BREAKAWAY & MARILLANA SOUTH MNES TARGETED VERTEBRATE FAUNA SURVEY

PREPARED FOR: BHP WESTERN AUSTRALIAN IRON ORE

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Project ID: 2302	Breakaway & Marillana South MNES Targeted Vertebrate Fauna Survey
Prepared for:	BHP Western Australian Iron Ore
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TABLE OF CONTENTS

TABLES

FIGURES

MAPS

PLATES

APPENDICES

1. EXECUTIVE SUMMARY

BHP Western Australia Iron Ore (BHP WAIO) commissioned Spectrum Ecology & Spatial (Spectrum) to undertake a single season, targeted Matters of National Environmental Significance (MNES) vertebrate fauna survey, including a habitat assessment and desktop study of the Breakaway and Marillana South tenements in the Pilbara region of Western Australia. This report may be used to support future Environmental Impact Assessment.

A desktop study of relevant literature, databases, and past surveys from the locality was undertaken to inform the likelihood of occurrence of MNES species potentially occurring in the Survey Area.

The survey was conducted over two field deployments, Phase 1 being conducted between 8 and 12 June 2023, and Phase 2 conducted between 10 and 13 July 2023. Passive monitoring equipment was deployed for approximately 30 days between survey phases. Sampling effort within the Survey Area included:

- 42 targeted searches;
- 43 habitat assessments;
- 960 days and nights of motion camera recording effort at seven sites;
- 287 nights of ultrasonic bat recording at nine sites; and
- 18 unbounded foot traverses, averaging 27.1 km per person, targeting evidence of MNES species.

MNES fauna were not recorded during the current survey. However, of the 27 MNES species identified in the desktop study, two were previously recorded in the Survey Area, and eight were assessed to have a high or medium likelihood of occurrence within the Survey Area, based on previous records and habitat preferences:

- Bridled Tern (*Onychoprion anaethetus*) – recorded;
- Ghost Bat (*Macroderma gigas*) – recorded;
- Northern Quoll (*Dasyurus hallucatus*) - high likelihood;
- Grey Falcon (*Falco hypoleucos*) - high likelihood;
- Common Sandpiper (*Actitis hypoleucos*) - high likelihood;
- Common Greenshank (*Tringa nebularia*) - high likelihood;
- Pilbara Olive Python (*Liasis olivaceus barroni*) – high likelihood;
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) – medium likelihood;
- Southern Whiteface (*Aphelocephala leucopsis*) – medium likelihood; and
- Pacific Swift (*Apus pacificus*) – medium likelihood.

Ironstone Hills and Drainage Lines represent the two broad landscapes identified within the Survey Area. Within these, the following landforms may potentially provide critical habitat for MNES species identified as potentially occurring in the Survey Area:

- Breakaways;
- Major Drainage Lines; and
- Minor Drainage Lines.

2. INTRODUCTION

2.1. Project Background

To potentially support future Environmental Impact Assessment, BHP Western Australia Iron Ore (BHP WAIO) commissioned Spectrum to undertake a single season, targeted MNES vertebrate fauna survey of the Breakaway and Marillana South tenements (hereafter the 'Survey Area'), located approximately 100 km northwest of Newman, in the Pilbara region of Western Australia (Map 2.1).

The Survey Area is defined by the following tenements:

- Breakaway tenement E47/1239 comprising 3,143 ha; and
- Marillana South tenement E47/4245 comprising 23 ha.

2.2. Scope of Work

The scope of this study was to:

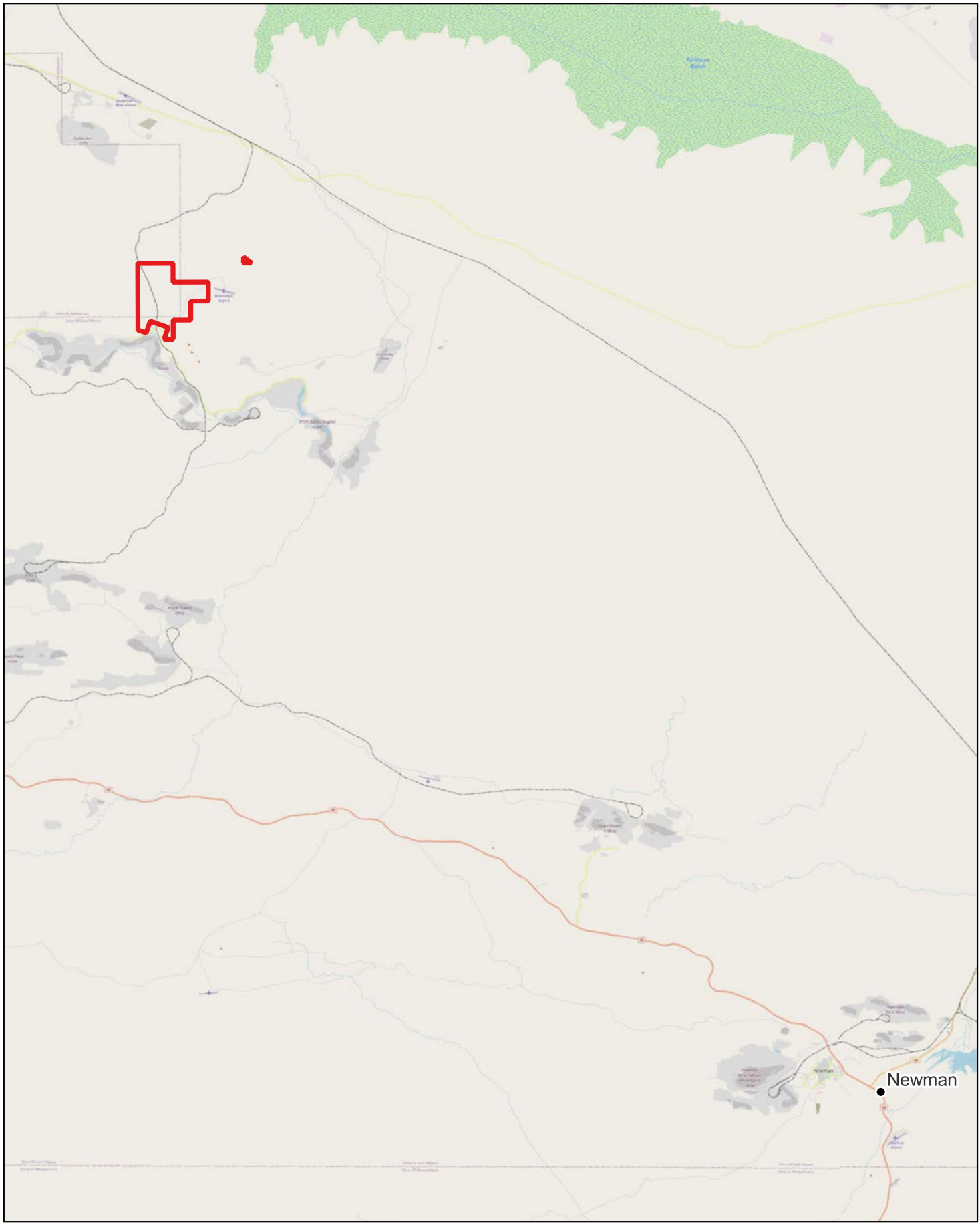
- complete a desktop study, consolidating MNES fauna records from relevant past biological surveys and relevant available database returns within a 50 km buffer of the Survey Area (hereafter the 'Study Area'),
- complete a single phase targeted terrestrial vertebrate fauna survey, specifically focusing on nationally listed species, considered as Matters of National Environmental Significance (MNES);
- assess, describe and map fauna habitats within the Survey Area;
- assess suitability of habitats within the Survey Area to support potentially occurring MNES fauna species, considering habitat preferences and desktop study results; and
- determine the likelihood of occurrence for MNES species within the Survey Area, based on the points above.

2.3. Legislation & Guidelines

Fauna in Western Australia are protected by the following legislation:

- the State *Environmental Protection Act 1986*;
- the State *Biodiversity Conservation Act 2016* (BC Act); and/or
- the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

For this report, only nationally threatened and Migratory species listed under the Commonwealth EPBC Act are considered (i.e. MNES species). In most cases, MNES fauna species are also specially protected under the State BC Act (Appendix A). Additionally, the Department of Biodiversity, Conservation and Attractions (DBCA) maintains a list of priority species that have not been assigned statutory protection under the BC Act but are considered data deficient, rare or near threatened (Appendix A).



Legend

Survey Area

Towns

N

0 5 10 15 km

Scale 1:490,700 @ A4

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

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 28-11-2023

Prepared for BHP WAIO

Survey Area Location

BHP Breakaway and Marillana South

MAP 2.1

3. REGIONAL CONTEXT

3.1. Bioregion

The Pilbara bioregion encompasses 178,060 km^2 and is broadly characterised by coastal plains and inland mountain ranges with cliffs and deep gorges (Bastin, 2008). The Survey Area is located within the Hamersley subregion of the Pilbara bioregion (DCCEEW 2020;), which is characterised as follows: "dissected by gorges (basalt, shale and dolerite), Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is Semi-desert tropical, average 300mm rainfall" (Kendrick, 2001).

3.2. Geology

The surface geology of Western Australia has been mapped at a scale of 1:500,000 (DMERS, 2017), which represents the finest-scale digital mapping available for the area mapped to the state extent.

Five geology units occur within the Survey Area, with Rt-PIP being the unit of largest extent, representing over 48% of the Survey Area, followed by X-PIP at almost 38% of the Survey Area. The geological units are listed in Table 3.1 and mapped on Map 3.1.

Table 3.1: Surface Geology

Unit Code	Landform	Description	Area in Survey Area (ha)	% of Survey Area	Total Pilbara Extent (ha)	% of Pilbara Extent Within Survey Area
Rt-PIP	Transported relict	Transported duricrust; cemented sand, gravel, cobbles, and boulders in alluvial/colluvial deposits	1,522.6	48.09	513,376	0.30
X-PIP	Exposed Bedrock	Exposed Bedrock	1,198.8	37.86	8,412,613	<0.1
Ac-PIP	Alluvial/fluvial	Clay, silt, sand, and gravel in fluvial channels	254.9	8.05	646,611	<0.1
Rt-fl-PIP	Transported relict	Transported limonitic duricrust; iron-cemented sand, gravel, cobbles and boulders	164.1	5.18	26,911	0.61
Rr-fh-PIP	Duricrust residual or relict	Hematitic duricrust, massive to rubbly; includes iron-cemented reworked products	25.6	0.81	25,693	0.10

3.3. Pre-European Vegetation

The Survey Area is located within the Pilbara region of the Eremaean Botanical Province (Beard & Sprenger, 1984), which is described and mapped at a scale of 1:250,000 (Beard et al., 2013). Mapping has since been updated to be consistent with the National Vegetation Information System (NVIS) descriptions at a scale of 1:250,000 (DPIRD, 2019). The Survey Area intersects two vegetation associations, (Table 3.2;

Map 3.1: Surface Geology

Map 3.2). Almost 57% of the Survey Area comprises Hammersley 18 with over 43% comprising Hammersley 82 mosaic. Over 99% of the pre-European vegetation extent remains uncleared for both associations, neither of which are restricted in the Pilbara region (DBCA 2019).

Although Beards vegetation mapping is broad scale in nature, it demonstrates that vegetation units occurring in the Survey Area are widespread in the Pilbara bioregion and occur contiguously outside of the Survey Area.

Table 3.2: Vegetation associations.

Vegetation association	Description	Extent in Survey Area		Extent in Pilbara Bioregion (ha)	Survey Area Proportion of Pilbara Bioregion (%)	% Uncleared in Pilbara Bioregion
		Area (ha)	Proportion (%)			
Hammersley 18	Low woodland; mulga (*Acacia aneura*)	1,798.2	56.8	676,557	0.26	99.3
Hammersley 82	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	1,367.8	43.2	2,563,583	<0.1	99.5

3.4. Land Systems

Fauna habitats may be broadly defined by land systems, which are characterised by topography, soils and vegetation (Van Vreeswyk et al., 2004). Land systems of Western Australia have been mapped at a scale of 1:250,000 (DAFWA 2016).

Five land systems occur within the Survey Area, with the main land systems comprising Platform and Newman (Table 3.3; Map 3.3). Land systems occurring in the Survey Area are well represented in the Pilbara, with the Survey Area containing less than 0.1% of each land systems extent in the Bioregion. None of the land systems are restricted in extent.

Table 3.3: Land Systems of the Survey Area.

