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.

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NEWMAN

G 5200258 G 5200259

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G 5200260 G 5200261 G 5200262

G 5200263 G 5200264 G 5200265

G 5200277

G 5200266 G 5200267 G 5200268

G 5200269 G 5200270 G 5200271

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G 5200272 G 5200273 G 5200274

Legend

- Study Area
- BHP Tenement
- Local Road

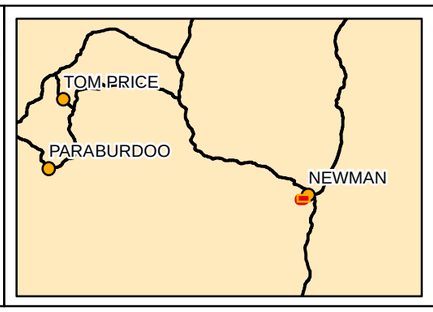
N

biologic Environmental Survey

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

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

720000 740000 760000 780000 800000

7440000 7420000 7400000

Great Northern Hwy

Marble Bar Rd

NEWMAN

Bird

- Curlew sandpiper - CR/MI
- Peregrine falcon - OS
- Caspian tern - MI
- Common greenshank - MI
- Common redshank - MI
- Common sandpiper - MI
- Glossy ibis - MI
- Gull-billed tern - MI
- Long-toed stint - MI
- Marsh sandpiper - MI
- Oriental plover - MI
- Pectoral sandpiper - MI
- Red-necked stint - MI
- Sharp-tailed sandpiper - MI
- Wood sandpiper - MI

Mammal

- Black-flanked rock-wallaby - EN
- Northern quoll - EN
- Ghost bat - VU
- Greater bilby - VU
- Pilbara leaf-nosed bat - VU
- Brush-tailed mulgara - P4
- Long-tailed dunnart - P4
- Western pebble-mound mouse - P4

Reptile

- Pilbara olive python - VU
- Pilbara flat-headed blind-snake - P1

Legend

- Study Area
- Local Road
- State Road

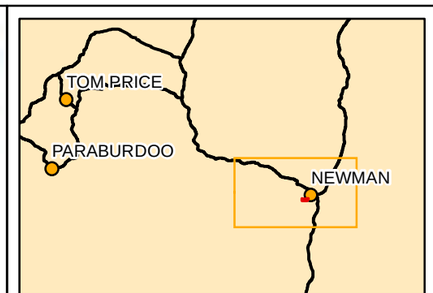
N

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).

