Coombanbunna Well

Level 2 Vertebrate Fauna Survey

Biologic Environmental Survey

Report to BHP Western Australian Iron Ore

October 2020

Document Status				
Revision No.	Author	Review / Approved for Issue	Approved for Issue to	
			Name	Date
1	R. Ellis; C. Proctor	C. Knuckey	T. Carroll	01/05/2020
2	R. Ellis	C. Knuckey	T. Carroll	20/05/2020
3	R. Ellis	C. Knuckey	T. Carroll	03/07/2020
4	R. Ellis	C. Knuckey	B. Menezies; T. Carroll	01/10/2020

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EXECUTIVE SUMMARY

BHP Western Australian Iron Ore (BHP WAIO) is investigating the biological values of the Coombanbunna Well area (hereafter referred to as the Study Area) to provide contextual biological information to inform future environmental approvals within and in the vicinity of the area. The Study Area is located approximately 13 kilometres (km) south-west of Newman and comprises multiple tenements, including three live exploration licenses (E5203448, E5203360 and E5203361) and part of one live mining lease (AM7000266), covering a total area of approximately 4,698.55 hectares (ha). To support this assessment, Biologic Environmental Survey Pty Ltd (Biologic) was commissioned to undertake a Level 2 vertebrate fauna assessment of the Study Area. This report documents the findings of this assessment, which consisted of a desktop assessment and a two-phase Level 2 field survey.

The desktop assessment was conducted prior to the field survey to identify all fauna species which have the potential to occur in the Study Area. The two-phase field survey was conducted between 26 November and 7 December 2019 (Phase 1) and between 25 February and 6 March 2020 (Phase 2). The primary objective of the two surveys was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on species of conservation 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). Specific methods included systematic trapping (pitfall, Elliott, funnel and cage trapping), avifauna censuses, spotlighting, motion-sensor cameras, acoustic bird call recordings, bat echolocation recordings, targeted searches and habitat assessments.

Five broad fauna habitat types were recorded and mapped within the Study Area, comprising, in decreasing order of extent, Stony Plain (1,915.23 ha, 51.8% of Study Area), Drainage Area/ Floodplain (841.14 ha, 22.7%), Hardpan Plain (578.31 ha, 15.6%), Mulga Woodland (286.87 ha, 7.8%) and Hillcrest/ Hillslope (77.01 ha, 2.1%). Four fauna habitats occurring within the Study Area are considered to be of moderate significance (Stony Plain, Drainage Area/ Floodplain, Mulga Woodland and Hillcrest/ Hillslope) and one to be of low significance (Hardpan Plain). No habitats occurring within the Study Area were deemed to be of high significance. The absence of highly significant habitats is due to the lack of critical habitat for any vertebrate species of high conservation significance. In instances where suitable habitat for conservation significant species occurs, it is often within widespread habitats and generally limited to supporting habitat, such as foraging/dispersal only. 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.

Of the four habitats deemed to be of moderate significance, two (Drainage Area/ Floodplain and Mulga Woodland) provides potential habitat for Brush-tailed Mulgara (*Dasycercus blythi* – Priority 4 DBCA), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form) – Vulnerable EPBC/BC Act) (Priority 5 foraging habitat only) and Peregrine Falcon (*Falco peregrinus* – Specially Protected BC Act) and primary foraging/dispersal habitat for the Ghost Bat (*Macroderma gigas* – Vulnerable EPBC/BC Act). Stony Plain habitat may also provide suitable foraging/dispersal habitat for Ghost Bat; however, this is likely to vary with the presence of trees, which provide perching sites during foraging, occurring at higher

density and the proximity to suitable roost habitat. The Hillcrest/ Hillslope habitat may provide suitable habitat for Long-tailed Dunnart (*Sminthopsis longicaudata* – Priority 4 DBCA) and potential Priority 3 foraging habitat for Pilbara Leaf-nosed Bat. Utilisation of Hillcrest/ Hillslope habitat for foraging by Pilbara Leaf-nosed Bat is likely to be limited to instances where outcropping occurs. The remaining habitat (Hardpan Plain) was deemed to be of low significance as it does not support species of high conservation value and/ or such species are not dependent on these habitats at the broad scale. Instances of this habitat may be suitable for the Western Pebble-mound Mouse (*Pseudomys chapmani* – Priority 4 DBCA) and Spotted Ctenotus (*Ctenotus uber* subsp. *johnstonei* – Priority 4 DBCA) and possibly Brush-tailed Mulgara and Long-tailed Dunnart.

No important habitat features (caves or water features) were recorded within the Study Area during the current survey.

The desktop assessment identified a total of 340 vertebrate fauna species as potentially occurring in the Study Area, comprising 45 mammals (including 36 native and 9 non-native), 197 birds, 91 reptiles and seven amphibians. The current field survey recorded 45% (153 species) of species identified in the desktop assessment, comprising 25 mammals (20 native and five introduced), 75 birds, and 51 reptiles and two amphibians. Species diversity recorded within the Study Area was comparable to previous surveys of similar survey effort (comprising two-phase pit trapping surveys) included in the desktop assessment. Vertebrate fauna species recorded within the Study Area were typical of assemblages of the five broad fauna habitat types recorded within the Pilbara region. This is supported by the fact that the five habitats mapped within the Study Area are typical of the Pilbara or adjacent regions and occur more broadly outside the Study Area.

Of the 38 species of conservation significance identified in the desktop assessment, two were recorded within the Study Area during the current survey:

- Pilbara Leaf-nosed Bat – recorded once from ultrasonic call recordings in the Mulga Woodland habitat on the northern edge of the Study Area;
- Western Pebble-mound Mouse - recorded eight times from secondary evidence (pebble mounds), including three deemed active and five inactive.

Given the habitats present within the Study Area and locations of nearby records identified during the desktop assessment, a further two species of conservation significance are considered highly likely to occur within the Study Area, Ghost Bat and Peregrine Falcon. During the Phase 2 survey, a Peregrine Falcon was recorded approximately 1 km southwest of the Study Area, and Ghost Bats have previously been recorded approximately 300 m north of the Study Area.

The occurrence of a further six species identified in the desktop assessment within the Study Area was considered Possible. The remaining 28 species were considered unlikely or highly unlikely to occur within the Study Area, based on the absence of suitable habitat occurring within the Study Area.

1 INTRODUCTION

1.1 Project Background

BHP Western Australian Iron Ore (BHP WAIO) is investigating the biological values of the Coombanbunna Well area (hereafter referred to as the Study Area) to provide contextual biological information to inform future environmental approvals within and in the vicinity of the area. The Study Area is located approximately 13 kilometres (km) south-west of Newman and comprises multiple tenements, including three live exploration licenses (E5203448, E5203360 and E5203361) and part of one live mining lease (AM7000266), covering a total area of approximately 4,698.55 hectares (ha) (Figure 1.1). The vertebrate fauna assessment does not apply to any specific development proposed by BHP WAIO; however, the assessment will be used to inform future environmental approvals within and more broadly in the vicinity of the Study Area.

To support this investigation, BHP WAIO commissioned Biologic Environmental Survey Pty Ltd (Biologic) to undertake a Level 2 vertebrate fauna assessment of the Study Area. This report documents the findings of this assessment, which consisted of a desktop assessment and a two-phase Level 2 field survey.

1.2 Scope and Objectives

The overarching objective of this assessment was to identify the occurrence of terrestrial vertebrate fauna species and their supporting habitats within the Study Area, with a focus on species of conservation significance. Specifically, the key objectives of the assessment were to:

- conduct a comprehensive desktop assessment (database searches and literature review) to identify vertebrate fauna species potentially occurring within the Study Area;
- define and delineate broad fauna habitats occurring within the Study Area, and describe their significance to vertebrate fauna, particularly species of conservation significance;
- conduct a two-phase Level 2 survey to identify vertebrate fauna species and fauna assemblages occurring within the Study Area; and
- assess the likelihood and distribution of vertebrate fauna of conservation significance occurring within the Study Area, and where determined to be present, map areas of suitable habitat by use (e.g. foraging, denning, roosting etc.).

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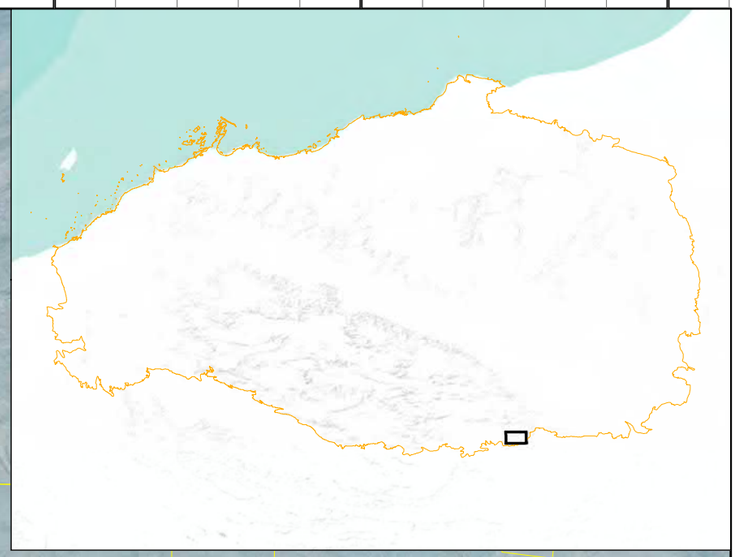

Legend

- Study Area
- BHP Tenure
- Pastoral tenure
- Pilbara Bioregion

IBRA Subregion

- Augustus (GAS 3)
- Hamersley (PIL 3)

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N

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0 0.4 0.8 1.6 2.4 3.2 km

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Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 1.1: Study Area location and adjacent BHP tenure

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

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1.3 Background to Protection of Fauna

Terrestrial fauna may be significant for a range of reasons, including (EPA, 2016a):

- being identified as a threatened or priority species;
- being a species with restricted distribution;
- enduring a degree of historical impact from threatening processes; or
- providing an important function required to maintain the ecological integrity of a significant ecosystem.

All native fauna in Western Australia (WA) are protected at a state level under the *Biodiversity Conservation Act 2016* (BC Act) and at a national level under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Any action that has the potential to impact native fauna needs to be approved by relevant state and/or federal departments in accordance with the WA *Environmental Protection Act 1986* (EP Act) and the federal EPBC Act.

While all native fauna is protected under these Acts, some species are afforded extra protection. These include: species that are considered Threatened under the EPBC Act and/or BC Act, or; migratory bird species that are protected under international agreements and subsequently listed as Migratory under the EPBC Act and/or BC Act (Table 1.1). Furthermore, any species that may be threatened but for which there is insufficient information available to allocate a threatened status under the EBPC Act and/or BC Act, can also be listed as Priority species by the WA Department of Biodiversity, Conservation and Attractions (DBCA) (Table 1.1).

For the purposes of this assessment, species considered to be of conservation significance are those that are afforded protection under the EPBC Act, BC Act and/or listed as Priority by DBCA (Table 1.1). A summary of applicable legislation and status codes is provided in Table 1.1.

Table 1.1: Definitions and terms for fauna of conservation significance

Act, Agreement or List	Status Codes[1]
Federal	
***Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)** In Australia, native fauna are protected under the EPBC Act. This Act makes provisions for an independent committee (the Threatened Species Scientific Committee [TSSC]), which is charged with maintaining a list of threatened species. Threatened species are listed under one of six categories, depending on their specific conservation status. Migratory bird species are those listed under international agreements and protected under the EPBC Act as a Matter of National Environmental Significance (MNES). Relevant international agreements include the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA), and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).	*Extinct:* • EX – Extinct • EW – Extinct in the Wild *Threatened:* • CR – Critically Endangered • EN – Endangered • VU – Vulnerable • CD – Conservation Dependent *Other:* • MI – Migratory
State	
***Biodiversity Conservation Act 2016* (BC Act)** In WA, native fauna are protected under the BC Act. Species in special need of protection are listed as being Extinct, Threatened or Specially Protected. Within these groups, species are listed under one of eight categories, depending on their specific conservation status. Migratory bird species are those listed under the Bonn Convention and/or CAMBA, JAMBA and ROKAMBA agreements.	*Extinct:* • EX – Extinct *Threatened:* • CR – Critically Endangered • EN – Endangered • VU – Vulnerable *Specially Protected:* • MI – Migratory • CD – Conservation Dependent • OS – Other specially protected fauna
DBCA Priority List The DBCA maintains a list of Priority species that are considered to be possibly threatened but have not been assigned statutory protection under the BC Act, as not enough information is available for an accurate determination of conservation status. These species are generally in urgent need of survey to determine their distribution and abundance.	*Poorly Known:* • P1 – Priority 1 • P2 – Priority 2 • P3 – Priority 3 *Rare, Near Threatened and other* • P4 – Priority

[1]See Appendix A for definitions of status codes

2 ENVIRONMENT

2.1 Biogeography

The Study Area is located within the Pilbara bioregion, as defined by the Interim Biogeographic Regionalisation of Australia (IBRA; Thackway & Cresswell, 1995). The Pilbara bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges (Thackway & Cresswell, 1995). Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses (Bastin, 2008). Within the Pilbara bioregion, the Study Area is located within the Hamersley (PIL 3) subregion (Figure 1.1). The Hamersley subregion is characterised by mountainous areas of Proterozoic sedimentary ranges (ironstone ranges) and plateaux dissected by gullies and gorges (Kendrick, 2001). Mulga low woodland over bunch grasses on fine-textured soils dominates in valley floors, while skeletal soils of the ranges are dominated by snappy gum (*Eucalyptus leucophloia*) over *Triodia brizoides* (Kendrick, 2001). Drainage is typically into the Fortescue River to the north, the Ashburton River to the south, or the Robe River to the west (Kendrick, 2001).

2.2 Climate

The Pilbara bioregion has a semi-desert to tropical climate, with rainfall occurring sporadically throughout the year, although mostly during summer (Thackway & Cresswell, 1995). Summer rainfall is usually the result of tropical storms in the north or tropical cyclones that impact upon the coast and move inland (Leighton, 2004). The winter rainfall is generally lighter and is the result of cold fronts moving north easterly across the state (Leighton, 2004). The average annual rainfall ranges from 200–350 mm, although there are significant fluctuations between years, with up to 1,200 mm falling in some locations in some years (BoM, 2020; McKenzie *et al.*, 2009).

Long-term climatic data is not available for the Study Area itself; however, long term climatic data is available from the Bureau of Meteorology (BoM) weather station at Newman Airport (station 7176), approximately 9 km west of the Study Area (BoM, 2020). This weather station is expected to provide the most accurate dataset for historic and current climatic conditions experienced within the Study Area.

2.3 Geology

The Hamersley Province has a long geological history, broadly comprising Archaean and Proterozoic metamorphic and sedimentary rocks with much younger (Tertiary) sedimentary deposits. Within and in the vicinity of the Study Area, those Tertiary deposits infill older erosion features, either broad valleys with clays and calcretes of groundwater derived origin, or narrow channel-fill deposits (including iron-rich Channel-iron Deposits).

The Study Area occurs across four broad (1:500,000) geological units (Table 2.1; Figure 2.1). The dominant geological unit occurring within the Study Area is the Fortescue Group, occupying approximately 41.1%, followed by Jeerinah Formation (34.3%), Bunjunah Formation (24.3%) and Marra Mamba Iron Formation (0.3%) (Table 2.1; Figure 2.1).

Table 2.1: Geology units within the Study Area

Geological unit	Description	Extent in Study Area	
		Hectares	%
Fortescue Group (A-FO-od)	Dolerite dyke or sill.	1,518.81	41.1%
Jeerinah Formation (A-FOj-xs-b)	Siliciclastic sedimentary rocks, mafic volcanic rocks and minor felsic volcanic rocks; local carbonate rocks, chert, and dolerite sills.	1,267.55	34.3%
Bunjinah Formation (A-FOu-bbo)	Pillowed and massive basaltic flows; basaltic breccia and basaltic volcanic sandstone; minor chert; amygdaloidal basalt flows occur in upper parts of formation; metamorphosed.	900.33	24.3%
Marra Mamba Iron Formation (A-Ham-cib)	Chert, banded iron-formation, mudstone, and siltstone; minor carbonate; metamorphosed.	11.86	0.3%
Total		**3,698.55**	**100%**

2.4 Soils

The CSIRO (2009) Atlas of Australian Soils described and mapped the soils of Australia following Bettany *et al.* (1967). The Study Area occurs across three soil units, Oc64, Fa13 and BE6 (Table 2.2; Figure 2.2). The dominant soil unit is Oc64, which covers approximately 82.7% of the Study Area (Table 2.2) and comprises low stony hills and dissected pediments on granite with occasional basic dykes. The chief soils are hard alkaline red soils (Dr2.33) having shallow stony horizons. Associated are shallow stony (Uc5.11) soils on steep slopes, (Uc1.22) soils along creek lines, and (Um5.11) soils on patches of calcrete (kunkar).

The second soil unit, covering approximately 15.8% of the Study Area, is Fa13 (Table 2.2; Figure 2.2). This soil unit comprises ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations, with some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. Fa13 is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some Uc5.11 soils on the steeper slopes. Associated are Dr2.33 and Dr2.32 soils on the limited areas of dissected pediments, while Um5.52 and Uf6.71 soils occur on the valley plains.

The remaining soil unit, BE6, covers only 1.6% of the Study Area and comprises extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops. Chief soils are shallow earthy loams (Um5.3) with associated (Gn) soils of units My5O and Mz23.

At the finer scale of land systems mapping, the Study Area consists primarily of stony soils, red shallow loams and calcareous shallow loams of the Rocklea land system and red/brown non-cracking clays, self-mulching cracking clays of the Elimunna land system (van Vreeswyk *et al.*, 2004). To a lesser extend the Study Area consists red loamy earths and red shallow loams or red loamy earths of the Boolgeeda land system, stony soils, red shallow loams and some red shallow sands of the Newman land system, and red-brown hardpan shallow loams, red loamy earths and some red sandy earths of the Spearhole land system (van Vreeswyk *et al.*, 2004).

Table 2.2: Soil units within the Study Area

Soil unit	Description	Extent in Study Area	
		Hectares	%
Oc64	Low stony hills and dissected pediments on granite with occasional basic dykes.	3,057.65	82.7%
Fa13	Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments.	582.67	15.8%
BE6	Extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops.	58.24	1.6%
Total		**3,698.55**	**100%**

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7402500

A-FOu-bbo

P_-HAj-xci-od

P_-HAb-cib

A-HAm-cib

A-HAd-kd

A-HAu-xsl-ci

A-FOj-xs-b

A-FOj-xs-b

A-FO-od

A-FOj-xs-b

A-FOu-bbo

A-g-PYV

Legend

Study Area

CODE, UNITNAME

- A-FO-od, Fortescue Group
- A-FOj-xs-b, Jeerinah Formation
- A-FOu-bbo, Bunjinah Formation
- A-HAm-cib, Marra Mamba Iron Formation

biologic Environmental Survey

N

1:40,000

0 0.3 0.6 1.2 1.8 2.4 km

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Figure 2.1: Broad geology of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

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Fa13
Oc64
BE6

Legend

Study Area

CSIRO Soil Unit

- BE6, Extensive flat and gently sloping plains
- Fa13, Ranges of banded jaspilite and chert along with shales
- Oc64, Low stony hills and dissected pediments on granite with occasional basic dykes: chief soils are hard

biologic Environmental Survey

N

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0 0.3 0.6 1.2 1.8 2.4 km

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Figure 2.2: Soil landscape units of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

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2.5 Land Systems

Van Vreeswyk *et al*. (2004) classified and mapped the land systems of the Pilbara according to similarities in landform, soil, vegetation, geology and geomorphology. An assessment of land systems provides an indication of the diversity and distribution of fauna habitats present within the Study Area.

The Study Area intercepts five land systems, none of which are limited in extent or protected as Priority Ecological Communities (DBCA, 2019b) (Figure 2.3; Table 2.3). The dominant land system is the Rocklea land system, covering approximately 61.3% of the Study Area (Figure 2.3; Table 2.3). The Rocklea land system is defined as "Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands" (van Vreeswyk *et al.*, 2004). The second most dominant is the Elimunna land system, covering approximately 36.1% of the Study Area (Figure 2.3; Table 2.3). The three remaining land systems, Boolgeeda, Newman and Spearhole, occupy only 2.0%, 0.5% and 0.1% of the Study Area respectively (Figure 2.3; Table 2.3). Of the five land systems occurring within the Study Area, the Newman land system contains the most significant habitats for many of the Matters of National Environmental Significance (MNES) species, as the rocky ridges and mountains associated with this land system can support important refugia and foraging habitats for Pilbara Leaf-nosed Bat, Ghost Bat, and Northern Quoll. The occurrence of this land system within the Study Area however, is only limited to a small 18.14 ha area located on the north-western edge of the Study Area (Figure 2.3).

Table 2.3: Land systems of the Study Area

Land system	Land type	Description	Extent in Study Area	
			Area (ha)	%
Rocklea (Roc)	Hills and ranges with spinifex grasslands	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	2,268.90	61.3%
Elimunna (Eli)	Stony plains with acacia shrublands	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	1,333.66	36.1%
Boolgeeda (Bgd)	Stony plains with spinifex grasslands	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	72.73	2.0%
Newman (New)	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	18.14	0.5%
Spearhole (Sph)	Wash plains on hardpan with mulga shrublands	Gently undulating gravelly hardpan plains and dissected slopes supporting groved mulga shrublands and hard spinifex.	5.12	0.1%
Total			**3,698.55**	**100%**

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7402500

Rocklea Land System
Newman Land System
Elimunna Land System
Newman Land System
Egerton Land System
Newman Land System
Boolgeeda Land System
Rocklea Land System
Spearhole
Elimunna Land System
Robe Land System
Elimunna
Spearhole Land System
Spearhole Land System
Spearhole
Elimunna

Legend

- Study Area

Land System

- Boolgeeda Land System
- Elimunna Land System
- Newman Land System
- Rocklea Land System
- Spearhole Land System

biologic Environmental Survey

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BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 2.3: Land Systems of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

2.6 Hydrology and Surface Drainage

No major watercourses occur within the Study Area. The nearest major watercourse in the vicinity of the Study Area is the Fortescue River, which occurs approximately 7 km south-east of the Study Area and flows in a north-easterly direction (Figure 2.4). While the Fortescue River does not intersect the Study Area, several small unnamed watercourses and drainage lines dissect the Study Area before joining the Fortescue River south and east of the Study Area (Figure 2.4). Most of these watercourses and drainage lines are ephemeral and often only flow during/ following large rainfall events.

2.7 Pre-European Vegetation

Beard (1975) broadly (1:1,000,000) mapped the major structural vegetation types of Western Australia. Shepherd *et al.* (2002) reinterpreted and updated the vegetation association mapping to reflect the National Vegetation Information System (NVIS) standards (ESCAVI, 2003). This update also accounts for extensive clearing since Beard (1975) mapping.

Two vegetation associations occur within the Study Area (Table 2.4, Figure 2.5). The dominant vegetation association is vegetation association 82, which is defined as "*Eucalyptus leucophloia* over *Triodia wiseana* hummock grasslands/ low tree steppe" and covers approximately 54.4% of the Study Area. The remaining vegetation association, covering approximately 45.6% of the Study Area, is vegetation association 18, which comprises low Mulga woodland dominated by *Acacia aneura*.

Table 2.4: Vegetation associations within the Study Area

Vegetation Association	Description	Extent in Study Area	
		Area (ha)	%
82	*Eucalyptus leucophloia* over *Triodia wiseana* hummock grasslands/ low tree steppe	2,012.18	54.4%
18	Mulga (*Acacia aneura*) low woodland	1,686.37	45.6%
Total		**3,698.55**	**100%**

2.1 Land Use and Tenure

The Study Area is located upon two pastoral leases, with the eastern and central portions occurring on the Ethel Creek Station and the western most portion on Prairie Downs Station (Figure 1.1). Dominant land use within the Study Area is native pasture associated with the two pastoral leases, with no mining or exploration activities having been undertaken within the Study Area to date.

Tenure within the Study Area comprises five tenements held by BHP WAIO, three live exploration licenses (E5203448, E5203360 and E5203361), part of one live mining lease (AM7000266) and one pending miscellaneous license (L5200199, located within exploration license E5203360) (Figure 1.1). The Study Area abuts BHP WAIO's the Western Ridge project area to the north, which is currently subject of extensive exploration activity (Figure 1.1).

