



Biologic Environmental Survey Pty Ltd
PO Box 179
Floreat, WA, 6014

19 January 2022

Attn: Tanya Carroll

BHP WAIO

Dear Tanya,

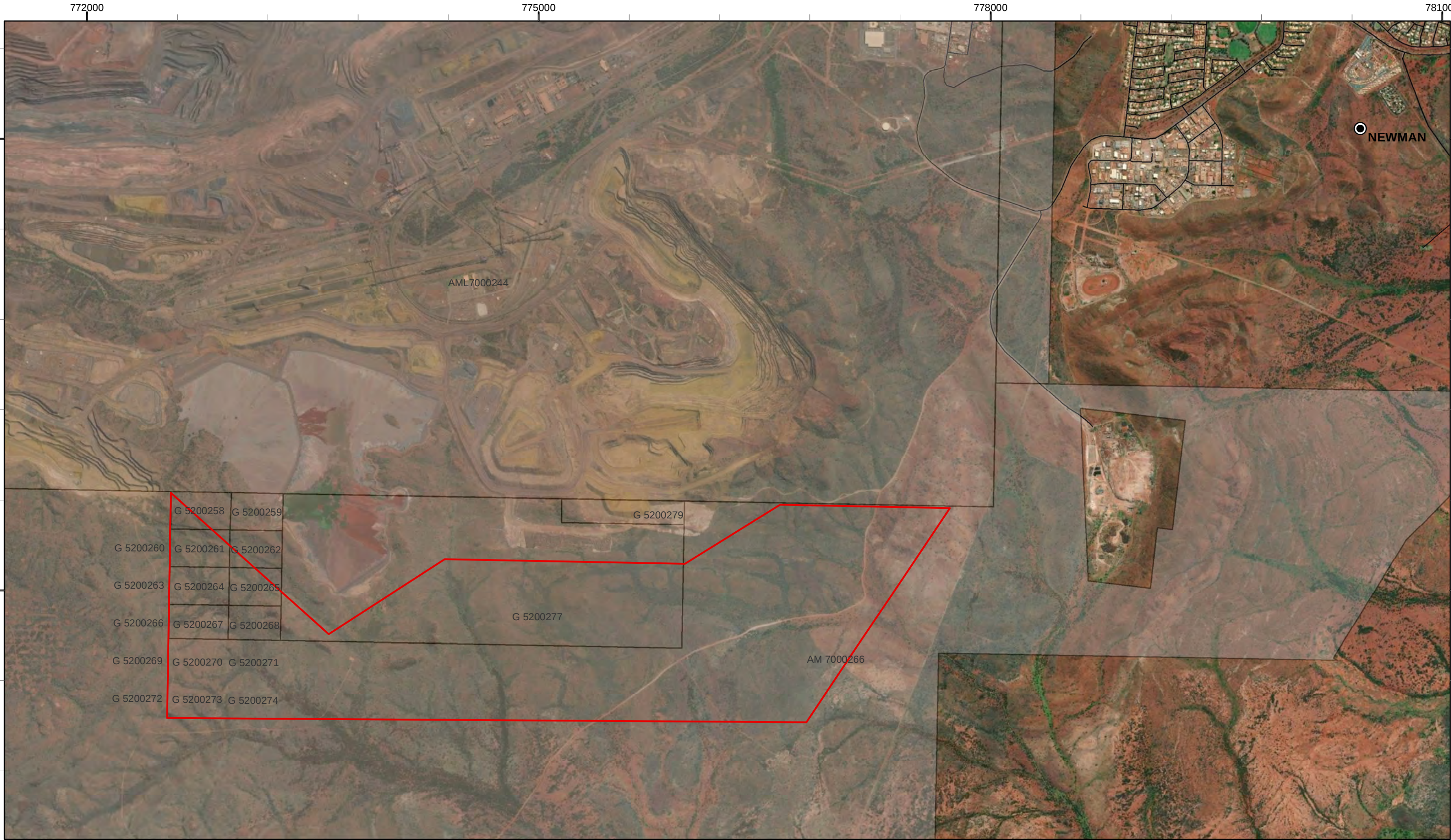
Please find below a memo summarising the Vertebrate Fauna Assessment undertaken by Biologic Environmental Survey (Biologic) for part of the Paddy Bore area located directly south of the Whaleback operations for the Western Ridge Project.

1. Introduction and Objectives

Biologic was commissioned by BHP Western Australia Iron Ore (BHP WAIO) to undertake a basic and targeted fauna survey for part of the Paddy Bore area within the Western Ridge Project area (herein the Study Area) (Figure 1.1). The Study Area is located directly south of BHP WAIO's Whaleback operations, approximately 2.2 kilometres (km) south-west of Newman, and covers approximately 513.46 hectares (ha) (Figure 1.1).

The key objectives of the assessment were to undertake a single season combined basic and targeted fauna survey within the Study Area and assess the likelihood of occurrence for species of significance listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act) and/or listed as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA).

Species of significance considered during this assessment were derived as part of a desktop assessment for the Western Ridge Pipelines Vertebrate Fauna Survey (Biologic, 2021b), which encompassed the Study Area. The likelihood of occurrence assessment for fauna of significance within the Study Area was determined following methods based on the species records during the survey (from direct observation and/or secondary evidence), the identification of suitable habitat and/or habitat features likely to support species (including their condition) recorded during the field survey and the occurrence of previous records of the species within and/or in the vicinity of the Study Area.



Legend

- Study Area
- BHP Tenement
- Local Road

Scale: 1:24,000

0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 27/05/2021

BHP WAIO
Western Ridge Pipeline
Targeted Fauna

Figure 1.1: Study Area

2. Methodology

2.1 Compliance and Licensing

This assessment was carried out in a manner consistent with the following documents developed by the Western Australian Environmental Protection Authority (EPA), DBCA (formerly Department of Parks and Wildlife [DPaW]), the Department of Agriculture, Water and the Environment (DAWE - formerly the Department of Environment [DoE], Department of Sustainability, Water, Population, and Communities [DSEWPaC] and Department of Environment, Water, Heritage and Arts [DEWHA]), relevant survey specific license conditions and BHP WAIO:

- BHP (2017) Guidance for vertebrate fauna surveys in the Pilbara (SPR-IEN-EMS-012);
- DBCA (2017) Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia;
- DEWHA (2010a) Survey guidelines for Australia's threatened bats;
- DEWHA (2010b) Survey guidelines for Australia's threatened birds;
- DoE (2013) Significant impact guidelines 1.1: Matters of national environmental significance;
- DoE (2016) EPBC Act referral guideline for the endangered northern quoll (*Dasyurus hallucatus*);
- DPaW (2017) Interim guidelines for the preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia;
- DSEWPaC (2011a) Survey guidelines for Australia's threatened mammals;
- DSEWPaC (2011b) Survey guidelines for Australia's threatened reptiles; and
- EPA (2020) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment.

The survey was conducted under DBCA Regulation 27 "Fauna Taking (Biological Assessment) Licence", issued to Chris Knuckey (licence number BA27000373). Under Section 40 of the BC Act, threatened species sampling was completed under a DBCA "Authorisation to Take or Disturb Threatened Species" issued to Chris Knuckey (authorisation number TFA 2021-0013).

3. Desktop Assessment

The desktop assessment for vertebrate fauna herein follows the methods of Biologic (2021b), which comprised five databases searched and 29 assessments reviewed (Table 3.1).

The literature review and database searches identified a total of 365 species of vertebrate fauna, which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 48 mammals (including 38 native and 10 non-native), 200 birds, 110 reptiles and seven amphibians (Table 3.1; Figure 3.1). Due to the size of the desktop assessment search area, and likelihood of encompassing habitats which may not occur within the Study Area, results of the desktop review are likely to include species which may not occur within the Study Area.

Of the 365 species of vertebrate fauna identified by the desktop assessment, 40 species are of significance, comprising eight mammals, 28 birds and four reptiles (Table 3.2). Two species of significance have previously been recorded within the Study Area, with one western pebble-mound mouse record and three peregrine falcon records. Based on the available data for the three peregrine falcon records within the Study Area, it appears the records are duplication of single record of the species (i.e. all records are at the same precise location with limited other available information (BHP WAIO, 2021)). Eight additional species have previously been recorded at Western Ridge, within 1 km of the Study Area (BHP WAIO, 2021): northern quoll, ghost bat, Pilbara olive python, wood sandpiper, common sandpiper, common greenshank, marsh sandpiper and common redshank (Figure 3.1).