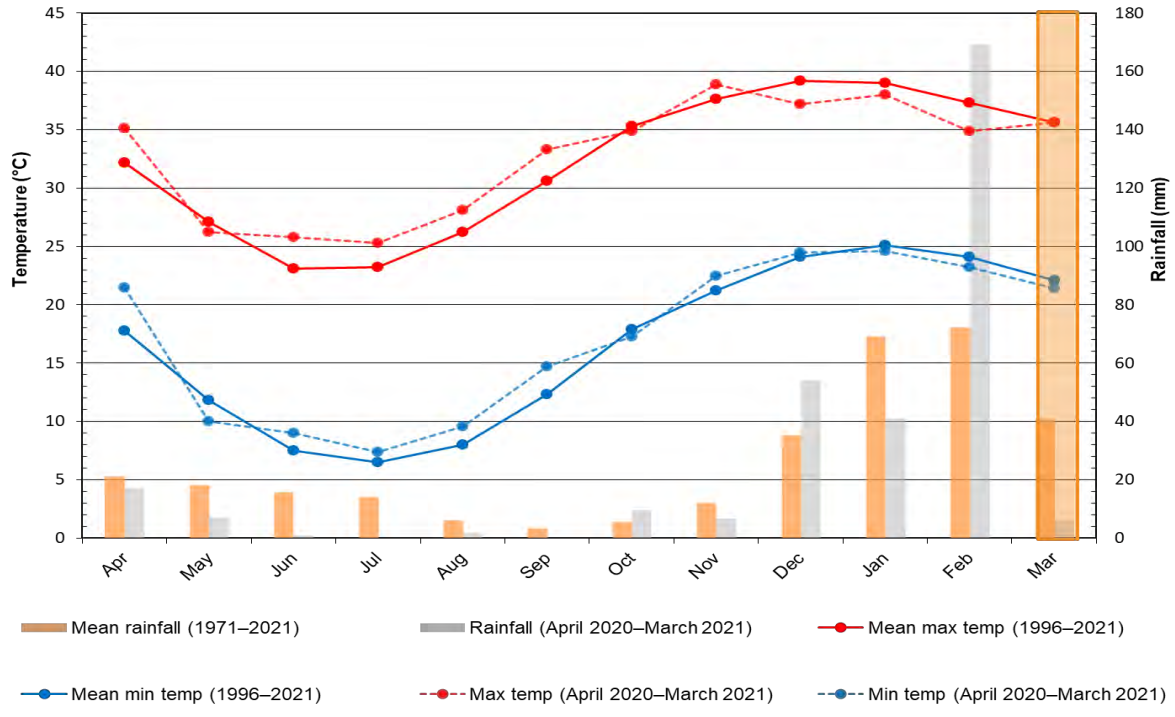


Figure 4.1: Monthly rainfall and long-term average rainfall for Newman Airport (Station ID 007176). Survey period indicated by green bar (BoM, 2021).

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**

773500
775000
776500
7411500
7410000

VWRP-18
VWRP-40
VWRP-19
VWRP-53
VWRP-43
VWRP-17
VWRP-42
VWRP-65
VWRP-84
VWRP-83
VWRP-85
VWRP-12
VWRP-81
VWRP-82
VWRP-49
VWRP-15
VWRP-45
VWRP-46
VWRP-48
VWRP-47
VWRP-35

Legend

Study Area

Sampling Site

Bilby Plot
Camera Trap
Habitat Assessment
SongMeter (acoustic)
SongMeter (ultrasonic)
Targeted Search

N

biologic Environmental Survey

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

TOM PRICE
PARABURDOO
NEWMAN

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 *Triodia* 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 *Eucalyptus* over *Acacia* and/or *Grevillea* shrubs with an understory dominated by *Triodia* 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 (*Acacia aneura*) 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 *Triodia* hummock grassland with scattered *Eucalyptus* trees and *Acacia* and/or *Grevillea* 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	

