# COVALENT LOGISTICS ROAD TERRESTRIAL VERTEBRATE FAUNA SURVEY

## Covalent Lithium

ecoscape

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# EXECUTIVE SUMMARY

Covalent Lithium engaged Ecoscape to conduct basic and targeted terrestrial fauna survey along a proposed product haul road route (Logistics Road), connecting the mine processing operations at Mt Holland to Great Eastern Highway. The proposed route is approximately 113 km, following an existing gazetted road that crosses areas of uncleared native vegetation and agricultural land. The total size of the survey area is 383 hectares (ha).

The survey was undertaken by Ecoscape from the 28th of March to the 5th of April 2022. The purpose of the survey was to delineate fauna habitats, obtain knowledge on the likely fauna assemblage and focus on identifying the presence/absence and suitable habitat of conservation significant listed species identified during the desktop assessment. This will allow for a better understanding of the local fauna's potential sensitivity to impacts resulting from the road installation. The outcomes of the survey and other information (e.g. desktop aspects) will be used to inform the environmental assessment and approvals process.

The key outcomes from the field survey identified:

- 136 Habitat assessments were conducted identifying four broad vertebrate fauna habitat types: Eucalypt Woodland, Shrubland, Regrowth and Seasonal Marsh/Wetland. Both the Eucalypt Woodland (15.87 ha) and the Shrubland (38.47 ha) provide habitat for most species in the area and made up the largest part of the survey area, with the Regrowth (0.01 ha) and Seasonal Marsh/Wetland (0.26 ha) being less common. These habitat types recorded during the survey are considered to be well represented outside the survey areas.
- Sixty-four vertebrate and one invertebrate fauna species were recorded during the survey, consisting of:
  - Twenty-two mammals (seven introduced)
  - Thirty-six birds
  - Six reptiles
  - One invertebrate.
- The conservation significant vertebrate fauna species recorded by the field survey were:
  - Malleefowl *Leipoa ocellata* (EPBC-VU, BC-VU), listed as a 'Threatened' fauna taxon at the conservation level of 'Vulnerable' under both Commonwealth and State legislation
  - Western Brush Wallaby *Notamacropus irma* (DBCA-P4), classified as 'Priority 4' by the State Department of Biodiversity, Conservation and Attractions.
  - Central Long-eared Bat *Nyctophilus major tor* (DBCA-P4), classified as 'Priority 4' by the State Department of Biodiversity, Conservation and Attractions. Ambiguous call recorded, this has been added on a precautionary basis
- The targeted Malleefowl mound searches identified two previously unrecorded Malleefowl nest mounds, one of which was active.
- In accordance with guidelines for the critically endangered Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina) (*ABAB), a targeted survey was conducted to determine the presence/absence of the sugar ant species (*Camponotus* sp. nr. *terebrans*) on which its larvae parasitise. Sugar ants were detected at two single trees out of the 100 trees sampled. Densities of sugar ant colonies found during this survey are low, however, it is a requirement that the presence of the sugar ant colonies be reported to DBCA.

# ACRONYMS AND ABBREVIATIONS

**Table 1: Acronyms and abbreviations**

| Acronyms | |
|---|---|
| **BC Act** | Western Australian *Biodiversity Conservation Act 2016* |
| **BoM** | Bureau of Meteorology |
| **CALM** | Western Australian Department of Conservation and Land Management (1985-2006, now DBCA) |
| **CD** | Conservation Dependent (fauna; specially protected species under the Western Australian BC Act) |
| **CR** | Critically Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act) |
| **DAWE** | Commonwealth Department of Agriculture, Water and Environment (2020-) |
| **DBCA** | Western Australian Department of Biodiversity, Conservation and Attractions |
| **DBH** | Diameter at Breast Height (1.3 m) |
| **DEC** | Western Australian Department of Environment and Conservation (2006-2013, now DBCA) |
| **DEWHA** | Commonwealth Department of the Environment, Water, Heritage and the Arts (2007-2010, now DAWE) |
| **DPaW** | Western Australian Department of Parks and Wildlife (2013-2017, now DBCA) |
| **DPIRD** | Western Australian Department of Primary Industries and Rural Development |
| **DSEWPaC** | Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2010-2013, now DAWE) |
| **DWER** | Western Australian Department of Water and Environmental Regulation |
| **EN** | Endangered (listed under Commonwealth EPBC Act and/or Western Australian BC Act) |
| **Ecoscape** | Ecoscape (Australia) Pty Ltd |
| **EP Act** | Western Australian *Environmental Protection Act 1986* |
| **EPA** | Western Australian Environmental Protection Authority |
| **EPBC Act** | Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* |
| **GDA 94** | Geographic Datum of Australia 1994 |
| **GIS** | Geographic Information System |
| **GPS** | Global Positioning System |
| **GWA** | Government of Western Australia |
| **ha** | hectare/hectares |
| **IBRA** | Interim Biogeographic Regionalisation for Australia |
| **IUCN** | International Union for Conservation of Nature |
| **km** | kilometre/kilometres |
| **m** | metre/metres |
| **MGA** | Map Grid of Australia |
| **MA** | Marine species (fauna; protected under international agreements and EPBC Act) |
| **MI** | Migratory species (fauna; specially protected species under the Western Australian BC Act, also EPBC Act) |
| **MNES** | Matters of National Environmental Significance |
| **OS** | Other specially protected species (fauna; specially protected species under the Western Australian BC Act) |
| **P; P1, P2, P3, P4, P5** | Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5) |
| **PMST** | Protected Matters Search Tool (hosted by DAWE, used to search for MNES) |
| **SoW** | Scope of Works |
| **sp.** | Species (generally referring to an unidentified taxon or when a phrase name has been applied) |
| **subsp.** | Subspecies (infrataxon) |
| **S1** | Schedule 1 Fauna species listed under the BC Act |
| **TSSC** | Threatened Species Scientific Committee |
| **VU** | Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act) |
| **WAM** | Western Australian Museum |
| ***** | Introduced fauna species |

# 1 INTRODUCTION

## 1.1 BACKGROUND

Covalent Lithium is developing the Mt Holland Lithium Project which will include the construction and operation of a fully integrated mine, concentrator, and refinery in Western Australia. The Mount Holland Lithium Project (the project) is an integrated project consisting of a mine, concentrator, and refinery to produce battery quality lithium hydroxide (LiOH) for the international market. The project is centred on the Earl Grey hard-rock lithium deposit 105 km south of Southern Cross in Western Australia and approximately 500 km east of Perth. It is owned by a 50-50 joint venture (JV) between subsidiaries of Wesfarmers Pty Ltd (WES:ASX) and Sociedad Química y Minera de Chile S.A. (SQM: NYSE). Covalent is the manager for the JV and is responsible for the development and operation of the project.

Covalent Lithium has identified a potential product haul road route (Logistics Road) to connect the mine processing operations at Mt Holland to Great Eastern Highway. The proposed route is from Great Eastern Highway at Moorine Rock, crossing both agricultural areas and uncleared native vegetation following existing gazetted roads for approximately 113 km terminating close to the entrance to the Mt Holland mine site on the Marvel Loch-Forrestania Road (**Figure 1**).

The proposed route requires an Environmental Protection Authority (EPA) Basic fauna survey, which was undertaken by Ecoscape from the 28th of March to the 5th of April 2022. The purpose of the survey was to delineate fauna habitats, obtain knowledge on the likely fauna species assemblage and focus on recording habitat for conservation significant listed species to better understand their potential sensitivity to impacts resulting from the road installation.

The outcomes of the survey and other information (e.g. desktop aspects) will be used to inform the environmental assessment and approvals process.

## 1.2 SURVEY AREA

The Covalent Lithium project area, known as the 'survey area' in this report, is located within the Shire of Yilgarn and intersects with the Avon Wheatbelt, Coolgardie, and Mallee bioregions of Western Australia, approximately 500km east of Perth (**Figure 1**).

The survey area overlays existing road infrastructure for the entire length (113 km), there are also nine proposed borrow pits of varying sizes. The total size of the survey area, including the existing cleared road, and the borrow pits is 382.91 ha. A section of the survey area was subject to a Basic fauna survey in 2020, undertaken by Ecoscape, for the construction of the water pipeline for the Mt Holland project site. The survey area intersects large contiguous expanses of native vegetation and is currently a gazetted road (**Figure 1**).

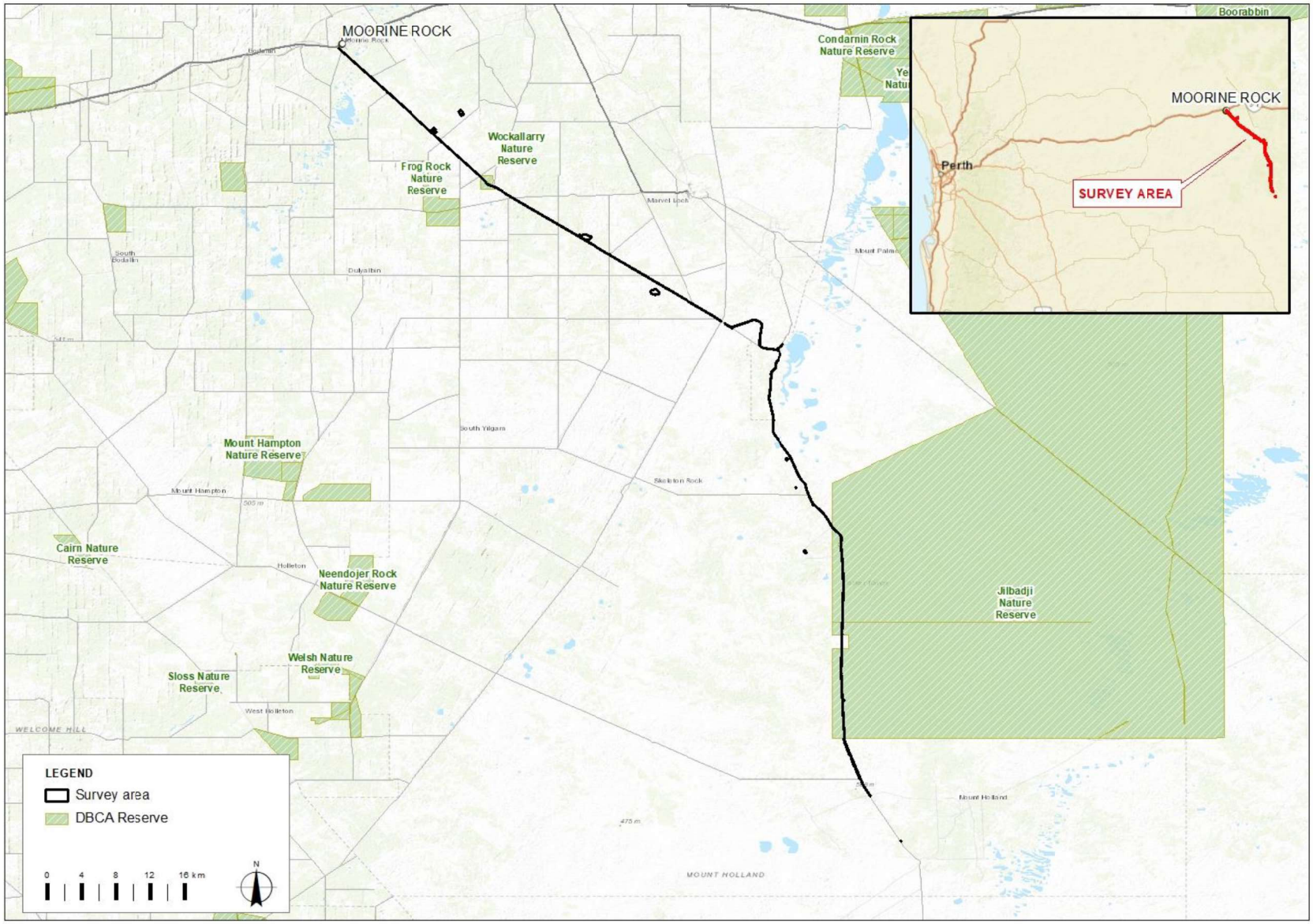


**Figure 1: Survey area location**

## 1.3 SURVEY REQUIREMENTS

Covalent Lithium required a desktop assessment, Basic fauna survey and a targeted fauna survey of the Survey Area, these were conducted in accordance with the requirements outlined in the Environmental Protection Authority's (EPA 2020) document Technical Guidance –Terrestrial vertebrate fauna surveys for environmental impact assessment. These surveys were:

- opportunistic collection and recording of fauna evidence including trail cameras; bat echolocation recorders; bird surveys
- targeted conservation significant fauna survey and habitat assessment.

In addition, a targeted fauna survey was required to determine the presence/absence of the sugar ant species (*Camponotus* sp. nr. *terebrans*) within the survey area. The sugar ant is the host species of the conservation listed species Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina) (*ABAB). The ABAB is a 'Threatened Species' that is listed as 'Critically Endangered' under the national *Environment Protection and Biodiversity Conservation Act 1999* and the state *Biodiversity Conservation Act 2016*. These surveys were conducted in accordance with the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) - *Guideline for the survey of arid bronze azure butterfly (ABAB) in Western Australia* (2020a).

The overarching objective of the surveys is to understand the environmental values with respect to fauna species within the proposed corridor for the proposed route. The survey sought to provide sufficient information on the fauna habitats and fauna species present, to accurately assess the impacts of the road construction.

## 1.4 COMPLIANCE

This environmental assessment was conducted in accordance with Commonwealth and State legislation and guidelines:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- Western Australian *Biodiversity Conservation Regulations 2018*
- Western Australian *Animal Welfare Act 2002*
- Department of Environment, Water, Heritage and the Arts (DEWHA 2009) *Matters of National Environmental Significance. Significant impact guidelines 1.1 - Environment Protection and Biodiversity Conservation Act 1999*
- Department of Sustainability Environment Water Population and Communities (DSEWPaC 2011a) *Survey guidelines for Australia's threatened mammals*
- DSEWPaC (2011b) *Survey guidelines for Australia's threatened reptiles*
- DEWHA (DEWHA 2010a) *Survey guidelines for Australia's threatened bats*
- DEWHA (DEWHA 2010b) *Survey guidelines for Australia's threatened birds*
- Department of Parks and Wildlife (DPaW 2017) *Interim Guideline for Preliminary Surveys of Night Parrot (Pezoporus occidentalis) in Western Australia*
- Threatened Species Scientific Committee ((TSSC 2016) *Conservation Advice Pezoporus occidentalis*
- Department of Environment and Conservation (2012). Chuditch (*Dasyurus geoffroii*) Recovery Plan
- Department for Environment and Heritage (2007). National Recovery Plan for Malleefowl
- DBCA - *Guideline for the survey of arid bronze azure butterfly (ABAB) in Western Australia* (2020a)
- DBCA - *Arid bronze azure butterfly (ABAB) survey in Western Australia additional information* (2020b).

Summaries of the main Acts under which this assessment was conducted, and related criteria and definitions, are available in **Appendix One**.

As well as those listed above, the assessment complied with EPA requirements for environmental survey and reporting in Western Australia, as outlined in:

- EPA (2020) *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*, known herein as the Fauna Technical Guidance
- EPA (2016) *Environmental Factor Guideline – Terrestrial Fauna*
- EPA (2021) *Statement of environmental principles, factors, objectives and aims of EIA*.

Additional details (definitions and criteria) relevant to these works are available in **Appendix One**.

# 2 DESKTOP ASSESSMENT

## 2.1 PHYSICAL ENVIRONMENT

### 2.1.1 CLIMATE

The closest Bureau of Meteorology (BoM) stations with long term records are Southern Cross and Hyden stations, both have similar records. Hyden station is located approximately 75 km south west of the survey area. The mean annual rainfall is 342 mm falling between May and September. The rainfall during the six month period prior to the field survey was 72% of the long-term average for this period (BoM 2022).

January is the hottest month with a mean maximum temperature of 33.8°C and minimum of 15.6°C. July is the coldest month with a mean maximum of 16.5°C and minimum of 4.7°C (BoM 2022).

According to the Köppen-Geiger climate classification, the survey area has an arid-steppe climate with (relatively) cold summers (Class BSk) that border Mediterranean (or continental) climates in continental interiors some distance from the coast (Peel, Finlayson & McMahon 2007). This classification is considered to represent a cold semiarid climate where the average temperature is below 18°C, summer maximum temperatures are considered to be warm to hot and the coldest month maximum is above 0°C. Large diurnal temperature variations are a feature of this climate zone.

**Figure 2** shows the average rainfall and temperatures of the survey area, with rainfall for the year preceding the field survey.

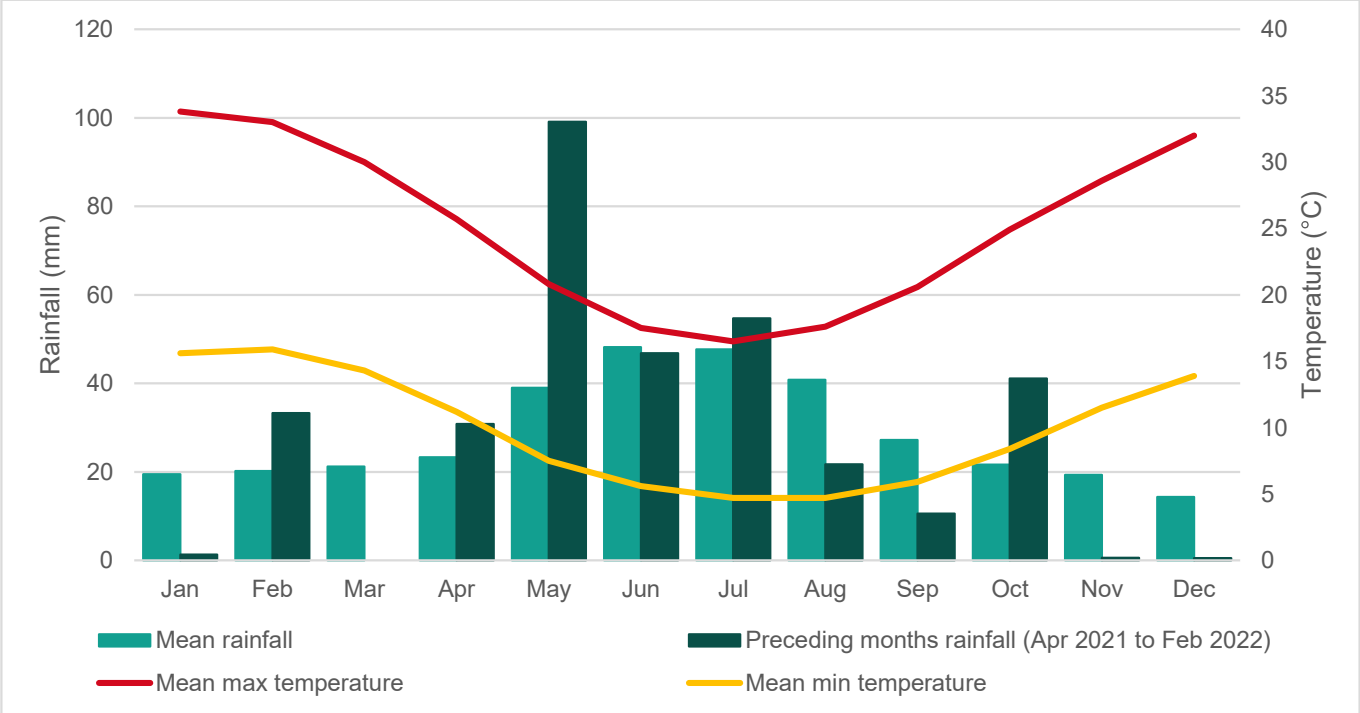


**Figure 2: Rainfall and temperature data for the survey area** (BoM 2022)

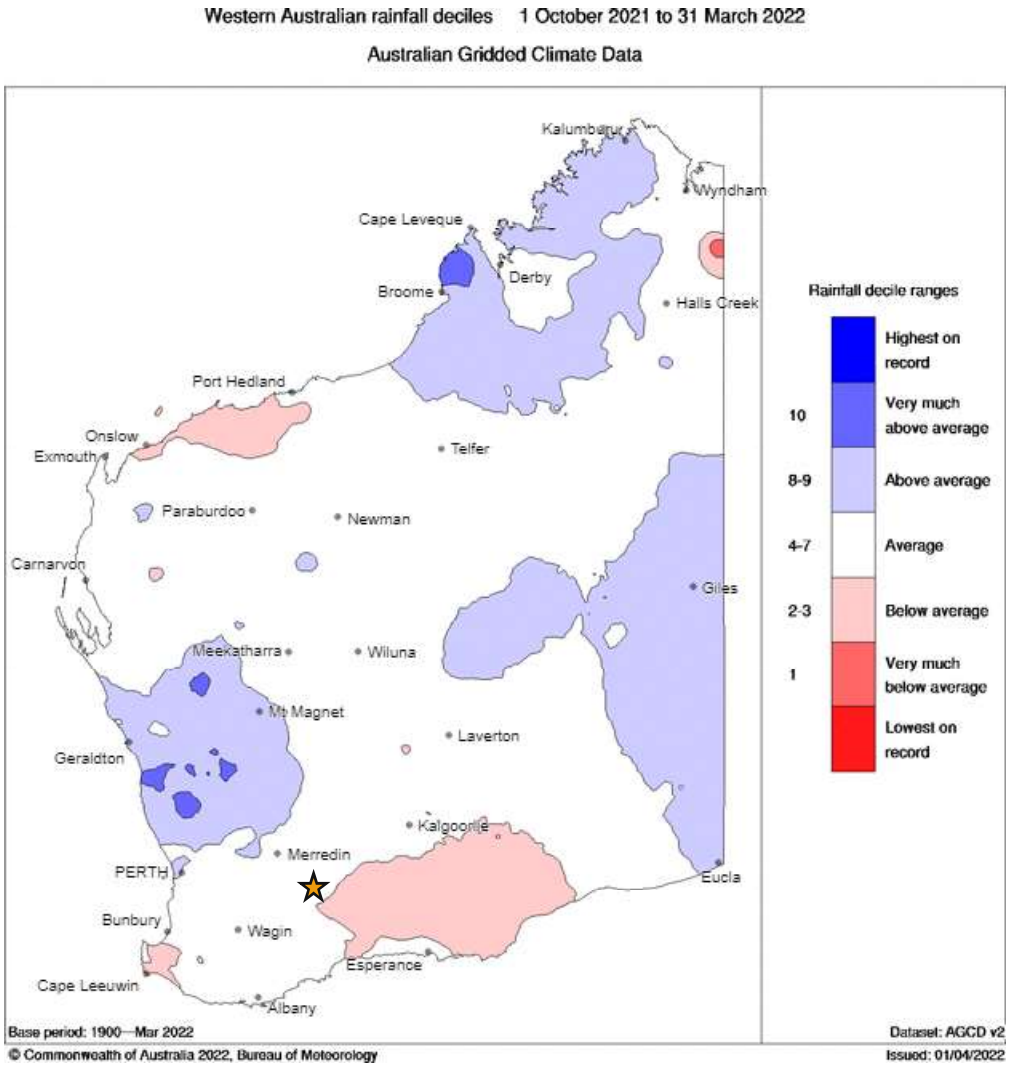


**Figure 3: Rainfall deciles for the 6 months prior to the field survey. The star in Figure 3 indicates the approximate location of the field survey.**

### 2.1.2 WETLANDS AND DRAINAGE

The survey area is located in the Swan Avon-Yilgarn catchment area (Landgate & Government of Western Australia 2022). The survey area intersects with four minor non-perennial watercourses. The closest wetland is Lake Cronin which is 33km south of the survey area.

### 2.1.3 ENVIRONMENTALLY SENSITIVE AREAS

The survey area intersects two mapped Environmentally Sensitive Areas (ESAs). These ESAs are associated with the Jilbadji Nature Reserve (R24049) and the Wockallarry Nature Reserve (R29537) (Landgate & Government of Western Australia 2022).

### 2.1.4 CONSERVATION LANDS

The proposed route intersects the Jilbadji Nature Reserve (R24049) and the Wockallarry Nature Reserve (R29537) and comes within 2.5 km of Frog Rock Reserve (R20262).

### 2.1.5 LAND USE HISTORY

Dominant land uses in the region include grazing native pastures (approximately 17%), UCL and Crown reserves (67%), Cultivation -Dry Land agriculture (2%) and Conservation Reserves (12%) (Cowan et al. 2001). The survey area includes evidence of disturbance from mineral exploration activity.

## 2.2 BIOLOGICAL ENVIRONMENT

### 2.2.1 BIOGEOGRAPHIC REGION

Biogeographic regions are delineated on the basis of similar climate, geology, landforms, vegetation and fauna and are defined in the Interim Biogeographical Regionalisation for Australia (IBRA) (Department of Agriculture Water and the Environment 2020). The survey area intersects two IBRA subregions of the Avon Wheatbelt and Coolgardie bioregions as described below.

> ***AVW1, Merredin*** *(Beecham (2001) The Avon Wheatbelt is an area of active drainage dissecting a Tertiary plateau in Yilgarn Craton. Gently undulating landscape of low relief. Proteaceous scrubheaths, rich in endemics, on residual lateritic uplands and derived sandplains; mixed eucalypt, Allocasuarina huegeliana and Jam-York Gum woodlands on Quaternary alluvials and eluvials. Within this bioregion, AW1 is an ancient peneplain with low relief, gently undulating landscape. There is no connected drainage; salt lake chains occur as remnants of ancient drainage systems that now only function in very wet years. Lateritic uplands are dominated by yellow sandplain. Climate is Semi-arid (Dry) Warm Mediterranean.*

> ***COO2, Southern Cross*** *(Cowan, Graham & Mckenzie 2001); The subregion has subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills. It lies on the 'Southern Cross Terrains' of the Yilgarn Craton. The granite strata of Yilgarn Craton are interrupted by parallel intrusions of Archaean Greenstone. Drainage is occluded. It has an arid to semi-arid Warm Mediterranean climate with 250-300 mm of mainly winter rainfall.*

### 2.2.2 THREATENED AND PRIORITY FAUNA

Combined database search results are incorporated into **Table 7** in **Appendix Two**.

Species identified by these database searches that are excluded from the field survey and further assessments (including likelihood assessments) are listed in **Table 8** along with the reason for their exclusion (e.g. marine species whose habitat does not occur within the survey area, invertebrates are not within the scope of the survey). Such excluded species are not further referenced in this document.

#### 2.2.2.1 NatureMap

NatureMap (DBCA 2007-2021) is maintained collaboratively by the DBCA and the Western Australian Museum (WAM). These records represent a combination of vouchered museum specimens and records obtained via the Fauna Survey Returns Database which are maintained by the DBCA. The NatureMap database is currently being updated and reports are no longer obtainable via this system. However, previous database reports are valid for 5 years, therefore this report will include the NatureMap data obtained for the Detailed fauna survey conducted for Covalent Lithium in 2021 (Ecoscape 2021b).

The NatureMap search identified 12 conservation-listed vertebrate fauna species that have been recorded within a 40 km radius of 757926E 6448785S.

The list is comprised of:

- Five mammals
- Four birds
- One reptile.

The NatureMap results are incorporated into **Table 7 Appendix Two**.

#### 2.2.2.2 EPBC-listed Threatened Fauna

The Protected Matters Search Tool (PMST) search, using a 20 km buffer, identified the following as having been recorded or having potential to occur within the search area:

- Two mammals
- Five birds

The PMST results are incorporated into **Table 7 Appendix Two**.

#### DBCA Database Search

A search of the DBCA databases was conducted (search reference: FAUNA#7051) using a 60 km buffer around the provided shapefiles of the survey area. Thirteen conservation-listed were identified as having previously been recorded from within the search area buffer, consisting of:

- Nine mammals
- Three birds
- One reptile.

The DBCA database results are incorporated into **Table 7 Appendix Two**

#### 2.2.2.3 Threatened and Priority Fauna Likelihood Assessment

The likelihood of conservation-listed fauna species, as identified by the database and literature searches, occurring within the survey area was assessed using the following criteria:

- suitability of habitat types likely to be present within the survey area
- distance between previous record of conservation-listed species and the survey area
- frequency and number of records in the region
- date of record of conservation-listed species (recent or historical)
- the record is naturally occurring (not from a sanctuary or translocated population).

The following were also taken into consideration during the assessment:

- sufficiency of information
- behavioural and ecological characteristics such as cryptic behaviours, size and mobility of species
- record certainty.

The categories of likelihood of occurrence, assessed using the above criteria, are shown in **Table 2**.

**Table 2: Categories for likelihood of occurrence of conservation-listed fauna**

| Likelihood Category | Criteria |
|---|---|
| **Known to occur** | Species previously recorded within the survey area within 25 years. |
| **Likely to occur** | Suitable habitat is expected to occur within the survey area and records of the species within 25 years exist within close proximity* |
| **May occur** | Suitable habitat is expected to occur within the survey area and historic records of the species exist within close proximity*<br>OR<br>Suitable habitat is expected to occur within the survey area and recent (<25yrs) records exist within the database search buffer but not in close proximity* |
| **Unlikely to occur** | Suitable habitat is expected to occur within the survey area however previous records are limited and/or historic and/or not in proximity**<br>OR<br>Suitable habitat is not expected to occur within the survey area and recent (<25yrs) records do not occur in close proximity* |
| **Very Unlikely to occur** | Suitable habitat is not expected to occur in the survey area<br>AND/OR<br>previous records are limited and/or historic and/or not in proximity** |

* close proximity = 15 km [= ¼ of the distance of the database search buffer]
** proximity = 30 km [= ½ of the distance of the database search buffer]

The likelihood of species occurring within the survey area are indicated in **Table 7** in **Appendix Two**. Five species were assessed as having a High likelihood of occurring within the survey area:

- *Dasyurus geoffroii* (Chuditch, Western Quoll)
- *Notamacropus Irma* (Western Brush Wallaby)
- *Leipoa ocellata* (Malleefowl)
- *Platycercus icterotis xanthogenys* (Western Rosella (inland))
- *Falco peregrinus* (Peregrine Falcon)

Likelihood of occurrence does not take into consideration factors such as frequency that a species occurs (or may occur), the duration that such species occupies (or may occupy) the survey area or dependence on habitat or resources within the survey area. Highly mobile species potentially only occur within (or for birds, overflying) the survey area for very brief periods and/or on very infrequent intervals. If a previous observation included in the database search records corresponds with this event it is listed as 'known'; if such a transient visitation is possible in the future the likelihood of such species occurring is likely listed as 'likely'.

Following the field survey, when actual survey area characteristics are better understood and the level of survey effort was considered, the likelihood of occurrence was re-evaluated. The post-survey likelihood is also incorporated into **Table 7** and discussed further in **Section 5.1.3.1,** including providing an indication of dependence of species on the habitat and resources available within the survey area.

#### 2.2.2.4 Black Cockatoos

According to DBCA mapping (DSEWPaC 2012), the survey area is outside the modelled distribution for Black Cockatoos, with the closest confirmed breeding area approximately 60km Southwest of the survey area (Landgate & Government of Western Australia 2022).