745000 750000 755000 760000 765000 770000 775000 780000 785000 790000 795000 800000

7420000 7415000 7410000 7405000 7400000 7395000 7390000

Fortescue River

Legend

- Study Area
- Minor watercourse
- Fortescue River

Sub-catchment

- Fortescue Marsh
- Ophthalmia

biologic Environmental Survey

N

1:150,000

0 1 2 4 6 8 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 2.4: Hydrology of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

762500 765000 767500 770000 772500 775000 777500

7410000
7407500
7405000
7402500

Legend

Study Area

Vegetation Association

18

82

biologic Environmental Survey

N

1:40,000

0 0.3 0.6 1.2 1.8 2.4 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 2.5: Pre-European vegetation associations of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

2.2 Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) occur within the Study Area (Figure 2.6). One TEC and one PEC occur within 50 km of the Study Area (Figure 2.6; Table 2.5); however, neither have conservation values related to terrestrial vertebrate fauna.

Table 2.5: Priority and Threatened Ecological Communities within 50 km of the Study Area

Name	Status	Description	Distance from Study Area	Applied Buffer
TEC				
Ethel Gorge Aquifer Stygobiont Community	Endangered	Stygofauna communities of the Ethel Gorge Aquifer	181 m NW	5 km
PEC				
Fortescue Valley Sand Dunes	Priority 3	Vegetation of sand dunes of the Hamersley Range/ Fortescue Valley	44.6 km N	500 m

690000 715500 741000 766500 792000 817500 843000 868500

7464000

7438500

7413000

7387500

7362000

Legend

Study Area

DBCA TEC/PECs

Ethel Gorge

Fortescue Valley Sand Dunes

biologic Environmental Survey

N

1:500,000

0 4 8 16 24 32 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 2.6: Threatened and Priority Ecological Communities within 50 km of the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

3 DESKTOP ASSESSMENT

A desktop assessment, comprising database searches and a literature review of the Study Area was undertaken prior to the field survey. The purpose of the desktop assessment was to identify vertebrate fauna potentially occurring in the Study Area, with a focus on species of conservation significance.

3.1 Methodology

3.1.1 Database Searches

Five fauna databases were searched, three to obtain information on all species previously recorded (NatureMap, Birdata and BHP WAIO Fauna Records Database), one to identify species of conservation significance previously recorded (DBCA Threatened Fauna Database), and one to identify species of conservation significance known or likely to occur within the region (Protected Matters Search Tool) (Table 3.1).

Table 3.1: Details of database searches conducted

Database	Data Access/ Receival Date	Search Area
DBCA (2019a) NatureMap	13/12/2019	Study Area with a 40 km buffer
DBCA (2019c) Threatened and Priority Fauna Database	18/12/2019	
Birdlife Australia (2019) Birdata	13/12/2019	
Department of Environment and Energy (DoEE) (2019a) Protected Matters Search Tool	13/12/2019	
BHP (2019) BHP WAIO Fauna Records Database	16/09/2019	Study Area with 20 km buffer. Includes any biological surveys completed for BHP WAIO within search area.

3.1.2 Literature Review

A review of available literature relevant to the Study Area was undertaken to compile a list of fauna habitats and vertebrate fauna species with the potential to occur within the Study Area. A total of 13 assessments were reviewed, comprising one Level 2 survey, ten Level 1 surveys (including two targeted level 1 surveys) and two desktop assessments (Table 3.2).

Table 3.2: Literature sources used for the review

Report Title	Reference	Survey Type	Distance from Study Area (km)
Astron (2010) Mt Whaleback TSF Flora, Vegetation and Fauna Assessment	A	Level 1	~1 km N
Biologic (2011) Orebody 35 and Western Ridge Vertebrate Fauna Survey	B	Two-phase Level 2	Immediately north of Study Area
Biologic (2014a) Orebody 24 Targeted Vertebrate Fauna Survey	C	Level 1/ Targeted	~13 km NE
Biologic (2014b) Orebody 25 Targeted Vertebrate Fauna Survey	D	Level 1/ Targeted	~8.5 km NE
Biologic (2016) Western Ridge Southern Tenements Vertebrate Fauna Desktop Assessment	E	Desktop	Within (eastern and western portions) and immediately north of Study Area
Ecologia (2005) Western Ridge Exploration Project Biological Survey	F	Level 1	Immediately north of Study Area
Ecologia (2006) Western Ridge Exploration Project Biological Survey	G	Level 1	Immediately north of Study Area
ENV (2010) Orebody 35 Vegetation Clearing Permit Area Flora and Fauna Assessment	H	Level 1	Immediately north of Study Area
ENV (2011a) Eastern Ridge (OB23/24/25) Fauna Assessment	I	Level 1	~8 km NE
ENV (2011b) Mt Whaleback East Flora, Vegetation and Fauna Assessment	J	Level 1	~1.5 km N
Onshore and Biologic (2009) Mt Whaleback Mine Site Flora and Vegetation and Fauna Assessment	K	Level 1	~1.2 km N
Onshore (2014) Western Ridge Biological Survey	L	Level 1	Immediately north of Study Area
Onshore (2018) Western Ridge E52/3448 Desktop Flora and Fauna Assessment	M	Desktop	Within (central portion) and immediately north of Study Area

3.2 Results

The literature review and database searches identified a total of 340 species of vertebrate fauna, which have previously been recorded and/or have the potential to occur within the Study Area. This comprised 45 mammals (including 36 native and 9 non-native), 197 birds, 91 reptiles and seven amphibians (Table 3.3; Appendix C). 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. Additionally, many species tend to be patchily distributed even where appropriate habitats are present, and many species of birds can occur as regular migrants, occasional visitors or vagrants.

Of the 340 species of vertebrate fauna identified by the desktop assessment, 38 species are of conservation significance, comprising eight mammals, 26 birds and four reptiles (Table 3.4). No vertebrate species of conservation significance have previously been recorded within the Study Area; however, three species, Ghost Bat (scats, echolocation recording and direct observation), Peregrine Falcon (direct observation) and Western Pebble-mound Mouse (active and inactive pebble mounds), have previously been recorded at Western Ridge, approximately 1 km directly north of the Study Area (BHP, 2019).

Table 3.3: 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							
Astron (2010) Mt Whaleback TSF Flora, Vegetation and Fauna Assessment	A	1	1	1	-	-	**3**
Biologic (2011) Orebody 35 and Western Ridge Vertebrate Fauna Survey	B	19	6	82	54	2	**163**
Biologic (2014a) Orebody 24 Targeted Vertebrate Fauna Survey	C	18	-	44	18	1	**81**
Biologic (2014b) Orebody 25 Targeted Vertebrate Fauna Survey	D	11	2	28	6	-	**47**
Biologic (2016) Western Ridge Southern Tenements Vertebrate Fauna Desktop Assessment	E	-	-	-	-	-	**-**
Ecologia (2005) Western Ridge Exploration Project Biological Survey	F	3	3	24	5	-	**35**
Ecologia (2006) Western Ridge Exploration Project Biological Survey	G	8	2	51	15	-	**76**
ENV (2010) Orebody 35 Vegetation Clearing Permit Area Flora and Fauna Assessment	H	4	1	25	5	-	**35**
ENV (2011a) Eastern Ridge (OB23/24/25) Fauna Assessment	I	10	-	46	13	2	**71**
ENV (2011b) Mt Whaleback East Flora, Vegetation and Fauna Assessment	J	2	1	29	7	-	**39**
Onshore and Biologic (2009) Mt Whaleback Mine Site Flora and Vegetation and Fauna Assessment	K	4	3	51	7	-	**65**
Onshore (2014) Western Ridge Biological Survey	L	-	-	37	8	-	**45**
Onshore (2018) Western Ridge E52/3448 Desktop Flora and Fauna Assessment	M	-	-	-	-	-	**-**
Database Searches							
DBCA (2019a) NatureMap		32	6	173	87	7	**305**
DBCA (2019c) Threatened and Priority Fauna Database		7	-	15	3	-	**25**
DoEE (2019a) Protected Matters Search Tool		4	8	17	1	-	**30**
Birdlife Australia (2019) Birdata		-	-	178	-	-	**178**
BHP WAIO (2019) BHP Fauna Records Database		34	-	145	45	1	**225**
Total species recorded		**36**	**9**	**197**	**91**	**7**	**340**
Conservation Significant species		**7**	**-**	**15**	**3**	**-**	**25**

Table 3.4: Species of conservation significance identified and their conservation status

Genus and Species	Common name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
MAMMALS					
DASYURIDAE					
Dasycercus blythi	Brush-tailed Mulgara			P4	
Dasyurus hallucatus	Northern Quoll	EN	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
AVES					
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		
FALCONIDAE					
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					
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

Genus and Species	Common name	Conservation Status			
		EPBC Act	BC Act	DBCA	IUCN
Calidris subminuta	Long-toed Stint	MI	MI		
Limosa limosa	Black-tailed Godwit	MI	MI		NT
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*	Unpatterned Robust Slider			P2	
TYPHLOPIDAE					
Anilios ganei	Pilbara Flat-headed Blind-snake			P1	

725000 737500 750000 762500 775000 787500 800000 812500

7437500 7425000 7412500 7400000 7387500

Vertebrate Fauna

- Black-flanked Rock-wallaby – EN (EPBC/BC Act)
- Black-tailed Godwit – MI (EPBC/BC Act)
- Brush-tailed Mulgara – P4 (DBCA)
- Caspian Tern – MI (EPBC/BC Act)
- Common Greenshank – MI (EPBC/BC Act)
- Common Redshank – MI (EPBC/BC Act)
- Common Sandpiper – MI (EPBC/BC Act)
- Curlew Sandpiper – CR/MI (EPBC/BC Act)
- Eastern Great Egret – MI (EPBC/BC Act)
- Ghost Bat – VU (EPBC/BC Act)
- Glossy Ibis – MI (EPBC/BC Act)
- Greater Bilby – VU (EPBC/BC Act)
- Gull-billed Tern – MI (EPBC/BC Act)
- Little Ringed Plover – MI (EPBC/BC Act)
- Long-tailed Dunnart – P4 (DBCA)
- Long-toed Stint – MI (EPBC/BC Act)
- Marsh Sandpiper – MI (EPBC/BC Act)
- Northern Quoll – EN (EPBC/BC Act)
- Oriental Plover – MI (EPBC/BC Act)
- Pectoral Sandpiper – MI (EPBC/BC Act)
- Peregrine Falcon – OS (BC Act)
- Pilbara Flat-headed Blind-snake – P1 (DBCA)
- Pilbara Leaf-nosed Bat – VU (EPBC/BC Act)
- Pilbara Olive Python – VU (EPBC/BC Act)
- Red-necked Stint – MI (EPBC/BC Act)
- Ruff – MI (EPBC/BC Act)
- Sharp-tailed Sandpiper – MI (EPBC/BC Act)
- Spotted Ctenotus – P2 (DBCA)
- Western Pebble-mound Mouse – P4 (DBCA)
- Wood Sandpiper – MI (EPBC/BC Act)

Legend

- Study Area

biologic Environmental Survey

N

1:225,000

0 1.75 3.5 7 10.5 14 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

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

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

4 FIELD SURVEY METHODS

4.1 Compliance

This assessment was carried out in a manner consistent with the following guidelines and recommendations from the Western Australian Environmental Protection Authority (EPA), Department of Biodiversity Conservation and Attractions (DBCA; formerly DPaW) and the Department of Agriculture. Water and the Environment (DAWE; formerly DEHWA, DSEWPaC, DoE):

- DEWHA (2010a) Survey Guidelines for Australia's Threatened Bats;
- DEWHA (2010b) Survey Guidelines for Australia's Threatened Birds;
- DSEWPaC (2011a) Survey Guidelines for Australia's Threatened Mammals;
- DSEWPaC (2011b) Survey Guidelines for Australia's Threatened Reptiles;
- DoE (2013) Significant Impact Guidelines 1.1: Matters of National Environmental Significance;
- EPA (2016c) Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna
- EPA (2016d) Technical Guidance: Terrestrial Fauna Surveys;
- DPaW (2017) Interim guidelines for the preliminary surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia; and
- DoE (2016) EPBC Act referral guideline for the endangered Northern Quoll (*Dasyurus hallucatus*).

4.2 Survey Timing and Weather

A two-phase Level 2 vertebrate fauna survey was undertaken from 26 November to 7 December 2019 (Phase 1, dry season), and from 25 February to 6 March 2020 (Phase 2, wet season). Observed weather conditions prior to and during all surveys are shown in Figure 4.1, alongside long-term climatic data for Newman Airport (station # 007176).

In the 12 months prior to the surveys, mean minimum and maximum temperatures recorded at Newman Airport were similar to or slightly higher than long-term averages for most months, with above average temperatures recorded throughout most of the year (Figure 4.1). Rainfall in the 12 months prior to the surveys was variable, with below long-term averages recorded through most the dry season and above averages during the majority of the wet season (Figure 4.1). Well above average rainfall was recorded during January 2020, which occurred as a result of multiple cyclones occurring in the north-west and subsequent rainfall (Figure 4.1).

Observed temperatures during the surveys were comparable to long-term averages; however, numerous days above long-term averages were recorded during both surveys. During the Phase 1 survey, minimum daily temperatures ranged between 18.8°C and 28.2°C and maximum temperatures ranged between 33.9°C and 42.7°C, compared to long-term minimum averages of 21.1°C and 24.1°C and maximum of 37.6°C and 39.3°C for November and December respectively. Minimum daily

temperatures during the Phase 2 survey ranged between 19.3ºC and 28.3ºC and maximum temperature between 34.6ºC and 42.5ºC, compared to long-term minimum averages of 24.0ºC and 22.1ºC and maximum of 37.3ºC and 35.4ºC for February and March respectively. Rainfall recorded during the surveys was well below long-term averages, with a total of 1.6 mm and 0.2 mm rainfall recorded at Newman Airport during the Phase 1 and Phase 2 surveys, respectively.

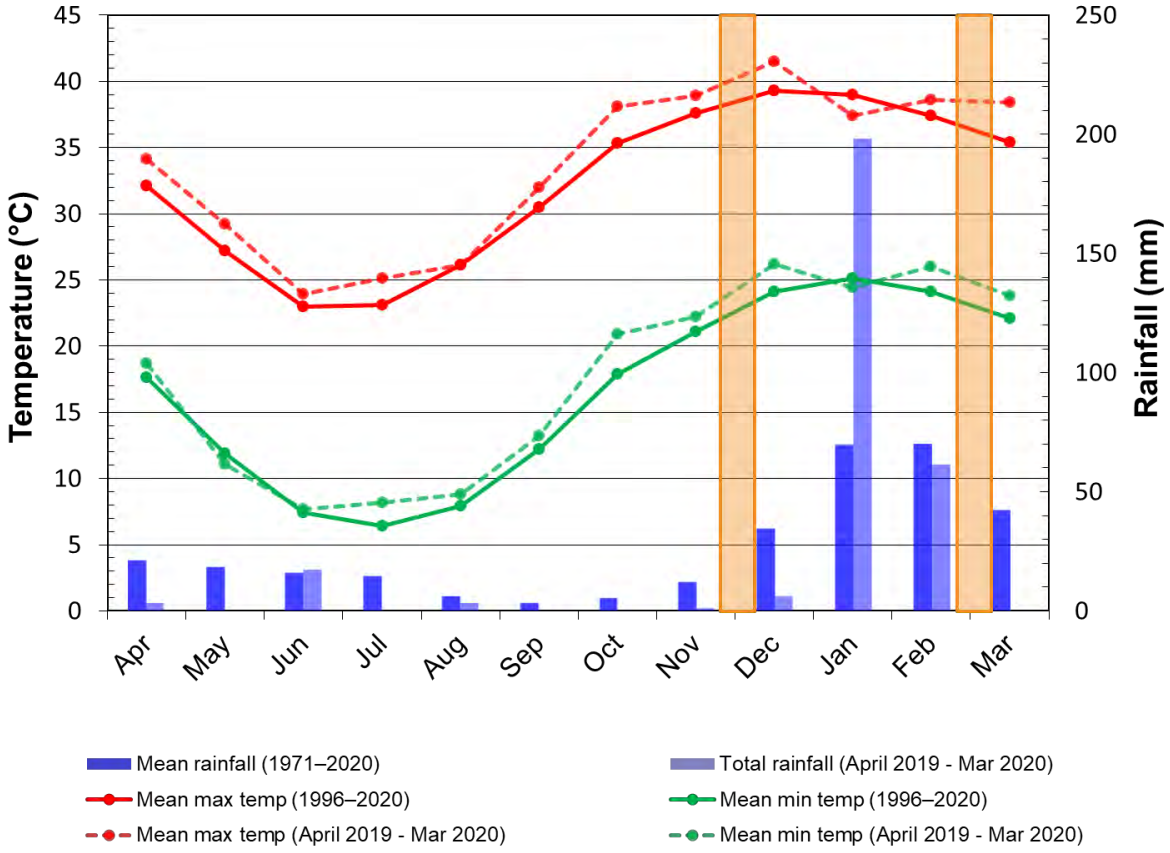

Figure 4.1: Long-term and current climatic data for Newman Airport (Station # 007176) (BoM, 2020) with approximate survey timing shown in shaded boxes

4.3 Survey Team and Licensing

The fauna sampling for this survey was conducted under a DBCA Regulation 27 “Fauna Taking (Biological Assessment) License” (BA27000158) issued to Ashleigh Jenkins. In accordance with Section 40 of the BC Act, threatened species sampling was completed under a DBCA “Authorisation to Take or Disturb Threatened Species” (authorisation number TFA 2019-0089) issued to Ashleigh Jenkins.

The assessment was led by senior zoologists with extensive experience with fauna in the region. The following personnel were involved in the field component of the project:

- Ryan Ellis (Senior Zoologist) – Phase 1 and 2;
- Chris Knuckey (Senior Zoologist) – Phase 1;
- Mark Gresser (Senior Zoologist) – Phase 1; and
- Courtney Proctor (Zoologist) – Phase 1 and 2.

4.4 Habitat Assessments

Habitat assessments were undertaken in the field to characterise and define habitats and their significance to vertebrate fauna. Habitat assessments were undertaken at 84 locations across the Study Area, including at all sampling sites (Figure 4.3; Appendix D).

Habitat assessments were conducted using methodology and terminology modified from the *Australian Soil and Land Survey Field Handbook* (National Committee on Soil and Terrain, 2009) with habitat condition adapted from EPA (2016b) vegetation condition assessment criteria. The characteristics recorded during the habitat assessments were:

- site information, photo and location;
- landform: slope, relative inclination of slope, morphological type and landform type;
- vegetation: leaf litter %, wood litter, hollow bearing trees, broad floristic formation, vegetation structure (tall, mid and low), and dominant species;
- land surface: micro relief, sheet erosion, rill erosion, gully erosion, gully depth, abundance and size of coarse fragments, rock outcropping, water bodies, comments on nests, burrows, roosts and diggings;
- soil: texture, colour;
- substrate: bare ground, rock size, rock type, rock outcropping; and
- condition/ disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

4.5 Sampling and Survey Methods

4.5.1 Systematic Trapping Sites

A total of six systematic trapping sites were established and sampled during the Phase 1 and Phase 2 field surveys, with sites representing most fauna habitats present within the Study Area (Figure 4.2; Figure 4.3; Table 4.1). The sites were setup to sample the most widespread and significant habitats, while ensuring adequate coverage across the entire Study Area. Each trapping site was open for seven consecutive nights each phase and checked daily within three hours of sunrise. Each site comprised the following:

- Pit traps – Ten pit traps comprising five 20 Litre buckets and five PVC pipes (16 centimetres [cm] diameter and 50 cm deep) were installed at each site. Traps were installed approximately 10–20 metres [m] apart along a single transect with a 7.5 m long by 0.3 m high aluminium drift fence bisecting each pit trap. Traps were placed in locations deemed most likely to catch fauna (i.e. areas with dense ground cover, litter, rocks etc.) and most representative of the broad fauna habitat occurring at the site. Styrofoam trays were placed within all pits to provide refuge for any captured fauna from exposure to environmental conditions (i.e. temperature, wind and rainfall) and predators.
- Funnel traps – Two funnel traps were placed at either end of the drift fence bisecting each pit trap. A total of 20 funnel traps were deployed at each systematic trapping site).

- Elliott traps – Twenty medium (Type B) Elliott style box traps were placed at each site. Traps were placed along two parallel transects adjacent to pit traps and positioned approximately 10–20 m apart. Each trap was positioned in habitat niches likely to be attractive to small non-volant mammals and reptiles (*i.e*. areas of cover and shade).
- Cage Traps – Two cage traps (20 x 20 x 56 cm) were located at each site, with one placed at each end of the trap site transect (Figure 4.2).

Shade covers for funnel, cage and Elliot traps were used to reduce exposure to environmental elements (i.e. direct sunlight and heat, rainfall and wind). Elliot and cage traps were baited with a universal bait mix comprising oats, peanut butter and sardines, and rebaited every 2–3 days.

Figure 4.2: Layout of traps at a systematic sampling site

4.5.2 Avifauna Sampling

A daily 20 to 30-minute avifauna census was undertaken at each systematic trapping site during the Phase 1 and Phase 2 surveys. Each census was undertaken within an area of approximately 2 ha and confined to the habitat type represented by each trapping site in order to collect assemblage data for each habitat. Each census was conducted between 0630 and 1030 whilst undertaking trap clearing and avifauna were recorded from either direct observation, call and/or secondary evidence (e.g. nests, feathers and/or tracks). The order of site visitation was staggered to reduce bias due to timing of arrival at sites and the recorders were rotated where possible to reduce observers' bias (Lindenmayer *et al.*, 2009). Additional sampling was undertaken during different periods of likely activity, including evening sampling during nocturnal searches. A total of seven 20 to 30-minute avifauna surveys was undertaken at each site, totalling 2.5 hours during each phase, for a total of 30 hours at all sites across both phases (Table 4.1). Supplementary five to ten-minute opportunistic avifauna sampling was undertaken at selected habitat assessment sites.

4.5.3 Ultrasonic Bat Recording

SongMeter (SM; Wildlife Acoustics Inc.) ultrasonic bat recorders were deployed at 21 locations representative of all habitats occurring within the Study Area during the Phase 1 and Phase 2 surveys, including all systematic trapping sites (Table 4.1; Figure 4.3). At each location, recorders were placed in or in the vicinity of areas of prospective foraging and/or roosting habitats and features most likely to be utilised by bats, such as natural or artificial waterbodies and caves. Recorders were deployed between two and three nights at each location for a total of 44 recording nights (Table 4.1). 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.

4.5.4 Acoustic Recording

SongMeter acoustic recorders were deployed at 12 locations during both phases of the field survey including three at systematic trapping sites where suitable habitat was present (Table 4.1; Figure 4.3). In an effort to target Night Parrot, the SM4 acoustic recorders were deployed in potential habitat recommended within the *Interim Guideline for Preliminary Surveys of Night Parrot (Pezoporus occidentalis) in Western Australia* (DPaW, 2017) – "stands of large, old clumps of spinifex (*Triodia*)... especially so if the identified area is part of a paleo-drainage system or contains healthy stands of samphire." SongMeters were deployed for four nights for a total of 48 recording nights (Table 4.1). Acoustic recordings were analysed for Night Parrot (*Pezoporus occidentalis*) calls by ornithologist Nigel Jackett. A list of non-target species recorded at each acoustic recorder site was also compiled and incorporated into the results for each site.