773500
775000
776500
7410000
7408500

Legend

Study Area

Fauna of Conservation Significance

Western pebble-mound mouse

Fauna Habitat

Breakaway/ Cliff

Drainage Area/ Floodplain

Hillcrest/ Hillslope

Mulga Woodland

Stony Plain

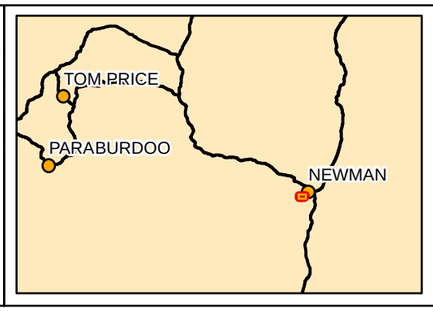
N

biologic Environmental Survey

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

Scientific Name	Common Name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
ESTRILDIDAE					
Emblema pictum	painted finch				
Taeniopygia guttata subsp. *castanotis*	zebra finch				
LOCUSTELLIDAE					
Eremiornis carteri	spinifexbird				
MALURIDAE					
Malurus leucopterus subsp. *leuconotus*	white-winged fairy-wren				
MEGAPODIIDAE					
Acanthagenys rufogularis	spiny-cheeked honeyeater				
Manorina flavigula	yellow-throated miner				
Lichenostomus keartlandi	grey-headed honeyeater				
PACHYCEPHALIDAE					
Colluricincla harmonica subsp. *rufiventris*	grey shrike-thrush				
PSITTACIDAE					
Melopsittacus undulatus	budgerigar				
PTILINORHYNCHIDAE					
Ptilonorhynchus maculatus subsp. *guttatus*	western bowerbird				
RHIPIDURIDAE					
Rhipidura leucophrys subsp. *leucophrys*	willie wagtail				
REPTILES					
AGAMIDAE					
Ctenophorus caudicinctus	ring-tailed dragon				
VARANIDAE					
Varanus acanthurus	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 (*Pseudomys chapmani*)	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 (*Dasycercus blythi*)			P4		Prefers spinifex *Triodia* spp. grasslands on sand plains and the swales between low dunes (Pavey *et al.*, 2012; Woolley, 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner *et al.*, 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 (*Dasyurus hallucatus*)	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 *et al.*, 2008).	~650 m west (2020) (Biologic, 2020c) ~3.5 km north (2007) (BHP WAIO, 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 (*Sminthopsis longicaudata*)			P4		Typically occurs on plateaus near breakaways and scree slopes, and on rugged boulder-strewn scree slopes (Burbidge *et al.*, 2008). Once considered rare but now shown to be relatively common and widespread in rocky habitats (Burbidge *et al.*, 2008).	~4.5 km north-west (1998) (BHP WAIO, 2021)		•			•	Possible	Resident	May occur as a resident in Stony Plain and Hillcrest/ Hillslope habitats.
HIPPOSIDERIDAE														
pilbara leaf-nosed bat (*Rhinonicteris aurantia* (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 WAIO, 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 (*Petrogale lateralis* subsp. *lateralis*)	EN	EN		NT	Rocky habitats, including gorges and gullies or outcrops with sufficient shelter habitat. Often vegetated with *Acacia* thickets and open low eucalypt woodlands with an understory of grasses and low shrubs (Willers *et al.*, 2011).	~23 km north-east (1975) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.
MEGADERMATIDAE														
ghost bat (*Macroderma gigas*)	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 *et al.*, 2008; Tidemann *et al.*, 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 *(Pseudomys chapmani)*			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 *et al.*, 2000).	~overlapping (2009) (BHP WAIO, 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 (*Macrotis lagotis*)	VU	VU		VU	Variety of habitats including spinifex hummock grassland and *Acacia* shrubland, on soft soils (Burrows *et al.*, 2012). In the Pilbara often associated with major drainage line sandy terraces (How *et al.*, 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 (*Apus pacificus*)	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 (*Charadrius leschenaultii* subsp. *leschenaultii*)	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 (*Charadrius dubius*)	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 (*Charadrius veredus*)	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 (*Ephippiorhynchus asiaticus*)				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 *et al.*, 2013).	~8.5 km east (2003) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present.
FALCONIDAE														
grey falcon (*Falco hypoleucos*)	VU	VU			Timbered lowlands, particularly Acacia shrubland and along inland drainage systems. Also frequent spinifex and tussock grassland (Burbidge *et al.*, 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 (*Falco peregrinus*)		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 *et al.*, 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 (*Hirundo rustica*)	MI	MI			The Barn Swallow is a non-breeding summer visitor to the Pilbara. It favors areas near water (Johnstone *et al.*, 2013).	~350 km north (2001) (DBCA, 2021)						Highly Unlikely	N/A	Suitable habitat not present.
LARIDAE														
caspian tern (*Sterna caspia*)	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 (*Gelochelidon nilotica*)	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.

