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**BENNETT RESOURCES  
VALHALLA PROJECT  
TARGETED GREATER BILBY SURVEY**

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*ecologia* Environment

463 Scarborough Beach Rd

OSBORNE PARK WA 6017

Phone: 08 6168 7200

Email: [admin@ecologia.com.au](mailto:admin@ecologia.com.au)

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## EXECUTIVE SUMMARY

Ecologia Environment (*ecologia*) was commissioned by Bennett Resources to undertake a targeted significant fauna survey at the Valhalla Project. The surveys were undertaken over a period of eight days between July 22 - 29, 2024. Survey methods utilised accorded with the Environmental Protection Authority's (EPA) guidance documents in addition to relevant state and Commonwealth guidance and technical documents and coincided with the appropriate survey timing for all target species.

### Survey Effort

All areas within the development envelope including the 10 proposed well sites and associated infrastructure (roads) were traversed at 20 m intervals searching for primary or secondary evidence of significant fauna taxa. A cumulative total of 72 hours were spent walking transects. Ten motion camera trapping sites (49 recording nights) and 10 ultrasonic recording sites (49 recording nights) were deployed (one at each proposed pad during the targeted surveys).

### Fauna Habitat

Three fauna habitat types were recorded, all which are considered widespread at local and regional scales with no habitats restricted to the development envelope. Mixed open woodland over tussock grasses on dune slopes and crests and is considered suitable for the greater bilby. The habitat in the south-east between Proposed Well 3 and Proposed Well 4 is considered the most suitable for bilbies

No rocky habitats considered critical for northern quolls or ghost bats was recorded.

### Significant fauna

Potential old greater bilby diggings at the base of shrubs at Proposed Well 4 and Proposed Well 3. These potential old diggings suggest that bilbies may have previously foraged within the area. According to the guidelines, old diggings on their own do not confirm presence and are considered as "potential greater bilby activity, presence not confirmed". To confirm presence, we would need to find scats, active burrows or tracks (fresh, very distinctive). After considerable survey effort in the vicinity of the diggings, none of those were found.

No secondary evidence of the northern quoll or ghost bat was recorded, and it is considered highly unlikely that either of these species will utilise any habitats within the development envelope.

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## 1 INTRODUCTION

### 1.1 PROJECT BACKGROUND

The Bennett Resources (the client) is proposing to undertake an unconventional exploration and appraisal drilling program within Petroleum Exploration Permit EP 371, located in the Canning Basin, West Kimberley of Western Australia. The project will require clearing of approximately 110 hectares.

The greater bilby (*Macrotis lagotis*) and the ghost bat (*Macroderma gigas*) are listed as Vulnerable, and the northern quoll (*Dasyurus hallucatus*) is listed as Endangered, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Biodiversity Conservation Act 2016*.

Bennett Resources engaged Ecologia Environment (*ecologia*) to undertake a targeted significant fauna survey to validate the presence or absence of significant species and within the proposed clearing areas.

### 1.2 SURVEY OBJECTIVES

The Environmental Protection Authority's (EPAs) environmental objectives for the factor *Terrestrial Fauna* (EPA, 2016) are: "to protect terrestrial fauna so that biological diversity and ecological integrity are maintained". In this context, 'ecological integrity' refers to the composition, structure, function and processes of ecosystems, and the natural range of variation of these elements.

The following activities were undertaken as part of the scope of works for this project:

1. Review previously completed desktop surveys and previously undertaken surveys.
2. Conduct targeted surveys for significant fauna, with a focus on the greater bilby, northern quoll and ghost bat. Methods used included, but were not limited to;
  - Motion cameras;
  - Autonomous recording units (ARUs);
  - Search transects; and
  - Active searches.

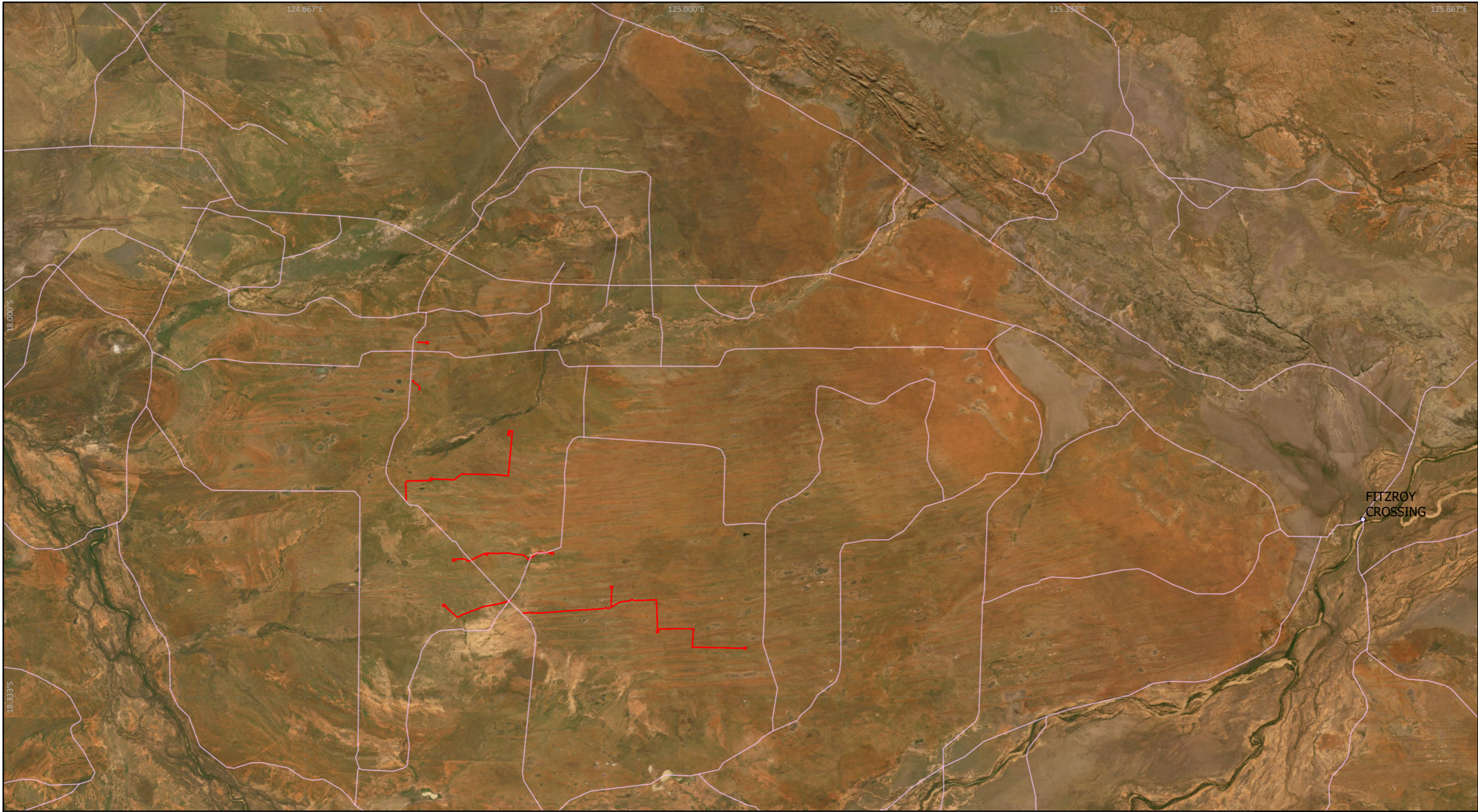
### 1.3 LEGISLATIVE AND REGULATORY FRAMEWORK

The survey was designed and undertaken to comply with the following statutory legislation and policies (definitions can be seen in Appendix A):

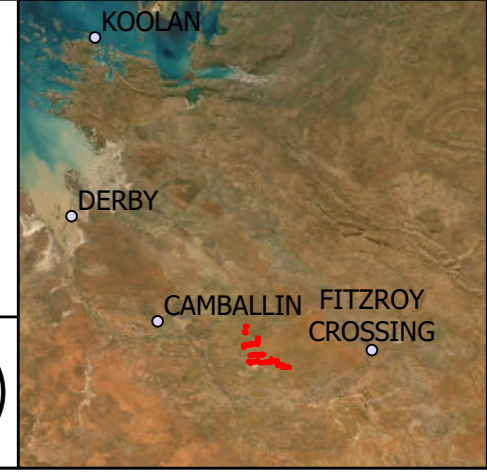
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Biodiversity Conservation Act 2016* (BC Act); and
- *Environmental Protection Act 1986* (EP Act).

The assessments complied with all necessary State and Commonwealth guidelines, including but not limited to:

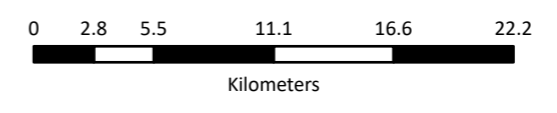
- Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020);
- EPBC Act Referral Guideline for the Endangered Northern Quoll (Commonwealth of Australia, 2016);
- Guidelines for Surveys to Detect the Presence of Bilbies, and Assess the Importance of Habitat in Western Australia (DBCA, 2017);
- Survey Guidelines for Australia's Threatened Mammals (DSEWPac, 2011); and
- Survey Guidelines for Australia's Threatened Bats (DSEWPac, 2010).



- Roads
- Town
- Disturbance footprint



**Map 1: Survey Area**



#### 1.4 DESKTOP SURVEY

A total of 11 surveys have previously been undertaken within the Valhalla project area (Table 1). The most recent survey undertaken by Eco Logical Australia (ELA) in 2021 included a detailed and targeted flora and vegetation survey and a basic fauna survey.

Eco Logical Australia (2021) outlined three broad fauna habitat types present within the project area including mixed open woodland over grassland on sandy clay flats and slopes; mixed open woodland over tussock grasses on dune slopes and crests; eucalypt open woodland and mixed shrubland on closed depression and creekline.

Eco Logical Australia (2021) recorded unconfirmed signs of the bilby (*Macrotis lagotis*) at four locations in the south-east of the project area within the mixed open woodland over tussock grasses on dune slopes and crests fauna habitat type.

Unconfirmed secondary evidence (scat) of the northern quoll was recorded by Low Ecological Services (2020). This unconfirmed record is outside the known distribution of the northern quoll in the Kimberley.

