biologic

Orebody 31 Vertebrate Fauna Survey

BHP Billiton Pty Ltd

January 2014

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EXECUTIVE SUMMARY

Biologic Environmental Survey (Biologic) was commissioned by BHP Billiton Iron Ore Pty Ltd to undertake a second season Level 2 vertebrate fauna survey of BHP Billiton Iron Ore's (BHPBIO's) Orebody 31 (OB 31) (the Study Area). This survey is to complement the Level 1 vertebrate fauna survey undertaken within the Study Area by ENV in January 2011.

This Study Area is approximately 6 km north of the Jimblebar/ Wheelarra Hill mining operations located in the eastern Ophthalmia Range approximately 40 km east of Newman in the Eastern Pilbara region of Western Australia. A field survey with trapping was conducted from 2-11 October 2013, and a night-time sampling survey was conducted from 2-6 December 2013.

The purpose of the survey was to:

1. Undertake a comprehensive fauna database review for the Study Area for Threatened, Specially Protected and Priority Fauna.
2. Undertake a comprehensive literature review of previous fauna surveys and records within and close to the Study Area.
3. Undertake additional fauna habitat assessments of the Study Area to further define and delineate main fauna habitats present.
4. Undertake a second-season Level 2 (as per Guidance Statement 56) vertebrate fauna survey.

A total of 269 vertebrate faunal species may occur in the OB 31 Study Area, based upon previous records, known distributions and habitat preferences of species. Upon completion of the current study, a total of 120 native vertebrate taxa have been recorded within the Study Area. This comprises 20 native mammal species, 56 bird species, 43 reptile species and one amphibian species. A further six species of introduced mammals have also been recorded.

Five conservation significant species have been recorded within the Study Area to date:

- Brush-tailed Mulgara *Dasycercus blythi* - Listed as Priority 4 by the Department of Parks and Wildlife (DPaW). Status under review by Department of Environment (DSEWPaC 2012);
- Western Pebble-mound Mouse *Pseudomys chapmani* – DPaW Priority 4;
- Australian Bustard *Ardeotis australis* – DPaW Priority 4;

- Rainbow Bee-eater *Merops ornatus* – Listed as Migratory under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) and on Schedule 3 of the *Wildlife Conservation Act 1950* (WCA); and
- Fork-tailed Swift *Apus pacificus* – EPBC Migratory, WCA Schedule 3.

According to online databases and previous surveys in the vicinity, an additional 13 conservation significant species have been recorded from adjoining areas. Of these, only the Bush Stone-curlew (likely), Oriental Plover (possible) and Pilbara Flat-headed Blindsnake (likely) may potentially occur within the Study Area due to availability of suitable habitats.

Five broad fauna habitats were identified within the Study Area:

1. Sand Plain;
2. Minor Drainage Line;
3. Drainage Area;
4. Crest/ Slope; and
5. Gorge/ Gully.

The habitats of greatest significance are the Sand Plain and the Gorge/ Gully habitat, as they provide potential habitat for a number of conservation significant fauna, including but not limited to, the Brush-tailed Mulgara, Australian Bustard and Rainbow Bee-eater.

1 INTRODUCTION

Biologic Environmental Survey (Biologic) was commissioned by BHP Billiton Iron Ore Pty Ltd (BHPBIO) to undertake a second season Level 2 vertebrate fauna survey of BHPBIO's Orebody 31 (OB 31), hereafter referred to as the 'Study Area'. This survey is to complement the Level 1 vertebrate fauna survey undertaken within the Study Area by ENV in January 2011.

The Study Area, covering an area of 33.35 km^2 (3335.85 ha), is located approximately 6 km north of the Jimblebar/ Wheelarra Hill mining operations. These operations are located in the eastern Ophthalmia Range approximately 40 km east of Newman in the Eastern Pilbara region of Western Australia.

The current vertebrate fauna assessment will be used to inform future environmental approvals across the Study Area, and is not assessing any specific development proposed by BHPBIO.

This report provides:

1. A comprehensive fauna database review for the Study Area considering:
    - Threatened fauna listed under the IUCN Red List;
    - Threatened fauna or migratory species listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC);
    - Declared Threatened Fauna and Other Specially Protected Fauna listed under the latest *WA Wildlife Conservation (Specially Protected Fauna) Notice 2012(2)*; and
    - Priority Fauna recognised by the Department of Parks and Wildlife (DPaW).

    The databases reviewed were:
    - Commonwealth Department of the Environment (DoE) Protected Matters database;
    - WA Department of Parks and Wildlife's (DPaW) Threatened Fauna database; and
    - DPaW and WA Museum's (WAM) NatureMap.
2. A review of all previous vertebrate fauna surveys undertaken within the Study Area or immediate surrounds. This review includes a summary of survey methods, main findings and conservation significant species recorded during the survey, along with their current status.
3. Fauna habitat assessments describing and mapping fauna habitat within the Study Area.

4. An assessment of the likelihood of habitat within the Study Area to support significant species listed in point 1 above.
5. A list of all fauna species recorded, via primary or secondary evidence, within the Study Area, including those recorded during the previous survey (ENV, 2011); and
6. The results of a single-season level 2 trapping survey and a targeted survey for species of conservation significance (as listed in point 1, above). Maps are provided showing the locations of species recorded during the survey, and previous records of conservation significant fauna determined via the literature and database reviews.

BHP
Marillana Creek
Western Mesa 4

BHP
Yandi

PMI
Phils Creek

Yandicoogina
HI-Yandi

Yandicoogina
HI-Yandi JSE

Mining
Area C
MAC-E

BHP
Area C

Weeli Wolli Springs

RIO TINTO
Hope Downs

Mount Robinson

GREAT NORTHERN HIGHWAY

Hope Downs
Joint Venture
HD4

MARBLE BAR ROAD

FORTESCUE RIVER

BHP
Orebody 24-25

BHP
Orebody 18

BHP
Mt Whaleback

NEWMAN

BHP
Orebody 35

BHP
Jimblebar (Project)

BHP
Jimblebar-Wheelarra-Hashimoto
1-4

JIGALONG
ABORIGINAL
RESERVE

JIGALONG
ABORIGINAL
RESERVE

JIGALONG
ABORIGINAL
RESERVE

SPEARHOLE CREEK

WESTERN CREEK

GREAT NORTHERN HIGHWAY

SAVORY CREEK

LOCATION MAP

biologic

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Datum: GDA94
Projection: MGA Zone 51

BHPBIO
OB31

Regional location
Figure 1.1

Legend

- Study Area
- Indigenous Reserve
- Watercourses
- Roads
- Railways
- Project Site
- Operating Mine site

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2 ENVIRONMENT

2.1 Biogeography

The Study Area falls within the Fortescue Plains subregion (PIL2) of the Pilbara Bioregion as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Creswell 1995). The Study Area lies at the southern extremity of the Hamersley subregion, ~400 m east of the Hamersley subregion (PIL3) and ~7.8 km north of the Augustus subregion (GAS3) of the Gascoyne Bioregion (Figure 1.1).

The Fortescue Plains subregion contains the Fortescue Marsh which is listed as a nationally important wetland (Environment Australia 2001) and a proposed Ramsar site (DEC 2009). Outside the Marsh this subregion is characterised by River Red Gum woodlands fringing drainage lines and deeply incised gorge systems (Kendrick 2001).

