to the field survey. The Study Area includes a buffer of approximately 50 km surrounding the Survey Area (Map 1.1), or as listed in Table 3.1.

3.1.1. Biological Database Searches

The following databases outlined in Table 3.1 were searched and incorporated into the desktop assessment.

Table 3.1: 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: 03/07/2024	40 km

3.1.2. Literature Review

Previously conducted surveys within the desktop Study Area were reviewed for the presence of Bilbies and the previous survey effort undertaken for this species to understand what areas were searched and the species' likelihood of occurrence, including if confirmed or potential evidence was recorded.

Reports were incorporated if they were provided by Fortescue, publicly available, or within Spectrum's database. The 29 survey reports plus the Fortescue's ongoing Fauna Monitoring Program that were incorporated into the desktop assessment, are listed in Table 2.2. Surveys within 10 km of the Survey Area provided local context, while the remaining reports provided regional context.

Table 3.2: Previously Conducted Biological Assessments

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
NSJW Detailed Vertebrate Fauna (Spectrum, 2025b)	Detailed and targeted – vertebrate fauna	May & September/October 2023	Within Survey Area
Fortescue Fauna Monitoring – 2013-2024 (ecologia, 2014, 2015a, 2015b; Ecoscape, 2017, 2018; Spectrum, 2019, 2020b, 2021, 2022, 2023, 2024, 2025a)	Significant fauna monitoring - Annual	2013-2024	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 (Australia), 2020a)	Targeted – vertebrate fauna	September 2019	Partially in Survey Area
Pilbara Transmission Project Terrestrial Fauna Desktop (Spectrum Ecology, 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 & 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
Conservation Significant Vertebrate Fauna Species Habitat Assessment: Roy Hill Rail (TE, 2011)	Basic & targeted – vertebrate fauna	January – February 2011	Partially in Survey Area
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	Targeted – vertebrate fauna	November 2010	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 Environmental (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	1.9 km E
North Star Filtration Plan Relocation Flora & Fauna (ecologia, 2014c)	Basic – vertebrate fauna	August 2014	1.5 km W
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	Basic & targeted – vertebrate fauna	July 2018	3.6 km NW
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	Basic – vertebrate fauna	August 2015	5.3 km W
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	5.5 km W

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Wodgina Gas Pipeline Targeted Fauna (360, 2018b)	Targeted – vertebrate fauna & SRE	June 2018	6.1 km W
P1000 Pilgangoora Project Flora & Fauna (APM, 2024)	Targeted – vertebrate fauna	September-October 2023	9.1 km N
Wodgina Aerodrome Targeted Fauna (360, 2018a)	Targeted – vertebrate fauna	June 2018	11.6 km NW
Pilgangoora Baseline Vertebrate Fauna (360, 2016)	Detailed – vertebrate fauna (single phase only)	March 2016	13 km NE
E45/2287 Infill Pilgangoora Project Flora & Fauna (Animal Plant Mineral (APM), 2023)	Targeted – vertebrate fauna	March 2023	15.5 km NE
Glacier Valley Terrestrial Vertebrate Fauna (Spectrum, 2021b)	Detailed – vertebrate fauna	May – October 2020	20.9 km E
Hemi Gold Detailed Vertebrate Fauna (Western Wildlife, 2023)	Detailed and targeted – vertebrate fauna & basic of transport corridors	September 2021, March & August 2022	28.1 km NW
Abydos DSO Project: Terrestrial Vertebrate Fauna Baseline Survey (Outback, 2011a)	Detailed – vertebrate fauna	May & September 2010	34.9 km E
Mt Dove DSO Project: Vertebrate Fauna (Outback, 2011b)	Detailed – vertebrate fauna	May & September 2010	32.8 km NW
Panorama Project Area: Baseline Fauna (Bamford, 2001)	Detailed – vertebrate fauna	June & September 2001	36 km E

3.1.3. Species Distribution Modelling

Species distribute in space and time according to their dispersal capabilities, ecophysiology needs, and the interaction with other species (Guisan, Thuiller and Zimmermann, 2017). Species distribution modelling looks to predict the locations of a species, associating known records (presences) to a set of environmental predictor variables that might help to describe any abiotic and biotic interactions. The relationship between known presences and environmental predictors are statistically compared using a wide range of mathematical techniques (Zurell *et al.*, 2020) Some mathematical models require presence and known absence locations, whereas others require presence and randomly generated background points. Some models may also only require presence data, in order to expand the opportunities to model understudied or rare species. Amongst the presence background mathematical models available, maximum entropy algorithms using MaxEnt is one of the most popular methods amongst the peer-reviewed literature (Elith *et al.*, 2011).

The distribution of the Bilby was predicted using an occurrence based (presence-background) SDM approach. The SDM extent covered an area of 178,231 km^2 or 17,823,126 ha, encompassing the entire Pilbara IBRA region.

3.1.3.1. Species Data & Environmental Variables

Species distribution modelling predicts species' probable locations from known "presences" and randomly generated "pseudo-absences", which are locations where the species is not present. Existing species locations sourced from the DBCA Threatened Fauna Database results were checked for accuracy and validity and used as occurrence records to train the model. Species records that were located within 20 m of each other were removed to address possible data duplication and model bias. To account for sampling bias and

spatial autocorrelation, sampling intensity across the SDM Study Area was represented as a separate variable. To achieve this, a bias layer was constructed from occurrence points of all species using a two-dimensional Kernel Density estimate in ArcGIS (Phillips and Dudík, 2008; Fourcade *et al.*, 2014).

Thirty-seven environmental variables were selected to represent the habitat preferences of the Bilby and predict potential occurrence within the SDM Study Area (Table 3.3). These variables were selected to meet ecophysiological requirements of the species related to the abiotic landscape and soil characteristics, geology, and climate preferences. Commonwealth Scientific and Industrial Research Organisation's (CSIRO's) soil and landscape grids were chosen focusing on slope, ridges and valleys, soil composition, and a Digital Elevation Model (DEM) obtained from the United States Geological Survey (USGS) Earth Explorer service was used (Grundy *et al.*, 2015; O'Brien and Searie, 2021).

Two vegetation indices were calculated from Landsat 8 level 2 satellite imagery (https://earthexplorer.usgs.gov/). The Normalised Vegetation Index (NDVI) and the Normalised Difference Wetness Index (NDWI) represent the greenness and moisture in vegetation (Qi *et al.*, 1994; Gao, 1996; Xue and Su, 2017). A set of categorical variables were used to represent the SDM Study Areas' environment: Soil Landscape Systems (Department of Primary Industries and Regional Development, 2022), Vegetation Units of Western Australia (Western Australian Government, 2020), and identified Soil types (Northcote *et al.*, 1968). All environmental datasets were set at the same resolution provided by CSIRO's soil and landscape grids at 88 m pixels (Table 3.3). To avoid multicollinearity and ensure the selection of only the most representative variables, a correlation test was undertaken. Environmental variables were assessed against each other for the SDM Study Area. Variables with correlation higher than 0.7 were excluded when performing the SDM (Dormann *et al.*, 2013).

Table 3.3: Environmental Predictor Variables

Environmental Variable	Description	Type	Source
Landscape Attributes			
Slope (%)^	Slope measures the inclination of the land surface from the horizontal.	Numeric	CSIRO
Slope (%) Median 300 m^	The median slope within a 300 m radius representing the typical slope in the local landscape.	Numeric	
Slope Relief Class^	Soil relief landform pattern classification based on Speight (2009).	Categorical	
Aspect^	The direction in which a land surface slope face is expressed in degrees from north.	Numeric	
Depth of Regolith	Metres of in situ and transported material overlying unweathered bedrock.	Numeric	
Topographic Wetness Index^	TWI estimates the relative wetness within moist catchments but is more commonly used as a measure of position on the slope with larger values indicating a lower slope position.	Categorical	
Topographic Position Index^	Topographic classification identifying upper, middle and lower parts on the slope with larger values indicating a lower slope position.	Numeric	
MrVBF	MrVBF is a topographic index designed to identify areas of deposited material at a range of scales based on the observations that valley bottoms are low and flat relative to their surroundings and that large valley bottoms are flatter than smaller ones.	Categorical	
Roughness^	Measure of the deviation of surface from its ideal form.	Numeric	
Relief^	The difference between a locations highest and lowest elevations.	Numeric	

Environmental Variable	Description	Type	Source
Relief 1000 m Radius^	The elevation range measures the full range of elevation within a 1000 m circular radius and can be used as a representation of local relief.	Numeric	
Relief 300 m Radius	The elevation range measures the full range of elevations within a 300 m circular radius and can be used as a representation of local relief.	Numeric	
Plan Curvature^	Contour is the rate of change of aspect (across the slope and represents topographic convergence or divergence).	Numeric	
Profile Curvature^	The rate of change of potential gradient down a flow line and represents the changes in flow velocity down a slope.	Numeric	
Digital Elevation Model (DEM) ^	Height above sea level.	Numeric	USGS
Soil Attributes			
Soils	National description of Australian soil types.	Categorical	CSIRO
Depth to Soil	Depth of soil profile (A & B horizons) in metres.	Numeric	
Bulk Density^	Bulk Density of the soil (g/cm3) at a depth of 0 – 5 cm.	Numeric	
pH^	pH in Calcium Chloride of the soil within the 0 – 5 cm depth layer.	Numeric	
Soil Available Water Capacity^	Computed plant-available water capacity of the soil at a depth of 0-5 m.	Numeric	
Soil Sand (%)	Percentage of sand content of the soil at a depth of 0-5 cm.	Numeric	
Soil Silt (%)^	Percentage of silt content of the soil at a depth of 0-5 cm.	Numeric	
Soil Clay (%)^	Percentage of clay content of the soil at a depth of 0-5 cm.	Numeric	
Soil Organic Carbon^	Mass fraction of carbon by weight in the < 2 mm soil material as determined by dry combustion at 900 Celsius.	Numeric	
Soil Total Phosphorus	Percentage of phosphorus content of the soil at a depth of 0-5 cm.	Numeric	
Soil Total Nitrogen^	Mass fraction of total nitrogen in the soil by weight.	Numeric	
Effective Cation Exchange Capacity^	Cations extracted using barium chloride ($BaCl_2$) plus exchangeable H + Al.	Numeric	
Geology, Land systems, & Water Courses			
Geology 1M	Seamless national coverage of outcrop and surficial geology.	Categorical	Geoscience Australia
Land Systems	Soil-landscape mapping at the systems level.	Categorical	
Lakes & Flats^	Euclidean distance from lakes and flats (swamps, saline coastal flats, and land subject to inundation).	Numeric	Calculated by Spectrum
Minor Watercourse	Euclidean distance from minor watercourse.	Numeric	
Major Watercourse^	Euclidean distance from major watercourse.	Numeric	
Vegetation			
Beard Vegetation	Pre-European vegetation maps original natural vegetation assumed to have existed prior to European settlement in Western Australia.	Categorical	DPIRD
Vegetation Indices			
NDVI^	Normalised Difference Vegetation Index (June 2021) from Landsat 8 Imagery.	Numeric	Calculated by Spectrum
NDWI^	Normalised Difference Water Index (June 2021) from Landsat 8 Imagery.	Numeric	

Environmental Variable	Description	Type	Source
Bioclimatic			
Bioclim1^	Annual Mean Temperature.	Numeric	Hijmans 2005
Bioclim12	Annual Precipitation.	Numeric	

^ Excluded from SDM due to correlation with other layers or based on MaxEnt model importance.

3.1.3.2. Maximum Entropy Model Parameterization & Validation

The SDM was generated using the software package MaxEnt v.3.4.3 (Phillips, Anderson and Schapire, 2006). MaxEnt models species' distributions to predict the probability of species occurrence based on a set of environmental variables in conjunction with known occurrence records and pseudo-absences (Phillips, Dudík and Schapire, 2004). Model settings and input parameters were optimised over three to five unique models. Key settings include 10,000 background points, 10 iterations, and a subsample replicate run type where presences were randomly partitioned into testing (80%) and training (20%) datasets to validate the model independently.

The predictive performance of models was tested by the area under the receiver operating curve (AUC) to the independent testing dataset (Hao *et al.*, 2019; Zurell *et al.*, 2020). AUC is considered as the probability that a presence location has a higher occurrence value than an absence location. Models with AUC values above 0.75 were considered of high performance. Environmental predictor variables were selected or extracted from the models according to the percent contribution and the permutation importance until the best performing model was found. A high permutation importance indicates that an environmental variable contains information that is not present in other variables.

3.1.3.3. Model Outputs

The SDM results were expressed as two outputs that display the probability of occurrence within the SDM Study Area. The first output represents the median probability of occurrence as a percentage across the area of interest as predicted by the SDM. The second output converts the probability of occurrence into three likelihood ranks: Low, Medium, and High. These ranks were defined using a data driven approach where the threshold of each represents the 95% (Medium) and 50% (High) occurrence of known presence records over the median predicted model output.

3.2. Survey Methods

3.2.1. Survey Timing & Weather

The targeted survey was completed from 4 to 9 August 2024, immediately following considerable rainfall, as outlined in Table 3.4. Additional survey sites located within the Survey Area were completed between 31 July to 1 August 2024 as part of Fortescue's Fauna Monitoring Program. Bilbies can be surveyed at any time of the year using non-invasive techniques (DBCA, 2017).

Table 3.4: Rainfall Recorded During the Survey

Month	July 2024		August 2024								
Day	30	31	01	02	03	04	05	06	07	08	09
Rainfall (mm)	0	0	0.2	10.1	15.3	1.4	0.1	0	0	0	0

Source: SILO Data (-21.2 E 118.75N)

Rainfall data was extracted from the Scientific Information for Land Owners (SILO) database (Queensland Government, 2024) for the centre of the Wodgina Targeted Bilby Assessment Study Area (-21.2066, 118.7585). SILO sources climatic data from the Bureau of Meteorology (BOM) and interpolates data between weather stations to provide a complete data set for any location. Figure 3.1 represents the total monthly rainfall for 2023 to 2024, and it also shows the monthly long-term median rainfall and median temperature. The BOM reference climate normal period of January 1961 to December 1990 was used for calculating climate statistics and evaluating rainfall conditions recorded prior to the survey (BOM, 2024a). Rainfall conditions were considered 'typical' if the total rainfall recorded over a period was between the 25th and 75th percentiles, for annual rainfall this range was 206.8 mm to 418.2 mm. Rainfall totals outside of the typical range were considered 'dry' or 'wet', and 'very dry' or 'very wet' if they were below the 10th or above the 90th percentiles, respectively (2024b). The following data was recorded:

- In the year preceding the Targeted survey, 174 mm of rainfall was recorded at the site, 154.6 mm lower than the median of the long term total annual rainfall (328.6 mm) for the same period.
- A total of 51.6 mm of rainfall was recorded in the three months prior to the survey (4 May to 4 August 2024), 24.3 mm higher than the median of the long term total rainfall (27.3 mm) for the same period.
- The rainfall conditions were typical for the three months preceding the Targeted survey and dry compared to the annual conditions of the climate reference period.

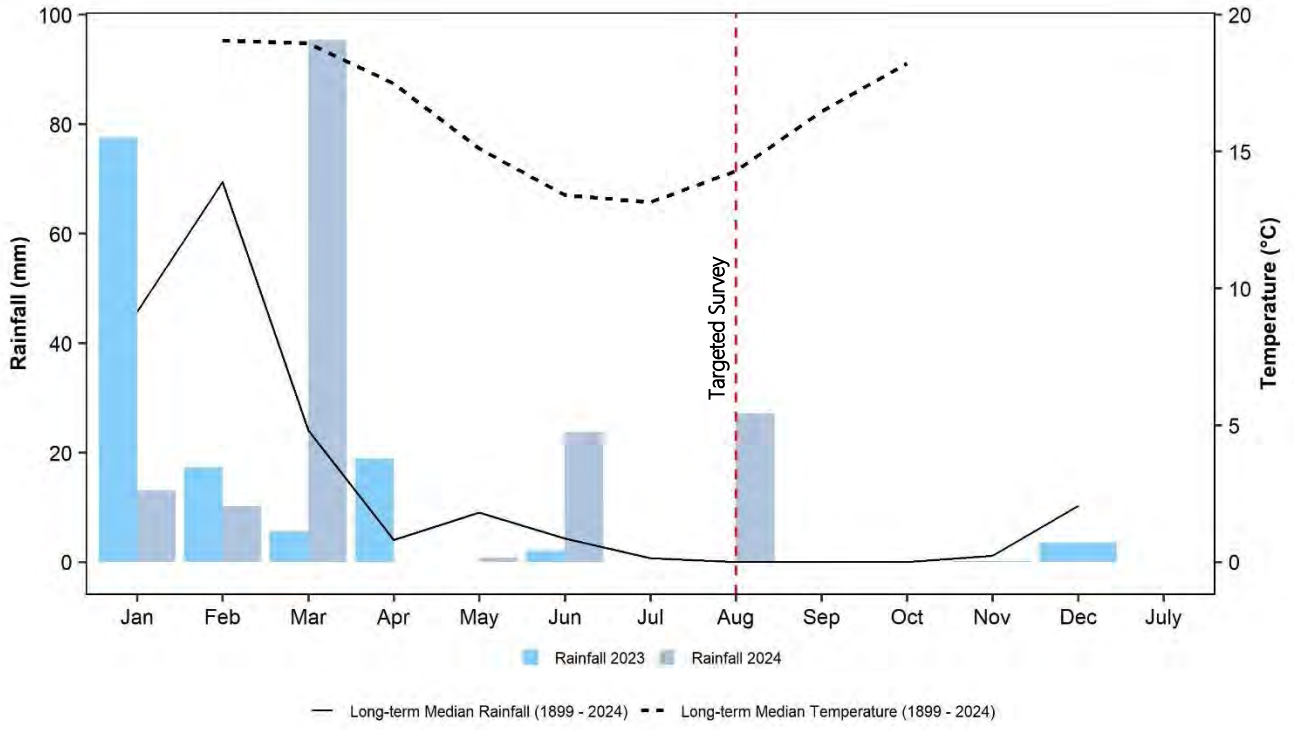


Figure 3.1: Rainfall Data at SILO Request Location (-21.2066, 118.7585).