Table 3.1: Summary of fauna species recorded within and in the vicinity of the Study Area in the desktop assessment

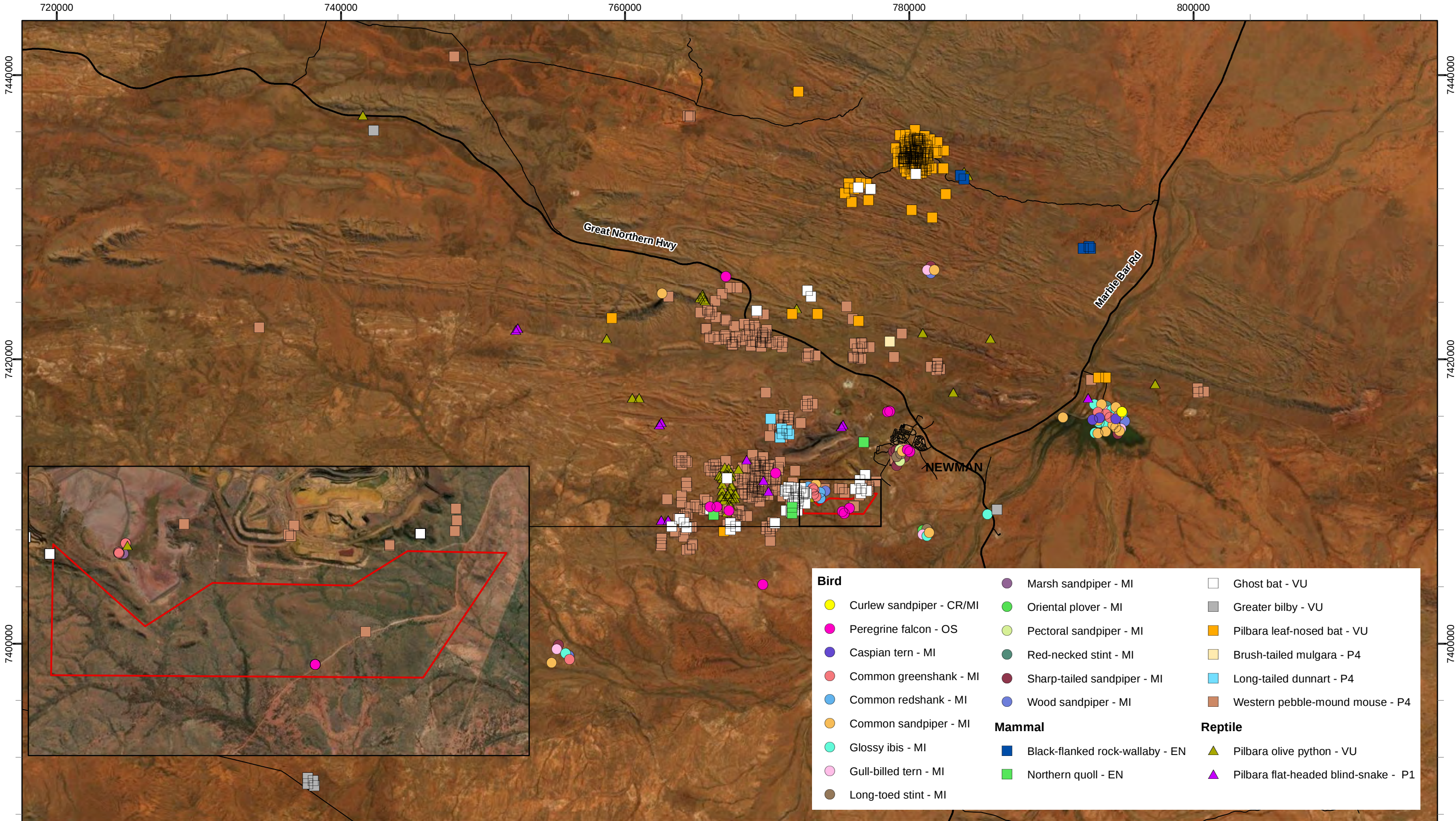
Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Literature Sources							
Biologic (2009) Newman Power Network Level 2 Flora and Level 1 Fauna Survey	A	5	3	51	12	0	71
Eco Logical (2012b) Orebody 37 Level 1 Vertebrate Fauna Assessment	B	4	4	64	11	1	84
Onshore (2014) Western Ridge Biological Survey	C	0	0	37	8	0	45
Onshore (2018) Western Ridge E52/3448 Desktop Flora and Fauna Assessment	D	-	-	-	-	-	-
Biologic (2020a) Coomabanbunna Well Level 2 Vertebrate Fauna Survey	E	20	5	73	45	2	145
Biologic (2011) Orebody 35 and Western Ridge Vertebrate Fauna Survey	F	19	6	82	54	2	163
Biologic (2016b) Western Ridge Southern Tenements Vertebrate Fauna Desktop Assessment.	G	-	-	-	-	-	-
Biologic (2020c) Western Ridge Targeted Vertebrate Fauna Survey	H	6	2	41	4	2	55
ecologia (2008) RGP5 Fauna Survey Newman to Jimblebar Junction	I	0	2	38	9	0	49
ENV (2011b) Mt Whaleback East Flora, Vegetation and Fauna Assessment	J	2	1	29	7	0	39
ENV (2011a) Eastern Ridge (OB23/24/25) Fauna Assessment	K	10	-	46	13	2	71
ENV (2010) Orebody 35 Vegetation Clearing Permit Area Flora and Fauna Assessment	L	4	1	25	5	0	35
ENV (2006) Mount Whaleback Fauna Assessment Survey Phase III	M	8	2	50	28	0	88
Astron (2010) Mt Whaleback TSF Flora, Vegetation and Fauna Assessment	N	1	1	1	0	0	3
Eco Logical (2012a) Level 1 Flora and Fauna Surveys Along the Great Northern Highway for Jimblebar Mine Module Transport	O	0	1	9	2	0	12
HGM (1999) Orebody 30 and Orebody 35 Soil & Biological Survey	P	19	3	113	90	4	228

Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Eco Logical (2011) Newman Power Line Corridor Level 1 Flora and Fauna Survey	Q	0	2	40	8	0	50
Biologic (2014b) Orebody 25 Targeted Vertebrate Fauna Survey	R	11	2	28	6	0	47
ecologia (2005) Western Ridge Exploration Project Biological Survey	S	3	3	24	5	0	35
ecologia (2006) Western Ridge Exploration Project Biological Survey	T	8	2	51	15	0	76
Onshore and Biologic (2009a) Mt Whaleback Mine Site Flora & Vegetation Survey and Fauna Assessment	U	4	3	51	7	0	65
Biologic (2014a) Orebody 24 Targeted Vertebrate Fauna Survey	V	18	0	44	18	1	81
ecologia (1998) Mt Whaleback Fauna Monitoring Programme: Baseline Sampling 1997-1998	W	9	2	97	45	3	156
ecologia (2004) Orebody 24 Expansion Biological Survey	X	1	2	62	21	0	86
GHD (2008) Myopic Project Area, Newman Flora and Fauna Assessment	Y	0	3	32	4	0	39
ENV (2009b) Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment	Z	1	2	59	8	0	70
ENV (2009a) Newman to Jimblebar Transmission Line and Newman Town Substation Terrestrial Fauna Assessment	AA	4	2	57	13	1	77
Biota (2001) Baseline Biological and Soil Surveys and Mapping for ML244SA West of the Fortescue River	AB	12	3	104	54	3	176
Onshore and Biologic (2009b) Myopic Exploration Leases Biological Survey	AC	0	3	49	7	0	59
Database Searches							
DBCA (2021) NatureMap		32	6	173	87	7	305
DBCA (2020) Threatened and Priority Fauna Database		7	-	15	3	-	25
DAWE (2021) Protected Matters Search Tool		4	8	18	1	-	31
BirdLife Australia (2021) Birddata		-	-	178	-	-	178
BHP WAIO (2021) BHP WAIO Fauna Records Database		34	-	145	45	1	225
Total species recorded		38	10	200	110	7	365
Significant species		8	-	28	4	0	40

Table 3.2: Significant species identified and their conservation status

Scientific Name	Common name	Conservation Status			
		EPBC	BC	DBCA	IUCN
MAMMALS					
DASYURIDAE					
<i>Dasycercus blythi</i>	brush-tailed mulgara			P4	
<i>Dasyurus hallucatus</i>	northern quoll	EN	EN		
<i>Sminthopsis longicaudata</i>	long-tailed dunnart			P4	
HIPPOSIDERIDAE					
<i>Rhinonictis aurantia</i> (Pilbara form)	Pilbara leaf-nosed bat	VU	VU		
MACROPODIDAE					
<i>Petrogale lateralis</i> subsp. <i>lateralis</i>	black-flanked rock-wallaby	EN	EN		NT
MEGADERMATIDAE					
<i>Macroderma gigas</i>	ghost bat	VU	VU		VU
MURIDAE					
<i>Pseudomys chapmani</i>	western pebble-mound mouse			P4	
THYLACOMYIDAE					
<i>Macrotis lagotis</i>	greater bilby	VU	VU		VU
BIRDS					
APODIDAE					
<i>Apus pacificus</i>	fork-tailed swift	MI	MI		
CHARADRIIDAE					
<i>Charadrius leschenaultii</i>	greater sand plover	VU/MI	VU/MI		
<i>Charadrius dubius</i>	little ringed plover	MI	MI		
<i>Charadrius veredus</i>	oriental plover	MI	MI		
CICONIIDAE					
<i>Ephippiorhynchus asiaticus</i>	black-necked stork				NT
FALCONIDAE					
<i>Falco hypoleucos</i>	grey falcon		VU		VU
<i>Falco peregrinus</i>	peregrine falcon		OS		
HIRUNDINIDAE					
<i>Hirundo rustica</i>	barn swallow	MI	MI		
LARIDAE					
<i>Sterna caspia</i>	caspian tern	MI	MI		
<i>Gelochelidon nilotica</i>	gull-billed tern	MI	MI		
MOTACILLIDAE					
<i>Motacilla cinerea</i>	grey wagtail	MI	MI		
<i>Motacilla flava</i>	yellow wagtail	MI	MI		
PSITTACIDAE					
<i>Pezoporus occidentalis</i>	night parrot	EN	CR		EN
<i>Polytelis alexandrae</i>	princess parrot	VU		P4	NT
ROSTRATULIDAE					