### 2.2.3 FAUNA HABITAT

Previous surveys conducted by Ecoscape identified the following broad habitat types occurring within the survey area or are known from nearby:

- Mallee woodland
- Salmon Gum woodland
- Shrubland

## 2.3 RELEVANT LITERATURE

### 2.3.1 PREVIOUS SURVEYS

The following documents have been identified as having relevance to current survey:

- Ecoscape Australia Pty Ltd (2019a) *Covalent Malleefowl Monitoring*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2019b) *2019 Mt Holland Chuditch Monitoring*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2020a) *2019 Mt Holland Malleefowl Monitoring*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2020b) *Pipeline Fauna Survey*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2020c) *Blue Vein and Powerline Access Roads Fauna Survey*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2020d) *2020 Mt Holland Chuditch Monitoring*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2021a) *2020 Malleefowl Monitoring*. Report prepared for Covalent Lithium Pty Ltd.
- Ecoscape Australia Pty Ltd (2021b) *Earl Grey Lithium Project – Detailed Terrestrial Fauna Survey*. Report prepared for Covalent Lithium Pty Ltd.

### 2.3.2 IBSA DATA SEARCH

The Department of Water and Environmental Regulation's (DWER's) *Index of Biodiversity Surveys for Assessments (IBSA)* Portal (DWER 2021) was searched for recent environmental surveys in the vicinity of the survey area.

The search, conducted on 21.03.2022, identified 14 environmental surveys that have been conducted within 150 km of the survey area. 11 of these listings did not have data accessible for review i.e. contained metadata only. The following documents had relevance to current survey:

- Western Wildlife (2017), Earl Grey Lithium Project: Level 2 vertebrate fauna survey with targeted Chuditch and Malleefowl surveys, 2016 – 2017. Unpublished report to Kidman Resources Limited.
- Mattiske Consulting Pty Ltd (2018). Threatened and Priority Flora Assessment, Earl Grey Lithium - Pre-Clearance Surveys.

### 2.3.3 OTHER LITERATURE

No other documents have been located that provide contextual information for this assessment.

# 3 METHODS

## 3.1 SURVEY AIMS

The aims of the biological survey were to:

- conduct a Basic fauna survey
- Chuditch (*Dasyurus geoffroii*) and Mallefowl (*Leipoa ocellata*) targeted surveys
- Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*, 'ABAB') targeted surveys.

Whilst these species were the targets of the surveys, any other conservation-listed fauna encountered directly or indirectly during the survey were also to be recorded.

## 3.2 GUIDING PRINCIPLES

The fauna and fauna habitat survey was conducted as a Basic survey according to the Fauna Technical Guidance (EPA 2020). The EPA recommends a Basic survey should:

- be conducted as a low intensity survey to gather broad fauna and habitat information
- verify the adequacy of the desktop assessment
- map, describe and photograph habitats
- record opportunistic fauna observations
- identify possible future survey site locations, access and logistics
- determine if a Detailed survey is required.

Targeted surveys were also conducted to gather information on significant fauna and habitats.

## 3.3 FAUNA FIELD SURVEY

The methods utilised during the field survey followed those outlined in the Fauna Technical Guidance (EPA 2020), conducted as a Basic survey.

Conservation criteria used in this assessment are included in **Table 5** and **Table 6** in **Appendix One**..

Survey method details are outlined below.

### 3.3.1 FAUNA SURVEY METHODS

The Basic fauna survey incorporated a number of survey techniques as per the Terrestrial Fauna Technical Guidance (EPA 2020) including habitat assessment, active searches, raking of spoil heaps and leaf litter, searches for secondary evidence such as scats and tracks, as well as opportunistic searches.

Survey techniques included:

- opportunistic bird observations while moving through the survey area
- turning of surface debris (rocks, logs, vegetation spoil heaps) that reptiles and mammals may shelter beneath
- raking of litter beds to locate fossorial reptile species
- tree hollow inspection to detect fauna
- baited motion cameras (Reconyx HC500) to capture evidence of cryptic and nocturnal fauna species not easily observed directly
- Anabat Swift recorders fitted with ultrasonic microphones to sample for bats.
- Targeted dig surveys for the ant species, *Camponotus sp. nr. terebrans.*

Fauna species were identified opportunistically based on sightings, calls, remains, diggings and other signs. Potential habitats for conservation significant species were identified and evaluated (see **Section 3.3.1.1**) and their likelihood of occurrence re-assessed.

Based on the desktop assessment, the following were considered to be "Likely to Occur" in the survey area and they, and habitat suitable to support them, were targeted during the field survey:

- *Dasyurus geoffroii* (Chuditch, Western Quoll)
- *Notamacropus Irma* (Western Brush Wallaby)
- *Leipoa ocellata* (Malleefowl)
- *Platycercus icterotis xanthogenys* (Western Rosella (inland))
- *Falco peregrinus* (Peregrine Falcon)

#### 3.3.1.1 Fauna Habitat Assessment

The fauna habitats present within the survey areas were identified and mapped. Fauna habitats were described as an area which is distinguishable from its surrounding area by its landform, vegetation and fauna assemblage occupying the area. In addition, its likelihood to harbour specialised fauna species which are not found in adjacent areas was taken into consideration.

The following information was used to identify and map all fauna habitats within the survey area:

- previous fauna habitat mapping
- land systems
- vegetation type and condition mapping
- aerial imagery
- landforms
- soil characteristics
- fauna assemblage information.

The composition and characteristics of each fauna habitat type was recorded, including noting suitability for various fauna suites or conservation-listed species. Habitat types were delineated in the field and digitised upon return from the field survey.

### 3.3.2 TARGETED SURVEY METHODS

#### 3.3.2.1 Chuditch Survey Methods

Chuditch (*Dasyurus geoffroyi*; EPBC-, BC Act VU)

The suitability of the survey area for Chuditch, also known as Western Quoll, such as the presence of fallen hollow logs and hollow standing trees, was recorded.

The survey area was intensively searched by walked search patterns looking for evidence of presence such as tracks, scats, and dens. Baited trail cameras were located in suitable habitat to detect presence of this species.

#### 3.3.2.2 Malleefowl Survey Methods

Malleefowl (*Leipoa ocellata*; EPBC-, BC Act VU)

Surveyors recorded the presence and locations of nest mounds of any age, as well as observations, tracks and scats. The *National Malleefowl Recovery Team Monitoring Manual* (NMRT 2019) provided guidance for Malleefowl survey methods.

#### 3.3.2.3 Arid Bronze Azure Butterfly Survey Methods

Methods used for the survey followed the Department of Biodiversity Conservation and Attractions (DBCA) ABAB survey guidelines (DBCA 2020a). The surveys were conducted under the guidance of Ecoscape Principal Zoologist Bruce Turner.

The ABAB survey guidelines state that the host ant colonies occur at the base of mature smooth-barked eucalypts. Host ant colonies seem to occur at two extremes - either the ant colonies are very sparse and difficult to find; or else they are very widespread, with ants obvious and abundant (DBCA 2020a).

To determine if the host ant is present at a site, and in what numbers, a random sample of trees is examined and assessed for ant presence/absence. Ant presence can be determined either by nocturnal survey (visiting the trees in the evening, commencing in the first hour after sunset) or by diurnal survey (disturbing the soil around the base of the trees, to a depth of ~ 10 cm, to determine if an ant colony is present). Ecoscape used the diurnal survey method by disturbing soil at the base of trees using a square mouthed shovel to dig 10 cm deep trenches at the base of the sampled trees.

100 trees were sampled at 10 separate locations where smooth barked trees were dominant. Trees sampled included those beside roads and tracks, where sugar ants (and the ABAB) are typically more abundant (DBCA 2020a). If a large colony of the host ant is present, the ants will be clearly apparent on tree trunks in the evening, or in nests at the base of trees during the day.

# 4 FIELD SURVEY RESULTS

## 4.1 FAUNA SURVEY

The fauna survey was conducted by Bruce Turner (Principal Zoologist), Robert Hemsworth (Senior Zoologist) and Sam Ryken (Senior Zoologist) from the 28th of March until the 5th of April 2022.

The survey was conducted in accordance with the requirements for a Basic survey as outlined in the Fauna Technical Guidance (EPA 2020). The habitat assessment points were traversed on foot and all habitats were assessed for quality and capability of supporting both locally common and significant fauna species.

### 4.1.1 FAUNA HABITAT

Four fauna habitat types were recorded within the survey area (**Table 3**):

- Eucalypt Woodland (Open/Closed)
- Shrubland
- Regrowth
- Seasonal Marsh

The quality of each habitat type was based on the field surveyor's experience and takes into consideration the level of disturbance to habitats from weeds, the amount of native vegetation, vegetation cover (density) and the context of the habitat with the surrounding landscape.

**Table 3: Fauna habitat types**

| Habitat type | Description | Photograph |
|---|---|---|
| | | |
| **Eucalypt woodland** | Open Eucalypt woodland consisting of mixed compositions of Eucalypt species. Occurring within this habitat type are Salmon Gum, Mallee, Mallet, Gimlet, Red Morrel and Wandoo. Occurring mostly over low shrubs on clay, clayey sand and sandy clay soils; minimal understory; 30-50% litter cover; high frequency of fallen logs.<br><br>Disturbance: Low to high.<br><br>Fire Age: >10 yrs.<br>**Extent**: 15.87 ha, 4.15% |  |

| Habitat type | Description | Photograph |
|---|---|---|
| **Shrubland** | Closed to dense shrublands of mixed species (*Allocasuarina, Hakea, Acacia*, and/or *Melaleuca*) on clay, clayey sand, sand or sandy clay soils; gravel; 50-95% litter cover.<br>Disturbance: Low to high.<br><br>Fire Age: 5-10 yrs.<br><br>**Extent**: 38.47 ha, 10.05% |  |
| **Regrowth** | Vegetation regrowth in previously cleared areas such as old borrow pits. Comprising of open shrubland of mixed species (*Allocasuarina, Hakea, Acacia*, and/or *Melaleuca*) on clayey sand or sandy clay soils; gravel; 10% litter cover.<br>Disturbance: Low to high.<br><br>Fire Age: >10 yrs.<br><br>**Extent**: 0.01 ha, 0.00% |  |
| **Seasonal Marsh** | Seasonal inundated marsh with Samphire and low *Melaleuca* shrub; clay soils; quartz; 5% litter cover.<br>Disturbance: Low.<br><br>Fire Age: >10 yrs.<br><br>**Extent**: 0.26 ha, 0.07% |  |

| Habitat type | Description | Photograph |
|---|---|---|
| **Cleared or developed** | Not habitat, includes borrow pits and land cleared for agricultural use.<br><br>Disturbance: High.<br><br>**Extent**: 328.29 ha, 85.74% |  |
| **Total Extent** | 382.91 ha, 100% | |

## EUCALYPT WOODLAND

The Eucalypt woodland type (15.87 ha) occurred in a variety of compositions within the survey area, with Salmon Gum woodlands over mixed shrub species (mostly *Melaleuca* sp.) on clay flats being the most frequently occurring form. This habitat type also included varying degrees of Gimlet (*E. Salubris*), Merrit (*E. flocktoniae*), Red Morrel (*E. longicornis*), Wheatbelt Wandoo (*E. capillosa*) and species of Mallet (e.g. *E. astringens*). Mallee woodland was included within the Eucalypt woodland habitat type, as it was usually interspersed with other Eucalypt species. Mallee woodland describes a structural type, and there is variability in plant species composition. Mallee woodland has a shrubland understorey ranging from minimal to dense.

Mallee woodland includes one or more of Tall Sand Mallee (*Eucalyptus eremophila*), Stiff-leaved Mallee (*E. rigidula*), Wheatbelt Wandoo (*E. capillosa*), Lerp Mallee (*E. incrassata*), Square-fruited Mallee (*E. prolixa*), Burracoppin Mallee (*E. burracoppinensis*), *E. ravida*, *E. urna*, White Mallee (*E. cylindriflora*), Yorrell (*E. gracilis*), Woodline Mallee (*E. cylindrocarpa*) and Merrit (*E. flocktoniae*) (Mattiske Consulting 2021). The understorey includes a range of shrubs, particularly *Melaleuca* spp.

Salmon Gum woodland is significant for the tall hollow-bearing trees and large fallen logs that provide shelter and nesting opportunities for a wide range of fauna species. It potentially supports conservation significant fauna including the Chuditch (*Dasyurus geoffroii*), Inland Western Rosella (*Platycercus icterotis xanthogenys*), and Central Long-eared Bat (*Nyctophilus major tor*). Where the woodland is interspersed with Mallee, Allocasuarina and Acacia species, it may also support Malleefowl (*Leipoa ocellata*). Eucalypt woodland also provides nesting habitat for small birds where the understorey is dense. In this habitat, the reptile assemblage is likely to vary depending upon the substrate type (e.g. clay, sand etc) and the litter cover.

## SHRUBLAND

Shrublands (38.47 ha) are common throughout the survey area. Shrublands occur on sandy-clay flats, gravelly sands and lateritic rises and vary in composition, but are usually dominated by species of Allocasuarina, Hakea, Acacia, Banksia and/or Melaleuca. Although sparse low mallee eucalypts may be present, this habitat lacks large trees. The dense structure of the vegetation provides shelter and nesting habitat for ground-dwelling birds. When in flower, shrubland habitats are likely to attract a suite of nectar-feeding bird species.

Shrublands also occur in small, isolated patches throughout Eucalypt woodland habitat, at a scale too small to be mapped (mostly Melaleuca species).

Shrublands potentially support conservation significant fauna including the Malleefowl (*Leipoa ocellata*), Chuditch (*Dasyurus geoffroii*), Rainbow Bee-eater (*Merops ornatus*), Western Brush Wallaby (*Notamacropus irma*) and Lake Cronin Snake (*Paroplocephalus atriceps*).

Strips of highly disturbed habitat; shrublands interspersed with areas of Salmon Gum and Mallee woodland, can also be found along roadsides in the parts of the survey area that have been developed for agricultural use. These areas of roadside vegetation support species typical of agriculturally developed land, such as Australian Ringneck (*Barnardius zonarius*), Magpie Lark (*Grallina cyanoleuca*), Willie Wagtail (*Rhipidura leucophrys*) and Galah (*Eolophus roseicapilla*).

#### REGROWTH

Several areas of regrowth (0.01 ha) were recorded in association with old borrow pits bordering the Shrubland habitat type. The open nature of this habitat in combination with young regrowth is potentially favoured by a suite of reptile species. Raptors will use open areas for foraging and macropod species are frequently seen in areas of regrowth as well foraging on young shrub species.

Within both the Eucalypt woodland and the Shrubland habitat there were areas with different stages of regrowth after fire or historical clearing.

#### SEASONAL MARSHLAND

There are two seasonal marshlands (0.26 ha) located in the survey area (**Map 2**). One wetland (**Map 2-8**) comprised of Samphire and low *Melaleuca* shrub on clay with quartz gravel. Whereas the second wetland (**Map 2-32**) is formed by a layer of granite and clay that retains water seasonally and is surrounded by low grasses.

The wetlands potentially support conservation significant bat species such as the Central Long-eared Bat (*Nyctophilus major tor*). Migratory waterbird species may use the wetland areas; however, this is unlikely as there is a larger wetland nearby; Lake Cronin which is 33km south of the survey area.

### 4.1.2 FAUNA ASSEMBLAGE

Sixty-four vertebrate and one invertebrate fauna species were recorded during the survey (**Table 9** in **Appendix Three**), consisting of:

- Twenty-two mammals (seven introduced)
- Thirty-six birds
- Six reptiles
- One invertebrate.

Of these, three are conservation-listed:

- *Notamacropus irma* (Western Brush Wallaby); P4 DBCA status, recorded on a camera trap.
- *Leipoa ocellata* (Malleefowl); VU EPBC status; VU BC status, recently used mound recorded.
- *Nyctophilus major tor* (Central Long-eared Bat); P4 DBCA status, ambiguous call recorded on a bat ultrasonic recorder.

The sugar ant *Camponotus sp. nr. Terebrans* was also recorded (

**Table** 12, **Image 3 and Image 4**: **Sugar ants (*Camponotus sp. nr. terebrans*),** which may indicate suitable habitat for the conservation listed Arid Bronze Azure Butterfly *(Ogyris subterrestris petrina)* CR EPBC status; CR BC status.

Survey sites are shown on **Map 2** and listed in **Table 10**, **Table** 11 and

**Table** 12 in **Appendix Three**.

### 4.1.3 SIGNIFICANT FAUNA AND ASSOCIATED HABITAT

The significant fauna species observed during the field survey are discussed below with respect to each species' habitat requirements, taking into consideration the findings of the field survey and survey effort.

#### 4.1.3.1 Western Brush Wallaby

A Western Brush Wallaby was recorded on a camera trap and scats were found during the field survey. Suitable habitat for Western Brush Wallaby is found throughout the survey area (54.61 ha). The Western Brush Wallaby's optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland and is uncommon in karri forest (Van Dyck & Strahan 2008).

#### 4.1.3.2 Malleefowl

Two Malleefowl (*Leipoa ocellata*) mounds were found during the survey (**Map 2**, **Table 11**), mound 1 (**Image 1** and Image 2) was found next to an old drill line and did not show any recent activity, mound 2 (**Image 1**) showed signs of very recent activity and was directly adjacent to a recently cleared track. Neither mound has previously been recorded as part of an Ecoscape fauna survey. Suitable Malleefowl habitat was found to occur in the survey area.

**Image 1 and Image 2: Malleefowl mounds located within the survey area.**

#### 4.1.3.3 Arid Bronze Azure Butterfly Survey Results

One hundred smooth-barked trees, comprising of Salmon Gum and Mallet, were sampled at 10 separate locations (**Table 12**, **Map 2**) across the survey area. Surveys identified the presence of two active colonies of the sugar ant (*Camponotus sp. nr. terebrans*) (**Image 3 and Image 4**), at locations Sugar Ant 1 and Sugar Ant 2 (**Map 2** - 42) immediately adjacent to the survey area.


**Image 3 and Image 4: Sugar ants (Camponotus sp. nr. terebrans)**

### 4.1.4 FAUNA SURVEY LIMITATIONS

**Table 4: Fauna survey limitations**

| Possible limitations | Constraints (yes/no): Significant, moderate or negligible | Comment |
|---|---|---|
| Availability of data and information | No | DBCA guidelines were specific and detailed. No constraints in obtaining data. |
| Competency/experience of the survey team, including bioregion experience | No | Field survey staff were experienced (36 years) with the targeted fauna survey methods used and with the identification of fauna and fauna habitat. |
| Scope of survey e.g. excluded fauna groups | No | Targeted species adequately sampled, and no sampling methods were constrained due to external factors. |
| Timing, weather, season | No | No constraints. |
| Disturbances that may have affected results | No | No significant disturbances were observed that could negatively affect survey results. |
| Proportion of fauna identified, recorded, or collected | No | The primary focus of the field survey was the definition of targeted species and fauna habitat types. |
| Adequacy of survey intensity and proportion of survey achieved | No | All major fauna habitat types including those favoured by conservation significant fauna were investigated and defined. |
| Access | No | No access issues encountered; survey areas adequately surveyed. |
| Data and analysis issues including sampling biases | No | Limited data collected; no analysis required. |

# 5 DISCUSSION

## 5.1 FAUNA SIGNIFICANCE

### 5.1.1 FAUNA HABITAT TYPES

Four broad fauna habitat types were recorded during the field survey (**Section 4.1.1**):

- Eucalypt woodland (15.87 ha)
- Shrubland (38.47 ha)
- Regrowth (0.01 ha)
- Seasonal Marsh (0.26 ha)

Within the two main habitat types (Eucalypt woodland and Shrubland) there were also areas with different stages of regrowth after fire or historical clearing. On a landscape scale, these areas of regrowth coupled with older unburnt areas, create a mosaic environment which can support a diverse range of species. Some of these species will have specific habitat requirements that will be unique e.g. Malleefowl require shrubland or open Mallee woodland over shrub, Chuditch require Eucalypt woodland with a high percentage of fallen hollow logs.

Cleared or developed areas, such as cleared borrow pits and roads are not considered to be habitat.

### 5.1.2 FAUNA ASSEMBLAGE

Sixty-four vertebrate fauna species and one targeted invertebrate species were recorded during the field survey (**Table 9** in **Appendix Three**). Survey techniques used included active searches, habitat assessments, trail cameras and ultrasonic recording units. All species recorded were expected to occur and were considered typical for the region and the habitat surveyed. The conservation significant vertebrate species that were recorded were Malleefowl (*Leipoa ocellata*), Western Brush Wallaby (*Notamacropus irma*) and Central Long-eared Bat (*Nyctophilus major tor*). The likelihood of occurrence of conservation significant species that were not recorded is discussed below. Each species is discussed with respect to their habitat requirements, taking into consideration the findings of the field survey and survey effort, and determining their post-survey likelihood of occurrence (**Table 7** in **Appendix Two**).

Targeted surveys for the sugar ant *Camponotus* sp. nr. *Terebrans* identified the presence of the species at two locations, Sugar Ant 1, and Sugar Ant 2 (**Map 2** - 42). The sugar ant is the host species of the conservation listed species the Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) and is discussed below.

### 5.1.3 RECORDED CONSERVATION-LISTED SPECIES

#### Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) – CR EPBC Act, CR BC Act

A targeted fauna survey was conducted to determine the presence/absence of the sugar ant species *Camponotus* sp. nr. *terebrans* within the survey area. The sugar ant is the host species of the conservation listed species Arid Bronze Azure Butterfly (*Ogyris subterrestris petrina*) *(*ABAB). The ABAB is a 'Threatened Species' that is listed as 'Critically Endangered' under the national *Environment Protection and Biodiversity Conservation Act 1999* and the state *Biodiversity Conservation Act 2016*. The surveys were conducted in accordance with the *DBCA - Guideline for the survey of arid bronze azure butterfly (ABAB) in Western Australia* (2020).

The ABAB has an obligate association with the sugar ant, with its larvae living within the ants' nest and protected by the ants during development. It is thought that the ants are rewarded with secretion that are produced by the larvae. In order to maintain this association, the ABAB requires large colonies of the sugar ants. Despite being widespread, the sugar ant is uncommon and (as of 2020) only three large colonies and several small colonies are known to occur, with the ABAB occurring at two of the large colonies, which are over 50 km from the survey area. The habitat at these two large colonies is mature mixed Gimlet *Eucalypt*

*Salubris* and Salmon Gum *Eucalypt Salmonophloia* woodland on red-brown loam soils, with an open understorey. The habitat where the colonies in this survey were found matches this habitat description.

According to the *DBCA - Guideline for the survey of arid bronze azure butterfly (ABAB) in Western Australia* (2020a), on-ground ABAB surveys may not be required, as the densities of sugar ant colonies found during this survey are low, ants were detected at two single trees out of the 100 trees sampled. However, it is a requirement that the presence of the sugar ant colonies be reported to DBCA.

#### Malleefowl (*Leipoa ocellata*) – VU EPBC Act, VU BC Act

Malleefowl are large stocky, mostly ground dwelling birds that construct large nesting mounds that contain decomposing leaf litter which they use to incubate their eggs. Malleefowl habitat consist of shrubland and Mallee woodland with sandy soils, high cover of leaf litter and that has been unburnt for a long period of time (Benshemesh 2007). Suitable Malleefowl habitat was found throughout the survey area, and it is highly likely that this species is widely distributed through this habitat.

Two Malleefowl mounds (points MF1; MF2) were recorded during the survey (**Map 2 –** 43; 55), only one showed signs of recent activity, however this mound was directly adjacent to a recently cleared track. The presence of an active mound may require an exclusion zone.

#### Western Brush Wallaby (*Notamacropus irma*) – P4 DBCA status

The Western Brush Wallaby's optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (Van Dyck & Strahan 2008). Suitable habitat for Western Brush Wallaby is found throughout the survey area (54.61 ha). One Western Brush Wallaby was recorded on a camera trap and multiple scats were found during the field survey. The DBCA database search returned 41 records of Western Brush Wallaby within the survey area, the majority of which have been recorded since 2016. Western Brush Wallabies have an estimated home range of 32.5 to 69.2 ha (Bamford, Inglis & Watson 2009) and the local area likely supports a resident population of an unknown number of individuals.

#### Central Long-eared Bat (*Nyctophilus major tor*) – P4 DBCA status

Central Long-eared Bat is widespread across the arid south of Australia, and though thought to have a population of substantially more than 10,000 individuals, the reliability of this estimate is low (Woinarski, Burbidge & Harrison 2014). Although only known from 15 localities in Western Australia, it is considered locally common in the Coolgardie Bioregion (DEWHA 2010). It occurs in eucalypt woodlands with a tall shrub understorey and around granite outcrops, roosting beneath bark, in tree crevices or in the foliage of trees (DEWHA 2010; Van Dyck & Strahan 2008). Current threats to this species are inferred and include habitat loss and fragmentation or inappropriate fire regimes leading to a loss of habitat and/or roost sites (Woinarski, Burbidge & Harrison 2014). The Central Long-eared Bat is known from Jilbadji Nature Reserve (DEWHA 2010), which the survey area intersects, and is likely to occur in the Mallee and Salmon Gum Woodland habitat, with 15.87 ha of suitable habitat occurring within the survey area.

The calls of long-eared bat species *Nyctophilus* spp. cannot be distinguished reliably, therefore either or both the Lesser Long-eared Bat *Nyctophilus geoffroyi* and/or the Central Long-eared Bat *Nyctophilus major tor* may have been present in the survey area. Given that the Central Long-eared Bat has been previously recorded in the Jilbadji Nature Reserve, it is likely that it occurs within the survey area, however trapping would be required to distinguish it from the sympatric Lesser Long-eared Bat for further confirmation.

#### 5.1.3.1 Post-survey Likelihood Assessment

The post-survey likelihood assessment is incorporated into **Table 7** in **Appendix Two**.

Conservation-listed fauna species identified during the desktop assessment as being known to occur in the survey area that were not recorded during the field survey are discussed below with respect to each species' habitat requirements, taking into consideration the findings of the field survey and survey effort.

### Western Rosella (Inland) (*Platycercus icterotis xanthogenys*) – P4 DBCA status

The Western Rosella only occurs in the south-west of Western Australia and is Western Australia's only rosella species. The subspecies, *Platycercus icterotis xanthogenys*, occurs in the drier inland areas and is known to occur in the survey area. This species feeds both in trees and on the ground and is sometimes seen eating grain along roadsides.

Suitable habitat occurs in the area and DBCA records indicate that this species has been recorded in the survey area, with 11 records from 2017 occurring within the Earl Grey Development Envelope. It is likely that, because this species is uncommon but widespread, it was just not observed during this survey. Therefore, the post-survey likelihood of the species occurring in the survey area is "Likely."

### Peregrine Falcon (*Falco peregrinus*) – OS BC status/DBCA status

This bird of prey saw massive declines in the 1960s and 1970s due to the use of the pesticide DDT. Populations in Australia have recovered better than elsewhere in the world, however it is still protected by legislation, as are all Australian raptors. This species is not confined to a specific habitat, although it is usually seen perching on poles, fences, or dead trees in agricultural areas. It nests on cliffs, buildings, or the old stick nests of other species e.g. Raven.

No Peregrine Falcons were recorded during the survey. DBCA records indicate that this species does occur in the survey area, with one record from 2017 occurring within the Earl Grey Development Envelope, however this species is likely to be transient in the area. The agricultural lands occurring at the northern end of the survey area are the preferred foraging habitat for this species, however, suitable breeding habitat is limited in these areas. Given the extent of the agricultural areas within the local region, clearing in this area is likely to have minimal impact on this species. The post-survey likelihood of the species occurring in the survey area is "Likely."

### Chuditch (*Dasyurus geoffroii*) – VU EPBC status; VU BC status/DBCA status

Once relatively abundant across semiarid Australia in every mainland state, the Chuditch today survives only in the south-west of Western Australia, living in Jarrah forests, drier woodlands, and Mallee shrubland in the far eastern Wheatbelt.

Chuditch require adequate numbers of suitable den and refuge sites (hollow logs or earth burrows) and sufficient prey biomass (large invertebrates, reptiles, and small mammals) to survive. They are capable of travelling long distances and have large home ranges, and even at their most abundant, Chuditch are generally present in low numbers. For this reason, they require habitats that are of a suitable size and not excessively fragmented (DBCA 2017). Chuditch are known to occur in the survey area and suitable habitat occurs throughout the area (Eucalypt Woodland 15.87 ha, and to a lesser extent Shrubland 38.47 ha).

There are 216 records of Chuditch occurring within the survey area buffer zone, with many occurring in the Earl Grey development envelope. The majority (201) of these records are from 2016 and 2017, during surveys conducted by Western Wildlife for Covalent Lithium (Western Wildlife 2017).

Chuditch are listed as vulnerable (VU) under the Commonwealth EPBC Act 1999 and the Western Australian BC Act 2016 and are considered as Matters of National Environmental Significance (MNES). Covalent Lithium has an ongoing Chuditch monitoring program to monitor the density of the local Chuditch population prior to, during, and post construction of the mine and associated infrastructure. Therefore, the absence of Chuditch in the present survey is not an indication of their absence from the survey area, as they have been recorded locally and suitable habitat exists within the survey area. Therefore, the post-survey likelihood of the species occurring in the survey area is "Known."