This figure represents the total monthly rainfall (mm), median monthly rainfall (mm), and median temperature (°C).

3.2.2. Survey Personnel

The field personnel details are presented in Table 3.5.

Table 3.5: Project Staff

Name	Position	Qualification	Years Consulting Experience	Tasks
Astrid Heidrich	Principal Zoologist	MSc.	16	Report review
Christopher Parker	Principal Ecologist	MSc.	15	Species Distribution Modelling
Erica MacIntyre	Senior Zoologist	BSc.	10	Project management, field survey, data analysis, report writing
Joel Wilson	Senior Zoologist	MSc (Res.)	4	Field survey, data analysis

3.2.3. Survey Techniques & Sites

Previous assessments in the Survey Area and surrounds, were reviewed as outlined in section 3.1.2. Areas that contained potential evidence during Spectrum's (2024b) survey were revisited (where possible), to see if further evidence was present. The SDM output was also used to assist in the site selection process.

Targeted searches were completed that aligned with the 2-hectare (ha) plot technique as defined in the Bilby survey guidelines (DBCA, 2017). The 2-ha plots were spaced at approximately 1 km (where possible) over the Survey Area to ensure coverage, and some sites were moved to align with the "High" SDM output. Additional sites were completed in areas of preferred habitat, and/or where the SDM output suggested ground-truthing. Additional searching was completed while traversing between sites using transects.

The targeted searches included looking for Bilby evidence in the form of tracks, scats, diggings, and burrows for approximately 50 person minutes at each site. Where plant species could be identified in the field, more focus was placed on specific species such as *Acacia* (see section 2.8.1), which are known to contain root-dwelling larvae (RDL) that the Bilby favours as a food source (Southgate *et al.*, 2019). Only clear tracks, scats and diggings at the base of vegetation containing RDL were recorded as confirmed presence as outlined by Southgate et al. (2019). If any ambiguous diggings or potential burrows were recorded, further searching was undertaken in the vicinity to attempt to find further evidence to confirm presence. Additional habitat, and tracking conditions were recorded, such as vegetation, substrate type, weather conditions, density of vegetation present, trackability of substrate, and shadow extent.

Overall, 62 plots were completed (54 during this survey and eight during annual monitoring), equating to 65.8 person-hours searching and 130.4 km traverses within and surrounding the Survey Area (Table 3.6, Table 3.7, Map 3.1, and Appendix B).

Survey sites are listed in Table 3.6, with more detail provided in Appendix B,. Site locations are displayed on Map 3.1.

Table 3.6: Bilby Search Sites

Site	Location		Survey Effort	SDM Output
	Easting	Northing	Person Minutes	
WDG_01	681479	7662787	84	Medium
WDG_02	682610	7662458	52	Medium
WDG_03	683400	7662518	54	Medium
WDG_04	682643	7661494	40	Medium
WDG_05	683634	7661435	106	Medium
WDG_06	685197	7661560	80	Medium
WDG_07	683420	7660571	60	Medium
WDG_08	684537	7660480	90	Medium
WDG_09	683713	7659498	104	Medium
WDG_10	684625	7659475	46	Medium
WDG_11	683053	7658377	46	Medium
WDG_12	684598	7658530	52	Medium
WDG_13	683622	7656477	40	Medium
WDG_14	683846	7656188	24	Medium
WDG_15	681992	7656014	158	High
WDG_16	683483	7655813	18	Medium
WDG_17	684224	7655520	70	High
WDG_18	682832	7655435	122	High
WDG_19	679644	7654429	60	High
WDG_20	680810	7654526	40	High

Site	Location		Survey Effort	SDM Output
	Easting	Northing	Person Minutes	
WDG_21	681357	7654456	56	High
WDG_22	682651	7654478	62	High
WDG_23	683571	7654520	102	Medium
WDG_24	680602	7653572	46	High
WDG_25	681439	7653448	110	Medium
WDG_26	682681	7653513	60	High
WDG_27	683621	7653405	68	High
WDG_28	684544	7653675	50	Medium
WDG_29	679501	7653586	34	Medium
WDG_30	680759	7652506	78	Medium
WDG_31	682221	7652298	40	High
WDG_32	683640	7652441	86	High
WDG_33	685944	7652199	28	High
WDG_34	679607	7651504	58	Medium
WDG_35	680958	7651620	56	High
WDG_36	683864	7651723	50	High
WDG_37	685919	7651313	17	High
WDG_38	686290	7651198	136	Medium
WDG_39	678734	7650597	52	High
WDG_40	680186	7650612	56	High
WDG_41	681573	7650401	62	High
WDG_42	683339	7650867	62	Medium
WDG_43	684634	7650490	58	High
WDG_44	685776	7650315	44	Medium
WDG_45	679141	7649646	86	Medium
WDG_46	680673	7649478	60	High
WDG_47	681640	7649433	48	Medium
WDG_48	682425	7649728	148	Medium
WDG_49	683574	7649598	50	Medium
WDG_50	684590	7649515	50	Medium
WDG_51	680687	7648487	52	Medium
WDG_52	681631	7648478	58	Medium
WDG_53	682570	7648492	58	Medium
WDG_54	681624	7647448	46	Medium
Total			3,473	
Total Person Hours			57.9	

Coordinate Reference System: GDA94 / MGA Zone 50

An additional eight Bilby sites were completed as part of the annual Fauna Monitoring Program for Fortescue, and have been included in this report. Four of these sites are located within the Survey Area while the additional four are located up to 6.6 km from the Survey Area. This provides further information about Bilbies in the vicinity of the Survey Area. The monitoring sites follow the same methods as used for this survey (2 ha search sites) with the addition of four cameras installed at one of the monitoring sites within the Survey Area where a resident Bilby was previously recorded. The cameras are installed long-term at active burrows and other recent signs to monitor the movements and activity levels of the resident Bilby. The monitoring sites are outlined in Table 3.7 and shown on Map 3.1.

Table 3.7: Fortescue Fauna Monitoring Bilby Sites

Site	Location		Survey Effort Person Minutes	SDM Output	Distance from Survey Area
	Easting*	Northing*			
MR GB OS 12	685687	7650691	42	Medium	Within Survey Area
MR GB OS 13	681220	7662425	56	Medium	Within Survey Area
MR GB OS 14	682355	7659785	44	Medium	Within Survey Area
MR GB OS 15	682893	7657639	40	Medium	1.6 km S
MR GB AS 41	686874	7648323	140	Medium to High	Within Survey Area
MR GB OS C02	675074	7643300	54	Medium	6.6 km SW
MR GB OS C03	676923	7651572	46	Medium to High	2.0 km W
MR GB OS C04	689893	7650254	52	Medium to High	2.9 km E
		Total	474		
		Total Person Hours	7.9		

*Coordinate Reference System: GDA94 / MGA Zone 50

3.2.4. Scat Collection

Scats were collected and stored in silica-based desiccant with a layer of cotton wool between the sample and the desiccant. The scat samples were then sent for DNA analysis at Helix Solutions. The scats were analysed to determine the potential number of individuals present, based on their genotypic variation. The DNA extraction was completed using the QIAGEN QIAamp Fast DNA Stool mini kit. Detailed methods of the DNA extraction and sequencing are presented in Appendix B.

675000
680000
685000
690000
7660000
7655000
7650000

See overview map for location

WDG_01
MR GB OS 12
WDG_02
WDG_03
WDG_04
WDG_05
WDG_06
WDG_07
WDG_08
MR GB OS 13
WDG_09
WDG_10
WDG_11
WDG_12
MR GB OS 14
WDG_13
WDG_14
WDG_15
WDG_16
WDG_17
WDG_18
WDG_19
WDG_21
WDG_22
WDG_23
WDG_29
WDG_24
WDG_25
WDG_26
WDG_27
WDG_28
WDG_30
WDG_31
WDG_32
WDG_33
MR GB OS C03
WDG_34
WDG_35
WDG_36
WDG_37
WDG_38
WDG_42
MR GB AS41
WDG_39
WDG_40
WDG_41
WDG_43
WDG_44
MR GB OS C04
WDG_45
WDG_48
WDG_49
WDG_50
WDG_46
WDG_47
WDG_51
WDG_52
WDG_53
MR GB OS 15
WDG_54
MR GB OS C02

Legend

- Survey Area

Survey Sites & Tracks

- Survey Sites
- Monitoring Sites
- Tracks

N

0 0.5 1 1.5 2 km

Scale 1:58,500 @ A3

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

Spectrum

Author: GF

Date: 30-01-2025

Survey Sites

Turner River Solar Hub Project

MAP

Prepared for Fortescue

3.1

3.2.5. Fauna Habitat Mapping

Fauna habitat mapping was previously completed for the majority of the Survey Area (see Table 3.2), primarily from Spectrum's (2025b) and 360's (2023) assessments. Fauna habitat mapping was reviewed and adjusted after ground truthing, and areas previously not mapped were filled in.

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 site and also opportunistically while traversing the Survey Area. The fauna habitat types were matched to Fortescue's domain names.

3.3. Limitations & Constraints

Survey specific limitations and constraints for the targeted fauna assessment completed at the Survey Area are discussed in Table 3.8.

Table 3.8: 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 these have been included in the desktop assessment.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	Senior Zoologist's Erica MacIntyre and Joel Wilson have suitable knowledge and experience conducting fauna surveys in the Pilbara region of Western Australia. Erica managed and completed the detailed fauna survey at NSJW and was therefore familiar with the area. The project was overseen by Principal Zoologist Astrid Heidrich, who has more than 15 years' experience conducting surveys in the Pilbara.
Timing/weather/season/cycle.	Partial	Bilby surveys can be conducted at any time of year using non-invasive techniques. The rain and windy conditions just prior to the survey may have impacted tracks, diggings and burrows, by making them less obvious or washing away recent evidence. However, the rain also assisted in identifying and finding fresh evidence.
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. However, a few fires have impacted the Survey Area as outlined in section 2.4. One fire in 2022 burnt approximately 51.5% of the Survey Area and the vegetation is still regrowing.
Remoteness and/or access problems.	No	The Survey Area has limited access tracks, so a helicopter was used to ensure full access to the area.

Limitation	Constraint	Comment
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	The sampling techniques employed were adequate for the target species. The rainfall prior to the survey may have impacted secondary evidence.
Proportion of fauna identified, recorded, and/or collected.	No	All vertebrate fauna species and signs encountered were identified in the field by experienced zoologists. Some diggings and burrows are not possible to attribute to a certain species as they could belong to multiple species.
The proportion of the task achieved and further work which might be needed.	No	All components of the targeted 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. 29 previous reports and ongoing fauna monitoring programs were reviewed
Intensity (in retrospect, was the intensity adequate).	No	Targeted searches for the Bilby were completed within areas of suitable habitat with suitable intensity.
Completeness (was the relevant area fully surveyed.	No	The habitat types that may host the Bilby were adequately surveyed.

4. RESULTS & DISCUSSION

4.1. Desktop Survey

4.1.1. Previous Survey Effort

The literature review identified 24 previous surveys and monitoring programs that have been undertaken in the Study Area. The locations of the surveys are shown on Map 4.1 and included in Appendix C. Seventeen of these reports occurred within 10 km of the Survey Area (local context) and 12 of the previous surveys (not including a desktop assessment) overlapped the Survey Area and included the following (Table 4.1, Map 4.2, Appendix C):

- NSJW Detailed Vertebrate Fauna Assessment (Spectrum, 2025b);
- Fortescue Fauna Monitoring from 2013 to 2024 (ecologia, 2014b, 2014a, 2014d, 2015a, 2015b; Ecoscape, 2015, 2016b, 2016a, 2017, 2018; Spectrum, 2019, 2020a, 2021, 2022, 2023, 2024, 2025a);
- North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna Assessment (360, 2023);
- North Star Junction Flora and Fauna Assessments (Ecoscape, 2021);
- Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape, 2020a);
- North Star Project Level 2 Vertebrate Fauna Assessment (ecologia, 2012a);
- North Star Access Corridor Flora, Vegetation & Vertebrate Fauna Assessment (ecologia, 2012b);
- Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010);
- Significant Vertebrate Fauna of Roy Hill Infrastructure Corridor (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, 2007); and
- Fortescue Stage A Rail (Biota, 2004).

Of the 29 fauna surveys and on monitoring program, 17 included targeted searches for the Bilby, which included 15 surveys within 10 km of the Survey Area (Table 4.1, Map 4.2). Spectrum (2025b) completed 45.5 hours of targeted searches for the Bilby, with five trapping grids (that included cage trapping) and 22 motion cameras recording 5,448 hours at the NSJW project. This area encompasses 63.5% of the total Survey Area. Another eight surveys (including the monitoring) completed targeted searches partially within the Survey Area. The recent detailed and targeted survey completed by 360 Environmental (2023) included two trapping grids and one targeted Bilby transect search (1.5 km by four personnel at 20 m spacing, approximately 6 km total length) located in the northern portion of the Survey Area (Table 4.1, Map 4.2).

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Table 4.1: Previous Survey Effort & Likelihood of Occurrence within 10 km of the Survey Area

Source	Survey Type	Distance from Survey Area	Likelihood of Occurrence	Previous Survey Effort				
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted Bilby Search	Motion Camera
NSJW Detailed Vertebrate Fauna Assessment (Spectrum, 2025b)	Detailed & targeted	Within	Recorded	5 x trapping grids	33	9	45.5 hours of searches for secondary evidence	22 x MCs (3-45 nights & 5,448 hours recording)
Fortescue Fauna Monitoring 2013-2024 (ecologia, 2014, 2015a, 2015b; Ecoscape, 2017, 2018; Spectrum, 2020, 2021, 2022, 2023, 2025a)	Annual significant fauna monitoring	Partially in	Recorded	-	-	Completed	5 x Bilby 2 ha search sites in Survey Area 4 x Bilby 2 ha search sites within 10 km	1 x in Survey Area 2 x MCs within 10 km
North Star Junction Renewable Energy Infrastructure Project Vertebrate Fauna (360, 2023)	Detailed & targeted	Partially in	Previously Recorded (DBCA Database)	2 x trapping grids in Survey Area 5 x trapping grids within 10 km	4 x in Survey Area, 21 x within 10 km	Completed	5^ x transect searches – approx. 6 km per search 32 km total (1 x in Survey Area, 4^ x within 10 km)	40 x MCs within 10 km
North Star Junction Flora and Fauna Assessments (Ecoscape, 2021)	Basic	Partially in	Recorded - potential evidence	-	3 x in Survey Area 12 x within 10 km	Completed	-	6 x MCs for 1-3 nights within 10 km
Pilbara Transmission Project Targeted Flora and Fauna (Ecoscape (Australia), 2020a)	Targeted	Partially in	Recorded - old evidence	-	-	-	Driving transects & grid searches completed, no mention of where or how many completed.	-
North Star Project Level 2 Vertebrate Fauna (ecologia, 2012a)	Detailed & targeted	Partially in	Medium	16 x trapping grids within 10 km	Completed	Completed	3 hour searching sandy plains with large spinifex	14 sites with 156 hours recording (1 x MC in Survey Area)

Source	Survey Type	Distance from Survey Area	Likelihood of Occurrence	Previous Survey Effort				
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted Bilby Search	Motion Camera
North Star Access Corridor Flora, Vegetation & Vertebrate Fauna (ecologia, 2012b)	Basic	Partially in	Medium	-	Completed	Completed	-	-
Conservation Significant Vertebrate Fauna Species Habitat Assessment: Roy Hill Rail (TE, 2011)	Basic & targeted	Partially in	Recorded - old evidence only	-	7 x in Survey Area, 30 x within 10 km	-	Searches in suitable habitat	22 x MCs with 5,448 hours of recording
Targeted Fauna Assessment of the Rail Duplication (Bamford, 2010)	Targeted	Partially in	Recorded - old evidence only	-	-	Completed	Searches for burrows, diggings and tracks in sandy habitats	-
Targeted Flora and Fauna of Rail Corridor GDP Areas 2449, 2462 & 2515 (Ecoscape, 2009)	Targeted	Partially in	Recorded – old and active	-	Completed	Completed	Transects*	-
Conservation Significant Vertebrate Fauna – Proposed Rail Corridor and Borrow Pits (ATA, 2007)	Targeted & basic – vertebrate fauna	Partially in	Recorded – old and active	-	Completed from helicopter to identify significant fauna habitat to target for searches	Completed	Grid searches with between 3-12 people spaced at 5-50m	-
Fortescue Stage A Rail (Biota, 2004)	Detailed	Partially in	Only recorded during the Hope Down surveys, unsure of locations	3 x trapping grids within 10 km (Hope Downs)	-	-	-	-
North Star Filtration Plan Relocation Flora & Fauna (ecologia Environment, 2014c)	Basic – vertebrate fauna	1.5 km W	Medium	-	10	Completed	Searches in sandy spinifex plains	8 x motion cameras at 8 sites (approx. 40 hours each, total 334 hours & 47 mins