**Table 1: Literature review and consolidation of previous results.**

Author	Report	Distance to Project Area	Significant flora	Significant ecological communities	Significant fauna	Declared Pests / WoNS
ELA (2021)	Valhalla Flora and Fauna Survey	Overlapping	<i>Nymphoides beaglensis</i> (P3)	Nil	Unconfirmed signs of the greater bilby ( <i>Macrotis lagotis</i> ) were observed.	* <i>Calotropis procera</i>
Low Ecological Services (2020)	Flora and Fauna Assessment Odin 2D and 3D seismic survey, Fitzroy Basin, Western Australia	Similar if not overlapping.	Nil	Nil	Unconfirmed signs of the northern quoll ( <i>Dasyurus hallucatus</i> ) and greater bilby ( <i>Macrotis lagotis</i> ) were observed.	* <i>Calotropis procera</i>
ELA (2018)	Valhalla Central 4 Flora and Fauna Survey	Within Development Envelope along creek line track.	Nil	Nil	Nil	Nil
ELA (2016)	Level 1 Vegetation, Flora and Fauna Survey of Kurrajong, Yakka Munga and Valhalla Central Well Sites	Valhalla Central A is the only site relevant, located within Development Envelope near marsh reroute.	<i>Pterocaulon intermedium</i> (no longer listed)	Nil at Valhalla Central A	Rainbow bee-eater ( <i>Merops ornatus</i> ); listed as Marine only	Nil
Murdoch University (2016)	Targeted bilby survey of proposed well site 'Valhalla Central', and immediate area	Within Development Envelope, central.	Nil	Nil	Nil	Nil
Buru Energy and Outback Ecology (2014)	Ophir, Paradise, Valhalla, Eden and Ellendale Flora, Vegetation and Fauna Survey Report	Adjacent to the west.	Nil	Nil	<i>Ardea modesta</i> (not currently listed), <i>Ardeotis australis</i> (not currently listed), <i>Burhinus grallarius</i> (not currently listed), <i>Merops ornatus</i> (listed as Marine only), <i>Tringa nebularia</i> (IA), <i>Tringa stagnatilis</i> (IA)	Nil
Low Ecological Services (2012a)	Asgard-1 Exploration Well: Flora, Vegetation and Fauna Survey	33 km north-northwest of Development Envelope.	Nil	Nil	Nil	Nil

Author	Report	Distance to Project Area	Significant flora	Significant ecological communities	Significant fauna	Declared Pests / WoNS
Low Ecological Services (2012b)	Asgard 2D Seismic Survey: Flora, Vegetation and Fauna Survey	Similar if not overlapping.	<i>Trianthema kimberleyi</i> (P1), <i>Goodenia virgata</i> (P2)	Nil	Australian bustard ( <i>Ardeotis australis</i> ; not currently listed) and rainbow bee-eater ( <i>Merops ornatus</i> ; not currently listed). Unconfirmed greater bilby burrow.	Nil
Low Ecological Services (2011a)	Flora and Vegetation Survey: Valhalla North	73 km north northwest of Development Envelope.	Nil	Nil	Rainbow bee-eater ( <i>Merops ornatus</i> ; not currently listed)	* <i>Calotropis procera</i> )
Low Ecological Services (2011b)	Valhalla East-1 Exploration Well: Flora and Fauna Survey	Within Development Envelope centre north about 5 km south from northern extent.	Nil	Nil	Australian bustard ( <i>Ardeotis australis</i> ; not currently listed)	Nil
Woodman Environmental Consulting (2007)	Valhalla 01 Well Site Flora and Vegetation Survey	Within Development Envelope to northwest.	<i>Goodenia byrnesii</i> (P1), <i>Triodia acutispicula</i> (P3), <i>Goodenia sepalosa</i> var. <i>glandulosa</i> (P3)	Nil	Nil	Nil

## 2 SURVEY METHODOLOGY

### 2.1 SURVEY TIMING AND EFFORT

The targeted significant fauna survey was conducted by two *ecologia* zoologists from July 22-29, 2024. The survey methods implemented accord with the *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020) and were undertaken in accordance with survey timing requirements for significant fauna likely to occur within the survey area. Targeted significant fauna survey effort is outlined in Table 2 - Table 3. Survey locations and transect track effort can be seen in Appendix B.

**Table 2: Motion camera and survey effort.**

Site	ARU Device ID	Camera Device ID	Date Deployed	Date retrieved	Nights
Alfheim	TC39	Eco015	23/07/2024	28/07/2024	5
Jotunheim	SM4-08	Eco003	23/07/2024	28/07/2024	5
Midgard	SM4-03	Eco005	23/07/2024	28/07/2024	5
Muspelhiem	SM4-07	Eco007	23/07/2024	28/07/2024	5
Nidavellir	SM4-05	Eco001	23/07/2024	28/07/2024	5
Vanaheim	SM4-01	Eco014	23/07/2024	28/07/2024	5
Proposed well 1	SM4-06	Eco012	23/07/2024	28/07/2024	5
Proposed well 2	TC88	RC13	23/07/2024	28/07/2024	5
Proposed well 4	TC40	B15	23/07/2024	28/07/2024	5
Proposed well 3	TC36	B05	24/07/2024	28/07/2024	4
Total					49

**Table 3: Targeted search effort.**

Site/Transect ID	Active search (mins)
Targeted searches (bilby)	4,320
Total	4, 320 (72 hours)

### 2.2 SITE SELECTION

Habitat features known to provide shelter and foraging opportunities for significant fauna species were preferentially targeted during the current survey. An overview of survey effort is provided in Appendix B.

## 2.3 SAMPLING METHODS

The survey was undertaken using a variety of sampling techniques in accordance with *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA, 2020).

### 2.3.1 Habitat Descriptions

A fauna habitat type broadly describes an area of habitat that is distinguished by its vegetation, soil characteristics and land features, and is likely to support a different fauna assemblage to that found in other fauna habitats.

Habitat assessments were undertaken within each of the 10 proposed pads to identify habitats considered suitable for greater bilbies, ghost bats and northern quolls. For each fauna survey site, the following parameters were recorded:

- broad habitat type;
- digital photographs;
- landform type;
- soil colour, type and characteristics;
- type and extent of non-vegetative surface cover;
- type of vegetation in lower, middle and upper strata;
- observable fire history and evidence of any disturbance;
- presence and extent of leaf litter and coarse woody debris;
- presence of, or distance to, water sources;
- presence of significant microhabitats such as tree hollows and rocky outcrops; and
- notes on suitability for hosting significant fauna.

A habitat condition rating was assigned to each habitat assessment site, delineated according to the habitat condition criteria described in Table 4. Habitat assessment sheets are provided in Appendix C.

**Table 4: Habitat condition assessment criteria.**

Habitat Condition	Criteria
Excellent	Pristine or nearly so, no obvious sign of damage caused by human activity since European settlement or introduced fauna and/or flora. No signs of recent, extensive fires.
Very Good	Some relatively slight signs of damage caused by human activity since European settlement e.g., damage to tree trunks by repeated fires, no significant signs of introduced fauna and/or flora or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activity since European settlement, including some obvious impact to vegetation structure such as that caused by low levels of grazing, weed introduction or by selective logging. Some tracks or secondary evidence of introduced fauna. Some signs of recent fires.
Poor	Still retains basic vegetation structure or ability to regenerate it after obvious impacts of human activity since European settlement such as partial clearing or very frequent fires. Presence of introduced fauna and/or flora.
Very Poor	Severely impacted by grazing, introduced fauna and/or flora, fire, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management.
Completely Degraded	Areas that are completely or almost completely without vegetation communities and are heavily impacted by extensive fires and/or introduced species e.g., cow paddock.

### 2.3.2 Greater Bilby Surveys

Targeted surveys for the greater bilby were undertaken in accordance with the *Guidelines for Surveys to Detect the Presence of Bilbies and Assess the Importance of Habitat in Western Australia* (DBCA, 2017). Given the size of the survey area (125 ha), linear search transects were traversed at intervals of 20 m to detect potential evidence of bilby occupancy or transient presence within the survey area (scat, diggings, burrows and tracks). Any evidence of greater bilby activity was documented and categorised in accordance with methodologies outlined in Dziminski and Carpenter (2018).

### 2.3.3 Ultrasonic Recorders

Song Meter 4 (SM4) ultrasonic ARUs and Titley Chorus ARUs have a high sampling frequency and enable the full spectrum of bat echolocation calls to be recorded without transformation, allowing greater accuracy and sensitivity. ARUs were deployed at each of the 10 pads within the survey area with microphones facing towards the sky at a height of at least 1 m above the ground, to record bat echolocation calls in the vicinity of the device.

Echolocation calls recorded were analysed by bat specialist Dr Kyle Armstrong to investigate potential usage of the survey area by the ghost bat (*Macroderma gigas* [VU]) (Appendix B) (Specialised Zoological, 2024).

### 2.3.4 Motion Camera Traps

Un-baited Browning Patriot Trail and X-Trail 3CR motion cameras were used to supplement baseline fauna assemblage data and provide information regarding the presence of introduced predators within the survey area. Ten motion cameras were deployed on fence lines around the boundary of the survey site to detect animals utilising the site. Each camera was set to record five images concurrently with no minimum time delay between triggers. All cameras were able to be triggered by movement using highly sensitive, passive infra-red motion sensors that function during the day and night.

### 2.3.5 Active Searches and Opportunistic Fauna Sightings

All proposed impact areas including pads and access tracks were traversed utilised included searching under and around old logs, stumps, and dead free-standing trees, investigating burrows and over-turning logs and stones. Supplementary search effort was undertaken in habitats likely to support significant fauna.

Tracks, burrows, scats, nests, feeding debris and diggings encountered during targeted searches and trap deployment were included in the species inventory for the survey area. Any fauna incidentally encountered while travelling between sites were incorporated into the opportunistic species list for the survey area. Targeted searches were conducted in rocky habitats for secondary evidence of significant fauna (sloughs and scats) and cave floors were inspected for northern quoll and bat scats as well as feeding debris from ghost bats.

## 2.4 STUDY TEAM AND LICENCES

The fauna assessment was planned, coordinated, executed, and reported by those summarised below in Table 5.

**Table 5: Study team and licences.**

Project staff				
Name	Qualification	Experience	Position	Project role
Shaun Grein	B. Sc. Biol.; Grad. Dip. Nat. Resources; MBA	>30 yrs	Managing Director/Senior Principal Scientist	Project management, reporting, QA
Tim McCabe	B.Sc. Env. Biol, Dip Proj Mngment, Cert III Vert Pest Mngment	>15 yrs	Principal Zoologist	Project management, field assessment, reporting, GIS
Thomas Burley	B.Sc. Cons. Biol. & Zool.; MWildlifeHth	>5 yrs	Zoologist	Field assessment

## 2.5 LIMITATIONS AND CONSTRAINTS

An assessment of survey-specific issues and limitations is detailed in Table 6.

**Table 6: Fauna survey limitations.**

Aspect	Limitation?	Comment
Competency/experience of the consultant carrying out the survey.	Nil	The principal zoologist has 15+ years of experience conducting terrestrial vertebrate fauna and avifauna surveys in Western Australia. All other zoologists involved in the fauna survey have 5+ years of experience conducting fauna surveys.
Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions).	Nil	The fauna survey focussed on collecting evidence for significant fauna species that may have the potential to occur in the survey area. The scope was well defined. Fauna and their habitats were surveyed using standardised and well-established techniques.
Proportion of fauna identified, recorded and/or collected.	Nil	The targeted fauna surveys focussed on significant fauna species that may have the potential to occur in the survey area. All fauna taxa observed were identified.
Sources of information (previously available information as distinct from new data).	Nil	Previous surveys conducted were reviewed were available for the area and considered adequate in providing appropriate contextual information for the study.
The proportion of the task achieved and further work which might be needed.	Nil	Planned survey works were conducted and completed. No further work is required to complete the survey scope.
Timing/weather/season/cycle.	Nil	The surveys were conducted during an appropriate time/season.
Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention).	Nil	The surveys were conducted without disturbance and survey effort was not adversely affected by weather events, natural disasters or accidental human intervention.
Intensity (in retrospect was the intensity adequate).	Nil	The survey intensity is considered adequate, and all habitat types were surveyed systematically or opportunistically.
Completeness (e.g. was relevant area fully surveyed).	Nil	All sections of the survey area were accessible during the surveys.
Resources (e.g. degree of expertise available in animal identification to taxon level).	Nil	Resources were adequate to carry out the survey and survey participants were competent in the identification of species. There were no resource issues encountered.
Remoteness and/or access problems.	Nil	There were no issues resulting from remoteness or access.
Availability of contextual (e.g. biogeographic) information on the region.	Nil	Sufficient contextual information was available on the region and the study area.
Efficacy of sampling methods (i.e. any groups not sampled by survey methods).	Nil	Sampling methods are considered adequate for basic and targeted vertebrate fauna surveys.

## 3 RESULTS AND DISCUSSION

### 3.1 FAUNA HABITAT

Fauna habitat assessments were undertaken at all 10 sites within the survey area to describe the fauna habitat types with the potential to support significant fauna species. Three main habitat types were recognised and align with those outlined by Eco Logical Australia (2021) including:

- Mixed open woodland over grassland on sandy clay flats and slopes;
- Mixed open woodland over tussock grasses on dune slopes and crests; and
- Eucalypt open woodland and mixed shrubland on closed depression and creek line.

The habitat types found within the proposed pads and associated access roads are considered common at a local and regional scale and none are restricted to the project area. Fauna habitat assessment sheets for each of the 10 pads are provided in Appendix C.