Land System & Description	Survey Area (ha)	% of Survey Area	Total Pilbara Extent (ha)	% of Total Pilbara Extent within Survey Area
Platform: Dissected slopes and raised plains supporting shrubby hard spinifex grasslands.	1,715.8	54.2	236,390	<0.1
Newman: Rugged jaspilite plateau, ridges and mountains supporting hard spinifex grasslands.	1,142.7	36.1	1,994,339	<0.1
McKay: Hills, ridges, plateaux remnants, and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with *Acacia* and occasional *Eucalyptus*.	190.2	6.0	425,967	<0.1
Robe: Low plateaux, mesas and buttes of limonite supporting soft spinifex and occasionally hard spinifex grasslands.	85.8	2.7	128,176	<0.1
Rocklea: Basalt hills, plateaux, lower slopes, and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	31.4	1.0	2,880,024	<0.1

3.5. Significant Lands

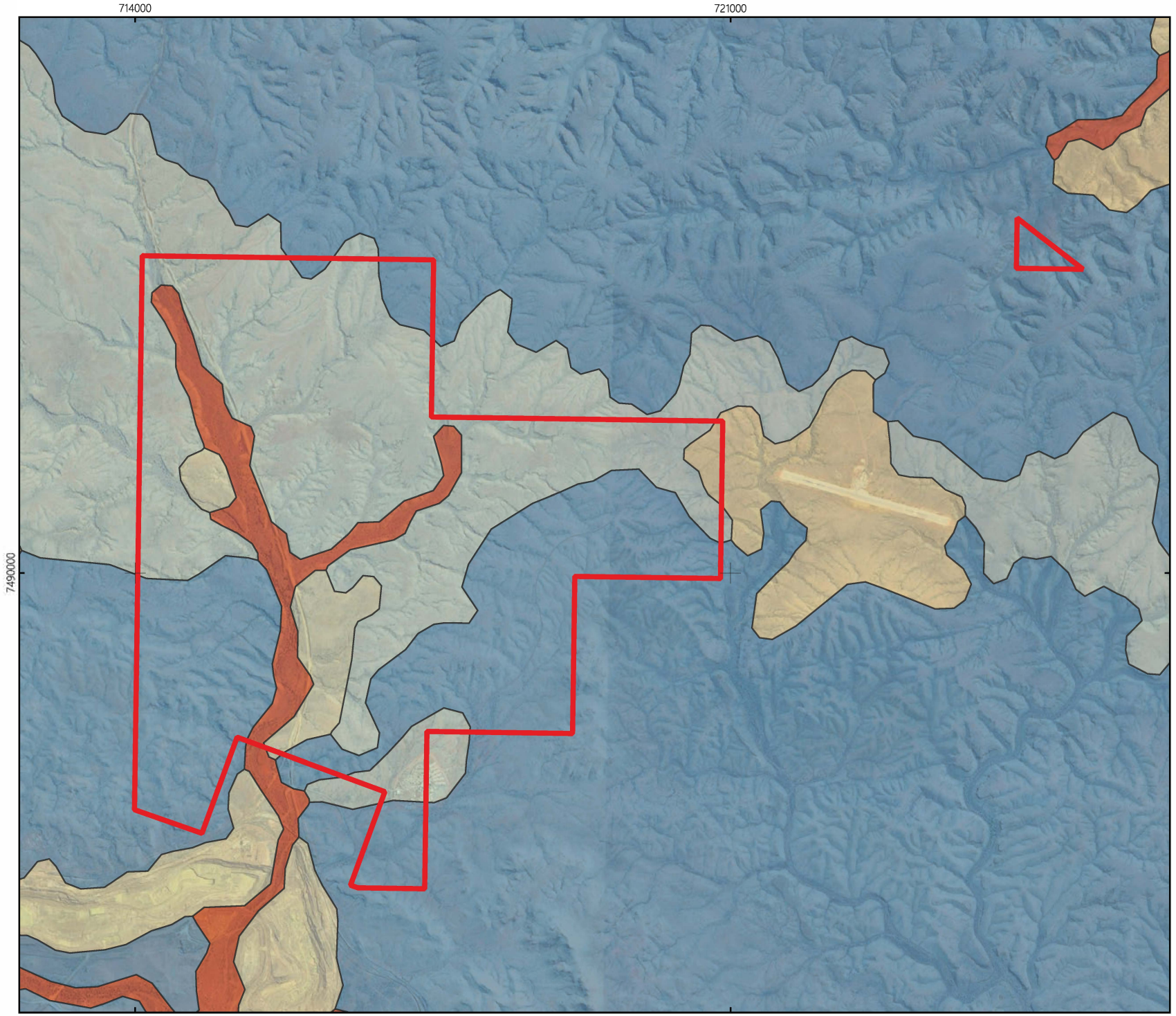
Significant lands may comprise the following:

- Conservation estate - land and waters vested in the Conservation and Parks Commission under the *Conservation and Land Management Act 1984*. These typically comprise National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DotEE 2016).
- Environmentally Sensitive Areas (ESA) – areas of native vegetation where the exemptions for clearing vegetation under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (Clearing Regulations) do not apply. (DWER 2019).

Two Environmentally Sensitive Areas and one Conservation Estate occur in the Survey Area locality (Map 3.4; Table 3.4).

Table 3.4: Environmentally Significant Areas within the Study Area

Reserve Name	Distance and Direction from Survey Area	Significant Land Type in Study Area	
		Conservation Estate	Environmentally Sensitive Areas
Karijini National Park	39 km W	✓	✓
Karijini (Hamersley Range) Gorges	41 km W	-	✓
Fortescue Marsh	23 km N	-	✓



Legend

- Survey Area

Geological Unit

- Ac-PIP
- Rr-fh-PIP
- Rt-fl-PIP
- Rt-PIP
- X-PIP

N

0 1 2 km

Scale 1: 6,500 @ A4

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

Spectrum GEOLOGY + SPATIAL

Author: GF

Date: 14-11-2023

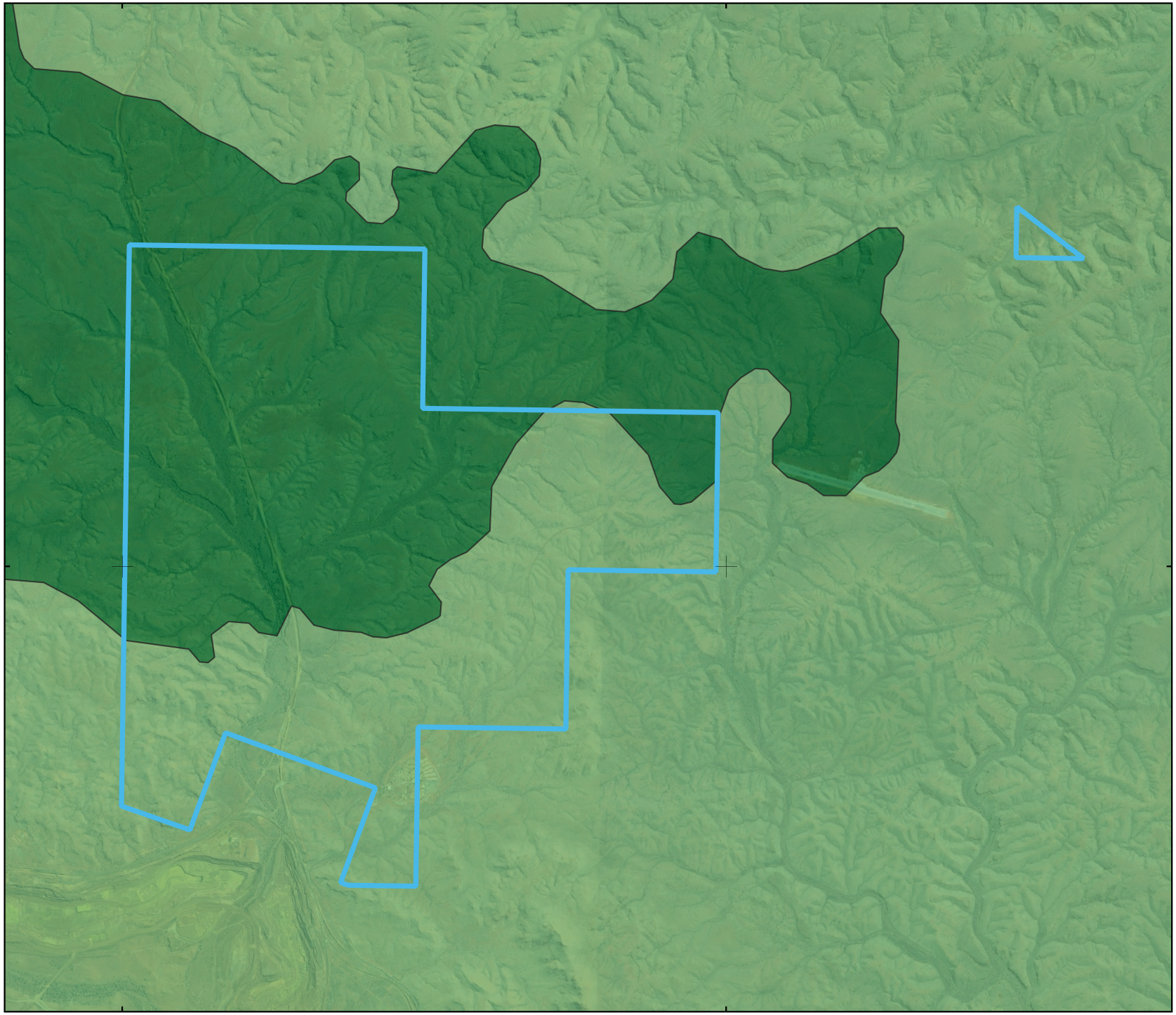
Surface Geology (1:500,000)

BHP Breakaway and Marillana South

MAP

Prepared for
BHP WAIO

3.1



Legend

Survey Area

Beard Vegetation Associations

18

82

N

0 1 2 km

Scale 1:61,500 @ A4

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

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 15-05-2024

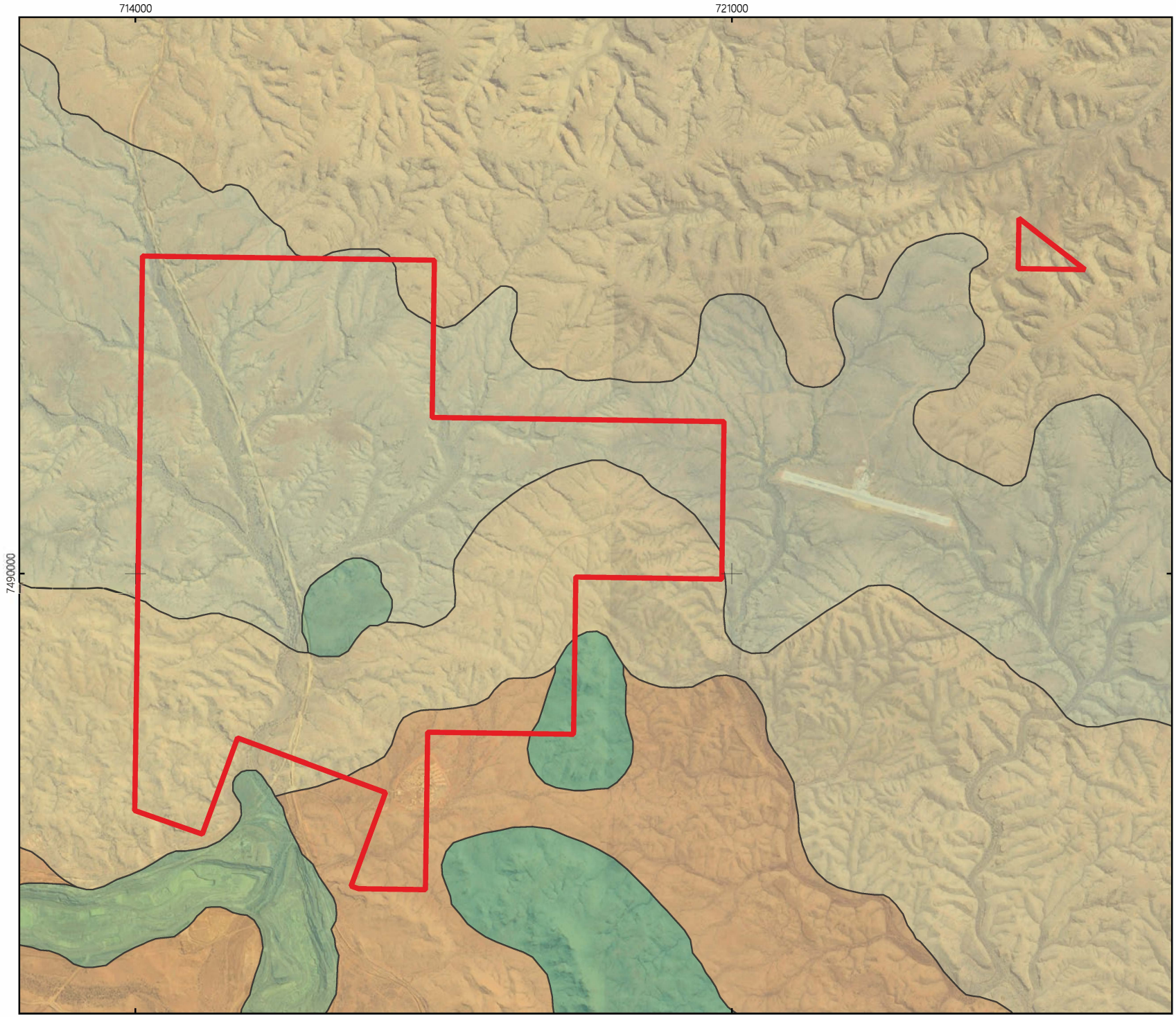
Beard Vegetation

BHP Breakaway and Marillana South

MAP

Prepared for
BHP WAIO

3.2



Legend

- Survey Area

Land Systems

- McKay Land System
- Newman Land System
- Platform Land System
- Robe Land System
- Rocklea Land System