Source	Survey Type	Distance from Survey Area	Likelihood of Occurrence	Previous Survey Effort				
				Trapping Grid	Habitat Assessment (HA)	Opportunistic Observations	Targeted Bilby Search	Motion Camera
Pippingarra and Wodgina Roads Flora & Fauna (Ecoscape, 2020b)	Basic – vertebrate fauna	1.9 km E	Previously recorded, low likelihood post survey	-	Completed for habitat mapping	Completed	23 x 30 min searches across 1 ha	10
Wodgina Lithium Project: Level 2 Vertebrate Fauna (WW, 2020)	Detailed	1.6 km W	Not provided due to lack of habitat	6 x trapping grids	Completed for habitat mapping	Completed	-	82 at 40 sites (208 trap nights)
Wodgina Project: Level 1 & Targeted Fauna (Stantec, 2018)	Basic & targeted	3.6 km NW	Confirmed – Gas pipeline & Aerodrome) Unlikely – Mine Area	-	54	-	Searches in suitable habitat	32 x MCs
North Star Aerodrome Flora & Fauna (ecologia, 2015c)	Basic – vertebrate fauna	5.3 km W		-	Completed for habitat mapping	-	19 hours active searches for all significant fauna*	13 sites (208 hours total)
Wodgina Hercules Project: Terrestrial Fauna (Outback, 2012)	Detailed & targeted	6.5 km W	Unknown	4 x trapping grids	Completed	Completed	-	-
Wodgina DSO Project: Terrestrial Fauna (Outback, 2009)	Detailed & targeted	5.6 km W	Unknown	6 x trapping grids	Completed	Completed	-	-
Wodgina Gas Pipeline Targeted Fauna Survey (360, 2018b)	Targeted	6.1 km NW	Confirmed	-	-	-	6 x 2 ha searches within 10 km 40 x 2 ha searches outside	3 x MCs within 10 km 12 x MCs outside All - 36 trap nights
P1000 Pilgangoora Project Flora & Fauna (APM, 2024)	Targeted – vertebrate fauna	9.1 km N	Possible				Targeted searches across a linear distance of 26 km*	11 x MCs totalling 152 trap nights

Notes:^ 1 x Bilby search located just outside 10 km ~225 m; * Transects completed through each area targeting all significant fauna.

620000
640000
660000
680000
700000
720000
740000
7700000
7680000
7660000
7640000
7620000
7600000

Legend

- Survey Area
- 10 km Buffer
- Study Area (50 km Buffer)

Previous Surveys Completed - Surveyed Areas

- Spectrum (2024)
- 360 (2023)
- Ecoscape (2021)
- Ecoscape (2020)
- Spectrum (2018)
- ecologia (2012a)
- ecologia (2012b)
- Terrestrial Ecosystems (2011)
- Bamford (2010)
- Ecoscape (2009)
- ATA Environmental 2007
- Biota (2004)
- Western Wildlife (2020)
- Stantec (2018)
- Outback Ecology (2012)
- Outback Ecology (2009)
- 360 (2018a)
- 360 (2018b)
- Spectrum (2021)
- Western Widlife (2023)
- Outback Ecology (2011a)
- Outback Ecology (2011b)
- Bamford (2001)
- 360 (2016)
- APM (2023)
- APM (2024)
- ecologia (2015c)
- ecologia (2014b)
- ecologia (2014c)
- Ecoscape (2020b)

Previous Surveys Completed - Survey Effort

- Habitat Assessment
- Motion Camera
- Opportunistic Site & Targeted Active Search
- Systematic Terrestrial Vertebrate Fauna Trapping
- Targeted Active Search
- Greater Bilby - occupancy site
- Greater Bilby - abundance site
- Targeted Search Area - Bilby

N

0 5 10 15 km

Scale 1:425,000 @ A3

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

Spectrum Ecological + Spatial

Author: EM

Date: 30-01-2025

Previous Survey Effort - Regional Context

Turner River Solar Hub Project

MAP

Prepared for Fortescue

4.1

660000 665000 670000 675000 680000 685000 690000 695000 700000

7670000 7665000 7660000 7655000 7650000 7645000 7640000

Legend

- Survey Area
- 10 km Buffer

Previous Surveys Completed - Surveyed Areas

- Spectrum (2024)
- 360 (2023)
- Ecoscape (2021)
- Ecoscape (2020)
- Spectrum (2018)
- ecologia (2012a)
- ecologia (2012b)
- Terrestrial Ecosystems (2011)
- Bamford (2010)
- Ecoscape (2009)
- ATA Environmental 2007
- Biota (2004)
- Western Wildlife (2020)
- Stantec (2018)
- Outback Ecology (2012)
- Outback Ecology (2009)
- 360 (2018a)
- 360 (2018b)

Previous Surveys Completed - Survey Effort

- Habitat Assessment
- Motion Camera
- Opportunistic Site, Targeted Active Search
- Systematic Terrestrial Vertebrate Fauna Trapping
- Targeted Active Search,Targeted active search
- Greater Bilby - occupancy site
- Greater Bilby - abundance site
- Targeted Search Area - Bilby

N

0 1 2 3 4 5 km

Scale 1:130,000 @ A3

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

Spectrum BIOLOGY + SPATIAL

Author: EM

Date: 05-09-2024

Previous Survey Effort - Local Context

Wodgina Project

MAP 4.2

Prepared for Fortescue

4.1.2. Previous Bilby Records

During a previous detailed and targeted vertebrate fauna survey completed within the Survey Area, potential evidence (in the form of old diggings and old burrows) was recorded from four locations, and a female Bilby was captured in a cage from an additional, fifth site (Spectrum, 2025b). The site was located in sandy plain habitat adjacent to minor drainage line habitat and some granite outcroppings. In addition to the trap capture, four burrows, scats, tracks and multiple diggings were recorded at the same site which was subsequently incorporated into Fortescue's Annual Fauna Monitoring Program and has since been monitored twice per year (site MR GB AS 41, Table 4.2, Map 4.3). Bilby evidence recorded from the site (and therefore within the Survey Area) during the monitoring has been included in Table 4.2 (Spectrum, 2025a).

The DBCA Fauna Database returned 397 Bilby records within the Study Area, while the Fortescue Internal Database returned 364. This demonstrates that the Bilby is frequently recorded within the Study Area and is widespread throughout the region.

No records were identified within the Survey Area from the DBCA Database; however, four were located just outside the boundary (within 100 m). These records were from 2013, with two of the four being certain, (motion camera records). Fortescue's Database contained 12 records within the Survey Area and an additional five within a 2 km radius. These records were made during two previous surveys (ATA, 2007; Ecoscape, 2009) and comprise secondary evidence (scats, burrows, and diggings). Two other records were made during two relatively recent surveys and occur within 100 m east of the Survey Area (Ecoscape, 2020, 2021). Details of the records within the Survey Area and a 2 km buffer are detailed in Table 4.2 and shown on Map 4.3.

Table 4.2: Previous Bilby Records within the Survey Area and 2 km Buffer

Survey Phase or Date	Site / Location / Distance	Type of Record / Reference	Fauna Habitat#	Habitat Definition#	Easting^	Northing^
Previous Records – Fortescue Internal Database – Previous Surveys & Fauna Monitoring						
22/07/2009	GDP2449	Old burrow (Ecoscape, 2009)	Plain (sand)	Critical	686333	7650954
August 2006	Burrow pit P4A	Inactive burrow	Plain (sand)	Critical	681599	7662775
August 2006	Burrow pit P4A	>15 (active and inactive) burrows and diggings (ATA, 2007)	Plain (sand)	Critical	681367	7662760
August 2006	Burrow pit P4A	Old digging	Formerly Plain (sand), now Cleared	N/A	681569	7661500
August 2006	North of burrow pit P4C	Old digging	Plain (sand)	Critical	683082	7658342
August 2006	Burrow pit P4C	Old digging	Formerly Plain (sand), now Cleared – disturbed, rehabbed	N/A	683176	7657666
25/05/2013	J-ML-FA_BB13	Inactive burrow (recently active)	Formerly Plain (sand), now Cleared – disturbed, rehabbed	N/A	682351	7659743
25/05/2013	J-ML-FA_BB14	Inactive burrow (recently active)	Formerly Plain (sand), now Cleared – disturbed, rehabbed	N/A	682389	7659812

Survey Phase or Date	Site / Location / Distance	Type of Record / Reference	Fauna Habitat#	Habitat Definition#	Easting^	Northing^
25/05/2013	J-ML-FA_BB15	Inactive burrow (recently active)	Formerly Plain (sand), now Cleared – disturbed, rehabbed	N/A	682410	7659789
25/05/2013	J-ML-FA_BB16	Inactive burrow (recently active)	Formerly Plain (sand), now Cleared – disturbed, rehabbed	N/A	682382	7659832
16/05/2019	MR GB OS 13	Old diggings	Formerly Plain (sand), now Cleared – disturbed, rehabbed	N/A	682349	7659703
22/07/2021	MR GB OS 12	Scats	Drainage Line/River/Creek (minor)	Critical	681423	7662812
Previous Records – Fortescue Internal Database – Previous Surveys & Fauna Monitoring (up to 2 km outside)						
22/09/2019	HV1905 27 m E	Old burrow (Ecoscape, 2020a)	Formerly Spinifex Sand Plain, now Cleared/Disturbed	N/A	686974	7650492
27/05/2021	NSJ_FN_P_FS04 84 m E	Potential diggings (x3) (Ecoscape, 2021)	Spinifex Sand Plain	Critical	686880	7650825
16/05/2019	R_F_P_MR GB OS15 1.4 km S	Two potential old diggings (Spectrum, 2020b)	Spinifex Sand Plain	Critical	686904	7648294
11/07/2020	R_F_P_MR GB OS15 1.4 km S	Potential tracks (gait pattern only) (Spectrum, 2021)	Spinifex Sand Plain	Critical	686904	7648294
22/07/2022	R_F_P_MR GB OS15 1.4 km S	Scats (Spectrum, 2023)	Spinifex Sand Plain	Critical	686904	7648294
Previous Records – DBCA Database – Previous Survey (up to 2 km outside)						
4/12/2013	Roy Hill Rail Line 87.9 m E (in rail cut out)	Motion camera recording	Spinifex Sand Plain	Critical	682989	7655465
4/12/2013	Roy Hill Rail Line 92 m E (in rail cut out)	Unknown	Spinifex Sand Plain	Critical	682991	7655474
4/12/2013	Roy Hill Rail Line 84.5 m W (in rail cut out)	Motion camera recording	Spinifex Sand Plain	Critical	682971	7655587
4/12/2013	Roy Hill Rail Line 81.8 m W (in rail cut out)	Unknown	Spinifex Sand Plain	Critical	682971	7655596
NSJW Survey						
17/05/2023	NS01	Female captured in cage	Spinifex Sand Plain	Critical	685937	7650777
15/05/2023	NS01	Active burrow	Spinifex Sand Plain	Critical	685937	7650778
17/05/2023	NS01	Old burrow recorded during Phase 1, active in Phase 2	Spinifex Sand Plain	Critical	685904	7650708
17/05/2023	NS01	Inactive burrow	Spinifex Sand Plain	Critical	685906	7650707
30/09/2023	NS01	Active burrow	Minor Drainage Line	Critical	685960	7650764
27/092023	NS01	Active burrow	Spinifex Sand Plain	Critical	685858	7650640
27/09/2023	NS01	Multiple confirmed diggings, scratchings and scat piles	Spinifex Sand Plain	Critical	685843	7650632

Survey Phase or Date	Site / Location / Distance	Type of Record / Reference	Fauna Habitat#	Habitat Definition#	Easting^	Northing^
20/05/2023	NS01-TS	Confirmed tracks	Minor Drainage Line	Critical	686045	7650915
20/05/2023	NS01-TS	Confirmed tracks	Spinifex Sand Plain	Critical	686078	7650998
20/05/2023	NS01-TS	Confirmed tracks	Spinifex Sand Plain	Critical	686173	7651006
24/05/23 to 29/06/23	NS01-MC30-LT	39 video records of Bilby entering and leaving burrow	Spinifex Sand Plain	Critical	685942	7650774
4/06/23, 16/06/23 & 7/09/23	NS01-MC33-LT	Three photos of a Bilby entering burrow over three days	Spinifex Sand Plain	Critical	685943	7650777
1/09/23 & 21/09/23	NS01-MC57	Two photos of Bilby at burrow	Spinifex Sand Plain	Critical	685944	7650775
26/08/23 to 21/09/23	NS01-MC63	Five photos of Bilby at burrow	Spinifex Sand Plain	Critical	685944	7650776
22/05/2023	NSOPP06	Potential, old burrow	Spinifex Sand Plain	Critical	685739	7652040
23/05/2023	NSOPP08	Potential old disused burrow	Spinifex Sand Plain	Critical	679715	7650593
2/10/2023	NSOPP12	Potential old digging	Spinifex Sand Plain	Critical	682368	7649956
3/10/2023	NSOPP13	Potential old digging	Spinifex Sand Plain	Critical	679770	7654577
4/10/2023	BD01	Potential old digging	Spinifex Sand Plain	Critical	686420	7651188
Fauna Monitoring Program 2024 (Spectrum, 2025a)						
26/03/2024	MR GB OS 12	Potential evidence only – two test burrows	Spinifex Sand Plain	Critical	681295	7662490
26/03/2024	MR GB OS C04	Potential evidence only - old burrow and diggings	Major Drainage Line	Critical	689868	7650132
25/03/2024	MR GB AS 41	Confirmed evidence - active burrow	Spinifex Sand Plain	Critical	685901	7650706
25/03/2024	MR GB AS 41	Confirmed evidence - scat	Spinifex Sand Plain	Critical	685880	7650686
25/03/2024	MR GB AS 41	Confirmed presence - clear tracks	Minor Drainage Line	Critical	685826	7650487
25/03/2024	MR GB AS 41	Confirmed presence - clear tracks	Minor Drainage Line	Critical	685832	7650554
30/03/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
1/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
4/04/2024	MR GB AS 41 MC1	Individual on motion camera	Spinifex Sand Plain	Critical	685797	7650796
6/04/2024	MR GB AS 41 MC1	Individual on motion camera	Spinifex Sand Plain	Critical	685797	7650796
6/04/2024	MR GB AS 41 MC2	Individual on motion camera	Spinifex Sand Plain	Critical	685943	7650776
6/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
13/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
16/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705

Survey Phase or Date	Site / Location / Distance	Type of Record / Reference	Fauna Habitat#	Habitat Definition#	Easting^	Northing^
19/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
20/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
21/04/2024	MR GB AS 41 MC2	Individual on motion camera	Spinifex Sand Plain	Critical	685943	7650776
21/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
22/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
23/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
24/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
27/04/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
29/04/2024	MR GB AS 41 MC1	Individual on motion camera	Spinifex Sand Plain	Critical	685797	7650796
30/04/2024	MR GB AS 41 MC2	Individual on motion camera	Spinifex Sand Plain	Critical	685943	7650776
1/05/2024	MR GB AS 41	Confirmed evidence - active burrow	Spinifex Sand Plain	Critical	685898	7650705
2/05/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
10/05/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
15/05/2024	MR GB AS 41 MC1	Individual on motion camera	Spinifex Sand Plain	Critical	685797	7650796
16/05/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
18/05/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
5/06/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
5/07/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
13/07/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705
27/07/2024	MR GB AS 41 MC1	Individual on motion camera	Spinifex Sand Plain	Critical	685797	7650796
29/07/2024	MR GB AS 41 MC3	Individual on motion camera	Spinifex Sand Plain	Critical	685902	7650705

^ = Coordinate reference system – GDA94, MGA94, Zone 50, # = see section 4.2.1, for further information regarding habitat.

It is often difficult to confirm from the majority of the database search results whether the secondary evidence records were potential presence or confirmed presence for the Bilby (Southgate *et al.*, 2019), as this information is not always included in the attributes, especially for any records prior to the Southgate *et al.* (2019) journal article. As outlined in section 3.2.3, confirmed presence is limited to clear tracks, scats and multiple diggings at the base of vegetation containing RDL that Bilbies use as food resource (Southgate *et al.*, 2019). Additionally, it is also likely that some of the records from the two databases are duplicates.