Mixed open woodland over tussock grasses on dune slopes and crests habitat type provides suitable substrates for burrowing and suitable foraging opportunities for the greater bilby. The remaining habitat types are not considered critical for significant fauna.

Rocky habitats known to provide shelter, denning and roosting habitat for northern quoll and ghost bat and considered critical for their survival are not present within the project area. Additionally, major drainage lines considered as dispersal habitat were not recorded.

### 3.2 SIGNIFICANT FAUNA ASSESSMENT

#### 3.2.1 Bilby (*Macrotis lagotis*) – Vulnerable EPBC Act and BC Act

##### **Distribution and habitat**

Once common over 70% of mainland Australia's arid and semiarid regions, the bilby is now patchily distributed through the Tanami, Great Sandy and Gibson Deserts (Maxwell, Burbidge, & Morris, 1996). Isolated populations also occur in south-west Queensland and to the north-east of Alice Springs. The species experienced a sudden and widespread population reduction in the early 1900s, and the distribution is believed to still be contracting northwards (Threatened Species Scientific Committee, 2016a). Since the 1800s, the bilby has experienced dramatic population reductions to the extent that it now occupies less than 20% of its former range (Threatened Species Scientific Committee, 2016a). The bilby occupies a variety of habitats, including open tussock grasslands, Acacia (mulga) shrubland and woodlands, hummock grasslands on plains and alluvial areas and cracking clays (Johnson, 2008; Maxwell et al., 1996; Threatened Species Scientific Committee, 2016a).

The bilby is a medium-sized nocturnal marsupial with soft, silky fur (Pavey, 2006). Bilbies are solitary animals which are predominantly nocturnal and shelter in burrows during the day (Threatened Species Scientific Committee, 2016a). This species has strong forelimbs and claws which are used to construct extensive tunnel systems up to 3 m long and 1.8 m deep. The diet of this species is highly specialised and it uses its long tongue to feed on seeds, insects, bulbs, fruit and fungi (Johnson, 2008). Reproduction is dependent on seasonal conditions and resource availability and litters consist of one to three offspring (Threatened Species Scientific Committee, 2016a). Females reach reproductive maturity at five months and males mature three months later (Threatened Species Scientific Committee, 2016a).

Reasons for historical decline included predation by feral predators on both young and adult bilbies, competition from rabbits and livestock, reduced food as a result of changed fire regimes, and drought (Johnson, 2008; Maxwell et al., 1996; O'Malley, 2006). Current threats impacting

bilby population numbers are identical to historical threats, with the addition of habitat loss and fragmentation due to land clearing and development.

### **Occurrence within the project area**

*ecologia* recorded potential old bilby diggings at the base of shrubs at Proposed Well 4 and Proposed Well 3 (Map 2). These potential old diggings suggest that bilbies have previously foraging within the area. According to the guidelines, old diggings on their own does not confirm presence and are considered as “potential bilby activity, presence not confirmed”. According to Dziminski and Carpenter (2018) only three types of sign provide definitive evidence of the presence of bilbies:

- Tracks
- Scats
- Multiple diggings into the base of Acacia shrubs where grubs are accessed.

After considerable survey effort in the vicinity of the potential diggings, no additional distinctive secondary or primary signs were recorded to confirm the presence of bilby within the project area.

Traditional custodian Tyrone Skinner indicated that bilbies are generally seen south of the Fitzroy River in the sandy country and not regularly encountered within the vicinity of the project area.

### **3.2.2 Northern Quoll (*Dasyurus hallucatus*) – Vulnerable EPBC Act and BC Act**

#### **Distribution and habitat**

The northern quoll once ranged contiguously across the north of Australia but is now restricted to six separate land units including the Pilbara (Department of the Environment, 2019). A 75% reduction of available habitat occurred during the 20<sup>th</sup> century and the species is now restricted to the Pilbara and northern Kimberley in Western Australia, with a few discrete populations across the Northern Territory and eastern Queensland (Braithwaite & Griffiths, 1994). The Pilbara is regarded as the stronghold population for the species given that the cane toad is not expected to make its way across the desert into parts of the Pilbara (Woinarski, Burbidge, & Harrison, 2014).

Preferred habitat for the northern quoll is rocky escarpments, but it also inhabits riverine habitats (Woinarski et al., 2014). Rocky habitats with rock crevices and caves support higher densities of northern quoll (S. van Dyck & R. Strahan, 2008; Woinarski et al., 2014). Predominantly inhabiting dissected rocky escarpments, a male quoll can have a home range of more than 100 ha while a female occupies territories of up to 35 ha (Steve Van Dyck & Ronald Strahan, 2008). This species exhibits both arboreal and terrestrial tendencies and utilises den sites in rock crevices, tree hollows, logs, termite mounds and goanna burrows (Oakwood, 2008).

Northern quoll populations considered important for the long-term survival of this species are outlined by the (Commonwealth of Australia, 2016) in the EPBC referral guidelines for the northern quoll. Populations important for the long-term survival of this species include:

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

The EPBC referral guidelines define a high-density population as being characterised by numerous camera triggers by multiple individuals at multiple sites and or traps (Commonwealth of Australia, 2016). A low density population is defined as on which is characterised by infrequent captures of one or two individuals which are confined to one or two sites or where no individuals have been trapped but latrine evidence is present (Commonwealth of Australia, 2016).

The EPBC referral guidelines for the northern quoll also outline habitat critical to the survival of the species (Commonwealth of Australia, 2016). Critical habitat for this species is outlined below:

- offshore islands where the northern quoll is known to exist;
- rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines or treed creek lines; and
- structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs.

Dispersal and foraging habitat which is associated with or connects populations important for long-term survival of the species are also considered critical habitat for the northern quoll (Commonwealth of Australia, 2016).

#### **Occurrence within the project area**

No habitats considered critical for the northern quoll were identified within the survey area and no dispersal habitat was recorded. It is considered highly unlikely that this species will be recorded within the project area with the nearest known records are greater than 100 km to the north in the Devonian Reef rocky habitats.

Traditional custodian Tyrone Skinner indicated that northern quolls have never been observed on Yungngora country or in the vicinity of the project area.

### **3.2.3 Ghost Bat (*Macrotis lagotis*) – Vulnerable EPBC Act and BC Act**

#### **Distribution and habitat**

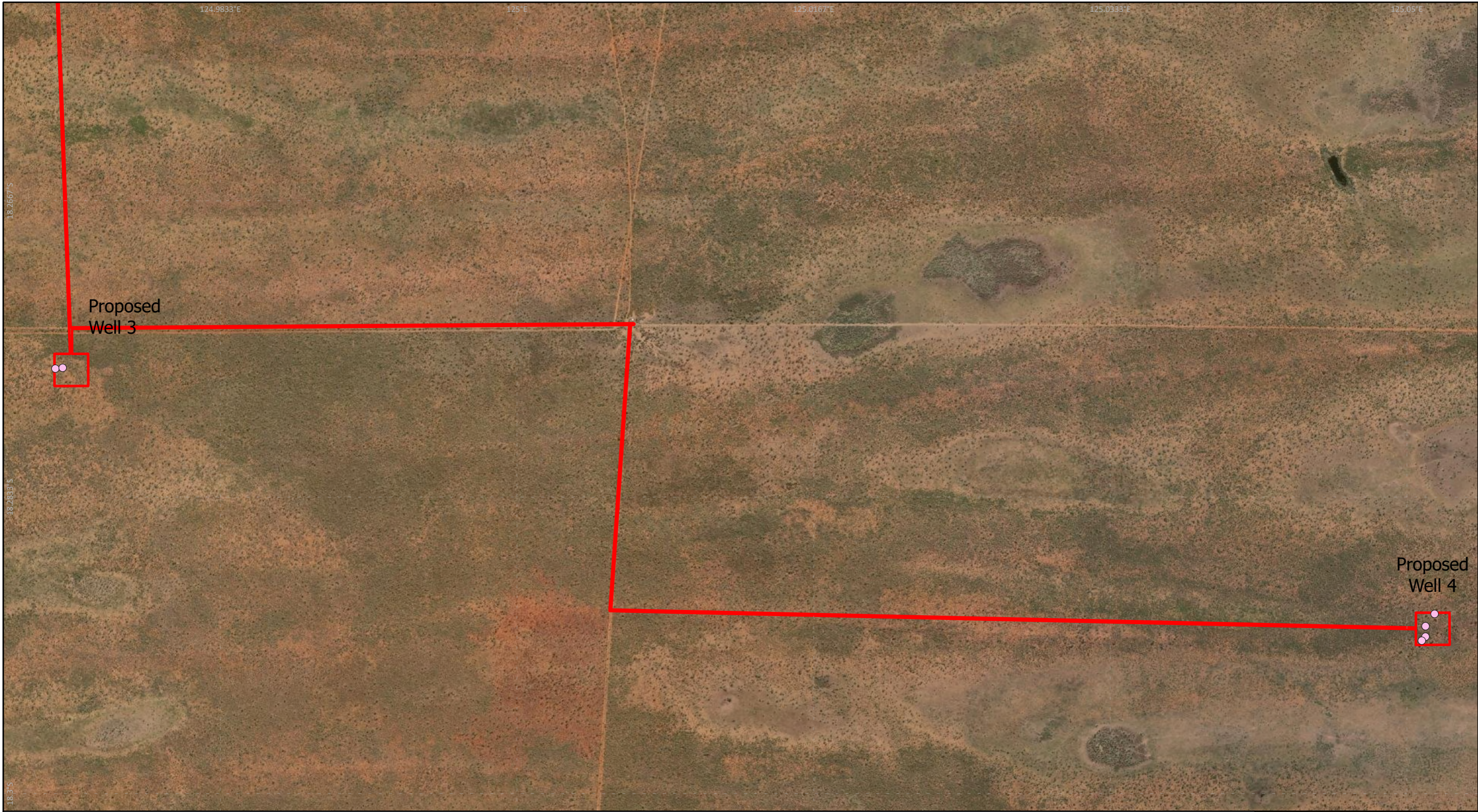
The ghost bat was historically distributed across much of Australia but now has a patchy but widespread distribution restricted to northern Australia (Threatened Species Scientific Committee, 2016b). Following European settlement, the distribution of this species contracted northward with arid zone populations undergoing the greatest contractions (Threatened Species Scientific Committee, 2016b). Ghost bat populations are highly structured and are considered to be genetically distinct at both local and regional scales (Threatened Species Scientific Committee, 2016b).

Ghost bats are known to move between a number of caves seasonally or as dictated by weather conditions (Hutson, Mickleburgh, & Racey, 2001) and disperse widely when not breeding but concentrate in a relatively few roost sites when breeding (Threatened Species Scientific Committee, 2016b).

The ghost bat is the largest microchiropteran bat in Australia, is strictly carnivorous and captures its prey mainly on the ground before returning to an established feeding site to devour its catch (Steve Van Dyck & Ronald Strahan, 2008). The diet of this species includes amphibians, reptiles, birds, small terrestrial mammals, insects and other bats (Steve Van Dyck & Ronald Strahan, 2008). Unlike other microchiropteran bat species, the ghost bat does not continuously call whilst in flight and instead uses its eyes and ears to scan for prey (Steve Van Dyck & Ronald Strahan, 2008). Females reach reproductive maturity between two and three years of age (Hoyle, Pople, & Toop, 2001).