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			
MOTACILLIDAE														
grey wagtail (*Motacilla cinerea*)	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 (*Motacilla flava*)	MI	MI			An uncommon but regular visitor to the Pilbara region (Johnstone *et al.*, 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 (*Pezoporus occidentalis*)	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 (*Polytelis alexandrae*)	VU		P4	NT	The Princess Parrot inhabits low open eucalypt woodlands and savannah shrublands in arid deserts, usually with *Casuarina* and *Allocasuarina* spp. Primarily breeds in Marble Gum hollows (Pavey *et al.*, 2014).	~50 km north (2012) (DBCA, 2021)						Unlikely	N/A	Suitable habitat not present.
ROSTRATULIDAE														
Australian painted snipe (*Rostratula benghalensis* subsp. *australis*)	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 (*Calidris acuminata*)	MI	MI			Favours flooded samphire flats and grasslands, mangrove creeks mudflats, beaches, river pools, saltwork ponds, sewage ponds and freshwater soaks (Johnstone *et al.*, 2013).	~17 km east (2009) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.
curlew sandpiper (*Calidris ferruginea*)	CR/ MI	CR/ MI		NT	Inhabits intertidal mudflats in sheltered coastal areas (i.e. estuaries, bays, inlets and lagoons) (Geering *et al.*, 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 *et al.*, 2007).	~17 km east (2005) (DBCA, 2020)						Unlikely	N/A	Suitable habitat not present.
pectoral sandpiper (*Calidris melanotos*)	MI	MI			Coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (Johnstone & Storr, 2004; Johnstone *et al.*, 2013). It prefers wetlands with open fringing mudflats and low, emergent or fringing vegetation (Geering *et al.*, 2007)	~16 km east (2012) (BHP WAIO, 2021)						Unlikely	N/A	Suitable habitat not present.
red-necked stint (*Calidris ruficollis*)	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 (*Calidris subminuta*)	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 (*Limosa limosa*)	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 (*Philomachus pugnax*)	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 (*Tringa glareola*)	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 *et al*., 2013).	~500 m north (2010) (Biologic, 2011)						Unlikely	N/A	Suitable habitat not present.
common sandpiper (*Tringa hypoleucos*)	MI	MI			Estuaries and deltas of streams, as well as banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans (Geering *et al*., 2007).	~500 m north (2013) (BHP WAIO, 2021; Onshore, 2013)						Unlikely	N/A	Suitable habitat not present.
common greenshank (*Tringa nebularia*)	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 *et al*., 2013).	~500 m north (2013) (BHP WAIO, 2021; Onshore, 2013)						Unlikely	N/A	Suitable habitat not present.
marsh sandpiper (*Tringa stagnatilis*)	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 (*Tringa totanus*)	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 WAIO, 2021; Onshore, 2013)						Unlikely	N/A	Suitable habitat not present.
THRESKIORNITHIDAE														
glossy ibis (*Plegadis falcinellus*)	MI	MI			Freshwater wetlands, irrigated areas, margins of dams, floodplains, brackish and saline wetlands, tidal mudflats, pastures, lawns and public gardens (Johnstone *et al*., 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 (*Liasis olivaceus* subsp. *barroni*)	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 (*Ctenotus uber* subsp. *johnstonei*)			P2		Within the Pilbara, the taxon is known from *Triodia* on hillslopes, *Acacia xiphophylla* over chenopods, and *Acacia xiphophylla* 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, *pers. comm*.).
unpatterned robust slider (*Lerista macropisthopus* subsp. *remota*)			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 *Lerista neander*.
TYPHLOPIDAE														
Pilbara flat-headed blind-snake (*Anilios ganei*)			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.

8. References

Anstee, S. D. (1996). Use of external mound structures as indicators of the presence of the pebble-mound mouse, *Pseudomys chapmani*, in mound systems. *Wildlife Research, 23*(4), 429-434. doi:http://dx.doi.org/10.1071/WR9960429

Armstrong, K. N. (2001). The distribution and roost habitat of the orange leaf-nosed bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia. *Wildlife Research, 28*(95-104). doi:https://doi.org/10.1071/WR00011

Armstrong, K. N., & Anstee, S. D. (2000). The ghost bat in the Pilbara: 100 years on. *Australian Mammalogy, 22*, 93–101. doi:https://doi.org/10.1071/AM00093

Astron. (2010). *Mt Whaleback TSF flora, vegetation and fauna assessment*. Astron Environmental Services, Perth, WA.

BHP. (2017). *Guidance for terrestrial vertebrate fauna surveys in the Pilbara*. Unpublished procedure prepared by BHP Billiton Iron Ore. BHP Billiton Iron Ore, Perth, WA.