2.2 Climate

The Pilbara region has a semi-desert to tropical climate. Rainfall events within the region are often sporadic and can occur within both summer and winter months, but mostly during the former season. Summer rainfall is a result of either tropical storms in the north or tropical cyclones that impact upon the coast and move inland. 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 about 200 to 350 mm, but there are significant fluctuations between years (Department of Water 2012) with up to 1200 mm falling in certain locations in some years (Niewiarowski & Reisinger 2007).

Temperatures vary significantly throughout the year with average maximum summer temperatures reaching 35°C to 40°C and winter temperatures generally fluctuating between 22°C and 30°C.

The climate of the OB 31 area is semi-arid, hot and mostly dry, with an average annual rainfall of 317.8 mm at Newman Aero (Figure 2.1). Most rainfall generally occurs in the summer rain season from December to June with occasional major deluge events from cyclones during the summer. Massive rainfall is associated with the summer cyclone season. These large rainfall events can result in flash flooding and extensive overland flooding. Watercourses are generally dry for most of the year and only flow after significant rainfall events. Creek flows subside rapidly after flooding, often within a few days to a week. River systems can flow for several weeks to a month, following a flood

event before drying up. However, water is retained in waterholes along the watercourses and in rock pools in gorges for many months into the dry season.

Scattered thunderstorms provide the majority of non-cyclonic rain with an average of 15 to 20 thunderstorms occurring each year, again mostly during summer. Infrequent and unreliable winter rain also occurs. Daily temperatures are often greater than 40°C for extended periods during summer.

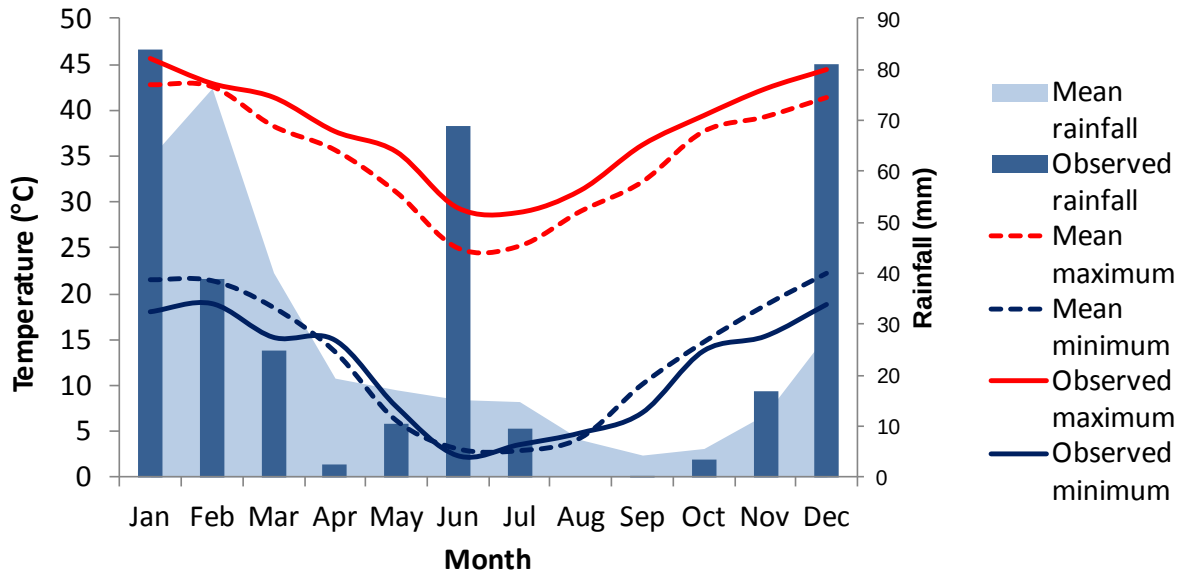

Figure 2.1 Average monthly temperature and rainfall observations at Newman Aero from January to December 2013, compared with longer-term climatic averages (Bureau of Meteorology 2013).

2.3 Physical environment

The Study Area is located east of the south-eastern boundary of the Ophthalmia Ranges, which forms part of the Hamersley Ranges to the north and west. The Newman region, characterised by Banded Iron Formations (BIFs) and Late Archaean greenstones, occurs to the west, giving way to the Early Archaean granitoids and metagabbro intrusive of the Augustus region to the south.

The Study Area itself is mostly flat in the southern section, covered in Cainozoic colluvial and alluvial plains. It is crossed by a horizontal ridgeline towards the central-eastern side of the Study Area which contains a series of north-south heading gullies and gorges. The Study Area largely comprises banded jaspilite and chert along with shales. The north-east section of the Study Area comprises soils associated with the Fortescue Valley: the surface is covered by stony gravels close to the ranges and

hills with acid red earths (Gn2.11) and some neutral red earths (Gn2.12). Red-brown hardpan is largely absent (Thorne & Tyler 1997). The Study Area mostly consists of the Newman Land System in the central section, Boolgeeda Land System along the north and south borders and Washplain Land System in the south-west.

2.4 Vegetation

Vegetation mapping of the Pilbara region was completed on a broad scale (1:1,000,000) by Beard (1975). According to Beard (1975), who broadly mapped the area as 'ranges and valley plains', the Study Area is situated in the Hamersley Plateau in the Eremaean Botanical Province of Western Australia. The ranges are described as a tree steppe of the *Eucalyptus- Triodia* association with a change to *Eucalyptus* mallee at the summits. The valley plains mainly carry Mulga low woodlands to shrubland (*Acacia aneura*) with some areas of open *Triodia* grassland. Shepherd *et al.* (2002) re-assessed the mapping of Beard (1975), updated the vegetation boundaries to account for clearing in the intensive land use zone, and divided some larger vegetation units into smaller units. For example, Vegetation type 82, described by Shepherd *et al.* (2002) corresponds with 'ranges and valley plains' of Beard (1975) as described above.

2.5 Surface Hydrology

The Study Area is located in the upper portion of the Fortescue River catchment, which drains to the Fortescue Marsh (RPS Aquaterra 2012). Jimblebar Creek, which drains north, is the major drainage line to the east of the Study Area, while Shovelanna Creek (running west) drains the south and western parts of the Study Area. Due to climatic conditions, these creeks are ephemeral with typically one to three flow events per year (RPS Aquaterra 2012). The broad central valley running central/ west to east throughout the Study Area forms a palaeodrainage channel which is filled with clay soils and shows evidence of periodic flooding/ sheet flows.

As mentioned previously (Section 2.2) the average annual rainfall at Newman Aero is approximately 310 mm, but rainfall occurs mainly as tropical summer storms, and annual totals vary widely. Drainage lines flow only after prolonged heavy rain, as short-duration flooding with rapid peaks and slightly less rapid decline. Along major watercourses, including the Fortescue River, water tends to pond and may persist as pools for several weeks to months.

2.6 Existing land use

The dominant land uses in the region including pastoralism and mining, but also include conservation, urban areas, recreation, and tourism (Kendrick 2001). Several iron ore mines and their

associated infrastructure are currently active in the area in close proximity to the Study Area, including Orebody 18 and Jimblebar, with more are expected to come online in the next few years. The Study Area is covered by the mineral lease AML7000244. It is also part of the Sylvania pastoral station, which is used for cattle grazing.