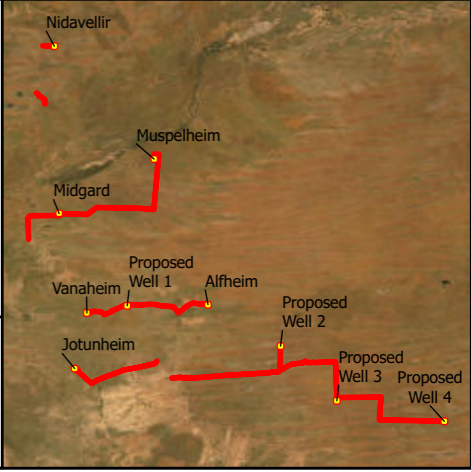
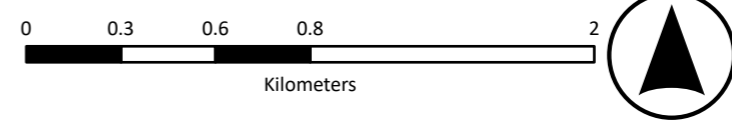
#### **Occurrence within the project area**

No rocky habitats suitable for roosting were recorded and no calls indicating social interaction or echolocation were recorded within the surveyed areas. It is considered highly unlikely that ghost bats will utilise any habitats within the survey area.



Disturbance footprint
 
● Bilby digging

**Map 2:** Location of significant fauna evidence within the survey area.



## 4 CONCLUSIONS

The key conclusions from the terrestrial vertebrate fauna assessment of the survey area are as follows:

- Three fauna habitat types were identified within the survey area.
- The habitat in the south-east between Proposed Well 3 and Proposed Well 4 is considered the most suitable for bilbies. Potential old bilby diggings were recorded at the base of shrubs at Proposed Well 4 and Proposed Well 3. These potential old diggings suggest that bilbies may have previously foraged within the area. According to the guidelines, on their own old diggings do not confirm presence and are considered as “potential bilby activity, presence not confirmed”. To confirm presence, there would need to find scats, active burrows or tracks (fresh, very distinctive). After considerable survey effort in the vicinity of the diggings, none of those were found.
- The remaining eight pads did not provide suitable habitat for bilbies.
- No rocky habitats considered as critical habitat (roosting or denning) for the ghost bat and northern quoll were identified and no major drainage lines considered as dispersal habitat were identified. It is considered unlikely that northern quolls and ghost bats will utilise any of the habitats found within the disturbance footprint.
- Motion cameras did not record any northern quolls.
- Analysis of autonomous recordings indicated that no significant bat species were recorded within the proposed well pads.

## 5 REFERENCES

- Braithwaite, R. W., & Griffiths, A. (1994). Demographic variation and range contraction in the northern quoll *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Wildlife Research*, 21, 203-217.
- Commonwealth of Australia. (2016). EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus*. In. Department of the Environment <http://www.environment.gov.au/system/files/resources/d7e011a7-bf59-40ed-9387-9afcb8d590f8/files/referral-guideline-northern-quoll.pdf>.
- DBCAs. (2017). *Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia*. Retrieved from
- Department of the Environment. (2019). *Dasyurus hallucatus* in Species Profile and Threats Database. Retrieved from <http://www.environment.gov.au/sprat>
- DSEWPaC. (2010). Survey Guidelines for Australia's Threatened Bats. Department of Sustainability, Environment, Water, Population and Communities.
- DSEWPaC. (2011). Survey guidelines for Australia's Threatened Mammals. Department of Sustainability, Environment, Water, Population and Communities.
- Dziminski, M. A., & Carpenter, F. M. (2018). *The conservation and management of the bilby (Macrotis lagotis) in the Pilbara*. Perth.
- Eco Logical Australia. (2021). Valhalla Flora and Fauna Survey. In.
- EPA. (2016). *Environmental Factor Guideline: Terrestrial Fauna*. Perth, Western Australia: Environmental Protection Authority.
- EPA. (2020). *Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Western Australia: Environmental Protection Authority.
- Hoyle, S. D., Pople, A. R., & Toop, G. J. (2001). Mark-recapture may reveal more about ecology than about population trends: Demography of a threatened ghost bat (*Macroderma gigas*) population. *Austral Ecology*, 26, 80-92.
- Hutson, A. M., Mickleburgh, S. P., & Racey, P. A. (2001). Microchiropteran Bats: Global Status Survey and Action Plan. *Macroderma gigas*. *IUCN Red List of Threatened Species*. Retrieved from [www.iucnredlist.org](http://www.iucnredlist.org)
- International Union for Conservation of Nature. (2014). Guidelines for using the IUCN Red List Categories and Criteria, Version 11. Prepared by the IUCN Standards and Petitions Subcommittee. Downloadable from <http://www.iucnredlist.org/documents/RedListGuidelines.pdf>. In.
- Johnson, K. A. (2008). Bilby, *Macrotis lagotis*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (pp. 191-193). Sydney: Reed New Holland.
- Maxwell, S., Burbidge, A. A., & Morris, K. D. (Eds.). (1996). *The 1996 Action Plan for Australian Marsupials and Monotremes*. Canberra: Wildlife Australia.
- O'Malley, C. (2006). Australian Threatened Species, Greater Bilby, *Macrotis lagotis*.
- Oakwood, M. (2008). Northern Quoll, *Dasyurus hallucatus*. In S. van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (3rd edition ed., pp. 57-59). Sydney: Reed New Holland.
- Pavey, C. (2006). *Threatened Species of the Northern Territory: Greater Bilby Macrotis lagotis*. Parks and Wildlife Commission - Northern Territory Government.

- Specialised Zoological. (2024). Acoustic analysis and bat call identification from Valhalla, Western Australia. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 22 August 2024, project reference SZ747. In: Specialised Zoological.
- Threatened Species Scientific Committee. (2016a). Conservation advice for *Macrotis lagotis* (greater bilby).
- Threatened Species Scientific Committee. (2016b). *Macroderma gigas* (ghost bat) Conservation Advice,.
- van Dyck, S., & Strahan, R. (2008). *The Mammals of Australia* (Third ed.). Sydney, New South Wales: Australian Museum Trust and Queensland Museum.
- Van Dyck, S., & Strahan, R. (2008). *The Mammals of Australia*. In (3rd edition ed.). Sydney: Reed New Holland.
- Woinarski, J. C. Z., Burbidge, A. A., & Harrison, P. L. (2014). *The Action Plan for Australian Mammals 2012*. Collingwood, Victoria: CSIRO Publishing.

## 6 APPENDICES

## Appendix A Definitions.

## SIGNIFICANT FAUNA

According to the *EPA Factor Guideline: Terrestrial Fauna* (EPA, 2016) animal taxa (or records) may be considered significant for a number of reasons including, but not restricted to, the following:

A taxon listed as 'Threatened' under the Biodiversity Conservation Act 2016 (WA) or the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth);

- A taxon on the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Fauna List;
- Species with restricted distributions;
- Degree of historical impact from threatening processes;
- Providing an important function required to maintain the ecological integrity of a significant ecosystem.

### **Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Cwlth)**

At a Commonwealth level, Threatened species are protected under the EPBC Act, which lists species in accordance with the criteria of the International Union for Conservation of Nature (International Union for Conservation of Nature, 2014), that is, 'Critically Endangered', 'Endangered', 'Vulnerable', 'Conservation Dependant', 'Extinct', or 'Extinct in the Wild' (see <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora> and <http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=fauna>).

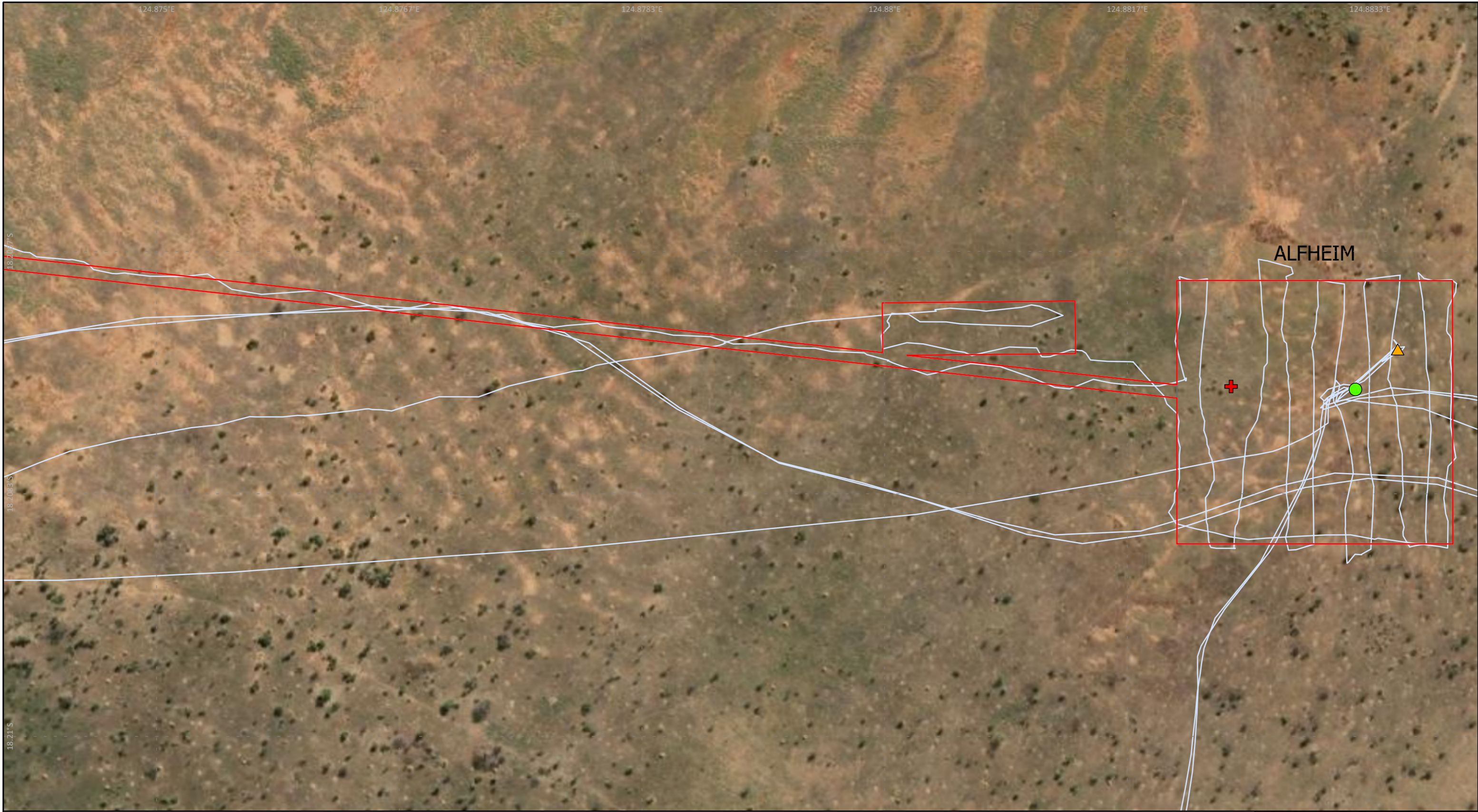
### **Biodiversity Conservation Act 2016 (Western Australia)**

At a State level, Threatened species are protected under the BC Act. These are taxa which have been adequately surveyed and are deemed to be either rare, in danger of extinction, or otherwise in need of special protection in the wild and are gazetted as Threatened (Declared Rare) Flora. Threatened species are further categorised by the Department of Biodiversity, Conservation and Attractions (DBCA) according to their level of threat using the International Union for Conservation of Nature (IUCN) red list criteria ((International Union for Conservation of Nature, 2014) (see <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities> for definitions).

### **Priority Fauna (DBCA)**

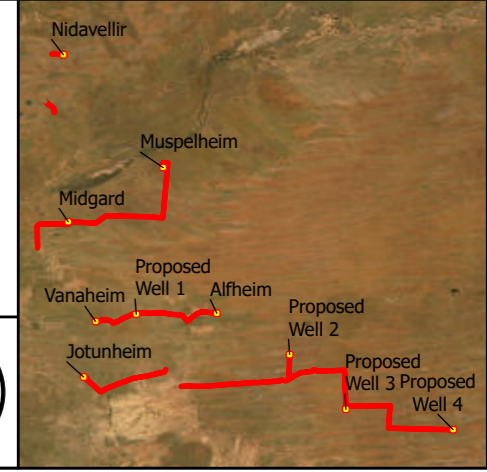
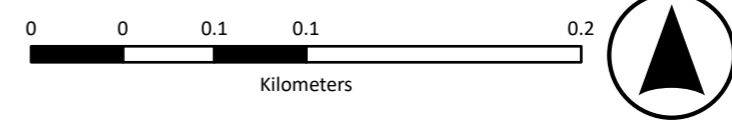
The DBCA maintains a list of Priority species, which are considered poorly known, uncommon or under threat but for which there is insufficient justification to be listed as Threatened, based on known distribution and population sizes. Priority species are assigned to one of four categories, described below. DBCA listed Priority species do not have any statutory protection (see <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants> for definitions.)