BHP WAIO. (2021). *BHP WAIO fauna records database (custom search)*.

Biologic. (2009). *Newman power network level 2 flora and level 1 fauna survey*. Biologic Environmental Survey,

Biologic. (2011). *Orebody 35 and Western Ridge vertebrate fauna survey*. Biologic Environmental Survey,

Biologic. (2014a). *Orebody 24 targeted vertebrate fauna survey*. Biologic Environmental Survey,

Biologic. (2014b). *Orebody 25 targeted vertebrate fauna survey*. Biologic Environmental Survey,

Biologic. (2016a). *Cathedral Gorge level 1 and targeted vertebrate fauna survey*. Biologic Environmental Survey,

Biologic. (2016b). *Western Ridge southern tenements vertebrate fauna desktop assessment*. Biologic Environmental Survey,

Biologic. (2020a). *Coombanbunna Well level 2 vertebrate fauna survey*. Biologic Environmental Survey, East Perth, WA.

Biologic. (2020b). *Developments in knowledge of ghost bat home range and foraging areas, and its application at Mining Area C - South Flank*. Unpublished report prepared for BHP Western Australian Iron Ore. Biologic Environmental Survey, East Perth, WA.

Biologic. (2020c). *Western Ridge targeted vertebrate fauna survey*. Biologic Environmental Survey, East Perth, WA.

Biologic. (2021a). *Western Ridge matters of national environmental significance fauna study*. Biologic Environmental Survey, East Perth, WA.

Biologic. (2021b). *Western Ridge Pipelines vertebrate fauna survey*. Unpublished report prepared for BHP WAIO. Biologic Environmental Survey, East Perth, WA.

Biota. (2001). *Baseline biological and soil surveys and mapping for ML244SA west of the Fortescue River*. Biota Environmental Sciences, Leederville, WA.

BirdLife Australia. (2021). Birdata (custom search). http://www.birdata.com.au/custom.vm

BirdLife International. (2016). Charadrius dubius. The IUCN Red List of Threatened Species 2016. doi:e.T22693770A86577884. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T22693770A86577884.en

BoM, Bureau of Meteorology. (2021). Climate Data Online. Retrieved 2021 http://www.bom.gov.au./climate/data/index.shtml

Braithwaite, R. W., & Griffiths, A. D. (1994). Demographic variation and range contraction in the northern quoll, *Dasyurus hallucatus (Marsupialia: Dasyuridae)*. *Wildlife Research, 21*, 203-217.

Burbidge, A. A., McKenzie , N. L., & Fuller, P. J. (2008). Long-tailed Dunnart (Sminthopsis longicaudata). In *Mammals of Australia* (Third ed., pp. 148-150). Sydney, New South Wales: Reed New Holland.

Burbidge, A. H., Johnstone, R. E., & Pearson, D. J. (2010). Birds in a vast arid upland: avian biogeographical patterns in the Pilbara region of Western Australia. *Records of the Western Australian Museum Supplement, 78*, 247-270.

Burrows, N. D., Dunlop, J., & Burrows, S. (2012). Searching for signs of bilby (*Macrotis lagotis*) activity in central Western Australia using observers on horseback. *Journal of the Royal Society of Western Australia, 95*, 167-170.

Cogger, H. G. (2014). *Reptiles and amphibians of Australia* (Seventh ed.). Collingwood, Victoria: CSIRO Publishing.

DAWE, Department of Agriculture, Water and the Environment. (2021). Protected Matters Search Tool (custom search). Retrieved 2021 www.environment.gov.au/erin/ert/epbc/index.html

DBCA, Department of Biodiversity, Conservation and Attractions. (2017). *Guidelines for surveys to detect the presence of bilbies and assess the importance of habitat in Western Australia*. Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia.