3 METHODOLOGY

3.1 Compliance

This literature and database review as well as field survey, was carried out in a manner consistent with the Western Australian (WA) Environmental Protection Authority (EPA), WA Department of Parks and Wildlife (DPaW) and BHPBIO's requirements for the environmental surveying and reporting of fauna, including the following documents:

- EPA Position Statement No. 3, Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002, or its revision);
- EPA Guidance No. 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004, or its revision);
- Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (WA Department of Environment and Conservation [DEC]/EPA, 2010);
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Bats;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Birds;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Mammals;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Reptiles;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Frogs;
- BHPBIO (2011) Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-012);
- BHPBIO (2010) Terrestrial Fauna Habitat Assessment Proforma (FRM-IEN-EMS-003);
- BHPBIO (2011) Biological Survey Spatial Data and Digital Photography Requirements (SPR-IEN-EMS-015); and
- BHPB Western Australia Projects Biological Survey Data Templates (FRM-IEN-EMS-002).

3.2 Literature and database review

A review of all publicly available literature relevant to the Study Area and nearby areas, and additional reports commissioned and held by BHPBIO, was undertaken in November 2013. The reports reviewed are listed below (Table 3.1).

Table 3.1 Reports used for the review.

Survey Title	Consultant	Year	Survey Type
Jimblebar Hub			
Jimblebar Mine Site Biological Survey (BHP Iron Ore Pty Ltd 1994)	BHP Iron Ore	1994	1 season with trapping
Jimblebar Wheelarra Hill 3 Flora and Fauna Assessment (Biota 2004)	Biota	2004	1 season no trapping
Jimblebar-Wheelarra Hill Expansion Biological Survey (ecologia Environmental 2004)	ecologia	2004	1 season with trapping
Jimblebar East Exploration Project Biological Survey (ecologia Environmental 2005)	ecologia	2005	1 season no trapping
Jimblebar Hashimoto Vertebrate Fauna Assessment (ecologia Environmental 2006a)	ecologia	2006	2 season with trapping
Jimblebar Marra Mamba Exploration Biological Survey (ecologia Environmental 2006b)	ecologia	2006	1 season, no trapping
West Jimblebar Fauna Assessment (ENV 2007b)	ENV Australia	2007	1 season, with trapping
Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology Services 2009c)	Outback Ecology	2009	2 season with trapping
Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback Ecology Services 2009a)	Outback Ecology	2009	2 season with trapping
Wheelarra Hill North Fauna Assessment (ENV Australia 2012)	ENV Australia	2012	2 seasons with trapping
Mt Newman Orebodies			
Orebody 18 Biological Assessment Survey (ecologia Environmental 1995)	ecologia	1995	1 season, with trapping
Orebody 18 Fauna Assessment Phase II (ENV 2007a)	ENV Australia	2007	1 season, with trapping
Orebody 31 Fauna Assessment (ENV 2011) [1]	ENV Australia	2011	1 season no trapping
Ore Body 19 Level 2 Vertebrate Fauna Survey (Biologic 2013a)	Biologic	2013	2 seasons with trapping

[1] Considered as the Season 1 of the current project.

Three databases were searched to obtain information on species previously recorded during field surveys (NatureMap) or species of conservation significance likely to occur within the Study Area (Protected Matters Database) (Table 3.2):

- DPaW's NatureMap database – to determine threatened fauna recorded from the region which also incorporates the results of the Pilbara Biological Survey (DEC 2006).
- DPaW's Threatened Fauna Database - to determine the most up to date threatened fauna recorded from the region.
- Department of the Environment (DoE) Protected Matters Database – to determine matters of national environmental significance likely to occur within the area based on bioclimatic modelling.

Table 3.2 Databases used for the review.

Provider	Database	Parameters
Department of Parks and Wildlife & WA Museum	NatureMap. Accessed 11 November 2013	Circle of radius 5 km centred on the point - 120º 07' 18" E, 23º 18' 37" S
Department of the Environment	Protected Matters Database Search Tool. Accessed 11 November 2013	Circle of radius 5 km centred on the point - 120º 07' 18" E, 23º 18' 37" S
Department of Parks and Wildlife	Threatened Fauna Database search	Circle of radius 30 km centred on the point - 119º 56' 17 " E, 23º 18' 24" S

3.3 Field assessment

A two season field assessment was undertaken: a Level 1 survey by ENV between 28 February and 2 March 2011 and 29 March and 1 April 2011 (first season), and a Level 2 survey by Biologic from 2 to 11 October 2013 (second season). Additionally, Biologic undertook nocturnal surveys in the Study Area from 2 to 6 December 2013. The purpose of these surveys were to verify the data collated during the literature and database reviews, map and describe the fauna habitats present within the Study Area, and undertake trapping and targeted surveys for fauna of conservation significance. The vertebrate fauna sampling for the second season of survey was conducted under the "Licence to Take Fauna for Scientific Purposes" No. SF009118 issued to M. O'Connell.

ENV also conducted a fauna assessment at Wheelarra Hill North (ENV 2012), of which some sampling sites overlapped with the southern section of the current Study Area (Figures 3.2, 4.1).

The following sections discuss methods used predominantly to Season 2 of the sample program only. Refer to ENV (2011) for details of methodologies employed for Season 1.

3.3.1 Survey team

Season 1: The following personnel undertook the first season of field work.

Mr Matthew Love	Senior Zoologist
Mr John Trainer	Zoologist

Season 2: The following personnel undertook the second season of field work.

Mr Thomas Rasmussen	Senior Zoologist
Mr Brad Maryan	Senior Zoologist
Dr Drew Gardner	Senior Zoologist
Dr Ruchira Somaweera	Senior Zoologist
Mrs Claire Brooks	Zoologist

Mr Bob Bullen of Bat Call WA, analysed the recordings from the Songmeter SM2BAT and Echometer detector systems used during the survey.

3.3.2 Climatic conditions

Data recorded at the Newman Aero weather stations during the four field surveys of the Study Area are presented in Figure 3.1 and long-term meteorological data at Newman Aero are presented in Figure 2.1. Weather during the surveys was generally consistent with the long-term average values for the respective months.