N

0 1 2 km

Scale 1:61,500 @ A4

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

Spectrum Ecology + Spatial

Author: GF

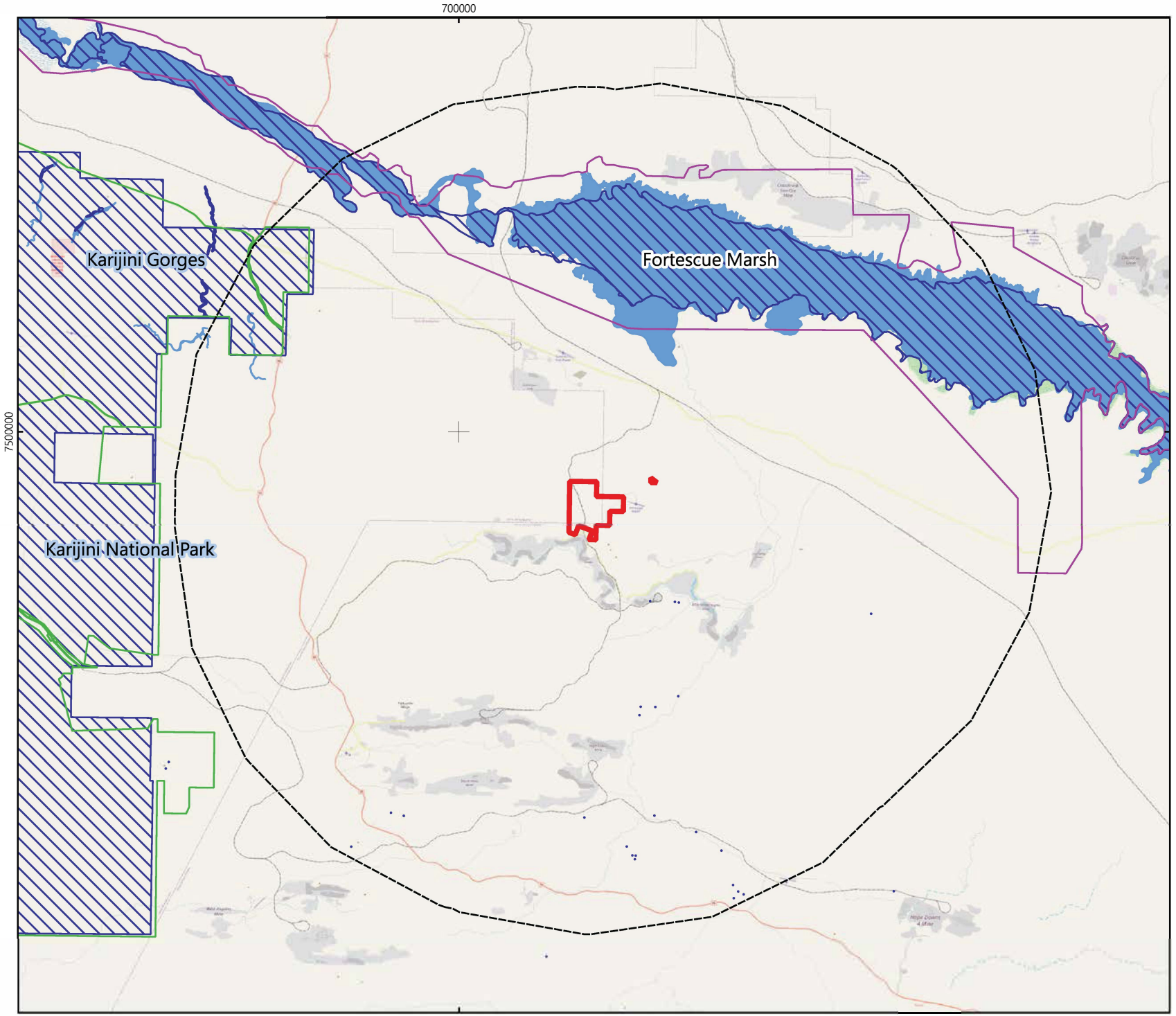
Date: 14-11-2023

Land Systems

BHP Breakaway and Marillana South

MAP 3.3

Prepared for
BHP WAIO



Legend

- Survey Area
- 50 km Buffer
- Environmentally Sensitive Areas
- Directory of Important Wetlands
- RAMSAR - Fortescue Marsh - Proposed Addition
- Conservation Estate

N

0 10 20 km

Scale 1:664,000 @ A4

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

Spectrum Ecology + Spatial

Author: GF

Date: 24-11-2023

Significant Lands

BHP Breakaway and Marillana South

MAP

Prepared for
BHP WAIO

3.4

4. METHODS

4.1. Desktop Study

A desktop study of relevant biological data sources was undertaken to identify MNES fauna species previously recorded in the Study Area. These were conducted within the largest available buffer of the Survey Area (40 km or 50 km, Table 4.1). Regional information was also reviewed to describe the biophysical characteristics of the Survey Area, in a regional context (Section 3).

4.1.1. Biological Database Searches

The following databases were searched and incorporated into the desktop study (Table 4.1).

Table 4.1: Summary of Database Searches

Data Source	Custodian	Details	Buffer
Commonwealth Protected Matters Search Tool (PMST)	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	Date: 14/04/2023	40 km
Threatened Fauna Database	Department of Biodiversity Conservation and Attractions (DBCA)	Date: 26/04/2023 Reference: 7654	40 km
NatureMap		Date: 14/11/2023	50 km
Atlas of Living Australia	National Research Infrastructure for Australia (NCRIS) / Commonwealth Scientific and Industrial Research Organisation (CSIRO) / Global Biodiversity Information Facility (GBIF)	Date: 14/04/2023	50 km

4.1.2. Literature Review

Relevant biological surveys and scientific papers previously completed within the Study Area were reviewed for the occurrence MNES fauna species (Table 4.2). These included both publicly available reports and those provided by BHP WAIO.

Table 4.2: Previously Conducted Biological Assessments

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Breakaway and Marillana South Basic Terrestrial Vertebrate Fauna Survey (Biologic, 2024)	Basic & Targeted – significant fauna	July 2022	Intersects Breakaway and Marillana South
Marillana Infrastructure Corridor Level 1 Vertebrate Fauna Survey (Biologic 2016)	Targeted – significant fauna	January 2016	Intersects Breakaway
Infrastructure Corridor Targeted Vertebrate Fauna Survey (Biologic 2019)	Targeted – significant fauna	April 2018 May 2018	Intersects Marillana South
Yandi Vertebrate Fauna Review (Biologic 2011b)	Targeted – significant fauna	December 2010	~1 km SW
BHP Rail Duplication Project RGP5 Fauna Survey Kurrajura Siding to Yandi WYE Including Yandi Repeater 1	Targeted – significant fauna	May 2008	~5 km W

Biological Assessment Name	Survey Level	Survey Timing	Distance to Survey Area
Summary of Important Findings from Rapid Growth Project 5 Railway project- Biological Assessments (ENV 2008)	Targeted – significant fauna	April 2008	~5 km W
Yandi Life of Mine Flora and Fauna (Maunsell Australia, 2003)	Targeted – significant fauna	September 2003	~5 km SW
Marillana Creek (Yandi) Iron Ore Mine Modification (Ecologia 2008)	Detailed	March 2008	~10 km W
Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013)	Detailed	May 2011 September 2011	~10 km NW
Barimunya Camp Vertebrate Fauna Survey (Biologic 2011a)	Targeted – significant fauna	April 2011	~50 km NE
Marillana Creek Western Access Corridor- Biological Assessment (HGM, 1999)	Detailed	April 1999	~50 km SW

4.1.3. Likelihood of Occurrence of MNES Fauna

The following information was collated for each MNES fauna taxon identified during the desktop study:

- Conservation status (EPBC Act and BC Act);
- Description of habitat requirements;
- Description of previous records;
- Distance of record to the Survey Area; and
- Recentness of records.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 4.3 (see Section 6.1).

Table 4.3: Likelihood of Occurrence Criteria

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

4.2. Fauna Survey

4.2.1. Survey Timing and Personnel

The survey was conducted over two field deployments, Phase 1 being between 8 and 12 June 2023, and Phase 2 between 10 and 13 July 2023. Passive monitoring equipment was deployed for the duration between survey phases for approximately 30 days (see Section 4.2). The survey was completed under Regulation 27 licence number BA27000846. Field personnel details are presented in Table 4.4.

Table 4.4: Field Personnel.

Name	Position	Qualification	Years Consulting Experience	Role	Phase	
					P1	P2
Melinda Henderson	Senior Zoologist	B.Sc. (Hons)	8	Project manager Field team lead	✓	
Brandon King	Spatial Ecologist	M.Env.Sc, B.Sc (Hons)	5	S26 supervisor	✓	✓
Yvonne Fong	Spatial Ecologist	M.Env.Sc, B.Sc (Hons)	4	Team member		✓

4.2.2. Survey Weather and Climate

Weather data were obtained from the Bureau of Meteorology weather station at Newman Airport (No. 7176), located approximately 60 km southeast of the Survey Area. Weather conditions were mild, but slightly warmer than average during both survey phases, with no rain recorded during the deployment periods (Table 4.5).

Long-term climate data were also obtained from Newman Airport (Figure 4.1). Maximum and minimum temperatures in the year preceding the survey were consistent with long-term averages. Total rainfall for the two months preceding the survey was below average, but three months prior it was above average due to a single rainfall event.

Table 4.5: Weather at Newman Airport (7176) during the survey.

	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun	10-Jul	11-Jul	12-Jul	13-Jul	Mean/Total
Max. temp. (°C)	21.3	22.8	25.8	27	22.6	23.5	24	25.2	26.8	24.3
Min. temp. (°C)	4.7	3.4	5.9	7.2	8.8	2.4	2.6	4.9	5.8	5.1
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0

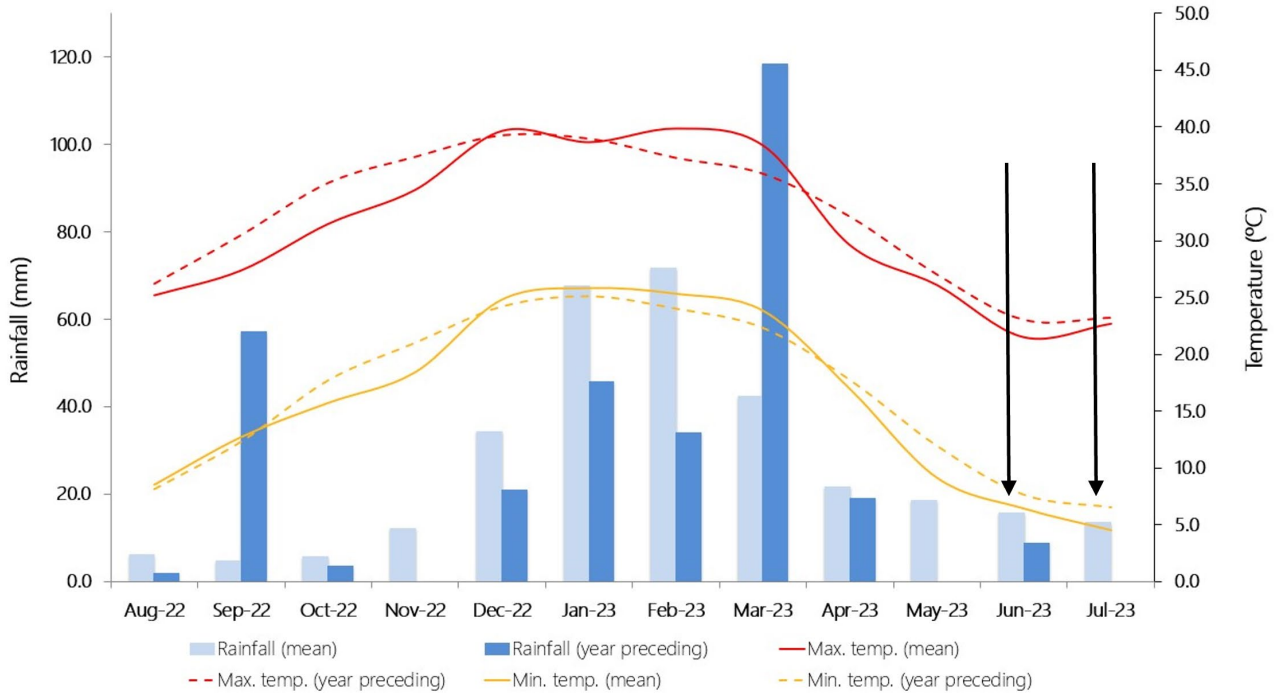


Figure 4.1: Climate and weather graph depicting long-term averages and weather preceding the survey (Long-term data rainfall 1974-2023, temperatures 1996 – 2023; arrows indicate survey timing).