Table 4.1: Survey effort by vertebrate sampling sites

Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Motion cameras (nights)	Targeted searches (person hrs)
Phase 1													
VCOW-01	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	2	-	-	-
VCOW-02	Systematic	70	140	140	14	364	2.5	1	2	2	-	-	-
VCOW-03	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	-
VCOW-04	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	2	-	-	-
VCOW-05	Systematic	70	140	140	14	364	2.5	1	1	2	4	4	-
VCOW-06	Systematic & targeted searches	70	140	140	14	364	2.5	1	1	2	4	4	1 (Bilby)
VCOW-07	SongMeter (ultrasonic & acoustic)	-	-	-	-	-	-	-	-	2	4	-	-
VCOW-08	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-
VCOW-09	Systematic	70	140	140	14	364	2.5	1	1	2	4	-	-
VCOW-10	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-
VCOW-14	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	2	-	-	-
VCOW-25	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	2	-	-	-
VCOW-30	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	-	4	-	1 (Bilby)
Phase 1 total		**420**	**840**	**840**	**84**	**2,184**	**15**	**6**	**7**	**22**	**24**	**8**	**2 (Bilby)**
Phase 2													
VCOW-02	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-
VCOW-05	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-
VCOW-06	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	1 (Bilby)
VCOW-08	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-
VCOW-09	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-
VCOW-10	Systematic	70	140	140	14	364	2.5	1	1	2	-	-	-

Site	Site type	Pits (nights)	Funnels (nights)	Elliotts (nights)	Cages (nights)	Total trap nights	Bird census (hrs)	Active foraging (person hrs)	Nocturnal searches (person hrs)	SongMeter (ultrasonic) (nights)	SongMeter (acoustic) (nights)	Motion cameras (nights)	Targeted searches (person hrs)
VCOW-21	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	3	-	-	-
VCOW-33	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	2	-	-	-
VCOW-38	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	-
VCOW-40	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	1 (Bilby)
VCOW-44	Motion Camera	-	-	-	-	-	-	-	-	-	-	10	-
VCOW-45	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	2	-	-	-
VCOW-48	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	-
VCOW-49	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	-
VCOW-52	Targeted searches	-	-	-	-	-	-	-	-	-	-	-	1 (Bilby)
VCOW-70	SongMeter (ultrasonic)	-	-	-	-	-	-	-	-	3	-	-	-
VCOW-71	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	-
VCOW-72	SongMeter (acoustic)	-	-	-	-	-	-	-	-	-	4	-	-
Phase 2 total		**420**	**840**	**840**	**84**	**2,184**	**15**	**6**	**6**	**22**	**24**	**10**	**3 (Bilby)**
Survey total		**840**	**1,680**	**1,680**	**168**	**4,368**	**30**	**12**	**13**	**44**	**48**	**18**	**5 (Bilby)**

762000 764000 766000 768000 770000 772000 774000 776000

7410000

7408000

7406000

7404000

Legend

Study Area

Site Type

- Habitat assessment
- Motion camera
- SongMeter (acoustic)
- Systematic trapping
- SongMeter (ultrasonic)
- Targeted search (Greater Bilby)

biologic Environmental Survey

N

1:40,000

0 0.3 0.6 1.2 1.8 2.4 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 4.3: Vertebrate fauna sampling within the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

4.5.5 Motion Cameras

A total of four individual motion cameras were deployed at three locations within the Study Area to survey for larger and/or cryptic species (i.e. conservation significant and introduced species) which may not be recorded by other sampling methods (Table 4.1; Figure 4.3). Camera traps were baited with a universal bait mix.

Each camera was set to record five seconds of video footage when triggered, continuously during their deployment. Cameras were deployed between four and five consecutive nights for a total of 18 camera trap nights over the duration of the Phase 1 and Phase 2 surveys (Table 4.1).

4.5.6 Nocturnal Surveys

Spotlighting was undertaken to detect the presence of any nocturnal fauna species within the Study Area. Nocturnal surveys were undertaken between sunset (approximately 1830) and 10:30pm when activity levels were highest for most nocturnal species. Each survey consisted of searches using head torches and, where possible, road spotting to detect fauna from movement, eye shine and other evidence of species presence. A total of 13 person hours of spotlighting was completed across six sites over four evenings during the Phase 1 and Phase 2 surveys, with additional opportunistic spotlighting undertake while traversing the study area between sampling sites.

4.5.7 Targeted Greater Bilby Sampling

Greater Bilby sampling within the Study Area comprised 2 ha survey plots (bilby plots) distributed within areas of suitable habitat across the Study Area, in accordance with DBCA survey guidelines for the species (DBCA, 2017a) (Table 4.1; Figure 4.3). Each bilby plot was subjected to targeted searches for a minimum of 25 minutes and comprised searches for secondary evidence for the species i.e. burrows, diggings, tracks and scats, as described by Southgate *et al.* (2019). Overall, a total of two bilby plots were sampled for Greater Bilby within the Study Area during the Phase 1 survey and a further three during the Phase 2 survey (including one site also sampled during Phase 1), with each searched for one person hour, totalling five person hours over the two survey phases.

4.5.8 Opportunistic Records

At all times while surveying, all records pertaining to species not previously recorded during the survey, rare species, species of conservation significance 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.

4.5.9 VHF Towers

Two VHF towers were installed within the Study Area during the Phase 1 survey to feed into the existing Motus network established at numerous BHP sites to monitor tagged Ghost Bat and Pilbara Leaf-nosed Bat movement across and within BHP tenure. The purpose of these towers was to increase the sampling area of the network on BHP tenure. The towers were installed at high elevation points in Hillcrest/ Hillslope habitat at sites VCOW-02 and VCOW-37. Each receiver tower comprised a single mast, measuring approximately 3 m in height, which was fitted with a 3 m high collinear omni-directional antenna. Data collected by the towers will be incorporated into exiting monitoring projects and is not incorporated herein for this report.

4.6 Taxonomy and Nomenclature

The latest checklist of mammal, reptile and amphibian names published by the WAM (2019) was used as a guide to the current taxonomy and nomenclature of these groups, with the exception of taxonomic changes published subsequent to the checklist. For birds, the current checklist of Australian birds maintained by Birdlife Australia (based on Christidis & Boles, 2008) was used in conjunction with the WAM (2019) species list. While compiling a list of fauna potentially occurring in the Study Area, all records were checked to ensure the latest taxonomy using recent publications and authorities.

4.7 Animal Welfare and Ethics

All sampling and survey methods implemented during the field survey were undertaken in accordance with relevant survey-specific license conditions, EPA (2016c) Technical Guidance for sampling terrestrial vertebrate fauna and DBCA Standard Operating Procedures (SOPs), and complied with the Western Australian *Animal Welfare Act* 2002 (AW Act) and the *Australian Code for the Care and Use of Animals for Scientific Purposes* (NHMRC, 2013) where applicable.

Relevant DBCA SOPs applicable to this survey include:

- DBCA (2018c) Dry Pitfall Trapping or Vertebrates;
- DBCA (2018a) Aluminium Box Traps for Capture of Terrestrial Vertebrates;
- DBCA (2018b) Cage Traps for Live Capture of Terrestrial Vertebrates;
- DBCA (2018d) Funnel Trapping for Terrestrial Fauna;
- DBCA (2018e) Hand Capture of Wildlife;
- DBCA (2017d) Hand Restraint of Wildlife;
- DBCA (2017b) Animal Handling and Restraint Using Soft Containment;
- DBCA (2017f) Transport and Temporary Holding of Wildlife;
- DBCA (2017e) Tissue Sample Collection and Storage for Mammals;
- DBCA (2018g) Vouchering Vertebrate Fauna Specimens;
- DBCA (2017c) First Aid for Animals; and
- DBCA (2018f) Managing Disease Risk in Wildlife Management.

4.8 Data Analysis

To estimate the adequacy and effectiveness of sampling during the survey, the cumulative number of species encountered from systematic sampling (i.e. trapping sites) was plotted against survey effort in terms of cumulative individuals or trap days/nights to develop a species accumulation curve for the survey, following EPA (2016c). The species accumulation curve assists in estimating total species richness and the proportion of species caught during the survey, with well-sampled species assemblages showing a distinct plateau following the initial rapid increase in the plotted data of species recorded, while under-sampled assemblages continuing to show a continual or slowly decreasing rise in species diversity. When a curve approaches a plateau, it suggests that sampling effort has been sufficient to adequately collect the majority of species comprising the faunal assemblage at the locations sampled (Thompson & Withers, 2003). The value at which the curve asymptotes can also be used as an approximate measure of the total size of the species diversity at the sampled location (Thompson ***et al.***, 2003).

Species accumulation curves were created for each faunal group (mammals, birds and herpetofauna). Accumulation curves and estimators were run using EstimateS v9.1.0 (Colarado, USA) and included the estimated number of species based on observed data recorded (S(est), formerly Sobs Mao Tau) and species richness estimators Chao 1, Chao 2, Jacknife 1 and Michaelis-Menten to predict the total number of species that could potentially be recorded using the same techniques.

Species accumulation curves and richness estimators for this survey were calculated using avifauna census data for birds and systematic trapping data for mammals, reptiles and amphibians at systematic trapping sites only. It should be noted that additional species were recorded from other techniques (i.e. opportunistic and targeted sampling methods) which are not included in the analysis as the survey effort and data are not statistically valid (i.e. not standardized or comparable).

4.9 Fauna Habitat Mapping and Significance

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

Fauna habitats were also assessed for the likelihood that they may support fauna of conservation significance. All major fauna habitats present within the Study Area were assessed for significance (as High, Moderate or Low) according to the criteria outlined in Table 4.2.

Table 4.2: Fauna habitat significance assessment criteria

Score	Possible criteria (score results from any possible criterion being met)
High	Fauna listed as threatened under the EPBC Act or BC Act have been recorded from this habitat type within the assessment areas.
	Habitat known to be suitable core habitat for EPBC Act and/or BC Act listed threatened fauna, and there are records of this species within 40 km.
	Habitat is regionally uncommon or limited in extent and known to support species listed as: • Threatened fauna under the EPBC Act and/or BC Act, but it is not their core habitat (e.g., may be used periodically/ seasonally or for dispersal). • Species of Special Conservation Interest or Other Specially Protected Species under the BC Act. • DBCA listed Priority fauna, which are known to be solely reliant on this habitat.
Moderate	Habitat known to support EPBC Act and/or BC Act listed Migratory fauna.
	Habitat that is regionally uncommon (e.g., occurs in small and isolated areas) and supports a particularly diverse and uncommon faunal assemblage.
	Habitat is common and widespread and known to support species listed as: • Threatened fauna under the EPBC Act and/or BC Act, but it is not their core habitat (e.g., may be used periodically/ seasonally or for dispersal). • Species of Special Conservation Interest or Other Specially Protected Species under the BC Act • DBCA listed Priority fauna, which are known to be solely reliant on this habitat.
Low	Habitat is widespread/common and does not solely support any DBCA listed Priority fauna.

4.10 Likelihood of Vertebrate Fauna Occurrence

The likelihood of occurrence within the Study Area was assessed for all conservation significant species identified in the desktop assessment using the decision matrix shown in Table 4.3. The occurrence assessment was based on known information relating to species' distribution, habitat preferences (landforms, substrates and vegetation associations), locality records from database searches and previous studies within and/or in the vicinity of the Study Area and results of the current survey pertaining to species records and/or habitats occurring within the Study Area. The fauna assessments assigned each species to one of six ratings, ranging from Confirmed to Highly Unlikely.

Due to several factors influencing species occurrence (i.e. known distribution, habitat preferences, ecology and/or dispersal capabilities), interpretation of occurrence assessment criteria may vary between species (i.e. a small species with limited dispersal capabilities previously recorded close to the Study Area may not necessarily occur within the Study Area, whereas larger species with greater dispersal and/or foraging capabilities may have an increased likelihood of occurring).

Where a species determined likelihood of occurrence differs from the assessment criteria in Table 4.3, detailed justification for the determined assessment will be provided in the discussion of that species. For example, historic or presumed erroneous records which may not be representative of species' current known distribution (i.e. locally/regionally extinct species) or limited sampling within or in the vicinity of the Study Area resulting in lack of contextual records which may influence a higher or lower determined likelihood of occurrence to criteria.

Table 4.3: Species likelihood of occurrence decision matrix

Range/occurrence categories (<50 years only)	Habitat Categories (within Study Area)			
	Core/critical habitat present	Foraging/dispersal habitat present	Marginal/intermittent habitat present	No suitable habitat present
Recorded in Study Area	Confirmed	Confirmed	Confirmed	Confirmed
Recorded within 10 km	Highly Likely	Likely	Possible	Possible
Recorded within 10–50km	Likely	Possible	Possible	Unlikely
Recorded within 50–100 km	Possible	Possible	Unlikely	Unlikely
Recorded >100 km	Possible	Unlikely	Unlikely	Highly Unlikely
Species considered locally/regionally extinct	Unlikely	Unlikely	Highly Unlikely	Highly Unlikely

5 FIELD SURVEY RESULTS AND DISCUSSION

5.1 Fauna Habitats

A total of five broad fauna habitat types were recorded and mapped across the Study Area, comprising Stony Plain, Drainage Area/ Floodplain, Hardpan Plain, Mulga Woodland and Hillcrest/ Hillslope (Table 5.1; Figure 5.1). Stony Plain, Drainage Area/ Floodplain and Hardpan Plain were the dominant broad fauna habitats within the Study Area, covering 51.8% (1,915.23 ha), 22.7% (841.14 ha) and 15.6% (578.31 ha) of the Study Area, respectively (Table 5.1; Figure 5.1). Mulga Woodland habitat covers 7.8% (286.87 ha) of the Study Area, while Hillcrest/ Hillslope covers only 2.1% (77.01 ha) of the Study Area (Table 5.1; Figure 5.1). Descriptions of the distinguishing characteristics and the occurrence within the Study Area for each of these habitat types are presented in Table 5.1, and the data from on-site habitat assessments are presented in Appendix D.

Of the five broad fauna habitats occurring within the Study Area, four are considered to be of Moderate significance (Stony Plain, Drainage Area/ Floodplain, Mulga Woodland and Hillcrest/ Hillslope) and one to be of Low significance (Hardpan Plain). No habitats occurring within the Study Area were deemed to be of High significance. The absence of highly significant habitats is due to the lack of critical habitat for any vertebrate species of high conservation significance. 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. The condition of habitats within the Study Area ranged from Excellent to Pristine. The greatest disturbances were caused by recent fire throughout parts of the Study Area and grazing by Cattle (*Bos Taurus*), and these were largely associated with Drainage Area/ Floodplain, Stony Plain and Hardpan Plain habitats.

Of the four habitats deemed to be of moderate significance, Drainage Area/ Floodplain and Mulga Woodland habitats provide suitable habitat for Brush-tailed Mulgara, Pilbara Leaf-nosed Bat (Priority 5 foraging habitat only, as defined by TSSC (2016b)) and Peregrine Falcon and primary foraging/dispersal habitat for the Ghost Bat. For Ghost Bat and Pilbara Leaf-nosed Bat, utilisation of these habitats is likely to be associated with areas located in the north of the Study Area, which are located closer to suitable roosting habitat located within the Western Ridge Area (Figure 5.1). Stony Plain habitat may also provide suitable foraging/dispersal habitat for Ghost Bat; however, its occurrence is likely to be dependent on the presence of trees, which provide perching sites during foraging, occurring at higher density and the proximity to suitable roost habitat occurring in the Western Ridge Area. Hillcrest/ Hillslope habitat may provide suitable habitat for Long-tailed Dunnart, potential Priority 3 foraging habitat for Pilbara Leaf-nosed Bat and possible foraging/dispersal habitat for Northern Quoll. Pilbara Leaf-nosed Bat and Northern Quoll occurrence would be dependent on the presence of suitable roosting or denning/shelter habitat adjacent to or in close proximity to areas where this habitat occurs The remaining habitat (Hardpan Plain) was deemed to be of low significance as they either do not support species of high conservation value and/ or such species are not dependent on these habitats at the broad-scale. Instances of this habitat may be suitable for the Western Pebble-mound Mouse and Spotted Ctenotus, and possibly Brush-tailed Mulgara and Long-tailed Dunnart.

Table 5.1: Broad fauna habitats occurring within the Study Area

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Conservation Significant Species	Photo
Stony Plain **1,915.23 ha** **51.8%** **Significance: Moderate**	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. Large patches of recently burnt areas with scattered natural post-fire regrowth occurring.	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: • Ghost Bat (foraging) • Western Pebble-mound Mouse • Brush-tailed Mulgara • Long-tailed Dunnart • Spotted Ctenotus	
Drainage Area/ Floodplain **841.14 ha** **22.7%** **Significance: Moderate**	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 large areas within the Study Area, particularly in the eastern lower lying areas 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) • Peregrine Falcon (foraging) • Western Pebble-mound Mouse (foraging) • Brush-tailed Mulgara • Spotted Ctenotus	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Conservation Significant Species	Photo
Hardpan Plain **578.31 ha** **15.6%** **Significance: Low**	Lower lying plain often sparsely vegetated with open or sparsely scattered Mulga over a sparse understory on heavy clay substrates with a stony or gravelly surface. Large areas often void of vegetation	Hardpan Plain habitat occurs over a single large low-lying area in the south of the Study Area. This fauna habitat is common throughout parts of the Pilbara bioregion and the Gascoyne bioregion to the south. Structure and condition is variable as a result of rainfall events and disturbance (i.e. fire and cattle grazing).	Suitable for: • Peregrine Falcon (foraging)	
Mulga Woodland **286.87 ha** **7.8%** **Significance: Moderate**	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 with sparse to no understory of mixed small shrubs and tussock grasses.	This habitat type is located in a few isolated patches within the eastern portion and northern edge of the Study Area. It often occurs within broader areas of Stony Plain and/or 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)	

Habitat	Distinguishing habitat characteristics	Extent of the habitat	Conservation Significant Species	Photo
Hillcrest/ Hillslope **77.01 ha** **2.1%** **Significance: Moderate**	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 a small area of a larger extent of the habitat intersecting the Study Area in the north and a larger isolated series of large stony hills in the southwest. Its occurrence is confined to more elevated parts of the Study 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) • Western Pebble-mound Mouse • Long-tailed Dunnart	

762500 765000 767500 770000 772500 775000 777500

7410000

7407500

7405000

7402500

Legend

- Study Area

Habitat

- Drainage Area/Floodplain
- Hardpan Plain
- Hillcrest/Hillslope
- Mulga Woodland
- Stony Plain

biologic Environmental Survey

N

1:40,000

0 0.3 0.6 1.2 1.8 2.4 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 5.1: Broad fauna habitat occurring within the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

5.2 Fauna Habitat Features

Caves

Caves can be important features within a landscape, particularly in arid zone systems, often providing stable microclimates, shelter and protection (Medellin *et al.*, 2017). No caves were recorded within the Study Area. Numerous caves known to support conservation significant species such as Ghost Bat and Northern Quoll are known to occur within the Western Ridge Area directly north of the Study Area (Biologic, 2020b).

Water Features

Water sources are a limiting factor for many ecosystems (James *et al.*, 1995), particularly within arid-zone ecosystems such as the Pilbara (Burbidge *et al.*, 2010; Doughty *et al.*, 2011) and often represent areas of comparatively high ecological productivity (Murray *et al.*, 2003). Mammals and birds have endothermic metabolisms and therefore require relatively continuous sources of food and moisture, while water for amphibians provides opportunities to forage (i.e. suitably wet periods) and breed (i.e. when water pools for long enough for them to complete the life cycle) (James *et al.*, 1995). These features are highlighted because they may provide important sources of food and water for species of conservation significance.

No natural water features were recorded within the Study Area during the surveys. A single area of pooling water was recorded at one site along a minor drainage channel in Hardpan Plain habitat in the south of the Study Area during the Phase 2 survey; however, the pooled water did not remain for the duration of the survey, indicating water presence was a result of rainfall preceding the survey. It is likely that temporary water features occur throughout parts of the Study Area where pooling or flowing water may be present following significant rainfall events, particularly within habitats occurring in low lying areas or those supporting minor drainage lines.

5.3 Fauna Recorded

5.3.1 Species Richness of Study Area

A total of 153 vertebrate fauna species, comprising 25 mammal species (20 native and five introduced), 75 bird species, 51 reptile species and two amphibian species were recorded from the Study Area during the current survey (Table 5.2; Appendix E). This comprises approximately 45% of the total number of species identified in the desktop assessment (n = 340) as potentially occurring within the Study Area (see section 3.2). In comparison with the results from previous surveys undertaken in the vicinity of the Study Area (Table 5.2), the total species diversity recorded during the current survey was comparable to other larger scale surveys comprising two-phase pit trapping Level 2 survey (i.e. Biologic, 2011).

Of the 153 species recorded during the current survey, four reptile species were not previously identified in the desktop assessment (Appendix C). These species included the Hamersley Range Spotted Gehyra (*Gehyra fenestrula*), a legless lizard (*Delma tincta*), a blind snake (*Anilios ammodytes*) and a skink (*Ctenotus hanloni*). Of these four species, the Hamersley Range Spotted Gehyra represents a recently described species formerly subsumed within the common and widespread Spotted Rock Dtella (*Gehyra punctata*) (Doughty *et al.*, 2018), which was also recorded during the current survey. The Study Area occurs at the southern limit of their distribution for one species (*Anilios ammodytes*), which is likely to have attributed to fewer records in the vicinity of the Study Area (DBCA, 2019a). The remaining two species (*Delma tincta* and *Ctenotus hanloni*) are considered relatively common and widespread within the Pilbara region. The Study Area occurs within the published distribution of the species; however, there are limited records of the species in the broader area of the Study Area, which may represent a small gap in known distribution (DBCA, 2019a). A greater diversity of species was recorded during the Phase 2 survey (129 species) when compared to the Phase 1 survey (103 species). A total of 80 species were recorded during both Phases, while 23 species were recorded during Phase 1 only and 49 species were recorded during Phase 2 only.

Table 5.2: Summary of fauna species recorded during the current survey and previous surveys in the vicinity of the Study Area

Source	Reference	Mammals (native)	Mammals (introduced)	Birds	Reptiles	Amphibians	Total
Literature Sources							
Astron (2010) Mt Whaleback TSF Flora, Vegetation and Fauna Assessment	A	1	1	1	-	-	**3**
Biologic (2011) Orebody 35 and Western Ridge Vertebrate Fauna Survey	B	19	6	82	54	2	**163**
Biologic (2014a) Orebody 24 Targeted Vertebrate Fauna Survey	C	18	-	44	18	1	**81**
Biologic (2014b) Orebody 25 Targeted Vertebrate Fauna Survey	D	11	2	28	6	-	**47**
Biologic (2016) Western Ridge Southern Tenements Vertebrate Fauna Desktop Assessment	E	-	-	-	-	-	**-**
Ecologia (2005) Western Ridge Exploration Project Biological Survey	F	3	3	24	5	-	**35**
Ecologia (2006) Western Ridge Exploration Project Biological Survey	G	8	2	51	15	-	**76**
ENV (2010) Orebody 35 Vegetation Clearing Permit Area Flora and Fauna Assessment	H	4	1	25	5	-	**35**
ENV (2011a) Eastern Ridge (OB23/24/25) Fauna Assessment	I	10	-	46	13	2	**71**
ENV (2011b) Mt Whaleback East Flora, Vegetation and Fauna Assessment	J	2	1	29	7	-	**39**
Onshore and Biologic (2009) Mt Whaleback Mine Site Flora and Vegetation and Fauna Assessment	K	4	3	51	7	-	**65**
Onshore (2014) Western Ridge Biological Survey	L	-	-	37	8	-	**45**
Onshore (2018) Western Ridge E52/3448 Desktop Flora and Fauna Assessment	M	-	-	-	-	-	**-**
Current Survey		**20**	**5**	**75**	**51**	**2**	**153**

5.3.2 Fauna Assemblages

Systematic Sampling Sites

Locations of systematic trapping sites were situated in areas considered to give a good representation of broad fauna habitats occurring within the Study Area. Two systematic trapping sites were located in Stony Plain habitat (VCOW-05 and VCOW-09) and one within all remaining habitats, including Drainage Area/ Floodplain (VCOW-06), Hardpan Plain (VCOW-10), Mulga Woodland (VCOW-08) and Hillcrest/ Hillslope (VCOW-02). All broad fauna habitats were subject to further survey effort using alternative sampling methods, including active foraging and SongMeter ultrasonic recordings to sample overall species diversity and target conservation significant species.

Mammals

A total of 25 mammal species from 12 families were recorded within the Study Area from 278 individual records (Appendix E). Bats were the most recorded native mammal group with 158 records, followed by dasyurids (*n* = 45) and macropods (*n* = 15). Five introduced mammal species were recorded within the Study Area from a total of 48 records. The most abundantly recorded species were introduced Cattle (*Bos taurus*), and native Gould's Wattled Bat (*Chalinolobus gouldii*), both with 34 records, followed by Northern Freetail-bat (*Chaerephon jobensis* subsp*. colonicus*) with 32 records. The most abundantly recorded mammal species at the systematic trapping sites was Little Red Kaluta (*Dasykaluta rosamondae*) with 31 records. The number of mammal species trapped during the survey was low, with only seven species recorded at systematic trapping methods. A further eight species were recorded from ultrasonic bat call recordings (all bat species), with the remaining 10 species recorded opportunistically from direct observation and secondary evidence.