Of the 17 regional surveys completed within 10 km of the Survey Area, 12 recorded the Bilby. This includes the two recently confirmed records of the female Bilby (NSJW and Fauna Monitoring Program). The remaining 10 records include:

- three reports cite old evidence (Bamford, 2010; TE, 2011; Ecoscape, 2020);
- one mentions potential evidence (Ecoscape, 2021);
- two state both old and fresh evidence (ATA, 2007; Ecoscape, 2009);
- one was previously recorded from DBCA searches (360, 2023);
- while two reports (Biota, 2004; Stantec, 2018) confirmed Bilby evidence from three previous surveys, with two already included in Table 4.1 (360, 2018a, 360, 2018b).

Dziminkski *et al.* (2020) investigated the validity of records in the Pilbara region as part of their comprehensive review of the historic and recent records of the Bilby in the Pilbara. This study outlined a confirmed Bilby range and identified areas that require further surveying due to inaccurate and historic records. The Survey Area falls inside the confirmed Bilby range and none of the previous records from the Study Area were considered inaccurate.

620000 640000 660000 680000 700000 720000 740000

7700000 7680000 7660000 7640000 7620000 7600000

Legend

Survey Area

Study Area (50 km Buffer)

Previous Bilby Records

DBCA Database

Fortescue Database

- Fortescue Fauna Monitoring
- Ecoscape (2021)
- Ecoscape (2020)
- Bamford (2010)
- Ecoscape (2009)
- ATA (2007)
- Other Consultant

Bilby Evidence Recorded at NSJW (Spectrum, 2025b) & 2024 wet season Fauna Monitoring (Spectrum, 2025a)

- Capture
- Motion camera
- Confirmed active burrow
- Confirmed digging
- Confirmed tracks
- Inactive burrow
- Potential old burrow
- Potential old digging
- Confirmed Scat
- Potential old burrow and diggings

Other Surveys

- Western Wildlife (2023)
- 360 (2018b)
- 360 (2018a)

N

0 5 10 15 km

Scale 1:425,000 @ A3

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

Spectrum

Author: EM

Date: 30-01-2025

Previous Bilby Records

Turner River Solar Hub Project

MAP

Prepared for Fortescue

4.3

4.1.3. Species Distribution Modelling

Two models were tested in the selection process, the final model achieved a very high performance with an AUC of 0.941 (Figure 4.1). A high AUC indicates the model was highly efficient at measuring presences and pseudo-absences. The statistical results of the model are displayed in Figure 4.1 and the spatial representation of the distribution is presented in Map 4.4.

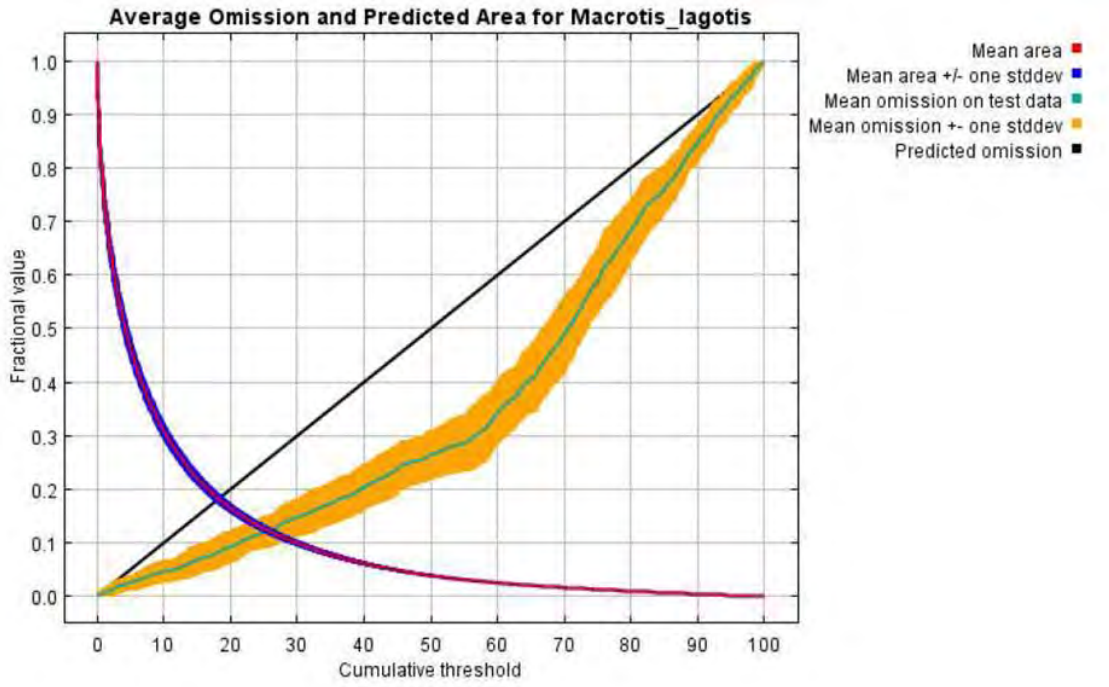


Figure 4.1: Average Omission & Predicted Area for Bilby
As a function of the cumulative threshold, average over the replicate runs (100).

Amongst the 37 environmental variables tested, 12 variables were the most influential when explaining the distribution of Bilbies (Table 4.3). The type of land system and soil environmental variables contributed most to the model, with 37.7% and 30.3% contribution, respectively. The environmental variable with the highest gain when used in isolation is soils, which appears to be the most important variable for the species, and fits with the species ecology. The environmental variable that decreases the gain the most when it is omitted is annual precipitation, which, therefore, appears to have the most information that is not present in the other variables. This result reinforces the hypothesis that Bilbies are associated with certain land systems, vegetation and soils which supports their burrowing and foraging requirements.

Table 4.3: Variable Contribution & Permutation Importance of the Best Performing Model

Environmental Variable	Description	Percent Contribution	Permutation Importance
Land Systems	Soil-landscape mapping at the systems level.	37.7	6
Soils	National description of Australian soil types.	30.3	15.4

Environmental Variable	Description	Percent Contribution	Permutation Importance
Pre-European Vegetation	Pre-European vegetation (The Department of Primary Industry Regional Development, 2019) maps original natural vegetation assumed to have existed prior to European settlement in Western Australia.	9.9	14.5
Bioclim12	Annual precipitation.	6.9	18.3
Geology	Seamless national coverage of outcrop and surficial geology.	6.1	6
Depth to Soil^	Depth of soil profile (A & B horizons) in metres.	3.1	4.4
MrVBF*	MrVBF is a topographic index designed to identify areas of deposited material at a range of scales based on the observations that valley bottoms are low and flat relative to their surroundings and that large valley bottoms are flatter than smaller ones.	3.1	0.3
Depth of Regolith	Metres of in situ and transported material overlying unweathered bedrock.	1	18.4
Relief	The difference between a locations highest and lowest elevations.	0.6	10.8
Soil Sand (%)	Percentage of sand content of the soil at a depth of 0-5 cm.	0.6	3.8
Major Watercourse	Euclidean distance from major watercourse.	0.6	1.5
Soil Total Phosphorus	Percentage of phosphorus content of the soil at a depth of 0-5 cm.	0.2	0.6

^Excluded from SDM based on MaxEnt model importance. *Excluded from SDM due to correlation with other layers.

An assessment of the probability ranks within the Study Area was performed, and the total predicted extent of the Bilby occupied 8,558,206.0 ha (48.0%), although the western portion of the Pilbara has no recent records (Dziminski and Carpenter, 2017). The range of probability of occurrence values for Medium and High likelihood ranks contain 95% and 50% of all known records of the Bilby, respectively.

Within the Study Area (probability of occurrence >0.05 or likelihood ranks Low to High), 298,213.2 ha (29.9%) was classified as having a Low probability rank (0.05 – 0.19). Areas of Medium (0.2 – 0.8) and High (0.8 – 1.0) probability ranks represented 408,567.1 ha (41.0%) and 76,137.1 ha (7.6%) of the total modelled extent, respectively. Thus, 48.6% (484,704.2 ha) of the Study Area is classified as a Medium or High likelihood rank.

Within the Survey Area, 180.3 ha (2.5%) was classified as having a Low probability rank (0.05 – 0.19), 5,362.9 ha (75.2%) was identified as Medium (0.2 – 0.8), while 1,585.1 ha or 22.2% was categorised as having a High probability rank (0.8 – 1.0, Table 4.4, Map 4.4). Therefore, a combined total of 6,948 97.4%) of the Survey Area is assigned a Medium or High likelihood rank.

Table 4.4: Species Distribution Modelling Habitat Category Extents

Species	Category	Representative Colours on Map	Survey Area (ha)	Percentage of Survey Area	Study Area (ha)	Percentage of Study Area	Pilbara IBRA (ha)	Percentage of Pilbara IBRA
Bilby	1 – Low 0.05-0.19	Green	180.3	2.5%	298,213.2	29.9%	5,412,156.8	30.4%
	2 – Medium 0.2-0.8	Orange	5,362.9	75.2%	408,567.1	41.0%	2,891,663.8	16.2%
	3 – High 0.8-1	Red	1,585.1	22.2%	76,137.1	7.6%	254,385.4	1.4%
		Total	**7,128.3**	**99.9%**	**782,917.4**	**78.5%**	**8,558,206.0**	**48.0%**

620000
640000
660000
680000
700000
720000
740000
7700000
7680000
7660000
7640000
7620000
7600000

Legend

Survey Area

Study Area

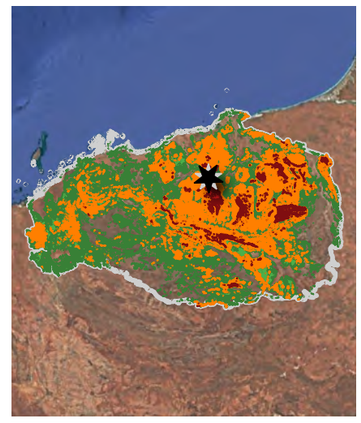
SDM

Low

Medium

High

Pilbara IBRA Region



N

0 5 10 15 km

Scale 1:425,000 @ A3

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

Spectrum Ecology + Spatial

Author: EM

Date: 30-01-2025

Species Distribution Modelling

Turner River Solar Hub Project

MAP

Prepared for Fortescue

4.4

4.2. Survey Results & Discussion

4.2.1. Bilby Habitat

Seven broad fauna habitat types were recorded from the Survey Area, these are predominately based on habitat mapping completed from previous surveys (360, 2023; Spectrum, 2025b). These habitats are summarised in Table 4.5, detailed in Table 4.6, and shown on Map 4.5:

Table 4.5: Broad Fauna Habitat Types and Extents in Survey Area

Fortescue Habitat Type	Spectrum Habitat Type	Extent (ha)	Percentage of Survey Area
Plain (sand)	Spinifex Sand Plain	6,272.8	87.9%
Plain (stony/gibber)	Spinifex Rocky Plain	212.1	3.0%
Drainage Line/River/Creek (major)	Major Drainage Line	43.5	0.6%
Drainage Line/River/Creek (minor)	Minor Drainage Line	78.3	1.1%
Granite Outcrops (boulder piles)	Granite Domes and Boulder Piles	121.1	1.7%
Granite Outcrops (flat domes)	N/A (360, 2023)	28.6	0.4%
Hills/Ranges/Plateaux	Hills, Ranges and Plateaux	62.7	0.9%
Cleared	Cleared/Disturbed	316.4	4.4%
	Total	7,135.4	

Suitable habitat for the Bilby was recorded from the majority of the Survey Area and from all habitats, with the exception of the Hills/Ranges/Plateaux and Cleared/Disturbed areas, with the former habitat likely only used sporadically. The female Bilby that was recorded from the Survey Area occupied Plain (sand), and Drainage Line/River/Creek (minor) habitat, with surrounding areas of Granite Outcrops (boulder piles). The latter is likely used for foraging or dispersal purposes only, due to the close proximity to critical habitat. The Bilby was also located within an area that has recently become fragmented by infrastructure (roads, rail line, power line corridor, camp and existing solar farm area) and other disturbances, such as an adjacent gravel pit and the recent fires that have impacted the eastern portion of the Survey Area.

Critical habitats in the Survey Area: Plain (sand, 87.9%), Drainage Line/River/Creek (minor, 1.7%) and Drainage Line/River/Creek (major, 0.6%).

The Plain (sand) and the Drainage Line/River/Creek (minor) habitats are the most likely areas to be occupied by the Bilby, followed by the Drainage Line/River/Creek (major) (Table 4.6, Map 4.5). The Bilby is typically found in areas where *Acacia bivenosa*, *A. colei*, *A. dictyophleba*, *A. melleodora*, *A. stellaticeps* and *A. trachycarpa* occurs, as these species host RDL (Southgate *et al.*, 2019). The Survey Area included *A. bivenosa*, *A. colei; A. stellaticeps;* and *A. trachycarpa*, with *A. stellaticeps* being the most common and widespread species. *Senna notabilis*, another plant known for hosting RDL, was also present in low density across the Survey Area. However, it is likely that the recent fires in 2021-2022 impacted the suitability of those habitats for the Bilby.

Supporting habitat in Survey Area: Plain (stony/gibber, 3.0%), Hills/Ranges/Plateaux (0.9%), Granite Outcrops (flat domes, 0.4%) and Granite Outcrops (boulder piles, 1.7%).

The Bilby may use the Plain (stony/gibber) for foraging and dispersal. The other two more elevated habitats may be used infrequently due to the proximity to critical habitat within the Survey Area, and likely only the lower elevated and sandier areas (Table 4.6, Map 4.5).

Additional areas were considered cleared and disturbed (Cleared), these areas provide little to no value to fauna. However, some rehabilitated areas have been included as disturbed and could potentially provide supporting habitat.

The critical and supporting fauna habitat types recorded from the Survey Area broadly align with those outlined in Table 2.5 (Cramer *et al.*, 2017; Northover *et al.*, 2023).

All the habitats present in the Survey Area are not restricted to this area and continue in the surrounding Abydos Plain. Given their high mobility and ability to forage over extensive areas, Bilbies may move into other parts of the mapped critical habitat (Plain (sand) and Drainage Line/River/Creek (minor & major) within the Survey Area (Map 4.5).

Table 4.6: Broad Fauna Habitat Types in the Survey Area

Habitat Type	Habitat Definition (Fortescue)	Habitat Description	Bilby Suitability	Habitat Photo
Plain (sand)	Critical	Widespread, flat sand plains consisting of varied substrate with mostly sand, or sandy-loam with some patches of quartz or granitic stones and low granitic outcropping scattered throughout. Vegetation consists of sparse *Corymbia hamersleyana over Acacia orthocarpa* and *A. ancistrocarpa* over patches of *A. stellaticeps* over *Triodia epactia* and *T. lanigera* low hummock grasses. Isolated patches of *Corymbia hamersleyana* scattered trees over *Acacia acradenia* over *Triodia schinzii* low hummock grasses occur in some areas associated with the patches of calcrete and quartz stones. Some small patches were recorded that comprised sparse vegetation on clay, however the small size of the area is unlikely to support a distinct fauna assemblage. Leaf and wood litter sparse, and generally restricted to underneath vegetation.	Suitable for breeding, foraging and dispersal. Predominantly sandy substrate, suitable for burrowing and contains scattered areas of plant species that may be used as a food resource due to hosting RDL: *Acacia stellaticeps*, *A. bivenosa*, *A. colei* and *Senna notabilis*. A large part of the southern portion of the Survey Area, and this habitat type, has been recently burnt over two consecutive years, which may impact some of its suitability for the Bilby.	 

Habitat Type	Habitat Definition (Fortescue)	Habitat Description	Bilby Suitability	Habitat Photo
Plain (stony/gibber)	Supporting	Small areas of flat plain with abundant ironstone stones/pebbles and some quartz. Vegetation consists of *Corymbia hamersleyana*, over *Acacia acradenia*, over *Triodia schinzii* low hummock grasses. Leaf and wood litter generally sparse and restricted to underneath vegetation on loamy clay.	Suitable for foraging and dispersal. Digging potential with two species of shrubs that may contain RDL: *A stellaticeps*, and *A. bivenosa*	
Drainage Line/River/Creek (major)	Critical	Wide drainage lines with large eucalypts, and sandy, gravel or small creek stone substrate that may fill intermittently during the wet season or during flooding events, or create pools that retain water sporadically. This habitat also includes the immediately adjacent low-lying drainage areas which are predominately sandy or may occasionally contain granite domes or outcropping. These areas typically feature denser vegetation and may be sporadically inundated during heavy rainfall events. The vegetation within the drainage line consists of *Eucalyptus camaldulensis* with scattered *Corymbia hamersleyana* over *Acacia trachycarpa* and *A. tumida* over Buffel grass **Cenchrus ciliaris* and *Triodia epactia* and *T. longiceps*. hummock grasses. The surrounding drainage areas include various *Acacia* species such as *A. trachycarpa* and *A. stellaticeps* over hummock grasses. Leaf	Suitable for breeding, foraging and dispersal. Two species of shrubs that may contain RDL: *A. trachycarpa and A. stellaticeps*. However, this habitat has been impacted by recent fires and grazing, limiting its suitability.	