Scientific Name	Common name	Conservation Status			
		EPBC	BC	DBCA	IUCN
<i>Rostratula benghalensis</i> subsp. <i>australis</i>	Australian painted snipe	EN	EN		EN
SCOLOPACIDAE					
<i>Calidris acuminata</i>	sharp-tailed sandpiper	MI	MI		
<i>Calidris ferruginea</i>	curlew sandpiper	CR/MI	CR/MI		NT
<i>Calidris melanotos</i>	pectoral sandpiper	MI	MI		
<i>Calidris ruficollis</i>	red-necked stint	MI	MI		NT
<i>Calidris subminuta</i>	long-toed stint	MI	MI		
<i>Limosa limosa</i>	black-tailed godwit	MI	MI		
<i>Philomachus pugnax</i>	ruff	MI	MI		
<i>Tringa glareola</i>	wood sandpiper	MI	MI		
<i>Tringa hypoleucos</i>	common sandpiper	MI	MI		
<i>Tringa nebularia</i>	common greenshank	MI	MI		
<i>Tringa stagnatilis</i>	marsh sandpiper	MI	MI		
<i>Tringa totanus</i>	common redshank	MI	MI		
THRESKIORNITHIDAE					
<i>Plegadis falcinellus</i>	glossy ibis	MI	MI		
REPTILES					
BOIDAE					
<i>Liasis olivaceus</i> subsp. <i>barroni</i>	Pilbara olive python	VU	VU		
SCINCIDAE					
<i>Ctenotus uber</i> subsp. <i>johnstonei</i>	spotted ctenotus			P2	
<i>Lerista macropisthopus</i> subsp. <i>remota</i>				P2	
TYPHLOPIDAE					
<i>Anilius ganeii</i>	Pilbara flat-headed blind-snake			P1	



Legend

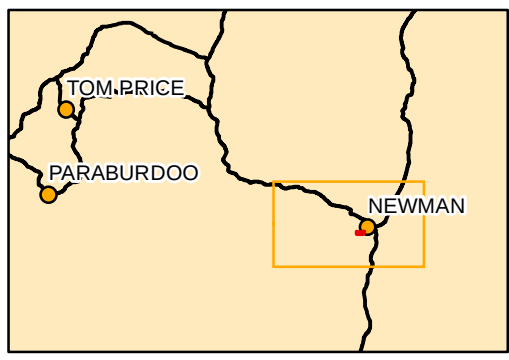
- Study Area
- Local Road
- State Road

biologic
Environmental Survey

Scale: 1:249,000

0 4 8 12 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994
Created 20/01/2022



BHP WAIO
Western Ridge Pipeline
Targeted Fauna

Figure 3.1: Vertebrate fauna of significance identified in the desktop assessment

4. Field Survey Methods

4.1 Survey timing and Personnel

A basic and targeted vertebrate fauna survey was conducted by experienced zoologists Ryan Ellis (Principal Zoologist) and Amy Hutchison (Zoologist) from the 24th to the 31st March 2021, concurrently with the Western Ridge Pipelines Vertebrate Fauna Survey (Biologic, 2021b) in areas adjacent to the Study Area. Survey personnel collectively have over 17 years of experience undertaking fauna surveys within the Pilbara region, including targeted sampling for species of significance returned in the desktop assessment utilised for this assessment.

4.2 Weather and Climate

Observed weather conditions prior to and during the survey are shown in Figure 4.1, alongside long-term climatic data for Newman Airport (station #007176). In the 12 months prior to the survey, mean minimum and maximum temperatures recorded at Newman Airport were similar to the long-term averages for most months (Figure 4.1). Rainfall in the months preceding the survey was variable, with below long-term averages recorded through most of the dry season. Rainfall was below long-term averages for most of the wet season as well, except February which recorded well above the long-term average for the month (169 mm) (Figure 4.1). In total, the rainfall received in the 11 months prior to the survey (April 2020 to February 2021, 309.00 mm) was well above annual long-term average for the same period, 275.1 mm (BoM, 2021). Observed maximum temperatures during the survey (Figure 4.1) were slightly above the long-term average on most days (BoM, 2021). No rainfall was recorded during the survey (Figure 4.1).

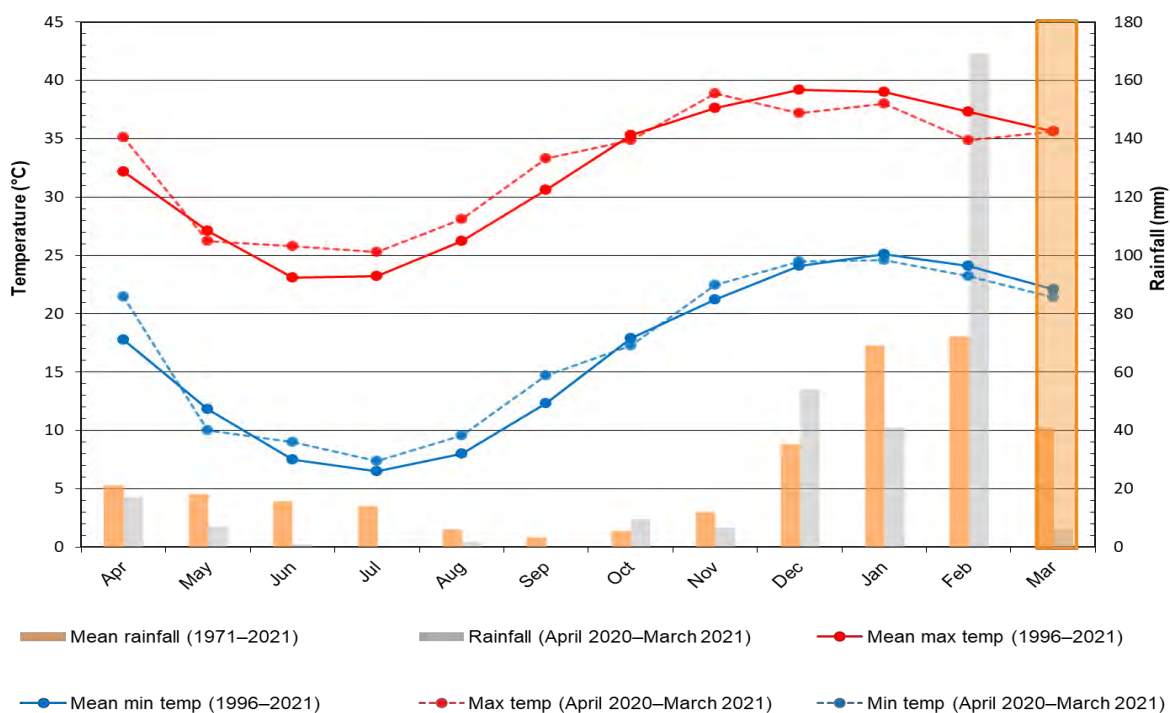


Figure 4.1: Monthly rainfall and long-term average rainfall for Newman Airport (Station ID 007176). Survey period indicated by green bar (BoM, 2021).

4.3 Habitat Assessments and Mapping

Habitat assessments were undertaken in the field to characterise and define habitats and their significance to vertebrate fauna. Habitat assessments were undertaken at 21 locations across the Study Area, including at all sampling sites (i.e. camera trap and targeted search sites, acoustic recorder sites and ultrasonic recorder sites) (Table 4.1; Figure 4.2). Assessments were conducted using methodology and terminology modified from the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009).

Fauna habitat mapping was completed for the Study Area using the vertebrate fauna habitat assessments completed during the field surveys, as well as high-resolution aerial imagery, vegetation, topographical, geology and soil mapping. Habitats were delineated and mapped across the Study Area at a scale of approximately 1:20,000.

4.4 Targeted Searches

Targeted searches were conducted within suitable habitat looking for evidence of any species of significance returned in the desktop assessment, including from direct observation, secondary evidence (scats, tracks and feeding remains) and potential roosts for bats of significance. Three targeted searches were conducted within the Study Area, focusing on northern quoll, ghost bat and Pilbara leaf-nosed bat (Table 4.1; Figure 4.2).

4.5 Ultrasonic Bat Recording

SongMeter (SM; Wildlife Acoustics Inc.) ultrasonic bat recorders were deployed at two locations within the Study Area (Table 4.1; Figure 4.2). Recorders were deployed for three consecutive nights at each location for a total of six recording nights. The jumper and audio settings used for all the SM units followed the manufacturer's recommendations contained in the user manual (Wildlife Acoustics, 2011, 2017). Selectable filters and triggers were also set using the manufacturer's recommendations. Bat calls were analysed by Robert Bullen of Bat Call WA.

4.6 Targeted Sampling – Northern Quoll Camera Traps

Sampling for northern quoll was undertaken by establishing three motion camera transects within the Study Area. Methods recommended by DoE (2016) involve each transect comprising ten motion cameras placed approximately 100 metres apart; however, due to the limited occurrence of suitable habitat for the species within the Study Area, between three to four cameras were deployed at each of the three sites sampled. Camera traps were left *in-situ* for five consecutive nights each, for a total of 50 sampling nights (Table 4.1; Figure 4.2). Cameras were positioned to allow detailed inspection of an individual's patterning to assist with future population estimates (as verified by Hohnen *et al.*, 2012) and baited with universal bait (a mixture of oats, peanut butter and sardines) within a non-reward receptacle (perforated and capped PVC pipe).