Species diversity and abundance recorded at the six trapping sites varied, with between 11 and 30 individual records occurring at each site, and total species diversity at each site ranging from five to eight. The highest species diversity was recorded at sites VCOW-06, VCOW-08 and VCOW-09, each recording eight species, largely comprising bat species, from a total number of records ranging from 19-30. In comparison, site VCOW-10 only recorded five species, from 11 individual records. The differences in overall species diversity and abundance is likely to be attributed to the different habitats or habitat characteristics occurring between sites.

Two conservation significant mammal species were recorded within the Study Area during the survey; Pilbara Leaf-nosed bat (one record from one site) and Western Pebble-mound Mouse (eight records from opportunistic locations) (Table 5.3; Figure 5.2).

Birds

A total of 75 bird species representing 29 families were recorded within the Study Area from a total of 1,104 individual records (Appendix E). The honeyeaters and allies (family Megapodidae) were the most abundant and diverse family with nine species recorded from a total of 179 individual records, followed by the family Artamidae (woodswallows and butcherbirds) with five species from 114 individual records. Maluridae (wrens) had equal second total number of individual records with 114; however, were represented by only four species. Singing Honeyeater was the most commonly recorded species during the survey, with 65 individual records.

Species diversity, abundance and complexity was highly variable throughout the Study Area. While many common and widespread species were shared between sites, a number of species were recorded at only one or few sites, particularly due to the variable presence and abundance of vegetation between sites.

The number of individual records captured from each systematic trapping site varied, with VCOW-06 recording the highest with 131 individual records, followed by VCOW-05 with 118 individual records. The number of records at three of the remaining sites (VCOW-08, VCOW-09 and VCOW-10) were similar, with between 108-112 individual records. VCOW-02 recorded significantly lower than all other

sites with only 30 records. Species diversity also varied between trapping sites with VCOW-05 and VCOW-10 having the highest diversity (34 and 31 species respectively). VCOW-06, VCOW-08 and VCOW-09 recorded similar number of species with 24, 29 and 27 respectively, while VCOW-02 recorded significantly lower than the others with only 11 species. Three of the systematic trapping sites (VCOW-05, VCOW-06 and VCOW-09) had an acoustic recorder deployed at the site to target Night Parrot. As a result, non-target bird species were also recorded which greatly increased each sites species diversity and abundance. The number of species recorded at sites VCOW-05, VCOW-06 and VCOW-09 increased from 19, 18 and 21 species to 34, 24 and 27 species, respectively. Abundance also increased from 58, 79 and 64 individual records to 118, 131 and 112 individual records, respectively. If using bird census data only, VCOW-10 recorded the highest species diversity (31 species) and VCOW-08 recorded the highest abundance (112 individual records).

Many species were recorded from opportunistic records within the Study Area, with 39 species recorded from 80 records, 50% (20 species) of which were not recorded at sampling sites. Additionally, 33 species from 411 records were recorded via acoustic recorders not deployed at trapping sites, some of which had not been recorded by any other sampling method.

One conservation significant bird species was recorded just outside the Study Area during the survey; Peregrine Falcon (one record from an opportunistic location) (Table 5.3; Figure 5.2).

Reptiles

A total of 51 reptile species representing 10 families were recorded from 324 individual records (Appendix E). Skinks were the most abundant group with 163 individual records, representing 16 species followed by the families Agamidae (dragon lizards) and Diplodactylidae (geckos) both with six species from 38 and 45 individual records, respectively. The remaining families were represented by five or fewer species (Appendix E). The most commonly recorded species was a skink (*Ctenotus inornatus*), recorded 57 times from five sites, including all but one trapping site.

Species diversity was relatively similar between trapping sites with the number of species ranging between 11 and 19 species, whereas abundance varied between all trapping sites, with the number of individual records ranging from 26 to 68. The highest species diversity was recorded at VCOW-06 with 19 species followed by VCOW-02, VCOW-05, VCOW-08 and VCOW-09 all recording 15 species each. Highest abundance of reptiles was recoded at site VCOW-06 with 68 individual records, followed by VCOW-08 with 54 records. The lowest species diversity and abundance was recorded at site VCOW-10 with 26 individual records representing 11 species. Additionally, seven species from 13 individual records were recorded opportunistically during the field survey, some of which were not recorded at sampling sites.

No conservation significant reptile species were recorded during the current survey.

Amphibians

Two amphibian species were recorded in the Study Area, neither of which are of conservation significance (Appendix E). Little Red Tree Frog (*Litoria rubella*) was captured at all systematic sampling sites bar one (VCOW-02). The highest number of records for this species was recorded at VCOW-09

with five individual records, followed by VCOW-08 with three records. VCOW-05 and VCOW-06 recorded two individual records each whilst VCOW-10 only recorded one. Sheep Frog (*Cyclorana maini*) was the other amphibian species captured during the current survey. This species was caught at all systematic sampling sites bar one (VCOW-02) and occurred in much higher abundance. The highest number of records for this species was recorded at VCOW-10 with 22 individual records, followed by VCOW-05 and VCOW-08, both with 19 records each. VCOW-06 and VCOW-09 recorded the lowest abundance with 16 and 11 records, respectively. No conservation significant frogs have the potential to occur within the Study Area.

Table 5.3: Fauna of conservation significance recorded during the current survey

Common Name (Scientific Name)	Site	Location		Habitat	Record Type	No. Records
		Latitude	Longitude			
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VCOW-25	-23.4171	119.6123	Mulga Woodland	Ultrasonic recording	1
Western Pebble-mound Mouse (*Pseudomys chapmani*)	OPP	-23.4254	119.5697	Stony Plain	Mound (inactive)	1
	OPP	-23.4248	119.5694	Stony Plain	Mound (inactive)	1
	OPP	-23.436	119.6692	Stony Plain	Mound (inactive)	1
	OPP	-23.4323	119.6037	Stony Plain	Mound (active)	1
	OPP	-23.4223	119.6781	Stony Plain	Mound (inactive)	1
	OPP	-23.4223	119.6782	Stony Plain	Mound (active)	1
	OPP	-23.4223	119.6782	Stony Plain	Mound (active)	1
	OPP	-23.4209	119.6789	Stony Plain	Mound (inactive)	1
Peregrine Falcon (*Falco peregrinus*)	OPP	-23.4504	119.6397	Stony Plain	Individual (alive)	1

5.4 Fauna of Conservation Significance

A total of 38 species of conservation significance have the potential to occur within the Study Area, based on the results of the desktop assessment (see Section 3.2), comprising eight mammals, 26 birds and four reptiles (see Table 3.4). No vertebrate species of conservation significance have previously been recorded within the Study Area; however, three species, Ghost Bat (scats, echolocation recording and direct observation), Peregrine Falcon (direct observation) and Western Pebble-mound Mouse (active and inactive pebble mounds), have previously been recorded within the Western Ridge Area directly north of the Study Area (BHP, 2019) (Figure 3.1).

Two conservation significant species were recorded within the Study Area during the current survey, Pilbara Leaf-nosed Bat and Western Pebble-mound Mouse (Table 5.3; Figure 5.2). Based on known species' distributions, previous records and the habitats present, a further two species were deemed Highly Likely to occur, six were deemed Possible and 28 were considered Unlikely or Highly Unlikely to occur (Table 5.4). The occurrence of those species of conservation significance which are MNES and a focus of this assessment is discussed in further detail below (Section 5.4.1). The occurrence of other species of conservation significance which have either been Confirmed as occurring in the Study Area or are considered Highly Likely to occur, Likely to occur, or to Possibly occur, is also discussed in more detail (Section 5.4.2 to 5.4.5). Consideration for some species as Unlikely or Highly Unlikely to occur within the Study Area is generally based on the absence of suitable habitat for the species and/or the Study Area occurring outside the known distribution for the species (Table 5.4).

762500 765000 767500 770000 772500 775000 777500

7410000
7407500
7405000
7402500

Legend

Study Area

Peregrine Falcon
Individual (alive)

Pilbara Leaf-nosed Bat
Ultrasonic call recorder

Western Pebble-mound Mouse
Mound (active)
Mound (inactive)

biologic Environmental Survey

N

1:40,000

0 0.3 0.6 1.2 1.8 2.4 km

BHP WAIO

Coombanbunna Well Level 2 Vertebrate Fauna Survey

Figure 5.2: Species of conservation significance recorded in the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Size A3. Created 06/02/2020

Table 5.4: Conservation significant species likelihood assessment

Genus and Species	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	Drainage Area/ Floodplain	Hardpan Plain	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).	~12 km north (2013) (Biologic, 2014a) ~27 km east (2018) (DBCA, 2019c)	•	•				Possible	Resident	May occur as a resident in Stony Plain and 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).	~3 km north (2019) (Biologic, 2020b) ~5 km north (2007) (BHP, 2019; Onshore, 2013)					•	Possible	Infrequent visitor (foraging/ dispersal only)	Suitable denning/shelter habitat not present. May rarely occur in Hillcrest/ Hillslope habitat 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).	~6 km north (1998) (BHP, 2019)	•				•	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).	~13 km north (2013) (Biologic, 2014a)		•		•	•	Recorded	Infrequent visitor (foraging/ dispersal only)	Recorded once from a single ultrasonic call recording in Mulga Woodland habitat during the Phase 1 survey. 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. Priority 5 and possibly Priority 3 foraging habitat (as defined by TSSC (2016b)) present within 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).	~24 km north-east (1975) (DBCA, 2019c)						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 Mylga woodlands (Biologic, 2020a; Richards *et al.*, 2008; Tidemann *et al.*, 1985; TSSC, 2016a).	~300m north (2006) (Ecologia, 2006) ~1 km north (Biologic, 2020b)		•		•		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.
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).	~200m north (2009) (Onshore & Biologic, 2009) (~112 records within 5 km of the Study Area)	•				•	Recorded	Resident	Recorded eight times during the current survey on undulating low hills within Stony Plain habitat. All records from secondary evidence (pebble mounds), including three active mounds and five inactive mounds. Likely to occur as a resident throughout Study Area where suitable stony habitat present.

Genus and Species	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	Drainage Area/ Floodplain	Hardpan Plain	Mulga Woodland	Hillcrest/ Hillslope			
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).	~8.5 km east (1979) (DBCA, 2019c)						Unlikely	N/A	Suitable habitat not present
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.	~85 km north-west (2013) (DBCA, 2019a)	•	•	•	•	•	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*)	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).	~10km north-east (Birdlife Australia, 2019) ~375 km north-west (2013) (DBCA, 2019a)						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 (1999) (DBCA, 2019a)						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).	~3.5 km east (1981) (DBCA, 2019a) ~100 km north (2017) (DBCA, 2019a)						Unlikely	N/A	Suitable habitat not present
FALCONIDAE														
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).	~1.5 km north (2010) (Biologic, 2011) ~150 m north (1998) (BHP, 2019) ~ 2 km north (Biologic, 2020b)	•	•	•		•	Highly Likely	Occasional visitor (foraging only)	Recorded once from direct observation of single individual ~1 km southwest of the Study Area. Likely to occur occasionally to forage. 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).	~390 km north (2001) (DBCA, 2019a)						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).	~18km north-east (2004, 2007, 2008) (DBCA, 2019c)						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).	~18 km north-east (2008) (DBCA, 2019c) ~3.5 km east (1978) (DBCA, 2019c)						Unlikely	N/A	Suitable habitat not present
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, 2019a)						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).	~250km north (Birdlife Australia, 2019) >500km north-east (2003) (DBCA, 2019a)						Unlikely	N/A	Suitable habitat not present

Genus and Species	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	Drainage Area/ Floodplain	Hardpan Plain	Mulga Woodland	Hillcrest/ Hillslope			
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).	~140 km north-west (2005) (DBCA, 2019c)							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 (2002) (DBCA, 2019a)						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, 2019a)						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).	~16km north-east (2012) (BHP, 2019; MWH, 2015)						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).	~16 km north-east (2012) (BHP, 2019; MWH, 2015)						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 north-east (2012) (BHP, 2019; MWH, 2015)						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).	~18k north-east (2005) (DBCA, 2019c)						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).	~16 km north-east (2012) (BHP, 2019; MWH, 2015)						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)	~16 km north-east (2014) (DBCA, 2019c)						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, 2019b)	~16 km north-east (2012) (BHP, 2019; MWH, 2015)						Unlikely	N/A	Suitable habitat not present
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).	~1.5 km 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).	~1.4 km north (2013) (BHP, 2019; 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	~1.4 km north (2010) (Biologic, 2011)						Unlikely	N/A	Suitable habitat not present

Genus and Species	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	Drainage Area/ Floodplain	Hardpan Plain	Mulga Woodland	Hillcrest/ Hillslope			
					samphire flats, beaches, river pools, and saltworks and sewage ponds (Johnstone *et al.*, 2013).									
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).	~1.4 km north (1998) (Ecologia, 1998)						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).	~1.4 km north (2013) (BHP, 2019; Trainor *et al.*, 2015)						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).	~3.5 km east (1978) (DBCA, 2019c)						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).	~1.5 km north (2010) (Biologic, 2011)						Unlikely	N/A	Suitable habitat not present
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, 2019c)	●				●	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)	~75 km north-west (2012) (DBCA, 2019a)						Unlikely	N/A	Suitable habitat not present. Desktop records likely erroneous.
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 and 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, 2019a)	~1.3 km north (2010) (Biologic, 2011)	●				●	Possible	Resident	May occur in Stony Plain and Hillcrest/ Hillslope habitats, particularly where most substrates present for prolonged periods.

5.4.1 EPBC Matters of National Environmental Significance

The sections below provide summaries on the Program Matters identified in the approved Program for BHP's Strategic Assessment (Greater Bilby, Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python) as well as the Night Parrot.

Northern Quoll (*Dasyurus hallucatus*) – Endangered (EPBC/BC Act)

The Northern Quoll tends to inhabit rocky habitats which offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994; DoE, 2016; 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).

No Northern Quoll or evidence of the species' occurrence was recorded within the Study Area during the current survey; however, the species is considered to possibly occur based on the presence of suitable core habitat in areas adjacent to the Study Area and the occurrence of previous records in the vicinity of the Study Area. Although no suitable denning/shelter habitat was recorded within the Study Area, suitable areas of habitat are known to occur in the Western Ridge Area and the species has been recorded from the Western Ridge Area on multiple occasions from secondary evidence (old scats within caves) during a recent targeted vertebrate fauna survey; however, the species is suspected of occurring in low abundance (Biologic, 2020b). Northern Quoll may occasionally occur within Hillcrest/ Hillslope habitat of the Study Area to forage or during dispersal movements, particularly in areas adjacent to or near areas of suitable habitat outside of the Study Area. Due to the isolated nature of most Hillcrest/ Hillslope habitat within the Study Area, the species is not considered likely to utilise these habitats on a regular basis.

With the exception of Northern Quoll records from the Western Ridge Area, approximately 3 km north of the Study Area, records of the species in the vicinity of the Study Area are sparse, with the nearest record to the Study Area occurring approximately 5 km north, dated from 2007 (BHP, 2019). Due to the absence of any records of the species occurring within the Study Area and the scarcity of records in the vicinity, the species occurrence within the Study Area may also be limited to infrequent visitations by dispersing individuals. With the exception of Hillcrest/ Hillslope habitat, the remaining habitats mapped within the Study Area are unlikely to provide significant habitat for the species.

Greater Bilby (*Macrotis lagotis*) – Vulnerable (EPBC/BC Act)

Extant populations of the Greater Bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils (Southgate, 1990). Throughout its distribution, it occupies three major vegetation types: open tussock grassland on uplands and hills, hummock grassland in plains and alluvial areas and occasionally mulga woodland/shrubland growing on ridges and rises, and (Southgate, 1990). Within the Pilbara region the species is sparsely distributed, and often associated with spinifex sandplain habitat (Dziminski & Carpenter, 2016).

No records or evidence of occurrence of Greater Bilby was recorded within the Study Area during the current survey. No suitable habitat considered likely to support the species as a resident was recorded within the Study Area. The nearest record of the species is located approximately 8.5 km east of the Study Area (DBCA, 2019c); however, based on the date of the record (1979), it is considered to be a

historic record and is unlikely to be an accurate representation of the species current occurrence within the Pilbara region. The nearest, more recent record (dated 2018) is located approximately 65 km east of the Study Area (DBCA, 2019c).

Based on the absence of nearby recent records of the species or suitable habitat for the species within the Study Area and relative isolation of the Study Area from other areas of suitable habitat outside of the Study Area, the species is considered Unlikely to occur. Although the species is known to utilise broad habitats occurring within the Study Area in other parts of its distribution (i.e. Mulga Woodland and Drainage Area/ Floodplain), these habitats are rarely utilised by the species within the Pilbara region, likely due to the high amount of alluvial material making substrates less suitable for burrowing activity compared to sand-plain habitats (Cramer *et al.*, 2017). The likelihood of these habitats being utilised by the species may also increase when larger areas of suitable habitat (e.g. sandplain) are present adjacent to or in the vicinity.

Ghost Bat (*Macroderma gigas*) – Vulnerable (EPBC/BC Act)

In the Pilbara region, the species roosts in deep, complex caves beneath bluffs of low rounded hills, often composed of Marra Mamba Iron Formation or banded iron formation, granite rock piles and abandoned mines (Armstrong & Anstee, 2000). They roost either individually or in colonies (Churchill, 2008) and move between a number of caves, both seasonally and as dictated by weather changes (van Dyck & Strahan, 2008). The species will often forage more broadly across habitats, often utilising drainage lines and other habitats where prey species are likely to be most abundant (Richards *et al.*, 2008; Tidemann *et al.*, 1985). Recent studies of ghost bat home range and foraging behaviour in the Pilbara region have identified Drainage Area/ Floodplain, Gorge/ Gully, Major Drainage Line and Mulga Woodland as high suitability foraging habitats for the species, followed by Stony Plain as moderate suitability (Biologic, 2020a; unpublished data). This suitability however, is variable depending on particular habitat characteristics, including the abundance of foraging structures (tree perches) and density of understory vegetation present (Biologic, 2020a; unpublished data).

No Ghost Bat or suitable roost caves likely to be used by the species were recorded within the Study Area during the current survey; however, detectability, particularly of foraging individuals is difficult due to their foraging behaviour (i.e. infrequent and highly variable calling during foraging) and capabilities of ultrasonic recording devices (i.e. limited detection zones). The species has previously been recorded on multiple occasions within the Western Ridge Area directly adjacent to the Study Area, including a 2006 record approximately 300 m north of the Study Area in Mulga Woodland habitat which extends into the Study Area (Ecologia, 2006). The species has previously been recorded on multiple occasions from direct observation and secondary evidence (including roost caves) within the Western Ridge Area, during a reconnaissance visit to caves during the Phase 1 survey and again in early 2020 (Biologic, 2020b).

Based on the occurrence of previous records of the species in close proximity to the Study Area and occurrence of potential foraging habitat (Mulga Woodland, Drainage Area/ Floodplain and possibly Stony Plain) the species is considered highly likely to occur. Due to the absence of any potential roosting habitat within the Study Area, occurrence of Ghost Bat within the Study Area is likely to be individuals originating

from outside the Study Area, particularly within the Western Ridge Area where known and likely roosting caves occur (Biologic, 2020b). The species occurrence within the Study Area is likely to be higher during use of any of these caves as a maternity roost and especially in areas located closer to known and potential roosting sites, particularly Stony Plain, Mulga Woodland and Drainage Area/ Floodplain habitats located in the north of the Study Area which are closer to known and likely roosting caves within the Western Ridge Area. The caves recorded within the Western Ridge Area represent the south-eastern extent of known roost caves for the species, indicating the species occurrence in this area may represent an important population, as defined by DoE (2013). This suggests that the potential foraging habitat occurring within Mulga Woodland and Drainage Area/ Floodplain habitats of the Study Area that is associated with (occurs in the vicinity of) these caves represents important foraging habitat for the species.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) – Vulnerable (EPBC/BC Act)

This species' limited ability to conserve heat and water means it requires warm (28–32 ºC) and very humid (85 – 100%) roost sites in caves (Armstrong, 2001; Churchill, 1991) and/or mine shafts as these enable the individuals to persist in arid climates by limiting water loss and energy expenditure (van Dyck & Strahan, 2008). Such caves are relatively uncommon in the Pilbara (Armstrong, 2001), which limits the availability of diurnal roosts for this species. Pilbara Leaf-nosed Bats roost in undisturbed caves, deep fissures or abandoned mine shafts. The species forages within and in the vicinity of roost caves and more broadly along waterbodies with suitable fringing vegetation supporting prey species (TSSC, 2016b). Pilbara Leaf-nosed Bats are predicted to travel up to 20 km from roost caves during nightly foraging (Cramer *et al.*, 2016); however, seasonal variation is known to occur, with foraging occurring up to 20 km in the dry season and up to 50 km during the wet season (Bullen, 2013). Long-distance movements by the species have also been recorded, with a single monitored individual recorded from two roost caves located 170 km distant approximately 12 months apart (Bullen & Reiffer, 2019), suggesting the species may forage and/or disperse over greater distances than previously thought.

Pilbara Leaf-nosed Bat was recorded once during the Phase 1 survey from ultrasonic call recording (Table 5.3; Figure 5.2). The species was recorded from a single call recording at 21:03 within Mulga Woodland habitat located in the north of the Study Area. Based on the late timing of the call, the record is likely to represent a foraging individual; however, the occurrence of the call provides no indication of the potential origin of the individual (i.e. where it may be roosting) and it is possible the individual originated from much further north based on the occurrence of suitable roosting habitat north of the Western Ridge Area. The nearest known roost of the species is located at Kalgan Creek, approximately 25 km north of the Study Area; however, sampling within the intervening area is sparse and additional sites may occur closer to the Study Area. The scarcity of records in the broader vicinity of the Study Area suggests the species is relatively uncommon in the area and its occurrence may be restricted to foraging events only. The species occurrence within the Study Area is likely to be occasional and restricted to foraging and/or dispersal movements, particularly within Mulga Woodland and Drainage Area/ Floodplain habitats. Within the Study Area, based on (TSSC, 2016b) categories of foraging habitat for the species, Mulga Woodland and

Drainage Area/ Floodplain provide potential Priority 5 foraging habitat and limited instances where outcropping occurs within Hillcrest/ Hillslope habitat provides potential Priority 3 foraging habitat.

No suitable roosting habitat occurs within the Study Area; however, suitable roosting habitat may occur in some caves within the Western Ridge Area. The species was not recorded during a recent targeted survey of the Western Ridge Area undertaken in early 2020; however, a number of potential nocturnal roost caves which may be utilised by the species were recorded (Biologic, 2020b). The species has previously been recorded approximately 13 km north of the Study Area in 2013 (Biologic, 2014a).

Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable (EPBC/BC Act)

The Pilbara Olive Python is moderately common through the ranges of the Pilbara region and the Mt Augustus area in the Gascoyne region. The species is often associated with rocky habitats (i.e. Gorge/Gully and Hillcrest/ Hillslope habitats) and drainage systems (i.e. Major Drainage Lines), including areas with localised 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). Pilbara Olive Python are primarily nocturnal and tend to shelter in small caves or under vegetation during the day, although it is occasionally active during the day during warmer summer months (Pearson, 1993).

No Pilbara Olive Python or suitable habitat likely to support the species was identified within the Study Area during the current survey. The nearest records of the species are located approximately 1.5–2 km north of the Study Area in the Western Ridge Area, including multiple recent records from a targeted survey completed across the area in early 2020 (Biologic, 2020b). Despite multiple records of the species within the Western Ridge Area, based on the absence of suitable habitat for the species within the Study Area, it is considered unlikely to occur.

Night Parrot (*Pezoporus occidentalis*) – Endangered (EPBC/BC Act)

The ecology and habitat preferences of the Night Parrot within the Pilbara region are poorly known. Based on accepted records, the habitat of the species comprises long-unburnt mature *Triodia* grasslands in stony or sandy environments (McGilp, 1931; North, 1898; Whitlock, 1924; Wilson, 1937), and of samphire and chenopod shrublands, including genera such as *Atriplex*, *Bassia* and *Maireana*, on floodplains and claypans, and on the margins of salt lakes, creeks or other sources of water (McGilp, 1931; Wilson, 1937). The current interim guidelines for preliminary surveys of Night Parrot in Western Australia suggest this species requires old-growth (often more than 50 years unburnt) spinifex (*Triodia*) for roosting and nesting (DPaW, 2017). Although little is known about foraging sites, habitats that comprise various grasses and herbs are thought to be suitable.