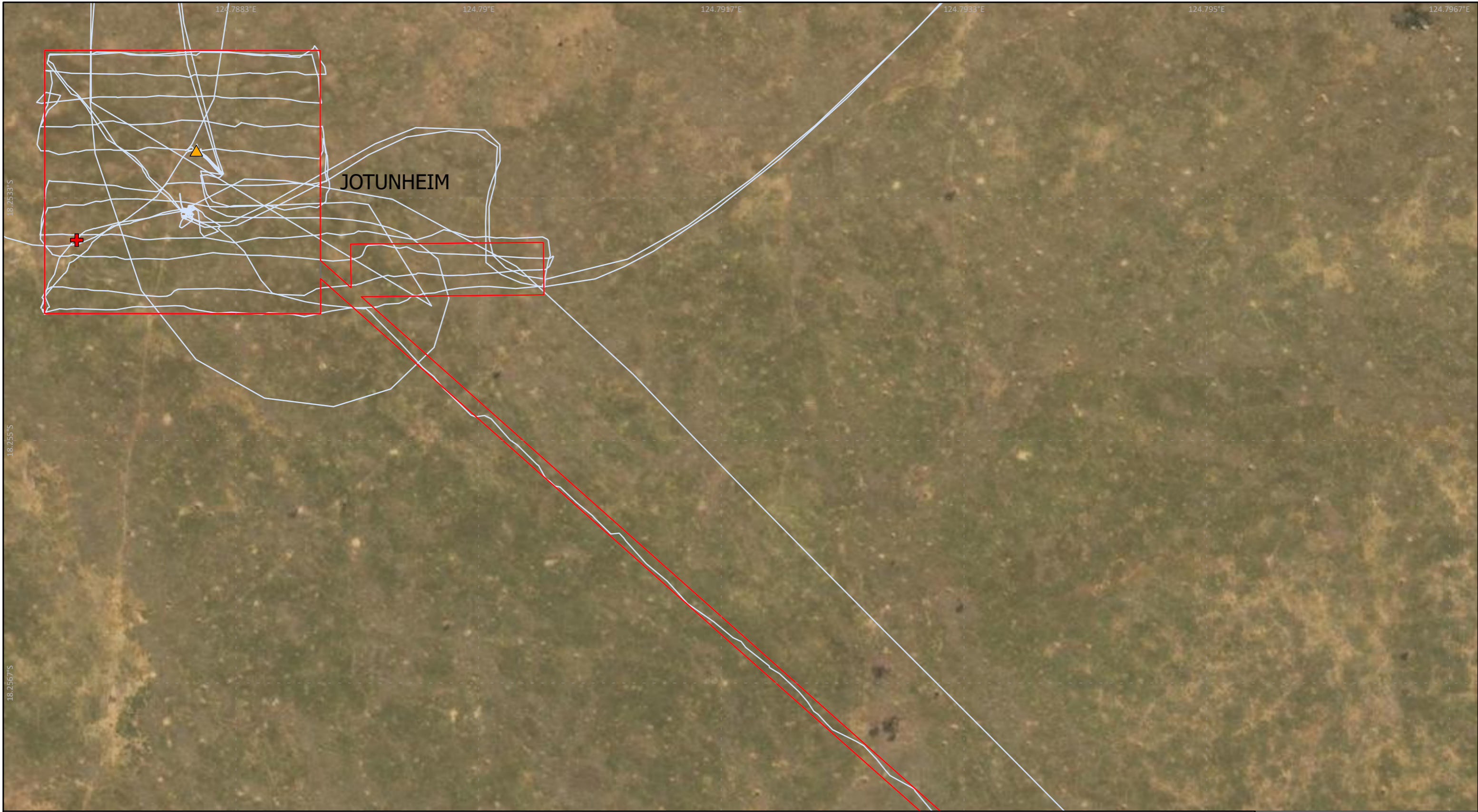
**Appendix B Location of all survey sites and search transects.**



- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

**Map 4:** Location of all survey sites and search transects.

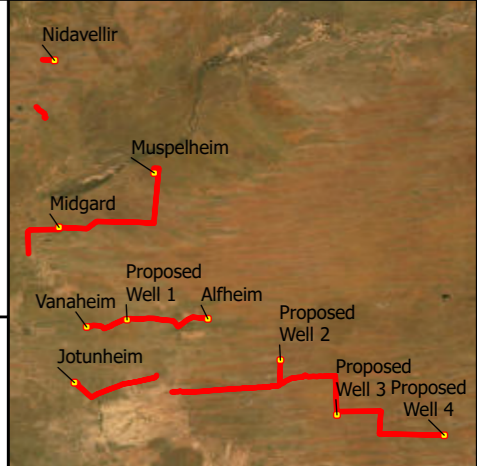
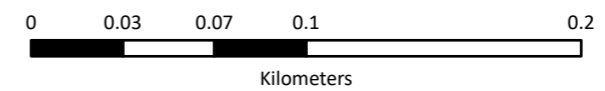


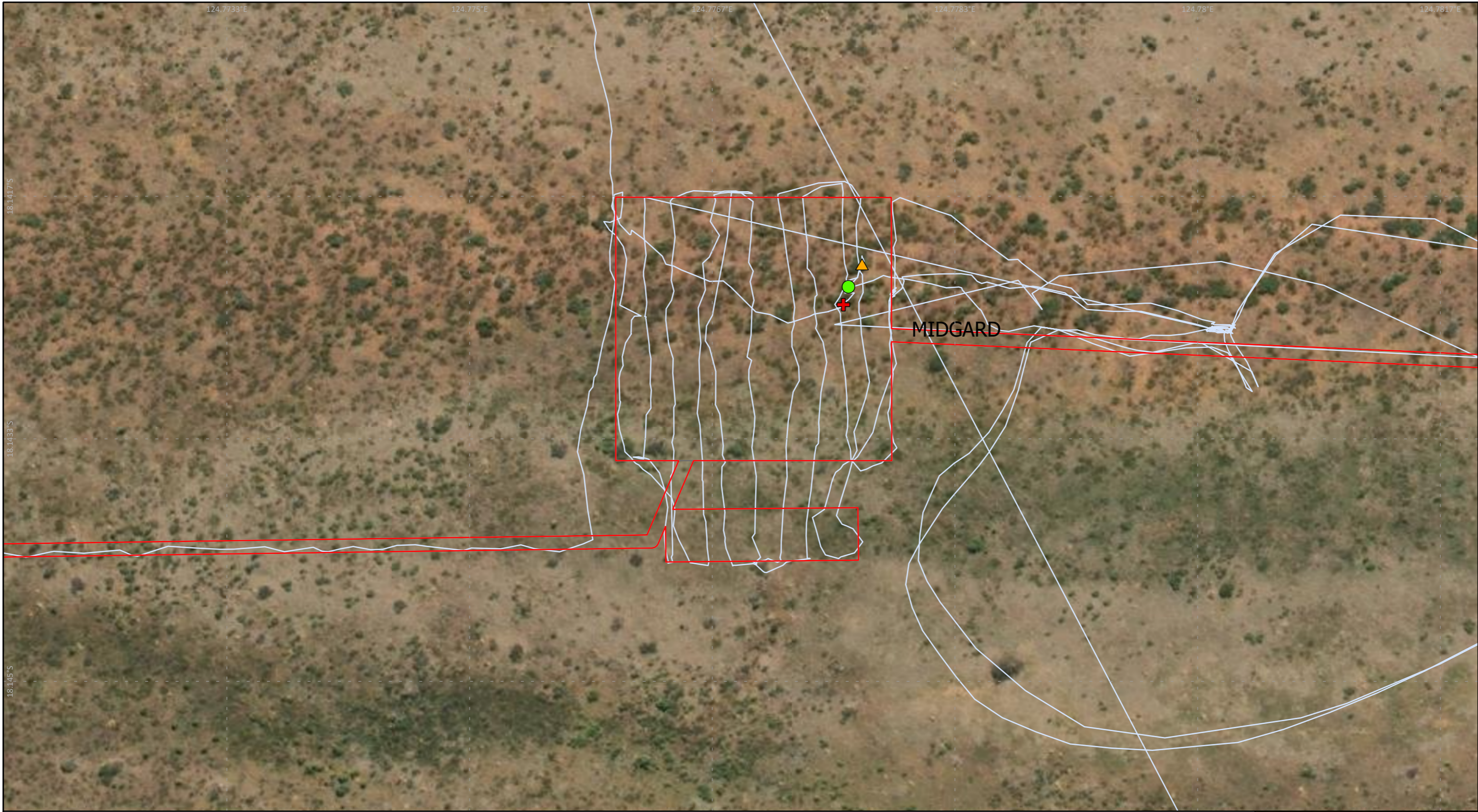


JOTUNHEIM

- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

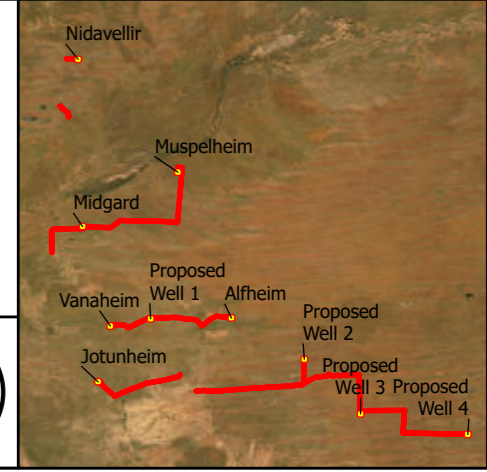
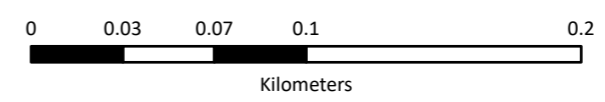
**Map 4:** Location of all survey sites and search transects.