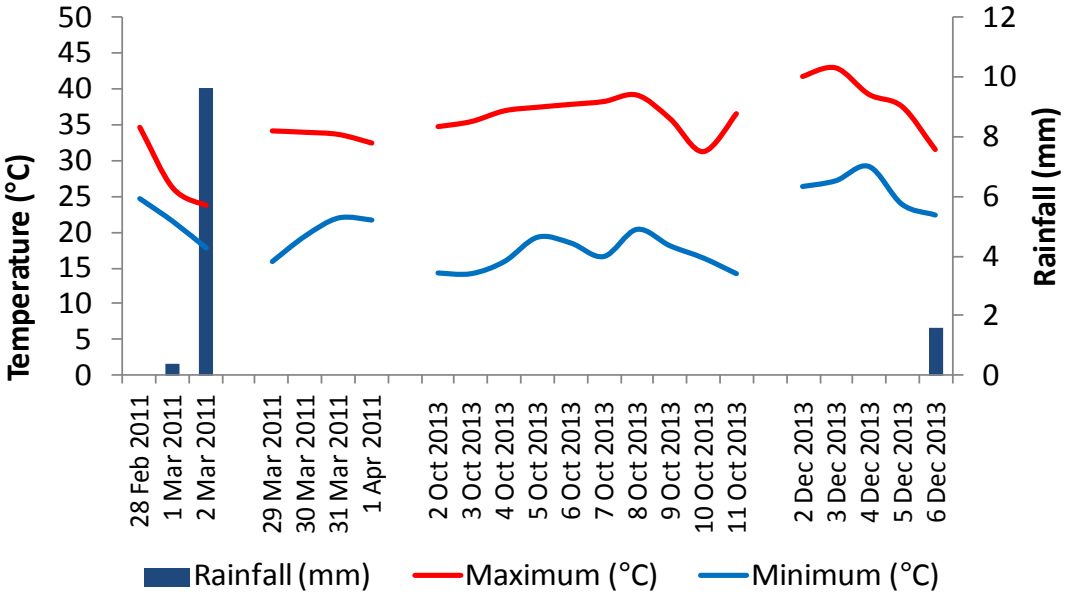

Figure 3.1 Daily temperatures and rainfall at Newman Aero during studies undertaken for this report. The field surveys were conducted between 28 Feb- 2 Mar 2011 (by ENV), 29 Mar- 1 Apr 2011 (by ENV), 2-11 Oct 2013 (by Biologic) and 2-6 Dec 2013 (by Biologic).

3.3.3 Bat surveys

Season 1: No bat recordings were undertaken during the first season Level 1 survey (ENV 2011). Two bat detector sites from the Wheelarra Hill North survey occur within the southern portion of the Study Area (ENV 2012) (Figure 3.2).

Season 2: Twenty eight overnight recordings of bat echolocation calls were made with four SM2BAT+ detectors (Wildlife Acoustics, USA) during the Season 2 survey. Recorders were placed in habitats deemed most likely to be attractive as foraging grounds to bats, such as drainage lines and woodlands (Department of Environment 2010). A total of nine locations were surveyed (Figure 3.2, Appendix A). The jumper and audio settings used for the SM2BAT+ followed the manufacturer's recommendations contained in the user manual (Wildlife Acoustics 2010). Selectable filters and triggers were also set using the manufacturer's recommendations. Bat calls were analysed by Mr Bob Bullen of Bat Call WA, a recognised expert in the field.

3.3.4 Motion sensitive cameras

Season 1: No remote camera trapping was undertaken during the first season Level 1 survey (ENV 2011). Motion sensitive video cameras were used during the Wheelarra Hill North survey, four of which overlap with the Study Area (ENV 2012) (Figure 3.2).

Season 2: Motion sensitive video cameras were used to survey for larger mammals, including introduced predators. Ten cameras were utilised, set at various locations in habitats likely to support target fauna such as Sand Plains and Gorge/ Gully habitats and also outside fresh burrows (Figure 3.2, Appendix A). A total of 84 hrs of motion camera survey was undertaken within the Study Area during Season 2 of the survey. The resulting footage was analysed visually.

3.3.5 Trapping

Season 1: No trapping was conducted during this first season Level 1 survey (ENV 2011). Two trapping sites undertaken as part of the Wheelarra Hill North survey occur within the Study Area (ENV 2012) (Figure 3.2).

Season 2: Traps were installed at five sites during Season 2. Site locations were chosen to represent all fauna habitats present in the Survey Area, based on aerial photography, prior knowledge of the area and proximity to access tracks.

At each site, traps were arranged as a linear transect of discrete trap units through the habitat being targeted. Each site consisted of 10 trap units. Each trap unit consisted of:

- A pitfall trap - either a 20 L bucket or a 50 cm length of stormwater PVC pipe with a diameter of 160 mm dug in to the ground, and bisected by a 6 m long, 30 cm high fence impermeable to ground-dwelling fauna.
- Funnel traps – placed at both ends of the fence.
- Elliott traps - twenty Elliott traps (9 x 9 x 32 cm) were placed in a line adjacent to the line of trap units.
- Cage traps - one cage trap (20 x 20 x 40 cm) was set at each end of the trap transect.

The Elliott and cage traps were baited daily with universal bait (a mixture of rolled oats, sardines and peanut butter).

Each trap site therefore consisted of 52 traps (five bucket, five pipe, 20 funnel, 20 Elliott and two cage traps). Shade covers were used over funnel and Elliot traps which reduce the likelihood of exposure related trap death, and all traps were cleared by no later than three hours after sunrise.

Traps were left open for seven nights during the survey (a total of 1820 trap nights during the survey). Details of the five trapping sites installed are provided in Appendix A and their locations are shown in Figure 3.2.

Some of the trapping sites of ENV's Wheelarra Hill North fauna survey (ENV 2012) overlapped with the southern section of the current Study Area (Figures 3.2).

3.3.6 Targeted fauna survey

Season 1: The purpose of the field survey was to verify the accuracy of the desktop survey and to further delineate and characterise the habitat present in the Study Area. Targeted searches were conducted at the 11 locations were habitat assessments were undertaken and opportunistic records of vertebrate fauna species documented.

Season 2: The following surveys were conducted.

Targeted transects

Targeted transect locations were selected to represent all the major habitat types present within the Study Area. During the targeted transects, the team recorded all vertebrate fauna species encountered, either from primary (i.e. direct observation) or secondary (e.g. burrows, scratchings, diggings and scats) evidence of significant species. Habitats were actively searched for secondary evidence. When diggings, burrows or scats were observed, a general search of the area determined the extent of burrows.

Nocturnal survey

Four night surveys, each with 3-4 observers, were conducted between 18:00 and 22:00 from 2-6 December 2013. Surveys utilised two vehicles and traversed roads within the Study Area at low speed with spotlights searching for fauna. Searches were also undertaken on foot within 200 m of the vehicles in habitat suitable for the target species. Nocturnal searches targeted crepuscular or highly nocturnal fauna such as night birds, mammals, amphibians and reptiles such as snakes and geckos that may be largely hidden during the day.

Bird surveys

Four bird surveys, each lasting 20 minutes, were conducted at seven sites, including four of the trapping sites (Figure 3.2: Birding). All bird surveys were completed by 10.00 a.m to ensure coverage of the period of greatest bird activity. Surveys were conducted by walking through the habitat and recording all birds observed using binoculars and identifying by their calls.

3.3.7 Incidental records

At all times while surveying, all records pertaining to species not previously recorded during the survey, rare or conservation significant fauna or other fauna of interest were documented. These records included indirect evidence such as tracks, scats and any other traces, as well as incidental sightings of live animals. Efforts were made to target likely microhabitats, such as by turning rocks, logs and anthropogenic debris such as discarded sign boards, tyres etc.

3.3.8 Habitat assessment

Season 1: A total of 11 fauna habitat assessments were carried out across each of the fauna habitats present in the Study Area during the first season Level 1 survey (ENV 2011) (Figure 3.2; Appendix D). Three habitat assessments undertaken as part of the Wheelarra Hill North survey occur within the Study Area (ENV 2012) (Figure 3.2).