Records of the Night Parrot within the Pilbara region are scarce, with the nearest contemporary record of the species located approximately 140 km northwest from April 2005 (DBCA, 2019a). Three individuals of the species were purportedly observed at Minga Well, a station bore and livestock watering point with large pools of water (Davis & Metcalf, 2008). The site is heavily degraded from cattle and lacks understory within a larger area; however, larger patches of old-growth *Triodia* grasslands occur in the vicinity along the peripherals of the Fortescue Marsh and chenopod shrublands occur throughout the marsh itself.

Despite this observation, subsequent targeted survey for the species at the location and in the vicinity have failed to record the species again.

No evidence of occurrence of Night Parrot was recorded within the Study Area during the current survey, including from targeted acoustic recorders deployed in areas of habitat considered possibly suitable for the species. Habitat within the Study Area was considered suboptimal for the species, particularly due to most areas of *Triodia* grasslands lacking large long-unburnt hummocks and the absence of any chenopod shrubland habitat within the Study Area. Although little is known about the species' habitat preferences and occurrence, particularly within the Pilbara region, the extent of which these habitats may still provide habitat for the species is unknown; however, based on the absence of any habitat considered to be of significance of the species, it is considered unlikely to occur within the Study Area, either as a resident or infrequent visitor during foraging and or dispersal/migration movements.

5.4.2 Species Confirmed within Study Area

In addition to the Pilbara Leaf-nosed Bat discussed above (see Section 5.4.1), one other species of conservation significance was confirmed as occurring within the Study Area.

Western Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4 (DBCA)

The Western Pebble-mound Mouse has experienced a significant decline in their range through the Gascoyne and Murchison and is now considered endemic to the Pilbara (Start *et al.*, 2000). This species almost exclusively occurs on the gentler slopes of rocky ranges and low undulating hills 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 & Armstrong, 2001).

The Western Pebble-mound Mouse was recorded a total of eight times during the current survey (Table 5.3; Figure 5.2). All records were from secondary evidence (pebble mounds) on low undulating stony hills and plains of Stony Plain habitat, comprising three mounds deemed active and five considered inactive (Table 5.3; Figure 5.2). The species has also previously been recorded approximately 200 m north of the Study Area (Onshore & Biologic, 2009).

The species is likely to occur within the Study Area as a resident, where its occurrence is likely to be common and widespread across Stony Plain and the lower slopes of Hillcrest/ Hillslope habitats. The species may also forage more broadly into Drainage Area/ Floodplain habitat where adjacent to habitat permitting burrowing and mound construction.

5.4.3 Species Highly Likely to Occur

In addition to Ghost Bat discussed above (see Section 5.4.1), one other species of conservation significance is considered Highly Likely to occur in the Study Area, Peregrine Falcon.

Peregrine Falcon (*Falco peregrinus*) – Specially Protected (BC Act)

In arid areas of its distribution, the Peregrine Falcon is often recorded 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 & Olsen, 1989). It also appears to prefer nesting on large ledges a reasonable distance (average of 13 m) from the top of the

cliff (Olsen & Olsen, 1989), possibly to avoid ground dwelling predators. Nesting may also occasionally occur in tall trees along drainage lines, including use of abandoned nests of other large bird species (Olsen & Olsen, 1989).

No Peregrine Falcons were recorded within the Study Area during the current survey; however, the species was recorded just outside the Study Area during the Phase 1 survey (Table 5.3; Figure 5.2). The species was recorded opportunistically from direct observation of a single individual approximately 1 km southwest of the Study Area (Table 5.3; Figure 5.2). The species has previously been recorded on multiple occasions within the Western Ridge Area to the north of the Study Area (BHP, 2019; Biologic, 2020b) and is considered highly likely to occur within the Study Area to forage within all broad fauna habitats occurring. Due to the species broad foraging range and the widespread occurrence of these habitats in the broader vicinity of the Study Area, foraging is likely to occur over a much broader area and not confined to the Study Area. No suitable nesting habitat was recorded within the Study Area; however, suitable habitat occurs more broadly to the north of the Study Area.

5.4.4 Species Likely to Occur

No other species of conservation significance identified in the desktop assessment are considered likely to occur in the Study Area.

5.4.5 Species Possibly Occurring

In addition to the Northern Quoll discussed above (see Section 5.4.1), a further five species of conservation significance are considered to possibly occur in the Study Area.

Brush-tailed Mulgara (*Dasycercus blythi*) – Priority 4 (DBCA)

The Brush-tailed Mulgara is often recorded from a range of sandy and stony plain habitats (Pavey *et al.*, 2012) and its likelihood of occurrence within the Study Area is Possible due to the presence of suitable habitat. No evidence of the species was recorded during the current survey; however, the species is considered to possibly occur as a resident in Drainage Area/ Floodplain habitats and possibly Stony Plain, particularly where suitable vegetation cover and sandy or loamy substrates permitting burrowing are present. The nearest record of the species to the Study Area is located approximately 12 km north Biologic (2014a).

Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4 (DBCA)

Despite the relatively widespread distribution of Long-tailed Dunnart, the species is often sparsely distributed and locally uncommon in the Pilbara region, where is often occurs in rugged rocky areas, scree slopes and stony plains and plateaus dominated by open shrubland and *Triodia* grassland vegetation (van Dyck *et al.*, 2013). No evidence of the Long-tailed Dunnart was recorded within the Study Area during the current survey; however, based on the presence of potential habitat for the species and the species previously being recorded approximately 6 km north of the Study Area (BHP, 2019), its likelihood of occurrence is considered possible. Within the Study Area, the species may occur as a resident within Hillcrest/ Hillslope and possibly Stony Plain habitats, potentially moving into adjacent habitats to forage and/or disperse.

Fork-tailed Swift (*Apus pacificus*) – Migratory (EPBC/BC Act)

The Fork-tailed Swift is a wide ranging but sparsely distributed species that occurs in a wide range of dry and/or open habitats (Johnstone & Storr, 1998). The species does not breed in Australia, migrating from breeding grounds in the northern Hemisphere. During its occurrence in Australia, the species is almost exclusively aerial, feeding and possibly also roosting aerially (DoE, 2018). The Fork-tailed Swift was not recorded during the current survey, and the nearest recent record (2013) is located approximately 85 km north-west of the Study Area (DBCA, 2019a); however, the species is considered to possibly occur. The species may occur as an infrequent visitor and may forage in the airspace above all habitats occurring within the Study Area, with landing or nesting unlikely.

Spotted Ctenotus (*Ctenotus uber* subsp. *johnstonei*) – Priority 2 (DBCA)

Habitat preferences of the Spotted Ctenotus are poorly known; however, previous records of the subspecies in the Pilbara region are associated with stony hillslope and plain habitats with variable vegetation cover, often dominated by open *Acacia* shrubland and *Triodia* hummock grassland (Cogger, 2014). No evidence of the Spotted Ctenotus was recorded during the current survey; however, the species is considered to possibly occur as a resident in Stony Plain and lower slopes of Hillcrest/ Hillslope habitats. The species has previously been recorded approximately 30 km east of the Study Area (DBCA, 2019c). It should be noted that there is currently some taxonomic uncertainty regarding the isolated Pilbara population of this subspecies, and the population may represent an undescribed taxon (P. Doughty, Western Australian Museum, *pers. comm*.).

Pilbara Flat-headed Blind-snake (*Anilios ganei*) – Priority 1 (DBCA)

Little is known about the Pilbara Flat-headed Blind-snake; however, it can be assumed that its ecology and behaviour are similar to other blind snake species (Cogger, 2014). Due to its fossorial nature, the species is rarely encountered, and little is known of the species habitat preferences. Records of the species are often associated with moist gorges and gullies (Wilson & Swan, 2014). The Pilbara Flat-headed Blind-snake was not recorded during the current survey; however, based on the occurrence of habitats that are similar to those in which the species has previously been recorded, and the occurrence of a previous record of the species approximately 1.3 km north of the Study Area (Biologic, 2011), it is considered to possibly occur. The species may occur as a resident within Hillcrest/ Hillslope and Stony Plain habitats, particularly in areas where leaf litter accumulates, and moisture is retained in leaf litter and substrates.

5.5 Field Survey Adequacy

5.5.1 Sampling Adequacy

The results below represent this survey accumulation curves for each taxa, due to differences in survey methods and statistical analysis between previous surveys, statistical comparisons between previous surveys were not possible. The results below are based on systematic sampling results (i.e. pit trapping and avifauna census results) only and do not include opportunistic sightings or other non-standardised sampling methods. Therefore, captures are not consistent and not enough data available to statistically compare in accumulation curves. Contextual comparisons between previous surveys have been made in Section 3.2.

While results of species accumulation curves can often show a reduced capture of species richness, this is generally attributed to the exclusion of species recorded from opportunistic or other sampling methods. Furthermore, many species may not have been recorded during the Phase 1 and Phase 2 surveys due to a number of factors which are likely to influence a species occurrence, abundance and/or activity levels, including temporal changes in habitats (i.e. degradation from fire and/or introduced species over time) and species (i.e. population fluctuations), climatic influences such as rainfall and/or temperature (i.e. climate change) and species detectability (i.e. some species naturally occur in low abundance or have fluctuating populations influenced by other factors such as rainfall). For example, some taxa such as amphibians are recorded in low abundance due to captures being dependent on climatic events such as rainfall.

Mammals

The species accumulation curve for mammals produced a steadily increasing line, indicating that an asymptote had not been reached (Figure 5.3). Richness estimators indicated that between 54% (Chao 1) and 73% (Michaelis Menten) of species had been recorded. A total of seven species were recorded and it was indicated that between nine to 13 species would be expected based on the results obtained. While mammal numbers were low, these results are likely to reflect the fact that species richness for mammals is typically lower than that for birds and herpetofauna, thus the capture of a single new species on any given day makes a proportionately large change to the overall dataset. Due to richness estimates only incorporating results recorded from standardised sampling methods for mammals (i.e. systematic trapping methods), a large portion of species (18 of 25 species; 72%) recorded from other non-systematic methods (i.e. opportunistic records) within habitats trapped are not included, including, but not limited to, Western Pebble-mound Mouse, Cow (*Bos taurus*), Euro (*Osphranter robustus* subsp. *erubescens*) and numerous bat species (Appendix E). Contextual mammal comparisons of total species recorded between previous surveys have been made in desktop assessment section 3.2 and also discussed in section 5.3.

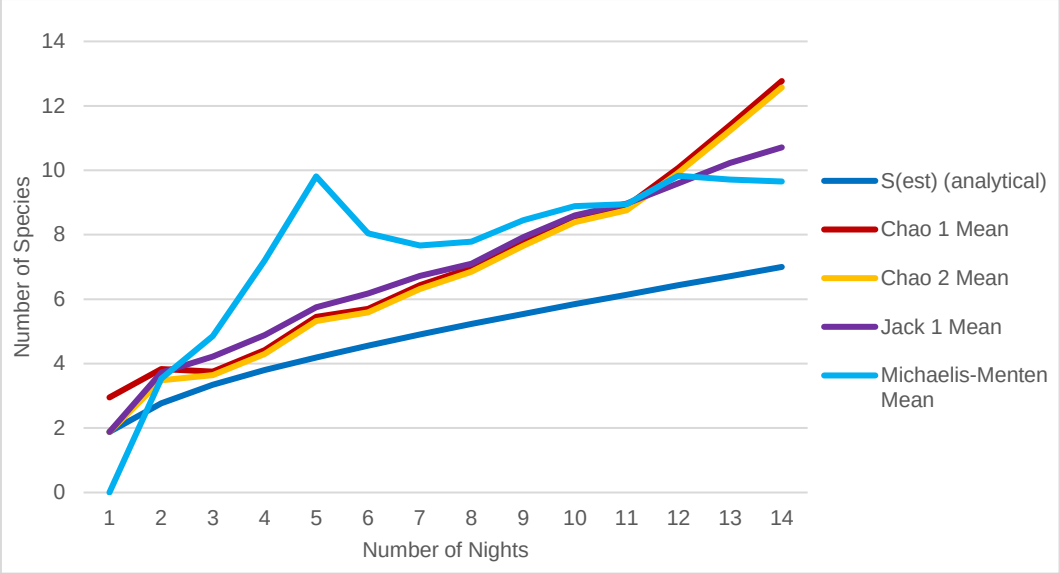

Figure 5.3: Species accumulation curve for mammals trapped at systematic sampling sites

Avifauna

Analysis of the avifauna data set from the dual phase survey produced a steadily increasing line over the 14-day sampling period, indicating that an asymptote had not been reached; however, was starting to gradually flatten towards a point plateau (Figure 5.4). Richness estimators indicated that the Survey was 79% (Chao 1), 80% (Chao 2), 77% (Jacknife 1) and 91% (Michaelis-Menten) adequate. A total of 58 species were recorded and it was indicated that 63 to 75 species would be expected based on the results obtained. These results indicate that additional survey effort may increase the species richness, although the avifauna censuses were effective in identifying and recording most of the bird assemblage present at these sites. As richness estimates do not include species recorded from methods other than avifauna census' at systematic trapping sites (i.e. opportunistic records), estimates do not include all species recorded during the survey. These include, but are not limited to, records of Brown Goshawk (*Accipiter fasciatus*), Marked Woodswallow (*Artamus personatus*) and Common Bronzewing (*Phaps chalcoptera*) (Appendix E). Contextual avifauna comparisons between previous surveys have been made in desktop assessment section 3.2 and also discussed in section 5.3.

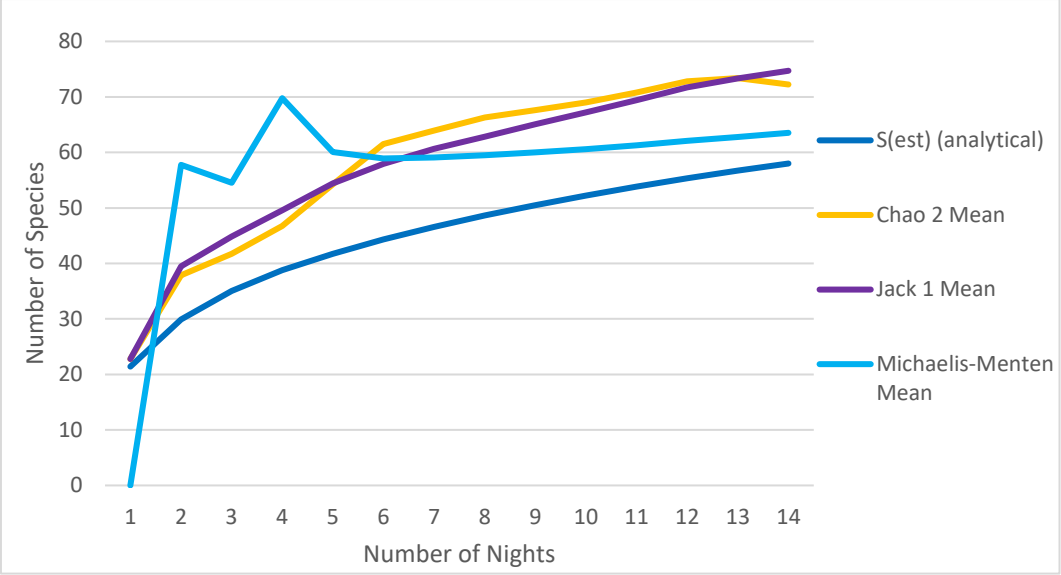

Figure 5.4: Species accumulation curve for birds recorded during avifauna census at systematic sampling sites

Herpetofauna

Analysis of the herpetofauna data set from the dual phase survey produced a steadily increasing line over the 14-day sampling period, indicating that an asymptote had not been reached; however, was close to reaching a point of plateau (Figure 5.5). Richness estimators indicated that between 66% (Chao 1) and 76% (Michaelis Menten) of species had been recorded. A total of 40 species were recorded and it was indicated that 53 to 59 species would be expected based on the results obtained. These results indicate that while additional survey effort may increase the species richness, the systematic trapping effort applied was effective in identifying and recording the majority of the herpetofauna assemblage present. Due to richness estimates only incorporating results recorded from standardised sampling methods for herpetofauna (i.e. systematic trapping methods), estimates do not include all species recorded during the survey, including, but not limited to, Yellow Spotted Monitor (*Varanus panoptes*), Slender Blue-tongue (*Cyclodomorphus melanops* subsp. *melanops*) and Western Brown Snake (*Pseudonaja mengdeni*) (Appendix E). Contextual herpetofauna comparisons between previous surveys have been made in desktop assessment section 3.2 and also discussed in section 5.3.

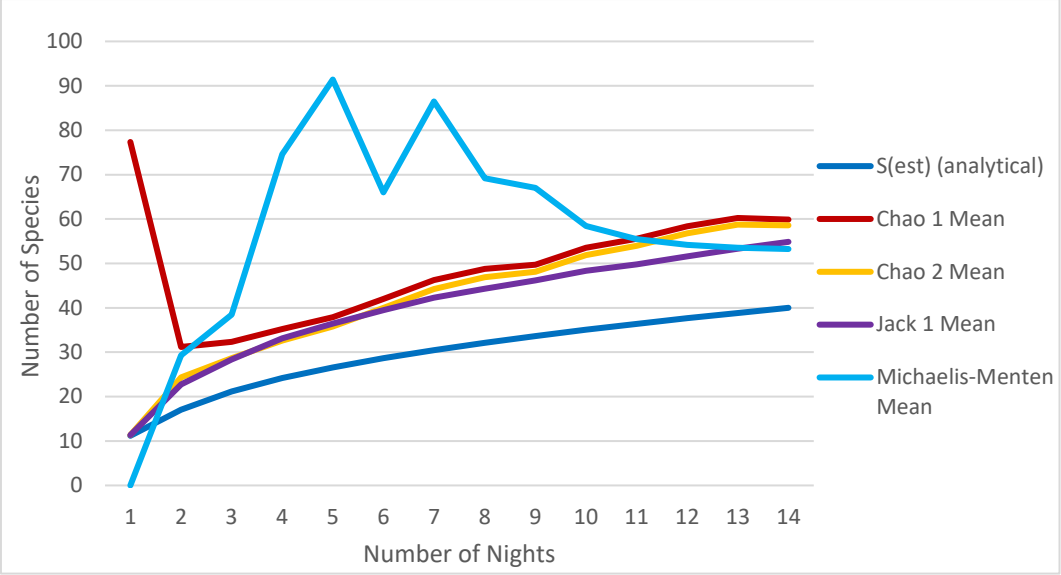

Figure 5.5: Species accumulation curve for herpetofauna trapped at systematic sampling sites

5.5.2 Potential Limitation and Constraints

The EPA (2016d) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 5.5 below.

Table 5.5: Survey limitations and constraints

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Experience of personnel	No	The field personnel involved in the survey are experienced in undertaking fauna surveys of similar nature, including with conservation significant fauna targeted during the survey.
Scope (faunal groups sampled and whether any constraints affect this)	No	The scope was a Level 2 survey and was conducted within that framework. All trapping methods were able to be undertaken as expected to sample all target fauna groups.
Proportion of fauna identified	No	The majority of fauna recorded in the Study Area were identified at the point of capture or observation. Bat calls were identified after they were recorded by Mr Robert Bullen, of Bat Call WA. Acoustic recordings were similarly analysed following the survey by Nigel Jackett, of Birdlife Australia. No fauna recorded during the survey were incompletely identified to relevant taxonomic levels.
Sources of information (recent or historic) and availability of contextual information	No	All contextual resources required to complete the assessment were available (previous surveys, database searches, environmental information, climate data). This included information from 13 biological surveys previously conducted in the vicinity of the Study Area, comprising a reasonable amount of previous survey effort. Also available were regional biodiversity surveys describing known assemblages of vertebrate fauna occurring in the Pilbara (McKenzie *et al.*, 2009).

Potential limitation or constraint	Limitation to current survey	Applicability to this survey
Proportion of the task achieved	No	A two-phase Level 2 (wet season and dry season pit trapping) survey of the Study Area was completed and related to the results of surveys in the broader area identified in the desktop assessment.
Timing / weather / season / cycle	No	Climactic conditions in during and preceding the Phase 1 and Phase 2 surveys were similar to or slightly above long-term averages. Above averages temperatures may have resulted in reduced activity and captures of some vertebrate groups during the surveys. Lower than average rainfall was recorded in the 2019 dry season (preceding the Phase 1 survey), potentially reducing the abundance and activity levels of some vertebrate groups during Phase 1 sampling; however, rainfall prior during the 2019–2020 wet season (preceding the Phase 2 survey) was above average.
Disturbances (e.g. fire or flood)	No	No disturbance occurred during or immediately prior to the surveys. Recent (1–3 years) fire has occurred in parts of the Study Area which may have influenced species diversity and abundance recorded where vegetation cover was heavily reduced.
Intensity of survey	No	A two-phase Level 2 (wet season and dry season pit trapping) survey was identified by BHP WAIO as the requirement for this survey. The trapping intensity, targeted searches, acoustic recordings and avifauna censuses were assessed as sufficient to meet this level of survey for the size of the Study Area.
Completeness of survey	No	The survey achieved enough coverage of the Study Area and associated habitats through the survey techniques employed and the habitat assessments undertaken for the two phases of the survey.
Resources (e.g. degree of expertise available)	No	All relevant resources and expertise required to complete the survey were available.
Remoteness or access issues	No	The Study Area was largely accessible either by vehicle or on foot, thus the sampling techniques used during this survey were unconstrained by accessibility or remoteness.
Availability of contextual information on the region	No	Fauna assemblages of the Pilbara region are fairly well documented, particularly for vertebrate fauna groups. All contextual resources required to complete the survey were available (previous surveys, database searches, environmental information, climate data etc.)

6 CONCLUSION

Five broad fauna habitat types were recorded and mapped within the Study Area, comprising, in decreasing order of extent, Stony Plain (1,915.23 ha, 51.8% of Study Area), Drainage Area/ Floodplain (841.14 ha, 22.7%), Hardpan Plain (578.31 ha, 15.6%), Mulga Woodland (286.87 ha, 7.8%) and Hillcrest/ Hillslope (77.01 ha, 2.1%). Four fauna habitat types occurring within the Study Area are considered to be of moderate significance (Stony Plain, Drainage Area/ Floodplain, Mulga Woodland and Hillcrest/ Hillslope) and one to be of low significance (Hardpan Plain). No habitats occurring within the Study Area were deemed to be of high significance. The absence of highly significant habitats is due to the lack of critical habitat for any vertebrate species of high conservation significance, or where habitat occurs, it is often widespread and limited to supporting habitat such as foraging/dispersal (i.e. foraging/dispersal) only. 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.

Of the four habitats deemed to be of moderate significance, Drainage Area/ Floodplain and Mulga Woodland habitats provide suitable habitat for Brush-tailed Mulgara, Pilbara Leaf-nosed Bat (Priority 5 foraging habitat only, as defined by (TSSC, 2016b)) and Peregrine Falcon and primary foraging/dispersal habitat for the Ghost Bat. Stony Plain habitat may also provide suitable foraging/dispersal habitat for Ghost Bat; however, this is likely to vary with the presence of trees, which provide perching sites during foraging, occurring at higher density and the proximity to suitable roost habitat. For Ghost Bat and Pilbara Leaf-nosed Bat, utilisation of these habitats is likely to be associated with areas located in the north of the Study Area, which are located closer to suitable roosting habitat located within the Western Ridge Area (Figure 5.1). Hillcrest/ Hillslope habitat may provide suitable habitat for Long-tailed Dunnart, potential Priority 3 foraging habitat for Pilbara Leaf-nosed Bat and possible foraging/dispersal habitat for Northern Quoll. Pilbara Leaf-nosed Bat and Northern Quoll occurrence would be dependent on the presence of suitable roosting or denning/shelter habitat adjacent to or in close proximity to areas where this habitat occurs. For Pilbara Leaf-nosed Bat, utilisation of Hillcrest/ Hillslope habitat is likely to be limited to instances where outcropping occurs. The remaining habitat (Hardpan Plain) were deemed to be of low significance as they either do not support species of high conservation value and/ or such species are not dependent on these habitats at the broad-scale. Instances of these habitats may be suitable for the Western Pebble-mound Mouse and Spotted Ctenotus, and possibly Brush-tailed Mulgara and Long-tailed Dunnart.