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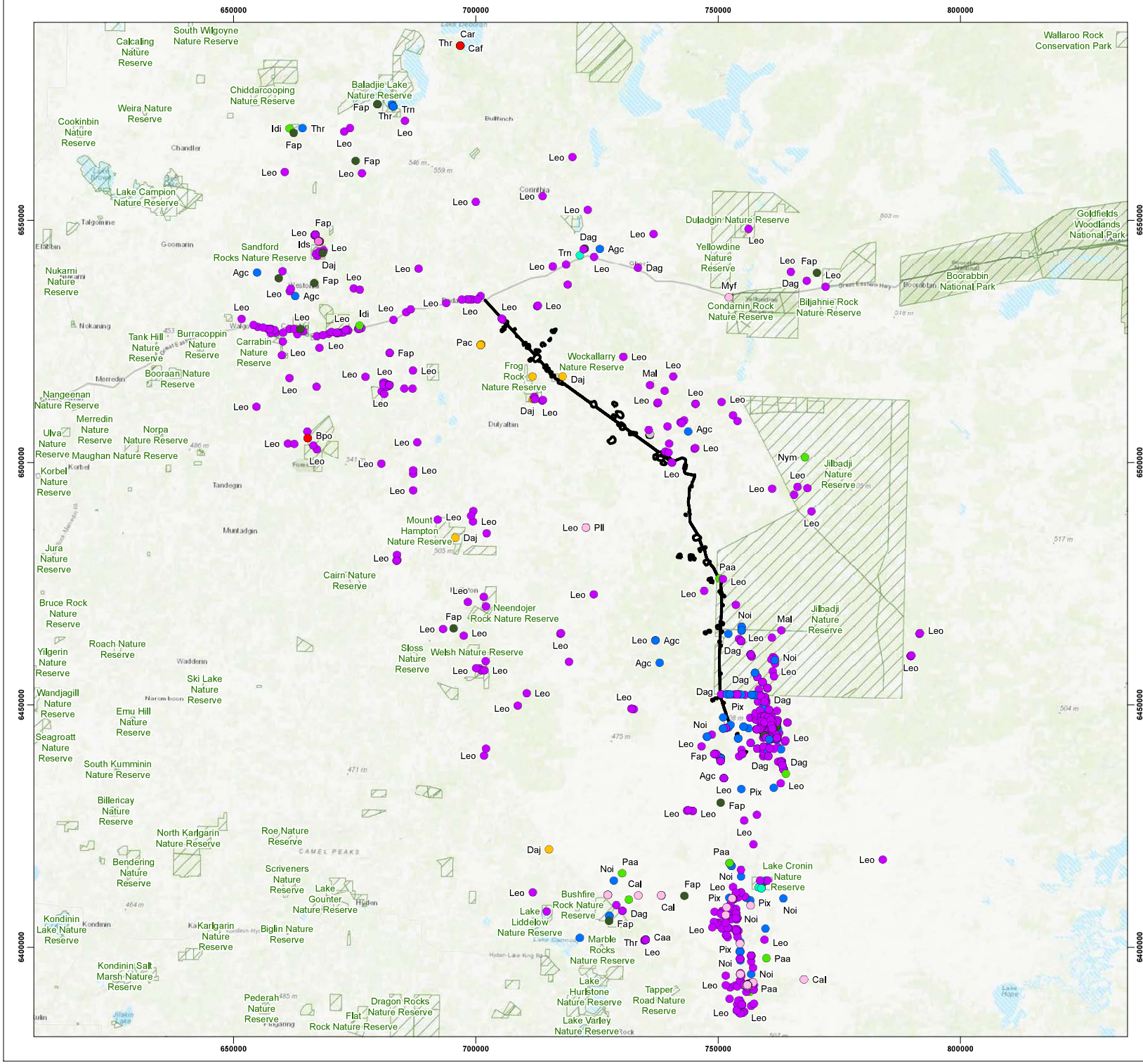
# MAPS




## LEGEND

- Survey
- DBCA Nature Reserve (2011)

### Conservation Significant Fauna

- Critically Endangered
- Endangered
- Endangered or Priority 3
- Vulnerable
- Conservation Dependent
- Migratory Species
- Other Specially Protected
- Priority 1
- Priority 3
- Priority 4

| Taxon Name | Code | Status |
|---|---|---|
| *Aganippe castellum* | Agc | P4 |
| *Apus pacificus* | App | MI |
| *Bettongia penicillata ogilbyi* | Bpo | CR |
| *Calidris acuminata* | Caa | MI |
| *Calidris ferruginea* | Caf | CR |
| *Calidris ruficollis* | Car | MI |
| *Calyptorhynchus latirostris* | Cal | EN |
| *Daphnia jollyi* | Daj | P1 |
| *Dasyurus geoffroii* | Dag | VU |
| *Falco peregrinus* | Fap | OS |
| *Idiosoma intermedium* | Idi | P3 |
| *Idiosoma sp.* | Ids | EN or P3 |
| *Leipoa ocellata* | Leo | VU |
| *Leporillus conditor* | Lec | CD |
| *Macrotis lagotis* | Mal | VU |
| *Myrmecobius fasciatus* | Myf | EN |
| *Notamacropus irma* | Noi | P4 |
| *Nyctophilus major tor* | Nym | P3 |
| *Parartemia contracta* | Pac | P1 |
| *Paroplocephalus atriceps* | Paa | P3 |
| *Petrogale lateralis lateralis* | Pll | EN |
| *Phascogale calura* | Phc | CD |
| *Platycercus icterotis xanthogenys* | Pix | P4 |
| *Thinornis rubricollis* | Thr | P4 |
| *Tringa nebularia* | Trn | MI |

**DATA SOURCES**:
SOURCE DATA: CONSERVATION LISTED FAUNA (DBCA, 2021), LEGISLATED LANDS AND WATERS (DBCA, 2011)
BASEMAP: ESRI TOPOGRAPHIC BASEMAP
SERVICE LAYERS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

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# DBCA DATABASE SEARCH RESULTS - FAUNA

## BASIC TERRESTRIAL VERTEBRATE FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

N

SCALE: 1:75,000 @ A3

0 7.5 15 22.5 30 km

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |

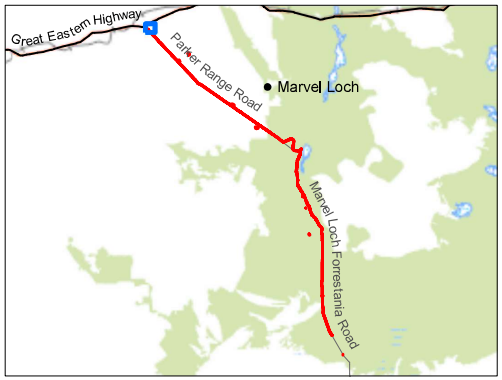
MAP 01


## LEGEND

Survey Area

**Fauna Habitat**

Cleared/Developed




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

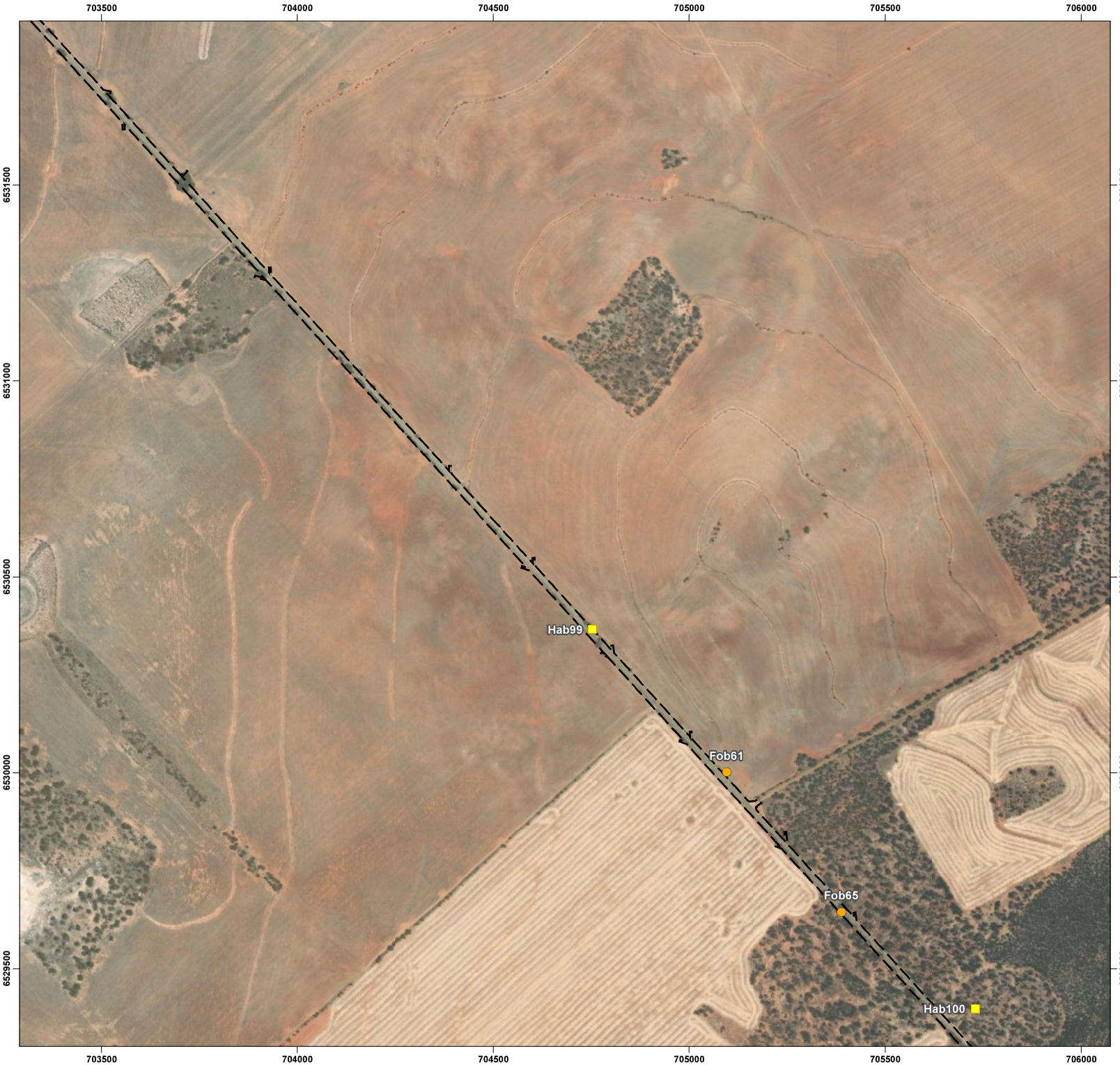
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-1

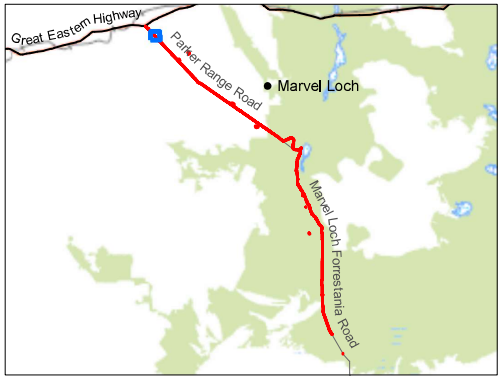



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

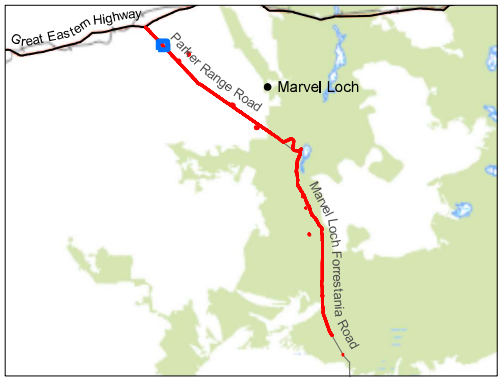
MAP 2-2


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

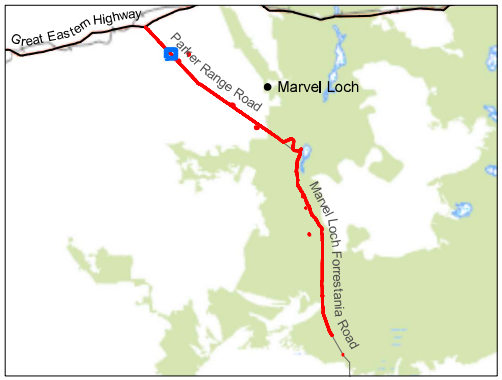
MAP 2-3


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

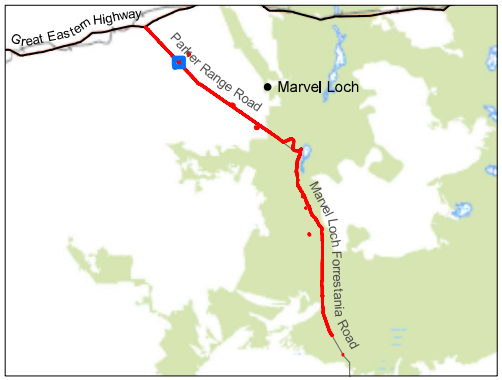
MAP 2-4


## LEGEND

- Fauna Observation Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

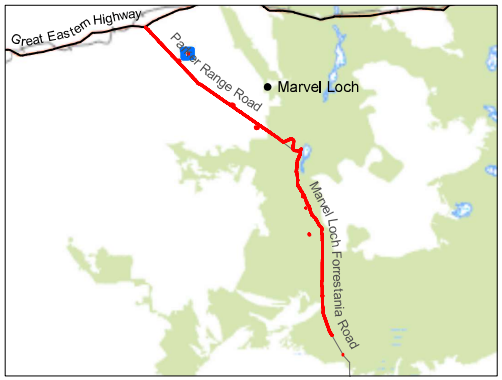
MAP 2-5


## LEGEND

Survey Area

**Fauna Habitat**

Cleared/Developed




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

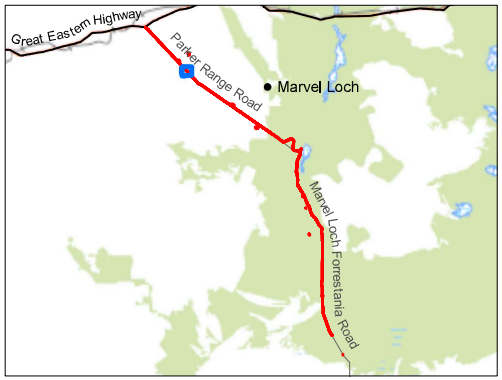
MAP 2-6


## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland

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AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

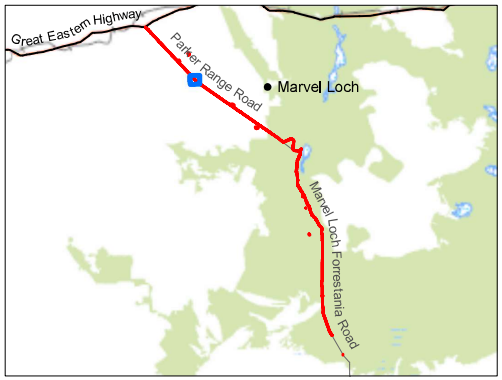
MAP 2-7


## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Seasonal Marsh
- Shrubland
- DBCA Nature Reserve (2011)

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AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

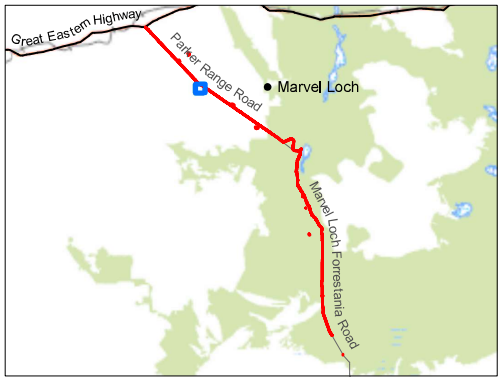
MAP 2-8


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

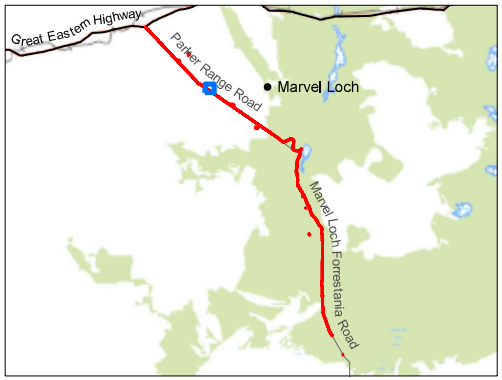
MAP 2-9


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)

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BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

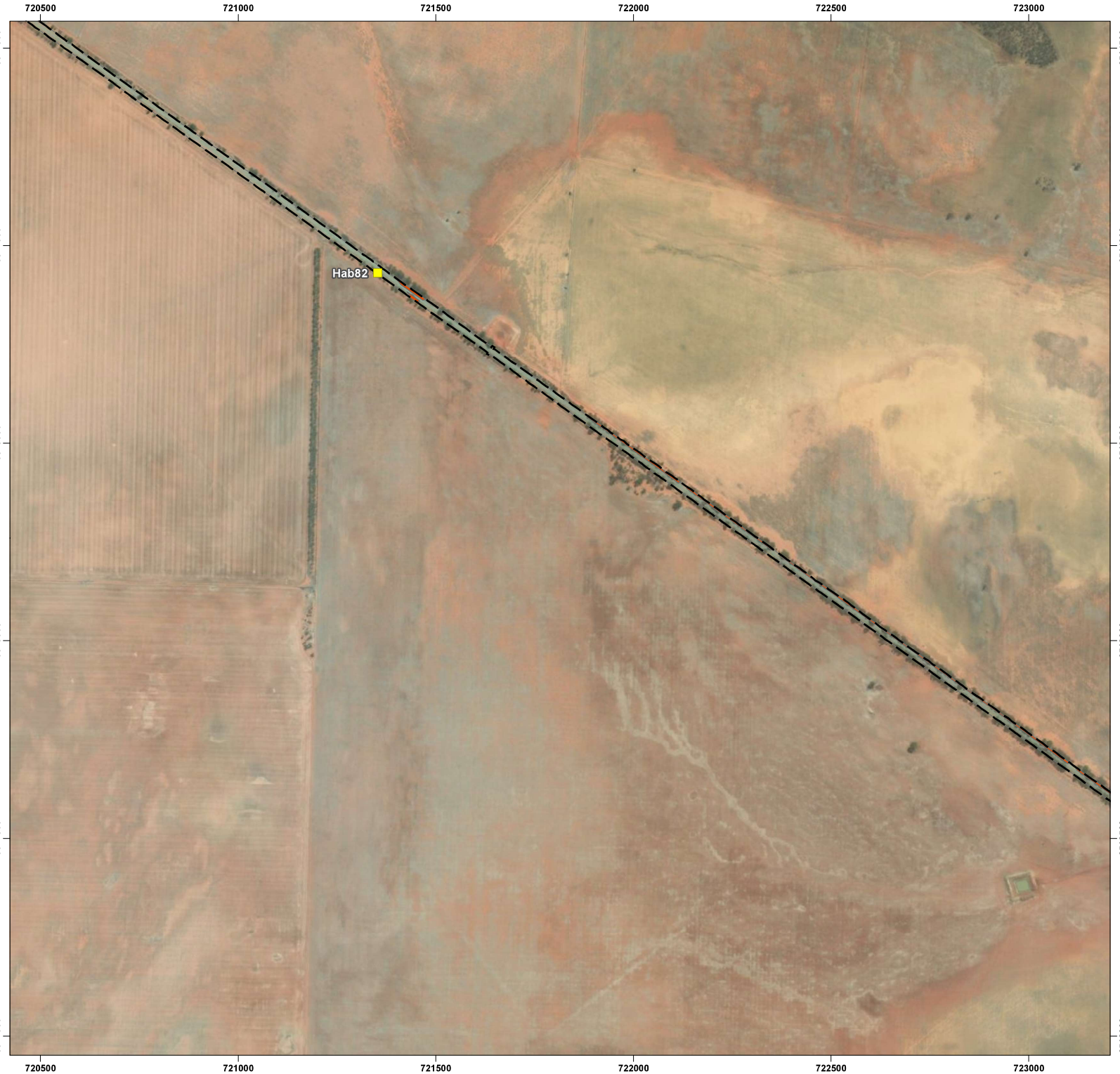
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-10

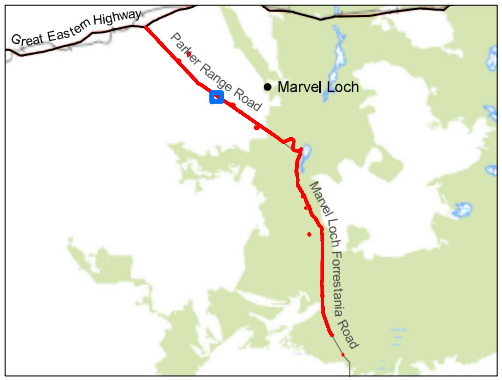



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)

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BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

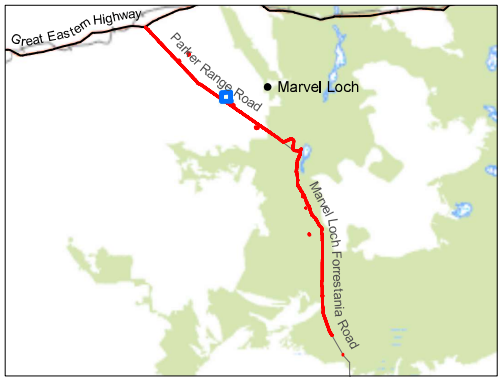
MAP 2-11


## LEGEND

- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

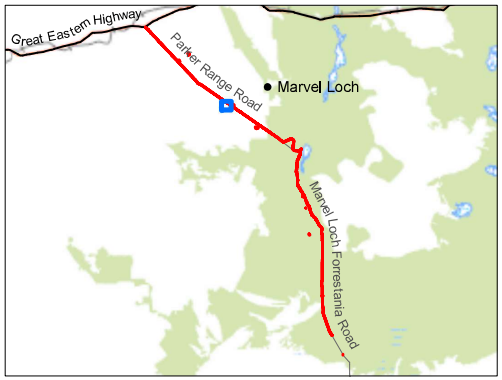
MAP 2-12


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
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AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

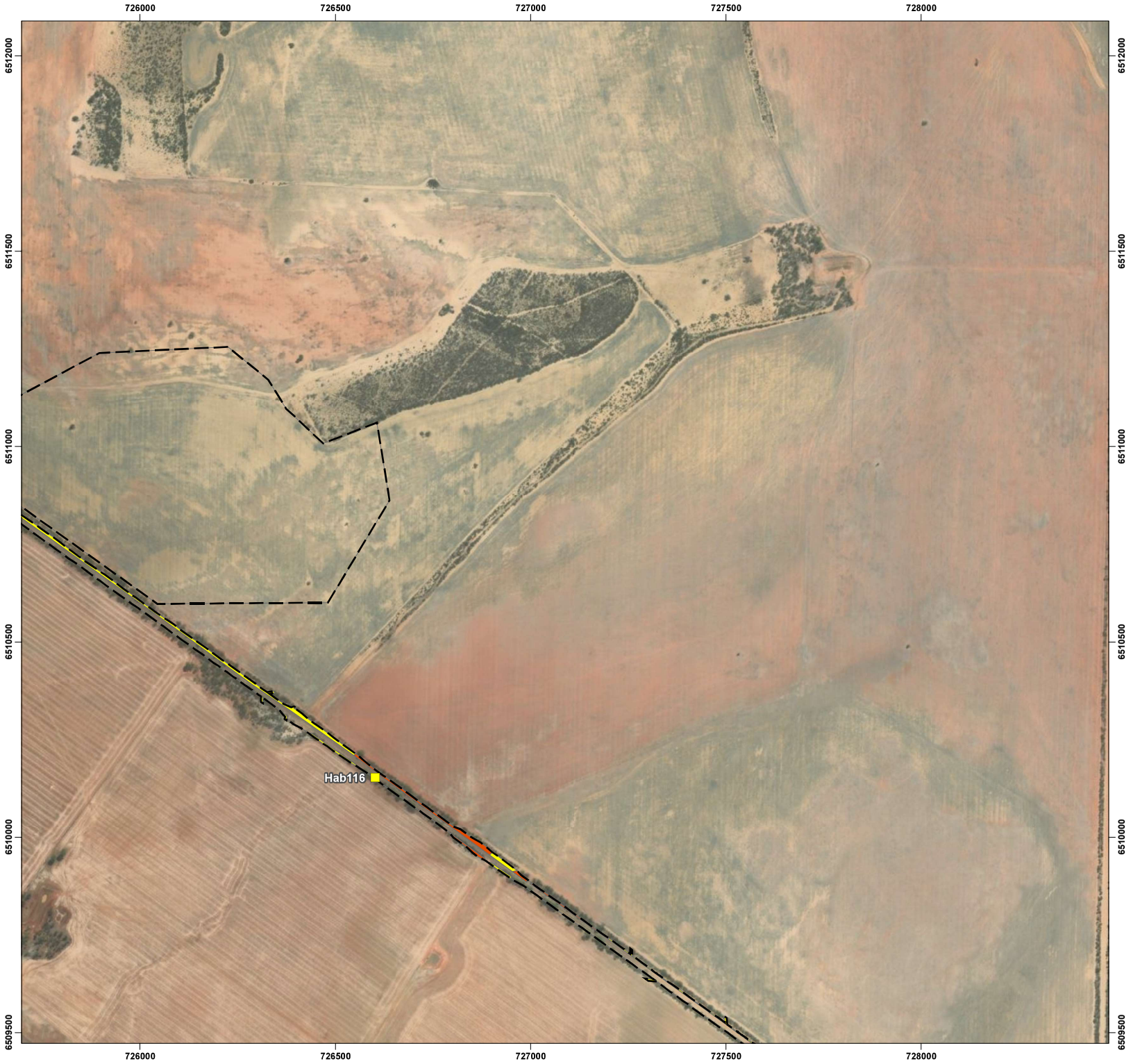
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-13

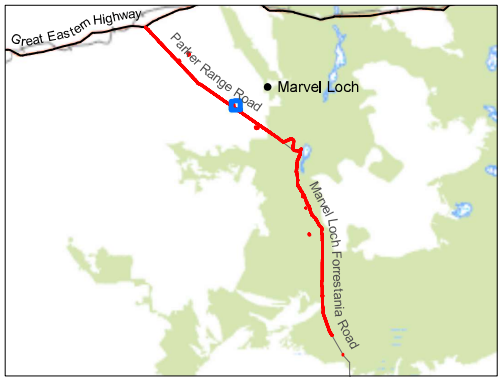



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

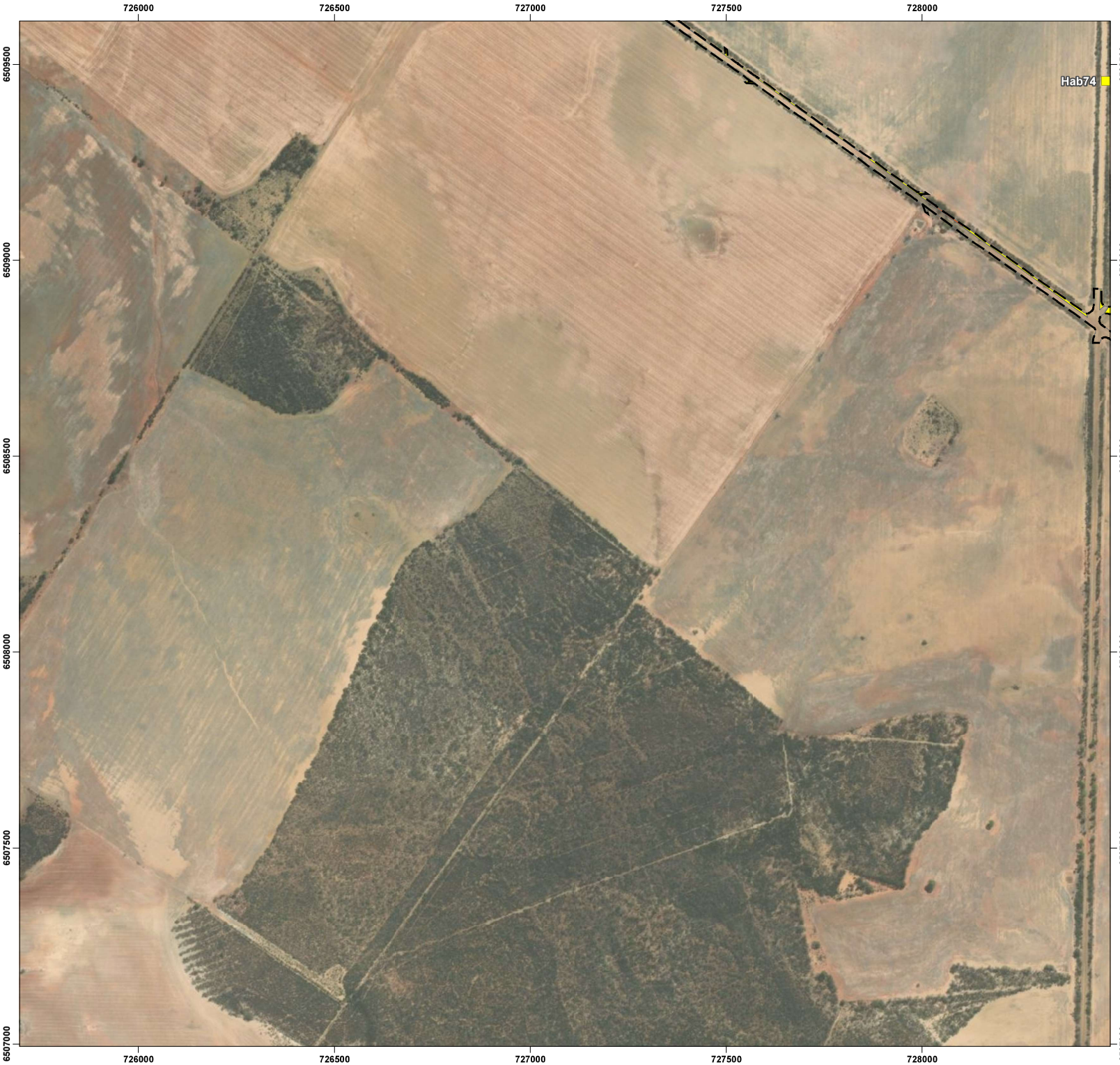
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-14

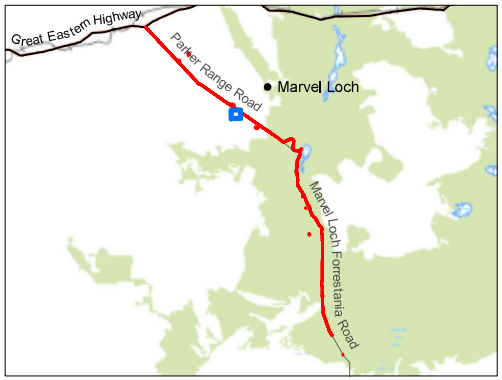



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

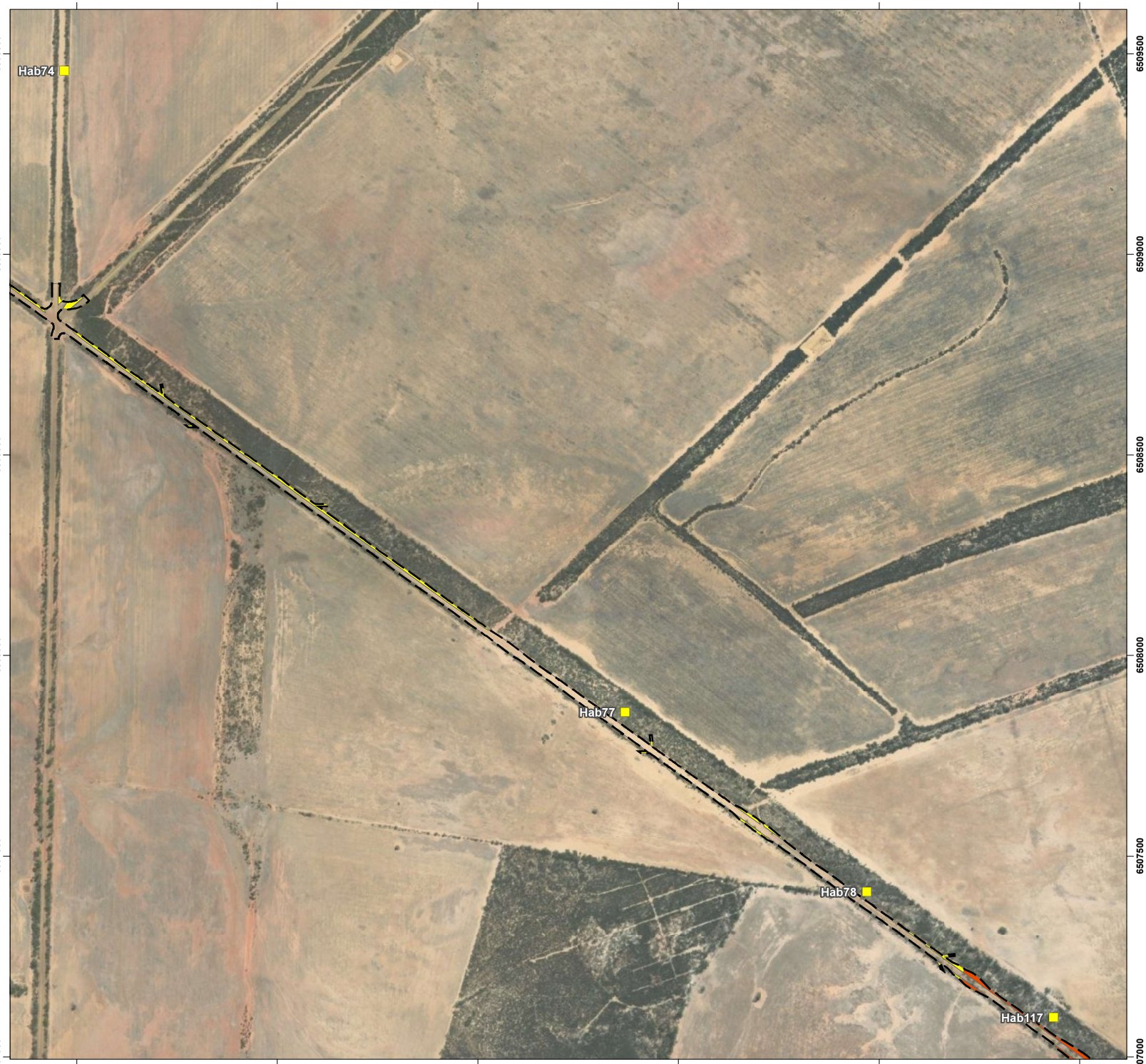
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-15