DBCA, Department of Biodiversity, Conservation and Attractions. (2020). Threatened and priority fauna database (custom search). from Department of Biodiversity, Conservation and Attractions http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals

DBCA, Department of Biodiversity, Conservation and Attractions. (2021). NatureMap: Mapping Western Australia's biodiversity (custom search). Retrieved 2021 http://naturemap.dec.wa.gov.au./default.aspx

DEWHA, Department of Environment, Water, Heritage and the Arts. (2010a). *Survey guidelines for Australia's threatened bats*. Canberra, Australian Capital Territory: Department of Environment, Water, Heritage and the Arts.

DEWHA, Department of Environment, Water, Heritage and the Arts. (2010b). *Survey guidelines for Australia's threatened birds*. Canberra, Australian Capital Territory: Department of Environment, Water, Heritage and the Arts.

DoE, Department of the Environment. (2013). *Matters of National Environmental Significance: Significant Impact Guidelines*. Department of the Environment, Canberra, Australian Capital Territory.

DoE, Department of the Environment. (2016). *EPBC Act referral guideline for the endangered northern quoll Dasyurus hallucatus*. Canberra, Australian Capital Territory: Department of the Environment.

DoEE, Department of the Environment and Energy. (2019). Species profile and threats database. from Department of the Environment and Energy http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

DPaW, Department of Parks and Wildlife. (2017). *Interim guideline for preliminary surveys of Night Parrot (Pezoporus occidentalis) in Western Australia*. Department of Parks and Wildlife, Kensington, Western Australia.

DSEWPaC, Department of Sustainability, Environment, Water, Population and Communities. (2011a). *Survey guidelines for Australia's threatened mammals*. Canberra, Australian Capital Territory: Department of Sustainability, Environment, Water, Population and Communities.

DSEWPaC, Department of Sustainability, Environment, Water, Population and Communities. (2011b). *Survey guidelines for Australia's threatened reptiles*. Canberra, Australian Capital Territory: Department of Sustainability, Environment, Water, Population and Communities.

Eco Logical. (2011). *Newman power line corridor level 1 flora and fauna survey*. Eco Logical Australia, Perth, WA.

Eco Logical. (2012a). *Level 1 flora and fauna surveys along the Great Northern Highway for Jimblebar Mine module transport*. Eco Logical Australia, Perth, WA.

Eco Logical. (2012b). *Orebody 37 level 1 vertebrate fauna assessment*. Eco Logical Australia, Perth, WA.

ecologia. (1998). *Mt Whaleback fauna monitoring programme: Baseline sampling 1997–1998*. ecologia Environmental Consultants, West Perth, WA.

ecologia. (2004). *Orebody 24 expansion biological survey*. ecologia Environmental Consultants, West Perth, WA.

ecologia. (2005). *Western Ridge exploration project biological survey*. ecologia Environmental Consultants, West Perth, WA.

ecologia. (2006). *BHPBIO Western Ridge exploration project biological survey*. ecologia Environmental Consultants, West Perth, WA.

ecologia. (2008). *RGP5 fauna survey Newman to Jimblebar junction*. ecologia Environmental Consultants, West Perth, WA.

ENV. (2006). *Mount Whaleback fauna assessment survey phase III*. ENV Australia, Perth, WA.

ENV. (2009a). *Newman to Jimblebar transmission line and Newman town substation terrestrial fauna assessment*. ENV Australia, Perth, WA.

ENV. (2009b). *Newman to Yandi transmission line terrestrial vertebrate fauna assessment*. ENV Australia, Perth, WA.

ENV. (2010). *Orebody 35 vegetation clearing permit area flora and fauna assessment*. ENV Australia, Perth, WA.

ENV. (2011a). *Eastern Ridge (OB23/24/25) fauna assessment*. ENV Australia, Perth, WA.

ENV. (2011b). *Mt Whaleback East flora, vegetation and fauna assessment*. ENV Australia, Perth, WA.

EPA, Environmental Protection Authority. (2020). *Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. Western Australia: Environmental Protection Authority.

Geering, A., Agnew, L., & Harding, S. (2007). *Shorebirds of Australia*. Collingwood, Victoria: CSIRO Publishing.

GHD. (2008). *Myopic project area, Newman: Flora and fauna assessment*. GHD Pty Ltd, Perth, WA.