4.7 Targeted Sampling – Greater Bilby Plot Searches

Greater bilby sampling within the Study Area comprised a single two hectare (ha) survey plot (bilby plot) within one area of suitable habitat of the Study Area, in accordance with DBCA survey guidelines for the species. The bilby plot was subjected to targeted searches for a minimum of 30 minutes and comprised searches for secondary evidence of the species' occurrence (i.e. burrows, diggings, tracks and scats, as described by Southgate *et al.* (2019)). One bilby plot was searched for 0.5 person hours for greater bilby within the Study Area (Table 4.1; Figure 4.2).

4.8 Targeted Sampling – Night Parrot Acoustic Recorders

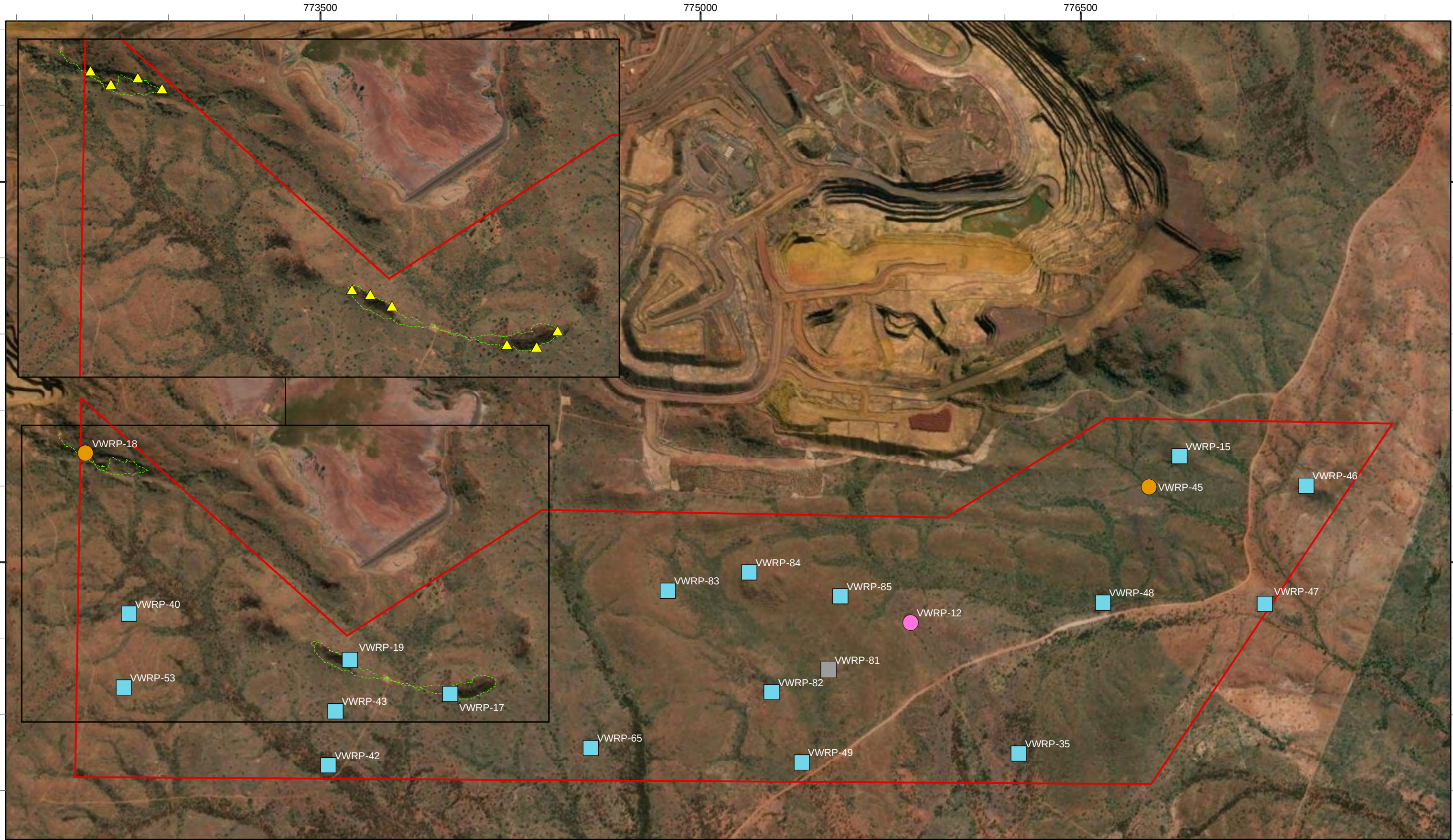
A SongMeter (SM; Wildlife Acoustics Inc.) acoustic recorder targeting night parrot was deployed at one location during the field survey (Table 4.1; Figure 4.2). The SM4 acoustic recorder was deployed in potential habitat recommended within the *Interim Guideline for Preliminary Surveys of Night Parrot (Pezoporus occidentalis) in Western Australia* (DPaW, 2017). The unit was deployed for six consecutive recording nights. Acoustic recordings were analysed for night parrot calls by Nigel Jackett.

4.9 Opportunistic Records

At all times while surveying, all records pertaining to species not previously recorded during the survey, rare species, significant species or other fauna of interest were documented. These records include those from primary (i.e. direct observation of species) or secondary (e.g. burrows, scratching's, diggings and scats) evidence. Efforts were made to target likely microhabitats by turning rocks, logs and anthropogenic debris where present.

Table 4.1: Survey effort by sampling site

Site ID	Latitude	Longitude	Habitat Type	Habitat assessment	Ultrasonic Recorder (nights)	Acoustic Recorder (nights)	Camera Traps (nights)	Targeted searches
VWRP-12	-23.3987	119.6988	Stony Plain	•		6		
VWRP-15	-23.3926	119.7090	Stony Plain	•				
VWRP-17	-23.4015	119.6811	Hillcrest/ Hillslope	•			15	Northern quoll, ghost bat, Pilbara leaf-nosed bat
VWRP-18	-23.3932	119.6669	Breakaway/ Cliff	•	3		20	Northern quoll, ghost bat, Pilbara leaf-nosed bat
VWRP-19	-23.4004	119.6772	Hillcrest/ Hillslope	•			15	Northern quoll, ghost bat, Pilbara leaf-nosed bat
VWRP-35	-23.4033	119.7031	Stony Plain	•				
VWRP-40	-23.3989	119.6686	Stony Plain	•				
VWRP-42	-23.4042	119.6764	Mulga Woodland	•				
VWRP-43	-23.4022	119.6767	Stony Plain	•				
VWRP-45	-23.3937	119.7079	Drainage Area/ Floodplain	•	3			
VWRP-46	-23.3936	119.7140	Stony Plain	•				
VWRP-47	-23.3978	119.7124	Drainage Area/ Floodplain	•				
VWRP-48	-23.3979	119.7062	Drainage Area/ Floodplain	•				
VWRP-49	-23.4037	119.6947	Drainage Area/ Floodplain	•				
VWRP-53	-23.4015	119.6685	Stony Plain	•				
VWRP-65	-23.4034	119.6866	Stony Plain	•				
VWRP-81	-23.4004	119.6957	Drainage Area/ Floodplain	•				Greater bilby
VWRP-82	-23.4013	119.6935	Drainage Area/ Floodplain	•				
VWRP-83	-23.3977	119.6894	Stony Plain	•				
VWRP-84	-23.397	119.6925	Stony Plain	•				
VWRP-85	-23.3978	119.6961	Stony Plain	•				
Total				21	6	6	50	3x northern quoll, ghost bat, Pilbara leaf-nosed bat 1x greater bilby



Legend

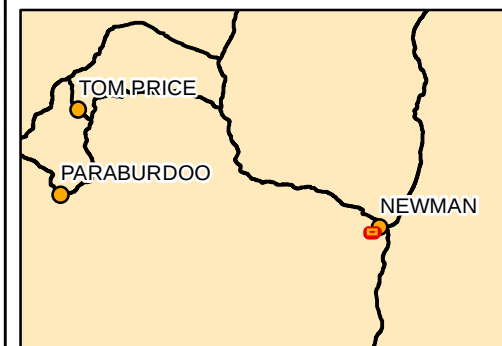
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|---|---|---|--|
| Study Area | Sampling Site | Habitat Assessment | Targeted Search |
| | Bilby Plot | SongMeter (acoustic) | |
| | ▲ Camera Trap | SongMeter (ultrasonic) | |



Scale: 1:14,250

0 0.25 0.5 0.75 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 20/01/2022



BHP WAIO
Western Ridge Pipeline
Targeted Fauna

Figure 4.2: Fauna sample sites and traverses

5. Likelihood of Occurrence

Following completion of the field assessment, significant species identified by the desktop assessment were assessed for their likelihood of occurring within the Survey Area using a decision matrix (Table 5.1). This decision matrix, each species was assigned to one of six categories of likelihood: Confirmed, Highly Likely, Likely, Possible, Unlikely, or Highly Unlikely.

The decision matrix is intended to be an indicative guide only, and the way in which it is interpreted may vary between species, depending on a given species' habitat preferences and ability to disperse, as well as the reliability and availability of contextual information. For example, considering species which have been previously recorded close to the Survey Area, a species with a limited dispersal capability will have a reduced likelihood of occurring in the Survey Area compared with a species with greater dispersal capability. It is also recognised that a lack of records in the vicinity of the Survey Area may indicate limited sampling effort rather than species' absence, and that previous records may include historic or presumed erroneous information which may misrepresent a species' current distribution. Where the determination of a species' likelihood of occurrence within the Survey Area deviates from the decision matrix, detailed justification for any variation will be presented.