Habitat Type	Habitat Definition (Fortescue)	Habitat Description	Bilby Suitability	Habitat Photo
Drainage Line/River/Creek (minor)	Critical	Narrow drainage lines dominated by shrubs and a sandy substrate that fills intermittently during the wet season or from flooding events. Occasional pools of water may be retained after large rainfall events. This habitat also includes the immediately adjoining areas of low-lying drainage areas which are predominately sandy or may occasionally contain some granite domes or outcropping. These areas are generally more densely vegetated and may be intermittently flooded during significant rainfall events. The vegetation is characterised by *Acacia* species, such as *A. trachycarpa* and *Acacia tumida* over *Triodia epactia* and *Triodia longiceps* low hummock grasses over mixed herbs and tussock grasses. Some leaf and wood litter present.	Suitable for breeding, foraging and dispersal. Two species of shrubs that may contain RDL: *Acacia trachycarpa and A. stellaticeps.* However, this habitat has been impacted by recent fires in the southern part of the Survey Area and by grazing, limiting its suitability.	
Granite Outcrops (boulder piles)	Supporting	This habitat is dominated by large, exposed granitic formations, including boulder piles and domes. These granitic formations rise prominently in the landscape, shaped by billions of years of extensive erosion. A sandy substrate occurs between granite piles and domes with very sparse leaf and wood litter. The vegetation is sparse due to the lack of substrate, with *Terminalia circumalata* over *Acacia eriopoda* and *A. tumida* over *Triodia epactia* hummocks.	Typically not suitable, but may use lower areas (more likely flat domes) for movement and/or foraging due to the surrounding Plain (sand) habitat. Some digging opportunities in sandier areas between granite outcrops. One species of shrub that may contain RDL - *Acacia stellaticeps.*	

Habitat Type	Habitat Definition (Fortescue)	Habitat Description	Bilby Suitability	Habitat Photo
Granite Outcrops (flat domes)	Supporting	This habitat is dominated by low, flat, granitic domes that are lacking in boulder piles. A sandy substrate occurs within the vicinity and between domes. This area is restricted to the northern part of the Survey Area. The vegetation is sparse due to the lack of substrate, with open *Acacia* shrublands over *Triodia* hummock grassland (360 Environmental, 2023).	Typically not suitable, but may use lower areas (more likely flat domes) for movement and/or foraging due to the surrounding Plain (sand) habitat. Some digging opportunities in sandier areas between granite outcrops. One species of shrub that may contain RDL - *Acacia stellaticeps*.	
Hills / Ranges / Plateaux	Supporting	Rocky hills and slopes with some rocky outcropping and shallow soils. Vegetation is dominated by *Acacia* spp. over *Triodia* hummock grassland.	This habitat is generally unsuitable due to its rocky substrate and shallow soils. It is likely occasionally used for foraging and dispersal only, and more likely the areas of lower elevation.	

675000 680000 685000 690000

7660000 7655000 7650000

WDG_01 WDG_02 WDG_03 MR GB OS 12 WDG_04 WDG_05 WDG_06 WDG_07 WDG_08 MR GB OS 13 WDG_09 WDG_10 WDG_11 WDG_12 MR GB OS 14 WDG_13 WDG_14 WDG_15 WDG_16 WDG_17 WDG_18 WDG_19 WDG_20 WDG_21 WDG_22 WDG_23 WDG_24 WDG_25 WDG_26 WDG_27 WDG_28 WDG_29 WDG_30 WDG_31 WDG_32 WDG_33 WDG_34 WDG_35 WDG_36 WDG_37 WDG_38 MR GB OS C03 WDG_39 WDG_40 WDG_41 WDG_42 WDG_43 MR GB AS41 WDG_44 MR GB OS C04 WDG_45 WDG_46 WDG_47 WDG_48 WDG_49 WDG_50 WDG_51 WDG_52 WDG_53 MR GB OS 15 WDG_54

Legend

- Survey Area
- Survey Sites
- Monitoring Sites

Fauna Habitat Types

- Plain (sand)
- Plain (stony/gibber)
- Drainage Line/River/Creek (Major)
- Drainage Line/River/Creek (Minor)
- Granite Outcrops (boulder piles)
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Cleared/Disturbed

N

0 0.5 1 1.5 2 km

Scale 1:58,500 @ A3

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

Spectrum

Author: EM Date: 09-09-2024

Fauna Habitat Types

Turner River Solar Hub Project

MAP

Prepared for Fortescue

4.5

4.2.2. Bilby Evidence

During the survey, confirmed presence of the Bilby was recorded from three sites: WDG_37, WDG_38 and MR GB AS 41 (see Map 4.5 and Map 4.6). Two of these sites (WDG_37 and MR GB AS 41) were completed at a known location of the Bilby recorded by Spectrum (2025b) during the NSJW detailed and targeted fauna assessment. The monitoring site (MR GB AS 41) was completed just prior to this targeted survey, with minimal scats (two samples) and fresh evidence recorded. Therefore, site WDG_37, focused on searching the area further to the north of the known activity area. The third site, WDG_38, was located to the east (across a road) of the other two sites, where old evidence had previously been recorded (Spectrum, 2025b). This small area was confirmed as being occupied by the Bilby, with fresh diggings, scats and active burrows. The resident female Bilby recorded from site MR GB AS 41 (and WDG_37) likely crosses the road regularly to move between its burrows and foraging areas (sites MR GB AS 41 /WDG_37 and WDG_38). The locations and details of the confirmed evidence recorded are detailed in Table 4.7, and all records are shown on Map 4.6.

During the survey, a total of 23 scat samples of varying age was collected from the sites. All scat samples were sent to Helix Solutions for analysis (Appendix D). Of the 23 samples collected, three contained fresh DNA and were successfully genotyped, with the remaining 20 failing across six repeat runs. Sequence analysis was then completed on the 20 failed samples; nine of which were successfully sequenced and matched to the Bilby. The remaining 11 were unsuitable for DNA sequencing due to DNA degradation from scat age and exposure to adverse weather conditions, such as recent rainfall. The three samples successfully genotyped all belonged to one individual (identity 6 in Appendix D) which is likely the female Bilby that Spectrum (2025b) previously trapped at the same location. It should be noted that other scat samples collected for Fortescue's Fauna Monitoring Program from Main Line Rail Bilby sites were also assessed at the same time and provided in a singular DNA report (Appendix D).

In addition to the confirmed evidence at three sites, potential evidence of the Bilby was recorded from 10 sites within the Survey Area, with old, ambiguous diggings and burrows that may be attributed to this species. The secondary evidence was difficult to confirm, partially due to the weather conditions preceding the survey (heavy rainfall). These sites were WDG_01, WDG_05, WDG_06, WDG_09, WDG_19, WDG_22, WDG_23, WDG_27, WDG_48, and MR GB OS C03. Site WDG_01 was in close proximity to an area where scats and other evidence had been recorded previously during the ongoing Fauna Monitoring Program and one other survey (ATA, 2007) during which recent evidence was recorded (fresh burrows and potential old diggings and burrows). Therefore, evidence at site WDG_01 may align with this older evidence, indicating that Bilbies may have been present some time ago. Details of potential diggings and burrows are outlined in Table 4.7, and are shown on Map 4.6.

Other signs from other more common species, such as the Australian Bustard and goannas (*Varanus* spp.), were detectable in some plots, indicating that if Bilbies were present, they would have been detected. The heavy rain and windy weather conditions that occurred just prior to the survey, and the windy conditions that continued, likely impacted the presence of secondary evidence, although improving the assessment of the age of signs.

Based on the previous surveys and evidence recorded, it is likely that Bilbies have been inhabiting the area surrounding sites MR GB AS41 /WDG_37 and WDG_38 for some time. Additionally, further Bilbies could be occupying areas adjacent to the Survey Area and using it for dispersal and foraging, which aligns with previous evidence (especially scats) recorded in the north.

Table 4.7: Bilby Evidence Recorded

Site	Location		Record Type	Photo
	Easting*	Northing*		
Confirmed Evidence				
WDG_37	685796 685966	7651060 7651067	Scat (S01 ,left) Scat (S09, right)	 
	685836 685725	7651035 7650729	Burrow (B02, left) Burrow B03, right)	 
	686001 685924	7651226 7651042	Digging & scat (S01, left) Digging (D07, right)	 

Site	Location		Record Type	Photo
	Easting*	Northing*		
	685920	7651039	Track (T01)	
WDG_38	686242	7651108	Scat (S02, left)	 
	686289	7651059	Scat (S03, right)	
	686250	7651097	Digging (D04, left)	 
	686288	7651059	Scratchings (D09, right)	
	686269	7651082	Burrow (B02, left)	 
	686260	7651017	Burrow (B04, right, current burrow)	

Site	Location		Record Type	Photo
	Easting*	Northing*		
MR GB AS 41	685770	7650735	Scat (S02)	
	685958 685929	7650772 7650754	Digging (D02, left) Digging (D04, right)	 
	685796 685908	7650795 7650735	Burrow (B01, left) Burrow (B04, right – fresh test burrow)	 
Potential – Old Evidence				
WDG_01	681426 681435	7662823 7662810	Potential old burrow (B01, left, filled with sand) Potential old burrow B02, right)	 

Site	Location		Record Type	Photo
	Easting*	Northing*		
	681485 681432	7662792 7662829	Old digging (D01, left) Old digging (D04, right)	 
WDG_05	683518 683525	7661358 7661334	Old digging (D01, left) Old digging (D09, right)	 
WDG_27	685796 685966	7651060 7651067	Old digging (D01, left) Old digging (D03, right)	 
WDG_48	682408 682375	7649779 7649917	Old digging (D03, left) Old digging (D08, right)	 

675000
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Legend

Survey Area

Bilby Evidence

Confirmed Bilby Evidence

- Burrow
- Digging
- Scat
- Track

Potential Bilby Evidence

- Burrow
- Digging

Fauna Habitat Types

- Plain (sand)
- Plain (stony/gibber)
- Drainage Line/River/Creek (Major)
- Drainage Line/River/Creek (Minor)
- Granite Outcrops (boulder piles)
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Cleared/Disturbed

N

0 0.5 1 1.5 2 km

Scale 1:58,500 @ A3

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

Spectrum Ecology + Spatial

Author: EM

Date: 30-01-2025

Confirmed & Potential Bilby Evidence

Tuner River Solar Hub Project

MAP 4.6

Prepared for Fortescue

4.2.3. Other Species Recorded

A total of 40 non-target species were also recorded during the survey. This included eight species of mammals, 28 birds and four reptiles (Table 4.8). Three of the mammal species recorded are considered significant fauna; Brush-tailed Mulgara (*Dasycercus blythi*, DBCA Priority 4 (P4)), Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*, DBCA P4) and the Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA P4; refer to section 4.2.4), while the remaining five species of mammal are introduced species. This includes the Feral Cat (*Felis catus*) and Dingo/Dog (*Canis familiaris*) which are a known threat to Bilbies and other native species. Additionally, the presence of European Cattle (*Bos taurus*), Horses (*Equus ferus*) and Donkey (*Equus africanus*) may impact Bilbies by competing for resources. The introduced herbivores degrade habitat by removing vegetation cover (overgrazing) and by trampling, causing soil compaction and damaging regenerating vegetation.

Table 4.8: Other Species Recorded

Species Name	Scientific Name	Conservation Status			Comments
		EPBC Act	BC Act	DBCA	
Mammals					
Brush-tailed Mulgara	*Dasycercus blythi*	-	-	P4	Burrows and diggings likely from this species at 10 sites
Spectacled Hare-wallaby	*Lagorchestes conspicillatus leichardti*	-	-	P4	Potential tracks of this species at two sites
Western Pebble-mound Mouse	*Pseudomys chapmani*	-	-	P4	One active mound
*Dingo, Dog	*Canis familiaris*	-	-	-	
*Cat	*Felis catus*	-	-	-	
*Horse	*Equus ferus*	-	-	-	
*Donkey	*Equus africanus*	-	-	-	
*European Cattle	*Bos taurus*	-	-	-	
Birds					
Emu	*Dromaius novaehollandiae*	-	-	-	
Australian Bustard	*Ardeotis australis*	-	-	-	
Spinifex Pigeon	*Geophaps plumifera*	-	-	-	
Diamond Dove	*Geopelia cuneata*	-	-	-	
Little Buttonquail	*Turnix velox*	-	-	-	
Little Eagle	*Hieraaetus morphnoides*	-	-	-	
Wedge-tailed Eagle	*Aquila audax*	-	-	-	
Spotted Harrier	*Circus assimilis*	-	-	-	

Species Name	Scientific Name	Conservation Status			Comments
		EPBC Act	BC Act	DBCA	
Rainbow Bee-eater	*Merops ornatus*	-	-	-	
Nankeen Kestrel	*Falco cenchroides*	-	-	-	
Brown Falcon	*Falco berigora*	-	-	-	
Galah	*Eolophus roseicapilla*	-	-	-	
Purple-backed Fairywren	*Malurus assimilis*	-	-	-	
White-winged Fairywren	*Malurus leucopterus*				
Brown Honeyeater	*Lichmera indistincta*	-	-	-	
Singing Honeyeater	*Gavicalis virescens*	-	-	-	
Grey-headed Honeyeater	*Ptilotula keartlandi*	-	-	-	
Yellow-throated Miner	*Manorina flavigula*	-	-	-	
Red-browed Pardalote	*Pardalotus rubricatus*				
Black-faced Woodswallow	*Artamus cinereus*	-	-	-	
Pied Butcherbird	*Cracticus nigrogularis*	-	-	-	
White-winged Triller	*Lalage tricolor*	-	-	-	
Willie Wagtail	*Rhipidura leucophrys*	-	-	-	
Torresian Crow	*Corvus orru*	-	-	-	
Rufous Songlark	*Cincloramphus mathewsi*	-	-	-	
Painted Finch	*Emblema pictum*	-	-	-	
Australian Zebra Finch	*Taeniopygia castanotis*	-	-	-	
Australian Pipit	*Anthus australis*	-	-	-	
Reptiles					
Western Ring-tailed Dragon	*Ctenophorus caudicinctus*	-	-	-	
Central Military Dragon	*Ctenophorus isolepis*	-	-	-	
Western Ring-tailed Dragon	*Ctenophorus caudicinctus*	-	-	-	
Leopard Skink	*Ctenotus pantherinus*	-	-	-	

Note: * = Introduced species

4.2.4. Other Significant Fauna Recorded

Three species of non-target significant fauna were recorded during the survey. Burrows and diggings likely belonging to the Brush-tailed Mulgara (*Dasycercus blythi*, DBCA P4) were recorded at 10 sites: WDG_02, WDG_05, WDG_06, WDG_15, WDG_18, WDG_23, WDG_26, WDG_32, WDG_37, and WDG_48. Numerous tracks recorded at sites (WDG_15 and WDG_18) were potentially from the Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*, DBCA P4). Spectrum (2023) recorded this species within 500 m of the Survey Area on a motion camera in 2022 as part of Fortescue's Fauna Monitoring Program. Additionally, an individual was recently sighted in September 2024, crossing the road near the Iron Bridge Gatehouse, approx. 8 km east of the Survey Area (Fortescue's Plant and Animal Register). The Western Pebble-mound Mouse (*Pseudomys chapmani*, DBCA P4) was recorded at site WDG_50, from one active mound. Details of the records are listed in Table 4.9, and shown on Map 4.7.

Table 4.9: Other Significant Fauna Recorded

Species	Site	Location		Record Type	Photo
		Easting	Northing		
Brush-tailed Mulgara *Dasycercus blythi*	WDG_02	682688	7662481	Burrow (B01)	
	WDG_06	685228	7661745	Burrow (B01)	
	WDG_15	682151	7655875	Burrow (B01)	

Species	Site	Location		Record Type	Photo
		Easting	Northing		
	WDG_18	682580	7655575	Diggings (D07)	
Brush-tailed Mulgara *Dasycercus blythi*	WDG_48	682411	7649782	Burrow (B02)	
Spectacled Hare-wallaby *Lagorchestes conspicillatus leichardti*	WDG_15	682115	7655845	Track (T02)	

Species	Site	Location		Record Type	Photo
		Easting	Northing		
	WDG_18	682625	7655547	Track (T06)	
Western Pebble-mound Mouse *Pseudomys chapmani*	WDG_50	684784	7649427	Active mound (PMM01)	

* Coordinate Reference System: GDA94 / MGA Zone 50

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Legend

Survey Area

Other Significant Fauna Recorded

- Brush-tailed Mulgara - Burrow
- Brush-tailed Mulgara - Digging
- Western Pebble-mound Mouse - Mound
- Spectacled Hare-wallaby - Track

Fauna Habitat Types

- Plain (sand)
- Plain (stony/gibber)
- Drainage Line/River/Creek (Major)
- Drainage Line/River/Creek (Minor)
- Granite Outcrops (boulder piles)
- Granite Outcrops (flat dome)
- Hills/Ranges/Plateaux
- Cleared/Disturbed

N

0 0.5 1 1.5 2 km

Scale 1:58,500 @ A3

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

Spectrum Ecology + Spatial

Author: EM

Date: 30-01-2025

Other Significant Fauna Recorded

Tuner River Solar Hub Project

MAP

Prepared for Fortescue

4.7

5. CONCLUSION

Twelve previous surveys have been completed partially within the Survey Area, with eight focussing on targeted searches for the Bilby.