HGM, Halpern Glick Maunsell. (1999). *Orebody 30 and Orebody 35 soil & biological survey*. Halpern Glick Maunsell, Perth, WA.

Higgins, P. J., & Davies, J. J. F. (Eds.). (1996). *Volume 3: Snipe to Pigeons*. Melbourne, Vic: Oxford University Press.

Hohnen, R., Ashby, J., Tuft, K., & McGregor, H. (2012). Individual identification of northern quolls (*Dasyurus hallucatus*) using remote cameras. *Australian Mammalogy, 35*(2), 131-135. doi:http://dx.doi.org/10.1071/AM12015

How, R. A., Dell, J., & Cooper, N. K. (1991). Ecological survey of Abydos-Woodstock Reserve, Pilbara region, Western Australia: Vertebrate fauna. *Records of the Western Australian Museum Supplement, 37*, 78-125.

Johnstone, R., & Storr, G. M. (1998). *Handbook of Western Australian Birds Volume I - Non-passerines (Emu to Dollarbird)*. Perth, Western Australia: Western Australian Museum.

Johnstone, R., & Storr, G. M. (2004). *Handbook of Western Australian birds. Volume II: Passerines (Blue-winged Pitta to Goldfinch)*. Perth, Western Australia: Western Australian Museum.

Johnstone, R. E., Burbidge, A. H., & Darnell, J. C. (2013). Birds of the Pilbara region, including seas and offshore islands, Western Australia: distribution, status and historical changes. *Records of the Western Australian Museum Supplement, 78*, 343-441.

Körtner, G., Pavey, C., & Geiser, F. (2007). Spatial ecology of the mulgara in arid Australia: impact of fire history on home range size and burrow use. *Journal of Zoology, 273*(4), 350-357.

National Committee on Soil and Terrain. (2009). *Australian soil and land survey field handbook* (Third ed.). Collingwood, Victoria: CSIRO Publishing.

Oakwood, M. (2000). Reproduction and demography of the northern quoll, *Dasyurus hallucatus*, in the lowland savanna of northern Australia. *Australian Journal of Zoology, 48*, 519–539. doi:https://doi.org/10.1071/ZO00028

Olsen, J., Debus, S., Rose, A. B., & Hayes, G. (2004). Breeding success, cliff characterisation and diet of peregrine falcon at high altitude in the Australian Capital Territory. *Corella, 28*(2), 33-37.

Olsen, P. D., & Olsen, J. (1986). Distribution, status, movement and breeding of the grey falcon *Falco hypoleucos*. *Emu - Austral Ornithology, 86*(1), 47-51.

Olsen, P. D., & Olsen, J. (1989). Breeding of the peregrine falcon *Falco peregrinus*. III. Weather, nest quality and breeding success. *Emu - Austral Ornithology, 89*(1), 6-14. doi:https://doi.org/10.1071/MU9890006

Onshore. (2013). *Flora and vegetation and vertebrate fauna review Mt Whaleback AML 7/244*. Unpublished report preapred for BHP Billiton Iron Ore. Onshore Environmental Consultants, Yallingup, WA.

Onshore. (2014). *Western Ridge biological survey*. Onshore Environmental Consultants, Yallingup, WA.

Onshore. (2018). *Western Ridge E52/3448 Desktop Flora and Fauna Assessment*. Unpublished report prepared for BHP WAIO. Onshore Environmental Consultants, Yallingup, WA.

Onshore, & Biologic. (2009a). *Mt Whaleback mine site flora and vegetation survey and fauna assessment*. Onshore Environmental Consultants & Biologic Environmental Survey, Yallingup, WA.

Onshore, & Biologic. (2009b). *Myopic exploration leases biological survey*. Onshore Environmental Consultants & Biologic Environmental Survey, Yallingup, WA.