Table 5.1: Species likelihood of occurrence decision matrix

		Habitat suitability of Study Area			
		Breeding habitat present	Foraging and dispersal habitat present	Marginally suitable habitat ² present	No suitable habitat present
Species Records ¹	Recorded in Study Area	Confirmed	Confirmed	Confirmed	Confirmed
	Recorded within 10 km of Study Area	Highly Likely	Likely	Possible	Possible
	Recorded within 10–50km of Study Area	Likely	Possible	Possible	Unlikely
	Recorded within 50–100 km of Study Area	Possible	Possible	Unlikely	Unlikely
	Recorded >100 km of Study Area	Possible	Unlikely	Unlikely	Highly Unlikely
	Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

¹ Only records within the previous 50 years are considered.

² Marginally suitable habitat is habitat which is possibly used by a species but is unlikely to be depended upon; for example, it may be used only when in proximity to core breeding, foraging or dispersal habitat.

6. Results and Discussion

6.1 Fauna Habitats of the Study Area

A total of five broad fauna habitat types were recorded and mapped across the Study Area, comprising, in decreasing order of extent, Stony Plain (313.78 ha, 61.1% of Study Area), Drainage Area/ Floodplain (144.64 ha, 28.2%), Mulga Woodland (45.28 ha, 8.8%), Hillcrest/ Hillslope (6.81 ha, 1.3%) and Breakaway/ Cliff (2.95 ha, 0.6%) (Table 6.1; Figure 6.1). All five habitats mapped are broadly distributed and well represented across the Pilbara bioregion and surrounding regions, and therefore support fauna assemblages which are generally common and widespread.

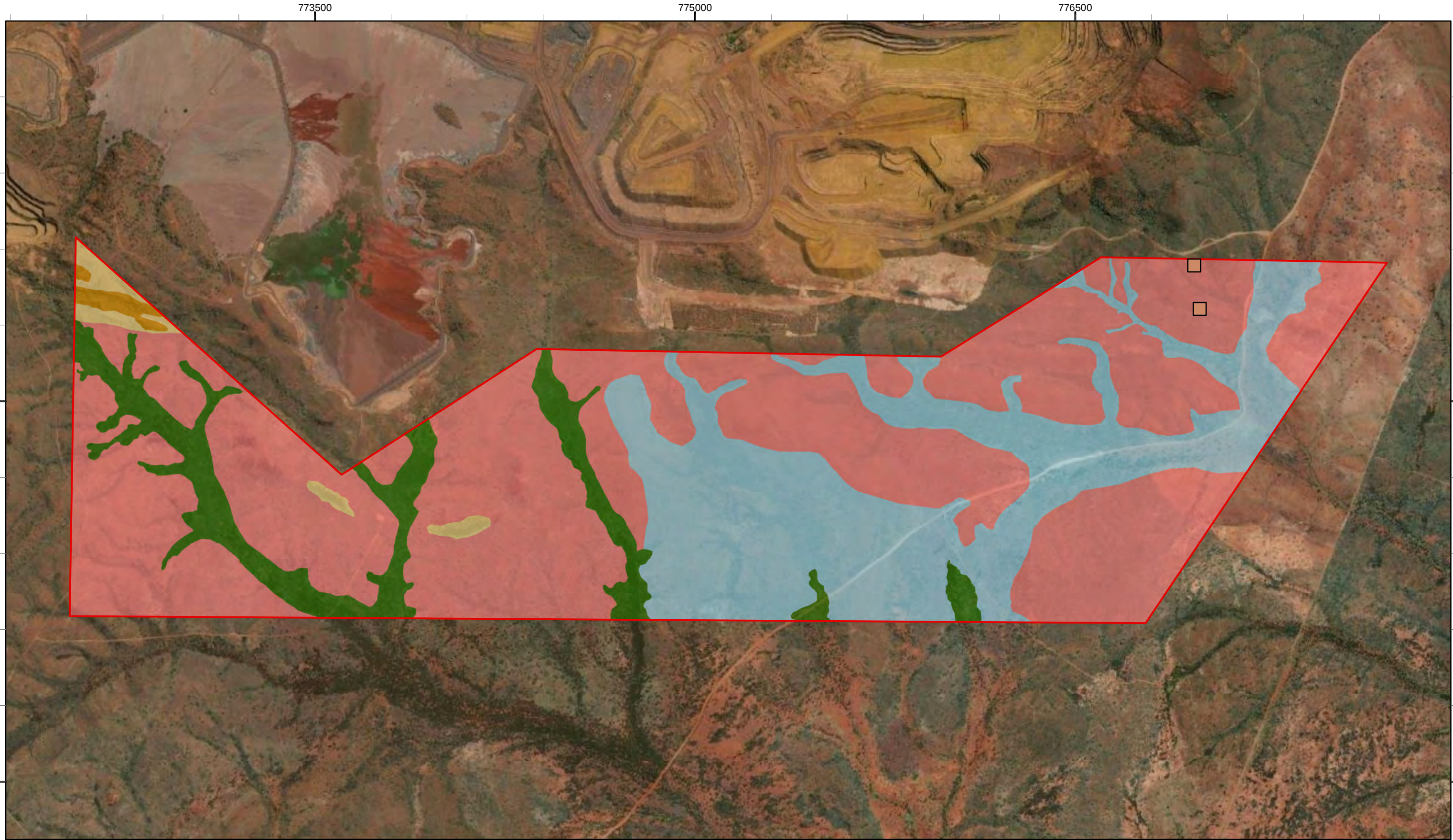
Stony Plain provides suitable habitat for western pebble-mound mouse, spotted ctenotus and foraging habitat for peregrine falcon. In areas where suitable perching trees are present, it also provides foraging habitat for ghost bat. Foraging and dispersal habitat for ghost bat and Pilbara leaf-nosed bat is also provided by Mulga Woodland, which is often associated with Drainage Area/ Floodplain. Drainage Area/ Floodplain also provides suitable habitat for brush-tailed mulgara and foraging habitat for grey falcon and peregrine falcon. Hillcrest/ Hillslope provides suitable habitat for western pebble-mound mouse, long-tailed dunnart, spotted ctenotus and Pilbara flat-headed blind-snake. It also provides foraging and dispersal habitat for northern quoll, ghost bat and Pilbara leaf-nosed bat, and foraging habitat for Peregrine falcon. Breakaway/ Cliff may provide suitable denning and shelter habitat for northern quoll and Pilbara olive python; however, its occurrence within the Study Area is relatively small and isolated. This habitat may also provide foraging habitat for ghost bat and Pilbara leaf-nosed bat, particularly where connectivity with other areas of suitable foraging habitat occurs adjacent to or in the vicinity of the Study Area.

Table 6.1: Broad fauna habitats of the Study Area

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Stony Plain 313.78 ha 61.11%	Stony Plain habitat comprises flat to low undulating areas and low hills with vegetation dominated by <i>Triodia</i> hummock grasses of various life stages with scattered eucalypts and patches of various small to medium shrub species on gravelly clay loam substrates. In low-lying areas isolated patches of accumulated sandy substrate can occur.	Stony Plain habitat occurs throughout a large portion of the Study Area, often occurring as the intervening area between other habitats. Stony Plain is one of the most common and widespread habitat types within the Pilbara region. The vegetation and substrate which make up this habitat type are characteristic features of the region.	Suitable for: • Peregrine falcon (foraging) • Western pebble-mound mouse • Spotted ctenotus	
Drainage Area/ Floodplain 144.64 ha 28.17%	Lower lying plain often subjected to sheet flow following large rainfall events. Vegetation and substrates of this habitat was variable, often comprising scattered <i>Eucalyptus</i> over <i>Acacia</i> and/or <i>Grevillea</i> shrubs with an understory dominated by <i>Triodia</i> hummock grasses and/or mixed tussock grasses on alluvial substrates, often comprising heavy clays and gravel. Tussock grasses were dominant within Drainage Area/ Floodplain habitat as a result of high rainfall in the months preceding the survey.	Drainage Area/ Floodplain habitat occurs across the eastern half of the Study Area. This fauna habitat is common throughout the Pilbara bioregion. Across the region its structure and condition is variable as a result of rainfall events and disturbance (i.e. fire and cattle grazing).	Suitable for: • Ghost bat (foraging/ dispersal) • Pilbara leaf-nosed bat (foraging/ dispersal) • Grey falcon (foraging) • Peregrine falcon (foraging) • Brush-tailed mulgara	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Mulga Woodland 45.28 ha 8.82%	Mulga woodland of varying density, often associated with minor Drainage Area/ Floodplain landforms or minor drainage systems subject to sheet flow following rainfall. Vegetation dominated by open mulga (<i>Acacia aneura</i>) with sparse to no understory of mixed small shrubs and tussock grasses. In the south of the western portion of the Study Area, Mulga woodland was characterised by bands of vegetation interspersed with bare substrate.	This habitat type dissects the western side of the of the Study Area, occurring within broader areas of Stony Plain and Drainage Area/ Floodplain habitats. Mulga Woodland is relatively common throughout the Pilbara bioregion, though often sparsely distributed and occurring in small, isolated patches.	Suitable for: • Ghost bat (foraging) • Pilbara leaf-nosed bat (foraging)	
Hillcrest/ Hillslope 6.81 ha 1.33%	Hillcrest/ Hillslope habitat comprises hills and undulating stony plains of higher elevation, supporting hard spinifex with a mantle of gravel and larger rocks with occasional outcropping or minor breakaway. Vegetation is dominated by hard <i>Triodia</i> hummock grassland with scattered <i>Eucalyptus</i> trees and <i>Acacia</i> and/or <i>Grevillea</i> shrubs.	Within the Study Area, Hillcrest/ Hillslope habitat is limited to the north-western corner, and two other small areas of the western side of the Survey Area. Although only represented over a small portion of the Study Area, Hillcrest/ Hillslope habitat is a characteristic habitat type of the Pilbara region. Its occurrence throughout the region is widespread and common.	Suitable for: • Northern quoll (foraging/ dispersal) • Ghost bat (foraging/ dispersal) • Pilbara leaf-nosed bat (foraging/ dispersal) • Pilbara olive python • Long-tailed dunnart • Western pebble-mound mouse • Peregrine falcon (foraging) • Spotted ctenotus • Pilbara flat-headed blind-snake	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Significant Species	Photo
Breakaway/ Cliff 2.95 ha 0.57%	Breakaway/ Cliff is rocky habitat, often with large rocks and boulders. Caves and overhangs are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	Within the Study Area, Breakaway/ Cliff habitat is restricted to the north-western corner. Breakaway/ Cliff is a common feature of the Pilbara, but because they tend to be narrow, linear features, they represent a small proportion of the total land area.	Suitable for: • Northern quoll (denning/ shelter) • Pilbara leaf-nosed bat (foraging, dispersal) • Ghost bat (foraging/ dispersal) • Pilbara olive python • Long-tailed dunnart • Pilbara flat-headed blind-snake	