The Bilby has previously been recorded from confirmed evidence (individual captured) in the Survey Area in 2023 by Spectrum (2025b), with additional records of potential evidence at other sites. Another 12 previous records of older evidence (confirmed and potential) have been found within the Survey Area as recorded on Fortescue's Internal Database and previous surveys. An additional five records from this database were located within 2 km of the Survey Area. The DBCA database search results had four records from 2013, just outside the Survey Area.

A total of 62 plots were completed during the survey, equating to 65.8 person-hours of searching, and 130.4 km of the Survey Area and surrounding area was traversed.

The SDM model achieved a very high performance with an AUC of 0.941, which indicates the model was highly efficient at measuring presences and pseudo-absences. Of the environmental variables tested, the type of land system and soil environmental variables contributed most to the model. With soils having the highest gain when used in isolation which appears to be the most important variable for the Bilby. Within the Study Area, 48.6% (484,704.2 ha) is classified as a Medium or High likelihood ranks, which contains 95% and 50% of all known records. Conversely, the Survey Area covered a total of 6,948 97.4%) which is assigned a combined Medium or High probability rank. The habitat mapping confirms this result, which identified three critical habitats, (Plain (sand), and Drainage Line/River/Creek (major & minor), that provide suitable breeding and foraging conditions for the Bilby. These habitats occupy 90.2% of the Survey Area and are suitable for burrowing and foraging due to the presence of plant species that contain RDL, a food resource for the Bilby. The remaining habitats are likely restricted to dispersal and occasional foraging only, if used at all. The habitats present are not restricted to the Survey Area and continue in the surrounding Abydos Plain. As the Bilby is highly mobile and forages over vast areas, Bilbies may move into additional areas of the critical habitats mapped within the Survey Area.

Confirmed Bilby presence was recorded from the already known Bilby location (WDG_37 and MR GB AS 41), with its area of occupancy increasing to include an additional small, fragmented area across a road surrounded by infrastructure and cleared areas (WDG_38). The female Bilby may be crossing the road regularly to move between burrows and foraging areas. Potential signs in the form of old burrows and old diggings were recorded elsewhere within the Survey Area.

Based on the previous surveys and evidence recorded during the current survey, it is likely that Bilbies have been inhabiting the area surrounding these sites for some time. Further Bilbies could be occupying areas adjacent to the Survey Area, which aligns with previous evidence (especially scats) recorded in the north.

Forty non-target species were recorded during the survey and included three significant species:

- Brush-tailed Mulgara – likely burrows and diggings;
- Spectacled Hare-wallaby – potential tracks; and
- Western Pebble-mound Mouse – one active mound.

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APPENDIX A: CONSERVATION CODES

Appendix A1: Definitions of Conservation Categories under the EPBC Act 1999.

Category	Definition
Extinct	The last member of the species has died.
Extinct in the Wild	Species known to survive only in cultivation or in captivity, or as a naturalised population well outside its past range.
Critically Endangered	Species facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Species facing a very high risk of extinction in the wild in the near future.
Vulnerable	Species facing a high risk of extinction in the wild in the medium-term future.
Conservation Dependent	Species the focus of a specific conservation program without which the species would become vulnerable, endangered, or critically endangered within five years.
Migratory	The EPBC Act provides for protection of migratory species as a matter of national environmental significance. Migratory species are those animals that migrate to Australia and its external territories or pass though or over Australian waters during their annual migrations (DotE 2013). Migratory species are listed under the following international conventions: • Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); • China-Australia Migratory Bird Agreement (CAMBA); • Japan-Australia Migratory Bird Agreement (JAMBA); and, Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Appendix A2: Definitions of Conservation Categories Under the BC Act 2016

Category (Code)	Definition
Threatened Species Protected under the Biodiversity Conservation Act and listed under the most recent Wildlife Conservation (Specially Protected Fauna Notice) or Wildlife Conservation (Rare Flora Notice). Species are listed as threatened when they face a high to very high risk of extinction in the wild.	
Critically Endangered (CR)	Species facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Species facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Species considered to be "facing a high risk of extinction in the wild in the medium-term future.
Extinct species	
Extinct species (EX)	The last member of the species has died.
Extinct in the wild species (EW)	Species known to survive only in cultivation or in captivity, or as a naturalised population well outside its past range.
Specially protected species Species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.	
Migratory species (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. 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.
Conservation Dependent (CD)	Fauna or flora of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
Other specially protected species (OS)	Fauna otherwise in need of special protection to ensure their conservation.

Appendix A2: Department of Biodiversity, Conservation and Attractions Priority Listing

Category	Definition
Priority species (P) Species that do not have statutory protection under the Biodiversity Conservation Act 2016, but are identified as conservation priorities due to insufficient information to assess their conservation status or they are deemed rare but not threatened, necessitating ongoing monitoring. A register of priority species is managed by the Department of Biodiversity Conservation and Attractions (DBCA).	
Priority 1	Poorly known species that are known from one or a few locations which are potentially at risk.
Priority 2	Poorly known species that are known from one or a few locations, some of which are on managed.
Priority 3	Poorly known species that are known from several locations, and the species does not appear to be under imminent threat.
Priority 4	(a) Rare. Species 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. (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: SURVEY SITE INFORMATION

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_01	681479	7662787	Plain (sand) & Drainage Line/River/Creek (Minor)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps, A. trachycarpa*	Sand	Thick	Up to 1/2	1-3 m	>5 years	Distinct	1 day	1 day	
WDG_02	682610	7662458	Plain (sand) & Granite Outcrops (flat domes)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	5 days	3 days	
WDG_03	683400	7662518	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	1 day	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_04	682643	7661494	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay, loam	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	5 days	3 days	
WDG_05	683634	7661435	Plain (sand)	Plain (sand) & Plain (stony/gibber)	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia bivenosa, A. stellaticeps*	Sand, loam	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	4 days	2 days	
WDG_06	685197	7661560	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	3 days	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_07	683420	7660571	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia colei, A. stellaticeps*	Sand, loam	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	5 days	3 days	
WDG_08	684537	7660480	Plain (sand)	Plain	High to low *Acacia* spp. over hummock grassland	*Acacia colei, A. stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	4 days	2 days	
WDG_09	683713	7659498	Plain (sand) & Plain (stony/gibber)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to all	1-3 m	>5 years	Distinct	5 days	2 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_10	684625	7659475	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia colei, A. stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	5 days	2 days	
WDG_11	683053	7658377	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 1/2	>3 m	>5 years	Slight	6 days	3 days	
WDG_12	684598	7658530	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia colei*	Sand	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	4 days	2 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_13	683622	7656477	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia colei, A. stellaticeps*	Clay, loam, laterite	Open	Up to 3/4	<1 m	1-5 years	Slight	6 days	3 days	
WDG_14	683846	7656188	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	-	Sand	Open	Up to ½	>3 m	>5 years	Slight	6 days	3 days	
WDG_15	681992	7656014	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia bivenosa, A. stellaticeps*	Sand	Open	Up to 3/4	1-3 m	>5 years	Distinct	2 days	0 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_16	683483	7655813	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	6 days	0 days	
WDG_17	684224	7655520	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 1/2	Continuously sandy	>5 years	Slight	6 days	3 days	
WDG_18	682832	7655435	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia bivenosa*	Sand, clay	Open	Up to 1/2	<1 m	>5 years	Distinct	2 days	0 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_19	679644	7654429	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	2 days	2 days	
WDG_20	680810	7654526	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	2 days	2 days	
WDG_21	681357	7654456	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	2 days	0 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_22	682651	7654478	Plain (sand) & Plain (stony/gibber)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 1/2	1-3 m	1-5 years	Distinct	2 days	0 days	
WDG_23	683571	7654520	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	2 days	0 days	
WDG_24	680602	7653572	Plain (sand)	Plain	Low shrubs of *Acacia* spp. and *Melaleuca* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to all	1-3 m	1-5 years	Distinct	2 days	2 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_25	681439	7653448	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	3 days	1 day	
WDG_26	682681	7653513	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	2 days	0 days	
WDG_27	683621	7653405	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	-	Sand	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	2 days	0 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_28	684686	7653543	Plain (sand)	Granite outcrops	Low shrubs of *Acacia* spp. and *Melaleuca* spp. over hummock grassland	-	Sand	Open	Up to 3/4	1-3 m	<1 year	Distinct	6 days	4 days	
WDG_29	679501	7653586	Plain (sand) & Drainage Line/River/Creek (Major)	Major Drainage Line incl. surrounding floodplain & plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	5 days	3 days	
WDG_30	680759	7652506	Plain (sand) & Drainage Line/River/Creek (Major/Minor)	Major Drainage Line incl. surrounding floodplain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 3/4	<1 m	1-5 years	Distinct	2 days	2 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_31	682221	7652298	Plain (sand)	Major Drainage Line incl. surrounding floodplain & plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Open	Up to 3/4	>3 m	1-5 years	Distinct	5 days	3 days	
WDG_32	683640	7652441	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	3 days	1 day	
WDG_33	686045	7652190	Plain (sand)	Minor Drainage Line incl. surrounding floodplain & plain	Low shrubs of *Acacia* spp. over hummock grassland	*Senna notabilis*	Sand	Open	Up to 3/4	1-3 m	<1 year	Distinct	6 days	0 days	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_34	679607	7651504	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to all	>3 m	<1 year	Distinct	1 day	1 day	
WDG_35	680958	7651620	Plain (sand) & Drainage Line/River/Creek (Minor)	Plain, Minor Drainage Line incl. surrounding floodplain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	-	Sand	Open	Up to 1/2	1-3 m	<1 year	Distinct	1 day	1 day	
WDG_36	683864	7651723	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	3 days	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_37	685919	7651313	Plain (sand) & Drainage Line/River/Creek (Minor) & Granite Outcrops (boulder piles)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 3/4	1-3 m	>5 years	Distinct	5 days	3 days	
WDG_38	686289	7651127	Plain (sand) & Drainage Line/River/Creek (Minor)	Minor Drainage Line incl. surrounding floodplain & plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Open	Up to 3/4	1-3 m	<1 year	Distinct	6 days	0 days	
WDG_39	678734	7650597	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	>5 years	No shadow	1 day	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_40	680186	7650612	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	<1 year	Distinct	1 day	1 day	
WDG_41	681573	7650401	Plain (sand) & Drainage Line/River/Creek (Minor)	Minor Drainage Line incl. surrounding floodplain & plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 1/2	1-3 m	<1 year	Distinct	1 day	1 day	
WDG_42	683339	7650867	Drainage Line/River/Creek (Minor) & Plain (sand)	Minor Drainage Line incl. surrounding floodplain	Mulga shrubland over hummock and tussock grassland	*Acacia stellaticeps*	Sand	Open	Up to 1/2	1-3 m	1-5 years	Distinct	3 days	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_43	684634	7650490	Plain (sand)	Plain with some granite outcropping	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 1/2	<1 m	1-5 years	Distinct	3 days	1 day	
WDG_44	685776	7650315	Plain (sand) & Drainage Line/River/Creek (Minor)	Minor Drainage Line incl. surrounding floodplain & plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps, Senna notabilis*	Sand, clay	Open	Up to 1/2	<1 m	1-5 years	Distinct	6 days	3 days	
WDG_45	679141	7649646	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Moderate	Up to 3/4	1-3 m	1-5 years	Distinct	1 day	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_46	680673	7649478	Plain (sand) & Drainage Line/River/Creek (Minor)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	<1 year	Distinct	1 day	1 day	
WDG_47	681640	7649433	Plain (sand) & Drainage Line/River/Creek (Minor)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia bivenosa, A. stellaticeps*	Sand	Moderate	Up to 1/2	1-3 m	1-5 years	Distinct	1 day	1 day	
WDG_48	682425	7649728	Plain (sand) & Drainage Line/River/Creek (Minor)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	3 days	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_49	683574	7649598	Plain (sand) & Drainage Line/River/Creek (Minor) & Granite Outcrops (boulder piles)	Minor drainage line incl. surrounding floodplain and granite outcropping	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 3/4	1-3 m	1-5 years	Distinct	3 days	1 day	
WDG_50	684590	7649515	Granite Outcrops (boulder piles) & Plain (sand)	Stony rises	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand	Open	Up to 1/4	<1 m	1-5 years	Distinct	3 days	1 day	
WDG_51	680687	7648487	Plain (sand)	Plain	Low woodland of *Eucalyptus* and *Acacia* spp. over hummock grassland	*Acacia stellaticeps*	Sand, clay	Moderate	Up to 1/2	1-3 m	1-5 years	Distinct	1 day	1 day	

Site	Location		Fauna Habitat Type	Habitat Features								Survey Conditions			Photo
	Easting*	Northing		Landform	Vegetation	RDL Shrubs Present	Substate Type	Vegetation Cover	Tracking Suitability	Sand Patch Size	Time Since Last Fire	Shadow	Time since rain	Time since windy	
WDG_52	681631	7648478	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	-	Sand	Open	Up to all	1-3 m	<1 year	Distinct	1 day	1 day	
WDG_53	682570	7648492	Plain (sand)	Plain	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia bivenosa, A. stellaticeps*	Sand	Open	Up to 1/4	<1 m	1-5 years	Distinct	2 days	1 day	
WDG_54	681624	7647448	Plain (sand)	Plain and Granite Outcropping	Low shrubs of *Acacia* spp. over hummock grassland	*Acacia bivenosa, A. stellaticeps*	Sand, clay	Moderate	Up to 1/4	<1 m	1-5 years	Distinct	3 days	1 day	

APPENDIX C: BILBY REGIONAL APPENDIX

Family & Scientific Name	Common Name	Conservation Status			Database Searches					Literature Review																								Current survey
		EPBC Act	BC Act	DBCA	PMST	DBCA	NatureMap	Atlas of Living Australia	Fortescue Internal Database	Spectrum (2024) NSJW Detailed Fauna	Fauna Monitoring 2013-2023 (ecologia, Ecoscape & Spectrum)	360 (2023) NSJ Vertebrate Fauna	Ecoscape (2021) NSJ Flora & Fauna	Ecoscape (2020) PTP Flora & Fauna	Spectrum (2018) PTP Fauna Desktop	ecologia (2012a) NS Level 2 Verebrate Fauna	ecologia (2012b) NS Access Corridor Flora & Fauna	Terrestrial Ecosystem (2011) Roy Hill Rail Significant Fauna	Targeted Fauna Assessment of the Rail Duplication Bamford (2010)	Ecoscape (2009) Targeted Flora & Fauna Rail Corridor GDPs	ATA (2007) Significant Fauna Proposed Rail Corridor & Borrow Pits	Biota Environmental (2004) FMG Stage A	Western Wildlife (2020) Wodgina Lithium Project Level 2 Fauna	Stantec (2018) Wodgina Project: Level 1 & Targeted Fauna	Outback Ecology (2011) Wodgina Hercules Project: Terrestrial Fauna	Outback Ecology (2009) Wodgina DSO Project: Terrestrial Fauna	360 (2018b) Wodgina Gas Pipeline Targeted Fauna	360 (2018a) Wodgina Aerodrome Targeted Fauna	Spectrum (2021) Glacier Valley Fauna	Western Wildlife (2023) Hemi Gold Detailed Fauna	Outback (2011) Abydos DSO fauna	Outback (2011) Mt dove DSO	Panorama Project Area: Baseline Fauna Study Bamford (2001)	
THYLACOMYIDAE																																		
Macrotis lagotis	Bilby	VU	VU		✓	✓	✓	✓	✓	✓	✓	D	SP	SO				SO	SO	SOA	SOA	S		O			S	S		SO				✓

Key

D - recorded from database search results

S - Presence recorded from secondary signs

SP - Presence recorded from secondary signs, potential only

SO - Presence recorded from secondary signs, old evidence

SOA - Presence recorded from secondary signs, old & active evidence

O - Presence from other survey

APPENDIX D: BILBY SCAT REPORT

*Please note that site names have been updated and are not as listed in the Bilby scat report.