Season 2: Thirty five fauna habitat assessments were conducted during this season (Figure 3.2; Appendix D). Habitats in the Study Area were assessed using methodology and terminology adapted from the *Australian Soil and Land Survey Field Handbook* (Commonwealth Scientific and Industrial Research Organisation 2009) and modified to suit the survey requirements according to BHPBIO guidelines. 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: disturbance, condition, leaf litter %, twig litter %, wood litter, dead stags and hollow bearing trees, broad floristic formation, tree structure (tall, mid and low), shrub structure (tall, mid and low), grass structure (tall, mid and low), dominant trees, shrubs, mistletoes, grasses and herbs;
- land surface: microrelief, 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; and
- substrate: bare ground, rock size, rock type, rock outcropping.

Fauna habitats were also assessed for the likelihood that they may support conservation significant fauna. All major fauna habitats present within the Study Area were sampled and scored for significance (High, Medium or Low) according to the criteria shown in Table 3.3 below. Conservation significant habitats are discussed in Section 6.

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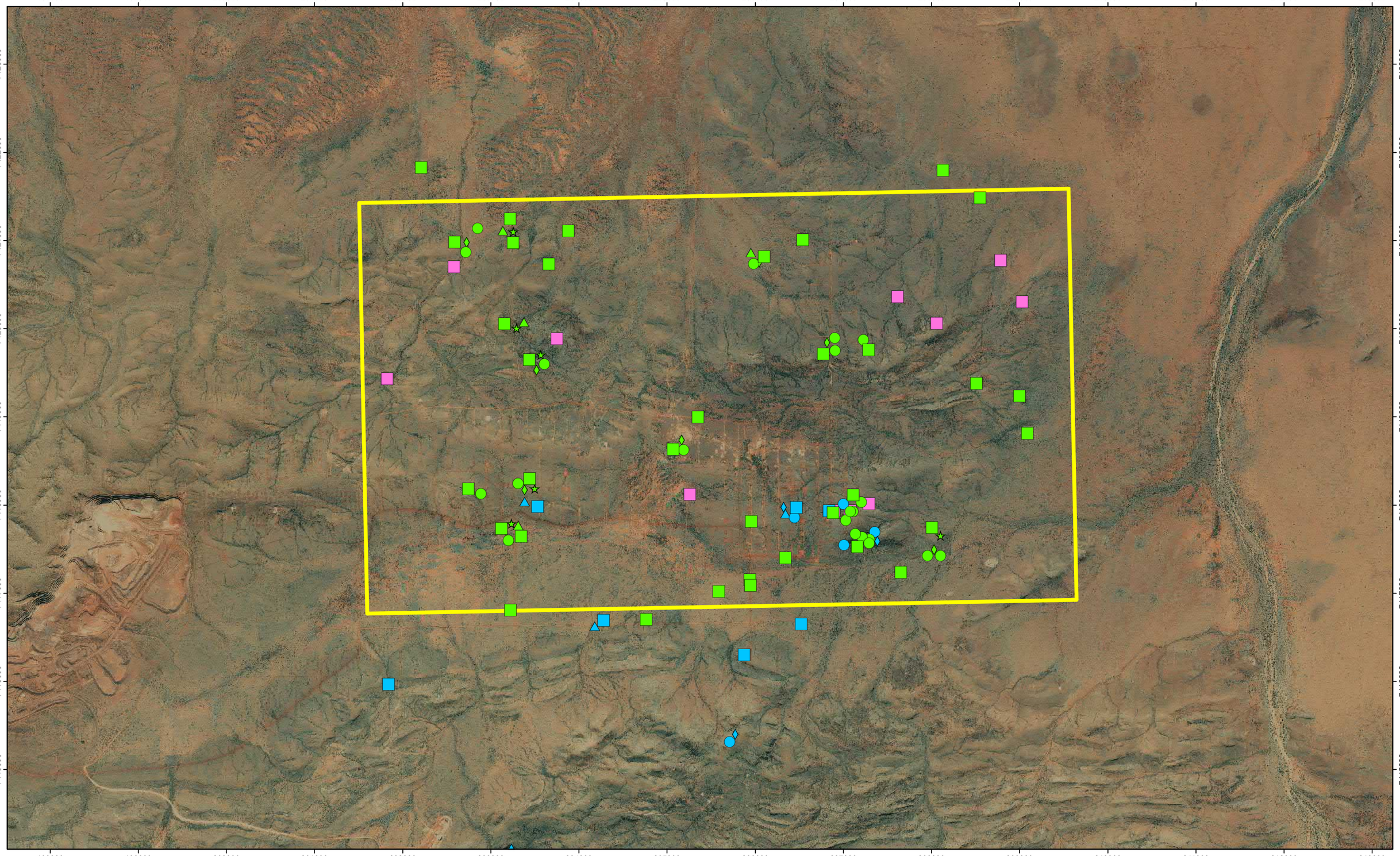

BHPBIO
OB 31
SAMPLING EFFORT AT THE STUDY AREA

FIGURE 3.2

biologic

FIGURE:	3.2	Date:	27 Feb. 2014
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Projection: MGA Zone 51

Legend

Study Area

Consultant
- Biologic
- ENV, 2011
- ENV, 2012

Survey Effort
- Bat Detector
- Birding
- Habitat Assessment
- Motion Camera
- Trapping Site

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3.4 Assessment of fauna habitat significance

Fauna habitats were also assessed for the likelihood that they may support conservation significant fauna. All major fauna habitats present within the Study Area were sampled and scored for significance (High, Medium or Low) according to the criteria shown

Table 3.3 below. Conservation significant habitats are discussed in Section 6.

Table 3.3 Fauna habitat significance assessment criteria.

Score	Criteria
High	Habitat supports EPBC listed threatened fauna. *OR* Habitat for species listed as above is present in the Study Area, and there are records of that species within 50 km of the Study Area. If limited surveys have been undertaken in the vicinity of the Study Area then a precautionary approach will be used and the species will be considered likely to be present. *OR* Uncommon habitat is critical habitat for a population of DPaW listed Priority fauna. For example, if habitat is limited in the region and the habitat in the Study Area forms a significant portion of the known habitat for a Priority species, it would be scored as High significance. *OR* Habitat that only occurs in small isolated geographic areas.
Medium	Habitat supports DPaW listed Priority fauna that are largely restricted to that habitat type within the Study Area. *OR* Habitat supports EPBC listed Migratory fauna. *OR* Habitat supports a particularly diverse and uncommon faunal assemblage. Habitat that occurs throughout region, and does not occur in small or isolated areas, is excluded.
Low	Habitat is widespread, common, and does not solely support any significant fauna.

3.4.1 Potential limitations and constraints

EPA Guidance Statement No. 56 (EPA, 2004) outlines several potential limitations to fauna surveys. These aspects are assessed and discussed in Table 3.4 below.

Table 3.4 Survey limitations and constraints.