Legend

-  Study Area
- Fauna of Conservation Significance**
-  Western pebble-mound mouse

Fauna Habitat

-  Breakaway/ Cliff
-  Drainage Area/ Floodplain

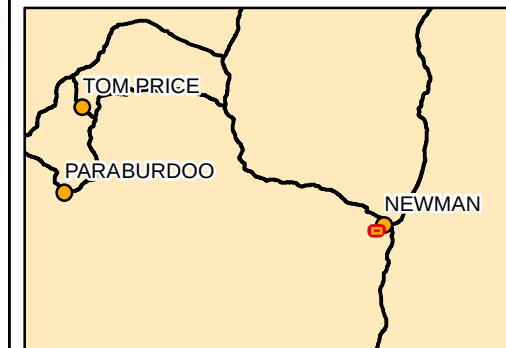
-  Hillcrest/ Hillslope
-  Mulga Woodland
-  Stony Plain



Scale: 1:14,250

0 0.25 0.5 0.75 Km

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 27/05/2021



BHP WAIO

Western Ridge Pipeline Targeted Fauna

**Figure 6.1: Fauna habitats
and significant species
recorded in the Study Area**

6.2 Fauna Recorded

A total of 31 vertebrate fauna species, comprising nine native mammal species, 20 bird species and two reptile species were recorded from the Study Area (Table 6.2). This comprises approximately 8.5% of the total number of species identified in the desktop assessment ($n = 365$) as potentially occurring within the Study Area (see section 3). All species recorded during the survey were previously identified in the desktop assessment.

Table 6.2: Vertebrate fauna recorded during the field survey

Scientific Name	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
MAMMALS					
MACROPODIDAE					
<i>Osphranter robustus</i> subsp. <i>erubescens</i>	euro				
<i>Osphranter rufus</i>	red kangaroo				
<i>Petrogale rothschildi</i>	Rothschild's rock-wallaby				
MOLOSSIDAE					
<i>Chaerephon jobensis</i> subsp. <i>colonicus</i>	northern freetail-bat				
MURIDAE					
<i>Pseudomys chapmani</i>	western pebble-mound mouse			P4	
<i>Zyzomys argurus</i>	common rock-rat				
VESPERTILIONIDAE					
<i>Chalinolobus gouldii</i>	Gould's wattled bat				
<i>Scotorepens greyii</i>	little broad-nosed bat				
<i>Vespadelus finlaysoni</i>	Finlayson's cave bat				
AVES					
AEGOTHELIDAE					
<i>Aegotheles cristatus</i>	Australian owllet-nightjar				
ALCEDINIDAE					
<i>Todiramphus pyrrhopygius</i>	red-backed kingfisher				
ARTAMIDAE					
<i>Artamus cinereus</i>	black-faced woodswallow				
BURHINIDAE					
<i>Burhinus grallarius</i>	bush stone-curlew				
CAMPEPHAGIDAE					
<i>Coracina novaehollandiae</i> subsp. <i>subpallida</i>	black-faced cuckoo-shrike				
COLUMBIDAE					
<i>Geopelia cuneata</i>	diamond dove				
<i>Geophaps plumifera</i> subsp. <i>ferruginea</i>	spinifex pigeon				
CORVIDAE					
<i>Corvus orru</i> subsp. <i>ceciliae</i>	Torresian crow				
CUCULIDAE					
<i>Cacomantis pallidus</i>	pallid cuckoo				

Scientific Name	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
ESTRILDIDAE					
<i>Emblema pictum</i>	painted finch				
<i>Taeniopygia guttata</i> subsp. <i>castanotis</i>	zebra finch				
LOCUSTELLIDAE					
<i>Eremiornis carteri</i>	spinifexbird				
MALURIDAE					
<i>Malurus leucopterus</i> subsp. <i>leuconotus</i>	white-winged fairy-wren				
MEGAPODIIDAE					
<i>Acanthagenys rufogularis</i>	spiny-cheeked honeyeater				
<i>Manorina flavigula</i>	yellow-throated miner				
<i>Lichenostomus keartlandi</i>	grey-headed honeyeater				
PACHYCEPHALIDAE					
<i>Colluricincla harmonica</i> subsp. <i>rufiventris</i>	grey shrike-thrush				
PSITTACIDAE					
<i>Melopsittacus undulatus</i>	budgerigar				
PTILINORHYNCHIDAE					
<i>Ptilonorhynchus maculatus</i> subsp. <i>guttatus</i>	western bowerbird				
RHIPIDURIDAE					
<i>Rhipidura leucophrys</i> subsp. <i>leucophrys</i>	willie wagtail				
REPTILES					
AGAMIDAE					
<i>Ctenophorus caudicinctus</i>	ring-tailed dragon				
VARANIDAE					
<i>Varanus acanthurus</i>	spiny-tailed monitor				

6.3 Fauna Species of Significance

One significant species was recorded within the Study Area during the current survey, western pebble-mound mouse (Figure 6.1; Table 6.3). Two pebble mounds were recorded in Stony Plain habitat, one recently inactive and one inactive (Table 6.3). Based on known species' distributions, previous records and the habitats present within the Study Area, a further two species were deemed Highly Likely to occur, ghost bat and peregrine falcon. A further nine species were deemed Possible and 28 were considered Unlikely ($n = 21$) or Highly Unlikely ($n = 7$) to occur (Table 6.4). Significant species recorded or assessed as Highly Likely, Likely or Possibly occurring within the Study Area are unlikely to be reliant on the Study Area or broad fauna habitats occurring within it for the species' persistence or long-term survival at a local and/or regional scale.

Table 6.3: Significant species recorded during the current survey

Common Name (Scientific Name)	Site	Location		Habitat	Record Type	No. Records
		Latitude	Longitude			
Western pebble-mound mouse (<i>Pseudomys chapmani</i>)	OPP	-23.3915	119.7098	Stony Plain	Mound (recently inactive)	1
	OPP	-23.3931	119.7100	Stony Plain	Mound (inactive)	1

Table 6.4: Likelihood of occurrence of significant fauna species within the Study Area