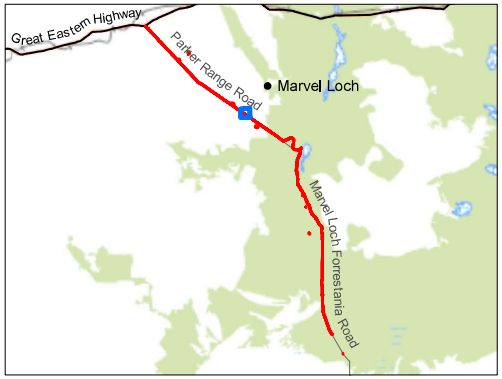



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

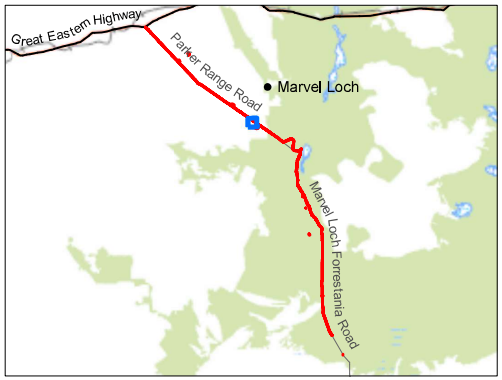
MAP 2-16


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

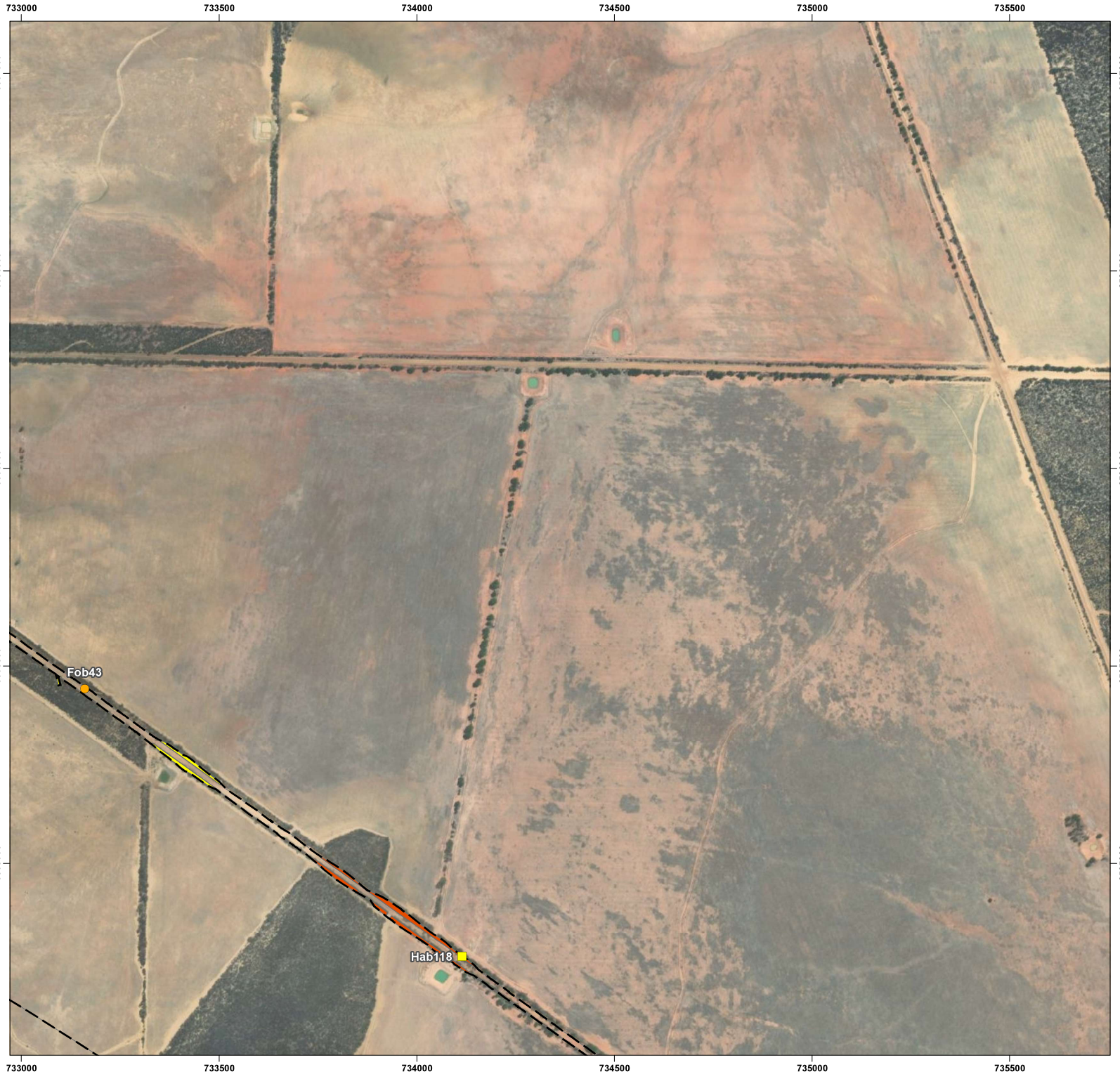
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-17

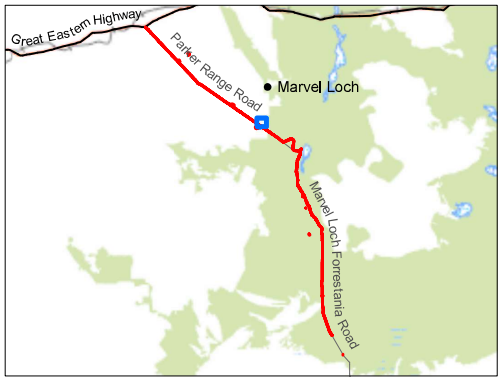



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

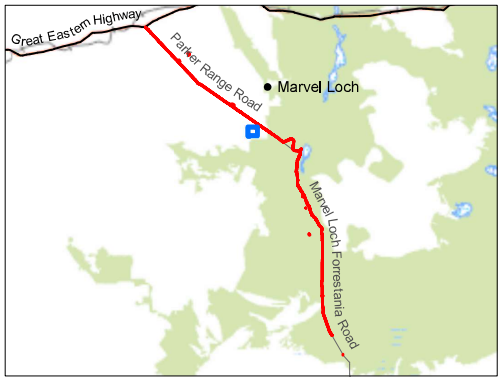
MAP 2-18


## LEGEND

Survey Area

**Fauna Habitat**

Cleared/Developed




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

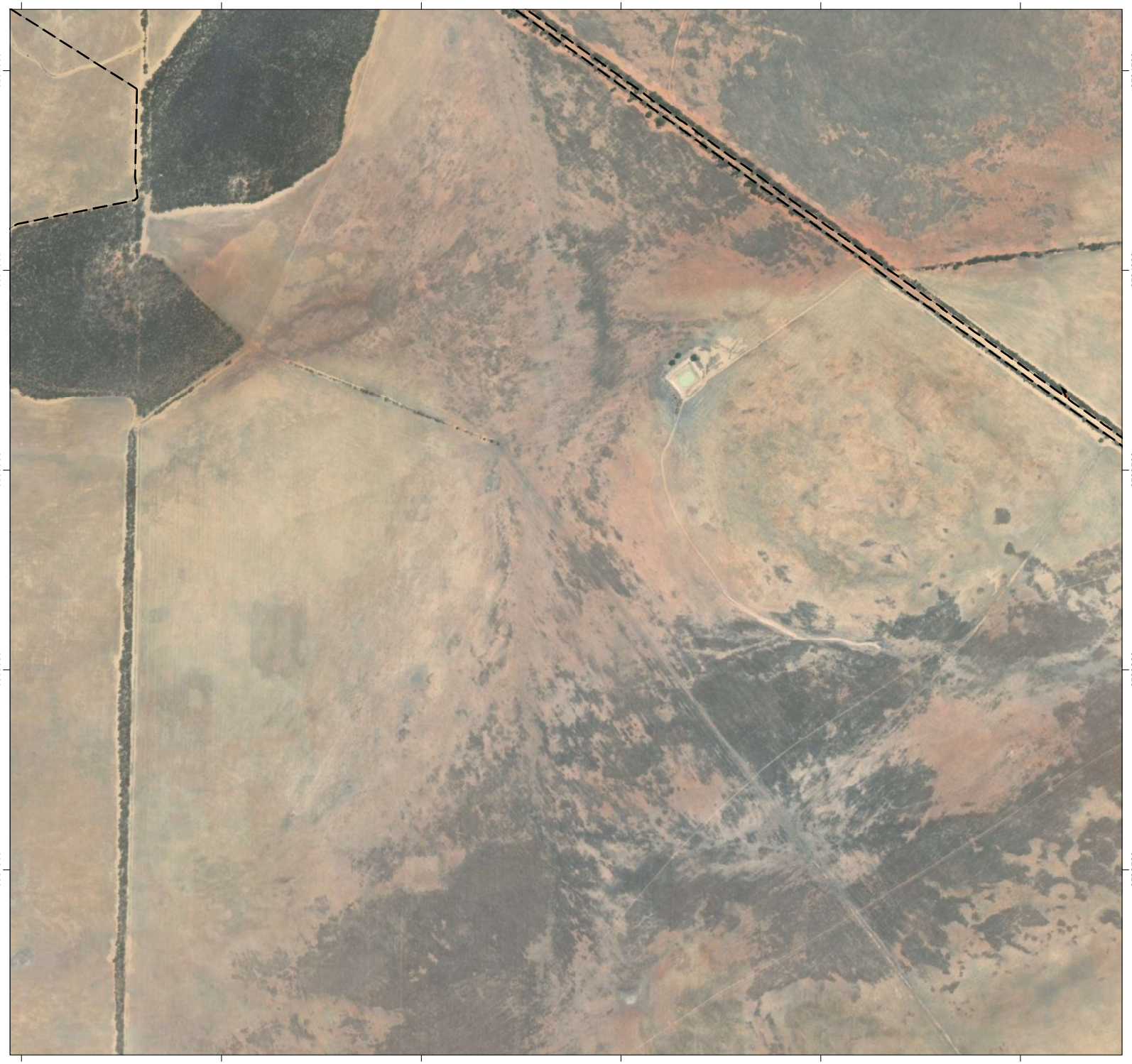
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-19



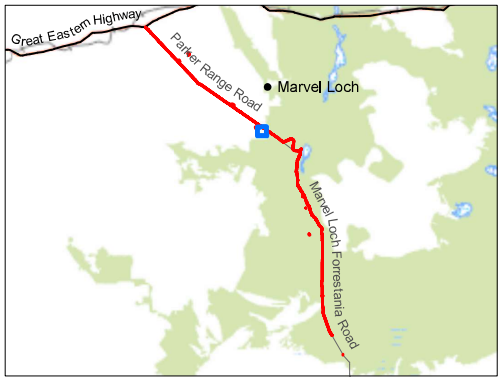

## LEGEND

Survey Area

**Fauna Habitat**

Cleared/Developed

Woodland (Open/Closed)




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

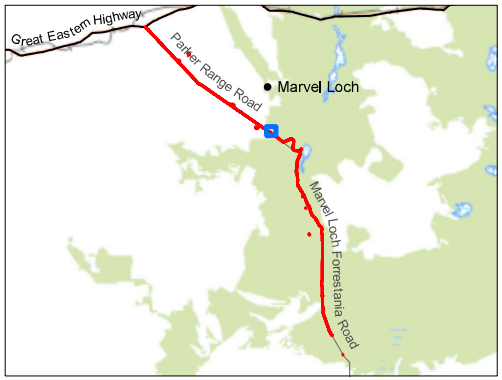
MAP 2-20


## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

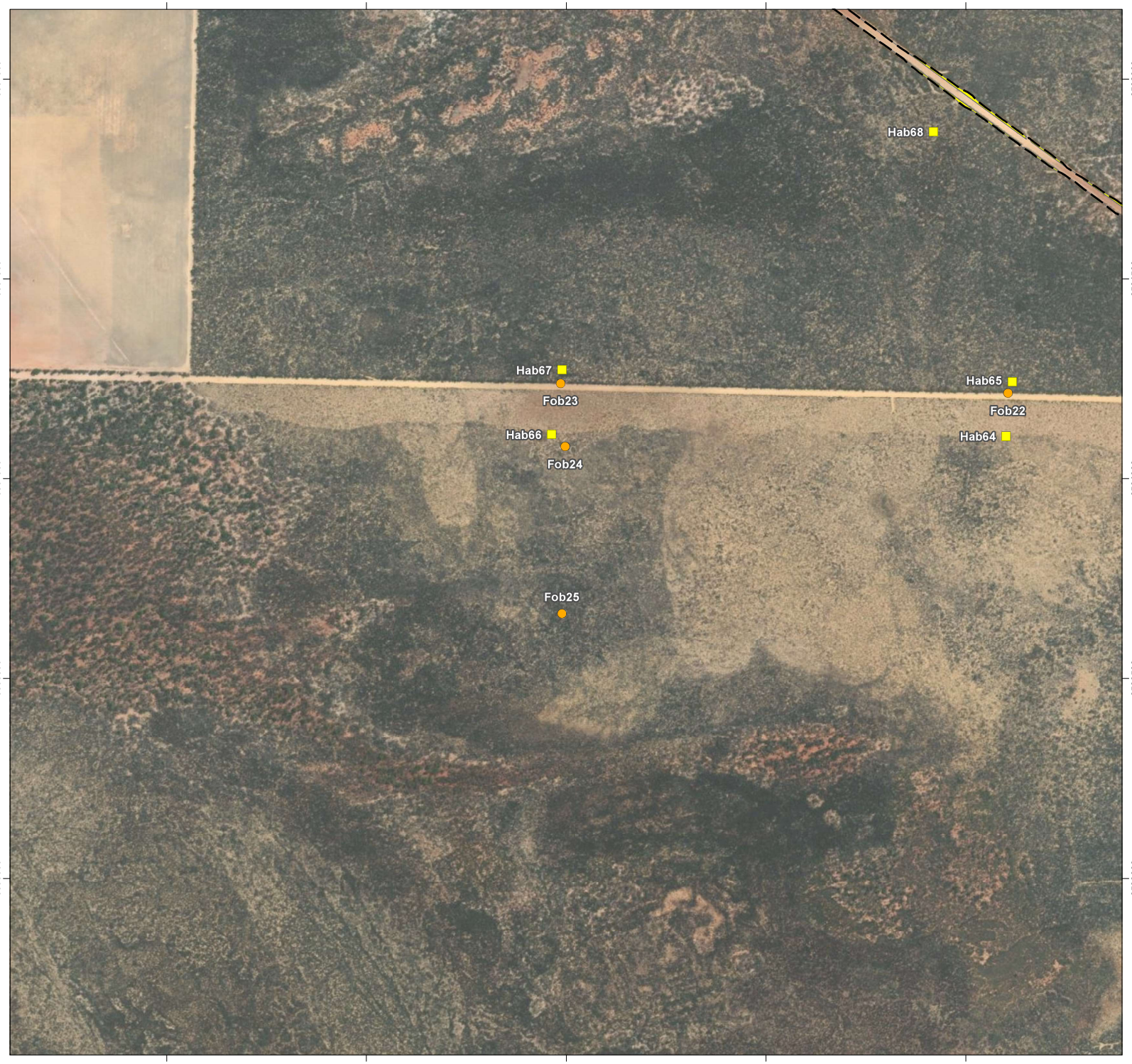
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-21

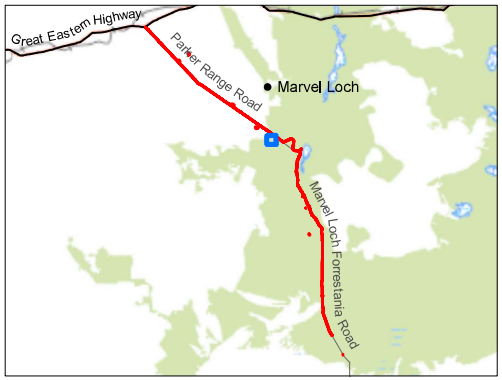



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

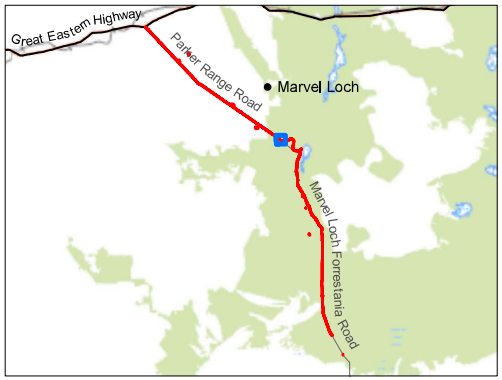
MAP 2-22


## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

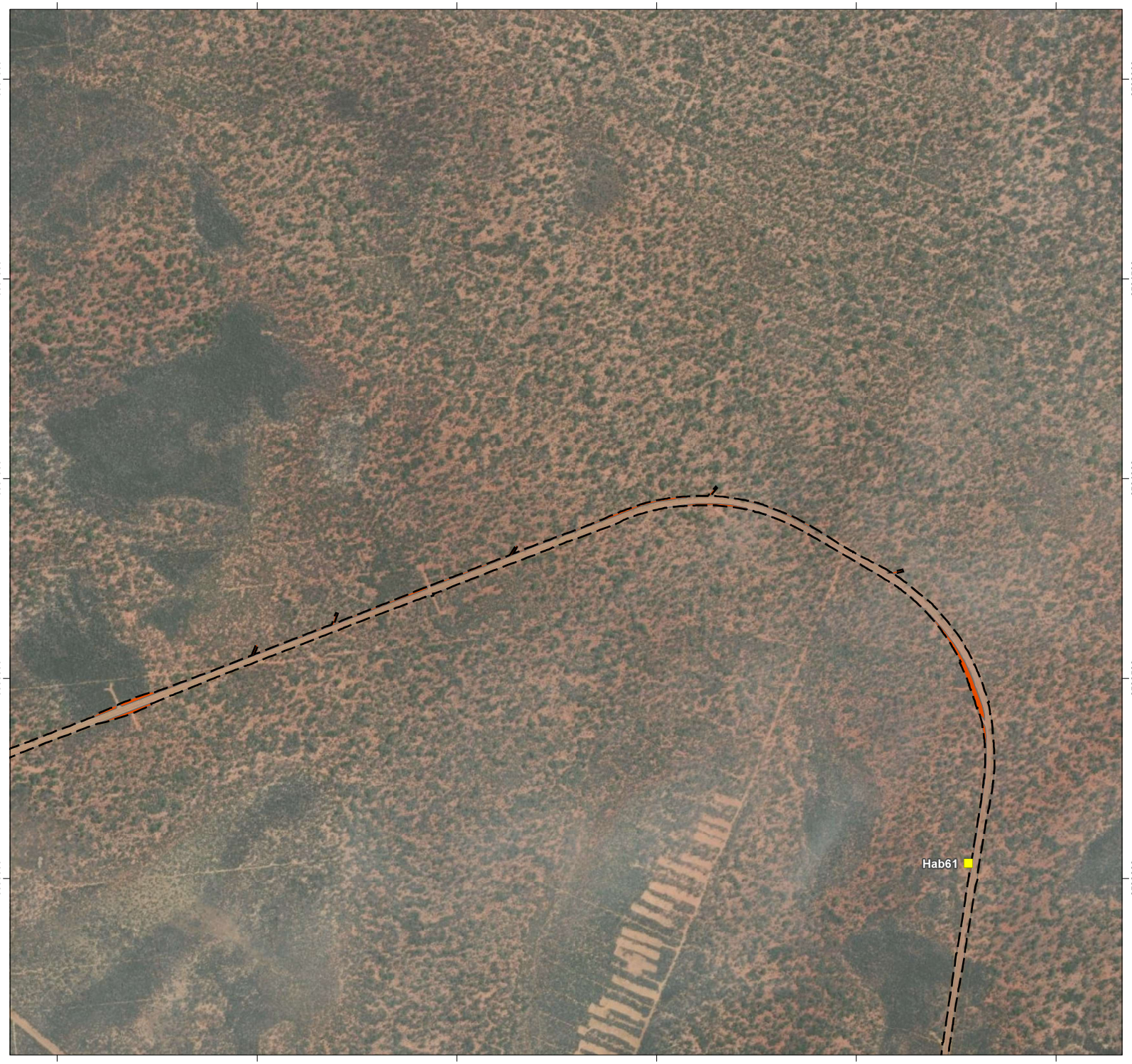
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-23

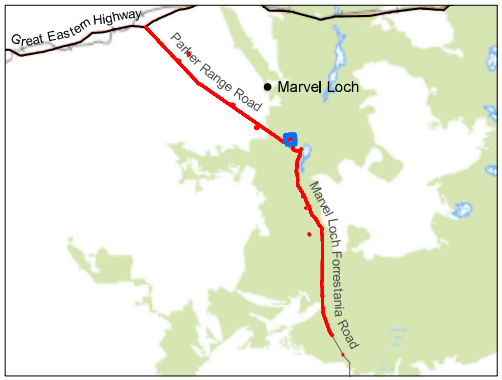



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

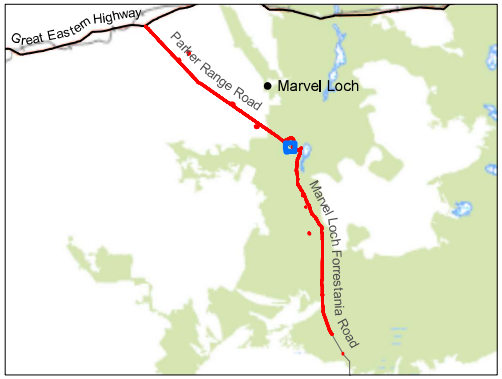
MAP 2-24


## LEGEND

- Fauna Observation Point
- Sugar Ant Survey Site
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

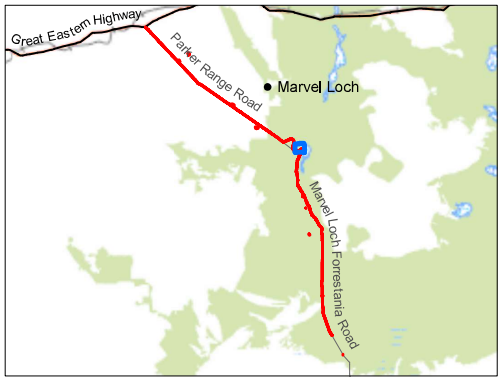
MAP 2-25


## LEGEND

- Fauna Observation Point
- Sugar Ant Survey Site
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

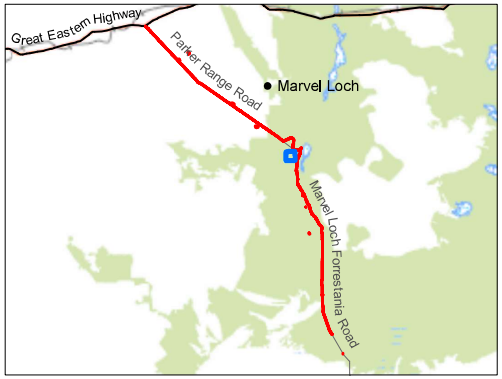
0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-26


## LEGEND




**DATA SOURCES**:
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SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

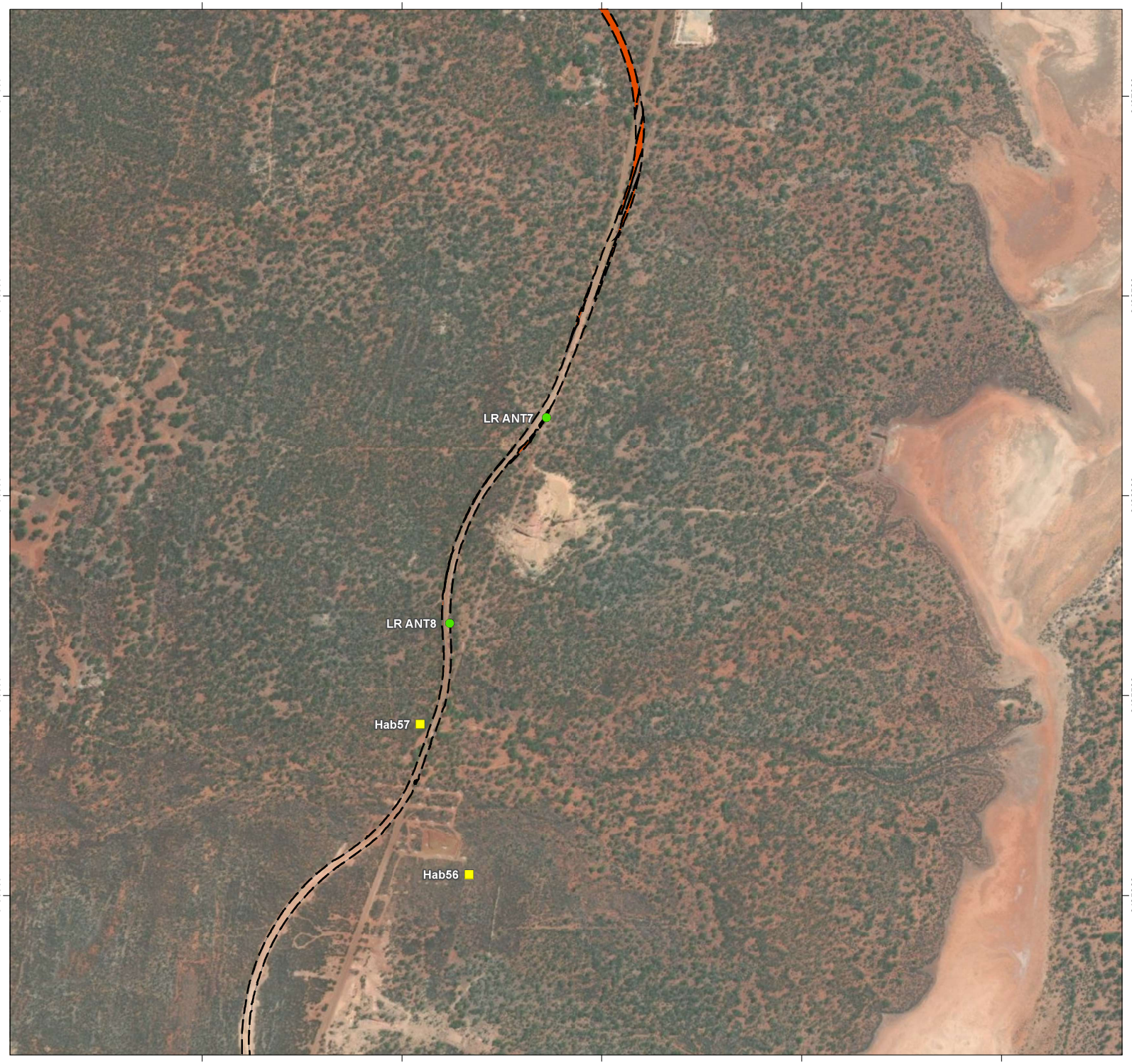
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-27

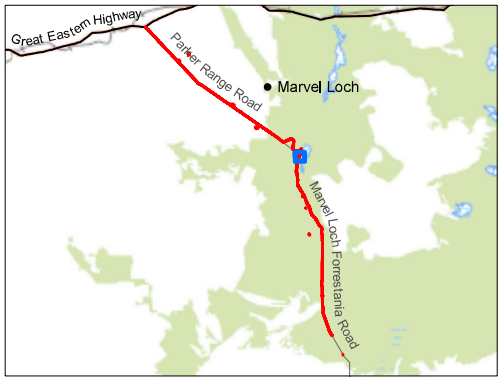



## LEGEND

- Sugar Ant Survey Site
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
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AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