4.2.3. Habitat Assessment

Fauna habitats were described and mapped, considering aerial imagery, land systems, geology, vegetation, and on-ground habitat descriptions. Habitat descriptions were conducted at each of the fauna sampling sites within the Survey Area (Map 4.1 and Appendix B).

Habitat was classified as 'critical' in accordance with EPBC Significant Impact Guidelines (DotE 2013). Critical habitats are defined as those that are necessary for:

- activities such as foraging, breeding, roosting, or dispersal;
- the long-term maintenance of the species (including the maintenance of species essential to the survival of the species, such as pollinators);
- maintaining genetic diversity and long-term evolutionary development; or
- the reintroduction of populations or recovery of the species.

Supporting habitat which may be used on a transitory or occasional basis does not represent critical habitat.

4.2.4. Targeted Searches

The desktop survey identified 27 MNES species potentially occurring within the Survey Area (four mammals, 21 birds and two reptiles; see Section 5.1). Threatened species were targeted using the field survey techniques outlined below. Rare and migratory bird species were recorded opportunistically throughout the Survey Area.

Targeted searches were conducted at 42 sites within the Survey Area (Map 4.1). Searches were conducted for 30 minutes at each site and comprised the following:

- habitat assessments;
- habitat specific searches to directly sight MNES species; and
- identification of secondary sign such as tracks, scats, burrows, diggings, feathers, pellets, nests and skin sloughs.

4.2.5. Motion Cameras

Motion sensitive cameras (Reconyx brand) capable of recording both the visible spectrum (day) and infra-red (night) images were deployed in habitats deemed suitable for Northern Quoll and Pilbara Olive Python. These include areas of persisting water and incised rocky areas (Table 4.6). Motion cameras were each mounted on a star picket approximately 1.5 m above the ground, facing downward, thereby maximising the chance of identifying individual quolls via their spot patterns. Cameras were baited with cotton rope soaked in fish oil, which were placed at the base of the star picket, thereby constituting a non-food reward attractant.

In total, 30 motion cameras were deployed at seven sites within two broad landscapes and four landforms. Total survey effort totalled 960 camera nights.

Table 4.6: Motion Camera Search Effort.

Site	Number of Cameras	Easting (mE)	Northing (mN)	Habitat		Deployment Date	Collection Date	Camera Effort (camera nights)
				Landscape	Landform			
BM07	5	715325	7490397	Drainage Lines	Major Drainage Line	09/06/23	12/07/23	165
BM15	5	715660	7490765	Ironstone Hills	Breakaway	10/06/23	12/07/23	160
BM08	5	715682	7489289		Breakaway	09/06/23	12/07/23	165
BM17	5	716306	7488657		Breakaway	10/06/23	12/07/23	160
BM20	4	724426	7493593		Hillslope	11/06/23	12/07/23	124
BM28	3	718957	7489220		Minor Drainage Line	11/06/23	12/07/23	93
BM29	3	718681	7489248		Minor Drainage Line	11/06/23	12/07/23	93
							Total	960

4.2.6. Bat Call Recorders

Bat call recorders (Wildlife Acoustics SM4BAT units) were deployed to target Ghost Bats and Pilbara Leaf-nosed Bats (Map 4.1). SM4 units detect and record full spectrum ultrasonic echolocation calls emitted during bat flight. Selected filters, triggers and audio settings followed the manufacturer's recommendations for bat detection of call frequencies up to 130 kHz (Wildlife Acoustics, 2021), with units programmed to record 30 minutes pre-sunset to 30 minutes post-sunrise.

Sampling was undertaken at nine sites within the Survey Area, with sampling effort totalling 287 nights (Table 4.7). The Song Meters were placed in locations where targeted species are most likely to forage.

Table 4.7: Bat Call Recorder Search Effort

Site	Easting (mE)	Northing (mN)	Habitat		Deployment Date	Collection Date	Recording Effort (days)
			Landscape	Landform			
BM04	714654	7492659	Drainage Lines	Minor Drainage Line	09/06/23	12/07/23	33
BM07	715325	7490397		Major Drainage Line	09/06/23	12/07/23	33
BM09	715516	7488190		Major Drainage Line	09/06/23	12/07/23	33
BM30	717836	7488547		Major Drainage Line	12/06/23	12/07/23	30
BM13	715410	7491750		Major Drainage Line	10/06/23	12/07/23	32
BM16	716162	7490120		Major Drainage Line	10/06/23	12/07/23	32
BMBat01	715791	7489242	Ironstone Hills	Breakaway	09/06/23	12/07/23	33
BM20	724426	7493593		Hillslope	11/06/23	12/07/23	30
BM26	718954	7490954		Minor Drainage Line	11/06/23	12/07/23	31
						Total	287

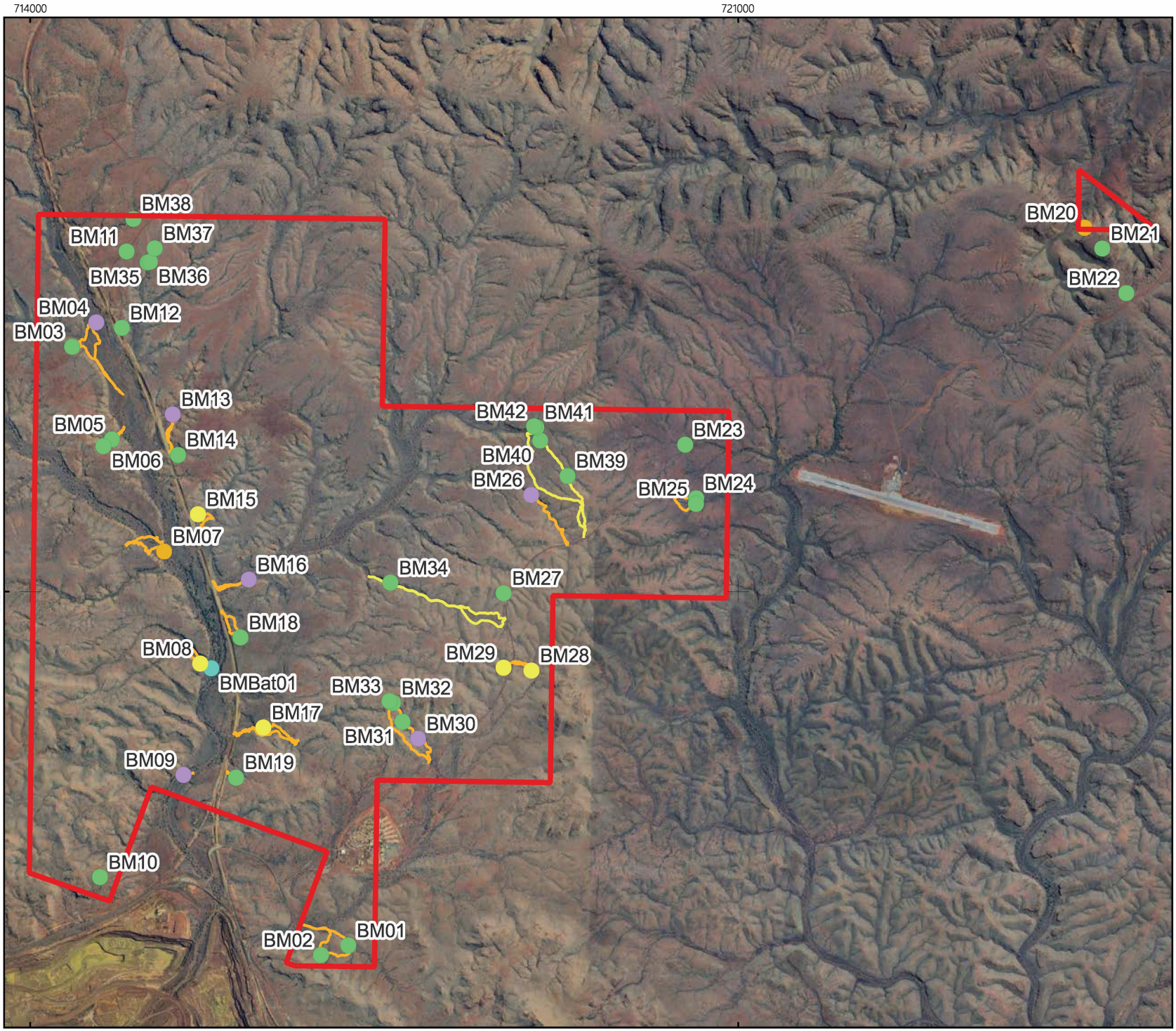
4.2.7. Foot traverses

Unbounded foot traverses were undertaken within prospective habitat to record secondary sign of Northern Quoll, Pilbara Olive Python and Bilby (tracks, scats, burrows, skin sloughs) and to determine occurrence of potentially suitable roosting caves for Ghost Bats and Pilbara Leaf-nosed Bats (Table 4.8 and Map 4.1). A total distance of 54.2 km was traversed on foot by two people (Table 4.8).

The field team were observant for opportunistic records of Grey Falcon and any potentially occurring Migratory listed species, while conducting foot traverses, driving and working within the Survey Area.

Table 4.8: Foot Traverse Search Effort

Survey Phase	Number of Traverses	Distance traversed (km)	No. People	Effort (km)
Phase 1	15	20.6	2	41.2
Phase 2	3	6.5	2	13
			Total	54.2



Legend

- Survey Area

Survey Sites

- Bat Recorder
- Targeted Search
- Targeted Search, Bat Recorder
- Targeted Search, Bat Recorder, Motion Camera
- Targeted Search, Motion Camera
- Foot Traverse Phase 1
- Foot Traverse Phase 2

N

0 1 2 km

Scale 1:52,500 @ A4

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

Spectrum Ecology + Spatial

Author: GF

Date: 28-11-2023

Survey Site Locations

BHP Breakaway and Marillana South

MAP

Prepared for
BHP WAIO

4.1

4.2.8. Data Analysis

4.2.8.1. Bat Call Recorders

Full spectrum call data were processed and analysed with Wildlife Acoustics Kaleidoscope Pro software version 5.6, using statistical pattern analysis to isolate and cluster similar vocalisations. Resultant clusters were categorised via Spectrum's call library, in conjunction with available reference material (Churchill, 2008; McKenzie & Bullen, 2009). Sonograms identified as Pilbara Leaf-nosed Bat or Ghost Bat were vetted manually to exclude any false positive identifications (Type I error). Additionally, cluster analysis is susceptible to misidentifying Ghost Bat calls (Type II error). Therefore, calls assigned to clusters with similar or overlapping call characteristics to Ghost Bats were also vetted manually.

If the signal to noise ratio (SNR) drops below a given threshold, calls will not be detected by cluster analysis, resulting in Type II errors (Wildlife Acoustics pers. comm., 2023). Therefore, to determine the number of Pilbara Leaf-nosed Bat calls more accurately, a second round of processing was conducted using the batch processing function. Here, refined parameters were used, and cluster analysis was omitted to isolate files that contained Pilbara Leaf-nosed Bat calls regardless of SNR (Table 4.9). Again, sonograms identified as Pilbara Leaf-nosed Bat were manually vetted.

Table 4.9: Batch Processing Parameters

Parameter	Setting
Frequency range	115 kHz to 130 kHz
Pulse duration	2-500 ms
Maximum inter-syllable gap	500 ms
Minimum number of pulses	2

4.3. Nomenclature

In accordance with EPA Technical Guidance (EPA 2020), species nomenclature for herpetofauna and mammals follows that of the current Western Australian Museum checklist of terrestrial vertebrate fauna and Avifauna nomenclature follows the Australian Biological Resources Study Federal Australian Faunal Directory (DCCEEW 2024), which predominantly corresponds to the International Ornithological Congress (IOC) Bird List version 13.1 (Gill et al., 2023).

4.4. Survey Limitations

Potential limitations and survey specific constraints are outlined in Table 4.10.