Common Name (Scientific Name)	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Critical Habitat Within the Study Area					Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA	IUCN			Stony Plain	Breakaway/ Cliff	Drainage Area/ Floodplain	Mulga Woodland	Hillcrest/ Hillslope			
Mammals														
DASYURIDAE														
brush-tailed mulgara (<i>Dasyercus blythi</i>)			P4		Prefers spinifex <i>Triodia</i> spp. grasslands on sand plains and the swales between low dunes (Pavey <i>et al.</i> , 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner <i>et al.</i> , 2007).	~10.5 km north-west (2013) (Biologic, 2014a) ~30 km east (2018) (DBCA, 2020)			•			Possible	Resident	May occur as a resident in Drainage Area/ Floodplain habitats.
northern quoll (<i>Dasyurus hallucatus</i>)	EN	EN		EN	The species tends to inhabit rocky habitats which offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994) (Oakwood, 2000). Other Microhabitat features important to the species include rock cover, proximity to permanent water and time-since last fire (Woinarski <i>et al.</i> , 2008).	~650 m west (2020) (Biologic, 2020c) ~3.5 km north (2007) (BHP WAI0, 2021; Onshore, 2013)		•			•	Possible	infrequent visitor (foraging/ dispersal only)	Suitable denning/ shelter habitat may be present in Breakaway/ Cliff habitat. May rarely occur in Hillcrest/ Hillslope habitats of the Study Area to forage and/or for dispersal particularly when occurring near suitable denning/shelter habitat occurring within Western Ridge Area.
long-tailed dunnart (<i>Sminthopsis longicaudata</i>)			P4		Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Burbidge <i>et al.</i> , 2008). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge <i>et al.</i> , 2008).	~4.5 km north-west (1998) (BHP WAI0, 2021)		•			•	Possible	Resident	May occur as a resident in Stony Plain and Hillcrest/ Hillslope habitats.
HIPPOSIDERIDAE														
pilbara leaf-nosed bat (<i>Rhinonictis aurantia</i> (Pilbara form))	VU	VU			Species roosts within caves and abandoned Mines with high humidity (95%) and temperature (32°C) (Armstrong, 2001). Species forages in caves and along waterbodies with fringing vegetation (TSSC, 2016b).	~5.7 km south-west (2019) (Biologic, 2020a) ~12.6 km north (2015) (BHP WAI0, 2021; Biologic, 2016a)		•	•	•	•	Possible	Infrequent visitor (foraging/ dispersal only)	May occasionally occur as an infrequent visitor to forage and/or during dispersal movements from areas supporting known and likely roosting habitat north of the Study Area in Western Ridge. Extensive sampling was undertaken within the Western Ridge area and some regional areas during 2020 (Biologic, 2021a), resulting in no further records of the species within or in close proximity of the Study Area.
MACROPODIDAE														
black-flanked rock-wallaby (<i>Petrogale lateralis</i> subsp. <i>lateralis</i>)	EN	EN		NT	Rocky habitats, including gorges and gullies or outcrops with sufficient shelter habitat. Often vegetated with <i>Acacia</i> thickets and open low eucalypt woodlands with an understory of grasses and low shrubs (Willers <i>et al.</i> , 2011).	~23 km north-east (1975) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.
MEGADERMATIDAE														
ghost bat (<i>Macroderma gigas</i>)	VU	VU		VU	Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned Mines (Armstrong & Anstee, 2000). These features often occur within habitats including gorge/gully, hill crest/ hill slope and low hills (Armstrong & Anstee, 2000). Forages broadly across habitats, particularly woodland and open woodland habitats, including eucalypt and Mulga woodlands (Biologic, 2020b; Richards <i>et al.</i> , 2008; Tidemann <i>et al.</i> , 1985; TSSC, 2016a).	~50 m west (2020) (Biologic, 2020c) ~200 m north (2011) (Onshore, 2013)		•	•	•	•	Highly Likely	Occasional to Frequent visitor (foraging/ dispersal only)	Likely to occur occasionally to regularly to forage and/or during dispersal movements from known and likely roosting habitat north of the Study Area, including known roosting caves located within the Western Ridge Area. No roosting habitat present within the Study Area.
MURIDAE														
western pebble-mound mouse (<i>Pseudomys chapmani</i>)			P4		This species occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Anstee, 1996; Start <i>et al.</i> , 2000).	~overlapping (2009) (BHP WAI0, 2021) (~106 records within 5 km of the Study Area)	•				•	Recorded	Resident	Recorded two times during the current survey within Stony Plain habitat. All records from secondary evidence (pebble mounds), both inactive mounds. Likely to occur as a resident throughout Study Area where suitable stony habitat present.
THYLACOMYIDAE														
greater bilby (<i>Macrotis lagotis</i>)	VU	VU		VU	Variety of habitats including spinifex hummock grassland and <i>Acacia</i> shrubland, on soft soils (Burrows <i>et al.</i> , 2012). In the Pilbara often associated with major drainage line sandy terraces (How <i>et al.</i> , 1991).	~9 km east (1979) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.



Common Name (Scientific Name)	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Critical Habitat Within the Study Area					Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA	IUCN			Stony Plain	Breakaway/ Cliff	Drainage Area/ Floodplain	Mulga Woodland	Hillcrest/ Hillslope			
Aves														
APODIDAE														
fork-tailed swift (<i>Apus pacificus</i>)	MI	MI			Inhabits dry/open habitats, inclusive of riparian woodlands and tea-tree swamps, low scrub, heathland or saltmarsh, as well as treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes (Johnstone & Storr, 1998). Almost exclusively aerial.	~54 km north-west (2011) (DBCA, 2021)	•	•	•	•	•	Possible	Infrequent visitor (foraging/ migration only)	May occasionally occur within the airspace above the Study Area to forage, unlikely to land or nest within Study Area.
CHARADRIIDAE														
greater sand plover (<i>Charadrius leschenaultii</i> subsp. <i>leschenaultii</i>)	VU/ MI	VU/ MI			A variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	~370 km north (2005) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.
little ringed plover (<i>Charadrius dubius</i>)	MI	MI			Bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers. Also found in artificial habitats including gravel pits, sewage works, industrial wastelands and rubbish tips (BirdLife International, 2016).	~430 km north-east (1999) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.
oriental plover (<i>Charadrius veredus</i>)	MI	MI			A variety of habitats, including coastal habitats, such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches as well as open inland environments such as, semi-arid or arid grasslands, where the grass is short and sparse (Johnstone & Storr, 2004).	~4.5 km south-east (1981) (DBCA, 2020) ~105 km north (2017) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present.
CICONIIDAE														
black-necked stork (<i>Ephippiorhynchus asiaticus</i>)				NT	Found along the northern coast and in coastal waters, and occasionally but rarely inland on larger rivers. Also occurs in tidal creeks and mudflats, saltwork ponds, and river pools (Johnstone <i>et al.</i> , 2013).	~8.5 km east (2003) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present.
FALCONIDAE														
grey falcon (<i>Falco hypoleucos</i>)	VU	VU			Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge <i>et al.</i> , 2010; Olsen & Olsen, 1986).	~80 km north-west (2008) (DBCA, 2020) ~98 km north (2016) (DBCA, 2021)			•			Possible	Infrequent visitor (foraging only)	May occur occasionally to forage within Drainage Area/ Floodplain habitat. Suitable nesting habitat not present.
Peregrine falcon (<i>Falco peregrinus</i>)		OS			In arid areas, it is most often encountered along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges occurring on tall, vertical cliff faces between 25 m and 50 m high (Olsen <i>et al.</i> , 2004; Olsen & Olsen, 1989).	~overlapping (1998) (BHP WAIO, 2021) ~3.2 km north-west (2010) (Biologic, 2011)	•		•		•	Confirmed/ Highly Likely	Occasional visitor (foraging only)	Previously recorded within Study Area on three occasions (BHP WAIO, 2021); however, records likely to be duplication of a single record. Likely to occur occasionally to forage, particularly within Stony Plain, Drainage Area/ Floodplain and Hillcrest/ Hillslope habitats. Frequency of visitation likely to be dependent on proximity of nesting in vicinity of Study Area. Suitable nesting habitat not present.
HIRUNDINIDAE														
barn swallow (<i>Hirundo rustica</i>)	MI	MI			The Barn Swallow is a non-breeding summer visitor to the Pilbara. It favors areas near water (Johnstone <i>et al.</i> , 2013).	~350 km north (2001) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.
LARIDAE														
caspian tern (<i>Sterna caspia</i>)	MI	MI			Mainly sheltered seas, estuaries and tidal creeks; occasionally near-coastal salt lakes (including saltwork ponds) and brackish pools in lower courses of rivers; rarely fresh water (Johnstone & Storr, 1998).	~17 km north-east (2004, 2007, 2008) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.
gull-billed tern (<i>Gelochelidon nilotica</i>)	MI	MI			Shallow sheltered seas close to land, estuaries, tidal creeks; and inundated samphire flats, flooded salt lakes, claypans and watercourses in the interior (Johnstone & Storr, 1998).	~4.5 km east (1978) (DBCA, 2020) ~17km north-east (2008) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.

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	EPBC Act	BC Act	DBCA	IUCN			Stony Plain	Breakaway/ Cliff	Drainage Area/ Floodplain	Mulga Woodland	Hillcrest/ Hillslope				
MOTACILLIDAE															
grey wagtail (<i>Motacilla cinerea</i>)	MI	MI			A rare vagrant to Western Australia where it has been recorded within various habitats with open waterbodies (Johnstone & Storr, 2004).	~140 km north-west (2012) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.	
yellow wagtail (<i>Motacilla flava</i>)	MI	MI			An uncommon but regular visitor to the Pilbara region (Johnstone <i>et al.</i> , 2013). Occupies a range of damp or wet habitats with low vegetation although favours edges of fresh water, especially sewage ponds (Johnstone & Storr, 2004).	~360 km north-west (1982) (DBCA, 2021) >500 km north-east (2003) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.	
PSITTACIDAE															
night parrot (<i>Pezoporus occidentalis</i>)	EN	CR		EN	The Night Parrot prefers sandy/stony plain habitat with old-growth spinifex for roosting and nesting in conjunction with native grasses and herbs for foraging (DPaW, 2017).	~135 km north-west (2005) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present	
princess parrot (<i>Polytelis alexandrae</i>)	VU		P4	NT	The Princess Parrot inhabits low open eucalypt woodlands and savannah shrublands in arid deserts, usually with <i>Casuarina</i> and <i>Allocasuarina</i> spp. Primarily breeds in Marble Gum hollows (Pavey <i>et al.</i> , 2014).	~50 km north (2012) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present.	
ROSTRATULIDAE															
Australian painted snipe (<i>Rostratula benghalensis</i> subsp. <i>australis</i>)	EN	EN		EN	Generally, occupies shallow terrestrial freshwater wetlands (i.e. temporary and permanent lakes, swamps and claypans) with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire (Johnstone & Storr, 1998)	~75 km north (2012) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present.	
SCOLOPACIDAE															
sharp-tailed sandpiper (<i>Calidris acuminata</i>)	MI	MI			Favours flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone <i>et al.</i> , 2013).	~17 km east (2009) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.	
curlew sandpiper (<i>Calidris ferruginea</i>)	CR/MI	CR/MI		NT	Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering <i>et al.</i> , 2007). This rare species generally roosts on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands (Geering <i>et al.</i> , 2007).	~17 km east (2005) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.	
pectoral sandpiper (<i>Calidris melanotos</i>)	MI	MI			Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone <i>et al.</i> , 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering <i>et al.</i> , 2007)	~16 km east (2012) (BHP WAI0, 2021)						Unlikely	N/A	Suitable habitat not present.	
red-necked stint (<i>Calidris ruficollis</i>)	MI	MI		NT	Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	~17.5 km east (2005) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.	
long-toed stint (<i>Calidris subminuta</i>)	MI	MI			They prefer shallow freshwater or brackish wetlands but are also fond of muddy shorelines, growths of short grasses, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. The Long-toed Stint also frequents permanent wetlands and forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Johnstone & Storr, 1998).	~4.5 km east (1981) (DBCA, 2020) ~17 km east (2001) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.	
black-tailed godwit (<i>Limosa limosa</i>)	MI	MI		NT	The species has a primarily coastal habitat environment. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks (Higgins & Davies, 1996)	~350 km north (2005) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.	
ruff (<i>Philomachus pugnax</i>)	MI	MI			Mainly fresh, brackish and saline wetlands with exposed mudflats. Found near lakes, swamps, pools, lagoons, tidal rivers and floodlands. Sometimes observed in sheltered coastal areas, including harbours and estuaries (DoEE, 2019)	~360 km north (2017) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.	