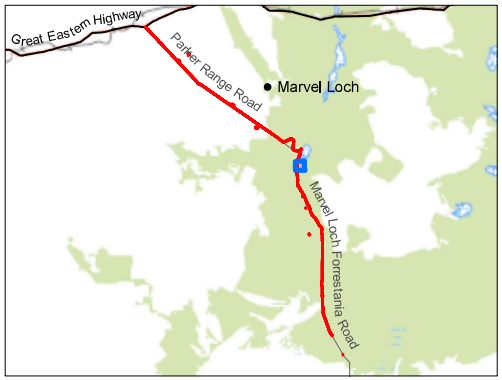
MAP 2-28


## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

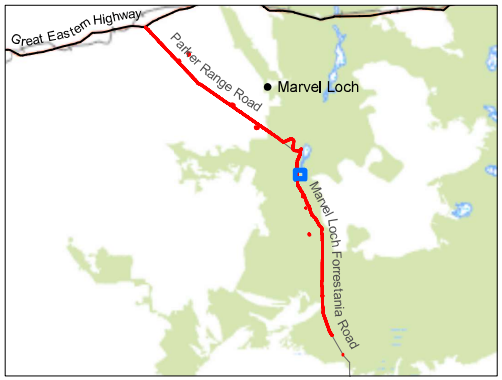
MAP 2-29


## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

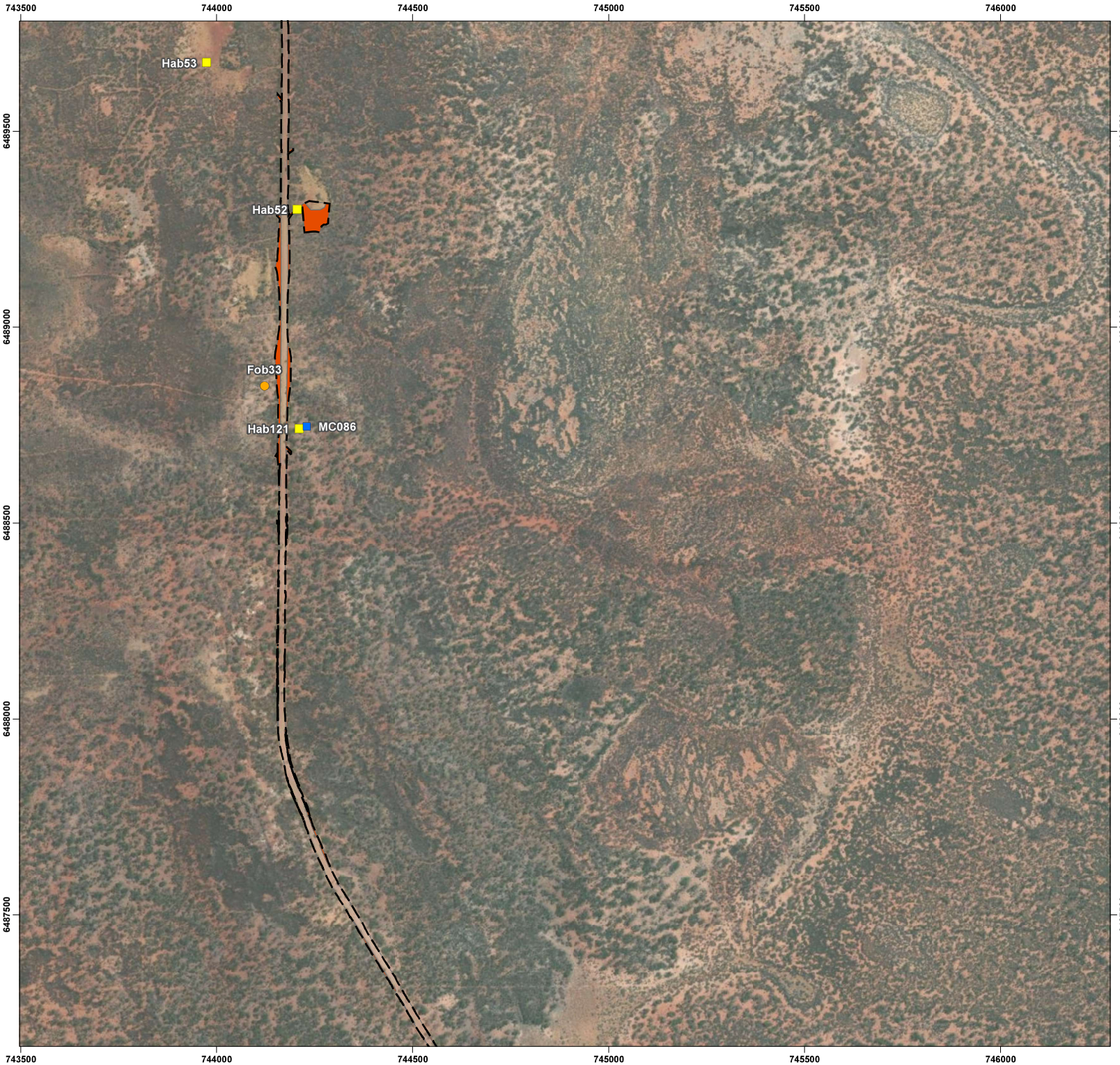
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-30

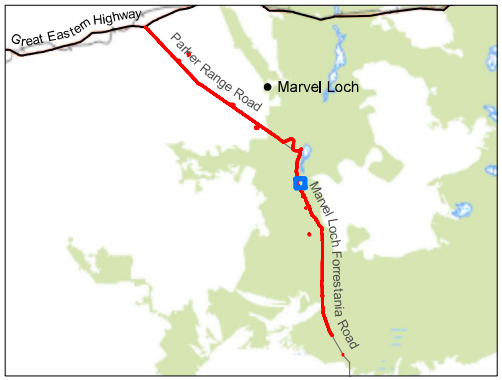



## LEGEND

- Motion Camera
- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

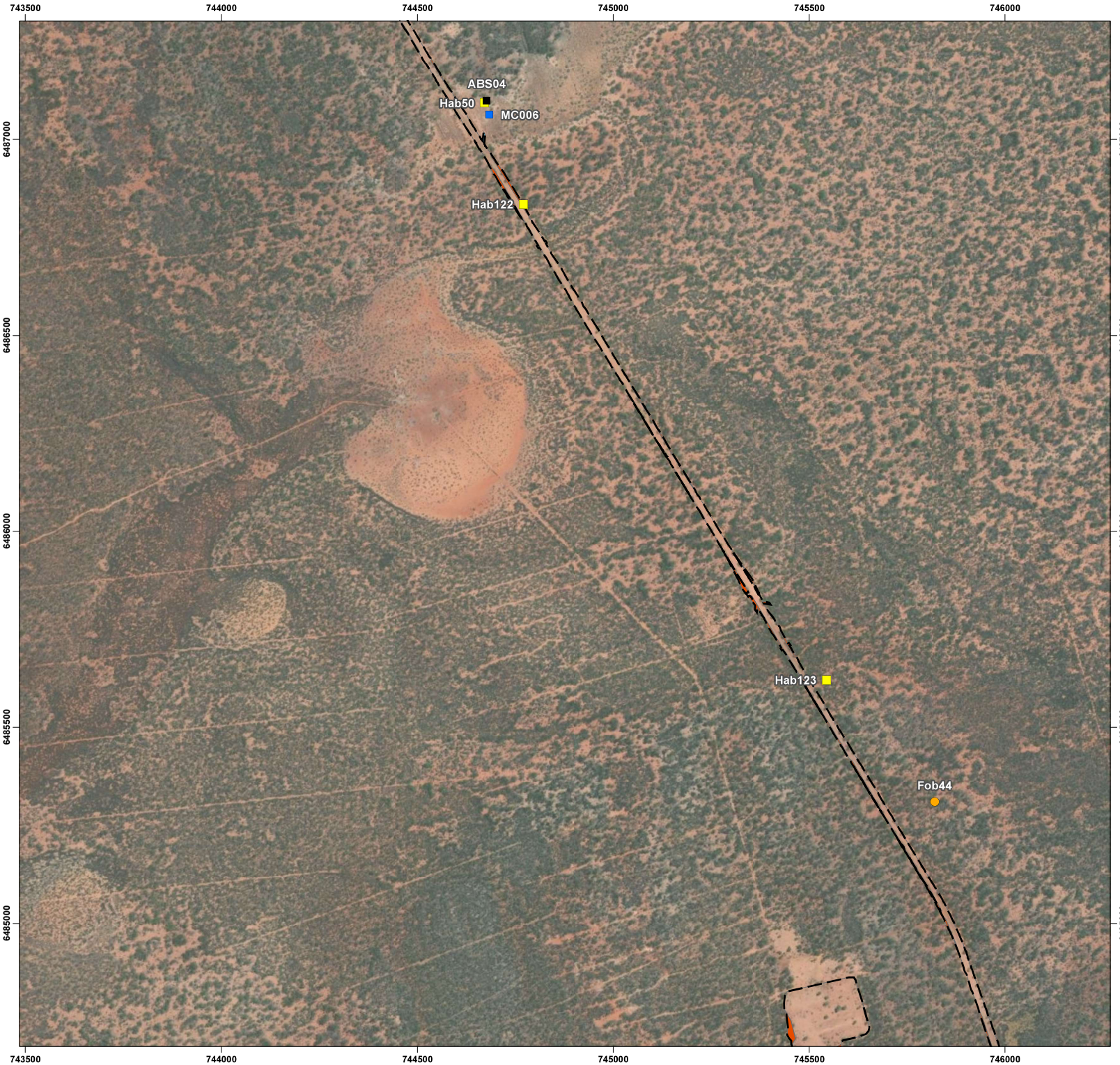
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-31

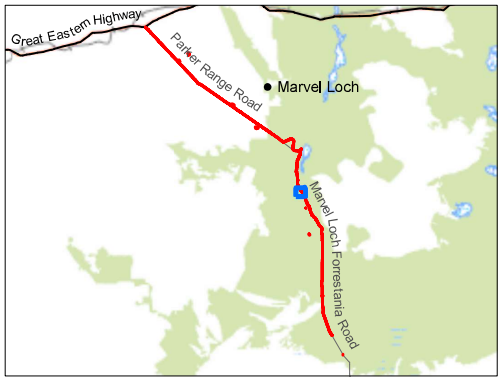



## LEGEND

- Bat Recorder
- Motion Camera
- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Seasonal Marsh
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

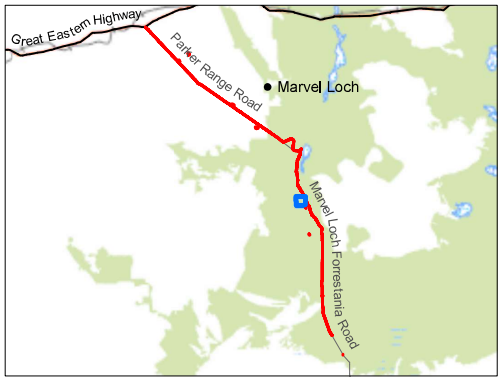
MAP 2-32


## LEGEND

- Fauna Observation Point
- Sugar Ant Survey Site
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

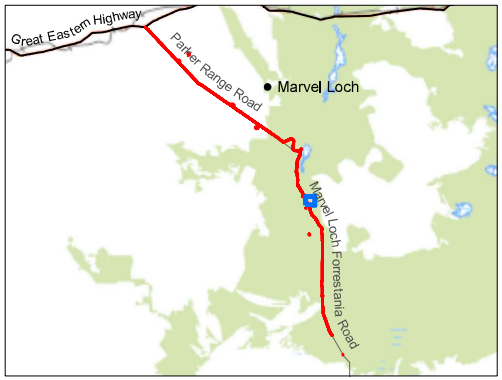
MAP 2-33


## LEGEND

- Motion Camera
- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

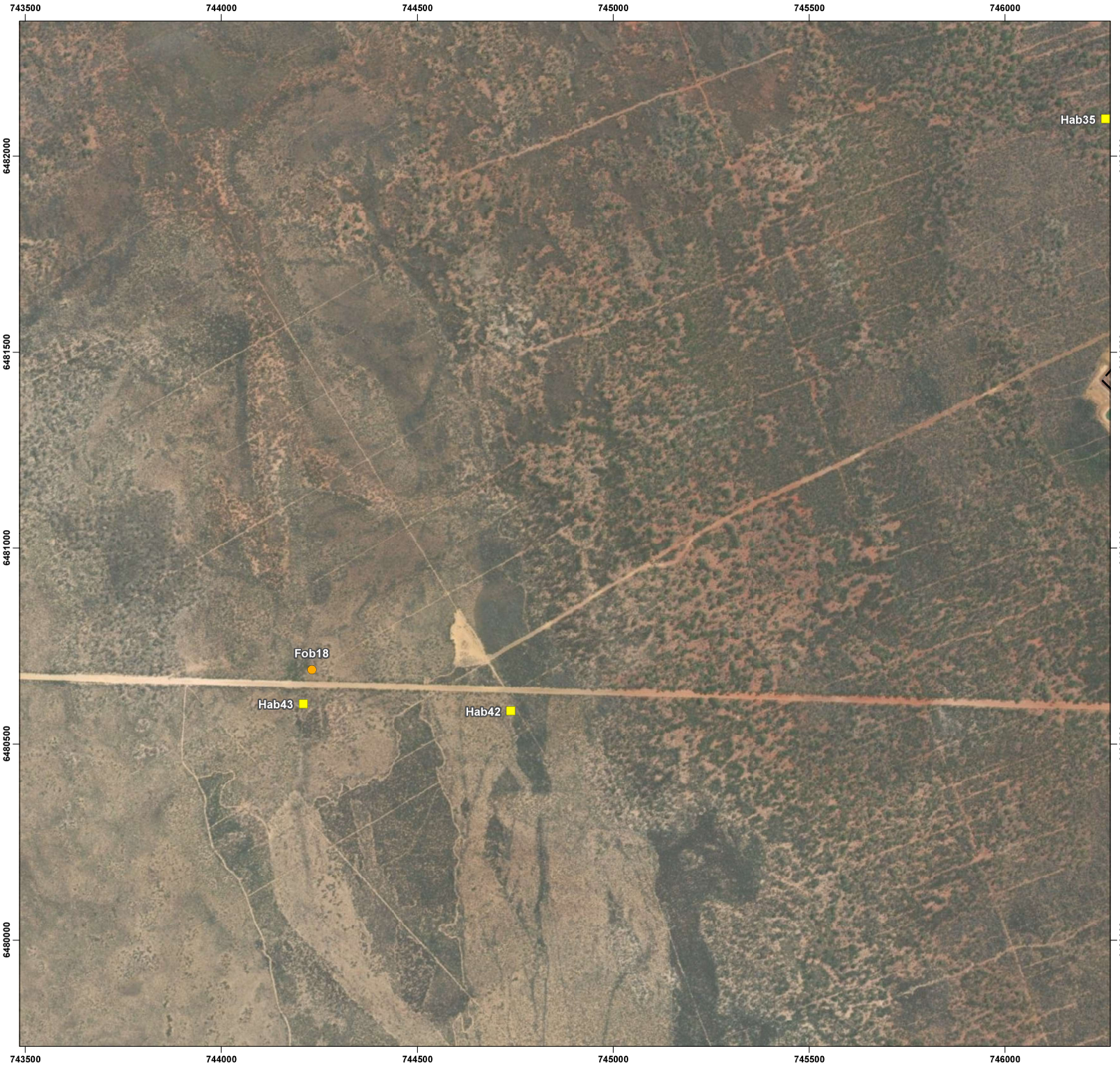
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-34

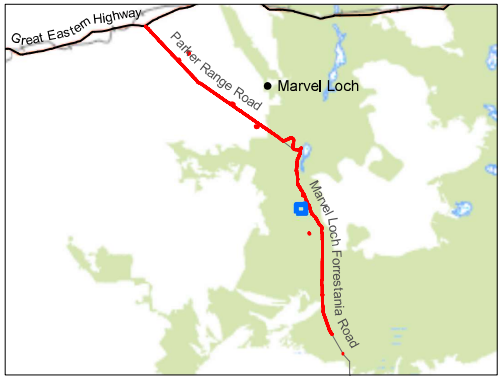



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

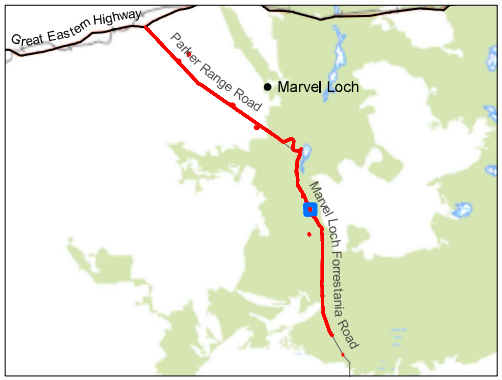
MAP
2-35


## LEGEND

- Motion Camera
- Fauna Observation Point
- Sugar Ant Survey Site
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

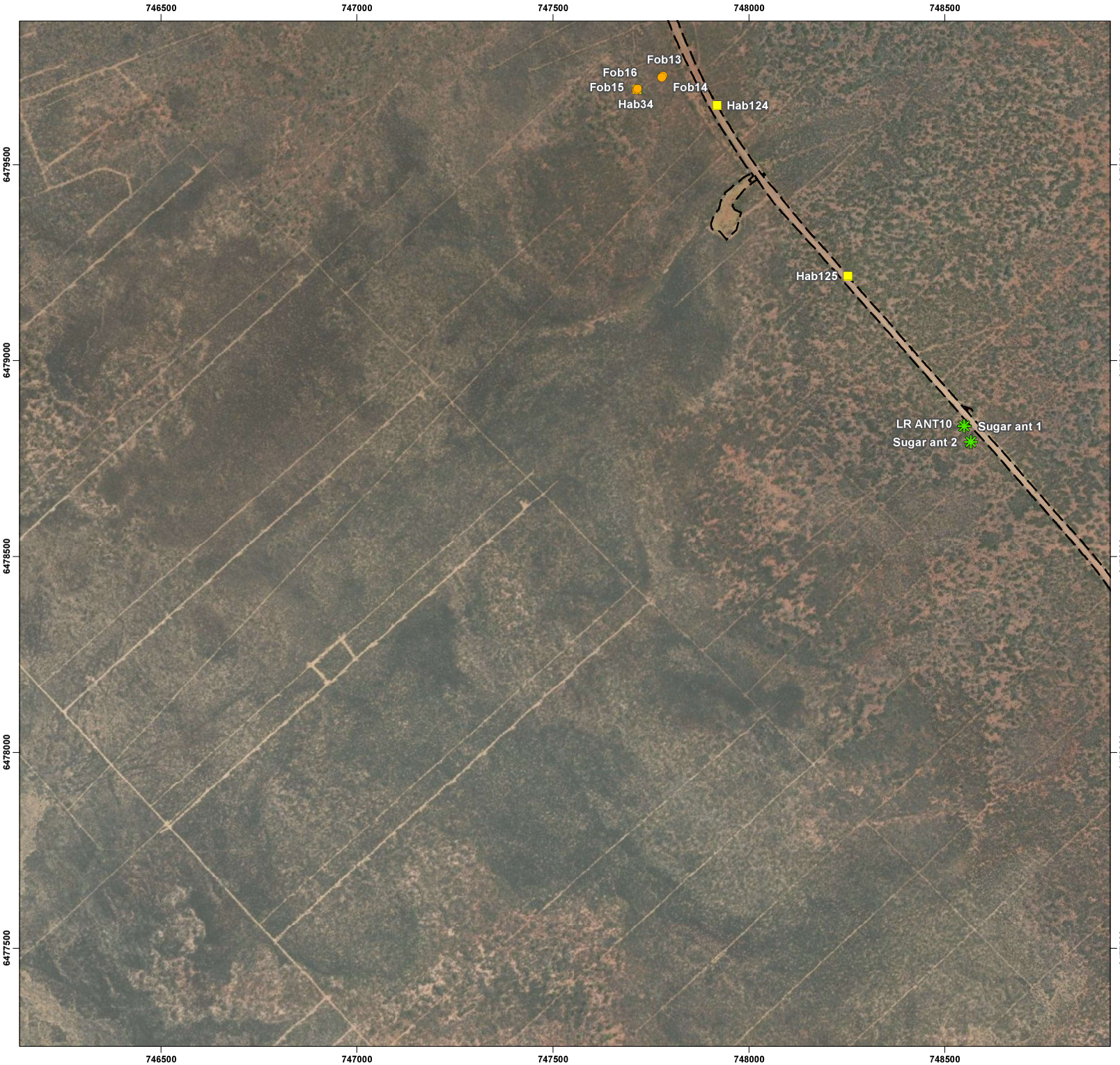
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-36

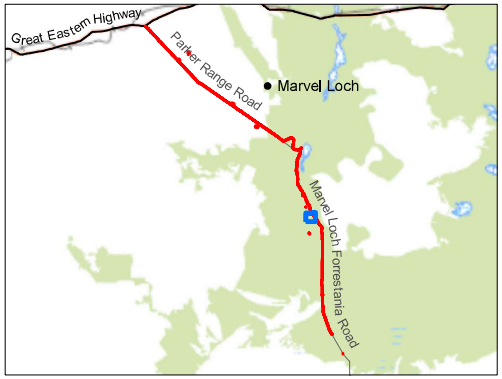



## LEGEND

- Fauna Observation Point
- Sugar Ant Colony Recorded
- Sugar Ant Survey Site
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

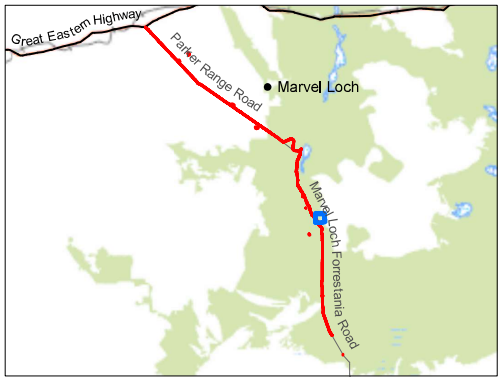
MAP 2-37


## LEGEND

- Bat Recorder
- Motion Camera
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

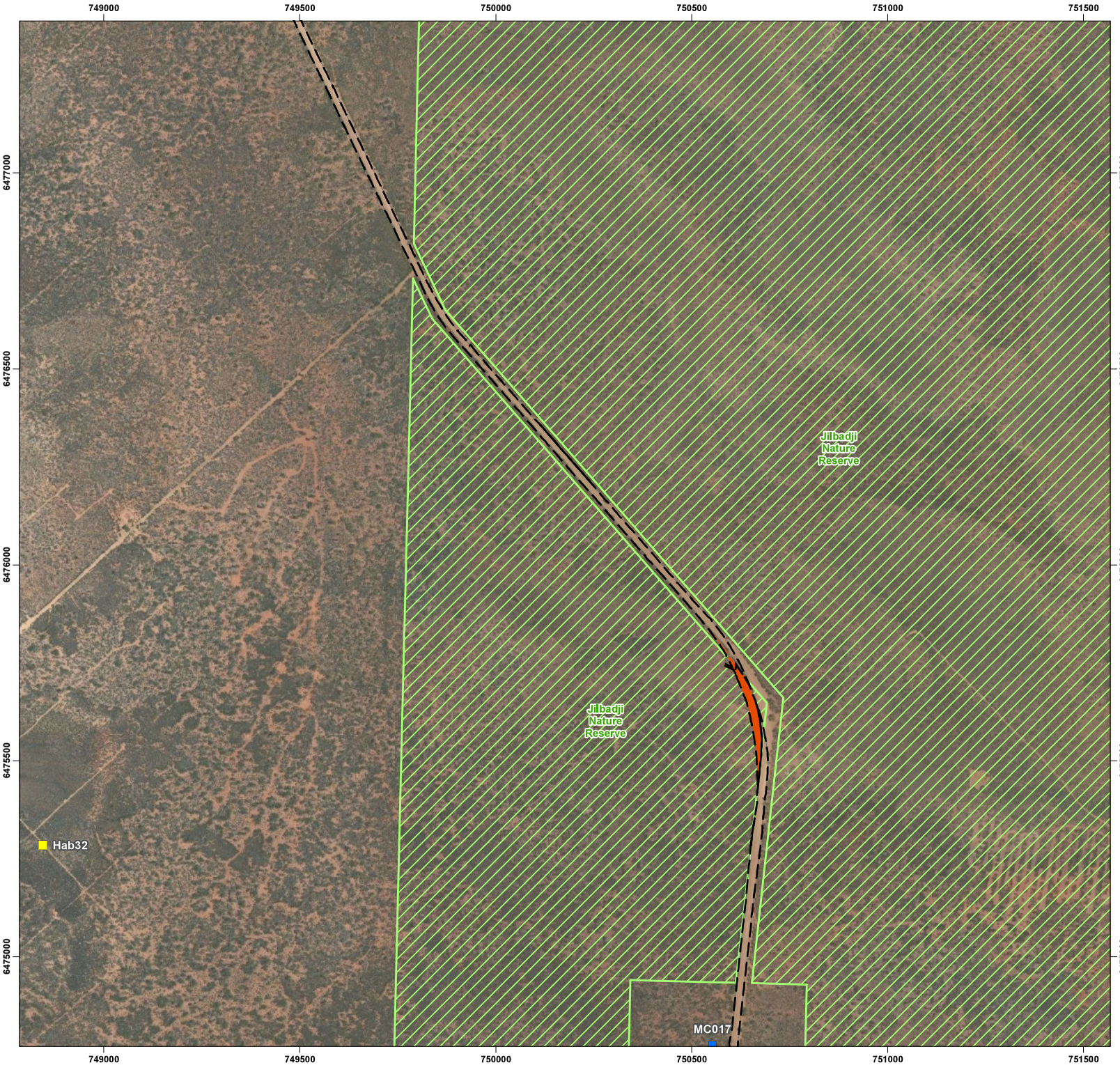
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-38

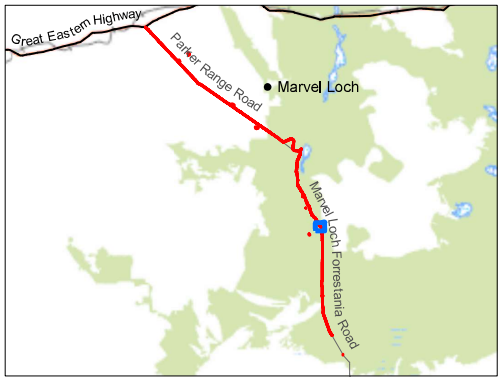



## LEGEND

- Motion Camera
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
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BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

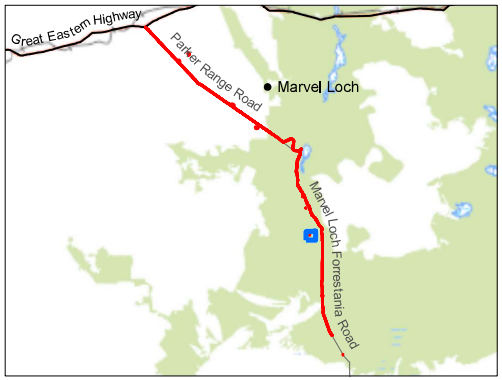
MAP 2-39


## LEGEND

Survey Area

**Fauna Habitat**

Cleared/Developed




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

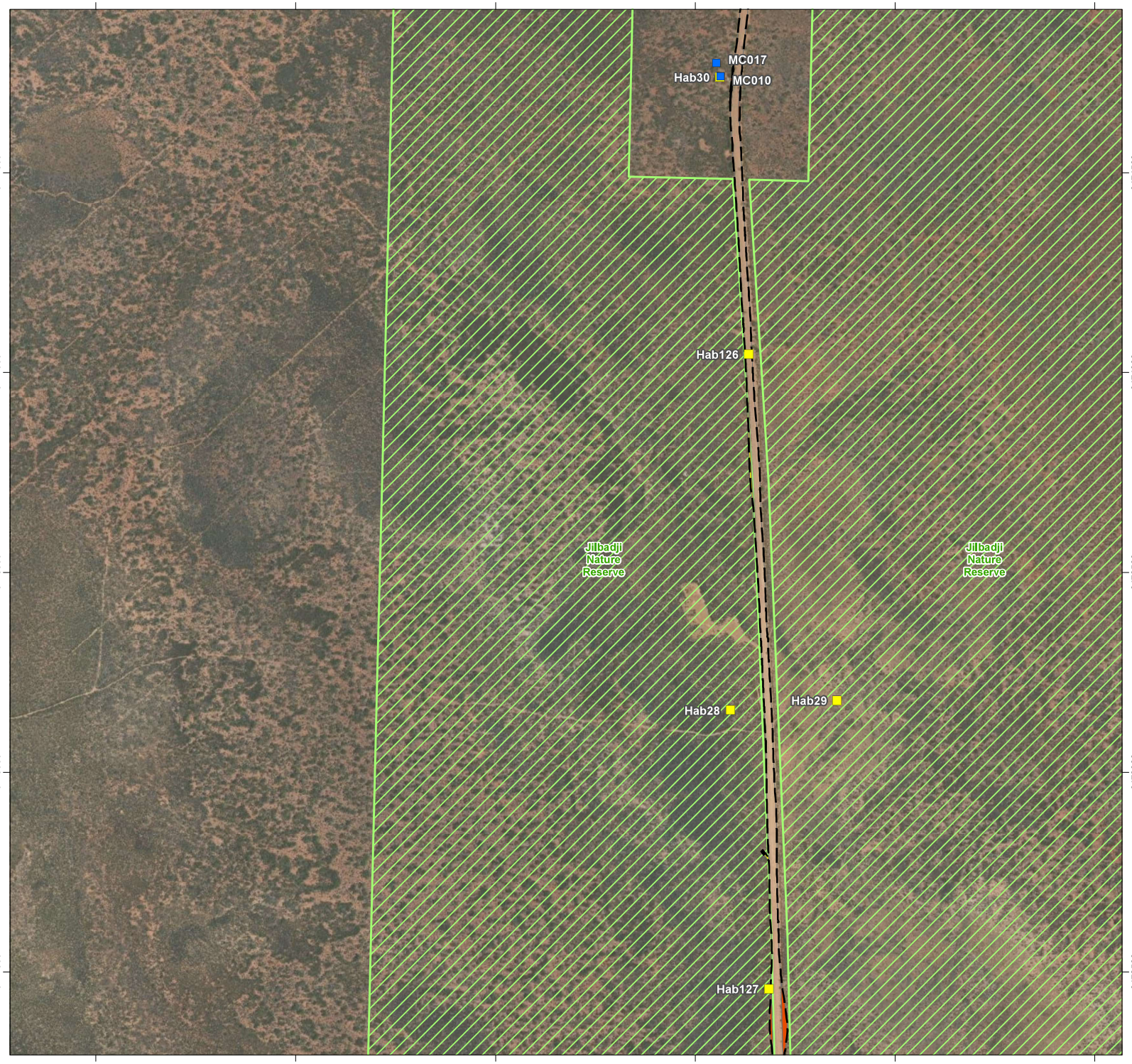
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-40

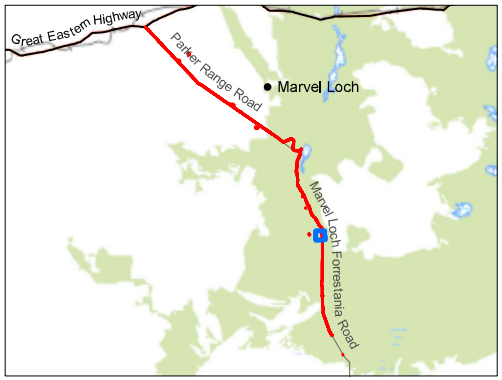



## LEGEND

- Motion Camera
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
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SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

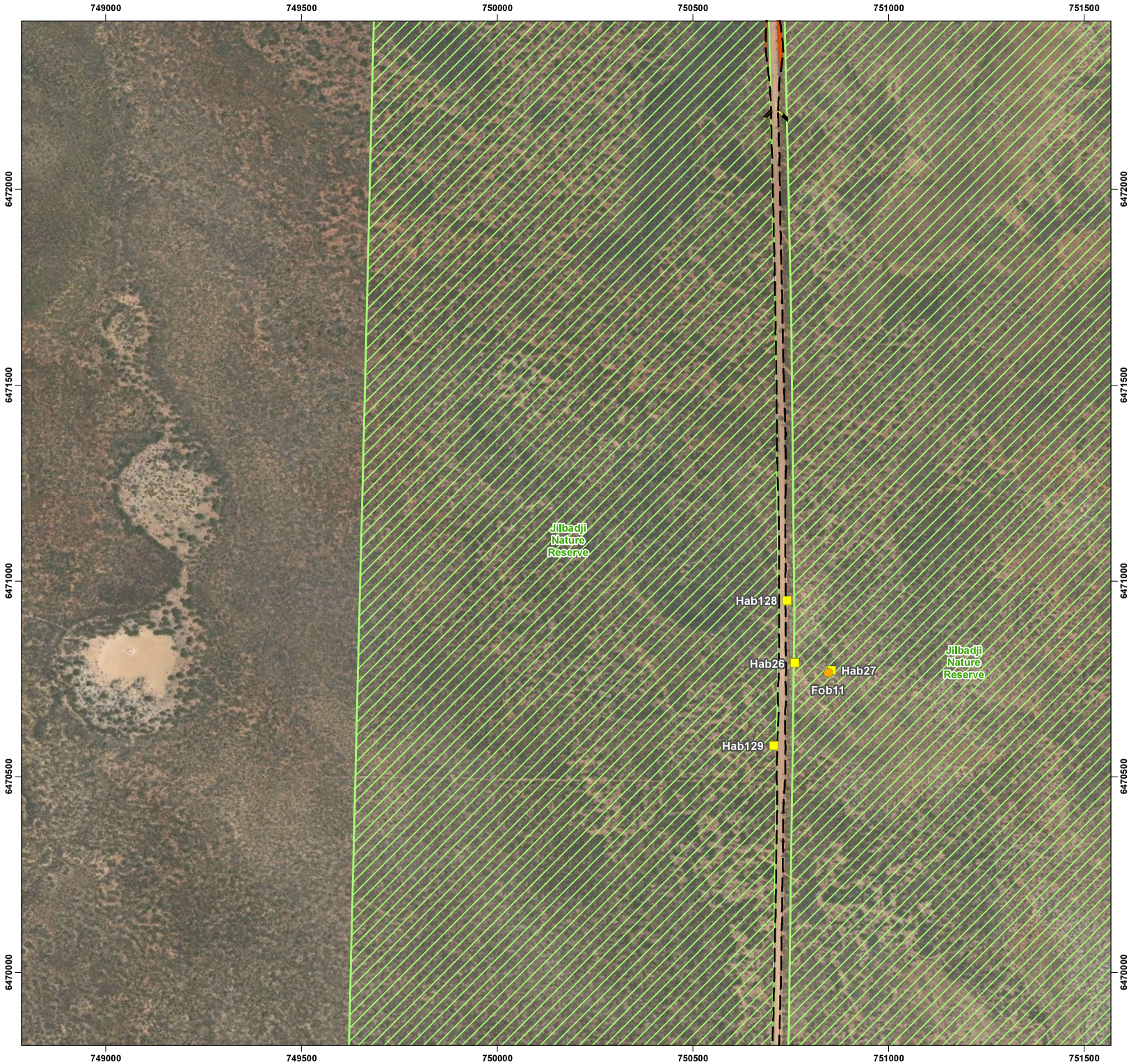
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-41