Table 4.10: Survey Limitations & Constraints

Potential Constraint	Limitation	Comment
Availability of the contextual information at a regional and local scale.	No	• Database searches provided adequate information to guide field survey design and effort for the given scope. There were multiple assessments conducted within the Study Area that were included in the desktop study.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	• The field team was led by a Senior Zoologist with eight years of knowledge and experience conducting fauna surveys in the Pilbara bioregion.
Timing/weather/season/cycle.	Potentially	• The field survey timing was considered appropriate for surveying mammals in the Pilbara bioregion but was suboptimal for reptiles and birds due to the cool weather, and limited rainfall in the two months leading up to the survey.

Potential Constraint	Limitation	Comment
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	• No significant or recent disturbances were recorded at the Survey Area that would have affected the survey results.
Remoteness and/or access problems. Area fully surveyed.	Yes	• Not every part of the Survey Area was ground-truthed or sampled, as parts of the Survey Area were inaccessible by vehicle. However, habitat verification was conducted via ground-truthing in conjunction with aerial imagery, geology, elevation contours and land systems mapping. • At Breakaway, habitat assessments and foot traverses were completed in habitats considered to represent the range of landforms and vegetation units present in the Survey Area. • Access to Marillana South was limited and could not be adequately surveyed.
The proportion of the task achieved and further work which might be needed.	No	• All components of a targeted assessment were completed. • Although habitats were assessed for suitability to support Night Parrot, passive acoustic monitoring did not form part of the scope and was not conducted.
Survey Effort	No	• A targeted survey was adequate to fulfill the scope at Breakaway. Targeted searches for MNES fauna species were completed within areas of prospective habitat. However, access to Marillana South was limited. • A suitable number of cameras and bat call recorders were deployed and over 54.2 km of foot traverses were conducted.

5. DESKTOP STUDY RESULTS

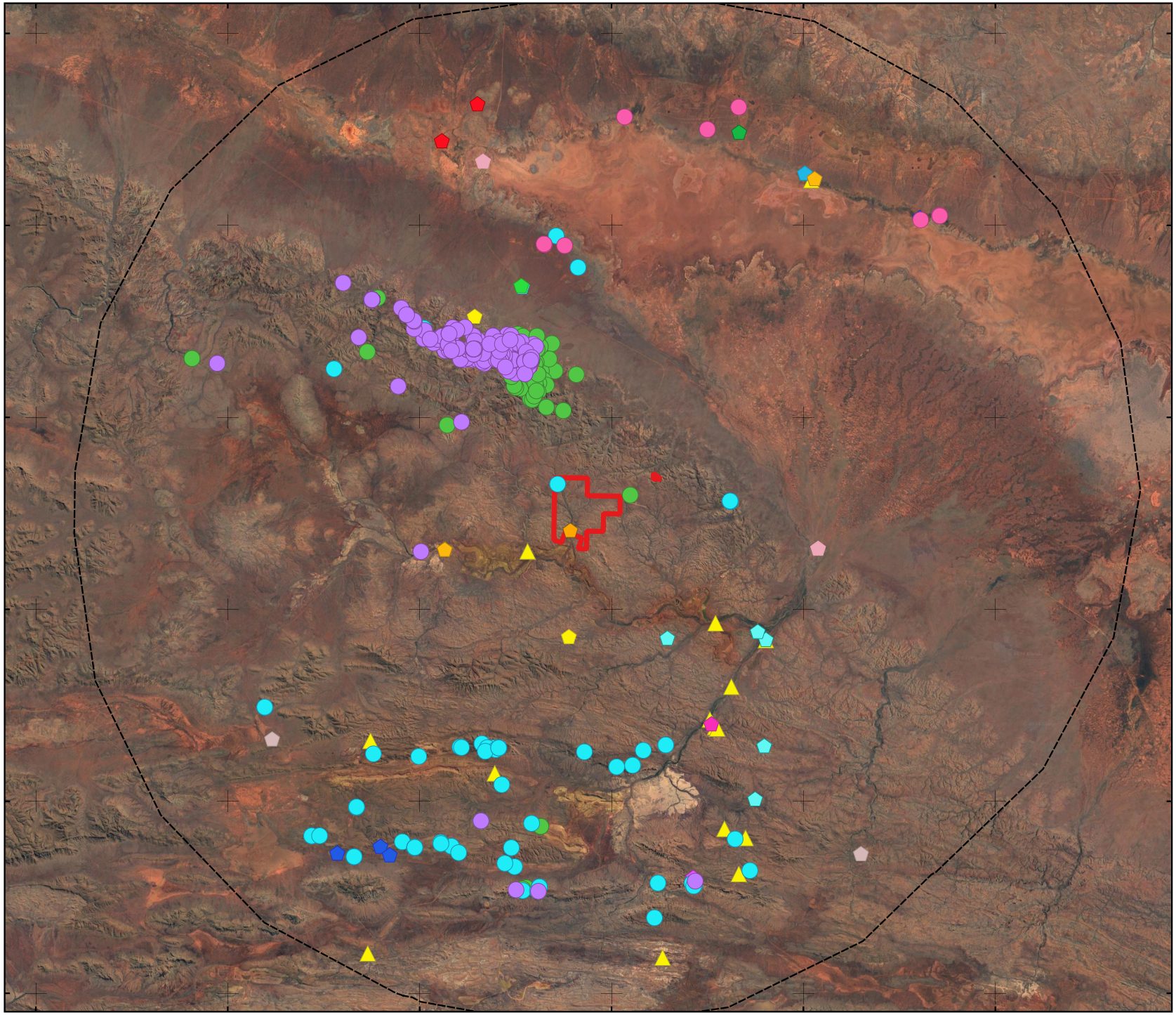
5.1. MNES Fauna

The desktop study identified 27 MNES species potentially occurring within the Survey Area (four mammals, 21 birds and two reptiles; Table 5.1 and Map 5.1). The Bridled Tern (*Onychoprion anaethetus*; EPBC Act & BC Act MI) has previously been recorded in the Survey Area.

Table 5.1: MNES Fauna Potentially Occurring in the Survey Area Locality

Common Name	Species Name	Conservation Status		Database Record			Previously Recorded in Survey Area
		EPBC Act	BC Act	PMST	DBCA	ALA	
Mammals							
Northern Quoll	*Dasyurus hallucatus*	EN	EN	✓	✓		N
Bilby	*Macrotis lagotis*	VU	VU	✓	✓		N
Pilbara Leaf-nosed	*Rhinonicteris*	VU	VU	✓	✓	✓	N
Ghost Bat	*Macroderma gigas*	VU	VU	✓	✓	✓	Y (Biologic, 2024)
Birds							
Curlew Sandpiper	*Calidris ferruginea*	CR, MI	CR	✓			N
Night Parrot	*Pezoporus*	EN	CR	✓	✓		N
Southern Giant Petrel	*Macronectes*	EN, MI	MI		✓		N
Australian Painted	*Rostratula australis*	EN; MI	EN	✓			N
Grey Falcon	*Falco hypoleucos*	VU	VU	✓	✓		N
Southern Whiteface	*Aphelocephala leucopsis*	VU	–	✓		✓	N
Pacific Swift	*Apus pacificus*	MI	MI	✓	✓	✓	N
Barn Swallow	*Hirundo rustica*	MI	MI	✓			N
Oriental Plover	*Charadrius veredus*	MI	MI	✓			N
Common Sandpiper	*Tringa hypoleucos*	MI	MI	✓		✓	N
Sharp-tailed	*Calidris acuminata*	MI	MI	✓			N
Pectoral Sandpiper	*Calidris melanotos*	MI	MI	✓			N
Wood Sandpiper	*Tringa glareola*	MI	MI	✓	✓	✓	N
Common Greenshank	*Tringa nebularia*	MI	MI		✓		N
Gull-billed Tern	*Gelochelidon nilotica*	MI	MI		✓		N
Caspian Tern	*Hydroprogne caspia*	MI	MI		✓		N
Bridled Tern	*Onychoprion anaethetus*	MI	MI			✓	Y (ALA)
Glossy Ibis	*Plegadis falcinellus*	MI	MI		✓		N
Osprey	*Pandion haliaetus*	MI	MI		✓		N
Eastern Yellow	*Motacilla*	MI	MI	✓			N
Grey Wagtail	*Motacilla cinerea*	MI	MI	✓			N
Reptiles							
Pilbara Olive Python	*Liasis olivaceus*	VU	VU	✓	✓	✓	N
Great Desert Skink	*Liopholis kintorei*	VU	VU	✓			N

CR- Critically Endangered; EN- Endangered; VU- Vulnerable; MI- Migratory.



Legend

- Survey Area
- 50 km buffer

Mammals

- Bilby
- Ghost Bat
- Northern Quoll
- Pilbara Leaf-nosed Bat

Migratory Birds

- Bridled Tern
- Caspian Tern
- Common Greenshank
- Common Sandpiper
- Fork-tailed Swift
- Glossy Ibis
- Gull-billed Tern
- Osprey
- Southern Giant Petrel
- Wood Sandpiper

Birds

- Grey Falcon
- Night Parrot
- Southern Whiteface

Reptiles

- Pilbara Olive Python

N

0 5 10 15 km

Scale 1:552,999.999436 @ A4

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

Spectrum ECOLOGY • SPATIAL

Author: GF

Date: 15-05-2024

MNES Fauna Desktop Results

BHP Breakaway and Marillana South

MAP

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5.1

6. SURVEY RESULTS & DISCUSSION

6.1. Fauna Habitat

Based on a landscape approach (see Section 4.2.3) two broad fauna habitats were noted in the Survey Area (Table 6.1). Landscapes and a subset of landforms relevant to the targeted MNES fauna are presented in Map 6.1.

Table 6.1: Fauna habitats within the Survey Area

Landscape	Landform	Extent within Survey Area (ha)	% within Survey Area
Ironstone Hills	• Breakaway; • Hillcrest/ Upper Hillslope; • Hillslope; and • Stony Plain.	2,921.6	92.3
Drainage lines	• Major Drainage Line; and • Minor Drainage Line	244.1	7.7

6.1.1. Ironstone Hills

Ironstone Hills comprised almost 2,921 ha within the Survey Area, of which over 106 ha consists of breakaway landform (Map 6.1; Table 6.1). Vegetation typically comprises *Eucalyptus leucophloia* or *Corymbia hamersleyana* isolated trees, over *Acacia* spp. sparse shrubland, over *Triodia wiseana* hummock grassland, on stony loam soils (Plate 6.1; Plate 6.2).

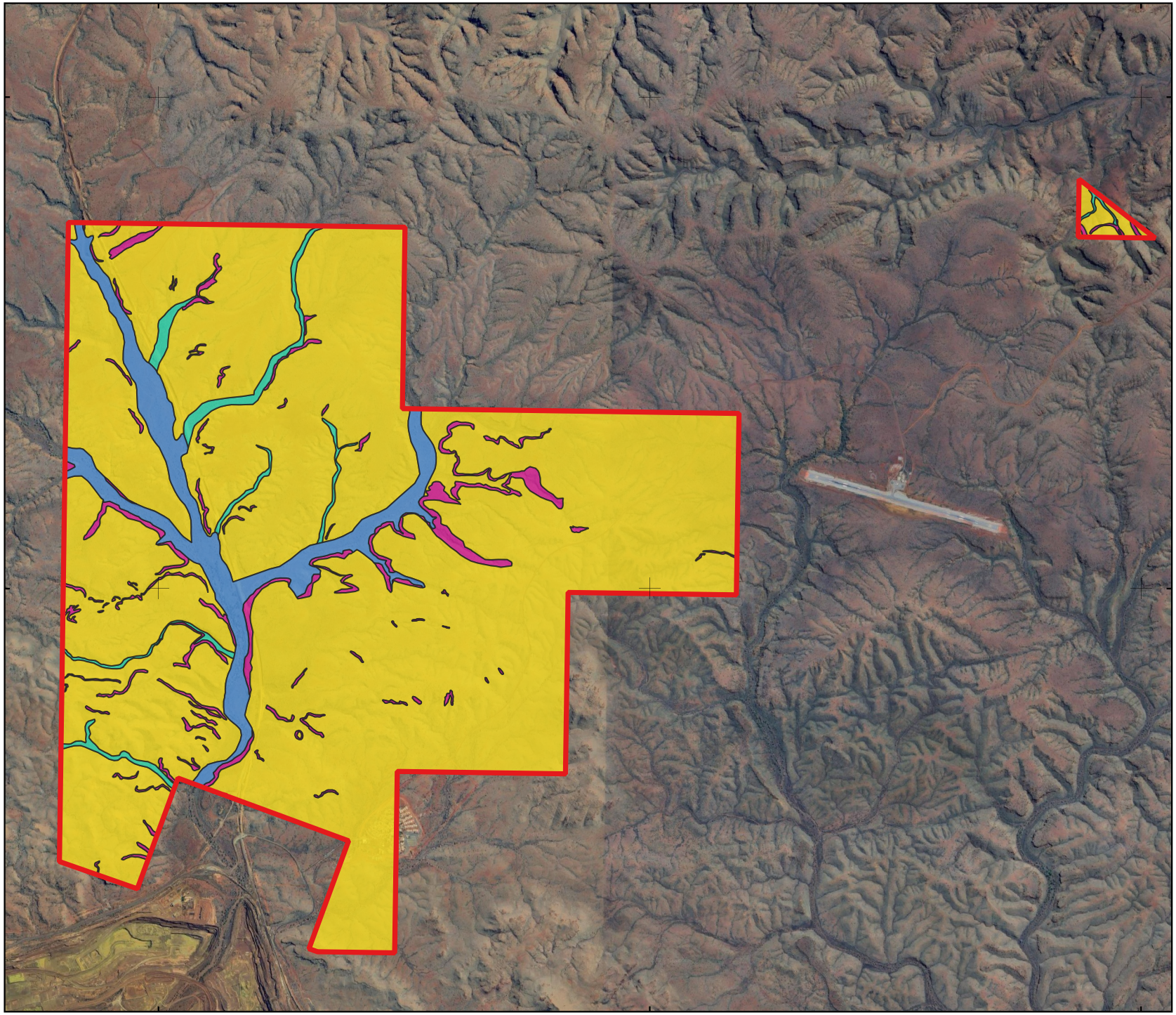
Plate 6.1: Stony Plain landform on Ironstone Hills.