Potential limitation or constraint	Applicability to this survey
Experience of personnel.	The field personnel involved in the survey each had five or more years of fauna survey experience. The team collectively had over 70 years of field experience in the region.
Scope	The scope was a two season survey and was conducted within that framework. ENV (2011) conducted a Level 1 survey as season 1 and Biologic a Level 2 survey as season 2. Biologic also conducted a separate nocturnal survey. The survey scope was suitable for a Level 2 survey.
Proportion of fauna identified	All observed fauna were identified at the point of observation. All recorded bat calls were identified; however due to identical characteristics in the calls of some bat species within a genus, it was not possible to differentiate all species using calls. Nevertheless all conservation significant species of bats were identified to species level.
Sources of information (recent or historic) and availability of contextual information	The Wheelarra North survey by ENV (2012) partially overlapped the current Study Area, and a number of other studies have been undertaken in the surrounding region. DPaW has also completed the Pilbara Biological Survey which provided information on regional distribution of selected species. These reports were available at the time this document was prepared.
Proportion of the task achieved	A two-season survey with a Level 1 first season and a Level 2 second season of the Study Area was completed, and related to the results of surveys in the broader area.
Disturbances (e.g. fire or flood).	Heavy rain prevented the sampling between 12:00-18:00 on 6 December, but did not affect the intended night work during the trip. No other disturbances affected the outcomes of the survey.
Intensity of survey.	A two-season survey was identified by BHPBIO as the requirement for this survey. A Level 1 first season and a Level 2 second season were undertaken.
Completeness of survey.	A Level 1 first season and a Level 2 second season were completed.
Resources (e.g. degree of expertise available).	All resources required to complete the survey were available.
Remoteness or access issues.	All sections in the tenement were accessible either by vehicle or on foot; all habitats within the Study Area were surveyed and all habitats considered to be suitable for conservation significant species were surveyed.

3.5 Taxonomy and nomenclature

The latest checklist of mammals, reptiles and amphibians published by the WA Museum (DEC and WAM 2013) were used as a guide to the current taxonomy and nomenclature of these groups. This

updated list in turn is formulated using up-to-date taxonomical literature. For birds, the current checklist of Australian birds, maintained by Birds Australia, was used. The bird list is based on the most recent review of the systematics and taxonomy of Australian birds by Christidis and Boles (2008).

3.6 Assessment of conservation significance

Within Western Australia, all native fauna is protected under the *Wildlife Conservation Act 1950* (WCA) and any action that has the potential to impact on native fauna needs to be approved by relevant State and/or Federal departments as dictated by the State *Environmental Protection Act 1986* and the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC).

Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are called conservation significant species. A summary of applicable legislation and status codes is provided in Table 3.5. Additional information on Status Codes is provided in Appendix B.

A number of migratory bird and marine species are prioritised for conservation under the EPBC or international agreements. In addition the International Union for the Conservation of Nature (IUCN) compiles a 'Red List' upon which species at risk of extinction are listed.

For some species there is insufficient information to determine their status. These species are generally considered by the EPA/ DPaW as 'conservation significant' for all development related approvals and are listed on a 'Priority List' which is regularly reviewed and maintained by the DPaW.

DPaW also identifies 'Threatened Ecological Communities' (TECs) that are naturally occurring biological assemblages found to fit into one of the four categories (Table 3.5). Possible TECs that do not meet these survey criteria are added to DPaW's 'Priority Ecological Communities' (PECs) lists under Priorities 1, 2 and 3.

Table 3.5 Conservation significance assessment guidelines.

Agreement, Act or List	Status Codes
International Level	
The IUCN Red List lists species at risk under nine categories (listed under 'Status Codes').	IUCN Extinct IUCN Extinct in the Wild IUCN Critically Endangered IUCN Endangered IUCN Vulnerable IUCN Near Threatened IUCN Least Concern IUCN Data Deficient IUCN Not Evaluated
Migratory taxa listed under the following international conventions are generally listed as Migratory or Marine under the federal Environment Protection and Biodiversity Conservation Act 1999 (see below): Japan-Australia Migratory Bird Agreement (JAMBA); China-Australia Migratory Bird Agreement (CAMBA); Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA); and, Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).	Generally listed as Migratory or Marine under the federal Environment Protection and Biodiversity Conservation Act 1999
Federal Level	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC) DSEWPaC lists threatened fauna, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists fauna that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes').	Extinct Extinct in the Wild Critically Endangered Endangered Vulnerable Conservation Dependent Migratory Marine
Threatened Ecological Communities (TECs) are those that are at risk of extinction.	Critically Endangered Endangered Vulnerable
State Level	
Wildlife Conservation Act 1950 (WCA) At a state level, native fauna are protected under the Wildlife Conservation Act 1950. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable.	Schedule 1 Schedule 2 Schedule 3 Schedule 4

Agreement, Act or List	Status Codes
DPaW Priority list (DPaW) The DPaW produces a list of Priority species and ecological communities (e.g. Priority Ecological Communities (PECs) or Threatened Ecological Communities (TECs)) that have not been assigned statutory protection under the Wildlife Conservation Act 1950. This system gives a ranking from Priority 1 to Priority 5.	Priority 1 Priority 2 Priority 3 Priority 4 Priority 5

4 RESULTS

4.1 Desktop review

4.1.1 Previous surveys

A review of fauna survey reports relevant to the Study Area was undertaken in November 2013 to expand upon the review conducted by ENV (2011). A total of 13 fauna surveys have been completed within and in the vicinity of the Study Area since 1994 (in addition to the two seasons of the current survey). These include one desktop review (comprising a database search and review of previous relevant surveys), three Level 1 surveys (comprising a desktop review as well as a reconnaissance field survey) and five single-season Level 2 surveys (comprising a desktop review with a more robust field sampling programme including trapping over two seasons). Table 4.1 shows the distance of these survey sites from the Study Area, a summary of the methodology used and the conservation significant species recorded.

Four of the studies partially overlapped with the current Study Area or were in the immediate vicinity (<10 km) of the Study Area. The localities and methodologies used during these previous surveys within and in the vicinity of the Study Area are summarized in Table 4.1 and the locations shown in Figure 4.1.