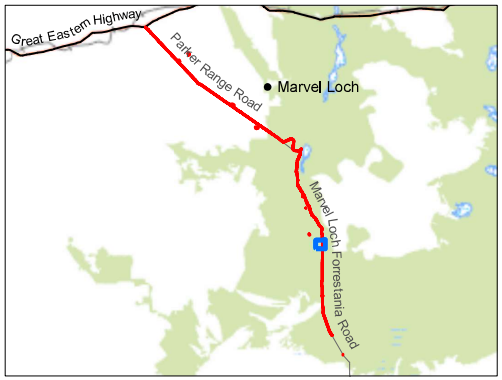



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
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SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

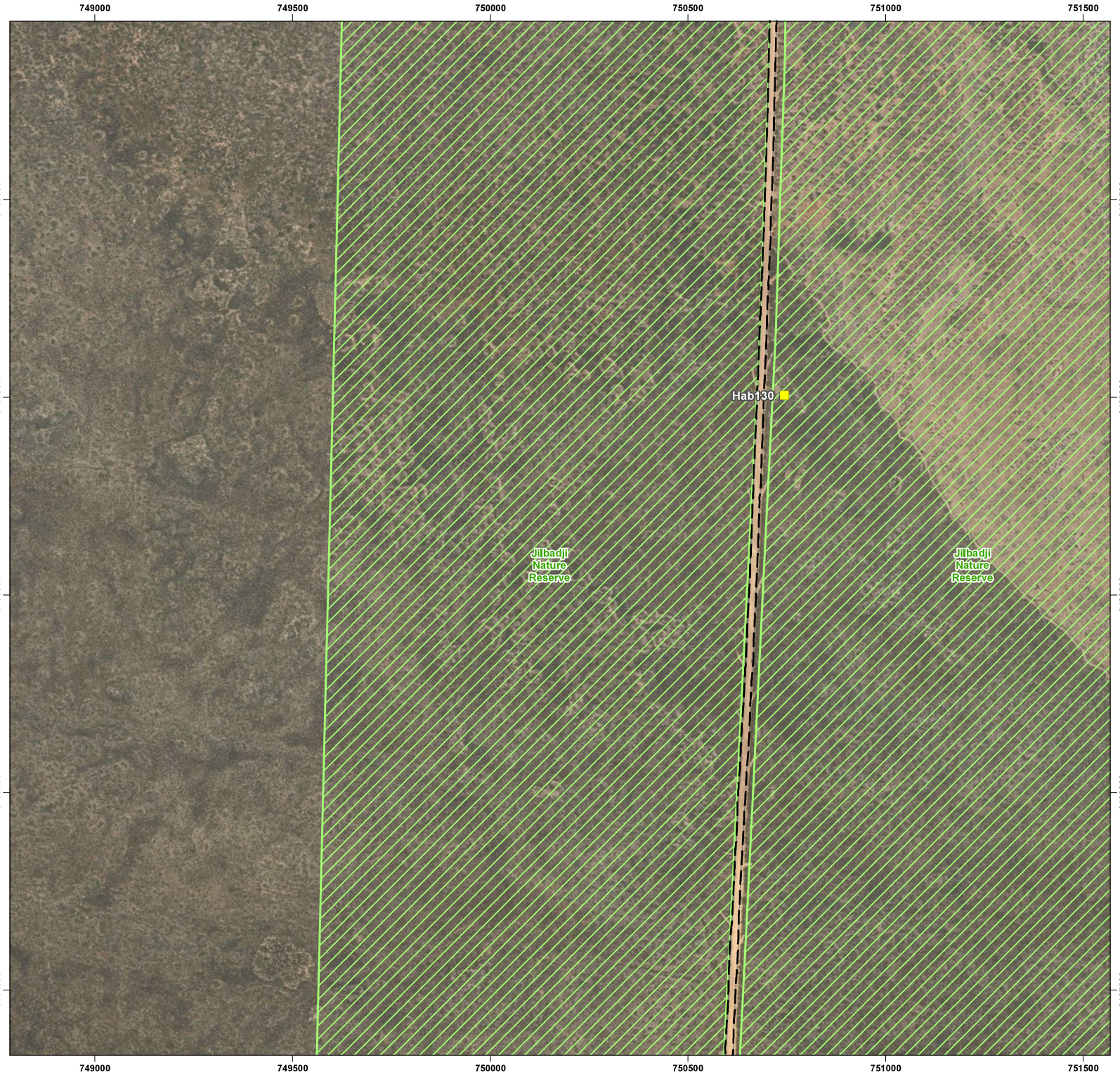
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-42

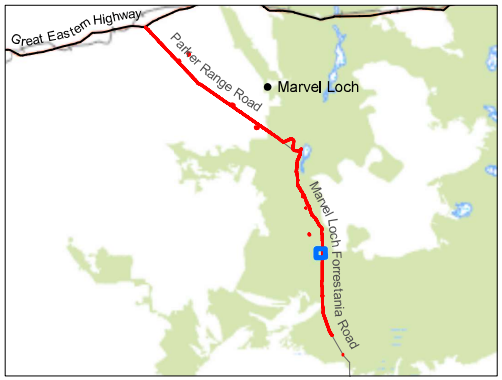



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

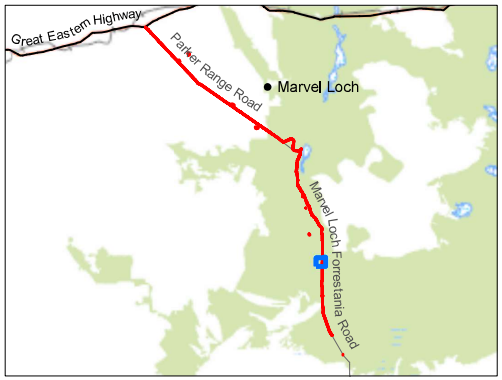
MAP 2-43


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

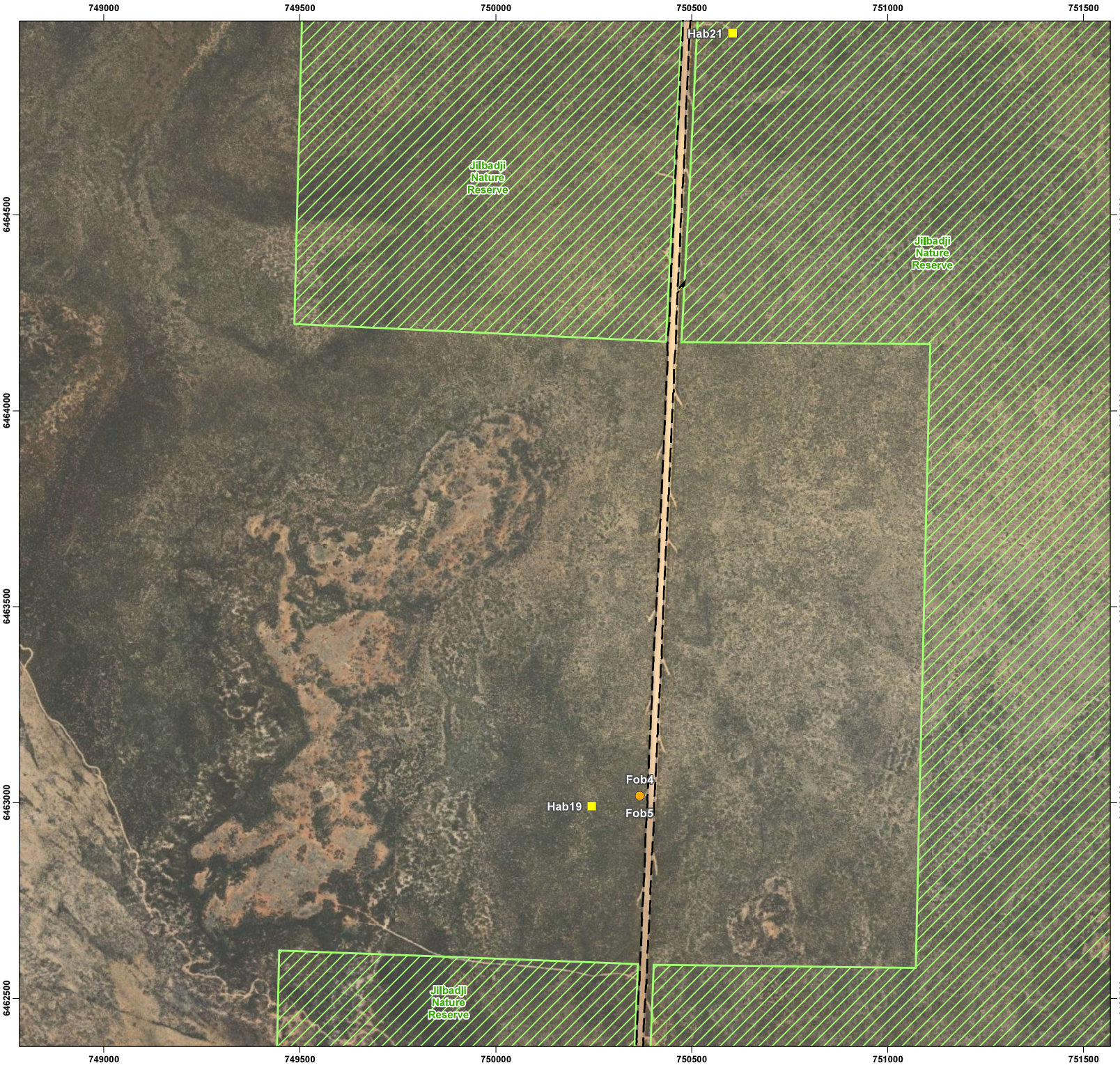
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-44

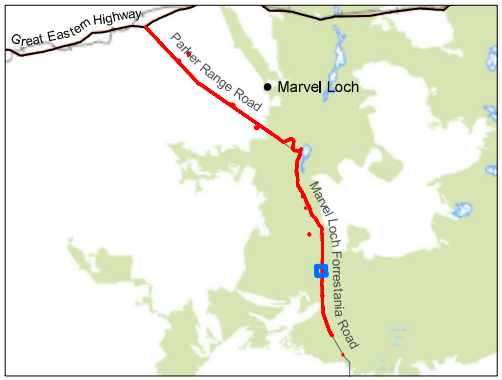



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

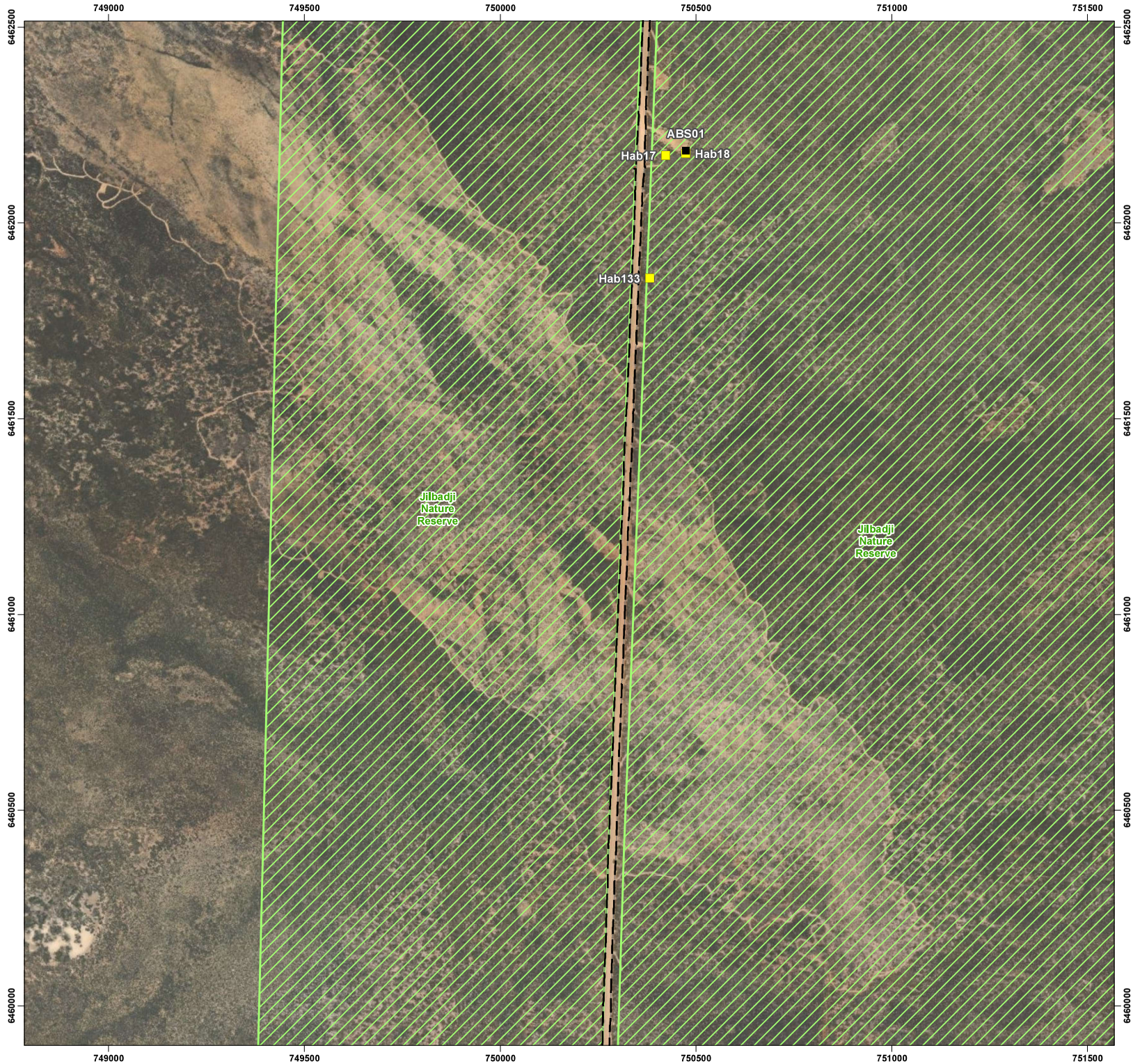
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-45

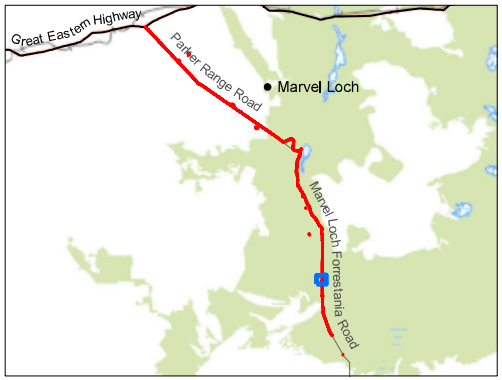



## LEGEND

- Bat Recorder
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

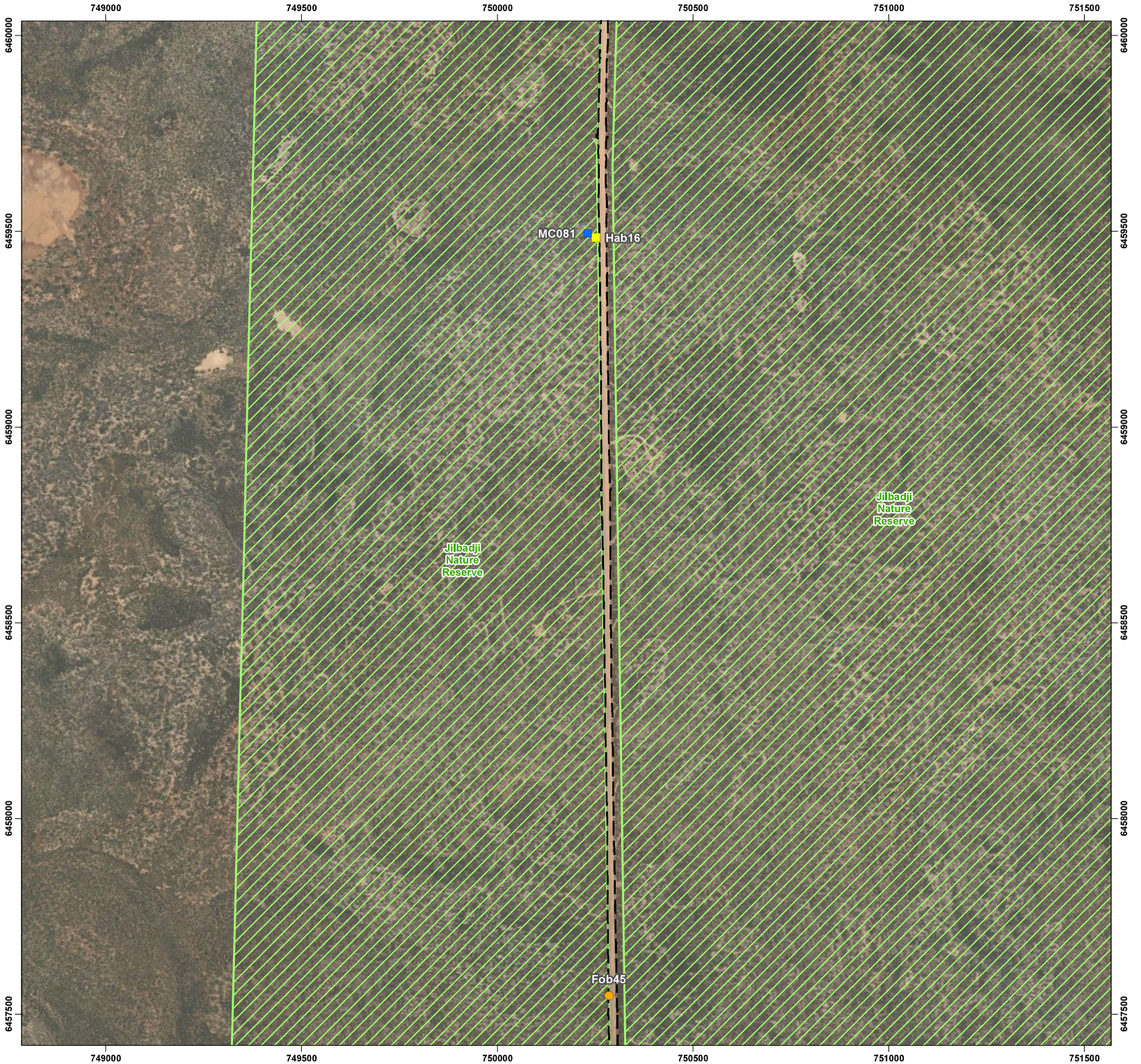
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-46

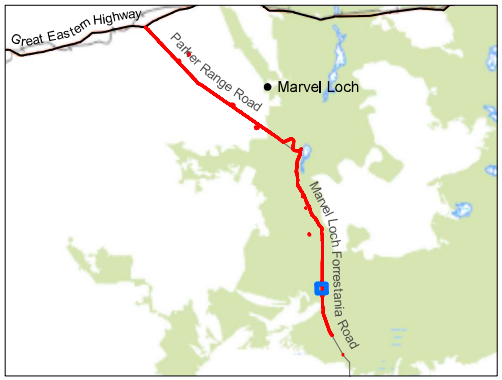



## LEGEND

- Motion Camera
- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

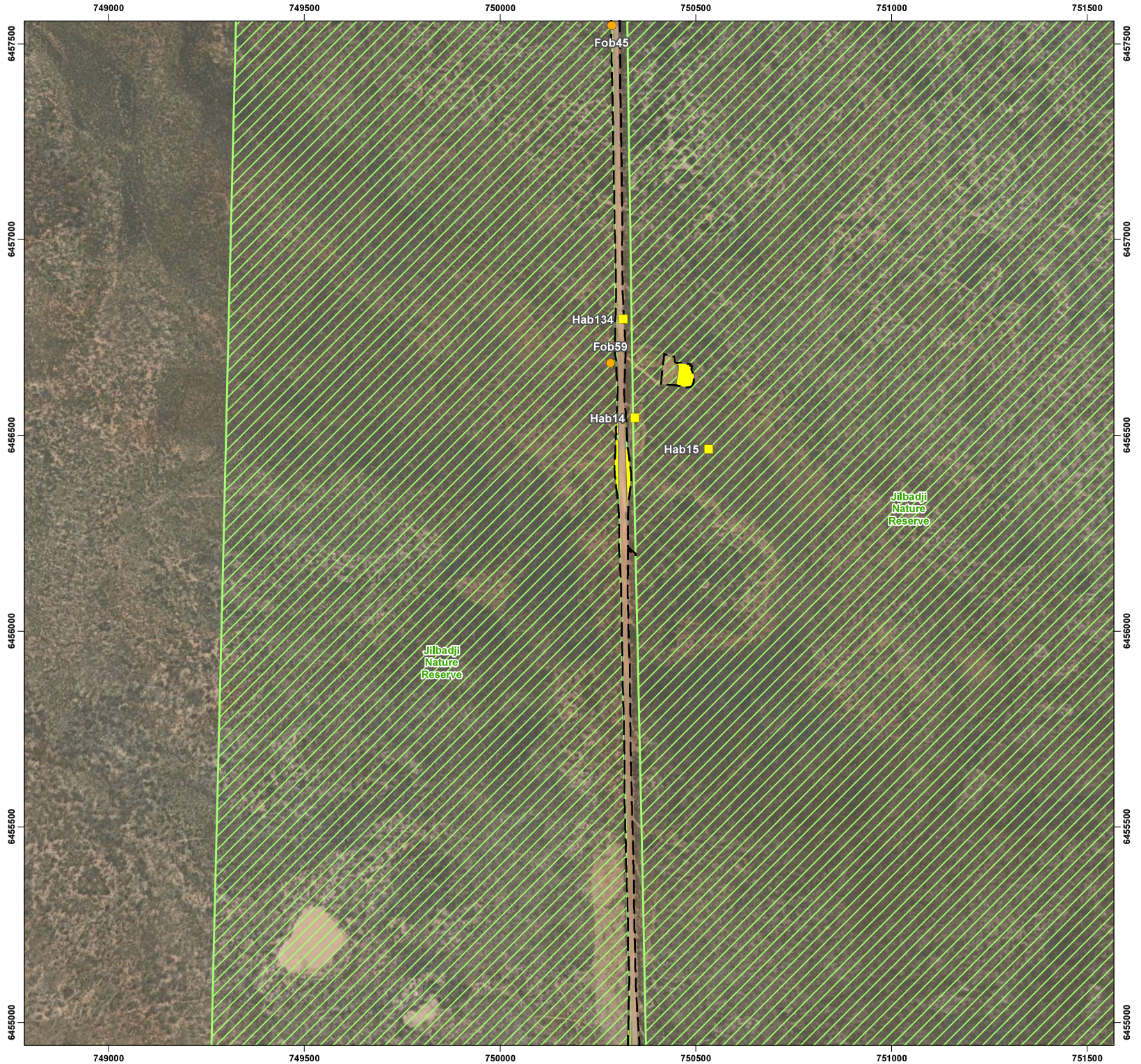
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-47

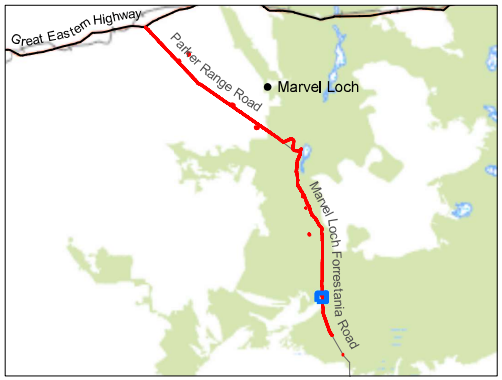



## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Regrowth
- Shrubland
- Woodland (Open/Closed)
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

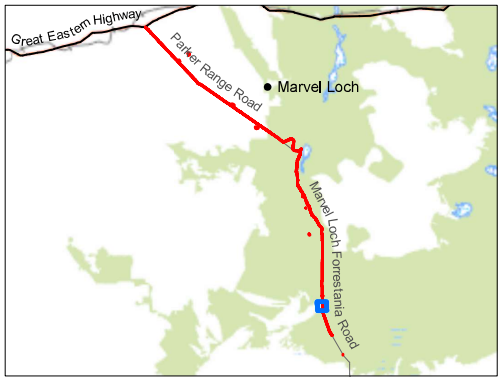
MAP 2-48


## LEGEND

- Fauna Observation Point
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

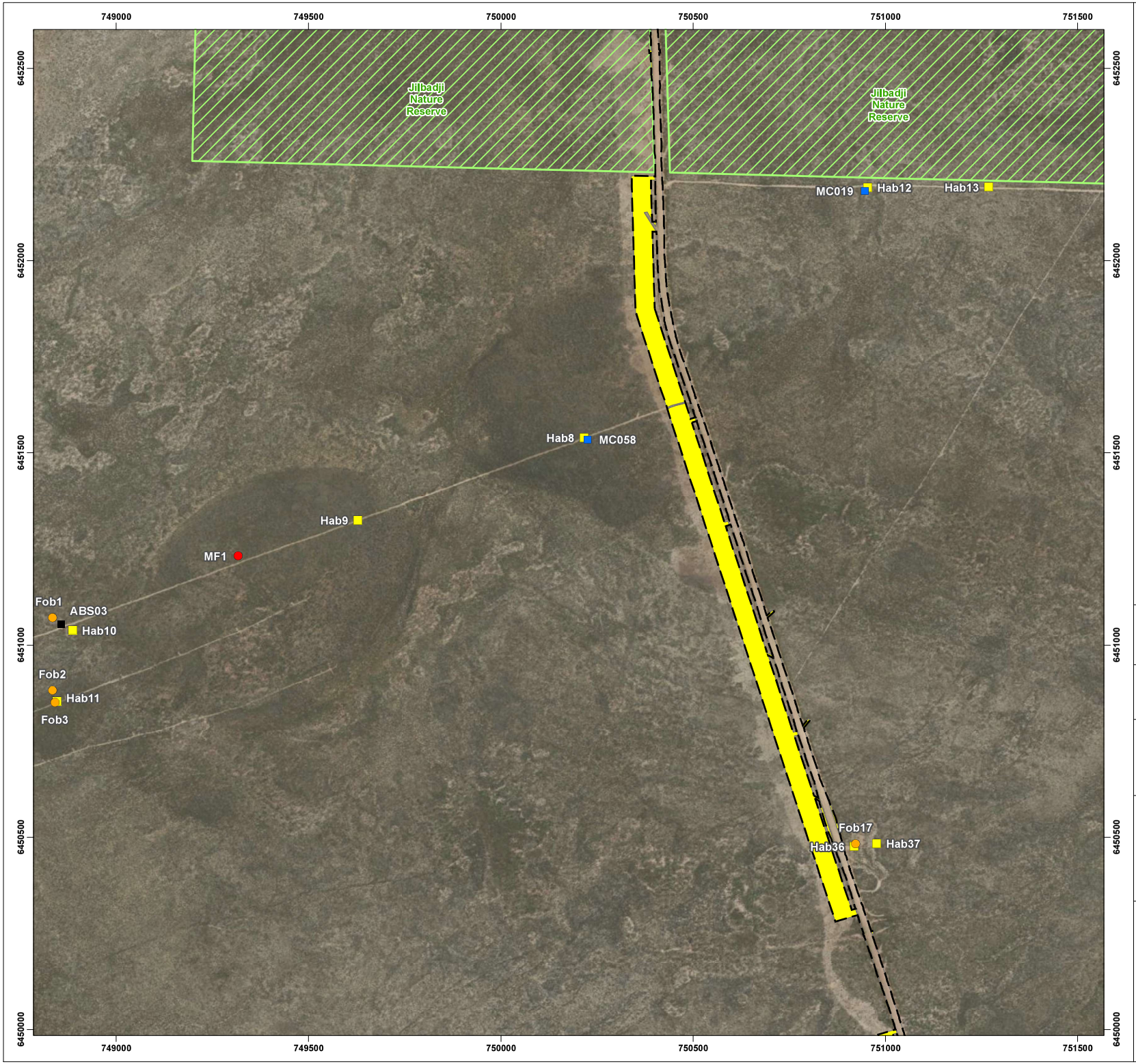
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-49

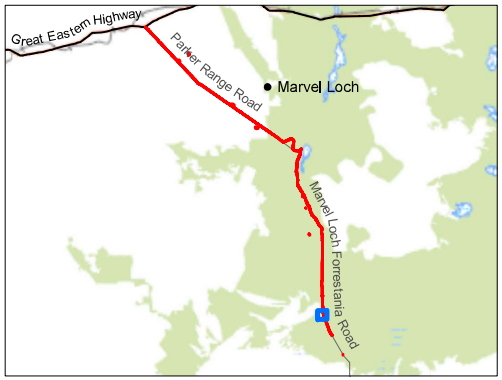



## LEGEND

- Bat Recorder
- Motion Camera
- Fauna Observation Point
- Malleefowl Mound Observation
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland
- DBCA Nature Reserve (2011)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-50

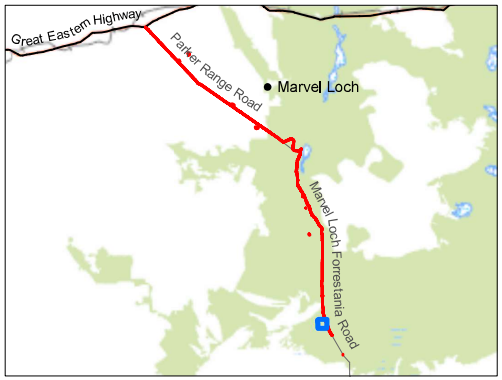

## LEGEND

Survey Area

**Fauna Habitat**

Cleared/Developed

Shrubland




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

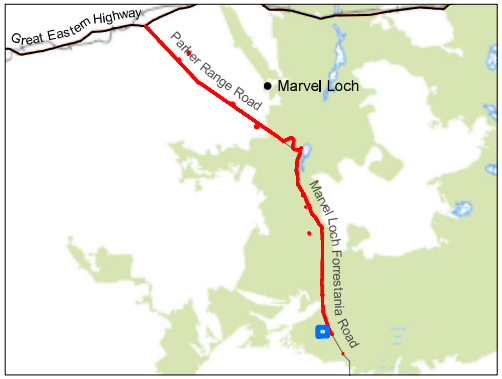
0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-51