Plate 6.2: Breakaway, Hillslope and Hillcrest landforms on Ironstone Hills.

6.1.2. Drainage Lines

Drainage lines comprised over 244 ha within the Survey Area, of which 191 ha comprises Major Drainage Line and 53 ha comprises Minor Drainage Line (Map 6.1; Table 6.1). Drainage lines with Survey Area typically contain *Eucalyptus Victrix* open woodland, over *Acacia* spp. shrubland, over *Triodia* sp. open hummock grassland (Plate 6.3).

Plate 6.3: Major Drainage Line landform.



Legend

- Survey Area

Fauna Habitats

- Breakaway
- Hillslope, Hillcrest and Stony Plain
- Major Drainage Line
- Minor Drainage Line

N

0 1 2 km

Scale 1:54,000 @ A4

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

Spectrum Ecology & Spatial

Author: DK

Date: 15/05/2024

Fauna Habitat Types

BHP Breakaway and Marillana South

MAP

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BHP WAIO

6.1

6.2. Fauna Species

6.2.1. Vertebrate Fauna Recorded

A total of 27 vertebrate fauna species were recorded during the survey: 17 native mammals, two introduced mammals, five birds, three reptiles. No MNES fauna species were recorded during the survey either by direct observation or secondary sign. One species, the Western-pebble Mound Mouse was recorded which is listed as DBCA Priority 4. Table 6.2 outlines the fauna recorded during the survey.

Table 6.2: Vertebrate Fauna Recorded from Survey Area

Species	Common Name	Conservation Status		
		EPBC Act	BC Act	DBCA
Mammals				
Tachyglossus aculeatus	Short-beaked Echidna			
Planigale tealei	Mt Tom Price Planigale			
Pseudantechinus woolleyae	Woolley's Pseudantechinus			
Osphranter robustus	Euro			
Pseudomys chapmani	Western-pebble Mound Mouse			P4
Zyzomys argurus	Rock Rat			
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat			
Taphozous georgianus	Common Sheathtail Bat			
Austronomus australis	White-striped Free-tailed Bat			
Chaerophon jobensis	Greater Northern Free-tailed Bat			
Ozimops lumsdenae	Northern Free-tailed Bat			
Chalinolobus gouldii	Gould's Wattled Bat			
Chalinolobus morio	Chocolate Wattled Bat			
Nyctophilus daedalus	Pallid Long-eared Bat			
Nyctophilus geoffroyi	Lesser Long-eared Bat			
Scotorepens greyii	Little Broad-nosed Bat			
Vespadelus finlaysoni	Finlayson's Cave Bat			
**Canis familiaris*	Wild Dog			
**Felis catus*	Feral Cat			
Birds				
Ocyphaps lophotes	Crested Pigeon			
Ptilotula keartlandi	Grey-headed Honeyeater			
Cracticus nigrogularis	Pied Butcherbird			
Colluricincla harmonica	Grey Shrike-thrush			
Rhipidura leucophrys	Willie Wagtail			
Reptiles				
Ctenotus saxatilis	Rock Ctenotus			
Morethia ruficauda	Fire-tailed Skink			
Varanus acanthurus	Spiny-tailed Monitor			
Total: 27				

* = introduced species; P4- DBCA Priority 4 listing.

6.2.2. MNES Fauna

Of the 27 MNES species identified as having the potential to occur in the Survey Area, two are known to occur within the Survey Area and eight are considered to have high or medium likelihood of occurrence (Table 6.3). These are described in further detail below.

6.2.2.1. Northern Quoll (*Dasyurus hallucatus*)

Conservation Status: EPBC Act Endangered; BC Act Endangered.

Distribution, Habitat and Ecology: The Northern Quoll is the smallest of the four Australian quoll species (Oakwood, 2008). The species formerly occurred across the northern parts of Australia. Since the arrival of the Cane Toad (*Rhinella marina*), the distribution of Northern Quoll has declined, especially in the more arid parts of its range (DCCEEW 2023b). In the Pilbara, Northern Quolls utilise rocky habitats during the day, sheltering in crevices, cracks and small caves. Critical denning habitats include rocky gorges, basalt hills, escarpments, mesas, plateau, granite boulder piles, caves, and breakaway and free faces, but also along coastal fringes and beaches (DCCEEW 2023b). Foraging may also occur in any adjacent habitat that provides suitable cover and food resources. Drainage lines are used for dispersal and as foraging habitat.

Northern Quoll populations are subject to fluctuation, driven by both the reproductive biology of the species and in response to regional stochastic processes such as rainfall, fire and related changes of prey populations (How et al., 2009). The species is adaptable and has also been recorded in artificial habitat such as rock armour underneath bridges, in quarries, camp sites and along breakwaters (DMP 2013; Ecologia 2012; Ecoscape 2016) The Northern Quoll is an omnivorous, opportunistic feeder that mostly consumes insects, fruits, vegetation, molluscs and vertebrate species including mammals, birds, reptiles and frogs (Dunlop et al., 2017).

Likelihood of Occurrence: A recent Northern Quoll record was recorded within 1 km east of the Breakaway Survey Area (Map 5.1). Additionally, approximately 200 records have been recorded ~10 km north of the Breakaway Survey area in the vicinity of Rio Tinto's Gudai-Darri mine. Suitable habitat exists within the Survey Area, so the Northern Quoll has a high likelihood of occurrence.

6.2.2.2. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

Conservation Status: EPBC Act Vulnerable; BC Act: Vulnerable.

Distribution, Habitat and Ecology: The Pilbara Leaf-nosed Bat is endemic to the Pilbara and Ashburton regions of Western Australia. It occurs in an isolated population, separate from the Orange Leaf-nosed Bat, that occurs in northern Australia (Armstrong, 2006b). Pilbara Leaf-nosed Bats differ genetically and morphologically, and they have slightly different call characteristics (Armstrong, 2001, 2003, 2006a). Their occurrence is influenced by the availability of suitable maternity roost caves (permanent diurnal roosts) that are considered critical for the survival of the species. Maternity roosts occur within 10 km of permanent water (Bullen, 2021; DCCEEW 2023). Their breeding cycle extends over a 9-month period, with mating taking place in July and the dispersal of independent young in February/March (Churchill, 2008; DCCEEW, 2023).

Pilbara Leaf-nosed Bats are insectivorous, with a large proportion of their diet consisting of moths, termites and beetles. Foraging habitat comprises *Triodia* hummock grassland, savannah, gorges, and riparian vegetation (Bullen, 2021; Duncan et al., 1999). Individuals may forage up to 20 km from a maternity roost during the dry season and further in the wet season (Bullen, 2021).

The bats emerge from their nocturnal roost after dusk and forage along rock faces, rocky gullies, gorges, and creek lines and water holes (Churchill, 2009; Department of the Environment, 2018). Individuals are vulnerable to the loss of body heat and moisture, and therefore require a stable warm microclimate.

Likelihood of Occurrence: A documented maternity roost is located approximately 14 km northwest of the Survey Area in the vicinity of Rio Tinto's Gudai-Darri mine (Map 5.1). Although there is no documented maternity roost occurring within the Survey Area, there is potential for Pilbara Leaf-nosed Bats to forage, or temporarily seek refuge within the Survey Area, particularly in the wet season.

6.2.2.3. Ghost Bat (*Macroderma gigas*)

Conservation Status: EPBC Act Vulnerable; BC Act Vulnerable.

Distribution, Habitat and Ecology: The Ghost Bat is a large carnivorous bat that once occurred across much of Australia but is now only known from isolated locations in northern Australia. (Armstrong & Anstee, 2000; Bat Call WA, 2021). The Ghost Bat is a carnivorous predator that hunts bats, rodents, invertebrates, and birds (Boles, 1999; Ecoscape 2018; Pettigrew et al., 1986). Prey detection is through a combination of passive listening, vision, and echolocation (Pettigrew et al., 1988). They have been documented to forage over a range of approximately 60 ha, with the size of their foraging area inversely related to the productivity of the landscape (Churchill, 2008).

Ghost Bats use a range of cave structures as short-term transient feeding roosts, long-term roosts and maternity roots (DCCEEW 2023c), with distribution partially influenced by the availability of suitable roosting caves (Churchill, 2008). Females and males aggregate for breeding during the dry season, giving birth in mid-October to late November in the Pilbara (Bullen, 2021), with young nursed over the wet season (Toop, 1985).

Likelihood of Occurrence: Three caves with suitable roosting characteristics were identified by Biologic (2024), one of which Ghost Bat scats were identified (Map 5.1). The breakaway habitat within the Survey Area is conducive to cave formation and as a result, Ghost Bats are deemed to have a high likelihood of occurrence.

6.2.2.4. Grey Falcon (*Falco hypoleucos*)

Conservation Status: EPBC Act Vulnerable; BC Act Vulnerable.

Distribution, Habitat and Ecology: The Grey Falcon is Australia's rarest falcon with an estimated population size of <1000 individuals (Schoenjahn, 2013). They occur in a wide variety of arid and semi-arid zones across an area of about 5 million km^2 (Schoenjahn et al., 2020), with temperature and rainfall influencing the distribution of the species (Schoenjahn et al., 200). Breeding habitat appears to be localised in zones with the highest annual average temperatures, and in areas with persistently dry and winter drought climatic conditions (Schoenjahn, 2013).

Grey Falcons are frequently recorded on lightly wooded plains and along major watercourses breeding in taller trees such as river gums, or on isolated anthropogenic structures such as communications towers (Johnstone et al, 2013). Nests are often used over several years and can be near nests of other falcons or raptor species (Schoenjahn, 2013). They forage in open landscapes such as rocky plains with hummock grasslands, lower shrublands, and minor drainage lines where they predominantly prey on birds, mainly pigeons and parrots (Olson and Olson, 1986; Schoenjahn, 2013).

Likelihood of Occurrence: The closest Grey Falcon record is a 2014 sighting, located approximately 13 km north of the Survey Area in rugged hills of the Newman land system (Map 5.1). Suitable habitat exists within the Survey Area and thus, the Grey Falcon has a high likelihood of occurrence.

6.2.2.5. Southern Whiteface (*Aphelocephala leucopsis*)

Conservation Status: EPBC Act Vulnerable

Distribution, Habitat and Ecology: The Southern Whiteface is a small bird, distributed throughout the drier regions of southern mainland Australia (Pizzey & Knight, 2012). This species favours dry open forest/woodland and inland scrubs such as mallee, mulga, cypress pine and saltbush. It forages almost exclusively on the ground, targeting insects, spiders, and seeds (Antos and Bennett, 2006; Antos, Bennett and White, 2008). The population has declined substantially by an estimated 30 to 50% every ten years since 1999, with no indication that the declines are slowing (Ehmke et al., 2021).

Breeding occurs from July to October, but the timing of breeding can be affected by rainfall in arid regions (Johnstone and Storr, 2004). They build a large domed nest of grass, bark and roots, usually in a hollow (Johnstone and Storr, 2004).

Likelihood of Occurrence: Recorded in 2007 approximately 36 km south of Survey Area, within similar rugged habitat to that of the Survey Area (Map 5.1). This species is deemed to have a medium likelihood of occurrence in the Survey Area.