No important habitat features (caves or water features) were recorded within the Study Area during the current survey. These are however present in parts of the Western Ridge Area located directly north of the Study Area and may act as source areas for some conservation significant species which may occur within the Study Area to forage and/or during dispersal movements.

A total of 153 vertebrate fauna species, comprising 25 mammal species (20 native and five introduced), 75 bird species, 51 reptile species and two amphibian species were recorded from the Study Area during the current survey. Of these, four species, all reptiles, were not recorded in the desktop assessment. Of

the four species not recorded in the desktop assessment, one represents a newly described species (Hamersley Rock Gehyra) and the remaining three represent relatively widespread and common Pilbara species for which the Study Area represents the southern extent of its distribution (*Anilios ammodytes*) or a small gap in the species known distribution (*Delma tincta* and *Ctenotus hanloni*). Species recorded during the current survey were typical of assemblages occurring within the broad fauna habitats occurring within the Study Area and more broadly across the Pilbara region.

Of the 38 species of conservation significance identified in the desktop assessment, two were recorded within the Study Area during the current survey:

- Pilbara Leaf-nosed Bat (VU – EPBC/BC Act) – recorded once from ultrasonic call recording in Mulga Woodland habitat on the northern edge of the Study Area;
- Western Pebble-mound Mouse (Priority 4 – DBCA) – recorded eight times from secondary evidence (pebble mounds), including three active and five inactive mounds.

The occurence of Pilbara Leaf-nosed Bat within the Study Area during the current survey was limited to a single foraging individual, with the timing of call (21:03) indicating a foraging individual. Due to the late time of the call, the origin of the individual, and therefore potential roost location, cannot be determined; however, it is possible it originated from roosting habitat well north of the Study Area which would result in less frequent occurrence of the species within the Study Area. The sparse number of records of the species during the current survey and more broadly in the vicinity of the Study Area suggests the species does not roost nearby and its occurrence in the broader area is relatively uncommon.

Records of Western Pebble-mound Mouse during the current survey indicate the species occurs within the Study Area as a resident; however, the species and suitable habitats are relatively common and widespread more broadly across the Pilbara region.

Given the habitats present within the Study Area and locations of nearby records identified during the desktop assessment, a further two species of conservation significance are considered highly likely to occur within the Study Area; Ghost Bat (VU – EPBC/BC Act) and Peregrine Falcon (Specially Protected – BC Act).

Two habitats within the Study Area provide suitable foraging habitat for Ghost Bat, Mulga Woodland and Drainage Area/ Floodplain. Based on the occurrence of multiple records in close proximity to the Study Area (i.e. within 5 km) it is highly likely the species will occur within the Study Area. As no suitable roosting habitat occurs within the Study Area, the species occurrence is likely to be confined to foraging events, with foraging individuals likely to originate from areas adjacent to and within the broader vicinity of the Study Area, particularly within the Western Ridge Area where known and likely roost caves occur (Biologic, 2020b).

It should be noted that known and potential roost caves within the Western Ridge Area represent the south-eastern extend of known roosts for the species in the broader region, which indicates the species occurrence in this area may represent an important population, as defined by DoE (2013). With consideration of this, the location of potential foraging habitat (Mulga Woodland and Drainage Area/

Floodplain) occurring within the Study Area is likely to provide important foraging habitat for this population, due to their close proximity to known and potential caves.

Peregrine Falcon was considered highly likely to occur within the Study Area based on the proximity of the records to the north and occurrence of potential foraging habitat within the Study Area, the species are considered highly likely to occur. Due to the absence of nesting habitat and broad foraging range of the species, it's occurrence within the Study Are is likely to vary, particularly if nesting is occurring close to the Study Area. The species is likely to forage broadly across most habitats occurring within the Study Area; however, the Study Area is not considered to be of particular importance to the specie due to the relatively widespread occurrence of these habitats in the surrounding area.

The occurrence of a further six species identified in the desktop assessment within the Study Area was considered Possible. The remaining 27 species were considered Unlikely or Highly Unlikely to occur within the Study Area, particularly due to the absence of suitable habitat occurring within the Study Area.

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8 APPENDICES

Appendix A – Conservation listings

International Union for Conservation of Nature

Category	Definition
Extinct (Ex)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (Ex)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (Cr)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (En)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (Vu)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases, great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Threatened	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild, only surviving in cultivation, captivity or as a naturalised population well outside its past range.
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future (i.e. 50% chance of extinction in the immediate future).
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future i.e. 20% chance of extinction in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future i.e. 10% chance of extinction in the medium-term future.
Conservation Dependent (CD)	Taxa which will become Vulnerable, Endangered or Critically Endangered if specific conservation efforts cease.
Other	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Biodiversity Conservation Act 2016

Category	Definition
Extinct	
Extinct (EX)	Presumed extinct i.e. there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild (EW)	Presumed extinct in the wild i.e. species which have been adequately searched for and there is no reasonable doubt that the last wild individual has died.
Threatened	
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild.
Specially Protected	
Migratory (MI)	Birds listed under international agreements relating to the protection of migratory birds i.e. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), China-Australia Migratory Bird Agreement (CAMBA), Japan-Australia Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).
Conservation Dependent (CD)	Species dependent on ongoing conservation intervention to prevent them becoming eligible for listing as threatened.
Other specially protected fauna (OS)	Species otherwise in need of special protection to ensure their conservation.

Department of Biodiversity, Conservation and Attractions Priority codes

Category	Definition
Poorly known	
Priority 1 (P1)	Species that are known from one or a few locations which are potentially at risk. Species whose occurrences are either small, on lands not managed for conservation or otherwise threatened with habitat destruction or degradation. Species that are well known from one or more locations but are under immediate threat from threatening processes. In urgent need of further survey.
Priority 2 (P2)	Species that are known from one or a few locations, some of which are on lands managed for conservation. Species that are well known from one or more locations but are under threat from threatening processes. In urgent need of further survey. In need of further survey.
Priority 3 (P3)	Species that are well known from several locations and are not are under imminent threat. Species known from few but widespread locations with either a large population size or with large areas of suitable habitat remaining, much of which is not under imminent threat. Species that are well known from one or more locations and threatening processes exist that could affect them.
Rare, Near Threatened and other species in need of monitoring	
Priority 4 (P4)	*Rare* – Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection but could be if present circumstances change. *Near Threatened* – Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable but are not listed as Conservation Dependent. *In need of monitoring* - Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy

Appendix B – Locations of vertebrate fauna sampling sites

Site	Methods	Habitat	Latitude	Longitude
VCOW-01	Habitat assessment and ultrasonic recorder	Drainage Area/ Floodplain	-23.4326	119.6793
VCOW-02	Habitat assessment, systematic, ultrasonic recorder and nocturnal searches	Hillcrest/ Hillslope	-23.4315	119.6036
VCOW-03	Habitat assessment and acoustic recorder	Drainage Area/ Floodplain	-23.4301	119.6971
VCOW-04	Habitat assessment and ultrasonic recorder	Hardpan Plain	-23.4359	119.6688
VCOW-05	Habitat assessment, systematic, acoustic recorder, motion camera (individual), ultrasonic recorder and nocturnal searches	Stony Plain	-23.4164	119.7065
VCOW-06	Habitat assessment, systematic, acoustic recorder, ultrasonic recorder, motion camera (individual), nocturnal searches and targeted searches	Drainage Area/ Floodplain	-23.4223	119.6782
VCOW-07	Habitat assessment and acoustic recorder and ultrasonic recorder	Stony Plain	-23.4226	119.5864
VCOW-08	Habitat assessment, systematic, ultrasonic recorder and nocturnal searches	Mulga Woodland	-23.4103	119.6891
VCOW-09	Habitat assessment, systematic, acoustic recorder, ultrasonic recorder and nocturnal searches	Stony Plain	-23.4135	119.6662
VCOW-10	Habitat assessment, systematic, ultrasonic recorder and nocturnal searches	Hardpan Plain	-23.4390	119.6599
VCOW-11	Habitat assessment	Drainage Area/ Floodplain	-23.4296	119.6991
VCOW-12	Habitat assessment	Stony Plain	-23.4239	119.5745
VCOW-13	Habitat assessment	Drainage Area/ Floodplain	-23.4315	119.6902
VCOW-14	Habitat assessment and ultrasonic recorder	Mulga Woodland	-23.4057	119.6712
VCOW-15	Habitat assessment	Mulga Woodland	-23.4309	119.6853
VCOW-16	Habitat assessment	Stony Plain	-23.4182	119.6552
VCOW-17	Habitat assessment	Drainage Area/ Floodplain	-23.4313	119.6799
VCOW-18	Habitat assessment	Stony Plain	-23.4238	119.6725
VCOW-19	Habitat assessment	Hardpan Plain	-23.4465	119.6510
VCOW-20	Habitat assessment	Drainage Area/ Floodplain	-23.4109	119.7120
VCOW-21	Habitat assessment and ultrasonic recorder	Mulga Woodland	-23.4178	119.5940
VCOW-22	Habitat assessment	Mulga Woodland	-23.4047	119.7140
VCOW-23	Habitat assessment	Drainage Area/ Floodplain	-23.4352	119.6738
VCOW-24	Habitat assessment	Stony Plain	-23.4151	119.6721
VCOW-25	Habitat assessment and ultrasonic recorder	Mulga Woodland	-23.4171	119.6123
VCOW-26	Habitat assessment	Stony Plain	-23.4083	119.6638

Site	Methods	Habitat	Latitude	Longitude
VCOW-27	Habitat assessment	Stony Plain	-23.4178	119.6799
VCOW-28	Habitat assessment	Mulga Woodland	-23.4189	119.6652
VCOW-29	Habitat assessment	Hardpan Plain	-23.4385	119.6784
VCOW-30	Habitat assessment, acoustic recorder and targeted searches	Stony Plain	-23.4212	119.6708
VCOW-31	Habitat assessment	Stony Plain	-23.4226	119.6397
VCOW-32	Habitat assessment	Hardpan Plain	-23.4441	119.6801
VCOW-33	Habitat assessment and ultrasonic recorder	Stony Plain	-23.4175	119.6610
VCOW-34	Habitat assessment	Stony Plain	-23.4185	119.6348
VCOW-35	Habitat assessment	Stony Plain	-23.4238	119.6289
VCOW-36	Habitat assessment	Stony Plain	-23.4265	119.5996
VCOW-37	Habitat assessment	Hillcrest/ Hillslope	-23.4057	119.6626
VCOW-38	Habitat assessment and acoustic recorder	Drainage Area/ Floodplain	-23.4288	119.6743
VCOW-39	Habitat assessment	Stony Plain	-23.4212	119.6193
VCOW-40	Habitat assessment, acoustic recorder and targeted searches	Drainage Area/ Floodplain	-23.4201	119.6436
VCOW-41	Habitat assessment	Drainage Area/ Floodplain	-23.4066	119.7091
VCOW-42	Habitat assessment	Stony Plain	-23.4068	119.7062
VCOW-43	Habitat assessment	Stony Plain	-23.4093	119.7028
VCOW-44	Habitat assessment and motion cameras (two)	Hardpan Plain	-23.4368	119.6690
VCOW-45	Ultrasonic recorder	Stony Plain	-23.4264	119.5704
VCOW-46	Habitat assessment	Stony Plain	-23.4300	119.5753
VCOW-47	Habitat assessment	Stony Plain	-23.4245	119.5694
VCOW-48	Habitat assessment and acoustic recorder	Stony Plain	-23.4244	119.6188
VCOW-49	Habitat assessment and acoustic recorder	Drainage Area/ Floodplain	-23.4061	119.7130
VCOW-50	Habitat assessment	Stony Plain	-23.4324	119.5961
VCOW-51	Habitat assessment	Drainage Area/ Floodplain	-23.4125	119.7081
VCOW-52	Habitat assessment and targeted searches	Stony Plain	-23.4140	119.7028
VCOW-53	Habitat assessment	Mulga Woodland	-23.4242	119.6937
VCOW-54	Habitat assessment	Hardpan Plain	-23.4356	119.6542

Site	Methods	Habitat	Latitude	Longitude
VCOW-55	Habitat assessment	Stony Plain	-23.4271	119.6533
VCOW-56	Habitat assessment	Stony Plain	-23.4268	119.6618
VCOW-57	Habitat assessment	Drainage Area/ Floodplain	-23.4287	119.6670
VCOW-58	Habitat assessment	Hardpan Plain	-23.4324	119.6637
VCOW-59	Habitat assessment	Drainage Area/ Floodplain	-23.4269	119.6803
VCOW-60	Habitat assessment	Drainage Area/ Floodplain	-23.4064	119.6952
VCOW-61	Habitat assessment	Drainage Area/ Floodplain	-23.4154	119.7141
VCOW-62	Habitat assessment	Stony Plain	-23.4224	119.6811
VCOW-63	Habitat assessment	Drainage Area/ Floodplain	-23.4237	119.6851
VCOW-64	Habitat assessment	Hillcrest/ Hillslope	-23.4288	119.6101
VCOW-65	Habitat assessment	Hillcrest/ Hillslope	-23.4258	119.6054
VCOW-66	Habitat assessment	Stony Plain	-23.4300	119.6174
VCOW-67	Habitat assessment	Stony Plain	-23.4274	119.5821
VCOW-68	Habitat assessment	Stony Plain	-23.4294	119.5871
VCOW-69	Habitat assessment	Stony Plain	-23.4263	119.5912
VCOW-70	Habitat assessment and ultrasonic recorder	Mulga Woodland	-23.4175	119.6079
VCOW-71	Habitat assessment and acoustic recorder	Stony Plain	-23.4143	119.6787
VCOW-72	Habitat assessment and acoustic recorder	Stony Plain	-23.4166	119.6877
VCOW-73	Habitat assessment	Hardpan Plain	-23.4479	119.6605
VCOW-74	Habitat assessment	Hardpan Plain	-23.4453	119.6627
VCOW-75	Habitat assessment	Hardpan Plain	-23.4473	119.6702
VCOW-76	Habitat assessment	Hardpan Plain	-23.4432	119.6721
VCOW-77	Habitat assessment	Drainage Area/ Floodplain	-23.4351	119.6773
VCOW-78	Habitat assessment	Stony Plain	-23.4078	119.6744
VCOW-79	Habitat assessment	Stony Plain	-23.4278	119.6452
VCOW-80	Habitat assessment	Drainage Area/ Floodplain	-23.4287	119.6320
VCOW-81	Habitat assessment	Stony Plain	-23.4309	119.6333
VCOW-82	Habitat assessment	Stony Plain	-23.4268	119.6250

Site	Methods	Habitat	Latitude	Longitude
VCOW-83	Habitat assessment	Stony Plain	-23.4181	119.6930
VCOW-84	Habitat assessment	Drainage Area/ Floodplain	-23.4148	119.6910

Appendix C – Vertebrate fauna identified in the desktop assessment

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
MAMMALS																								
BOVIDAE																								
**Bos taurus*	Cow					•				•		•				•								•
CAMELIDAE																								
**Camelus dromedarius*	Camel					•			•															•
CANIDAE																								
**Canis familiaris*	Dog								•	•	•	•		•			•	•		•	•			•
**Vulpes vulpes*	Fox								•															
DASYURIDAE																								
Dasycercus blythi	Brush-tailed Mulgara			P4		•		•		•			•											
Dasykaluta rosamondae	Little Red Kaluta					•				•														•
Dasyurus hallucatus	Northern Quoll	EN	EN		EN				•	•														
Ningaui timealeyi	Pilbara Ningaui					•																		•
Planigale sp.	Undescribed Pilbara planigale									•		•												
Pseudantechinus woolleyae	Woolley's Pseudantechinus					•						•												
Sminthopsis crassicaudata	Fat-tailed Dunnart					•																		
Sminthopsis longicaudata	Long-tailed Dunnart			P4		•		•		•														
Sminthopsis macroura	Stripe-faced Dunnart					•				•		•		•										•
Sminthopsis ooldea	Ooldea Dunnart					•																		•
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					•																		
EMBALLONURIDAE																								
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat					•				•		•	•	•					•					•
Taphozous georgianus	Common Sheathtail-bat					•				•		•	•	•			•		•					•
Taphozous hilli	Hill's Sheathtail-bat					•				•		•												•
EQUIDAE																								

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
**Equus asinus*	Donkey								•	•		•												•
**Equus caballus*	Horse					•			•	•		•												
FELIDAE																								
**Felis catus*	Cat					•			•	•		•		•		•					•			•
HIPPOSIDERIDAE																								
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU			•		•	•	•			•											•
LEPORIDAE																								
**Oryctolagus cuniculus*	Rabbit					•			•	•		•				•	•				•			
MACROPODIDAE																								
Osphranter robustus subsp. *erubescens*	Euro					•				•		•	•	•		•	•	•			•			•
Osphranter rufus	Red Kangaroo					•				•	•	•	•			•	•	•	•	•	•			•
Petrogale lateralis subsp. *lateralis*	Black-flanked Rock-wallaby	EN	EN		NT	•		•																
Petrogale rothschildi	Rothschild's Rock-wallaby					•				•		•	•			•		•			•			
Petrogale sp.	Rock-wallaby					•																		
MEGADERMATIDAE																								
Macroderma gigas	Ghost Bat	VU	VU		VU	•		•	•	•		•	•				•							
MOLOSSIDAE																								
Austronomus australis	White-striped Freetail-bat									•				•			•		•					
Chaerephon jobensis subsp. *colonicus*	Northern Freetail-bat					•				•			•	•			•		•					•
Ozimops lumsdenae	Northern Free-tailed Bat									•		•	•	•					•					•
MURIDAE																								
**Mus musculus*	House Mouse					•			•	•														
Notomys alexis	Spinifex Hopping-mouse					•				•			•											
Pseudomys chapmani	Western Pebble-mound Mouse			P4		•		•		•		•	•					•	•	•				•
Pseudomys desertor	Desert Mouse					•				•														•

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
Pseudomys hermannsburgensis	Sandy Inland Mouse					●				●		●												●
Zyzomys argurus	Common Rock-rat					●				●		●	●											●
TACHYGLOSSIDAE																								
Tachyglossus aculeatus	Echidna					●				●		●	●											
THYLACOMYIDAE																								
Macrotis lagotis	Greater Bilby	VU	VU		VU	●		●	●															
VESPERTILIONIDAE																								
Chalinolobus gouldii	Gould's Wattled Bat					●				●		●	●	●			●		●					●
Nyctophilus geoffroyi	Lesser Long-eared Bat					●				●		●	●	●										●
Scotorepens balstoni	Inland Broad-nosed Bat					●																		
Scotorepens greyii	Little Broad-nosed Bat					●				●		●	●	●					●		●			●
Vespadelus finlaysoni	Finlayson's Cave Bat					●				●		●	●	●			●		●					●
AVES																								
ACANTHIZIDAE																								
Acanthiza apicalis	Inland Thornbill					●	●			●		●				●	●							●
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					●	●											●						
Acanthiza robustirostris	Slaty-backed Thornbill					●	●										●							●
Acanthiza uropygialis	Chestnut-rumped Thornbill					●	●			●		●					●		●		●	●		●
Aphelocephala leucopsis	Southern Whiteface					●	●																	
Gerygone fusca	Western Gerygone					●	●			●		●					●		●		●			●
Pyrrholaemus brunneus	Redthroat					●	●					●												●
Smicrornis brevirostris	Weebill					●	●			●		●	●	●		●	●	●	●	●	●	●		●
ACCIPITRIDAE																								
Accipiter cirrocephalus	Collared Sparrowhawk					●	●			●														
Accipiter fasciatus	Brown Goshawk					●	●			●		●	●			●					●			●

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
Aquila audax	Wedge-tailed Eagle					•	•			•		•	•			•	•					•		•
Circus approximans	Swamp Harrier					•	•																	
Circus assimilis	Spotted Harrier					•	•			•												•		•
Elanus caeruleus subsp. *axillaris*	Black-shouldered Kite					•	•			•														•
Haliaeetus leucogaster	White-bellied Sea-eagle					•	•			•														
Haliastur sphenurus	Whistling Kite					•	•			•		•	•						•	•	•	•		•
Hamirostra isura	Square-tailed Kite					•	•			•														
Hamirostra melanosternon	Black-breasted Buzzard					•	•			•											•	•		•
Hieraaetus morphnoides	Little Eagle					•	•			•									•					
Milvus migrans	Black Kite					•	•			•														
ACROCEPHALIDAE																								
Acrocephalus australis	Australian Reed-Warbler					•	•			•		•									•			
AEGOTHELIDAE																								
Aegotheles cristatus	Australian Owlet-nightjar					•	•			•			•			•						•		•
ALAUDIDAE																								
Mirafra javanica	Horsfield's Bushlark					•	•			•														
ALCEDINIDAE																								
Dacelo leachii subsp. *leachii*	Blue-winged Kookaburra					•	•			•			•						•					
Todiramphus pyrrhopygius	Red-backed Kingfisher					•	•			•							•		•	•	•			•
Todiramphus sanctus	Sacred Kingfisher					•	•			•														•
ANATIDAE																								
Anas gracilis	Grey Teal					•	•			•		•									•			
Anas rhynchotis	Australasian Shoveler					•	•																	
Anas superciliosa	Pacific Black Duck					•	•			•		•									•			
Aythya australis	Hardhead					•	•			•		•									•			

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
Biziura lobata	Musk Duck					•	•																	
Chenonetta jubata	Australian Wood Duck					•	•			•														
Cygnus atratus	Black Swan					•	•			•		•												
Dendrocygna arcuata	Wandering Whistling Duck					•	•			•														
Dendrocygna eytoni	Plumed Whistling-duck					•	•			•														
Malacorhynchus membranaceus	Pink-eared Duck					•	•			•											•			
Stictonetta naevosa	Freckled Duck					•	•			•														
Tadorna tadornoides	Australian Shell Duck					•	•			•		•												
ANHINGIDAE																								
Anhinga novaehollandiae	Australasian Darter					•	•			•														
ANSERANATIDAE																								
Anseranas semipalmata	Magpie Goose					•	•																	
APODIDAE																								
Apus pacificus	Fork-tailed Swift	MI	MI				•		•															
ARDEIDAE																								
Ardea garzetta	Little Egret					•	•			•														
Ardea ibis	Cattle Egret					•	•		•															
Ardea intermedia	Intermediate Egret					•	•			•														
Ardea modesta	Eastern Great Egret					•	•		•	•		•												
Ardea novaehollandiae	White-faced Heron					•	•			•		•												
Ardea pacifica	White-necked Heron					•	•			•														
Nycticorax caledonicus subsp. *australasiae*	Nankeen Night-Heron					•	•			•														•
ARTAMIDAE																								
Artamus cinereus	Black-faced Woodswallow					•	•			•		•	•			•	•		•		•	•		•
Artamus cyanopterus	Dusky Woodswallow					•	•																	

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
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Artamus minor	Little Woodswallow					●	●			●		●	●	●			●			●				
Artamus personatus	Masked Woodswallow					●	●			●								●		●				●
Artamus superciliosus	White-browed Woodswallow					●	●			●														
Cracticus nigrogularis	Pied Butcherbird					●	●			●		●	●	●			●	●	●		●	●		●
Cracticus tibicen	Australian Magpie					●	●			●		●	●			●	●		●					●
Cracticus torquatus	Grey Butcherbird					●	●			●		●		●		●			●					●
BURHINIDAE																								
Burhinus grallarius	Bush Stone-curlew					●	●																	●
CACATUIDAE																								
Cacatua roseicapilla	Galah					●	●			●		●	●	●			●	●	●		●			●
Cacatua sanguinea	Little Corella					●	●			●			●						●			●		●
Nymphicus hollandicus	Cockatiel					●	●			●				●					●		●	●		●
CAMPEPHAGIDAE																								
Coracina maxima	Ground Cuckoo-shrike					●				●		●	●									●		
Coracina novaehollandiae subsp. *subpallida*	Black-faced Cuckoo-shrike					●				●		●	●				●	●		●	●	●		●
Lalage tricolor	White-winged Triller					●	●			●		●					●				●			●
CAPRIMULGIDAE																								
Eurostopodus argus	Spotted Nightjar					●	●			●		●					●	●						●
CASUARIIDAE																								
Dromaius novaehollandiae	Emu					●	●			●														●
CHARADRIIDAE																								
Charadrius leschenaultii	Greater Sand Plover	VU/ MI	VU/ MI				●																	
Charadrius dubius	Little Ringed Plover	MI	MI							●														
Elseyornis melanops	Black-fronted Dotterel					●	●			●		●												