Pavey, C. R., Nano, C. E. M., Cole, J. R., McDonald, P. J., Nunn, P., Silcocks, A., & Clarke, R. H. (2014). The breeding and foraging ecology and abundance of the princess parrot (*Polytelis alexandrae*) during a population irruption. *Emu - Austral Ornithology, 114*(2), 106-115. doi:http://dx.doi.org/10.1071/MU13050

Pavey, C. R., Nano, C. E. M., Cooper, S. J. B., Cole, J. R., & McDonald, P. J. (2012). Habitat use, population dynamics and species identification of mulgara, *Dasycercus blythi* and *D. cristicauda*, in a zone of sympatry in central Australia. *Australian Journal of Zoology, 59*(3), 156-169. doi:https://doi.org/10.1071/ZO11052

Pearson, D. J. (1993). Distribution, status and conservation of pythons in Western Australia. In D. Lunney & D. Ayers (Eds.), *Herpetology in Australia: A diverse discipline* (pp. 383-395). Sydney, New South Wales: Royal Zoological Society of NSW.

Richards, G. C., Hand, S., Armstrong, K. N., & Hall, L. S. (2008). Ghost bat. In S. van Dyck & R. Strahan (Eds.), *Mammals of Australia* (Third ed.). Sydney, New South Wales: Reed New Holland.

Southgate, R., Dziminski, M. A., Paltridge, R., Schubert, A., & Gaikhorst, G. (2019). Verifying bilby presence and the systematic sampling of wild populations using sign-based protocols – with notes on aerial and ground survey techniques and asserting absence. *Australian Mammalogy, 41*(1). doi:https://doi.org/10.1071/AM17028

Start, A. N., Anstee, S. D., & Endersby, M. (2000). A review of the biology and conservation status of the ngadji, *Pseudomys chapmani* Kitchener, 1980 (Rodentia: Muridae). *CALMScience, 3*(2), 125-147.

Tidemann, C. R., Priddel, D. M., Nelson, J. E., & Pettigrew, J. D. (1985). Foraging behaviour of the Australian ghost bat *Macroderma gigas* (Microchiroptera: Megadermatidae). *Australian Journal of Zoology, 33*(5), 705-713. doi:http://dx.doi.org/10.1071/ZO9850705

TSSC, Threatened Species Scientific Committee. (2016a). *Conservation advice: Macroderma gigas, ghost bat*. TSSC, Threatened Species Scientific Committee, Canberra, Australian Capital Territory.

TSSC, Threatened Species Scientific Committee. (2016b). *Conservation advice: Rhinonicteris aurantia (Pilbara form), Pilbara leaf-nosed bat*. Australian Government, Canberra, Australian Capital Territory.

Wildlife Acoustics, Inc. (2011). *Song meter SM2BAT+ ultrasonic recorder*. Wildlife Acoustics Inc., Massachusetts, United States of America.

Wildlife Acoustics, Inc. (2017). *Song Meter SM4BAT FS bioacoustics recorder user guide*. Wildlife Acoustics Inc., Massachusetts, United States of America.

Willers, N., Mawson, P., Morris, K., & Bencini, R. (2011). Biology and population dynamics of the black-flanked Rock-wallaby (*Petrogale lateralis lateralis*) in the central wheatbelt of Western Australia. *Australian Mammalogy, 33*, 117-127.

Wilson, S., & Swan, G. (2014). *A complete guide to reptiles of Australia*. Sydney, New South Wales: New Holland Publishers.

Woinarski, J. C. Z., Oakwood, M., Winter, J., Burnett, S., Milne, D., Foster, P., Myles, H., & Holmes, B. (2008). *Surviving the toads: Patterns of persistence of the northern quoll Dasyurus hallucatus in Queensland*. Report to the Australian Government's Natural Heritage Trust. http://www.nt.gov.au/nreta/wildlife/programs/quoll/pdf/qld_quolls_finalreport.pdf

Woolley, P. A. (2006). Studies on the crest-tailed mulgara *Dasycercus cristicauda* and the brush-tailed mulgara *Dasycercus blythi* (Marsupialia: Dasyuridae). *Australian Mammalogy, 28*, 117-120. doi:https://doi.org/10.1071/AM06018