6.2.2.6. Pacific Swift (*Apus pacificus*)

Conservation Status: EPBC Act Migratory; BC Act Migratory

Distribution, Habitat and Ecology: The Pacific swift is a migratory, non-breeding visitor to Australia from September to April. Within Western Australia, it is abundant in coastal areas of the Pilbara, and Kimberley regions (DCCEEW 2023a). The species is known to be highly nomadic, rarely landing, spending much of their time foraging in large flocks high above the canopy. The species is known to be insectivorous, but its food source is relatively unknown within Australia (Menkhorst et al., 2019).

Likelihood of Occurrence: The Pacific Swift was not recorded during the survey. However, 14 individuals were recorded approximately 20 km southeast of Survey Area in 2011 (Map 5.1). Pacific Swifts are highly mobile and may fly over the Survey Area sporadically between September and April. This species is deemed to have a medium likelihood of occurrence in the Survey Area.

6.2.2.7. Bridled Tern (*Onychoprion anaethetus*)

Conservation Status: EPBC Act Migratory; BC Act Migratory

Distribution, Habitat and Ecology: Typically occurs on sheltered coasts, offshore islands, estuaries and large inland wetlands. This species breeds in colonies on rocky islands. Diet predominantly comprises marine fish.

Likelihood of Occurrence: One vagrant individual was recorded in the Survey Area in 2011. Critical and supporting habitat for this species is absent from the Survey Area.

6.2.2.8. Other Migratory Shorebirds

The desktop study returned a small number of records of the following migratory shorebirds in the Survey Area locality: Common Sandpiper (*Actitis hypoleucos*) and Common Greenshank (*Tringa nebularia*). Being wader species, habitat within the Survey Area is sub-optimal. However, it is possible that drainage lines may be utilised periodically following heavy rainfall. No individuals were recorded in the current survey.

6.2.2.9. Pilbara Olive Python (*Liasis olivaceus barroni*)

Conservation Status: EPBC Act Vulnerable; BC Act Vulnerable.

Distribution, Habitat and Ecology: The Pilbara Olive Python is a geographically isolated subspecies of Olive Python. Individuals typically occur near water or in pools where they ambush prey such as birds, rodents, bats and wallabies (Ellis, 2010; Pearson, 2003; Wilson & Swan, 2021). During the cooler months, they will shelter in caves and rock crevices, away from water (DEWHA 2008). Male Pilbara Olive Pythons travel up to

4 km during the winter months in search of females, with home ranges thought to be up to 450 ha (Pearson, 2003).

Where conditions are optimal, eggs are laid in Spring with young hatching at the start of the wet season (December-January). Once hatched, the young will disperse whilst foraging conditions for reptiles are ideal (Pearson, 2003).

Likelihood of Occurrence: Multiple records occur in the Survey Area locality (Map 5.1) with suitable habitat occurring in the Survey Area in the form of major Drainage Lines Hillslopes and Breakaways. As a result, there is a high likelihood of occurrence within the Survey Area.

Table 6.3: MNES Fauna Species Likelihood of Occurrence.

Family & Species	Common Name	Conservation Status		Preferred Habitats	Habitat Available	Locality Records	Likelihood of Occurrence
		EPBC Act	BC Act				
MAMMALS							
Macroderma gigas	Ghost Bat	VU	VU	Wide variety of habitats with suitable roosts (caves, rock piles and abandoned mines). Will travel 2 km from roost to hunt and utilise other structures as feeding roosts (culverts, rock overhangs, trees).	✓	Scats were recorded within the Survey Area in 2022 (Biologic, 2024).	Recorded
Dasyurus hallucatus	Northern Quoll	EN	EN	Most common on dissected rocky escarpments, gorges and boulder piles. Typically, rocky areas with suitable denning sites and access to surface water. Typically utilise major drainage lines and treed creek lines for movements and dispersal.	✓	One individual recorded in 2018, 1 km E of the Breakaway Survey Area. Approximately 200 records ~ 10 km N of the Breakaway Survey area in the vicinity of Rio Tionto's Gudai-Darri mine.	High
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	VU	Occurrence influenced by the availability of suitable roost caves that offer high humidity and a stable temperature. Restricted to caves with semi-permanent or permanent water nearby, usually in rocky habitat. Foraging typically occurs over open grasslands in gorges, low hills and plains.	✓	Closest record ~11 km WNW of the Survey Area. Known maternity roost ~14 km NW of the Survey Area.	Medium
Macrotis lagotis	Bilby	VU	VU	Variety of habitats with suitable soil substrates and availability of food resource plants species. Habitats can include *Triodia* grassland plains, *Acacia* shrubland, mulga woodland and cracking clays.	–	Three individuals recorded in 2012 & 2013 ~27 km N of the Survey Area on alluvial plain, adjacent to Fortescue Marsh.	Low
BIRDS							
Onychoprion anaethetus	Bridled Tern	MI	MI	Sheltered coasts, offshore islands, estuaries and large inland wetlands.	–	One individual recorded within the Survey Area in 2011.	Recorded
Actitis hypoleucos	Common Sandpiper	MI	MI	Narrow steep shorelines and mangrove lined creeks. Also inhabits inland ephemeral wetland habitat.	✓	Two individuals recorded ~10km S from Survey Area in 2022. One individual recorded ~20km NW of Study Area in 2019.	High
Tringa nebularia	Common Greenshank	MI	MI	Inland wetlands and sheltered coastal environments.	✓	Two individuals recorded in 2013 ~5km SW of the Study Area.	High
Falco hypoleucos	Grey Falcon	VU	VU	Generally open plains and woodland habitats in arid interior.	✓	13 km N of the Survey Area, recorded in 2014.	High
Apus pacificus	Pacific Swift	MI	MI	Nomadic, almost entirely aerial lifestyle over a variety of habitats; mostly occurring over inland plains, associated with storm fronts.	✓	14 individuals recorded ~20km SE of Survey Area in 2011.	Medium
Aphelocephala leucopsis	Southern Whiteface	VU	–	Dry open forest/woodland and inland scrubs such as mallee, mulga, cypress pine and saltbush.	✓	One individual recorded in 2007 ~35km SE of Survey Area.	Medium
Hydroprogne caspia	Caspian Tern	MI	MI	Sheltered coasts, offshore islands, estuaries and large inland wetlands.	–	Closest recorded is ~40 km N of the Survey Area at Fortescue Marsh.	Low
Gelochelidon nilotica	Gull-billed Tern	MI	MI	Sheltered coasts, offshore islands, estuaries and large inland wetlands.	–	One individual recorded ~20 km N in 2012 and one individual recorded 35 km N in 2017.	Low
Charadrius veredus	Oriental Plover	MI	MI	Open areas such as grasslands and sparsely vegetated plains. During hottest parts of the day collects in large flocks on wet ground associated with wetlands.	✓	Species not recorded within 50km of Survey Area.	Low
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	Shallow wetlands with muddy edges and emergent grass, sedges and low vegetation. Near the coast they frequent lagoons, swamps, lakes and pools and inland, dams, waterholes, saltpans, bore swamps and drains.	✓	Species not recorded within 50km of Survey Area.	Low
Tringa glareola	Wood Sandpiper	MI	MI	Shallow freshwater wetlands with taller, dense, fringing vegetation.	–	Two individuals recorded in 2022 within ~50km SE of Survey Area by a water body with rocky edges. Four individuals recorded in 2011 ~35km SW of the Survey Area. Eleven individuals recorded ~40km NE of Survey Area in 2009.	Low
Plegadis falcinellus	Glossy Ibis	MI	MI	Freshwater waterbodies, marshes, lakes and river lagoons, flood-plains, wet meadows, swamps, sewage ponds. Occasionally found in estuarine waters or dry grassland (Menkhorst et al., 2019; Morcombe, 2003).	✓	One individual recorded 35 km N in 2017.	Low
Pandion haliaetus	Osprey	MI	MI	Coastal and terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers (Menkhorst et al., 2019).	–	One individual recorded ~18 km E in 2011 and one individual recorded ~33 km N in 2012.	Low

Family & Species	Common Name	Conservation Status		Preferred Habitats	Habitat Available	Locality Records	Likelihood of Occurrence
		EPBC Act	BC Act				
Pezoporus occidentalis	Night Parrot	CR	EN	Arid or semi-arid environments. Recorded from long unburnt *Triodia* grasslands and/or Chenopod shrublands featuring large dense clumps of vegetation.	–	Species not recorded within Survey area or surroundings.	Low
Rostratula australis	Australian Painted Snipe	EN; MI	EN	Shallow terrestrial freshwater wetlands, permanent and temporary lakes, claypans and swamps. Typical habitat comprises grass and sedges.	–	Species not recorded within 50km of Survey Area.	Very low
Macronectes giganteus	Southern Giant Petrel	EN, MI	MI	Southern oceans, will enter bays and harbours. Rarely found on mainland.	–	One individual recorded in 2011 ~22 km SE of Survey Area.	Very Low
Calidris ferruginea	Curlew Sandpiper	CR; MI	CR; MI	Intertidal mudflats in sheltered coastal areas. Less often inland around water bodies with muddy and sandy bare edges.	–	Species not recorded within 50km of Survey Area.	Very low
Calidris melanotos	Pectoral Sandpiper	MI	MI	Shallow coastal wetlands with open mudflats and low vegetation.	–	Species not recorded within 50km of Survey Area. Suitable habitat does not occur in Survey Area.	Very low
Erythrotriorchis radiatus	Red Goshawk	EN	EN	Coastal and subcoastal in forest and wooden lands in tropical and warm-temperate environments.	✓	Species not recorded within the Survey area or surroundings. Nearest record ~650 km NE of Survey Area.	Very low
Hirundo rustica	Barn swallow	MI	MI	Open country in coastal lowlands and near water. Preference for accessible anthropogenic structures.	–	Species not recorded within the Survey Area or surroundings. Nearest Record ~350 km NE of Survey Area. No suitable habitat available in the Survey Area.	Very low
Motacilla flava	Eastern Yellow Wagtail	MI	MI	Wetlands with low vegetation, including marshes, wet meadows and muddy lakeshores.	–	No records within Survey area and surroundings. Nearest Record ~280 km NNW of Survey Area.	Very Low
Motacilla cinerea	Grey Wagtail	MI	MI	Near flowing water and rocky habitat. Preference for areas with trees, branches and exposed roots.	–	No records within Survey area and surroundings. Nearest record ~650 km NE of Survey Area.	Very Low
REPTILES							
Liasis olivaceus barroni	Pilbara Olive Python	VU	VU	Watercourses and rocky gorges and gullies in vicinity of permanent or semi-permanent water.	✓	Multiple records in locality. Closest record ~3km SW of Survey Area.	High
Liopholis kintorei	Great Desert Skink	VU	VU	Arid sand flats and clay-based or loamy soils dominated by *Triodia*.	–	Closest record is ~400 km NE of Survey Area.	Very low

CR-Critically Endangered; EN- Endangered; VU-Vulnerable; MI-Migratory

7. HABITAT SIGNIFICANCE

When assessing habitat value, it is important to determine if it represents critical habitat (as defined in Section 4.2.3). It is assumed that some proportion of critical habitat must be maintained across the species' range to ensure their persistence in the region.

Considering the above, in combination with MNES species habitat preferences, three habitats represent critical habitat in the Survey Area:

- Breakaways;
- Major Drainage Lines; and
- Minor Drainage Lines.

These habitats are relevant to the MNES species with high or medium likelihood of occurrence within the Survey Area (Table 7.1). Based on aerial imagery, land systems mapping, and supported by Kendrick (2001), the fauna habitats identified in the Survey Area also occur more broadly within the Hamersley subregion.

Table 7.1: Habitat significance of MNES species with high or medium likelihood of occurrence.

Species	Common Name	Breakaways	Major Drainage Lines	Minor Drainage Lines
Dasyurus hallucatus	Northern Quoll	Critical	Critical	–
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	Critical	Supporting	Supporting
Macroderma gigas	Ghost Bat	Critical	Supporting	Supporting
Falco hypoleucos	Grey Falcon	–	Critical	Critical
Aphelocephala leucopsis	Southern Whiteface	–	Supporting	Supporting
Apus pacificus	Pacific Swift	Supporting	Supporting	Supporting
Onychoprion anaethetus	Bridled Tern	–	–	–
Actitis hypoleucos	Common Sandpiper	–	Supporting	–
Tringa nebularia	Common Greenshank	–	Supporting	–
Liasis olivaceus barroni	Pilbara Olive Python	Critical	Critical	Supporting

8. GLOSSARY

BC Act	State Biodiversity Conservation Act 2016.
BHP WAIO	BHP Western Australian Iron Ore.
DBCA	Department of Biodiversity, Conservation and Attractions.
DCCEEW	Department of Climate Change, Energy, the Environment and Water.
EPA	Environmental Protection Authority of Western Australia.
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
IBRA	Interim Biogeographic Regionalisation for Australia.
Landform	A geomorphological unit that is largely defined by its surface form and location in the study area.
MNES species	Species that are listed as Matters of National Environmental Significance under the EPBC Act.
Spectrum	Spectrum Ecology and Spatial.
Study Area	50 km buffer from the Survey Area in which the desktop study was conducted.
Survey Area	The area in which the targeted survey was completed, as defined by BHP WAIO and the following tenements: i. Breakaway tenement E47/1239 comprising 3,143 ha; and ii. Marillana South tenement E47/4245 comprising 23 ha.
Taxa (singular: taxon)	Taxonomic groups of any rank, such as a species, family, or class.