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Charadrius ruficapillus	Red-capped Plover					●	●					●												
Charadrius veredus	Oriental Plover	MI	MI					●	●															
Erythrogonys cinctus	Red-kneed Dotterel						●			●														
Vanellus tricolor	Banded Lapwing					●	●																	
CICONIIDAE																								
Ephippiorhynchus asiaticus	Black-necked Stork				NT	●	●																	
CLIMACTERIDAE																								
Climacteris melanurus	Black-tailed Treecreeper						●																	
COLUMBIDAE																								
**Columba livia*	Domestic Pigeon								●															
Geopelia cuneata	Diamond Dove					●	●			●			●	●		●	●			●	●			●
Geopelia humeralis	Bar-shouldered Dove					●	●																	
Geopelia striata subsp. *placida*	Peaceful Dove					●	●			●		●						●		●	●			●
Geophaps plumifera subsp. *ferruginea*	Spinifex Pigeon					●	●			●		●	●	●			●	●	●	●	●	●		●
Ocyphaps lophotes	Crested Pigeon					●	●			●		●	●			●	●	●	●		●	●		●
Phaps chalcoptera	Common Bronzewing					●	●			●		●	●			●	●			●		●		●
CORVIDAE																								
Corvus bennetti	Little Crow					●	●			●			●			●								●
Corvus orru subsp. *cecilae*	Torresian Crow					●	●			●		●							●		●	●		●
CUCULIDAE																								
Cacomantis pallidus	Pallid Cuckoo					●	●			●							●		●			●		●
Centropus phasianinus subsp. *highami*	Pheasant Coucal					●	●			●														
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo					●	●			●							●							●
Chrysococcyx osculans	Black-eared Cuckoo					●	●		●										●					
DICAEIDAE																								

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Dicaeum hirundinaceum	Mistletoebird					•	•			•		•		•										
ESTRILDIDAE																								
Emblema pictum	Painted Finch					•	•			•		•	•	•			•		•	•	•	•		•
Neochmia ruficauda subsp. *subclarescens*	Star Finch (Western)					•	•			•		•									•			
Taeniopygia guttata subsp. *castanotis*	Zebra Finch					•	•			•		•	•	•		•	•	•	•	•	•	•		•
FALCONIDAE																								
Falco berigora	Brown Falcon					•	•			•		•	•				•		•		•			•
Falco cenchroides	Nankeen Kestrel					•	•			•		•	•				•	•	•	•	•	•		•
Falco longipennis	Australian Hobby					•	•			•			•				•		•					
Falco peregrinus	Peregrine Falcon		OS			•	•	•		•		•	•											•
GLAREOLIDAE																								
Stiltia isabella	Australian Pratincole					•	•			•														
HIRUNDINIDAE																								
Cheramoeca leucosterna	White-backed Swallow					•	•			•														
Hirundo neoxena	Welcome Swallow					•	•																	
Hirundo rustica	Barn Swallow	MI	MI						•															
Petrochelidon ariel	Fairy Martin					•	•			•		•												
Petrochelidon nigricans	Tree Martin					•	•			•		•				•								
LARIDAE																								
Larus novaehollandiae	Silver Gull					•	•																	
Sterna caspia	Caspian Tern	MI	MI			•	•	•																
Sterna hybrida	Whiskered Tern						•			•														
Gelochelidon nilotica	Gull-billed Tern	MI	MI			•		•																
Cladorhynchus leucocephalus	Banded Stilt					•	•																	
LOCUSTELLIDAE																								

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Eremiornis carteri	Spinifexbird					•	•			•			•	•				•		•		•		•
Megalurus cruralis	Brown Songlark						•			•									•					
Megalurus gramineus	Little Grassbird					•	•			•														
Megalurus mathewsi	Rufous Songlark						•			•				•			•				•			•
MALURIDAE																								
Amytornis striatus subsp. *whitei*	Striated Grasswren					•	•			•		•	•			•				•				•
Malurus lamberti subsp. *assimilis*	Variegated Fairy-wren					•	•			•		•	•	•		•	•	•	•	•	•	•		•
Malurus leucopterus subsp. *leuconotus*	White-winged Fairy-wren					•	•			•		•					•	•	•	•	•			•
Malurus splendens	Splendid Fairy-wren					•	•			•		•												
Stipiturus ruficeps	Rufous-crowned Emu-wren					•	•																	•
MEGAPODIIDAE																								
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					•	•			•		•		•		•	•			•	•	•		•
Certhionyx variegatus	Pied Honeyeater					•	•																	•
Epthianura aurifrons	Orange Chat					•																		
Epthianura tricolor	Crimson Chat					•	•			•		•	•				•							•
Gavicalis virescens	Singing Honeyeater					•	•			•		•	•	•		•	•	•	•	•	•	•		•
Conopophila whitei	Grey Honeyeater					•	•											•						•
Lichmera indistincta	Brown Honeyeater					•	•			•		•					•	•	•		•			•
Manorina flavigula	Yellow-throated Miner					•	•			•		•	•	•			•	•	•		•	•		•
Melithreptus gularis subsp. *laetior*	Black-chinned Honeyeater					•	•			•														
Ptilotula keartlandi	Grey-headed Honeyeater					•	•			•		•	•	•					•					•
Ptilotula pencillata	White-plumed Honeyeater						•			•		•		•			•		•	•	•			•
Purnella albifrons	White-fronted Honeyeater					•	•			•		•												
Sugomel niger	Black Honeyeater						•											•	•	•				
MEROPIDAE																								

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Merops ornatus	Rainbow Bee-eater					•	•		•	•	•	•	•	•		•			•		•	•		•
MONARCHIDAE																								
Grallina cyanoleuca	Magpie-lark					•	•			•		•	•	•					•	•	•	•		•
MOTACILLIDAE																								
Anthus australis subsp. *australis*	Australasian Pipit					•	•			•		•					•				•			
Motacilla cinerea	Grey Wagtail	MI	MI						•															
Motacilla flava	Yellow Wagtail	MI	MI						•															
NEOSITTIDAE																								
Daphoenositta chrysoptera	Varied Sittella											•												
OTIDIDAE																								
Ardeotis australis	Australian Bustard					•	•			•		•		•					•			•		
PACHYCEPHALIDAE																								
Colluricincla harmonica subsp. *rufiventris*	Grey Shrike-thrush					•	•			•		•	•	•			•		•	•		•		•
Pachycephala rufiventris subsp. *rufiventris*	Rufous Whistler					•	•					•					•	•	•	•	•	•		•
Oreoica gutturalis	Crested Bellbird					•	•			•		•				•	•	•	•	•	•	•		•
PARDALOTIDAE																								
Pardalotus rubricatus	Red-browed Pardalote					•	•			•		•									•	•		•
Pardalotus striatus subsp. *murchisoni*	Striated Pardalote					•	•			•		•												•
PELECANIDAE																								
Pelecanus conspicillatus	Australian Pelican					•	•			•														
PETROICIDAE																								
Melanodryas cucullata	Hooded Robin					•	•			•		•				•	•		•		•	•		•
Petroica goodenovii	Red-capped Robin					•	•			•		•	•				•			•	•			•
PHAETHONTIDAE																								
Phalacrocorax carbo	Black Cormorant					•	•			•														

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Phalacrocorax melanoleucos	Little Pied Cormorant					•	•			•														
Phalacrocorax sulcirostris	Little Black Cormorant					•	•			•														
Phalacrocorax varius subsp. *hypoleucos*	Pied Cormorant					•	•			•														
PHASIANIDAE																								
Coturnix pectoralis	Stubble Quail					•	•																	
Coturnix ypsilophora	Brown Quail					•	•																	
PODARGIDAE																								
Podargus strigoides	Tawny Frogmouth					•	•			•		•	•					•						
PODICIPEDIDAE																								
Podiceps cristatus	Great Crested Grebe					•	•			•														
Poliocephalus poliocephalus	Hoary-headed Grebe					•	•			•														
Tachybaptus novaehollandiae	Australasian Grebe					•	•			•		•												
POMATOSTOMIDAE																								
Pomatostomus superciliosus	White-browed Babbler					•	•			•		•	•									•		
Pomatostomus temporalis subsp. *rubeculus*	Grey-crowned Babbler					•	•			•		•	•	•			•	•	•	•	•			•
PSITTACIDAE																								
Melopsittacus undulatus	Budgerigar					•	•			•				•			•		•		•			•
Neopsephotus bourkii	Bourke's Parrot					•	•																	
Neophema elegans	Elegant Parrot											•												
Pezoporus occidentalis	Night Parrot	EN	CR		EN				•															
Psephotus varius	Mulga Parrot					•	•					•	•				•							
Platycercus zonarius subsp. *zonarius*	Port Lincoln Parrot					•	•			•		•	•	•		•	•	•	•	•	•	•		•
Polytelis alexandrae	Princess Parrot	VU		P4	NT		•		•															
PSOPHODIDAE																								
Psophodes occidentalis	Chiming Wedgebill					•	•																	

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Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush					•	•																	•
PTILINORHYNCHIDAE																								
Ptilonorhynchus maculatus subsp. *guttatus*	Western Bowerbird					•	•			•		•	•				•		•	•	•			
RALLIDAE																								
Fulica atra	Eurasian Coot					•	•			•		•									•			
Gallirallus philippensis	Buff-banded Rail					•	•																	
Porphyrio porphyrio	Purple Swamphen					•	•			•														
Porzana pusilla	Baillon's Crake					•	•																	
Porzana tabuensis	Spotless Crake					•	•			•														
Tribonyx ventralis	Black-tailed Nativehen					•	•			•														
RECURVIROSTRIDAE																								
Himantopus himantopus	Black-winged Stilt					•				•		•												
Recurvirostra novaehollandiae	Red-necked Avocet					•	•																	
RHIPIDURIDAE																								
Rhipidura albiscapa	Grey Fantail					•	•					•					•							•
Rhipidura leucophrys subsp. *leucophrys*	Willie Wagtail					•	•			•		•	•	•		•	•	•	•	•	•			•
ROSTRATULIDAE																								
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			•	•	•		•														

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Limosa limosa	Black-tailed Godwit	MI	MI		NT					•														
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			•		•		•														
STRIGIDAE																								
Ninox boobook	Boobook Owl						•			•		•	•	•		•								•
Ninox connivens	Barking Owl					•	•			•														
THRESKIORNITHIDAE																								
Platalea flavipes	Yellow-billed Spoonbill					•	•			•														
Platalea regia	Royal Spoonbill					•	•			•														
Plegadis falcinellus	Glossy Ibis	MI	MI			•	•	•		•														
Threskiornis molucca	Australian White Ibis						•			•														
Threskiornis spinicollis	Straw-necked Ibis					•	•			•														
TURNICIDAE																								
Turnix velox	Little Button-quail					•	•			•							•		•		•	•		•
TYTONIDAE																								
Tyto alba	Barn Owl					•	•					•												
REPTILES																								
AGAMIDAE																								
Ctenophorus caudicinctus	Ring-tailed Dragon					•				•		•	•	•			•	•	•	•	•	•		•
Ctenophorus isolepis subsp. *isolepis*	Military Dragon or Crested Dragon					•				•		•	•	•					•		•	•		•
Ctenophorus nuchalis	Central Netted Dragon					•				•														

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Ctenophorus reticulatus	Western Netted Dragon					•																		•
Diporiphora amphiboluroides	Mulga Dragon					•																		
Gowidon longirostris	Long-nosed Dragon					•				•		•	•				•	•	•	•	•			•
Tympanocryptis diabolicus/pseudosephos	Hamersley/Goldfields Pebble Dragon				DD	•																		•
Pogona minor subsp. *minor*	Dwarf Bearded Dragon					•				•		•				•								•
BOIDAE																								
Antaresia perthensis	Pygmy Python					•				•		•								•				•
Antaresia stimsoni	Stimson's Python					•						•												•
Aspidites melanocephalus	Black-headed Python					•				•		•												•
Liasis olivaceus subsp. *barroni*	Pilbara Olive Python	VU	VU			•		•	•	•		•	•	•					•					
CARPHODACTYLIDAE																								
Nephrurus cinctus	Banded Knob-tailed Gecko					•				•														•
CHELUIDAE																								
Chelodina steindachneri	Flat-shelled Turtle					•																		
DIPLODACTYLIDAE																								
Diplodactylus conspicillatus	Fat-tailed Gecko					•				•		•												•
Diplodactylus puher	Fine-faced Gecko					•																		
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko					•				•		•		•										•
Lucasium stenodactylum	Gecko					•				•		•												•
Lucasium wombeyi	Gecko					•				•														•
Oedura fimbria	Western Marbled Velvet Gecko					•				•		•									•			
Rhynchoedura ornata	Western Beaked Gecko					•				•		•												•
Strophurus elderi	Jewelled Gecko					•																		•
Strophurus wellingtonae	Gecko					•						•												

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ELAPIDAE																								
Acanthophis wellsi	Pilbara Death Adder					•				•										•				•
Brachyurophis approximans	North-western Shovel-nosed Snake					•						•												
Demansia psammophis subsp. *cupreiceps*	Yellow-faced Whipsnake					•																		
Demansia rufescens	Rufous Whipsnake					•						•					•							
Furina ornata	Moon Snake					•						•												•
Parasuta monachus	Snake					•						•												
Pseudechis australis	Mulga Snake					•				•		•	•				•				•			•
Pseudonaja mengdeni	Western Brown Snake					•				•														•
Pseudonaja modesta	Ringed Brown Snake					•						•												•
Suta fasciata	Rosen's Snake					•																		
Suta punctata	Little Spotted Snake					•																		
Vermicella snelli	Pilbara Bandy Bandy					•																		
GEKKONIDAE																								
Gehyra fenestrula	Hamersley Range Spotted Gehyra																							•
Gehyra pilbara	Pilbara Dtella					•																		
Gehyra punctata	Spotted Rock Dtella					•				•		•		•			•					•		•
Gehyra variegata	Tree Dtella					•				•		•		•			•	•	•	•		•		•
Heteronotia binoei	Bynoe's Gecko					•						•					•							•
Heteronotia planiceps	Gecko					•																		
Heteronotia spelea	Desert Cave Gecko					•				•		•				•								
PYGOPODIDAE																								
Delma butleri	Legless Lizard					•						•												
Delma elegans	Legless Lizard					•						•												
Delma nasuta	Long-nosed Delma					•				•														

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Delma pax	Legless Lizard					•				•		•	•											•
Delma tincta	Legless Lizard																							•
Lialis burtonis	Burton's legless lizard					•				•		•				•								•
Pygopus nigriceps	Legless Lizard					•						•												
Delma haroldi	Neck-barred Delma					•																		
SCINCIDAE																								
Carlia munda	Shaded-litter Rainbow Skink					•				•		•	•				•		•					•
Carlia triacantha	Desert Rainbow Skink					•				•		•							•					
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink					•										•								•
Cryptoblepharus ustulatus	Russet Snake-eyed Skink					•				•		•	•											•
Ctenotus ariadnae	Ariadna's Ctenotus					•																		
Ctenotus duricola	Skink					•				•		•										•		•
Ctenotus grandis subsp. *titan*	Grand Ctenotus					•																		•
Ctenotus hanloni	Skink																							•
Ctenotus inornatus	Skink					•				•		•	•				•	•	•	•		•		•
Ctenotus leonhardii	Skink					•						•												
Ctenotus pantherinus subsp. *ocellifer*	Leopard Ctenotus					•				•		•	•			•	•		•					•
Ctenotus rubicundus	Ruddy Ctenotus					•				•														
Ctenotus rutilans	Skink					•				•			•											
Ctenotus schomburgkii	Skink					•						•												
Ctenotus serventyi	North-western Sandy-loam Ctenotus									•			•						•					
Ctenotus uber	Spotted Ctenotus					•																		•
Ctenotus uber subsp. *johnstonei*	Spotted Ctenotus			P2		•		•																
Cyclodomorphus melanops subsp. *melanops*	Slender Blue-tongue					•											•							•

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
Egernia cygnitos	Pygmy Spiny-tailed Skink (western)					●																		
Egernia depressa	Pygmy Spiny-tailed Skink					●				●		●							●					●
Egernia formosa	Goldfields Crevice-skink					●				●		●	●											
Eremiascincus richardsonii	Broad-banded Sand Swimmer					●																		
Lerista bipes	Two-toed Skink					●																		
Lerista macropisthopus remota	Skink			P2		●																		
Lerista muelleri	Skink					●						●					●							
Lerista neander	Skink					●				●		●					●					●		●
Lerista zietzi	Pilbara Blue-tailed Slider					●						●												
Menetia greyii	Common Dwarf Skink					●				●		●												●
Menetia surda subsp. *surda*	Skink					●																		●
Morethia ruficauda subsp. *exquisita*	Fire-tailed Skink					●				●		●	●						●					●
Proablepharus reginae	Skink																		●					
Tiliqua multifasciata	Central Blue-tongue Lizard					●				●		●												●
TYPHLOPIDAE																								
Anilios ammodytes	Blind Snake																							●
Anilios ganei	Pilbara Flat-headed Blind-snake			P1		●		●		●		●												
Anilios grypus	Blind Snake											●												●
Anilios hamatus	Blind Snake											●												
VARANIDAE																								
Varanus acanthurus	Spiny-tailed Monitor					●				●		●	●				●				●			●
Varanus brevicauda	Short-tailed Pygmy Monitor					●				●		●										●		
Varanus bushi	Bush's Monitor					●																		
Varanus caudolineatus	Stripe-tailed Pygmy Monitor					●						●					●							●
Varanus giganteus	Perentie					●				●		●	●							●				

Species	Common Name	Conservation Status				Database Searches					Previous Surveys													Current survey
		EPBC Act	BC Act	DBCA	IUCN	NatureMap	Birdata	DBCA T&P Fauna	EPBC Protected Matters	BHP WAIO Fauna Records Database	A	B	C	D	E	F	G	H	I	J	K	L	M	
Varanus gouldii	Gould's Monitor or Bungarra					•												•			•			
Varanus panoptes	Yellow Spotted Monitor					•						•												•
Varanus pilbarensis	Pilbara Rock Monitor					•				•			•											•
Varanus tristis subsp. *tristis*	Racehorse Goanna					•				•		•	•											•
AMPHIBIANS																								
PELODRYADIDAE																								
Cyclorana maini	Sheep Frog					•						•							•					•
Litoria rubella	Little Red Tree Frog					•				•		•	•						•					•
LIMNODYNASTIDAE																								
Neobatrachus kunapalari	Kunapalari Frog					•																		
Platyplectrum spenceri	Centralian Burrowing Frog					•																		
MYOBATRACHIDAE																								
Pseudophryne douglasi	Gorge Toadlet					•																		
Uperoleia russelli	Russell's Toadlet					•																		
Uperoleia saxatilis	Pilbara Toadlet					•																		