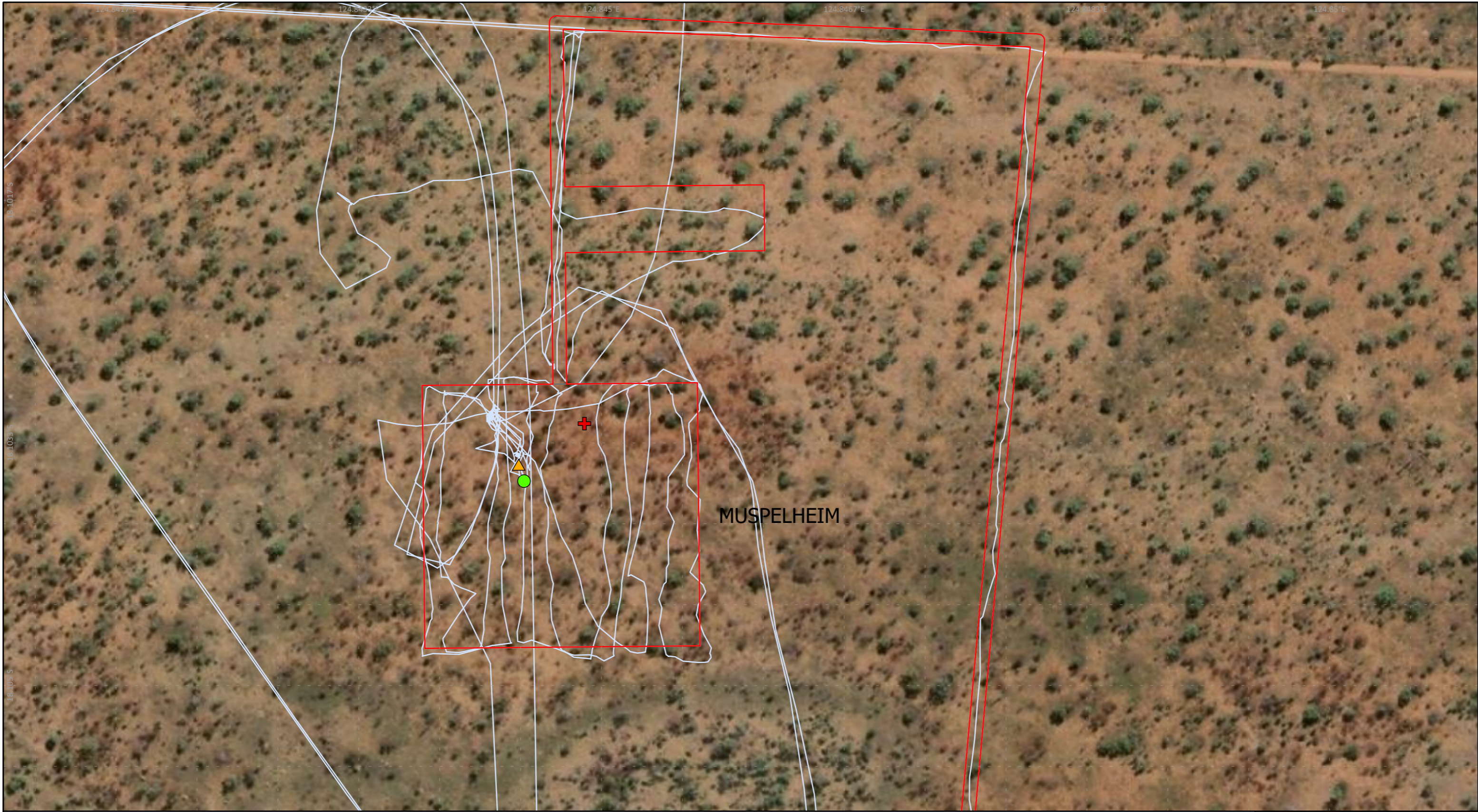




- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

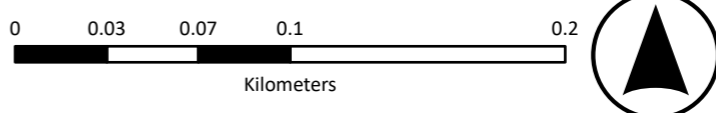
**Map 4:** Location of all survey sites and search transects.





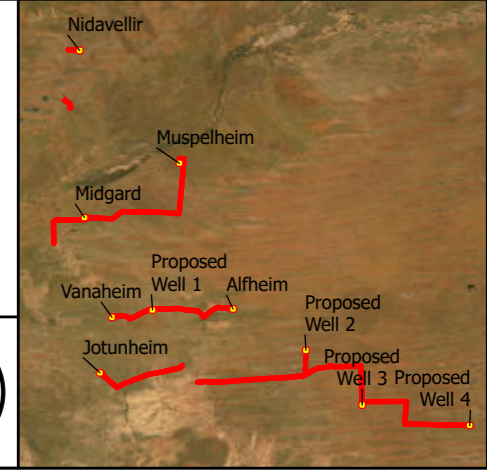
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- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

**Map 4:** Location of all survey sites and search transects.

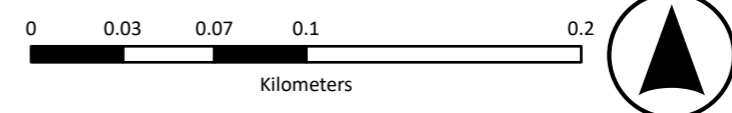


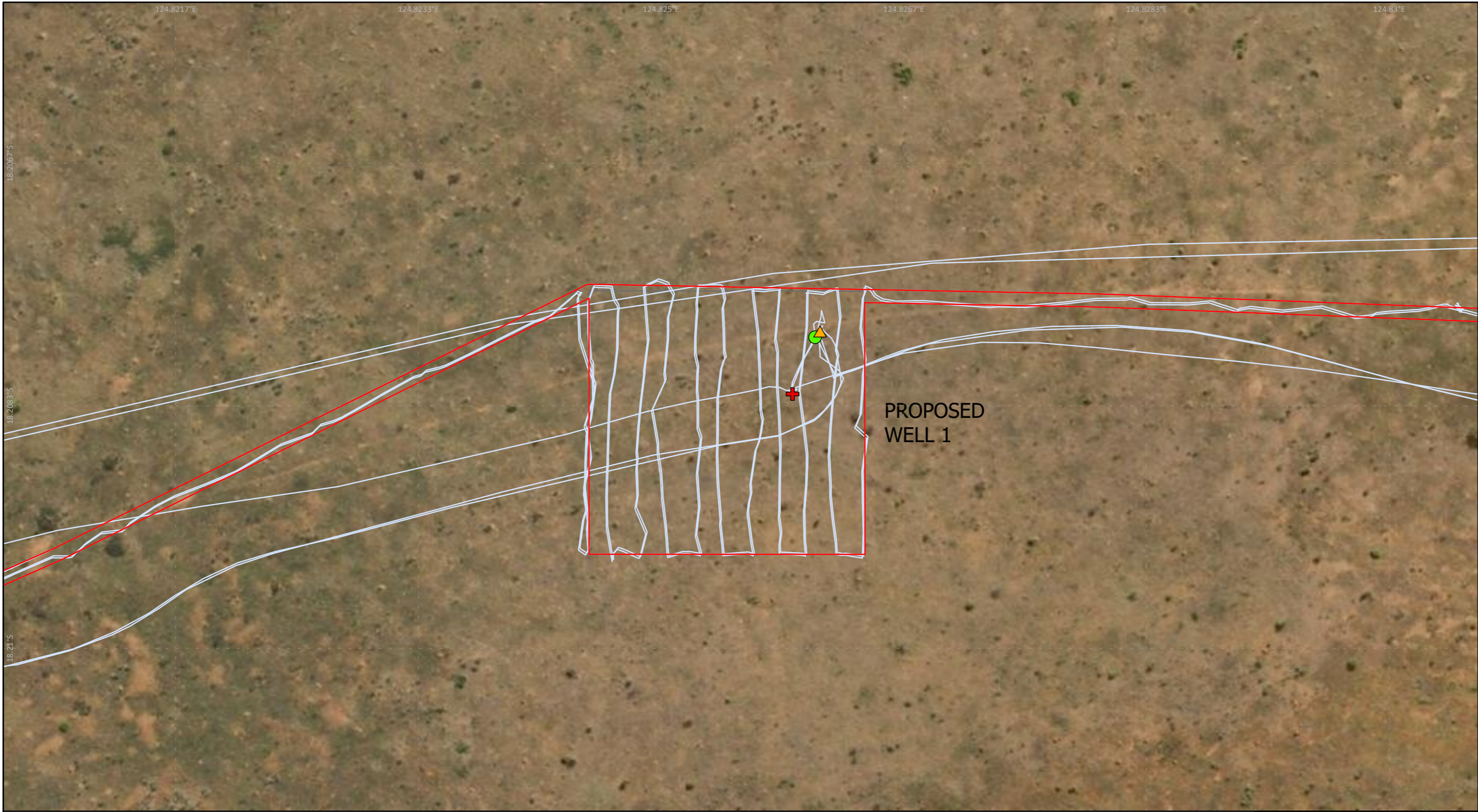


- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks



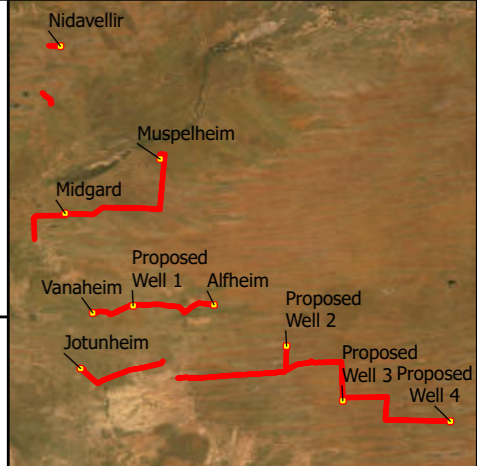
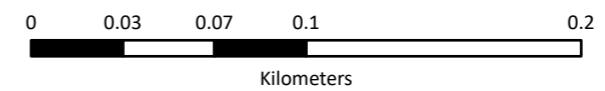
**Map 4:** Location of all survey sites and search transects.

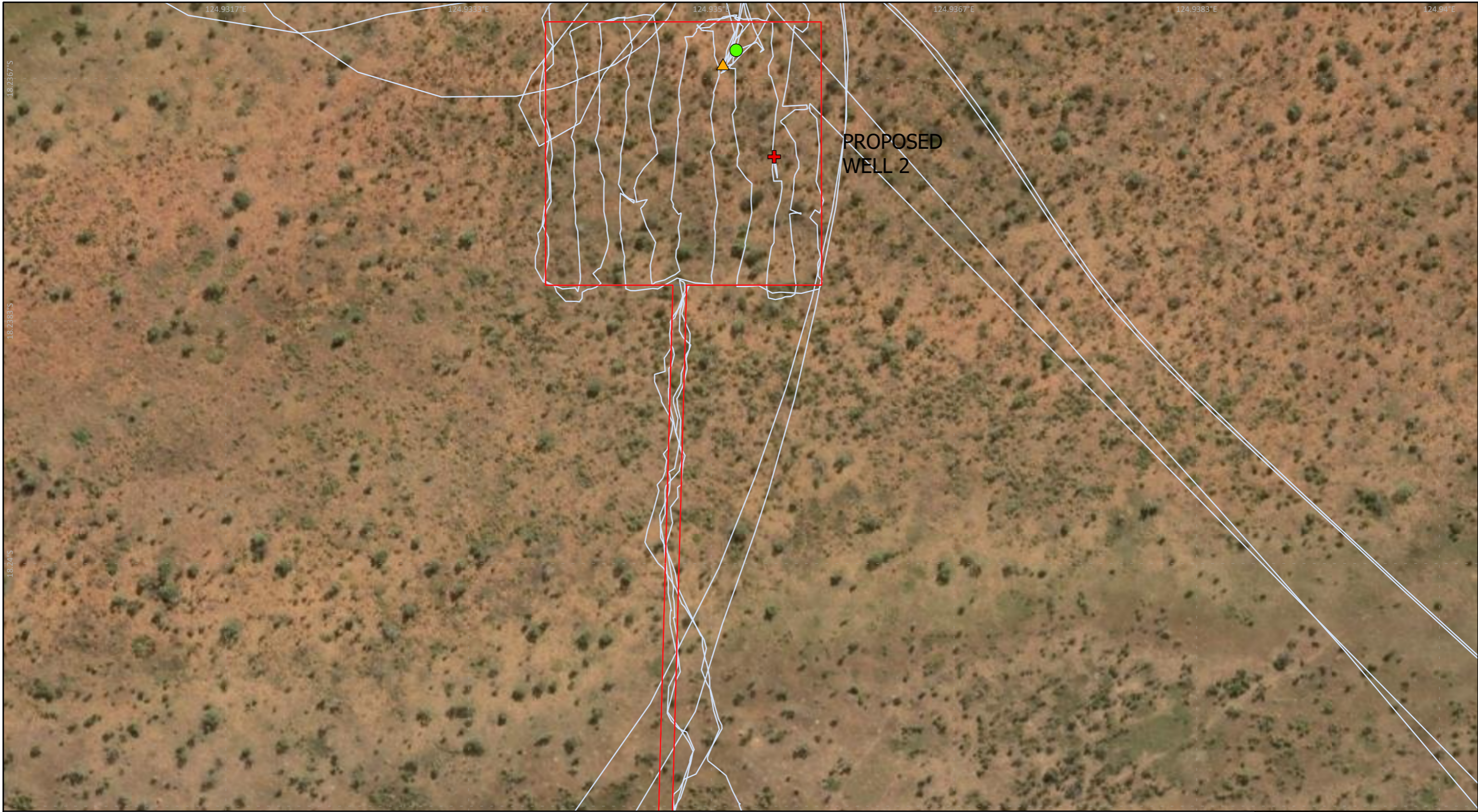




- Disturbance footprint
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- ARU
- + Habitat assessment
- Survey effort tracks

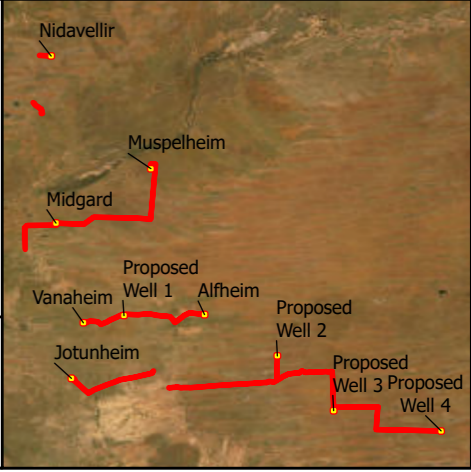
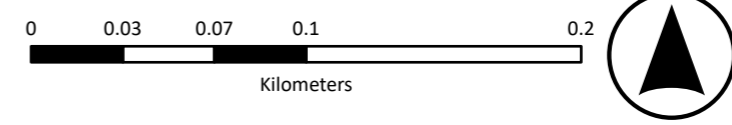
**Map 4:** Location of all survey sites and search transects.





- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

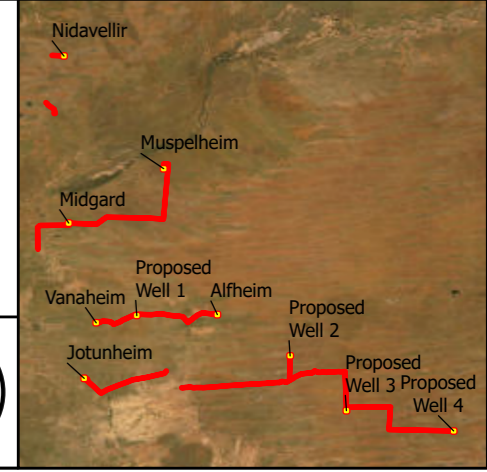
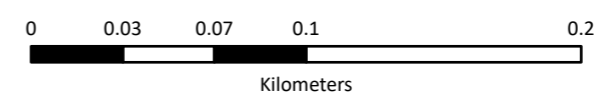
**Map 4:** Location of all survey sites and search transects.





- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

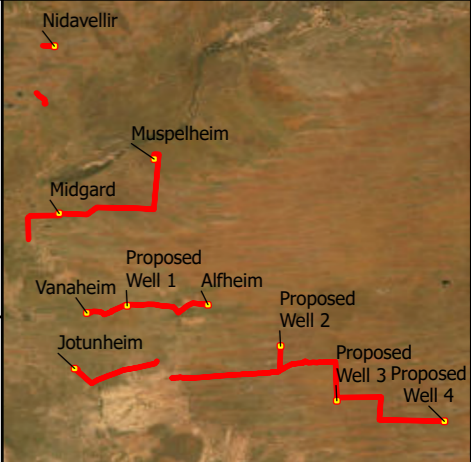
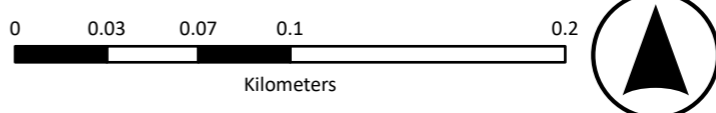
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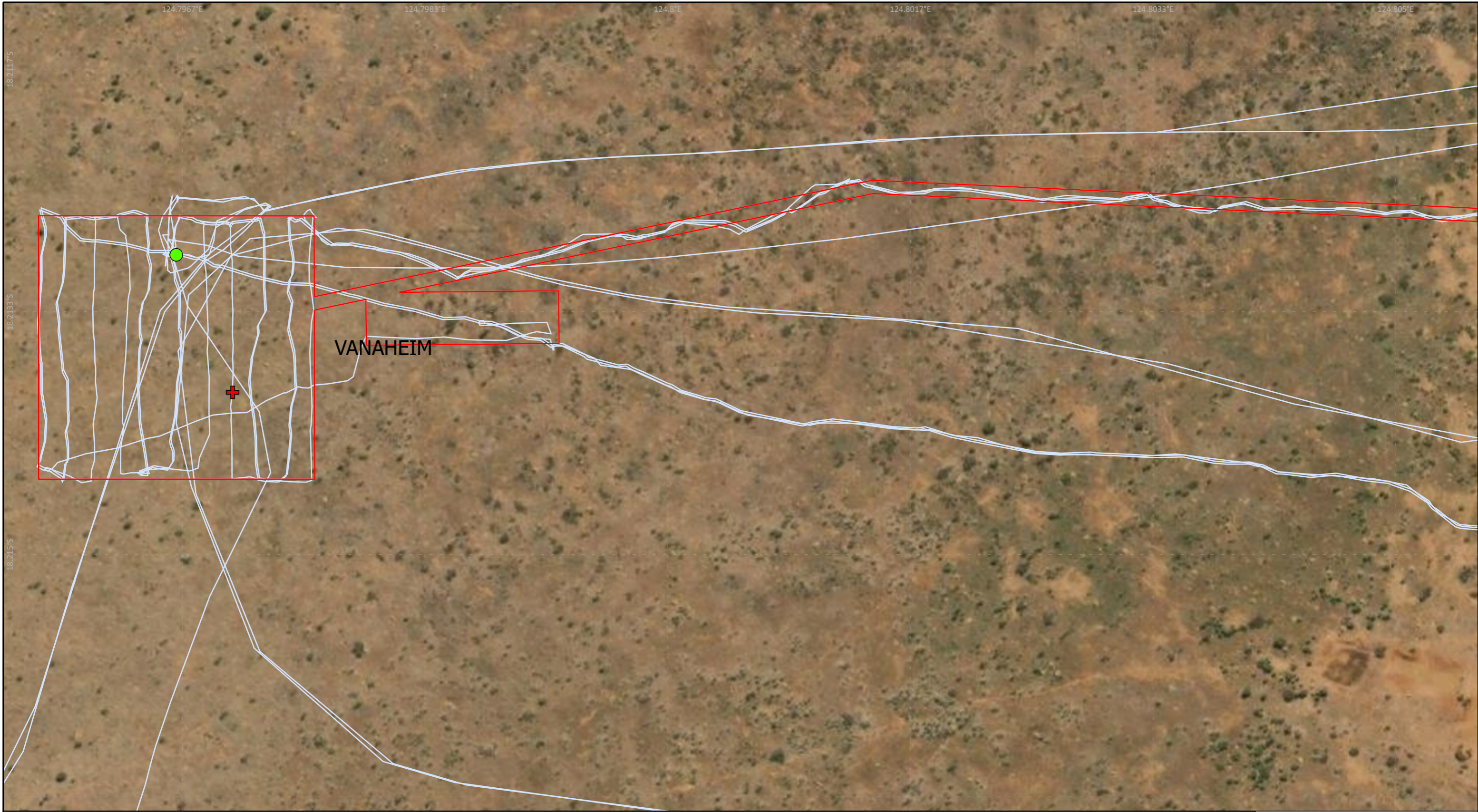




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- Survey effort tracks

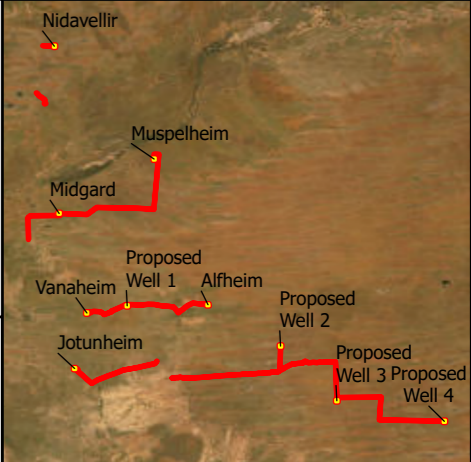
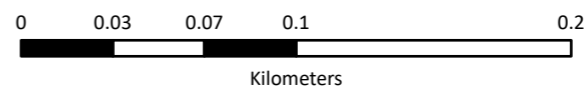
**Map 4:** Location of all survey sites and search transects.





- Disturbance footprint
- ▲ Motion camera
- ARU
- + Habitat assessment
- Survey effort tracks

**Map 4:** Location of all survey sites and search transects.



## Appendix C Fauna habitat assessment sheets

# Nidaviller

Date	23/07/2024		
Site type	Habitat assessment		
Coordinate	124.7734°E -18.0235°S		
Habitat type	Open woodland		
Habitat description	Open eucalypt woodland over scattered shrubs over spinifex on sandy substrates. Termite mounds are main habitat feature.		
Habitat condition	Very Good		
Suitability for significant species	No		
Evidence of significant species	No		
Disturbance	Evidence of longterm cattle use		
Time since fire	1 – 2 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	Landform (other)	
Slope	Negligible	Aspect	NA
Soil colour	Light brown	Soil texture	Sand
Bare soil	10 – 30	Drainage	NA
Rock type	NA	Rock size	NA
Rock abundance	NA		
Upper stratum	Open woodland		
Middle stratum	Scattered shrubs		
Lower stratum	Open hummock grassland		



# Midgard

Date	23/07/2024		
Site type	Habitat assessment		
Coordinate	124.7775°E -18.1424°S		
Habitat type	Open shrubland		
Habitat description	Scattered trees and boats over open shrubland over hummock grassland on sandy loam substrates.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	No		
Disturbance	Evidence of longterm cattle use		
Time since fire	1 – 2 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Small hollows		
Landform	Undulating plain	<b>Landform (other)</b>	
Slope	Negligible	<b>Aspect</b>	NA
Soil colour	Orange	<b>Soil texture</b>	Sandy loam
Bare soil	30 – 70	<b>Drainage</b>	NA
Rock type	NA	<b>Rock size</b>	NA
Rock abundance	NA		
Upper stratum	Scattered trees		
Middle stratum	Tall open shrubland		
Lower stratum	Open hummock grassland		



# Jotunheim

Date	24/07/2024		
Site type	Habitat assessment		
Coordinate	124.7872°E -18.2536°S		
Habitat type	Hummock/Tussock Grassland		
Habitat description	Hummock grassland with scattered boabs on clay loams with an abundance of termite mounds.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	No		
Disturbance	Evidence of longterm cattle use		
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	<b>Landform (other)</b>	
Slope	Negligible	<b>Aspect</b>	NA
Soil colour	Light brown	<b>Soil texture</b>	Sandy clay loam
Bare soil	30 – 70	<b>Drainage</b>	NA
Rock type	NA	<b>Rock size</b>	NA
Rock abundance	NA		
Upper stratum	Scattered trees		
Middle stratum	Scattered shrubs		
Lower stratum	Hummock and tussock grassland		



# Alfheim

Date	26/07/2024		
Site type	Habitat assessment		
Coordinate	124.8823°E -18.2075°S		
Habitat type	Hummock/Tussock Grassland		
Habitat description	Hummock grassland with on clay loams with an abundance of termite mounds.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	No		
Disturbance	Evidence of longterm cattle use		
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	<b>Landform (other)</b>	
Slope	Negligible	<b>Aspect</b>	NA
Soil colour	Light brown	<b>Soil texture</b>	Sandy clay loam
Bare soil	30 – 70	<b>Drainage</b>	NA
Rock type	NA	<b>Rock size</b>	NA
Rock abundance	NA		
Upper stratum			
Middle stratum	Scattered shrubs		
Lower stratum	Hummock and tussock grassland		