Table 4.1 Survey effort for surveys in the vicinity of OB 19

Survey	Jimblebar Biological Survey	Orebody 18 Biological Assessment Survey	Jimblebar Wheelarra Hill 3 Flora and Fauna Assessment	Jimblebar-Wheelarra Hill Expansion Biological Survey	Jimblebar East Exploration Project Biological Survey	Jimblebar Hashimoto Vertebrate Fauna Assessment	Jimblebar Marra Mamba Exploration Biological Survey	Orebody 18 Fauna Assessment Phase II	Jimblebar West Fauna Assessment	Jimblebar Wheelarra Hill Flora and Fauna Assessment	Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment	Orebody 31 Fauna Assessment	Wheelarra Hill North Fauna Assessment	Ore Body 19 Level 2 Vertebrate Fauna Survey	Current survey
Consultant	BHP Iron Ore	ecologia	Biota	ecologia	ecologia	ecologia	ecologia	ENV Australia	ENV Australia	Outback Ecology	Outback Ecology	ENV Australia	ENV Australia	Biologic	Biologic
Year	1994	1995	2004	2004	2005	2006	2006	2007	2007	2009	2009	2011	2012	2013	2013
Type	1 season with trapping Level 2	1 season with trapping Level 2	Desktop review	1 season with trapping Level 2	1 season No trapping Level 1	2 season with trapping Level 2	1 season No trapping Level 1	1 season with trapping Level 2	1 season with trapping Level 2	2 season with trapping Level 2	2 season with trapping Level 2	1 season No trapping Level 1	2 season with trapping Level 2	2 season with trapping Level 2	1 season with trapping Level 2
Distance to Study Area	~4.5 km S	Immediate SW	~3.4 km S	~4.5 km S	~17 km E	~4.3 km SE	~4.5 km S	Immediate SW	~5 km SW	~3.2 km S	~3.2 km S	Study Area	Partially overlap in South	~3.6 km W	Study Area
Duration	11-22 Jun 1994	10 – 19 Aug 1995	28,29 Aug 2003[2]	9 Feb – 13 Mar 2004	8 Feb – 14 Feb 2005	26 Aug – 16 Sep 2005, 6 – 15 Feb 2006	2-28 May 2006	18 - 29 Sep 2006	14-21 May 2007	4-15 Jun 2008, 25 Sep – 2 Oct 2008	4 to 15 Jun 2008, 27 Sep -3 Oct 2008	28 Feb – 2 Mar 2011, 29 Mar – 1 Apr 2011	7 – 18 Apr, 4 –13 Oct 2011	24 May – 6 Jun 2013, 27 Aug – 6 Sep 2013	2-11 Oct 2013, 2-6 Dec 2013 (night work)
No. of trapping sites	18	6	No field component on fauna	5	45	6	none	5	1	5	9	none	7	6	5
Site type	Varied. Most were 10 Medium Elliott and 5 pitfalls	2 lines of 10 medium Elliott traps plus 10 pitfalls open between 7 and 10 nights.		2 trap lines of 20 Elliott,10 pitfall, 4 funnel	none	trap lines of 20 Elliott,10 pitfall, 2 funnel, 2 cage traps	none	5 cage traps, 10 medium Elliott traps, 20 funnel traps, 20 pot traps open for 9 nights	10 Elliott and 10 funnel traps (Trap lines also opened at Coodiner)	2 trap lines of 5 buckets, 5 pipes20 Elliott, 20 funnel traps and 2 cage traps.	2 trap lines of 20 Elliott,10 pitfall, 4 funnel, 2 cage traps	none	trap lines of 10 Elliott,1 pitfall, 2 funnel, 2 cage traps	Each trap site with trap lines of 10 pitfall (5 buckets and 5 pipes), 20 funnel, 20 Elliot and 2 cage traps	Each trap site with trap lines of 10 pitfall (5 buckets and 5 pipes), 20 funnel, 20 Elliot and 2 cage traps
Trap nights	675 Elliott 175 Pitfall	840 Elliott trap 359 Pitfalls		620 Elliott 307 pitfall 260 funnel	none	2640 Elliott 1220 pitfall 1320 funnel 360 cage	none	225 cage 450 Elliott 675 Funnel 630 pots	30 Elliott, 30 Funnel	520 Elliott 260 Pitfall 216 Funnel 52 Cage	1330 Elliott 250 pitfall 322 funnel 126 cage	none	176 Elliott 980 pitfall 1,960 funnel 316 cage	1680 Elliott 840 pitfall 1680 funnel 168 cage	700 Elliott 350 pitfall 700 funnel 70 cage
Diurnal search (hrs)	18	Not specified		15	246	59	42	Not specified	35	12	22	Not specified	60	>500	>900
Nocturnal search (hours)	Not specified	Not specified		Not specified	48	19	19	5 nights (hours not specified)	12	5.5	18.75	Not specified	19	80	80
Bird surveys (hrs)	9	29		12.3		45	19.7	19 hours	34	8	19	Not specified	49	11	9.3

[2] No fauna sampling was conducted exept recording fauna habitats

Survey	Jimblebar Biological Survey	Orebody 18 Biological Assessment Survey	Jimblebar Wheelarra Hill 3 Flora and Fauna Assessment	Jimblebar-Wheelarra Hill Expansion Biological Survey	Jimblebar East Exploration Project Biological Survey	Jimblebar Hashimoto Vertebrate Fauna Assessment	Jimblebar Marra Mamba Exploration Biological Survey	Orebody 18 Fauna Assessment Phase II	Jimblebar West Fauna Assessment	Jimblebar Wheelarra Hill Flora and Fauna Assessment	Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment	Orebody 31 Fauna Assessment	Wheelarra Hill North Fauna Assessment	Ore Body 19 Level 2 Vertebrate Fauna Survey	Current survey
Bird Survey method	30 minute census	1 hour census and opportunistic		20 minute census	20 minute census	20 minute census	20 minute census	opportunistic	Opportunistic	60 minute census	20 minute 100 m radius census	opportunistic	15 minute census	Four 20 min surveys at each site	Four 20 min surveys at seven sites
Bat recording nights	none	none		25	2	30	15	6	3	1	(By Specialized Zoology)	none	2	48	28
Bat recording hours	none	none		Not specified	4	Not specified	Not specified	13.7	4	6	none	none	5	576	336
Bat recording method	none	none		Anabat	Anabat	Anabat	Anabat	Anabat	Anabat	Anabat	none	none	Anabat & SM2BAT	SM2BAT	SM2BAT
Mammals (native)	6	10	No field component on fauna	8	8	18	6	12	5	9	10	5	23	22	17
Mammals (intro)	6	4		1	2	5	4	3	4	4	6	2		2	5
Birds	40	44		62	41	85	64	55	72	26	47	42	59	64	39
Reptiles	11	31		31	17	57	24	42	27	21	27	9	55	48	42
Amphibians	0	0		5	0	5	1	0	0	0	2	1	2	1	0
Conserv. Significant Spp.	Western Pebble-mound Mouse, Australian Bustard	none	None	Bush Stone-Curlew, Rainbow Bee-eater	Australian Bustard, Rainbow Bee-eater	Australian Bustard, Rainbow Bee-eater [3]	Western Pebble-mound Mouse, Australian Bustard, Rainbow Bee-eater	Common Sandpiper, Bush Stone-curlew, *Ramphotyphlops ganei*	Australian Bustard, Rainbow Bee-eater	Western Pebble-mound Mouse, Rainbow Bee-eater, *Ctenotus uber johnstonei*[4]	Western Pebble-mound Mouse, Australian Bustard, Bush Stone-Curlew, Rainbow Bee-eater	None	Western Pebble-mound Mouse, Australian Bustard, Rainbow Bee-eater	Brush-tailed Mulgara, Pilbara Olive Python, Western Pebble-mound Mouse, Rainbow Bee-eater, Pilbara Flat-headed Blindsnake	Brush-tailed Mulgara, Australian Bustard, Rainbow Bee-eater

[3] Ghost Bat and Pilbara Leaf-nosed Bat were recorded, but these were considered by Specialised Zoological (2008) to be erroneous

[4] This subspecies of skink, first described in 1980 (Storr 1980), is listed as Priority 2 by the DPaW. Little is known of this taxon and its taxonomic status is uncertain. The type locality is Balgo Hill in the far north east of Western Australia. Specimens from the Pilbara may be grouped with *Ctenotus uber johnstonei*, or more likely it may belong to an undescribed taxon, in which case it would have no official conservation status. Within the Pilbara, the taxon is only currently known from a few localities on the western plains surrounding the Fortescue Marshes. Thus, it is considered a doubtful taxon herein and not discussed further.