## LEGEND




**DATA SOURCES**:
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

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# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

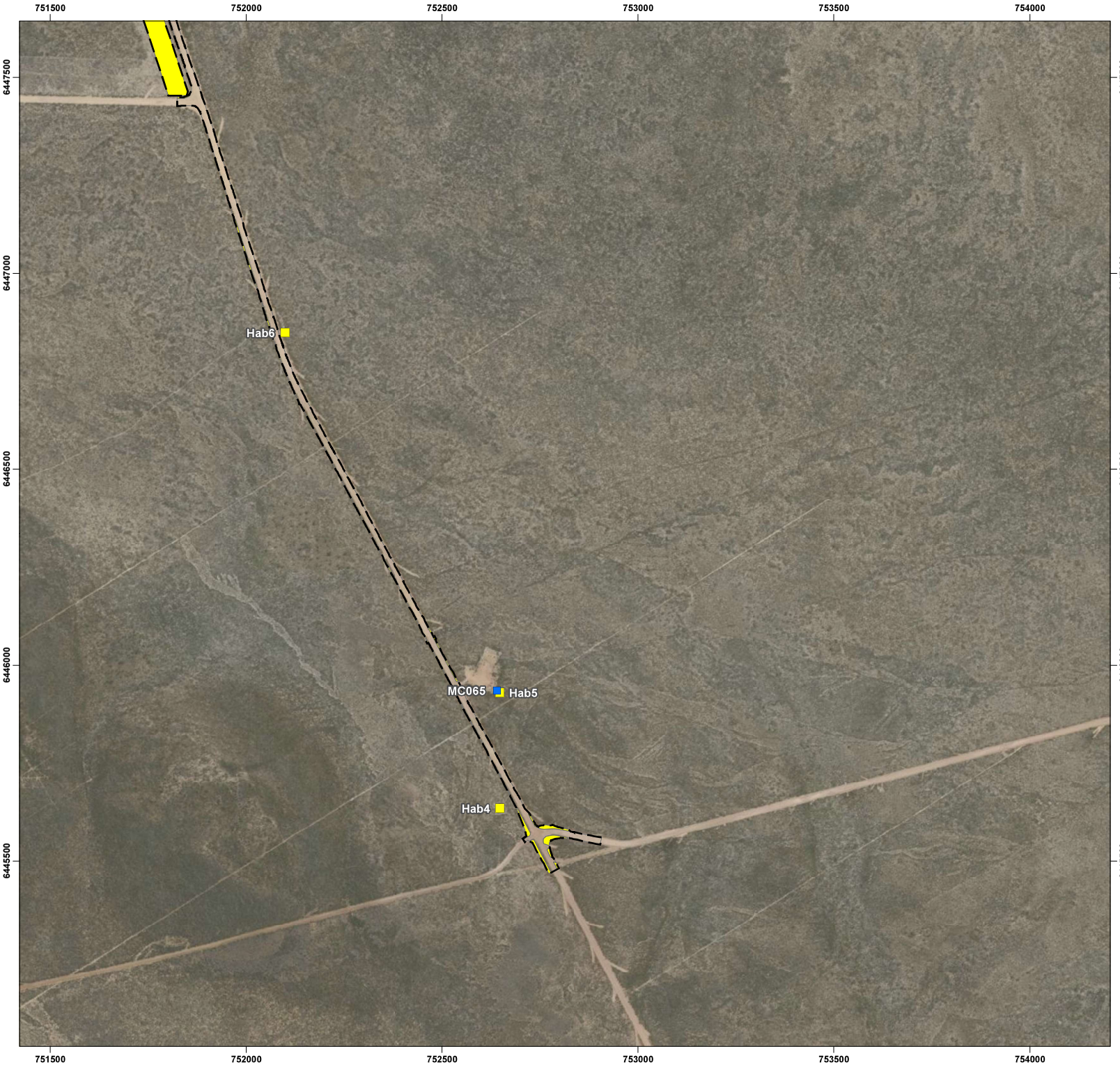
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-52

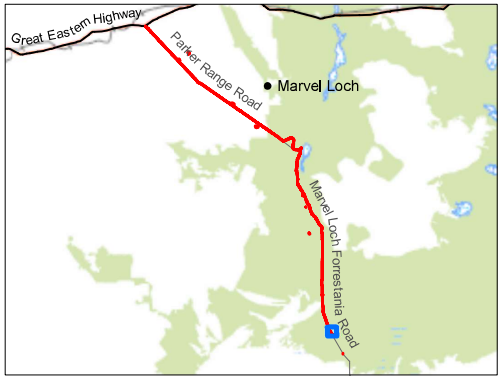



## LEGEND

- Motion Camera
- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Shrubland




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

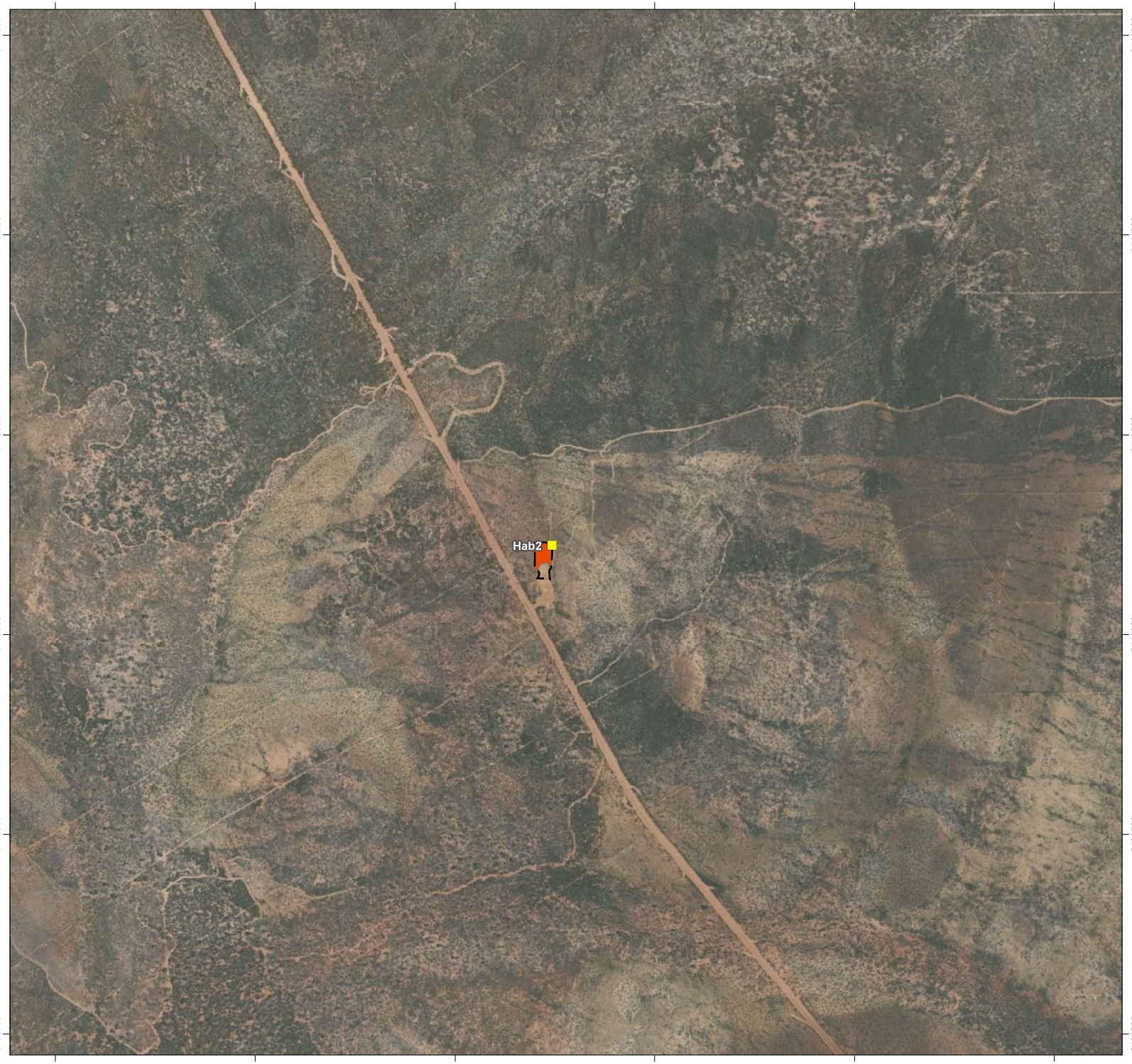
N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP 2-53

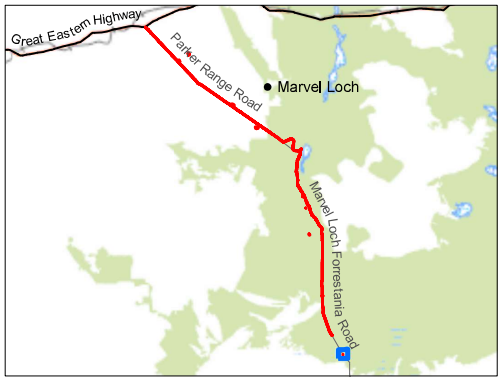



## LEGEND

- Habitat Assessment Point
- Survey Area

**Fauna Habitat**

- Cleared/Developed
- Woodland (Open/Closed)




**DATA SOURCES**
SOURCE DATA: FAUNA (ECOSCAPE 2022), LEGISLATED LANDS AND WATERS (DBCA 2011)
AERIAL: ESRI (2021 AND 2022)
BASE MAP: GEOSCIENCE AUSTRALIA TOPOGRAPHY
SERVICE LAYERS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

ecoscape

# FAUNA HABITAT

## LOGISTICS ROAD FAUNA SURVEY

covalent LITHIUM

COORDINATE SYSTEM: GDA 1994 MGA ZONE 50
PROJECTION: TRANSVERSE MERCATOR
DATUM: GDA 1994
UNITS: METER

SCALE: 1:9,500 @ A3

N

0 100 200 300 m

PROJECT NO: 4715-22

| REV | AUTHOR | APPROVED | DATE |
|---|---|---|---|
| 00 | NW | BT | 29/07/2022 |
| 01 | KP | RH | 24/01/2024 |

MAP
2-54

# APPENDIX ONE LEGISLATIVE CONTEXT, DEFINITIONS AND CRITERIA

## COMMONWEALTH ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999

The EPBC Act is a legal framework to protect and manage matters of national environmental significance (MNES) including important flora, fauna, ecological communities, and heritage areas listed under the Act.

Threatened taxa (flora and fauna) are protected under the EPBC Act, which lists species and ecological communities that have been assessed as meeting the criteria to be listed as Critically Endangered, Endangered, Vulnerable, Conservation Dependant, Extinct, or Extinct in the Wild, as detailed in **Table 5**.

Threatened Ecological Communities protected under the EPBC Act are categorised as Critically Endangered, Endangered or Vulnerable, also detailed in this table.

Migratory species subject to international agreements are also protected under the EPBC Act. The definition of a migratory species under the Act follows that prescribed by the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (Department of the Environment 2021):

> *Migratory species are the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries.*

Species listed by the following international agreements are currently protected under the EPBC Act:

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
- China-Australia Migratory Bird Agreement (CAMBA)
- Japan-Australia Migratory Bird Agreement (JAMBA)
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

**Table 5: EPBC Act categories for flora, fauna, and ecological communities**

| Category | Threatened species | Threatened Ecological Communities |
|---|---|---|
| **Extinct** | A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died. | n/a |
| **Extinct in the wild** | A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time:<br>(a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or<br>(b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form. | n/a |
| **Critically Endangered (CE)** | A native species is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria. | An ecological community is eligible to be included in the *critically endangered* category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria |

| Category | Threatened species | Threatened Ecological Communities |
|---|---|---|
| **Endangered (EN)** | A native species is eligible to be included in the *endangered* category at a particular time if, at that time:<br>(a) it is not critically endangered; and<br>(b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria. | An ecological community is eligible to be included in the *endangered* category at a particular time if, at that time:<br>(a) it is not critically endangered; and<br>(b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria. |
| **Vulnerable (VU)** | A native species is eligible to be included in the *vulnerable* category at a particular time if, at that time:<br>(a) it is not critically endangered or endangered; and<br>(b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria. | An ecological community is eligible to be included in the *vulnerable* category at a particular time if, at that time:<br>(a) it is not critically endangered or endangered; and<br>(b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria. |
| **Conservation Dependent** | A native species is eligible to be included in the conservation dependent category at a particular time if, at that time:<br>(a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered, or critically endangered; or<br>(b) the following subparagraphs are satisfied:<br>(i) the species is a species of fish;<br>(ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long-term survival in nature are maximised;<br>(iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory;<br>(iv) cessation of the plan of management would adversely affect the conservation status of the species. | n/a |

## WESTERN AUSTRALIAN ENVIRONMENTAL PROTECTION ACT 1986

The Western Australian EP Act was created to provide for an Environmental Protection Authority (the EPA) that has the responsibility for:

- prevention, control and abatement of pollution and environmental harm
- conservation, preservation, protection, enhancement, and management of the environment
- matters incidental to or connected with the above.

The EPA is responsible for providing the guidance and policy under which environmental assessments are conducted. It conducts environmental impact assessments (based on the information provided by the proponent), initiates measures to protect the environment and provides advice to the Minister responsible for environmental matters.

## WESTERN AUSTRALIAN BIODIVERSITY CONSERVATION ACT 2016

The Western Australian BC Act provides for the conservation, protection and ecologically sustainable use of biodiversity and biodiversity components in Western Australia.

Threatened species (both flora and fauna) and ecological communities that meet the categories listed within the BC Act are protected under this legislation and require authorisation by the Minister to take or disturb. These are known as Threatened Flora, Threatened Fauna, and Threatened Ecological Communities. The conservation categories of Critically Endangered, Endangered and Vulnerable are detailed in **Table 6**; these categories align with those of the EPBC Act. Some State-listed threatened species and ecological communities are provided with additional protection as they are also listed under the Commonwealth EPBC Act (see **Table 5** for conservation status category descriptions).

The most recent Western Australian flora and fauna listings were published in the Government Gazette on 11 September 2018 (Government of Western Australia 2018a).

### PRIORITY-LISTED FLORA AND FAUNA

Flora are listed as PF where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to TF categories. Whilst PF are not specifically listed in the BC Act, some may qualify as being of special conservation interest and thereby have a greater level of protection than unlisted species.

There are three categories covering Western Australian-listed TF and four categories covering PF species which are outlined in **Table 6**. PF for Western Australia are regularly reviewed by the DBCA whenever new information becomes available, with species status altered or removed from the list when data indicates that they no longer meet these requirements.

Conservation significant fauna species are listed by the DBCA as Priority Fauna where populations are geographically restricted or threatened by local processes, or where there is insufficient information to formally assign them to threatened fauna categories. Whilst Priority Fauna are not specifically listed in the BC Act, these have a greater level of significance than other native species. The categories covering Priority Fauna species are outlined in **Table 6**.

Flora and fauna species may be listed as being of special conservation interest if they have a naturally low population, have a restricted natural range, are subject to or recovering from a significant population decline or reduction of range or are of special interest, and the Minister considers that taking may result in depletion of the species. Migratory species and those subject to international agreement are also listed under the Act. These are known as 'specially protected species' in the BC Act.

**Table 6: Conservation codes for Western Australian flora and fauna** (DBCA 2019)

| **Conservation Codes for Western Australian Flora and Fauna** | |
|---|---|
| Threatened, Extinct and Specially Protected fauna or flora[1] are species[2] which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.<br>**The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the *Biodiversity Conservation Act 2016*.**<br>**Categories of Threatened, Extinct and Specially Protected fauna and flora are:** | |
| **T** | **Threatened species**<br>Listed by order of the Minister as Threatened in the category of critically endangered, endangered, or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).<br>Threatened fauna is that subset of 'Specially Protected Fauna' listed under schedules 1 to 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for Threatened Fauna.<br>Threatened flora is that subset of 'Rare Flora' listed under schedules 1 to 3of the *Wildlife Conservation (Rare Flora) Notice 2018* for Threatened Flora.<br>The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below. |

| Conservation Codes for Western Australian Flora and Fauna | |
|---|---|
| **CR** | **Critically endangered species**<br>Threatened species considered to be "*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*".<br>Listed as critically endangered undersection 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines. Published under schedule 1 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for critically endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for critically endangered flora. |
| **EN** | **Endangered species**<br>Threatened species considered to be "*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*".<br>Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines. Published under schedule 2 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for endangered fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for endangered flora. |
| **VU** | **Vulnerable species**<br>Threatened species considered to be "*facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines*".<br>Listed as vulnerable undersection 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines. Published under schedule 3of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for vulnerable fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for vulnerable flora. |
| **Extinct species**<br>**Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.** | |
| **EX** | **Extinct species**<br>Species where "*there is no reasonable doubt that the last member of the species has died*", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).<br>Published as presumed extinct under schedule 4of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* for extinct fauna or the *Wildlife Conservation (Rare Flora) Notice 2018* for extinct flora. |
| **EW** | Extinct in the wild species<br>Species that "*is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form*", and listing is otherwise in accordance with the ministerial guidelines (section 25of the BC Act).<br>Currently there are no threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice. |
| **Specially protected species**<br>**Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.**<br>**Species that are listed as threatened species (critically endangered, endangered, or vulnerable) or extinct species under the BC Act cannot also be listed as Specially Protected species.** | |
| **MI** | **Migratory species**<br>Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15of the BC Act).<br>Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.<br>Published as migratory birds protected under an international agreement under schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018. |
| **CD** | **Species of special conservation interest (conservation dependent fauna)**<br>Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14of the BC Act).<br>Published as conservation dependent fauna under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018.* |
| **OS** | **Other specially protected species**<br>Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18of the BC Act).<br>Published as other specially protected fauna under schedule 7of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*. |

| Conservation Codes for Western Australian Flora and Fauna | |
|---|---|
| P | **Priority species**<br>Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora.<br>Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.<br>Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations. |
| 1 | **Priority 1: Poorly-known species**<br>Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey. |
| 2 | **Priority 2: Poorly-known species**<br>Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey. |
| 3 | **Priority 3: Poorly-known species**<br>Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey. |
| 4 | **Priority 4: Rare, Near Threatened and other species in need of monitoring**<br>(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.<br>(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.<br>(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy. |
| **[1] The definition of flora includes algae, fungi, and lichens.**<br>**[2] Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).** | |

## ENVIRONMENTALLY SENSITIVE AREAS

There are a number of areas within Western Australia identified as being of environmental significance within which the exemptions to the Native Vegetation Clearing Regulations do not apply. These are referred to as Environmentally Sensitive Areas (ESAs), and are declared under section 51B of the EP Act and described in the *Environmental Protection (Environmentally Sensitive Areas) Notice*.

## CONSERVATION ESTATE

The National Reserve System is a network of protected areas managed for conservation under international guidelines. The objective of placing areas of bushland into the Conservation Estate is to achieve and maintain a comprehensive, adequate, and representative reserve system for Western Australia. The Conservation and Parks Commission is the vesting body for conservation lands, forest and marine reserves that are managed by DBCA (Government of Western Australia 2018b).

# APPENDIX TWO DESKTOP ASSESSMENT RESULTS AND LIKELIHOOD ASSESSMENTS

**Table 7: Fauna database results and likelihood assessments**

Blue shading indicates high likelihood; darker blue indicates species is known (recorded) from the survey area. Species identified by database searches but not included in this assessment are listed in **Table 8**, along with the reason for their exclusion.

| Species | Common name | Conservation status | | Database | | | Likelihood of occurrence | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC Act | WA | PMST** | DBCA | NatureMap | Desktop | Post-survey |
| **Mammals** | | | | | | | | |
| *Bettongia penicillata ogilbyi* | Woylie, Brush-tailed bettong | EN | CR | | X | | Very Unlikely | Very Unlikely |
| *Dasyurus geoffroii* | Chuditch, Western Quoll | VU | VU | Known | X | X | Known | Known |
| *Leporillus conditor* | Greater stick-nest rat, Wopilkara | VU | CD | | X | | Very Unlikely | Very Unlikely |
| *Macrotis lagotis* | Bilby, Dalgyte | VU | VU | | X | X | Very Unlikely | Very Unlikely |
| *Myrmecobius fasciatus* | Numbat, Walpurti | EN | EN | | X | | Very Unlikely | Very Unlikely |
| *Notamacropus irma* | Western brush wallaby | | P4 | | X | X | Known | Known |
| *Nyctophilus major tor* (Call was ambiguous) | Central long-eared bat | | P4 | | X | | Very Unlikely | Likely |
| *Petrogale lateralis lateralis* | Black-flanked rock-wallaby, Black-footed rock-wallaby, Moororong | EN | EN | | X | | Very Unlikely | Very Unlikely |
| *Phascogale calura* | Red-tailed Phascogale, Red-tailed Wambenger, Kenngoor | VU | EN | Likely | X | | May Occur | Unlikely |
| *Pseudomys australis* | Plains rat | VU | VU | | | X | Unlikely | Unlikely |
| *Pseudomys chapmani* | Western Pebble-mound Mouse | | P4 | | | X | Unlikely | Unlikely |
| **Birds** | | | | | | | | |
| *Calyptorhynchus latirostris* | Carnaby's Black Cockatoo, Short-billed Black-cockatoo | EN | EN | Likely | | X | Unlikely | Unlikely |
| *Chalcites osculans* | Black-eared Cuckoo | MI/MA | | Known | | | May Occur | May Occur |
| *Falco hypoleucos* | Grey Falcon | VU | VU | May | | | May Occur | May Occur |
| *Falco peregrinus* | Peregrine falcon | | S | | X | X | Known | Likely |
| *Leipoa ocellata* | Malleefowl | VU | VU | Known | X | X | Known | Known |
| *Merops ornatus* | Rainbow Bee-eater | MI/MA | IA | May | | X | May Occur | May Occur |
| *Motacilla cinerea* | Grey Wagtail | MI/MA | IA | May | | | May Occur | May Occur |
| *Pezoporus occidentalis* | Night Parrot | EN | CR | May | | | Very Unlikely | Very Unlikely |

| Species | Common name | Conservation status | | Database | | | Likelihood of occurrence | |
|---|---|---|---|---|---|---|---|---|
| | | EPBC Act | WA | PMST** | DBCA | NatureMap | Desktop | Post-survey |
| *Platycercus icterotis xanthogenys* | Western rosella (inland) | | P4 | | X | X | Known | Likely |
| **Reptiles** | | | | | | | | |
| *Paroplocephalus atriceps* | Lake Cronin snake | | P3 | | X | X | May Occur | May Occur |

**Table 8: Excluded species and reason for exclusion**

| Species | Common name | Conservation status | | Reason excluded from assessment |
|---|---|---|---|---|
| | | EPBC Act | WA | |
| *Actitis hypoleucos* | Common Sandpiper | MI/MA | IA | Migratory wetland species, no suitable habitat in survey area |
| *Aganippe castellum* | Tree-stem trapdoor spider | | P4 | Invertebrate; not within the scope of the project |
| *Apus pacificus* | Fork-tailed Swift | MI/MA | MI/IA | Migratory wetland species, no suitable habitat in survey area |
| *Bulbucus ibis* | Cattle Egret | MI/MA | | Migratory wetland species, no suitable habitat in survey area |
| *Calidris acuminata* | Sharp-tailed Sandpiper | MI/MA | MI/IA | Migratory wetland species, no suitable habitat in survey area |
| *Calidris ferruginea* | Curlew Sandpiper | CR/MI/MA | VU/IA | Migratory wetland species, no suitable habitat in survey area |
| *Calidris melanotos* | Pectoral Sandpiper | MI/MA | | Migratory wetland species, no suitable habitat in survey area |
| *Calidris ruficollis* | Red-necked stint | MI | MI/IA | Migratory wetland species, no suitable habitat in survey area |
| *Daphnia jollyi* | Water flea | | P1 | Invertebrate; not within the scope of the project |
| *Idiosoma intermedium* | Coolgardie shield-backed trapdoor spider | | P3 | Invertebrate; not within the scope of the project |
| *Idiosoma nigrum* | Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider | **VU** | | Invertebrate; not within the scope of the project |
| *Parartemia contracta* | Brine shrimp | | P1 | Invertebrate; not within the scope of the project |
| *Thinornis rubricollis* | Hooded Dotterel, Hooded Plover | MI/MA | P4 | Migratory wetland species, no suitable habitat in survey area |
| *Tringa nebularia* | Common greenshank | | IA | Migratory wetland species, no suitable habitat in survey area |

# APPENDIX THREE FIELD SURVEY RESULTS

**Table 9: Recorded fauna species**

| Species | Common name | EPBC Act status | Western Australian status |
|---|---|---|---|
| **Mammals** | | | |
| *Canis familiaris* | Wild Dog* | | |
| *Equus asinus* | Donkey* | | |
| *Tachyglossus aculeatus* | Short-beaked Echidna | | |
| *Vulpes vulpes* | Fox* | | |
| *Notamacropus irma* | Western Brush Wallaby | | P4 |
| *Macropus fuliginosus* | Western Grey Kangaroo | | |
| *Felis catus* | Feral Cat* | | |
| *Oryctolagus cuniculus* | European Rabbit* | | |
| *Notomys mitchellii* | Mitchell's Hopping Mouse | | |
| *Sminthopsis dolichura* | Little Long-tailed Dunnart | | |
| *Sminthopsis gilberti* | Gilbert's Dunnart | | |
| *Rattus rattus* | Black Rat* | | |
| *Mus musculus* | House Mouse* | | |
| ***Chalinolobus gouldii*** | Gould's Wattled Bat | | |
| ***Chalinolobus morio*** | Chocolate Wattled Bat | | |
| ***Scotorepens balstoni*** | Inland Broad-nosed Bat | | |
| ***Vespadelus baverstocki*** | Inland Forest Bat | | |
| ***Vespadelus regulus*** | Southern Forest Bat | | |
| ***Austronomus australis*** | White-striped Free-tailed Bat | | |
| ***Ozimops kitcheneri*** | Western Free-tailed Bat | | |
| ***Ozimops petersi*** | Inland Free-tailed Bat | | |
| ***Nyctophilus geoffroyi and/or Nyctophilus major tor*** **Note: Ambiguous identification** | Lesser Long-eared Bat and/or Central Long-eared Bat | | P4 (Central Long-eared Bat) |
| **Birds** | | | |
| *Acanthiza apicalis* | Inland Thornbill | | |
| *Acanthiza inornata* | Western Thornbill | | |
| *Acanthiza uropygialis* | Chestnut-rumped Thornbill | | |
| *Aquila audax* | Wedge-tailed eagle | | |
| *Artamus cyanopterus* | Dusky Woodswallow | | |
| *Barnardius zonarius* | Australian Ringneck | | |
| *Climacteris rufus* | Rufus Treecreeper | | |
| *Corvus coronoides* | Australian Raven | | |
| *Cracticus nigrogularis* | Pied Butcherbird | | |
| *Cracticus torquatus* | Grey Butcherbird | | |
| *Daphoenositta chrysoptera* | Varied Sitella | | |
| *Dromaius novaehollandiae* | Emu | | |
| *Drymodes brunneopygia* | Southern Scrub Robin | | |
| *Eolophus roseicapilla* | Galah | | |
| *Eopsaltria griseogularis* | Western Yellow Robin | | |

| Species | Common name | EPBC Act status | Western Australian status |
|---|---|---|---|
| *Gavicalis virescens* | Singing Honeyeater | | |
| *Grallina cyanoleuca* | Magpie Lark | | |
| *Gymnorhina tibicen* | Australian Magpie | | |
| *Hirundo neoxena* | Welcome Swallow | | |
| *Leipoa occelata* | Malleefowl | VU | VU |
| *Lichenostomus leucotis* | White-eared Honeyeater | | |
| *Malurus pulcherrimus* | Blue-breasted Fairywren | | |
| *Manorina flavigula* | Yellow-throated Miner | | |
| *Ocyphaps lophotes* | Crested Pigeon | | |
| *Pachycephala pectoralis* | Golden Whistler | | |
| *Petrochelidon nigricans* | Tree Martin | | |
| *Phaps chalcoptera* | Common Bronzewing | | |
| *Pomatostomus Superciliosus* | White-browed babbler | | |
| *Rhipidura albiscapa* | Grey Fantail | | |
| *Rhipidura leucophrys* | Willie Wagtail | | |
| *Strepera versicolor* | Grey Currawong | | |
| *Taeniopygia castanotis* | Zebra finch | | |
| *Oreoica gutturalis* | Crested Bellbird | | |
| *Cinclosoma clarum* | Western Chestnut Quail-thrush | | |
| *Calamanthus cautus* | Shy Heathwren | | |
| *Pyrrholaemus brunneus* | Redthroat | | |
| **Reptiles** | | | |
| *Ctenophorus cristatus* | Bicycle Dragon | | |
| *Moloch horridus* | Thorny Devil | | |
| *Pseudonaja affinis* | Dugite | | |
| *Tiliqua rugosa* | Shingleback, Bobtail | | |
| *Varanus gouldii* | Sand Goanna | | |
| *Egernia richardi* | Woodland Crevice Skink | | |
| **Invertebrates** | | | |
| *Camponotus sp. nr. terebrans* | Sugar Ant | | |

*introduced

**Table 10: Habitat assessment sites (GDA94, Zone 50)**

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Hab1** | Habitat Assessment | Mallee woodland over dense shrubland (some Allocasuarina sp.) | 759418 | 6441113 |
| **Hab2** | Habitat Assessment | Open Mallee woodland over shrub/regrowth | 755742 | 6440223 |
| **Hab3** | Habitat Assessment | Low shrubland with some Banksia sp. | 753997 | 6443915 |
| **Hab4** | Habitat Assessment | Low shrubland, some Mallee, Allocasuarina sp | 752647 | 6445635 |
| **Hab5** | Habitat Assessment | Low to medium shrubland with Mallee, Allocasuarina sp and sparse Banksia | 752646 | 6445930 |
| **Hab6** | Habitat Assessment | Low shrubland with spread out Mallee, some Banksia | 752099 | 6446849 |
| **Hab7** | Habitat Assessment | Mostly Allocasuarina sp, some Banksia sp | 751766 | 6447887 |
| **Hab8** | Habitat Assessment | Closed medium shrubland with sparse Mallee, Allocasuarina sp | 750216 | 6451540 |