# Vanaheim

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Date	26/07/2024		
Site type	Habitat assessment		
Coordinate	124.797°E -18.2138°S		
Habitat type	Grassland		
Habitat description	Hummock and tussock grassland with on clay loams with an abundance of termite mounds.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	No		
Disturbance	Evidence of longterm cattle use		
Time since fire	2 – 5 yrs		
Leaf litter cover	< 10		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	No		
Tree hollows	No		
Landform	Plain	<b>Landform (other)</b>	
Slope	Negligible	<b>Aspect</b>	NA
Soil colour	Light brown	<b>Soil texture</b>	Sandy clay loam
Bare soil	30 – 70	<b>Drainage</b>	NA
Rock type	NA	<b>Rock size</b>	NA
Rock abundance	NA		
Upper stratum			
Middle stratum	Scattered shrubs		
Lower stratum	Hummock and tussock grassland		



# Muspelheim

<b>Date</b>	27/07/2024		
<b>Site type</b>	Habitat assessment		
<b>Coordinate</b>	124.8448°E -18.1032°S		
<b>Habitat type</b>	Open woodland		
<b>Habitat description</b>	Open eucalypt woodland and baobs over scattered shrubs over spinifex on sandy substrates. Termite mounds present.		
<b>Habitat condition</b>	Very Good		
<b>Suitability for significant species</b>	No		
<b>Evidence of significant species</b>	No		
<b>Disturbance</b>	Evidence of longterm cattle use		
<b>Time since fire</b>	1 – 2 yrs		
<b>Leaf litter cover</b>	< 10		
<b>Woody debris</b>	< 10		
<b>Rocky crevices/caves</b>	NA		
<b>Large trees</b>	No		
<b>Tree hollows</b>	No		
<b>Landform</b>	Plain	<b>Landform (other)</b>	
<b>Slope</b>	Negligible	<b>Aspect</b>	NA
<b>Soil colour</b>	Light brown	<b>Soil texture</b>	Sand
<b>Bare soil</b>	10 – 30	<b>Drainage</b>	NA
<b>Rock type</b>	NA	<b>Rock size</b>	NA
<b>Rock abundance</b>	NA		
<b>Upper stratum</b>	Open woodland		
<b>Middle stratum</b>	Scattered shrubs		
<b>Lower stratum</b>	Tussock grass land / sedgeland / herbland		



# Proposed Well 1

<b>Date</b>	28/07/2024		
<b>Site type</b>	Habitat assessment		
<b>Coordinate</b>	124.8259°E -18.2082°S		
<b>Habitat type</b>	Grassland		
<b>Habitat description</b>	Scattered trees over open shrubland over tussock and hummock grasses with an abundance of termite mounds.		
<b>Habitat condition</b>	Good		
<b>Suitability for significant species</b>	No		
<b>Evidence of significant species</b>	No		
<b>Disturbance</b>	Evidence of longterm cattle use		
<b>Time since fire</b>	1 – 2 yrs		
<b>Leaf litter cover</b>	< 10		
<b>Woody debris</b>	< 10		
<b>Rocky crevices/caves</b>	NA		
<b>Large trees</b>	No		
<b>Tree hollows</b>	No		
<b>Landform</b>	Plain	<b>Landform (other)</b>	
<b>Slope</b>	Negligible	<b>Aspect</b>	NA
<b>Soil colour</b>	Light brown	<b>Soil texture</b>	Sandy clay loam
<b>Bare soil</b>	30 – 70	<b>Drainage</b>	NA
<b>Rock type</b>	NA	<b>Rock size</b>	NA
<b>Rock abundance</b>	NA		
<b>Upper stratum</b>	Scattered low trees		
<b>Middle stratum</b>	Open shrubland		
<b>Lower stratum</b>	Open tussock grassland / sedgeland / herbland		



# Proposed Well 2

Date	24/07/2024		
Site type	Habitat assessment		
Coordinate	124.9354°E -18.2372°S		
Habitat type	Open shrubland		
Habitat description	Scattered trees over open shrubland over tussock and hummock grasses.		
Habitat condition	Good		
Suitability for significant species	No		
Evidence of significant species	No		
Disturbance	Evidence of longterm cattle use		
Time since fire	1 – 2 yrs		
Leaf litter cover	10 – 40		
Woody debris	< 10		
Rocky crevices/caves	NA		
Large trees	Yes		
Tree hollows	Small hollows		
Landform	Plain	<b>Landform (other)</b>	
Slope	Negligible	<b>Aspect</b>	NA
Soil colour	Light brown	<b>Soil texture</b>	Sandy loam
Bare soil	10 – 30	<b>Drainage</b>	NA
Rock type	NA	<b>Rock size</b>	NA
Rock abundance	NA		
Upper stratum	Scattered trees		
Middle stratum	Tall open shrubland		
Lower stratum	Hummock grassland		



# Proposed Well 3

<b>Date</b>	24/07/2024		
<b>Site type</b>	Habitat assessment		
<b>Coordinate</b>	124.9747°E -18.276°S		
<b>Habitat type</b>	Open shrubland		
<b>Habitat description</b>	Scattered eucalypts over tall acacia tumida shrubland in sandy loam soils.		
<b>Habitat condition</b>	Very Good		
<b>Suitability for significant species</b>	Yes		
<b>Evidence of significant species</b>	Old bilby diggings		
<b>Disturbance</b>	Evidence of longterm cattle use		
<b>Time since fire</b>	2 – 5 yrs		
<b>Leaf litter cover</b>	< 10		
<b>Woody debris</b>	< 10		
<b>Rocky crevices/caves</b>	NA		
<b>Large trees</b>	No		
<b>Tree hollows</b>	No		
<b>Landform</b>	Plain	<b>Landform (other)</b>	
<b>Slope</b>	Negligible	<b>Aspect</b>	NA
<b>Soil colour</b>	Orange	<b>Soil texture</b>	Sandy loam
<b>Bare soil</b>	10 – 30	<b>Drainage</b>	NA
<b>Rock type</b>	NA	<b>Rock size</b>	NA
<b>Rock abundance</b>	NA		
<b>Upper stratum</b>	Scattered trees		
<b>Middle stratum</b>	Tall open shrubland		
<b>Lower stratum</b>	Hummock grassland		



# Proposed Well 4

<b>Date</b>	23/07/2024		
<b>Site type</b>	Habitat assessment		
<b>Coordinate</b>	124.8733°E -18.2081°S		
<b>Habitat type</b>	Open shrubland		
<b>Habitat description</b>	Scattered trees and boats over open <i>Acacia tumida</i> shrubland over hummock grassland on sandy loam substrates.		
<b>Habitat condition</b>	Very Good		
<b>Suitability for significant species</b>	Yes		
<b>Evidence of significant species</b>	Old bilby diggings		
<b>Disturbance</b>	Evidence of longterm cattle use		
<b>Time since fire</b>	1 – 2 yrs		
<b>Leaf litter cover</b>	< 10		
<b>Woody debris</b>	< 10		
<b>Rocky crevices/caves</b>	NA		
<b>Large trees</b>	Yes		
<b>Tree hollows</b>	Small hollows		
<b>Landform</b>	Undulating plain		
<b>Slope</b>	Negligible		
<b>Soil colour</b>	Orange		
<b>Bare soil</b>	30 – 70		
<b>Rock type</b>	NA		
<b>Rock abundance</b>	NA		
<b>Upper stratum</b>	Scattered trees		
<b>Middle stratum</b>	Tall open shrubland		
<b>Lower stratum</b>	Open hummock grassland		
	<b>Landform (other)</b>		
	<b>Aspect</b>		NA
	<b>Soil texture</b>		Sand
	<b>Drainage</b>		NA
	<b>Rock size</b>		NA



## Appendix D Bat Call Analysis Report



## **Acoustic analysis and bat call identification from Valhalla, Western Australia**

Prepared for **Ecologia Environment Pty Ltd**

Version **29 October 2024**

SZ project reference **SZ747**

**Specialised Zoological** ABN 92 265 437 422  
Dr Kyle Armstrong and Yuki Konishi  
Tel +61 (0)404 423 264  
kyle.n.armstrong@gmail.com

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

Specialised Zoological (2024). Acoustic analysis and bat call identification from Valhalla, Western Australia. Unpublished report by Specialised Zoological for Ecologia Environment Pty Ltd, 29 October 2024, project reference SZ747.

### Version history

Date	Version	Note
2024-10-29	2024-10-29	Final version

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## Summary

Bat identifications from bioacoustic recordings are provided for the Valhalla project area, c. 55 km west of Fitzroy Crossing, in the Kimberley region of 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.

The scope of the analysis was limited to identifying several bat species of conservation significance, and those of particular interest given their vulnerability to the disturbance of their cave roosts.

- Ghost Bat *Macroderma gigas* (Megadermatidae)
- Dusky Leaf-nosed Bat *Hipposideros ater* (Hipposideridae)
- Northern Leaf-nosed Bat *Hipposideros stenotis* (Hipposideridae)
- Orange Diamond-faced Bat *Rhinonycteris aurantia* (Rhinonycteridae)
- Bare-rumped Sheath-tailed Bat *Saccolaimus saccolaimus* (Emballonuridae)

The dataset consisted of 50 recording nights from ten recording sites (**Table 1**).

Analysis targeted the distinctive echolocation calls of these species.

No example of any of these species was observed.

**Table 1.** Summary of recordings made on the survey.

Site	Serial	Latitude	Longitude	First night	Last night	No. nights
	<b>SM4BAT</b>					
.	SM4-01	-18.14295	124.77647	23/07/2024	27/07/2024	5
.	SM4-03	-18.17731	124.86775	23/07/2024	27/07/2024	5
.	SM4-05	-18.02306	124.77339	23/07/2024	27/07/2024	5
.	SM4-06	-18.16355	124.79235	23/07/2024	27/07/2024	5
.	SM4-07	-18.10308	124.844	23/07/2024	27/07/2024	5
.	SM4-08	-18.16358	124.79205	23/07/2024	27/07/2024	5
	<b>Chorus</b>					
TC36	644436	-18.20998	125.5833	23/07/2024	27/07/2024	5
TC39	644439	-18.20762	124.88323	23/07/2024	27/07/2024	5
TC40	644440	-18.29056	125.05232	23/07/2024	27/07/2024	5
TC88	636488	-18.23644	124.93535	23/07/2024	27/07/2024	5

## Methods

The data provided were recorded in full spectrum WAV format with Wildlife Acoustics Song Meter SM4BAT bat detectors (sampling rate 384 kHz, set to turn on automatically at sunset and off at sunrise) and Titley Scientific Anabat Chorus bat detectors (sampling rate 500 kHz).

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

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

Species were identified based on information in Churchill (2008), Armstrong et al. (2021a) and the author's own unpublished information.

## References

- Armstrong K.N., Broken-Brow J., Hoyer G., Ford G., Thomas M. and Corben C. (2021a). Effective detection and identification of sheath-tailed bats of Australian forests and woodlands. *Australian Journal of Zoology* 68:346–363. <https://doi.org/10.1071/ZO20044>
- Armstrong K.N., Clarke S., Linke A., Scanlon A., Roetman P., Hitch, A.T. and Donnellan S.C. (2021b). Citizen science implements the first intensive acoustics-based survey of insectivorous bat species across the Murray-Darling Basin of South Australia. *Australian Journal of Zoology* 68: 364–381. <https://doi.org/10.1071/ZO20051>
- Churchill, S.K. (2008). *Australian bats*. 2<sup>nd</sup> ed. Allen and Unwin, Crows Nest, NSW.

## 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 several key echolocating bat species in bulk ultrasonic recordings. Further comment on these species was 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 identifications have been made 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.
9. This version of the document supersedes any previous version. Previous drafts are not authorised by us for submission to the regulator or the public domain.