Helix Molecular Solutions

Genotyping the Greater Bilby (*Macrotis lagotis*) from scat samples for individual identification



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Genotyping Greater Bilby (*Macrotis lagotis*) Individuals from Scat Samples

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1.0 Glossary

allele	An allele is one of two or more versions of DNA sequence (a single base or a segment of bases) at a given genomic location.
B_p	Base pairs. They are the fundamental unit of double-stranded nucleic acids consisting of two nucleobases bound to each other by hydrogen bonds. They form the building blocks of the DNA double helix.
DNA	Deoxyribonucleic acid. DNA is the molecule that carries genetic information for the development and functioning of an organism.
FA	Fragment Analysis. Fragment analysis is a genetic analysis method that uses fluorescently labelled DNA fragments and capillary electrophoresis to size and genotype DNA.
F_{IS}	Inbreeding Coefficient also known as heterozygote deficit; a measurement of the reduction in heterozygosity of an individual as a result of non-random mating within its subpopulation.
genotype	A genotype is a scoring of the type of variant present at a given location (i.e. a locus) in the genome.
H_E	Expected Heterozygosity.
H_O	Observed Heterozygosity.
HWE	Hardy Weinberg Equilibrium. It is a principle stating that the genetic variation in a population will remain constant from one generation to the next in the absence of disturbing factors. When mating is random in a large population with no disruptive circumstances, the law predicts that both genotype and allele frequencies will remain constant because they are in equilibrium.
I	Information index.
loci	Plural of locus.
locus	A specific, fixed position on a chromosome where a particular gene or genetic marker is located.
N_a	Number of alleles. Allelic variation at a locus that can be measured/observed within a population.
N_e	Number of effective alleles. The number of equally frequent alleles that it would take to achieve the same expected heterozygosity as in your studied population. This number is, in general, lower than the actual (observed) number of alleles.
PCR	Polymerase Chain Reaction. A method widely used to make millions to billions of copies of a specific DNA sample rapidly, allowing scientists to amplify a very small sample of DNA (or a part of it) sufficiently to enable detailed study.
Polymorphism	Refers to the presence of two or more variant forms of a specific DNA sequence (allele) that can occur among different individuals or populations.
uH_E	Unbiased Expected Heterozygosity.

2.0 Executive Summary

Helix Molecular Solutions (Helix) was engaged by Spectrum Ecology to perform DNA extractions from faecal (scat) samples collected during a targeted survey. The objective of this project was to assign individual identification based on the unique genotypes. DNA was extracted from Forty-five bilby scat samples submitted to Helix Molecular Sciences (Helix) from the project area. Eighteen samples yielded DNA of sufficient quality to produce a clean genotype suitable for individual discrimination. When all sampling years are considered, genotypes were assigned to a total of six distinct genotype identity groups, with each group representing the identity of a single individual. Three groups were exclusive to the current survey and three had previously been detected by Helix from surveys that occurred in 2021, 2022 and 2023. None of the three previously detected groups were identified in the current scat collection. Across the four survey years (2021 – 2024) there have been in total, six individual bilbies (*Macrotis lagotis*) detected.

3.0 Introduction

3.1 Study Scope

Spectrum Ecology and Spatial engaged Helix to determine the minimum number of individual bilbies (*Macrotis lagotis*) collected from the project area across three sampling periods (25th March / 1st May, 30 – 31st July, and 5th – 9th August 2024). This was undertaken by extracting DNA from scat samples collected during surveys, followed by genotyping those that yielded high quality DNA.

4.0 Methods

DNA was extracted from forty-five scat samples suspected to belong to the Greater Bilby (*Macrotis lagotis*). Collections occurred during three sampling periods: the March/May collection garnered *n*=12 samples, the July collection yielded *n*=11 samples and the August collection amassed *n*=22 samples (Table 1). Scat samples submitted to Helix were stored in a sterile vial in silica-based desiccant to preserve DNA through the provision of a dry environment. Samples were moderately to extremely dry upon receipt and ranged in size from small to large. One to three scats from each sample were selected for extraction. During analysis, reference genetic data was included from previous collections within the general project area to determine if the same individuals were detected across different survey years (2021 – 2023, Table 2).

Table 1 **Bilby scat sample identification and collection details from the current collection.** Shaded cells represent samples that did not produce a useable genotype.

Sampling locality	Easting (m)	Northing (m)	Collection date	Sampling year	Scat Field ID	Scat size	Scat moisture status	Helix ID
MR GB OS 23	696795	7607964	1/5/2024	2024	MRGB OS23 S1	Medium	Dry	**TJ01**
MR GB OS 23	696781	7607927	1/5/2024	2024	MRGB OS23 S2	Medium	Moderate	**TJ02**
MR GB OS 23	696781	7607927	1/5/2024	2024	MRGB OS23 S2.1	Med-Large	Dry	**TJ03**
MR GB OS 23	696829	7607937	1/5/2024	2024	MRGB 23 Scat 3	Small-Med	Moderate	**TJ04**
MR GB OS 23	696817	7607961	1/5/2024	2024	MRGB OS23 Scat 4	Large	Moderate	**TJ05**
MR GB OS 23	696811	7607966	1/5/2024	2024	MRGB OS23 S5	Med-Large	Very dry	**TJ06**
MR GB OS 23	696798	7607944	1/5/2024	2024	MRGB OS23 S6	Medium	Dry	**TJ07**
MR GB OS 23	696795	7607945	1/5/2024	2024	MRGB OS23 S7	Small-Med	Very dry	**TJ08**
MR GB OS 23	696792	7607973	1/5/2024	2024	MRGB OS23 S8	Large	Moderate	**TJ09**
MR GB OS 23	696761	7607983	1/5/2024	2024	MRGB OS23 S9	Small-Med	Very dry	**TJ10**
MR GB OS 23	696761	7607983	1/5/2024	2024	MRGB OS23 Scat 9.1	Small	Moderate	**TJ11**
MR GB AS 41	685880	7650686	25/3/2024	2024	MRGB ASI41	Small	Very dry	**TJ12**
MR GB OS 23	696748	7607992	30/7/2024	2024	GB23 P01	Med-Large	Very dry	**TJ13**
MR GB OS 23	696735	7607997	30/7/2024	2024	GB23 P02	Small	Very dry	**TJ14**
MR GB OS 23	696771	7607999	30/7/2024	2024	GB23 P03	Small	Very dry	**TJ15**
MR GB OS 23	696796	7607971	30/7/2024	2024	GB23 P04	Small	Dry	**TJ16**
MR GB OS 23	696796	7607971	30/7/2024	2024	GB23 P05	Small	Very dry	**TJ17**
MR GB OS 23	696780	7607997	30/7/2024	2024	GB23 P06	Large	Very dry	**TJ18**
MR GB OS 23	696797	7607970	30/7/2024	2024	GB23 P07	Large	Dry	**TJ19**
MR GB OS 23	696797	7607970	30/7/2024	2024	GB23 P08	Small-Med	Very dry	**TJ20**
MR GB OS 23	696795	7607972	30/7/2024	2024	GB23 P09	Med-Large	Very dry	**TJ21**
MR GB AS 41	685921	7650713	31/7/2024	2024	GB41 P01	Small	Extremely dry	**TJ22**
MR GB AS 41	685770	7650735	31/7/2024	2024	GB41 P02	Med-Large	Very dry	**TJ23**
WDG_43	682102	7655845	5/8/2024	2024	WDG_43 01	Medium	Moderate	**TJ24**

Sampling locality	Easting (m)	Northing (m)	Collection date	Sampling year	Scat Field ID	Scat size	Scat moisture status	Helix ID
WDG_54	686001	7651226	8/8/2024	2024	Peanut 01	Med-Large	Dry	**TJ25**
WDG_54	686136	7651140	8/8/2024	2024	Peanut 02	Medium	Dry	**TJ26**
WDG_54	686003	7651040	8/8/2024	2024	Peanut 03	Medium	Very dry	**TJ27**
WDG_54	685796	7651060	8/8/2024	2024	Peanut 04	Medium	Dry	**TJ28**
WDG_54	685814	7651052	8/8/2024	2024	Peanut 05	Small-Large	Very dry	**TJ29**
WDG_54	685813	7651048	8/8/2024	2024	Peanut 06	Medium	Dry	**TJ30**
WDG_54	685916	7651036	8/8/2024	2024	Peanut 07	Med-Large	Very dry	**TJ31**
WDG_54	685924	7651041	8/8/2024	2024	Peanut 08	Extra-large	Dry	**TJ32**
WDG_54	685924	7651043	8/8/2024	2024	Peanut 09	Medium	Very dry	**TJ33**
WDG_54	685946	7651044	8/8/2024	2024	Peanut 10	Med-Large	Very dry	**TJ34**
WDG_54	686003	7651034	8/8/2024	2024	Peanut 11	Large	Very dry	**TJ35**
WDG_54	685966	7651067	8/8/2024	2024	Peanut 12	Medium	Dry	**TJ36**
WDG_54	685989	7650969	8/8/2024	2024	Peanut 13	Large	Very dry	**TJ37**
WDG_54	685994	7650969	8/8/2024	2024	Peanut 14	Med-Large	Very dry	**TJ38**
WDG_51	686243	7651114	9/8/2024	2024	WDG_51 01	Large	Very dry	**TJ39**
WDG_51	686242	7651108	9/8/2024	2024	WDG_51 02	Medium	Very dry	**TJ40**
WDG_51	686289	7651059	9/8/2024	2024	WDG_51 03.1	Medium	Very dry	**TJ41**
WDG_51	686289	7651059	9/8/2024	2024	WDG_51 03.2	Small	Very dry	**TJ42**
WDG_51	686291	7651118	9/8/2024	2024	WDG_51 04	Medium	Very dry	**TJ43**
WDG_51	686292	7651115	9/8/2024	2024	WDG_51 05	Large	Very dry	**TJ44**
WDG_12	682582	7655575	5/8/2024	2024	WDG_12 01	Large	Very dry	**TJ45**

Table 2 **Bilby scat sample identification and collection details collated from the three previous sampling years (2021 – 2023).**
Shaded cells represent samples that did not produce a useable genotype.

Sampling locality	Easting (m)	Northing (m)	Collection date	Sampling year	Scat Field ID	Scat size	Scat moisture status	Helix ID
MR GB OS23	696704	7608025	27/06/2023	2023	MR GB OS 23 SO1	Medium	Dry	**SM01**
MR GB OS23	696704	7608025	27/06/2023	2023	MR GB OS 23 SO2	Large	Dry	**SM02**
MR GB OS23	696704	7608025	03/03/2023	2023	MR GB OS 23 SO3	Large	Dry	**SM03**
MR GB OS23	665350	7717540	03/03/2023	2023	MR GB OS 23 SO4	Medium	Dry	**SM04**
MR GB OS23	696790	7607969	03/03/2023	2023	2300 GB OS 23	Large	Dry	**SM05**
MR GB OS23	696736	7608005	28/02/2023	2023	2300 GB OS 23	Med–Large	Dry	**SM06**
MR GB OS23	696772	7607974	27/6/2022	2022	GBS01	Med-Large	Dry	**RP01**
MR GB OS23	696775	7607972	27/6/2022	2022	GBS02	Med-Large	Dry	**RP02**
MR GB OS23	696771	7607972	27/6/2022	2022	GBS03	Med-Large	Dry	**RP03**

Sampling locality	Easting (m)	Northing (m)	Collection date	Sampling year	Scat Field ID	Scat size	Scat moisture status	Helix ID
MR GB OS23	696793	7607985	27/6/2022	2022	GBS04	Med-Large	Dry	**RP04**
MR GB OS23	696853	7608012	27/6/2022	2022	GBS05	Med-Large	Dry	**RP05**
MR GB OS23	696844	7608034	27/6/2022	2022	GBS06	Med-Large	Dry	**RP06**
MR GB ASC16	745448	7606559	11/7/2022	2022	C16 Scat 01	Med-Large	Dry	**RP07**
MR GB OS23	696686	7608071	11/6/2021	2021	OS23 SCAT01NP	Medium	Dry	**QT1**
MR GB OS23	696689	7608074	11/6/2021	2021	OS23 SCAT02NP	Small - Med	Wet	**QT4**
MR GB ASC16	-	-	11/6/2021	2021	ASC16 SCAT02NP	Small - Med	Dry	**QT6**
MR GB ASC16	745257	7606709	11/6/2021	2021	ASC16 SCAT03NP	Medium	Moderate	**QT7**
MR GB OS23	696682	7608055	11/6/2021	2021	OS23 SCAT04NP	Medium	Dry	**QT9**
MR GB OS23	696689	7608032	11/6/2021	2021	OS23 SCAT05NP	Med - Large	Dry	**QT8**
MR GB OS23	696761	7608120	11/6/2021	2021	OS23 SCAT06NP	Med - Large	Dry	**QT10**
MR GB ASC16	744890	7606952	11/6/2021	2021	ASC16 SCAT01NP	Medium	Wet	**QT14**
MR GB OS23	696689	7608075	11/6/2021	2021	OS23 SCAT03NP	Medium	Wet	**QT15**

4.1 DNA Extraction, PCR Amplification and Fragment Sizing

All scat samples submitted to Helix were extracted using the QIAGEN QIAamp Fast DNA Stool mini kit (Qiagen, Hilden, Germany). Samples were washed in buffer as per Carpenter *et al*. (2017), incubated in the buffer overnight to allow maximum recovery of DNA and eluted as per manufacturers protocols.

Seven microsatellite loci (Moritz *et al*. 1997 and Smith *et al*. 2009) were amplified using the QIAGEN Multiplex PCR kit (Qiagen, Hilden, Germany) in triplicate (Table 3). PCR products were analysed on an ABI3730XL Sequencer using Genescan-500 LIZ internal standard (Thermo Fisher Scientific) and scored using the software Geneious Prime® version 2024.0.7 (Drummond *et al.* 2011). Individual genotypes were based on molecular weights.

Table 3 **Summary Information for the seven microsatellite loci used on the Bilby scat samples across all sampling years.**
T optimal annealing temperature, B_p allele size range.

Loci	Repeat bases	Primer sequences (5' - 3')	*T*	B_p
B22	$(CA)_{16}$	F: GGT ATG AGG AAT TAG AAT TAC AGG	55	183-193
		R: CGG TAT TAA ATG GGC TAT GGA GT		
B63	$(CA)_{14}$	F: CTT AGG CAA ATA GGG TGA AGT GG	55	232-250
		R: CAG AAC CAT TAG GAA GGA GTT TC		
B41	$(CA)_{14}$	F: TGA CTT TCT TTT GCT ACA ACA ACC	55	177-192
		R: GGA AAA GTT TTT AGC CTA ATA GTG G		
B55	$(CA)_{24}$	F: GCA CCA ACC TAT CCT CTT CAT TC	55	186-196
		R: CTA CAA GTC TGA TAA TTC CAG GC		
B02	$(CA)_{17}$	F: GCA TGT ACT TAA CCC CCT TTG CC	55	170-183

Loci	Repeat bases	Primer sequences (5' - 3')	*T*	B_p
		R: CCC GAC AAT CCA GCC TGT TAT TC		
B17	$(CA)_{16}$	F: AGC CTG TGT GTC TTA AAA TGC	55	212-221
		R: CTC CAA TTC ACT TTT CCT GAG AC		
B56	$(CA)_{23}$	F: CACACTTATACATACACGTACACG	55	157-170
		R: CAC TAA CAA ATA TGC TTG GGA AAG G		

For quality control, samples that failed genotyping were diluted and re-amplified to test if PCR failure was due to inhibitors in the DNA. When this did not yield additional data points a species identification PCR was performed to confirm the quality of the DNA and species of origin. Species identification PCR amplified an internal fragment of the cytochrome oxidase I gene (COI) which was then compared against the publicly available database GenBank (ncbi.nlm.nih.gov/genbank/) to determine the most likely species of origin. Ten of the twenty-seven scat samples amplified and were sent to third party service Australian Genome Research Facility (AGRF) for sanger sequencing. The sequences were edited using GENEIOUS Prime software version 2024.0.7 (Drummond *et al*. 2011).

4.2 Genetic Diversity Analyses

Basic population genetic statistics were generated using *R* (R core team, 2022) software and the excel add-in GenAlEx version 6.5 (Peakall and Smousse, 2006, 2012). The *R* package 'PopGenReport' (Adamack and Gruber, 2017) was used to assess data quality in the form of null alleles, with the frequency of null alleles determined per locus using the method of Brookfield (1996). Departures from Hardy-Weinberg equilibrium (*HWE*) were assessed for each locus and sampling year with the *R* package 'pegas' (Paradis, 2010), using an exact test with 1000 Monte Carlo permutations and $\alpha = 0.05$. The *R* package 'poppr' (Kamvar *et al*. 2014) was used to evaluate the level of missing data. GenAlEx (Peakall and Smousse, 2006, 2012) was used to calculate the number of alleles (N_A), number of effective alleles (N_E), observed and unbiased expected heterozygosities (H_O and uH_E), the Information index (I) and the inbreeding coefficient (F_{IS}).

The *R* package 'poppr' (Kamvar *et al*. 2014) was used to create an accumulative genotype curve to assess whether the number of loci was sufficient to discriminate unique multilocus genotypes (MLG's) from the genetic data of unknown individuals. Loci were randomly sampled until $n - 1$ loci (n being the total number of loci), and the number of observed genotypes were counted with each iteration. A distribution for each locus was generated by resampling 10,000 times without replacement. A plateau point in the curve indicates that the loci are sufficient to accurately describe the number of MLG's in the data. The 'poppr' (Kamvar *et al*. 2014) package was also used to discriminate between the identified MLG's and assign them to genotype identity groups. Assignment was confirmed through manual appraisal of the genetic data.

5.0 Results

Seven loci were successfully amplified in eighteen bilby scat samples collected from the project area. The current sample genotypes were combined with genotypes generated during prior collections for analysis.