Common Name (Scientific Name)	Conservation Status				Preferred Broad Habitats	Nearest Record to the Study Area	Potential Critical Habitat Within the Study Area					Likelihood of Occurrence	Occurrence	Comments
	EPBC Act	BC Act	DBCA	IUCN			Stony Plain	Breakaway/ Cliff	Drainage Area/ Floodplain	Mulga Woodland	Hillcrest/ Hillslope			
wood sandpiper (<i>Tringa glareola</i>)	MI	MI			Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, freshwater lagoons and bore overflows (Johnstone <i>et al.</i> , 2013).	~500 m north (2010) (Biologic, 2011)						Unlikely	N/A	Suitable habitat not present.
common sandpiper (<i>Tringa hypoleucos</i>)	MI	MI			Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Geering <i>et al.</i> , 2007).	~500 m north (2013) (BHP WAI0, 2021; Onshore, 2013)						Unlikely	N/A	Suitable habitat not present.
common greenshank (<i>Tringa nebularia</i>)	MI	MI			Species occurs as a non-breeding summer Migrant which occurs throughout the region. Occurs mainly in Tidal mudflats, mangrove creeks, flooded samphire flats, beaches, river pools, and saltworks and sewage ponds (Johnstone <i>et al.</i> , 2013).	~500 m north (2013) (BHP WAI0, 2021; Onshore, 2013)						Unlikely	N/A	Suitable habitat not present.
marsh sandpiper (<i>Tringa stagnatilis</i>)	MI	MI			Lives in permanent or ephemeral wetlands of varying salinity, and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In Western Australia they prefer freshwater to marine environments. The species usually forages in shallow water at the edge of wetlands and roost or loaf on tidal mudflats, near low saltmarsh, and around inland swamps (Johnstone & Storr, 1998).	~500 m north (2010) (Biologic, 2011)						Unlikely	N/A	Suitable habitat not present.
common redshank (<i>Tringa totanus</i>)	MI	MI			It is found at sheltered coastal wetlands with bare open flats and banks of mud or sand. They are also found around salt lakes, freshwater lagoons, artificial wetlands and saltworks and sewage farms. The species has been observed feeding in shallow water, on wet bare mud or sand, or on algal deposits and roosting on small elevated areas such as estuarine sandbars and muddy islets surrounded by water (Johnstone & Storr, 1998).	~500 m north (2010) (BHP WAI0, 2021; Onshore, 2013)						Unlikely	N/A	Suitable habitat not present.
THRESKIORNITHIDAE														
glossy ibis (<i>Plegadis falcinellus</i>)	MI	MI			Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone <i>et al.</i> , 2013).	~4.5 km east (1978) (DBCA, 2020) ~8.5 km east (2000) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.
Reptiles														
BOIDAE														
Pilbara olive python (<i>Liasis olivaceus</i> subsp. <i>barroni</i>)	VU	VU			Associated with drainage systems, including areas with localized drainage and watercourses (Pearson, 1993). In the inland Pilbara the species is most often encountered near permanent waterholes in rocky ranges or among riverine vegetation (Pearson, 1993).	~500 m north (2010) (Biologic, 2011)		•			•	Possible	Resident	May occur in Breakaway/ Cliff and Hillcrest/ Hillslope habitats.
SCINCIDAE														
spotted ctenotus (<i>Ctenotus uber</i> subsp. <i>johnstonei</i>)			P2		Within the Pilbara, the taxon is known from <i>Triodia</i> on hillslopes, <i>Acacia xiphophylla</i> over chenopods, and <i>Acacia xiphophylla</i> scattered tall shrubs to high open shrubland (Cogger, 2014).	~30 km east (2018) (DBCA, 2021)	•				•	Possible	Resident	May occur in Stony Plain and lower slopes of Hillcrest/ Hillslope habitats. Taxonomic status of the disjunct Pilbara population unknown, may represent an undescribed taxon (P. Doughty, Western Australian Museum, <i>pers. comm.</i>).
unpatterned robust slider (<i>Lerista macropisthopus</i> subsp. <i>remota</i>)			P2		Woodlands and semi-arid scrubs with sandy substrate (Cogger, 2014)	~2.5 km west (2010) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present. Desktop records likely erroneous. Previous records most likely attributed to <i>Lerista neander</i> .
TYPHLOPIDAE														
Pilbara flat-headed blind-snake (<i>Anilius ganei</i>)			P1		Little is known of the species' ecology, but it is often associated with moist soils and leaf litter within gorges and gullies ((Wilson & Swan, 2014)), and potentially within a wide range of other stony habitats. The species has been recorded from numerous habitats but is most likely to be present in rocky terrain and along drainage lines (DBCA, 2021)	~3.7 km west (2010) (Biologic, 2011)		•			•	Possible	Resident	May occur in Breakaway/ Cliff and Hillcrest/ Hillslope habitats, particularly where most substrates present for prolonged periods.

7. Limitations

The (EPA, 2020) outlines several potential limitations to vertebrate fauna surveys. These aspects are assessed and discussed in Table 7.1 below. No major limitations or constraints were identified for the survey.

Table 7.1: Survey constraints and limitations

Potential limitation or constraint	Constraint	Applicability to this survey
Sources/availability of data and information (recent or historic) and availability of contextual information	No	A significant amount of survey work has been undertaken in the wider local area and the surrounding region, and most of these previous survey results were available for review. These reports were available at the time of reporting.
Competency/ experience of the survey team	No	The field personnel involved in the survey are experienced in undertaking fauna surveys of similar nature, including with the significant species targeted during the survey. Technical personnel with relevant expertise assisted with analysis of ultrasonic recordings (Bob Bullen), and analysis of acoustic recordings (Nigel Jackett).
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope was a basic level vertebrate fauna survey with targeted sampling components, which was conducted within the EPA (2020) framework.
		Northern quoll –The species was sampled following survey guidelines in relation to survey design and effort, site coverage, and detectability (DoE, 2016). However, due to a lack of suitable habitat camera trap transects had to be shortened. Camera trap transects were set during this assessment for 50 sampling nights. Targeted searches were undertaken for secondary evidence (e.g. scats).
		Pilbara leaf-nosed bat - The species has been sampled through targeted surveys (ultrasonic recording; six sampling nights). Bat detectors were placed at significant habitat areas including water features where possible. Sampling was undertaken during the wet season, when bats are likely to be dispersing, and there is a greater likelihood of detection.
		Greater bilby - Greater bilby sampling in the Study Area consisted of targeted bilby plots and opportunistic records. Due to the Study Area consisting of minimal greater bilby habitat, only one bilby plot was conducted.
		Ghost bat - The species has been sampled through targeted surveys (ultrasonic recording; six sampling nights). Bat detectors were placed at significant habitat areas.
		Night parrot - Sampling has been conducted throughout the Study Area. The acoustic detectors range is only ~300 metres (DPaW, 2017), but due to the limited night parrot habitat present within the area, it is considered adequate coverage. One SM4 recorder was deployed for six nights. Conditions during the recording period were generally good, with no rain and low winds recorded.
		Pilbara olive python - Targeted diurnal searches were undertaken in potential habitat for active individuals, scats, and water features likely to support the species.

Potential limitation or constraint	Constraint	Applicability to this survey
Timing, weather, and season	No	Field surveys occurred over appropriate or optimal periods for sampling the target species. No weather or seasonality constraints or limitations were identified during the surveys.
Disturbances (e.g. fire or flood)	No	No disturbance occurred during or immediately prior to the survey that was likely to impinge on the results of this assessment.
Proportion of fauna identified	No	All fauna observed during the field surveys were identified to species level. Species identification of fauna recorded via camera traps and SongMeter ultrasonic recorders were able to be accurately identified with the assistance of technical personnel with relevant expertise.
Adequacy of the survey intensity and proportion of the survey achieved	No	A basic and targeted survey was undertaken across the Study Area to assist with decisions on future environmental approvals. The sampling methods and survey intensity was high and focussed on significant.
Remoteness or access issues	No	The Study Area was accessible either by vehicle or on foot, thus the sampling techniques used in these areas during this survey were unconstrained by accessibility or remoteness.
Problems with data and analysis, including sampling bias	No	No limitations with data collection and/or analysis were encountered during the field survey or during subsequent analysis.

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