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Hab9** | Habitat Assessment | Closed shrubland with sparse Mallee, Allocasuarina sp. | 749628 | 6451325 |
| **Hab10** | Habitat Assessment | Low shrubland with Allocasuarina and Banksia sp. | 748886 | 6451039 |
| **Hab11** | Habitat Assessment | Closed shrubland, Allocasuarina sp. | 748845 | 6450854 |
| **Hab12** | Habitat Assessment | Open Mallee woodland over shrubs | 750953 | 6452191 |
| **Hab13** | Habitat Assessment | Low closed shrubland with Banksia sp. Allocasuarina sp. | 751268 | 6452192 |
| **Hab14** | Habitat Assessment | Shrubland, Allocasuarina sp, Hakea sp | 750344 | 6456545 |
| **Hab15** | Habitat Assessment | Shrubland, Allocasuarina sp. | 750533 | 6456466 |
| **Hab16** | Habitat Assessment | Open Mallee woodland over shrub | 750252 | 6459484 |
| **Hab17** | Habitat Assessment | Shrubland with Callitris and Mallee over Leptospermum reeds on yellow sand | 750423 | 6462173 |
| **Hab18** | Habitat Assessment | Mostly Melaleuca with sparse Mallee | 750473 | 6462178 |
| **Hab19** | Habitat Assessment | Shrubland, Allocasuarina sp | 750245 | 6462991 |
| **Hab20** | Habitat Assessment | Regrowth, some shrub, Hakea and Allocasuarina sp | 750573 | 6465055 |
| **Hab21** | Habitat Assessment | Shrubland Melaleuca | 750604 | 6464964 |
| **Hab22** | Habitat Assessment | Allocasuarina with sparse Mallee | 749970 | 6466185 |
| **Hab23** | Habitat Assessment | Open Mallee woodland over shrub (Melaleuca) | 748200 | 6465234 |
| **Hab24** | Habitat Assessment | Closed shrubland with spread out Mallee | 747407 | 6464923 |
| **Hab25** | Habitat Assessment | Closed low shrubland mostly Allocasuarina sp | 750849 | 6466795 |
| **Hab26** | Habitat Assessment | Regrowth, shrubland over pit | 750760 | 6470790 |
| **Hab27** | Habitat Assessment | Open Salmon gum woodland over shrub, old fire scar | 750854 | 6470772 |
| **Hab28** | Habitat Assessment | Closed Allocasuarina shrubland | 750587 | 6473156 |
| **Hab29** | Habitat Assessment | Open shrubland fire scar | 750855 | 6473180 |
| **Hab30** | Habitat Assessment | Open Salmon Gum with Gimlet, over shrubland | 750561 | 6474740 |
| **Hab31** | Habitat Assessment | Shrubland mostly Acacia | 748723 | 6475401 |
| **Hab32** | Habitat Assessment | Mallee woodland over Acacia shrub | 748844 | 6475286 |
| **Hab33** | Habitat Assessment | Shrubland | 748269 | 6475915 |
| **Hab34** | Habitat Assessment | Open Salmon Gum woodland over shrub | 747715 | 6479692 |
| **Hab35** | Habitat Assessment | Open Salmon Gum woodland over medium shrubland | 746256 | 6482095 |
| **Hab36** | Habitat Assessment | Regrowth, Allocasuarina sp | 750919 | 6450477 |
| **Hab37** | Habitat Assessment | Shrubland, Allocasuarina sp, Mallee | 750977 | 6450484 |
| **Hab38** | Habitat Assessment | Open Salmon Gum woodland over shrub | 749530 | 6477479 |
| **Hab39** | Habitat Assessment | Open Salmon Gum woodland over shrub | 749415 | 6477460 |
| **Hab40** | Habitat Assessment | Woodland with Mallet over Melaleuca shrub | 747488 | 6480465 |
| **Hab41** | Habitat Assessment | Woodland with Mallet over Melaleuca shrub | 747622 | 6480559 |
| **Hab42** | Habitat Assessment | Low shrubland (fire scar), Mallee woodland south-east corner | 744738 | 6480584 |
| **Hab43** | Habitat Assessment | Acacia shrubland | 744209 | 6480603 |
| **Hab44** | Habitat Assessment | Allocasuarina low shrubland | 741981 | 6480643 |
| **Hab45** | Habitat Assessment | Allocasuarina low shrubland | 741957 | 6480771 |
| **Hab46** | Habitat Assessment | Allocasuarina shrubland with sparse Mallee | 746928 | 6482345 |
| **Hab47** | Habitat Assessment | Open Salmon Gum and other eucalypt sp woodland over Melaleuca shrub | 745718 | 6484344 |
| **Hab48** | Habitat Assessment | Open woodland, Gimlet/ Morrel over shrubs | 745801 | 6484594 |
| **Hab49** | Habitat Assessment | Open Salmon Gum woodland over shrub | 745066 | 6484589 |
| **Hab50** | Habitat Assessment | Marsh wetland, samphire, melaleuca shrub | 744671 | 6487094 |

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Hab51** | Habitat Assessment | Open Salmon Gum woodland over shrub (regeneration) | 743267 | 6489118 |
| **Hab52** | Habitat Assessment | Borrow pit 37 | 744205 | 6489301 |
| **Hab53** | Habitat Assessment | Borrow pit 36.2 | 743974 | 6489675 |
| **Hab54** | Habitat Assessment | Grassland with some trees | 743795 | 6492103 |
| **Hab55** | Habitat Assessment | Salmon Gum woodland over low shrub (regeneration) | 744020 | 6493516 |
| **Hab56** | Habitat Assessment | Low open Salmon Gum woodland over shrub (regrowth) | 744667 | 6495053 |
| **Hab57** | Habitat Assessment | Open Salmon Gum woodland over melaleuca shrub | 744545 | 6495429 |
| **Hab58** | Habitat Assessment | Open Salmon Gum and Wandoo woodland over low shrub | 743079 | 6498173 |
| **Hab59** | Habitat Assessment | Allocasuarina shrubland | 743097 | 6499137 |
| **Hab60** | Habitat Assessment | Allocasuarina shrubland, some Mallee and Acacia | 743236 | 6499114 |
| **Hab61** | Habitat Assessment | Open Salmon Gum woodland over Melaleuca shrub | 743280 | 6500038 |
| **Hab62** | Habitat Assessment | Low shrubland mostly Acacia | 739822 | 6501070 |
| **Hab63** | Habitat Assessment | Shrubland with Mallee | 738815 | 6499920 |
| **Hab64** | Habitat Assessment | Low shrubland with sparse Grevillea | 738100 | 6501107 |
| **Hab65** | Habitat Assessment | Allocasuarina shrubland | 738116 | 6501243 |
| **Hab66** | Habitat Assessment | Shrubland mixed | 736963 | 6501111 |
| **Hab67** | Habitat Assessment | Allocasuarina shrubland | 736989 | 6501273 |
| **Hab68** | Habitat Assessment | Allocasuarina shrubland | 737919 | 6501869 |
| **Hab69** | Habitat Assessment | Shrubland, Acacia sp. | 736063 | 6505599 |
| **Hab70** | Habitat Assessment | Shrubland, mostly Acacia with Mallee | 732424 | 6505897 |
| **Hab71** | Habitat Assessment | Open Salmon Gum woodland over shrub | 728247 | 6504355 |
| **Hab72** | Habitat Assessment | Allocasuarina shrubland | 728393 | 6504243 |
| **Hab73** | Habitat Assessment | Shrubland Allocasuarina and Acacia | 728014 | 6504446 |
| **Hab74** | Habitat Assessment | Low mixed shrubland | 728469 | 6509458 |
| **Hab75** | Habitat Assessment | Acacia shrubland next to cleared land | 728529 | 6512203 |
| **Hab76** | Habitat Assessment | Shrubland Acacia sp. mostly with some Mallee | 729667 | 6509937 |
| **Hab77** | Habitat Assessment | Mixed shrubland with some Mallee | 729867 | 6507860 |
| **Hab78** | Habitat Assessment | Shrubland (open) some Mallee | 730469 | 6507412 |
| **Hab79** | Habitat Assessment | Open shrubland, Allocasuarina and Acacia | 724567 | 6511549 |
| **Hab80** | Habitat Assessment | Acacia shrubland | 724593 | 6511648 |
| **Hab81** | Habitat Assessment | Open Salmon Gum woodland over Melaleuca, some parts with Mallee and shrub | 724392 | 6511769 |
| **Hab82** | Habitat Assessment | Mostly cleared some shrub and unknown species of Eucalypt planted along road | 721353 | 6513931 |
| **Hab83** | Habitat Assessment | Open Salmon Gum woodland and Mallee over shrub | 720002 | 6514890 |
| **Hab84** | Habitat Assessment | Callitris open shrubland | 717514 | 6516689 |
| **Hab85** | Habitat Assessment | Acacia shrubland | 717166 | 6516878 |
| **Hab86** | Habitat Assessment | Wetland with patches of sandy clay and grass, surrounded by open shrub | 716478 | 6517260 |
| **Hab87** | Habitat Assessment | Mixed dense shrubland with Acacia, Allocasuarina and Mallee | 716120 | 6517896 |
| **Hab88** | Habitat Assessment | Shrubland with Allocasuarina and mostly Acacia | 715502 | 6518459 |
| **Hab89** | Habitat Assessment | Shrubland mostly Acacia | 714814 | 6519191 |
| **Hab90** | Habitat Assessment | Open Salmon Gum woodland | 714847 | 6519301 |
| **Hab91** | Habitat Assessment | Shrubland with Allocasuarina and Acacia | 714339 | 6519728 |

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Hab92** | Habitat Assessment | Closed Salmon Gum and Mallee woodland over shrub | 712708 | 6521309 |
| **Hab93** | Habitat Assessment | Shrubland with Allocasuarina and Acacia with some Mallee | 712641 | 6521700 |
| **Hab94** | Habitat Assessment | Acacia shrubland | 712673 | 6523129 |
| **Hab95** | Habitat Assessment | Shrubland with mostly Acacia with some Allocasuarina and Mallee | 713833 | 6524295 |
| **Hab96** | Habitat Assessment | Shrubland with Allocasuarina and Acacia, some sparse Eucalypt tree sp. | 715778 | 6526838 |
| **Hab97** | Habitat Assessment | Shrubland with Allocasuarina and Acacia, some sparse Eucalypt tree sp. | 716180 | 6526961 |
| **Hab98** | Habitat Assessment | Shrubland with Allocasuarina and Acacia, some sparse Eucalypt tree sp. | 715872 | 6527297 |
| **Hab99** | Habitat Assessment | Cleared or developed, occasional Salmon Gum and shrub | 704753 | 6530367 |
| **Hab100** | Habitat Assessment | Open Salmon Gum woodland with Mallee and Melaleuca | 705730 | 6529399 |
| **Hab101** | Habitat Assessment | Acacia shrubland with sparse Mallee | 706161 | 6528886 |
| **Hab102** | Habitat Assessment | Shrubland with Allocasuarina and Acacia | 706406 | 6528431 |
| **Hab103** | Habitat Assessment | Acacia shrubland with Mallee | 705604 | 6527076 |
| **Hab104** | Habitat Assessment | Open Salmon Gum woodland over Melaleuca and Acacia shrubland with sparse Mallee | 707488 | 6527430 |
| **Hab105** | Habitat Assessment | Cleared land with occasional Salmon Gum and shrub | 707405 | 6527424 |
| **Hab106** | Habitat Assessment | Acacia shrubland with sparse Mallee | 707526 | 6527272 |
| **Hab107** | Habitat Assessment | Open Salmon Gum woodland over Melaleuca | 707885 | 6526955 |
| **Hab108** | Habitat Assessment | Shrubland Allocasuarina and Acacia sp. | 708187 | 6526579 |
| **Hab109** | Habitat Assessment | Wandoo woodland with unknown eucalypt sp., some Salmon Gum over shrub | 708948 | 6525752 |
| **Hab110** | Habitat Assessment | Mixed shrubland with some Salmon Gum, Wandoo interspersed further south | 709333 | 6525340 |
| **Hab111** | Habitat Assessment | Mallee woodland over shrub | 717970 | 6516416 |
| **Hab112** | Habitat Assessment | Open Salmon Gum and Morrel woodland | 718743 | 6515847 |
| **Hab113** | Habitat Assessment | Mallee woodland with Salmon Gum over shrub | 719688 | 6515150 |
| **Hab114** | Habitat Assessment | Open Salmon Gum woodland over Melaleuca with some Mallee | 724837 | 6511438 |
| **Hab115** | Habitat Assessment | Shrubland with some Mallee | 725604 | 6510891 |
| **Hab116** | Habitat Assessment | Open woodland consisting of Morrel, Salmon Gum, and Mallee | 726602 | 6510153 |
| **Hab117** | Habitat Assessment | Eucalypt woodland over mixed shrubland | 730934 | 6507098 |
| **Hab118** | Habitat Assessment | Open Salmon Gum woodland with Mallee over shrub | 734115 | 6504766 |
| **Hab119** | Habitat Assessment | Wandoo and Salmon Gum open woodland | 736397 | 6503064 |
| **Hab120** | Habitat Assessment | Salmon Gum woodland over low shrub (regeneration) | 743922 | 6491367 |
| **Hab121** | Habitat Assessment | Open Salmon Gum woodland over Melaleuca and other shrub (some regeneration) | 744210 | 6488742 |
| **Hab122** | Habitat Assessment | Salmon Gum woodland over melaleuca with Mallee Morrel further south | 744770 | 6486836 |
| **Hab123** | Habitat Assessment | Open woodland with Morrel, Gimlet, and Salmon Gum over Melaleuca and low shrub | 745544 | 6485622 |
| **Hab124** | Habitat Assessment | Salmon Gum woodland with Mallet and Mallee (regeneration) | 747919 | 6479652 |
| **Hab125** | Habitat Assessment | Open woodland of Salmon Gum and Morrel over shrub (Melaleuca) | 748252 | 6479217 |
| **Hab126** | Habitat Assessment | Shrubland with Acacia and sparse Mallee | 750634 | 6474047 |

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Hab127** | Habitat Assessment | Open Salmon Gum woodland over dense shrub | 750684 | 6472458 |
| **Hab128** | Habitat Assessment | Shrubland (mostly Acacia and some Allocasuarina) with sparse Mallee | 750740 | 6470951 |
| **Hab129** | Habitat Assessment | Salmon Gum woodland with Gimlet over low shrubland | 750706 | 6470580 |
| **Hab130** | Habitat Assessment | Shrubland with Calistris, Allocasuarina and some Mallee | 750744 | 6469006 |
| **Hab131** | Habitat Assessment | Salmon Gum woodland (young) over shrub | 750545 | 6465922 |
| **Hab132** | Habitat Assessment | Closed shrubland (Allocasuarina, Calistris, and Acacia) | 750546 | 6465709 |
| **Hab133** | Habitat Assessment | Mallee woodland with some Salmon Gum over shrub | 750383 | 6461859 |
| **Hab134** | Habitat Assessment | Shrubland with Allocasuarina and Acacia, varying degrees of Mallee | 750315 | 6456798 |
| **Hab135** | Habitat Assessment | Mallee woodland with mostly shrub | 750434 | 6453183 |
| **Hab136** | Habitat Assessment | Shrubland of Allocasuarina and Acacia with sparse Mallee | 750444 | 6452951 |

**Table 11: Fauna observation sites (GDA94, Zone 50)**

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **MF1** | Fauna Observation | *Leipoa ocellata* | 749316 | 6451232 |
| **Fob1** | Fauna Observation | *Pomatostomus superciliosus* | 748833 | 6451071 |
| **Fob2** | Fauna Observation | *Drymodes brunneopygia* | 748833 | 6450882 |
| **Fob3** | Fauna Observation | *Pomatostomus superciliosus* | 748840 | 6450851 |
| **Fob4** | Fauna Observation | *Macropus irma* | 750368 | 6463017 |
| **Fob5** | Fauna Observation | *Drymodes brunneopygia* | 750367 | 6463018 |
| **Fob6** | Fauna Observation | *Tachyglossus aculeatus* | 749893 | 6466149 |
| **Fob7** | Fauna Observation | *Macropus fuliginosus* | 749893 | 6466157 |
| **Fob8** | Fauna Observation | *Gavicalis virescens* | 748258 | 6465169 |
| **Fob9** | Fauna Observation | *Varanus gouldii* | 748121 | 6465217 |
| **Fob10** | Fauna Observation | *Dromaius novaehollandiae* | 751029 | 6466631 |
| **Fob11** | Fauna Observation | *Eopsaltria griseogularis* | 750845 | 6470765 |
| **MF2** | Fauna Observation | *Leipoa ocellata* | 748722 | 6475400 |
| **Fob12** | Fauna Observation | *Macropus fuliginosus* | 748732 | 6475395 |
| **Fob13** | Fauna Observation | *Pachycephala pectoralis* | 747780 | 6479727 |
| **Fob14** | Fauna Observation | *Macropus irma* | 747777 | 6479723 |
| **Fob15** | Fauna Observation | *Acanthiza apicalis* | 747713 | 6479691 |
| **Fob16** | Fauna Observation | *Lichenostomus leucotis* | 747716 | 6479694 |
| **Fob17** | Fauna Observation | *Macropus fuliginosus* | 750922 | 6450483 |
| **Fob18** | Fauna Observation | *Artamus cyanopterus* | 744230 | 6480690 |
| **Fob19** | Fauna Observation | *Acanthiza apicalis* | 741946 | 6480659 |
| **Fob20** | Fauna Observation | *Cracticus torquatus* | 746990 | 6482343 |
| **Fob21** | Fauna Observation | *Pomatostomus superciliosus* | 745756 | 6484362 |
| **Fob22** | Fauna Observation | *Macropus fuliginosus* | 738105 | 6501214 |
| **Fob23** | Fauna Observation | *Tachyglossus aculeatus* | 736986 | 6501239 |
| **Fob24** | Fauna Observation | *Dromaius novaehollandiae* | 736997 | 6501081 |
| **Fob25** | Fauna Observation | *Falco berigora* | 736988 | 6500662 |

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Fob26** | Fauna Observation | *Barnardius zonarius* | 732406 | 6505931 |
| **Fob27** | Fauna Observation | *Equus asinus* | 732445 | 6505871 |
| **Fob28** | Fauna Observation | *Aquila audax* | 728185 | 6504257 |
| **Fob29** | Fauna Observation | *Tachyglossus aculeatus* | 728277 | 6504245 |
| **Fob30** | Fauna Observation | *Eolophus roseicapilla* | 728160 | 6504389 |
| **Fob31** | Fauna Observation | *Vulpes vulpes* | 728526 | 6511827 |
| **Fob32** | Fauna Observation | *Cracticus nigrogularis* | 729666 | 6509969 |
| **Fob33** | Fauna Observation | *Canis familiaris* | 744122 | 6488850 |
| **Fob34** | Fauna Observation | *Barnardius zonarius* | 724609 | 6511572 |
| **Fob35** | Fauna Observation | *Eolophus roseicapilla* | 724600 | 6511615 |
| **Fob36** | Fauna Observation | *Rhipidura leucophrys* | 724587 | 6511534 |
| **Fob37** | Fauna Observation | *Manorina flavigula* | 719984 | 6514876 |
| **Fob38** | Fauna Observation | *Tiliqua rugosa* | 717519 | 6516652 |
| **Fob39** | Fauna Observation | *Taeniopygia castanotis* | 717468 | 6516713 |
| **Fob40** | Fauna Observation | *Hirundo neoxena* | 712124 | 6522198 |
| **Fob41** | Fauna Observation | *Petrochelidon nigricans* | 715786 | 6526776 |
| **Fob42** | Fauna Observation | *Moloch horridus* | 732140 | 6506181 |
| **Fob43** | Fauna Observation | *Ctenophorus cristatus* | 733159 | 6505443 |
| **Fob44** | Fauna Observation | *Strepera versicolor* | 745820 | 6485310 |
| **Fob45** | Fauna Observation | *Moloch horridus* | 750285 | 6457548 |
| **Fob46** | Fauna Observation | *Moloch horridus* | 751626 | 6448246 |
| **Fob47** | Fauna Observation | *Malurus pulcherrimus* | 753989 | 6443881 |
| **Fob48** | Fauna Observation | *Acanthiza inornata* | 753933 | 6443889 |
| **Fob49** | Fauna Observation | *Drymodes brunneopygia* | 753958 | 6443853 |
| **Fob50** | Fauna Observation | *Moloch horridus* | 750353 | 6454136 |
| **Fob51** | Fauna Observation | *Acanthiza uropygialis* | 743442 | 6497795 |
| **Fob52** | Fauna Observation | *Lichenostomus leucotis* | 743422 | 6497761 |
| **Fob53** | Fauna Observation | *Rhipidura leucophrys* | 743377 | 6497775 |
| **Fob54** | Fauna Observation | *Cracticus nigrogularis* | 743463 | 6497732 |
| **Fob55** | Fauna Observation | *Daphoenositta chrysoptera* | 743403 | 6497810 |
| **Fob56** | Fauna Observation | *Gavicalis virescens* | 743480 | 6497753 |
| **Fob57** | Fauna Observation | *Pachycephala pectoralis* | 743402 | 6497762 |
| **Fob58** | Fauna Observation | *Climacteris rufus* | 744774 | 6497384 |
| **Sugar ant 1** | Fauna Observation | *Camponotus sp. nr. terebrans* | 748549 | 6478834 |
| **Sugar ant 2** | Fauna Observation | *Camponotus sp. nr. terebrans* | 748567 | 6478793 |
| **Fob59** | Fauna Observation | *Ctenophorus cristatus* | 750281 | 6456685 |
| **Fob60** | Fauna Observation | *Pseudonaja affinis* | 708019 | 6526762 |
| **Fob61** | Fauna Observation | *Corvus coronoides* | 705095 | 6530002 |
| **Fob62** | Fauna Observation | *Grallina cyanoleuca* | 709663 | 6524960 |
| **Fob63** | Fauna Observation | *Gymnorhina tibicen* | 708225 | 6526525 |
| **Fob64** | Fauna Observation | *Ocyphaps lophotes* | 706965 | 6527903 |
| **Fob65** | Fauna Observation | *Aquila audax* | 705388 | 6529645 |

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Fob66** | Fauna Observation | *Phaps chalcoptera* | 710386 | 6524195 |
| **Fob67** | Fauna Observation | *Rhipidura albiscapa* | 705866 | 6528834 |

**Table 12: Sugar ant survey sites (GDA94, Zone 50)**

| Site Name | Site Type | Description | Easting | Northing |
|---|---|---|---|---|
| **Ant 1** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 747478 | 6480530 |
| **Ant 2** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 745720 | 6484328 |
| **Ant 3** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 743222 | 6497877 |
| **Ant 4** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 743442 | 6497665 |
| **Ant 5** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 744016 | 6497541 |
| **Ant 6** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 744796 | 6497475 |
| **Ant 7** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 744861 | 6496195 |
| **Ant 8** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 744618 | 6495681 |
| **Ant 9** | Targeted survey | *Camponotus sp. nr. terebrans* absent | 746082 | 6484464 |
| **Ant 10** | Targeted survey | *Camponotus sp. nr. terebrans* present | 748549 | 6478835 |

# APPENDIX FOUR BAT CALL ANALYSIS

# Acoustic analysis and bat call identification from Mt Holland, Western Australia

Prepared for **Ecoscape Australia Pty Ltd**

Version **27 June 2022**

SZ project reference **SZ617**


Prepared by **Dr Kyle Armstrong and Yuki Konishi**

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This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2022). Acoustic analysis and bat call identification from Mt Holland, Western Australia. Unpublished report by Specialised Zoological for Ecoscape Australia Pty Ltd, 27 June 2022, project reference SZ617.

## Summary

Bat identifications from acoustic recordings are provided from Mt Holland, c. 80 km south of Southern Cross, Western Australia. The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics.

At least nine species of bat were identified as being present (**Tables 1** and **2**). Representative echolocation calls for each identification are illustrated (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006). Further details are available should verification be required.

## Methods

The data provided were recorded in full spectrum WAV format with Titley Scientific Anabat Swift bat detectors (sampling rate 500 kHz, set to turn on automatically at sunset and off at sunrise). WAV files were converted to Zero Crossings format in Wildlife Acoustics Kaleidoscope version 5.1.9 software, and then opened in Titley Scientific Anabat Insight version 2.0.1 software. A filtering and decision tree process was run to allocate each Zero Crossings file to a frequency band representing one or more bat species, and then the presence of species in each frequency band group was validated by inspecting examples to allocate a species-level identification. The dataset comprised four recording sites, with the sampling period extending from 29 March to 28 April 2022. Identifications are presented as a site by species matrix, rather than a matrix giving explicit identifications per recording night within each site.

Species were identified based on information in Churchill (2008), and the author's own unpublished material. Nomenclature follows Jackson and Groves (2015).

## Comments on identifications

Most species were identified unambiguously, but some call types have more than one possibility for their source. For example, the calls of long-eared bat species *Nyctophilus* spp. cannot be distinguished reliably, and both candidate species might have been present. Likewise, some call sequences of Gould's Wattled Bat *Chalinolobus gouldii* can appear very similar to those produced by the Inland Free-tailed Bat *Ozimops petersi*, but *C. gouldii* was recognised based on the alternating high and low characteristic frequency in successive pulses, and *O. petersi* was identified based on pulse shapes.

## Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.
7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.
8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.

## References

ABS (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australasian Bat Society Newsletter* 27: 6–9. [ISSN 1448-5877]

Churchill, S.K. (2008). *Australian bats.* 2nd ed. Allen and Unwin, Crows Nest, NSW.

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

**Table 1**. Species identified in the present survey from all sites combined.

| | |
|---|---|
| **VESPERTILIONIDAE** | |
| Gould's Wattled Bat | *Chalinolobus gouldii* |
| Chocolate Wattled Bat | *Chalinolobus morio* |
| Inland Broad-nosed Bat | *Scotorepens balstoni* |
| Inland Forest Bat | *Vespadelus baverstocki* |
| Southern Forest Bat | *Vespadelus regulus* |
| | |
| ***Ambiguous identifications*** | |
| Lesser Long-eared Bat / ***and/or*** Central Long-eared Bat | *Nyctophilus geoffroyi* / ***and/or*** *Nyctophilus major tor* |
| **MOLOSSIDAE** | |
| White-striped Free-tailed Bat | *Austronomus australis* |
| Western Free-tailed Bat | *Ozimops kitcheneri* |
| Inland Free-tailed Bat | *Ozimops petersi* |

**Table 2**. Species identifications, with the degree of confidence indicated by a code (see *Table 1* for full species names).

| | ABS1 | ABS2 | ABS3 | ABS4 |
|---|---|---|---|---|
| *A. australis* | X | X | X | — |
| *C. gouldii* | X | X | X | — |
| *C. morio* | X | X | X | — |
| *Nyctophilus* sp. | NC | NC | NC | — |
| *O. kitcheneri* | X | X | X | — |
| *O. petersi* | X | X | X | — |
| *S. balstoni* | X | X | X | — |
| *V. baverstocki* | X | X | X | — |
| *V. regulus* | X | X | X | — |

| | | |
|---|---|---|
| ABS1 | serial 622828 | 31.948657 S, 119.649943 E |
| ABS2 | serial 622905 | 31.811107 S, 119.635905 E |
| ABS3 | serial 622742 | 31.725390 S, 119.582327 E |
| ABS4 | serial 622898 | 32.048963 S, 119.635035 E |

**Definition of confidence level codes**

**—** Recording issue, no identifications available.

**X** Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

**NC Needs Confirmation**. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the *Comments on identifications* section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

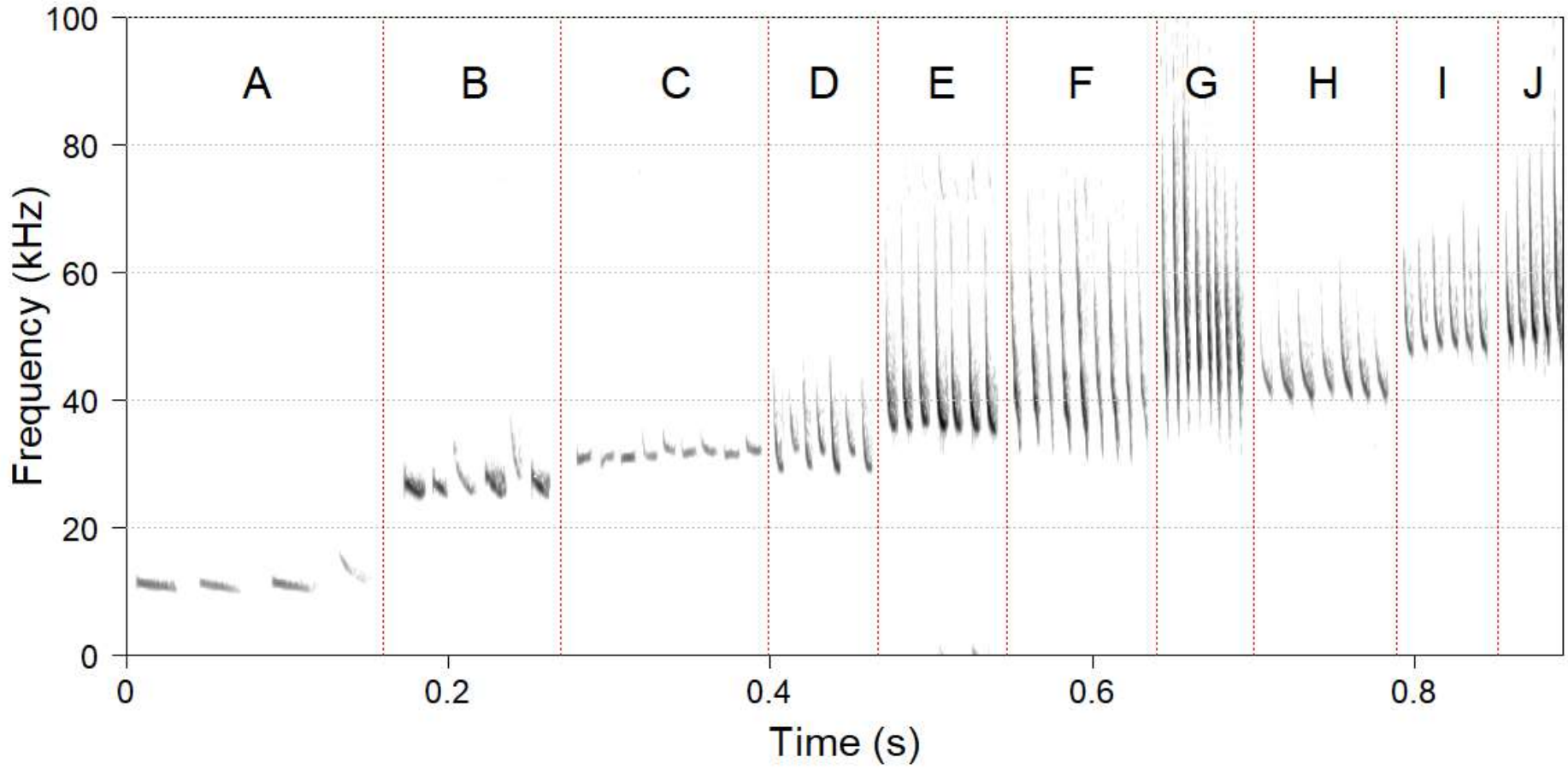


**Figure 1**. Representative echolocation call sequence portions of the species identified (**A**: *Austronomus australis*; **B**: *Ozimops kitcheneri*; **C**: *Ozimops petersi*; **D**: *Chalinolobus gouldii*; **E**: *Scotorepens balstoni*; **F**,**G**: *Nyctophilus geoffroyi / N. major tor*; **H**: *Vespadelus regulus*; **I**: *Vespadelus baverstocki*; **J**: *Chalinolobus morio*; time between pulses has been compressed).