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Appendix A: Conservation Categories

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

Category	Definition
Extinct (EX)	There is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	The species is known to survive only in cultivation or in captivity, or as a naturalised population well outside its past range.
Critically Endangered (CR)	The species is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	the species is not critically endangered, but it is facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	The species is not critically endangered or endangered, but it is facing a high risk of extinction in the wild in the medium-term future.
Conservation Dependent (CD)	The species is the focus of a specific conservation program without which the species would become vulnerable, endangered or critically endangered within five years.
Migratory (MI)	The EPBC Act provides for protection of migratory species as a matter of national environmental significance. Migratory species are those animals that migrate to Australia and its external territories or pass though or over Australian waters during their annual migrations (DotE 2013).(DotE 2013).(DotE 2013).(DotE 2013).(DotE 2013).(DotE 2013). Migratory species are listed under the following international conventions: • Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); • China-Australia Migratory Bird Agreement (CAMBA); • Japan-Australia Migratory Bird Agreement (JAMBA); and, • Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

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

Code	Definition (BC Act)
Threatened Species (T) Published as Specially Protected under the Wildlife Conservation Act 1950, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora). • Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. • Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines".
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines".
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines".
Extinct species Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.	
Extinct species (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the wild species (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form".
Specially protected species 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. 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.	
Migratory species (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program.
Conservation Dependent (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Priority species (P) Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the priority fauna or priority flora Lists maintained by the Department of Biodiversity, Conservation and Attractions.	
Priority 1: Poorly-known species (P1)	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.
Priority 2: Poorly-known species (P2)	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.
Priority 3: Poorly-known species (P3)	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.
Priority 4: Rare, Near Threatened and other species in need of monitoring (P4)	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B: Survey Sites

Survey Site	Method	Date	Easting (mE)	Northing (mN)	Landform	Fire Age (years)	Condition	Habitat Description
BMBat01	Bat Recorder	2023-09-06	715791	7489242	Breakaway	2-5	Very Good	Breakaway; *Eucalyptus leucophloia* isolated trees , over mixed sparse shrubland, over T*riodia* sp. hummock grassland and tussock grassland.
BM01	Targeted Search	2023-06-08	717146	7486506	Minor Drainage Line	> 5	Very Good	Minor drainage; *Eucalyptus* sp. isolated trees, over *Acacia* sp. shrubland, over sedgeland and *Triodia* sp. hummock grassland.
BM02	Targeted Search	2023-06-08	716876	7486411	Hillslope	2-5	Very Good	Hillslope; sparse *Acacia* spp. shrubland, over *Triodia* sp. hummock grassland.
BM03	Targeted Search	2023-06-09	714415	7492418	Hillcrest/ Upper Hillslope	> 5	Very Good	Hill crest; *Corymbia deserticola* and *Eucalyptus leucophloia* isolated trees, over *Acacia* spp. shrubland, over *Triodia* sp. hummock grassland.
BM04	Bat Recorder Targeted Search	2023-06-09	714654	7492659	Minor Drainage Line	2-5	Very Good	Minor drainage; *Corymbia hamersleyana* isolated trees, over *Acacia* sp. and *Eromophila* sp. shurbland, over mixed tussock grassland.
BM05	Targeted Search	2023-06-09	714808	7491503	Hillslope	1-2	Very Good	Hillslope; *Corymbia* sp. isolated trees over *Acacia* sp. sparse shrubland, over *Triodia* sp. hummock grassland.
BM06	Targeted Search	2023-06-09	714724	7491435	Hillslope	> 5	Very Good	*Eucalyptus leucophloia* isolated trees over *Acacia* sp. shrubland, over Triodia sp. hummock grassland.
BM07	Bat Recorder Targeted Search Motion Camera	2023-06-09	715325	7490397	Major Drainage Line	2-5	Very Good	Major drainage; *Eucalyptus victrix* isolated trees, over *Acacia* sp. Shrubland, over mixed tussock grasses.
BM08	Targeted Search Motion Camera	2023-06-09	715682	7489289	Breakaway	2-5	Very Good	Breakaway; *Eucalyptus leucophloia* isolated trees, over *Acacia* spp. shrubland, over *Triodia* sp. hummock grassland.
BM09	Bat Recorder Targeted Search	2023-06-09	715516	7488190	Major Drainage Line	2-5	Very Good	Major drainage; *Eucalyptus victrix* open woodland, over *Acacia* spp. shrubland, over mixed tussock grasses.
BM10	Targeted Search	2023-06-09	714691	7487181	Hillcrest/ Upper Hillslope	> 5	Very Good	Hill crest; *Eucalyptus leucophloia* isolated trees, over *Grevillea wickhamii* sparse shrubland, over T*riodia wiseana.*
BM11	Targeted Search	2023-06-10	714954	7493360	Hillcrest/ Upper Hillslope	> 5	Very Good	Hill crest; *Corymbia hamersleyana* isolated isolated trees over *Grevillea wickhamii* sparse shrubland, over *Triodia* sp.
BM12	Targeted Search	2023-06-10	714906	7492605	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope; *Corymbia hamersleyana* isolated trees, over *Grevillea wickhamii* and *Acacia* spp. shrubland, over *Triodia wiseana.*
BM13	Bat Recorder Targeted Search	2023-06-10	715410	7491750	Major Drainage Line	2-5	Very Good	Major drainage; *Corymbia hamersleyana*. over mixed shrub over mixed grasses.
BM14	Targeted Search	2023-06-10	715463	7491349	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope; *Eucalyptus gamophylla* isolated trees, over *Tecticornia* sp. sparse shrubland, over *Triodia* sp. Hummock grassland.
BM15	Targeted Search Motion Camera	2023-06-10	715660	7490765	Breakaway	2-5	Very Good	Breakaway above drainage; *Eucalyptus leucophloia* and *Corymbia hamersleyana*. over *Grevillea wickhamii* open shrubland, over *Triodia* sp. hummock grassland.
BM16	Bat Recorder Targeted Search	2023-06-10	716162	7490120	Major Drainage Line	2-5	Very Good	Major drainage; *Eucalyptus victrix* open woodland, over *Acacia* sp. shrubland, over mixed tussock grasses.
BM17	Targeted Search Motion Camera	2023-06-10	716306	7488657	Breakaway	2-5	Very Good	Breakaway and drainage line; *Corymbia* sp. isolated trees over *Acacia* sp. sparse shrubland, over *Triodia* sp. hummock grassland.
BM18	Targeted Search	2023-06-10	716080	7489547	Hillcrest/ Upper Hillslope	2-5	Very Good	Hill crest; *Corymbia* sp. isolated trees over A*cacia* sp. closed shrubland, over *Triodia* sp. hummock grassland.
BM19	Targeted Search	2023-06-10	716037	7488162	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope; *Eucalyptus leucophloia* isolated trees over *Acacia colei* and *Grevillea wickhamii* sparse shrubland, over *Triodia* sp. hummock grassland.
BM20	Bat Recorder Targeted Search Motion Camera	2023-06-11	724426	7493593	Hillslope	2-5	Very Good	Hillslope; *Eucalyptus leucophloia* isolated trees over *Acacia* sp. open shrubland, over *Triodia* sp. hummock grassland.
BM21	Targeted Search	2023-06-11	724601	7493389	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope; *Eucalyptus gamophylla* isolated trees over *Acacia* sp. open shrubland, over *Triodia* sp. hummock grassland.
BM22	Targeted Search	2023-06-11	724839	7492948	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope, *Eucalyptus gamophylla* Isolated trees, over *Acacia* sp. open shrubland, over *Triodia* sp. hummock grassland.
BM23	Targeted Search	2023-06-11	720477	7491450	Minor Drainage Line	2-5	Very Good	Minor drainage; *Corymbia hamersleyana* isolated trees, over *Acacia colei*. shrubland, over *Triodia* sp. hummock grassland.
BM24	Targeted Search	2023-06-11	720586	7490920	Minor Drainage Line	> 5	Very Good	Minor drainage; *Corymbia hamersleyana* Isolated trees, over Acacia colei open shrubland, over Triodia sp. hummock grassland.
BM25	Targeted Search	2023-06-11	720584	7490867	Stony Plain	2-5	Very Good	Plain; *Corymbia* sp. isolated trees, over *Acacia colei* and *Grevillea wickhami* open shrubland, over *Triodia* sp. hummock grassland.
BM26	Bat Recorder Targeted Search	2023-06-11	718954	7490954	Minor Drainage Line	2-5	Very Good	Minor drainage; *Eucalyptus victrix* open woodland, over *Acacia* spp. shrubland, over *Triodia* sp. Hummock grassland and mixed tussock grasses.

Survey Site	Method	Date	Easting (mE)	Northing (mN)	Landform	Fire Age (years)	Condition	Habitat Description
BM27	Targeted Search	2023-06-11	718682	7489985	Hillcrest/ Upper Hillslope	> 5	Very Good	Hillslope; *Grevillea wickhamii* sp. Isolated shrubs, over *Triodia* sp. hummock grassland.
BM28	Targeted Search Motion Camera	2023-06-11	718957	7489220	Minor Drainage Line	2-5	Very Good	Minor drainage; *Corymbia hamersleyana* isolated trees over *Acacia* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM29	Targeted Search Motion Camera	2023-06-11	718681	7489248	Hillcrest/ Upper Hillslope	2-5	Very Good	Minor drainage, *Eucalyptus leucophloia* isolated trees, over *Acacia* spp. sparse shrubland, over *Triodia* sp. Hummock grassland.
BM30	Targeted Search Bat Recorder	2023-06-12	717836	7488547	Minor Drainage Line	2-5	Very Good	Minor drainage. *Eucalyptus leucophloia* isolated trees, over sparse *Acacia* sp. shrubland, over mixed tussock grasses.
BM31	Targeted Search	2023-06-12	717682	7488714	Minor Drainage Line	2-5	Very Good	Minor drainage; *Eucalyptus leucophloia* isolated trees over *Acacia* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM32	Targeted Search	2023-06-12	717588	7488901	Major Drainage Line	> 5	Very Good	Minor drainage; *Eucalyptus leucophloia* isolated trees over *Acacia* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM33	Targeted Search	2023-06-12	717553	7488918	Hillslope	2-5	Very Good	Hillslope, *Eucalyptus leucophloia* isolated trees over *Acacia* sp. and *Senna* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM34	Targeted Search	2023-06-12	717562	7490089	Minor Drainage Line	2-5	Very Good	Minor drainage; *Corymbia* sp. isolated trees over *Acacia* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM35	Targeted Search	2023-07-12	715163	7493252	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope; *Corymbia hamersleyana*. isolated trees, over *Acacia* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM36	Targeted Search	2023-07-12	715185	7493258	Breakaway	2-5	Very Good	Breakaway; *Corymbia deserticola* isolated trees, over *Grevillea wickhamii* and *Acacia* sp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM37	Targeted Search	2023-07-12	715232	7493391	Minor Drainage Line	2-5	Very Good	Minor drainage; *Corymbia hamersleyana* isolated trees, over *Acacia* spp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM38	Targeted Search	2023-07-12	715021	7493679	Minor Drainage Line	2-5	Very Good	Minor Drainage; Hillslope; *Corymbia hamersleyana* isolated trees, over *Acacia* spp. and *Grevillea wickhamii* isolated shrubs, over *Triodia* sp. hummock grassland.
BM39	Targeted Search	2023-07-13	719314	7491140	Minor Drainage Line	2-5	Very Good	Minor Drainage; *Corymbia deserticola* isolated trees, over *Acacia* spp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM40	Targeted Search	2023-07-13	719043	7491491	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope, *Eucalyptus leucophloia* isolated trees, over *Acacia* sp. and *Grevillea wickhamii* isolated shrubs, over *Triodia* sp. hummock grassland.
BM41	Targeted Search	2023-07-13	719005	7491621	Hillcrest/ Upper Hillslope	2-5	Very Good	Hillslope; *Eucalyptus leucophloia* isolated trees, over *Acacia* spp. isolated shrubs, over *Triodia* sp. hummock grassland.
BM42	Targeted Search	2023-07-13	718983	7491632	Hillslope	-	-	Hillslope; *Eucalyptus leucophloia* isolated trees, over *Acacia* sp. isolated shrubs, over *Triodia* sp. sparse hummock grassland.