Appendix D – Vertebrate fauna habitat assessments

Appendix D: Vertebrate fauna habitat assessments

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VCOW-01	-23.4326, 119.6793	26-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	None Discernible	Mulga Woodland, Acacia Shrubland	Nil	Moderate	None	Prone to Flooding	Cattle Grazing	Old (6+ yr)
VCOW-02	-23.4315, 119.6036	26-11-2019	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	Flat	Flat	Clay Loam	Few Small Patches	Minor Outcropping	Gravel (1-4cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	Low	Low	None	None	Fire	Moderate (3 to 5 yr)
VCOW-03	-23.4301, 119.6971	26-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	2	None	Cattle Grazing	Old (6+ yr)
VCOW-04	-23.4359, 119.6688	26-11-2019	Hardpan Plain	Minor Drainage Line	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Negligible	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Tussock Grassland	Nil	High	None	None	Cattle Grazing	Old (6+ yr)
VCOW-05	-23.4164, 119.7065	26-11-2019	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Mulga Woodland, Acacia Shrubland	Nil	Moderate	3	None	None Discernible	Old (6+ yr)
VCOW-06	-23.4223, 119.6782	26-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Nil	High	None	None	None Discernible	Old (6+ yr)
VCOW-07	-23.4226, 119.5864	28-11-2019	Stony Plain	Stony Plain	Flat	Low	Clay Loam	Scarce	Limited Outcropping	Small Rocks (11-20cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland	Low	Low	None	None	None Discernible	Old (6+ yr)
VCOW-08	-23.4103, 119.6891	27-11-2019	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Many Small Patches	Scattered Eucalypts, Scattered Mulga, Scattered Spinifex	Nil	Low	None	None	Cattle Grazing	Old (6+ yr)
VCOW-09	-23.4135, 119.6662	29-11-2019	Stony Plain	Stony Plain	Flat	Low	Clay Loam	Few Small Patches	Limited Outcropping	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Moderate	1	None	Road/ Access Track	Old (6+ yr)
VCOW-10	-23.439, 119.6599	27-11-2019	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Mulga Woodland, Eremophila	Nil	Low	None	None	Cattle Grazing	Old (6+ yr)
VCOW-11	-23.4296, 119.6991	29-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Pebbles (5-10cm)	Scarce	Mulga Woodland, Scattered Eremophila Shrubs	Nil	Low	2	None	Cattle Grazing	Old (6+ yr)
VCOW-12	-23.4239, 119.5745	28-11-2019	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-13	-23.4315, 119.6902	29-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Small Patches	Limited Outcropping	Gravel (1-4cm)	Scarce	Mulga Woodland, Acacia Shrubland	Nil	Low	2	None	Cattle Grazing	Old (6+ yr)
VCOW-14	-23.4057, 119.6712	29-11-2019	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Many Large Patches	Scattered Eucalypts, Mulga Woodland, Spinifex Hummock Grassland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-15	-23.4309, 119.6853	29-11-2019	Mulga Woodland	Minor Drainage Line	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Many Large Patches	Mulga Woodland	Nil	Moderate	3	Prone to Flooding	Cattle Grazing	Old (6+ yr)
VCOW-16	-23.4182, 119.6552	29-11-2019	Stony Plain	Undulating Low Hills	Flat	Flat	Clay Loam	None Discernible	Limited Outcropping	Gravel (1-4cm)	None Discernible	Spinifex Hummock Grassland, Scattered Acacia	Nil	Low	None	None	None Discernible	Old (6+ yr)
VCOW-17	-23.4313, 119.6799	29-11-2019	Drainage Area/ Floodplain	Stony Plain	Flat	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	None Discernible	Spinifex Hummock Grassland	Nil	Low	None	None	None Discernible	Old (6+ yr)
VCOW-18	-23.4238, 119.6725	29-11-2019	Stony Plain	Undulating Low Hills	North	Low	Clay Loam	Scarce	Limited Outcropping	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Low	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-19	-23.4465, 119.651	29-11-2019	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	None Discernible	Mulga Woodland, Eremophila Shrubland	Nil	Moderate	None	None	Cattle Grazing	Old (6+ yr)
VCOW-20	-23.4109, 119.712	30-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	None	None	None Discernible	Old (6+ yr)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VCOW-21	-23.4178, 119.594	30-11-2019	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Many Small Patches	Mulga Woodland	Nil	Low	None	None	Cattle Grazing	Old (6+ yr)
VCOW-22	-23.4047, 119.714	30-11-2019	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Sandy Clay Loam	Many Small Patches	Negligible	Negligible	Many Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland, Tussock Grassland	Nil	Moderate	None	None	None Discernible	Old (6+ yr)
VCOW-23	-23.4352, 119.6738	29-11-2019	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Scarce	Negligible	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Mulga Woodland	Nil	Low	None	None	Cattle Grazing	Old (6+ yr)
VCOW-24	-23.4151, 119.6721	30-11-2019	Stony Plain	Undulating Low Hills	West	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland, Scattered Acacia	Nil	Low	None	None	None Discernible	Old (6+ yr)
VCOW-25	-23.4171, 119.6123	30-11-2019	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Moderate	3	Prone to Flooding	Cattle Grazing	Old (6+ yr)
VCOW-26	-23.4083, 119.6638	30-11-2019	Stony Plain	Undulating Low Hills	Flat	Flat	Clay Loam	None Discernible	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Scattered Acacia, Scattered Grevillea	Nil	Low	None	None	None Discernible	Old (6+ yr)
VCOW-27	-23.4178, 119.6799	02-12-2019	Stony Plain	Hillcrest/ Upper Hillslope	South	Moderate	Clay Loam	Scarce	Moderate Outcropping	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland, Scattered Grevillea	Low	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-28	-23.4189, 119.6652	30-11-2019	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Negligible	Scarce	Mulga Woodland	Nil	Moderate	None	None	Cattle Grazing	Old (6+ yr)
VCOW-29	-23.4385, 119.6784	03-03-2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Mulga Woodland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-30	-23.4212, 119.6708	30-11-2019	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Moderate	None	None	Cattle Grazing	Old (6+ yr)
VCOW-31	-23.4226, 119.6397	28-02-2020	Stony Plain	Undulating Low Hills	South	Moderate	Clay Loam	Scarce	Minor Outcropping	Gravel (1-4cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland	Low	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-32	-23.4441, 119.6801	03-03-2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Gravel (1-4cm)	Scarce	Mulga Woodland, Acacia Shrubland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-33	-23.4175, 119.661	04-12-2019	Stony Plain	Boulders/ Rockpiles	South	Flat	Clay Loam	Few Small Patches	Major Outcropping	Pebbles (5-10cm)	Many Small Patches	Mulga Woodland, Scattered Tussock Grassland	Moderate	Nil	None	None	None Discernible	Old (6+ yr)
VCOW-34	-23.4185, 119.6348	04-12-2019	Stony Plain	Undulating Low Hills	South	Low	Clay Loam	Scarce	Moderate Outcropping	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Acacia Shrubland	High	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-35	-23.4238, 119.6289	04-12-2019	Stony Plain	Undulating Low Hills	Flat	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Acacia Shrubland, Mulga Woodland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-36	-23.4265, 119.5996	05-12-2019	Stony Plain	Undulating Low Hills	Flat	Low	Clay Loam	Scarce	Minor Outcropping	Gravel (1-4cm)	Scarce	Scattered Eucalypts, Acacia Shrubland, Spinifex Hummock Grassland	Low	Nil	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-37	-23.4057, 119.6626	05-12-2019	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	South/ East	Steep	Clay Loam	Scarce	Major Outcropping	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Acacia Shrubland, Spinifex Hummock Grassland	Low	Nil	None	None	None Discernible	Moderate (3 to 5 yr)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VCOW-38	-23.4288, 119.6743	27-02-2020	Drainage Area/ Floodplain	Undulating Low Hills	Flat	Low	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts	Nil	Low	None	None	Road/ Access Track	Old (6+ yr)
VCOW-39	-23.4212, 119.6193	29-02-2020	Stony Plain	Undulating Low Hills	South	Moderate	Clay Loam	Scarce	Major Outcropping	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland, Scattered Eucalypts, Acacia Shrubland	Low	Nil	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-40	-23.4201, 119.6436	28-02-2020	Drainage Area/ Floodplain	Sandy/ Stony Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Spinifex Hummock Grassland, Scattered Eucalypts, Acacia Shrubland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-41	-23.4066, 119.7091	29-02-2020	Drainage Area/ Floodplain	Minor Drainage Line	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Negligible	Many Small Patches	Mulga Woodland, Scattered Eucalypts, Tussock Grassland	Nil	Moderate	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-42	-23.4068, 119.7062	29-02-2020	Stony Plain	Stony Plain	North	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Low	None	None	Road/ Access Track	Old (6+ yr)
VCOW-43	-23.4093, 119.7028	29-02-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland, Mulga Woodland	Nil	Low	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-44	-23.4368, 119.669	29-02-2020	Hardpan Plain	Minor Drainage Line	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Negligible	Few Small Patches	Mulga Woodland, Tussock Grassland	Nil	Moderate	None	Prone to Pooling	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-45	-23.4264, 119.5704	29-02-2020	Stony Plain	Minor Drainage Line	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Gravel (1-4cm)	Few Large Patches	Spinifex Hummock Grassland, Mulga Woodland, Scattered Eucalypts	Nil	Low	None	None	None Discernible	Old (6+ yr)
VCOW-46	-23.43, 119.5753	29-02-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-47	-23.4245, 119.5694	29-02-2020	Stony Plain	Undulating Low Hills	South	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Low	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-48	-23.4244, 119.6188	29-02-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland, Acacia Shrubland	Nil	Low	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-49	-23.4061, 119.713	27-02-2020	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Clay Loam	Many Small Patches	Limited Outcropping	Gravel (1-4cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Nil	None	None	Road/ Access Track	Moderate (3 to 5 yr)
VCOW-50	-23.4324, 119.5961	01-03-2020	Stony Plain	Undulating Low Hills	South/ East	Low	Clay Loam	Scarce	Moderate Outcropping	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Moderate	Nil	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-51	-23.4125, 119.7081	01-03-2020	Drainage Area/ Floodplain	Stony Plain	Flat	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Nil	None	None	Road/ Access Track	Moderate (3 to 5 yr)
VCOW-52	-23.414, 119.7028	01-03-2020	Stony Plain	Sandy/ Stony Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	High	None	None	None Discernible	Old (6+ yr)
VCOW-53	-23.4242, 119.6937	01-03-2020	Mulga Woodland	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-54	-23.4356, 119.6542	01-03-2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, Tussock Grassland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-55	-23.4271, 119.6533	01-03-2020	Stony Plain	Stony Plain	Flat	Low	Clay Loam	None Discernible	Major Outcropping	Pebbles (5-10cm)	Scarce	Mulga Woodland, Acacia Shrubland, Spinifex Hummock Grassland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VCOW-56	-23.4268, 119.6618	01-03-2020	Stony Plain	Undulating Low Hills	West	Low	Clay Loam	Scarce	Moderate Outcropping	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-57	-23.4287, 119.667	01-03-2020	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Low	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-58	-23.4324, 119.6637	01-03-2020	Hardpan Plain	Minor Drainage Line	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Gravel (1-4cm)	Many Small Patches	Mulga Woodland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-59	-23.4269, 119.6803	01-03-2020	Drainage Area/ Floodplain	Minor Drainage Line	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Tussock Grassland, Acacia Shrubland	Nil	Moderate	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-60	-23.4064, 119.6952	01-03-2020	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Low	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-61	-23.4154, 119.7141	02-03-2020	Drainage Area/ Floodplain	Stony Plain	Flat	Flat	Clay Loam	Few Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Acacia Shrubland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-62	-23.4224, 119.6811	02-03-2020	Stony Plain	Hillcrest/ Upper Hillslope	South/ East	Moderate	Clay Loam	Scarce	Major Outcropping	Pebbles (5-10cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Low	Nil	None	None	None Discernible	Old (6+ yr)
VCOW-63	-23.4237, 119.6851	02-03-2020	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	Scarce	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-64	-23.4288, 119.6101	02-03-2020	Hillcrest/ Hillslope	Hillcrest/ Upper Hillslope	North/ East	Steep	Clay Loam	None Discernible	Moderate Outcropping	Gravel (1-4cm)	None Discernible	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	Moderate	Nil	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-65	-23.4258, 119.6054	02-03-2020	Hillcrest/ Hillslope	Undulating Low Hills	North	Low	Clay Loam	Scarce	Limited Outcropping	Pebbles (5-10cm)	None Discernible	Spinifex Hummock Grassland	Nil	Nil	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-66	-23.43, 119.6174	02-03-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Scattered Eucalypts, Tussock Grassland, Acacia Shrubland	Nil	Low	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-67	-23.4274, 119.5821	02-03-2020	Stony Plain	Minor Drainage Line	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Acacia Shrubland, Spinifex Hummock Grassland	Nil	Moderate	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-68	-23.4294, 119.5871	02-03-2020	Stony Plain	Undulating Low Hills	Flat	Low	Clay Loam	Scarce	Negligible	Gravel (1-4cm)	None Discernible	Spinifex Hummock Grassland, Acacia Shrubland	Nil	Nil	None	None	Frequent Fire	Recent (0 to 2 yr)
VCOW-69	-23.4263, 119.5912	02-03-2020	Stony Plain	Undulating Low Hills	South	Low	Clay Loam	None Discernible	Limited Outcropping	Gravel (1-4cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Nil	None	None	Frequent Fire	Recent (0 to 2 yr)
VCOW-70	-23.4175, 119.6079	02-03-2020	Mulga Woodland	Stony Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Mulga Woodland, Spinifex Hummock Grassland	Nil	Low	None	None	Cattle Grazing	Old (6+ yr)
VCOW-71	-23.4143, 119.6787	02-03-2020	Stony Plain	Stony Plain	Flat	Low	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Acacia Shrubland, Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Low	None	None	None Discernible	Old (6+ yr)
VCOW-72	-23.4166, 119.6877	02-03-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Many Small Patches	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Moderate	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-73	-23.4479, 119.6605	03-03-2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	None Discernible	Acacia Shrubland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-74	-23.4453, 119.6627	03-03-2020	Hardpan Plain	Minor Drainage Line	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Acacia Shrubland, Mulga Woodland, Tussock Grassland	Nil	Nil	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-75	-23.4473, 119.6702	03-03-2020	Hardpan Plain	Hardpan Plain	Flat	Flat	Clay Loam	Many Large Patches	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Tussock Grassland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)

Site ID	Coord.	Date	Habitat Type	Landform	Aspect	Slope	Soil Type	Soil Avail.	Outcropping Rock Type	Rock Size	Veg. Litter	Dominant Veg. Type	Rocky Cracks / Crevices	Burrowing Suitability	Hollows	Water present	Disturbances	Last Fire
VCOW-76	-23.4432, 119.6721	03-03-2020	Hardpan Plain	Minor Drainage Line	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Negligible	Many Small Patches	Scattered Eucalypts, Mulga Woodland, Tussock Grassland	Nil	Low	3	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-77	-23.4351, 119.6773	03-03-2020	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Low	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-78	-23.4078, 119.6744	03-03-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland, Acacia Shrubland	Nil	Nil	None	None	Road/ Access Track	Old (6+ yr)
VCOW-79	-23.4278, 119.6452	03-03-2020	Stony Plain	Stony Plain	Flat	Low	Clay Loam	Scarce	Limited Outcropping	Gravel (1-4cm)	None Discernible	Acacia Shrubland, Spinifex Hummock Grassland	Nil	Nil	None	None	None Discernible	Recent (0 to 2 yr)
VCOW-80	-23.4287, 119.632	04-03-2020	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Evenly Spread	Negligible	Gravel (1-4cm)	Scarce	Acacia Shrubland, Scattered Eucalypts, Mulga Woodland	Nil	Low	None	None	Cattle Grazing	Moderate (3 to 5 yr)
VCOW-81	-23.4309, 119.6333	04-03-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	None Discernible	Limited Outcropping	Gravel (1-4cm)	None Discernible	Spinifex Hummock Grassland, Scattered Eucalypts, Acacia Shrubland	Nil	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-82	-23.4268, 119.625	04-03-2020	Stony Plain	Hillslope	North/ East	Steep	Clay Loam	Scarce	Major Outcropping	Pebbles (5-10cm)	Scarce	Acacia Shrubland, Spinifex Hummock Grassland	Low	Nil	None	None	None Discernible	Moderate (3 to 5 yr)
VCOW-83	-23.4181, 119.693	06-03-2020	Stony Plain	Stony Plain	Flat	Flat	Clay Loam	Many Small Patches	Negligible	Gravel (1-4cm)	Few Small Patches	Scattered Eucalypts, Spinifex Hummock Grassland	Nil	Nil	None	None	None Discernible	Old (6+ yr)
VCOW-84	-23.4148, 119.691	06-03-2020	Drainage Area/ Floodplain	Drainage Area/ Floodplain	Flat	Flat	Clay Loam	Few Small Patches	Negligible	Gravel (1-4cm)	Scarce	Tussock Grassland, Mulga Woodland	Nil	Low	None	None	None Discernible	Moderate (3 to 5 yr)

Appendix E – Fauna recorded during the current survey

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
MAMMALS													
BOVIDAE													
**Bos taurus*	Cow					2	5	1	1	5	1	40	55
CAMELIDAE													
**Camelus dromedarius*	Camel										1		1
CANIDAE													
**Canis familiaris*	Dog							1					1
DASYURIDAE													
Dasykaluta rosamondae	Little Red Kaluta						10	16		6			32
Ningaui timealeyi	Pilbara Ningaui					1	3	3	1	2			10
Sminthopsis macroura	Stripe-faced Dunnart										3		3
Sminthopsis ooldea	Ooldea Dunnart								1				1
EMBALLONURIDAE													
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat								2			2	4
Taphozous georgianus	Common Sheathtail-bat					4		2		2		4	12
Taphozous hilli	Hill's Sheathtail-bat					4		2		4		7	17
EQUIDAE													
**Equus asinus*	Donkey						2	1			1		4
FELIDAE													
**Felis catus*	Cat							1				7	8
HIPPOSIDERIDAE													
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU									1	1

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
MACROPODIDAE													
Osphranter robustus subsp. *erubescens*	Euro					1	2			2		4	9
Osphranter rufus	Red Kangaroo						1	1	1	1	1	2	7
MOLOSSIDAE													
Chaerephon jobensis subsp. *colonicus*	Northern Freetail-bat					2	2	2	4	4		16	32
Ozimops lumsdenae	Northern Free-tailed Bat										2	2	4
MURIDAE													
Pseudomys chapmani	Western Pebble-mound Mouse			P4								8	8
Pseudomys desertor	Desert Mouse						1						1
Pseudomys hermannsburgensis	Sandy Inland Mouse							1	1				2
Zyzomys argurus	Common Rock-rat					1							1
VESPERTILIONIDAE													
Chalinolobus gouldii	Gould's Wattled Bat					2	2	2	4	4	2	18	34
Nyctophilus geoffroyi	Lesser Long-eared Bat											2	2
Scotorepens greyii	Little Broad-nosed Bat						2	2	4	4	2	11	25
Vespadelus finlaysoni	Finlayson's Cave Bat					2	2		2	4	2	15	27
AVES													
ACANTHIZIDAE													
Acanthiza apicalis	Inland Thornbill									1	22		23
Acanthiza robustirostris	Slaty-backed Thornbill										4		10
Acanthiza uropygialis	Chestnut-rumped Thornbill								14		15		29
Gerygone fusca	Western Gerygone								1				1

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
Pyrrholaemus brunneus	Redthroat								1		10		11
Smicrornis brevirostris	Weebill						1		10			1	12
ACCIPITRIDAE													
Accipiter fasciatus	Brown Goshawk											4	4
Aquila audax	Wedge-tailed Eagle										1	4	5
Circus assimilis	Spotted Harrier								1				1
Elanus caeruleus subsp. *axillaris*	Black-shouldered Kite										1	1	2
Haliastur sphenurus	Whistling Kite										2	2	4
Hamirostra melanosternon	Black-breasted Buzzard									1			1
AEGOTHELIDAE													
Aegotheles cristatus	Australian Owlet-nightjar						4	4				24	32
ALCEDINIDAE													
Todiramphus pyrrhopygius	Red-backed Kingfisher									4			4
Todiramphus sanctus	Sacred Kingfisher						4	4				4	12
ARDEIDAE													
Nycticorax caledonicus subsp. *australasiae*	Nankeen Night-Heron											4	4
ARTAMIDAE													
Artamus cinereus	Black-faced Woodswallow					5		35		18	66	8	132
Artamus personatus	Masked Woodswallow											114	114
Cracticus nigrogularis	Pied Butcherbird						1	4	4	6	3	25	43
Cracticus tibicen	Australian Magpie							4				13	17
Cracticus torquatus	Grey Butcherbird											4	4

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
BURHINIDAE													
Burhinus grallarius	Bush Stone-curlew						4					1	5
CACATUIDAE													
Cacatua roseicapilla	Galah									4		30	34
Cacatua sanguinea	Little Corella											2	2
Nymphicus hollandicus	Cockatiel						8	6			18		32
CAMPEPHAGIDAE													
Coracina novaehollandiae subsp. *subpallida*	Black-faced Cuckoo-shrike					1	6		1	2	2	1	13
Lalage tricolor	White-winged Triller								6				6
CAPRIMULGIDAE													
Eurostopodus argus	Spotted Nightjar							4		4		20	28
CASUARIIDAE													
Dromaius novaehollandiae	Emu						1						1
COLUMBIDAE													
Geopelia cuneata	Diamond Dove						4	4	11	1	5	32	57
Geopelia striata subsp. *placida*	Peaceful Dove								1			1	2
Geophaps plumifera subsp. *ferruginea*	Spinifex Pigeon					4				4		4	12
Ocyphaps lophotes	Crested Pigeon						4		4	1	30	8	47
Phaps chalcoptera	Common Bronzewing											1	1
CORVIDAE													
Corvus bennetti	Little Crow						1				5		6
Corvus orru subsp. *cecilae*	Torresian Crow						6	2	3	6		23	40

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
CUCULIDAE													
Cacomantis pallidus	Pallid Cuckoo							2				8	10
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo								2			4	6
ESTRILDIDAE													
Emblema pictum	Painted Finch					1				2		6	9
Taeniopygia guttata subsp. *castanotis*	Zebra Finch					17	15	45	39	7	47	73	243
FALCONIDAE													
Falco berigora	Brown Falcon										1	1	2
Falco cenchroides	Nankeen Kestrel					1		2				1	4
Falco peregrinus	Peregrine Falcon		OS									1	1
LOCUSTELLIDAE													
Eremiornis carteri	Spinifexbird					5	13	14		8		21	61
Megalurus mathewsi	Rufous Songlark							1				1	2
MALURIDAE													
Amytornis striatus subsp. *whitei*	Striated Grasswren					3							3
Malurus lamberti subsp. *assimilis*	Variegated Fairy-wren						17	12	22	25	2	20	98
Malurus leucopterus subsp. *leuconotus*	White-winged Fairy-wren						11	4		4	4	29	52
Stipiturus ruficeps	Rufous-crowned Emu-wren						4			7			11
MEGAPODIIDAE													
Acanthagenys rufogularis	Spiny-cheeked Honeyeater						9	12	3	11	4	22	61
Certhionyx variegatus	Pied Honeyeater									1			1
Epthianura tricolor	Crimson Chat								2		4	1	7

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
Gavicalis virescens	Singing Honeyeater						4	8	21	4	1	41	79
Conopophila whitei	Grey Honeyeater								3				3
Lichmera indistincta	Brown Honeyeater								1				1
Manorina flavigula	Yellow-throated Miner					3	5	7	1		1	8	25
Ptilotula keartlandi	Grey-headed Honeyeater					9		10				2	21
Ptilotula pencillata	White-plumed Honeyeater							4			18	9	31
MEROPIDAE													
Merops ornatus	Rainbow Bee-eater						1			1	2	1	5
MONARCHIDAE													
Grallina cyanoleuca	Magpie-lark											2	2
PACHYCEPHALIDAE													
Colluricincla harmonica subsp. *rufiventris*	Grey Shrike-thrush						4		1			12	17
Pachycephala rufiventris subsp. *rufiventris*	Rufous Whistler						4		23	4		12	43
Oreoica gutturalis	Crested Bellbird						6	6	11	1	6	27	57
PARDALOTIDAE													
Pardalotus rubricatus	Red-browed Pardalote						7	5		3			15
Pardalotus striatus subsp. *murchisoni*	Striated Pardalote								1		1		2
PETROICIDAE													
Melanodryas cucullata	Hooded Robin						4				1	16	21
Petroica goodenovii	Red-capped Robin							1					1
POMATOSTOMIDAE													
Pomatostomus temporalis subsp. *rubeculus*	Grey-crowned Babbler								25			13	38

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
PSITTACIDAE													
Melopsittacus undulatus	Budgerigar							6			8	6	20
Platycercus zonarius subsp. *zonarius*	Port Lincoln Parrot											17	17
PSOPHODIDAE													
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush										1		1
RHIPIDURIDAE													
Rhipidura albiscapa	Grey Fantail								1				1
Rhipidura leucophrys subsp. *leucophrys*	Willie Wagtail					1		10	7	8	5	18	49
STRIGIDAE													
Ninox boobook	Boobook Owl											8	8
TURNICIDAE													
Turnix velox	Little Button-quail						1			1	1	3	6
REPTILES													
AGAMIDAE													
Ctenophorus caudicinctus	Ring-tailed Dragon					10	1	1		1	1	6	20
Ctenophorus isolepis subsp. *isolepis*	Military Dragon or Crested Dragon							3					3
Ctenophorus reticulatus	Western Netted Dragon										7	1	8
Gowidon longirostris	Long-nosed Dragon							1	1		1	1	4
Tympanocryptis diabolicus/pseudosephos	Hamersley/Goldfields Pebble Dragon				DD						3		3
Pogona minor subsp. *minor*	Dwarf Bearded Dragon							1					1
BOIDAE													
Antaresia perthensis	Pygmy Python					1				1			2

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
Antaresia stimsoni	Stimson's Python					1							1
Aspidites melanocephalus	Black-headed Python											1	1
CARPHODACTYLIDAE													
Nephrurus cinctus	Banded Knob-tailed Gecko								1	1			2
DIPLODACTYLIDAE													
Diplodactylus conspicillatus	Fat-tailed Gecko						2	5	13		5		25
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko					1							1
Lucasium stenodactylum	Gecko					3		5	2	5	5		20
Lucasium wombeyi	Gecko					1							1
Rhynchoedura ornata	Western Beaked Gecko							1					1
Strophurus elderi	Jewelled Gecko					1							1
ELAPIDAE													
Acanthophis wellsi	Pilbara Death Adder									1			1
Furina ornata	Moon Snake									1			1
Pseudechis australis	Mulga Snake								1				1
Pseudonaja mengdeni	Western Brown Snake							1					1
Pseudonaja modesta	Ringed Brown Snake										1		1
GEKKONIDAE													
Gehyra fenestrula	Hamersley Range spotted Gehyra					6							6
Gehyra punctata	Spotted Rock Dtella					2							2
Gehyra variegata	Tree Dtella						4	2	6	2	3		17
Heteronotia binoei	Bynoe's Gecko					2	6	4	1	2	1	2	18

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
PYGOPODIDAE													
Delma pax	Legless Lizard							1	3				4
Delma tincta	Legless Lizard						1		3				4
Lialis burtonis	Burton's legless lizard							1					1
SCINCIDAE													
Carlia munda	Shaded-litter Rainbow Skink					3	2	6	5	2	2		21
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink						1		1				2
Cryptoblepharus ustulatus	Russet Snake-eyed Skink					1						1	2
Ctenotus duricola	Skink						2	1			10		13
Ctenotus grandis subsp. *titan*	Grand Ctenotus						3						3
Ctenotus hanloni	Skink					1	2	4		1			8
Ctenotus inornatus	Skink					7	4	25	12	12			60
Ctenotus pantherinus subsp. *Ocellifer*	Leopard Ctenotus						7	4	4	4	1		20
Ctenotus uber	Spotted Ctenotus						1				1		2
Cyclodomorphus melanops subsp. *melanops*	Slender Blue-tongue									1			1
Egernia depressa	Pygmy Spiny-tailed Skink								2				2
Lerista neander	Skink								1				1
Menetia greyii	Common Dwarf Skink							2	1				3
Menetia surda subsp. *surda*	Skink						6						6
Morethia ruficauda subsp. *exquisita*	Fire-tailed Skink					5	2						7
Tiliqua multifasciata	Central Blue-tongue Lizard					3	5	4	5	3			20
TYPHLOPIDAE													

Species	Common Name	Conservation Status				Total Number of Individuals by Site							
		EPBC Act	BC Act	DBCA	IUCN	VCOW-02	VCOW-05	VCOW-06	VCOW-08	VCOW-09	VCOW-10	Other sampling sites/ Opportunistic records	Total
Anilios ammodytes	Blind Snake								1				1
Anilios grypus	Blind Snake									1			1
VARANIDAE													
Varanus acanthurus	Spiny-tailed Monitor					5	2	1				1	9
Varanus caudolineatus	Stripe-tailed Pygmy Monitor						1						1
Varanus panoptes	Yellow Spotted Monitor										2	1	3
Varanus pilbarensis	Pilbara Rock Monitor					1							1
Varanus tristis subsp. *tristis*	Racehorse Goanna								1				1
AMPHIBIANS													
PELODRYADIDAE													
Cyclorana maini	Sheep Frog						90	57	104	35	100	56	442
Litoria rubella	Little Red Tree Frog						2	5	7	6	1	1	22
Total number of individuals recorded						**121**	**325**	**386**	**416**	**256**	**450**	**923**	**2,888**