The genotype accumulation curve plateaus at four loci, indicating four loci are sufficient to accurately discriminate the number of unique individuals in this dataset with high confidence (Figure 1). Sample genotypes of less than four loci were excluded from further analyses (see Table 1 and Table 2)

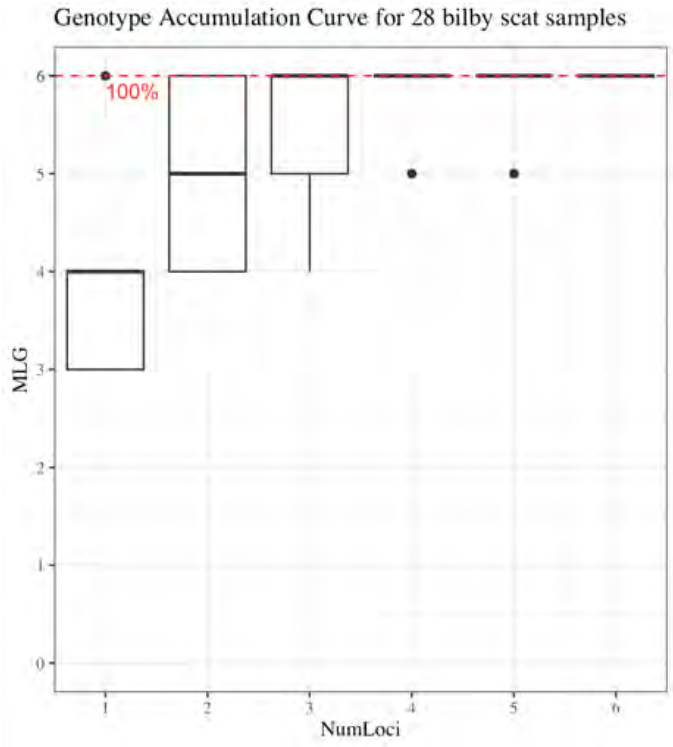

Figure 1 **Multilocus genotype curve used to determine required number of loci for discrimination of unknown individuals from scat samples.**
MLG = Number of multilocus genotypes detected, NumLoci = Number of loci sampled. Dotted line (--) depicts 100% discrimination of genotypes.

All seven loci were polymorphic and conformed to Hardy-Weinberg equilibrium. No null alleles were detected. Of the analysed samples with a unique genotype and four or greater working loci, missing data was insignificant and averaged 1.5%. The number of alleles observed across the seven loci ranged from 1.75 (± 0.25) to 2.25 (± 0.25) and averages 1.96 (± 0.13) alleles (Table 4). The number of effective alleles is similar, ranging from 1.60 (± 0.25) – 2.15 (± 0.54) and averaging 1.83 (± 0.26) effective alleles. The information index averages 0.58 (± 0.16) across loci, with *B55* identified as the most informative (I = 0.77 ± 0.08) and *B17* the least informative (I = 0.43 ± 0.25) loci. Observed and unbiased expected heterozygosity's are moderate and similar, averaging about 70 % (mean H_o = 0.70 ± 0.19, mean uH_e = 0.68 ± 0.20). No inbreeding is detected, as exemplified by the negative inbreeding coefficient estimate (mean F_{IS} = -0.78 ± 0.05).

Table 4 **Genetic diversity statistics generated from seven microsatellite loci for the unique Bilby genotypes (*n* = 6) collected during four survey years.**
N_a – number of alleles, N_e – number of effective alleles, I – information index, F_{IS} - inbreeding coefficient, H_o - observed heterozygosity, uH_e - unbiased expected heterozygosity.

Loci	N_a	N_e	I	F_{IS}	H_o	uH_e
B55	2.25 ± 0.25	2.14 ± 0.14	0.77 ± 0.08	-0.90	1.00 ± 0.00	0.93 ± 0.07
B22	1.75 ± 0.25	1.60 ± 0.25	0.50 ± 0.16	-0.83	0.58 ± 0.25	0.58 ± 0.25
B63	2.25 ± 0.63	2.15 ± 0.54	0.68 ± 0.27	-0.74	0.75 ± 0.25	0.72 ± 0.24
B41	1.75 ± 0.25	1.70 ± 0.24	0.51 ± 0.17	-0.85	0.67 ± 0.24	0.63 ± 0.24
B02	1.75 ± 0.25	1.60 ± 0.25	0.50 ± 0.16	-0.83	0.58 ± 0.25	0.58 ± 0.25
B17	1.75 ± 0.48	1.64 ± 0.39	0.43 ± 0.25	-0.50	0.41 ± 0.25	0.43 ± 0.26
B56	2.25 ± 0.25	2.00 ± 0.00	0.74 ± 0.04	-0.83	0.91 ± 0.08	0.90 ± 0.10
Mean	**1.96 ± 0.34**	**1.83 ± 0.26**	**0.58 ± 0.16**	**-0.78 ± 0.05**	**0.70 ± 0.19**	**0.68 ± 0.20**

For this current sampling year, eighteen of the forty-five submitted samples were of sufficient quality to assign a genotype identity (Table 5). Twenty-seven samples failed genotyping across six repeat runs, amplifying for only three or less loci. Sequence analysis confirmed that nine of these samples originated from the bilby (100% sequence match to *Macrotis lagotis*); however sequence analysis of the remaining eighteen samples was not possible due to DNA degradation (Table 5) - a factor which precluded the 27 samples from use in microsatellite analysis. DNA degradation can likely be attributed to scat age and/or exposure to adverse weather conditions. Of the eighteen remaining samples that were assigned a genotype identity, three genotypes (individual identity groups *four, five* and *six*) were identified. All three genotypes were new and were detected ten, five and three times respectively. When all four sampling years (2021 – 2024) are considered, six individual bilbies were detected from the total sixty-seven scat samples. In addition to the three genotypes exclusive to the current collection, one genotype is solely detected from samples collected in 2022 and 2023 (individual identity group *one*) and two genotypes are restricted to samples collected during the 2021 and 2022 sampling periods (individual identity groups *two* and *three*). None of the previously detected genotypes were observed in the current collection (2024).

Table 5 **Bilby scat identifying characteristics, number of genotyped loci and individual identity group assignment for samples collected across the project area during four sampling years. BOLD text indicates samples identified as bilby through genetic sequencing.**

Helix ID	Field Scat ID	Sampling Year	Sampling Point	Individual Identity
TJ01	MRGB OS23 S1	2024	MR GB OS 23	*4*
TJ02	MRGB OS23 S2	2024	MR GB OS 23	Failed
TJ03	MRGB OS23 S2.1	2024	MR GB OS 23	Failed
TJ04	MRGB 23 Scat 3	2024	MR GB OS 23	*5*
TJ05	MRGB OS23 Scat 4	2024	MR GB OS 23	Failed
TJ06	MRGB OS23 S5	2024	MR GB OS 23	*4*
TJ07	MRGB OS23 S6	2024	MR GB OS 23	*4*
TJ08	MRGB OS23 S7	2024	MR GB OS 23	*4*
TJ09	MRGB OS23 S8	2024	MR GB OS 23	*4*

Helix ID	Field Scat ID	Sampling Year	Sampling Point	Individual Identity
TJ10	MRGB OS23 S9	2024	MR GB OS 23	*5*
TJ11	MRGB OS23 Scat 9.1	2024	MR GB OS 23	*5*
TJ12	MRGB ASI41	2024	MR GB AS 41	*6*
TJ13	GB23 P01	2024	MR GB OS 23	*4*
TJ14	GB23 P02	2024	MR GB OS 23	*5*
TJ15	GB23 P03	2024	MR GB OS 23	*4*
TJ16	GB23 P04	2024	MR GB OS 23	*4*
TJ17	GB23 P05	2024	MR GB OS 23	*5*
TJ18	GB23 P06	2024	MR GB OS 23	*4*
TJ19	GB23 P07	2024	MR GB OS 23	*4*
TJ20	GB23 P08	2024	MR GB OS 23	Failed
TJ21	**GB23 P09**	**2024**	**MR GB OS 23**	**Failed**
TJ22	**GB41 P01**	**2024**	**MR GB AS 41**	**Failed**
TJ23	GB41 P02	2024	MR GB AS 41	Failed
TJ24	WDG_43 01	2024	WDG 43	Failed
TJ25	**Peanut 01**	**2024**	**WDG 54**	**Failed**
TJ26	Peanut 02	2024	WDG 54	Failed
TJ27	Peanut 03	2024	WDG 54	Failed
TJ28	Peanut 04	2024	WDG 54	Failed
TJ29	**Peanut 05**	**2024**	**WDG 54**	**Failed**
TJ30	Peanut 06	2024	WDG 54	Failed
TJ31	Peanut 07	2024	WDG 54	Failed
TJ32	Peanut 08	2024	WDG 54	Failed
TJ33	**Peanut 09**	**2024**	**WDG 54**	**Failed**
TJ34	**Peanut 10**	**2024**	**WDG 54**	**Failed**
TJ35	Peanut 11	2024	WDG 54	Failed
TJ36	Peanut 12	2024	WDG 54	Failed
TJ37	Peanut 13	2024	WDG 54	Failed
TJ38	**Peanut 14**	**2024**	**WDG 54**	**Failed**
TJ39	WDG_51 01	2024	WDG 51	Failed
TJ40	**WDG_51 02**	**2024**	**WDG 51**	**Failed**
TJ41	**WDG_51 03.1**	**2024**	**WDG 51**	**Failed**
TJ42	WDG_51 03.2	2024	WDG 51	*6*
TJ43	**WDG_51 04**	**2024**	**WDG 51**	**Failed**
TJ44	WDG_51 05	2024	WDG 51	*6*
TJ45	WDG_12 01	2024	WDG 12	Failed
SM03	MR GB OS 23 SO3	2023	MR GB 0S 23	*1*

Helix ID	Field Scat ID	Sampling Year	Sampling Point	Individual Identity
SM06	2300 GB OS 23	2023	MR GB 0S 23	*1*
RP01	MR GB OS 23	2022	MR GB 0S 23	*2*
RP02	MR GB OS 23	2022	MR GB 0S 23	*1*
RP03	MR GB OS 23	2022	MR GB 0S 23	*2*
RP05	MR GB OS 23	2022	MR GB 0S 23	*2*
RP07	MR GB AS C16	2022	MR GB ASC16	*3*
QT4	OS23 SCAT02NP	2021	MR GB 0S 23	*2*
QT9	OS23 SCAT04NP	2021	MR GB ASC16	*2*
QT7	ASC16 SCAT03NP	2021	MR GB 0S 23	*3*

6.0 Discussion

Scat DNA extraction and genotype assignment has been successful to determine the minimum number of unique bilby individuals collected from the project area, from samples with sufficient quality DNA.

Based on the genetic diversity of the bilby individuals and variability of the microsatellite loci, it was determined that at least four loci are required for accurate discrimination between individual genotypes. Eighteen of the forty-five scat samples produced good quality genomic DNA with a high amplification success rate of at least six loci. Of these eighteen genotypes, three unique individuals were detected and assigned the genotype identification codes *four*, *five* and *six*. All three genotypes represented new, distinct individuals. None of the three previously identified genotypes were detected from the current collection.

7.0 References

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Appendix 1 Bilby (*Macrotis lagotis*) microsatellite genotyping results

Table 6 **Genotypes and individual identity assignments for the current bilby scat samples.** Genotyping is based on seven microsatellite loci and coloured shading signifies dye type.

Helix ID	Sample ID	B55		B22		B63		B41		B02		B17		B56		Individual ID
TJ01	MRGB OS23 S1	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ02	MRGB OS23 S2	0	0	0	0	0	0	0	0	172?	174?	210?	210?	0	0	-
TJ03	MRGB OS23 S2.1	0	0	0	0	0	0	0	0	180?	180?	0	0	0	0	-
TJ04	MRGB 23 Scat 3	184	190	191	193	234	236	177	183	172	174	211	211	158	168	5
TJ05	MRGB OS23 Scat 4	190	196/198	193	193	228?	228?	177	183?	174	174	197?	197?	168	168	-
TJ06	MRGB OS23 S5	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ07	MRGB OS23 S6	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ08	MRGB OS23 S7	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ09	MRGB OS23 S8	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ10	MRGB OS23 S9	184	190	191	193	234	236	177	183	172	174	211	211	158	168	5
TJ11	MRGB OS23 Scat 9.1	184	190	191	193	234	236	177	183	172	174	211	211	158	168	5
TJ12	MRGB ASI41	190	196	193	193	228	238	177	177	174	174	197	218	168	168	6
TJ13	GB23 P01	190	196	193	193	228	236	177	183	174	174	197	211	156	168	6
TJ14	GB23 P02	184	190	191	193	234	236	177	183	172	174	211	211	158	168	4
TJ15	GB23 P03	190	196	193	193	0	0	177	183	174	174	197	211	156	168	5
TJ16	GB23 P04	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ17	GB23 P05	184	190	191	193	234	236	177	183	172	174	211	211	158	168	4
TJ18	GB23 P06	190	196	193	193	228	236	177	183	174	174	197	211	156	168	5
TJ19	GB23 P07	190	196	193	193	228	236	177	183	174	174	197	211	156	168	4
TJ20	GB23 P08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
TJ21	GB23 P09	194	194/196	193	193	236?	236?	177	177	174	174	197	197/211	156/168	156/168	-
TJ22	GB41 P01	0	0	0	0	0	0	0	0	0	0	212?	212?	0	0	-
TJ23	GB41 P02	196?	196?	0	0	0	0	0	0	0	0	210?	210?	0	0	-
TJ24	WDG_43 01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ25	Peanut 01	184?	184?	0	0	0	0	177?	177?	168/174	174?	0	0	168/170	168/170	-
TJ26	Peanut 02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ27	Peanut 03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-

Helix ID	Sample ID	B55		B22		B63		B41		B02		B17		B56		Individual ID
TJ28	Peanut 04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ29	Peanut 05	182	184/190	193/197	193/197	234?	238?	177/183	177/183	168?	168?	0	0	168	168	-
TJ30	Peanut 06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ31	Peanut 07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ32	Peanut 08	190?	190?	0	0	0	0	0	0	174?	174?	218?	218?	166?	168?	-
TJ33	Peanut 09	190/196	190/196	193?	193?	238	238	177?	177?	174/180	174/182	218?	218?	164/170	168/170	-
TJ34	Peanut 10	184?	184?	193	193	0	0	177?	177?	168/174	168/174	0	0	168	168	-
TJ35	Peanut 11	190?	190?	193/197	193/197	238?	238?	177?	177?	0	0	211?	211?	168?	168?	-
TJ36	Peanut 12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ37	Peanut 13	0	0	0	0	0	0	0	0	174?	174?	211?	211?	166/168	168	-
TJ38	Peanut 14	190?	190?	193?	193?	228?	228?	0	0	174?	174?	197?	197?	0	0	-
TJ39	WDG_51 01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
TJ40	WDG_51 02	0	0	0	0	0	0	177?	177?	168?	169?	0	0	168?	168?	-
TJ41	WDG_51 03.1	0	0	0	0	228?	228?	0	0	174?	174?	0	0	168?	168?	-
TJ42	WDG_51 03.2	190	196	193	193	228	238	177	177	174?	174?	197	218	168	168	6
TJ43	WDG_51 04	190?	190?	193/197	197	0	0	183/177	183/177	172?	172?	211?	211?	168?	168?	6
TJ44	WDG_51 05	190	196	193	193	228	238	177	177	174?	174?	197	218	168	168	-
TJ45	WDG_12 01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-

Table 7 **Previously reported genotypes and individual identity assignments for the two successfully amplified Bilby scat samples that were collected in March – June 2023.** Genotyping is based on seven microsatellite loci and coloured shading signifies dye type.

Helix ID	Sample ID	B55		B22		B63		B41		B02		B17		B56		Individual ID
SM03	MR GB OS 23 SO3	190	196	193	193	230	238	177	183	174	174	211	211	157	168	1
SM06	2300 GB OS 23	190	196	193	193	230	238	177	183	174	174	211	211	157	168	1

Table 8 Previously reported genotypes and individual identity assignments for the five successfully amplified Bilby scat samples that were collected in June 2022.
Genotyping is based on seven microsatellite loci and coloured shading signifies dye type.

Helix ID	Sample ID	B55		B22		B63		B41		B02		B17		B56		Individual ID
RP01	GBS01	184	190	191	197	236	238	177	183	169	172	211	211	159	166	2
RP02	GBS02	190	196	193	193	230	238	177	183	174	174	211	211	157	168	1
RP03	GBS03	184	190	191	197	236	238	177	183	169	172	211	211	159	166	2
RP05	GBS05	184	190	191	197	236	238	177	183	169	172	211	211	159	166	2
RP07	C16 Scat 01	186	190	191	193	232	232	183	183	169	189	210	221	159	168	3

Table 9 Previously reported genotypes and individual identity assignments for the three successfully amplified Bilby scat samples that were collected in June 2021.
Genotyping is based on seven microsatellite loci and coloured shading signifies dye type.

Helix ID	Sample ID	B55		B22		B63		B41		B02		B17		B56		Individual ID
QT4	OS23 SCAT02NP	184	190	191	197	236	238	177	183	169	172	211	211	159	166	2
QT9	OS23 SCAT04NP	184	190	191	197	236	238	177	183	169	172	211	211	159	166	2
QT7	ASC16 SCAT03NP	186	190	191	193	232	232	183	183	169	189	210	221	159	168	3