190000 195000 200000 205000 210000 215000 220000 225000

7420000 7415000 7410000 7405000

Legend

- Season 2 of the current survey (Biologic 2013)
- Jimblebar Hashimoto Vertebrate Fauna Assessment (ecologia Environmental 2006)
- Jimblebar Mine Site Biological Survey (BHP 1994)
- Jimblebar Wheelarra Hill 3 Flora and Fauna Assessment (Biota 2004)
- Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology Services 2009)
- Orebody 18 Fauna Assessment Phase II (ENV Australia 2007)
- Orebody 31 Fauna Assessment (ENV Australia 2011)
- West Jimblebar Fauna Assessment (ENV Australia, 2007)
- Wheelarra Hill North Fauna Assessment (ENV 2012)
- Jimblebar-Wheelarra Hill Expansion Biological Survey (ecologia Environmental 2004)
- Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback Ecology Services 2009)

biologic

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BHPBIO
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Location of previous studies within and in the immediate vicinity of the Study Area
Figure 4.1

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4.1.2 Database searches

DPaW NatureMap

A NatureMap search, based on a circle of 5 km radius from the point 120º 07' 18"E, 23º 18' 37"S (centre of the Study Area), reported a total of 19 mammal species (including four introduced species), 56 bird species, 53 reptile species and two amphibian species, totalling 130 vertebrate species (see Appendix C). The conservation significant species identified by NatureMap comprise:

Mammals

- Ghost Bat *Macroderma gigas* – DPaW Priority 4;
- Western Pebble-mound Mouse *Pseudomys chapmani* – DPaW Priority 4;

Birds

- Bush Stone-Curlew *Burhinus grallarius* - DPaW Priority 4; and
- Rainbow Bee-eater *Merops ornatus* – EPBC Migratory, WCA Schedule 3.

EPBC Protected Matters Report

The EPBC Protected Matters Report, based on a circle of 5 km radius from the point 120º 07' 18"E, 23º 18' 37"S listed four threatened species and five migratory species.

Mammals

- Northern Quoll *Dasyurus hallucatus* – EPBC Endangered, WCA Schedule 1, IUCN Endangered;
- Greater Bilby *Macrotis lagotis* – EPBC Endangered, WCS Schedule 1, IUCN Vulnerable;
- Northern Marsupial Mole *Notoryctes caurinus* [5]– EPBC Endangered, WCA Schedule 1;
- Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* – EPBC Vulnerable, WCA Schedule 1;

Birds (Migratory species)

- Fork-tailed Swift *Apus pacificus* – EPBC Migratory, WCA Schedule 3;
- Eastern Great Egret *Ardea modesta* – EPBC Migratory, WCA Schedule 3;
- Cattle Egret *Bubulcus ibis* – EPBC Migratory, WCA Schedule 3;
- Rainbow Bee-eater *Merops ornatus* – EPBC Migratory, WCA Schedule 3; and

[5] The habitat required for this species, sand ridges and plains, does not occur within the OB 31 Study Area, thus it is highly unlikely to be present.

- Oriental Plover *Charadrius veredus* – EPBC Migratory, WCA Schedule 3.

DPaW Threatened Fauna Database search

A DPaW Threatened Fauna Database Search based on a circle of 30 km radius from the point 119°45'17" E, 23°18'24" S (centre of the Eastern Ophthalmia mining area), reported one mammal (a DPaW Priority 4 species) and two birds (one DPaW Priority 4 species and one species listed under international agreements) with conservation significance from the Study Area.

4.2 Current Field Survey

Season 1

During the Level 1 survey by ENV (2011), 59 species of vertebrates including seven mammals, 42 birds, nine reptiles and one amphibian were opportunistically recorded. These included three conservation significant species:

Mammals

- Western Pebble-mound Mouse *Pseudomys chapmani* – DPaW Priority 4;

Birds

- Australian Bustard *Ardeotis australis* – DPaW Priority 4; and
- Forktailed Swift *Apus pacificus* – EPBC Migratory, WCA Schedule 3.

Season 2 (including night work)

A total of 98 native vertebrate fauna species, comprising 17 native mammals (together with a further five introduced species), 39 birds and 42 reptiles (Appendix C) were recorded during the field survey. Three conservation significant species were recorded during the second season:

Mammals

- Brush-tailed Mulgara (*Dasycercus blythi*) - DPaW Priority 4; Status under review by DoE (DSEWPaC 2012);

Birds

- Australian Bustard *Ardeotis australis* – DPaW Priority 4; and
- Rainbow Bee-eater *Merops ornatus* – EPBC Migratory, WCA Schedule 3.

4.3 Fauna species expected to occur in the Study Area

The number of native species potentially occurring in the Study Area, based on species recorded in fauna surveys in the vicinity of the Study Area and those recorded in online

databases (NatureMap, DPaW Threatened Fauna Database and EPBC Protected Matters database), totals 260 species of vertebrate. This comprises 36 species of native mammals (with a further nine introduced species), 125 species of birds, 91 species of reptiles and eight species of amphibians.

Detailed lists of the fauna expected to occur in the Study Area based on literature and database searches, are presented in Appendix C. Species profiles and conservation listings are presented in Section 5, which only considers conservation significant fauna.

Given that there has been only two previous surveys at least partially overlapping the Study Area, the list of species recorded from the site is based on findings of these surveys and the current survey. These species are discussed in Section 4.4. However, some species identified during the database searches as potentially occurring within the Study Area have not been recorded to date, despite suitable habitat being present. The absence of these records may be for a few reasons, including: 1) some species are transient and may only be present on rare occasions and thus have not been recorded during the field survey; and 2) some species may occur in similar ecological niches to other species present within the Study Area, and thus are not present despite suitable habitat being available. Additional sampling, especially with trapping, would also likely to detect additional species. Also, the databases recorded a number of migratory waders that were recorded at the Ophthalmia Dam, ~10 km west of the Study Area. Despite close proximity, suitable habitat for these species does not occur within the Study Area, thus it is highly unlikely that these species will occur within the Study Area.

4.4 Fauna species recorded within the Study Area

To date, a total of 120 native vertebrate fauna species have been recorded from within the Study Area. This comprises 20 species of native mammals (with a further five introduced species), 56 species of birds, 43 species of reptiles and one species of amphibian.

4.4.1 Native mammals

Of the 36 native mammals that may potentially occur within the Study Area, 20 species (55.5%) from six families have been recorded to date. The current survey recorded 17 species of native mammals. Of these the Ooldea Dunnart (*Sminthopsis ooldea*) was recorded from the general area for the first time. The marked increase in the number of mammals recorded during the second season (seven during Season 1 compared to 17

during Season 2) is likely due to the inclusion of trapping and utilisation of bat call recorders.

4.4.2 Birds

A total of 125 species of birds were found to potentially occur in the Study Area through literature and database searches, of which 56 (44.8%) have been recorded to date within the Study Area boundaries. Of these, 24 species have been recorded during both seasons of the current survey.

4.4.3 Reptiles

Of the 91 species of reptiles that may occur in the Study Area, 43 (~47.3%) have been recorded to date. The marked increase in the number of reptiles recorded during the second season (nine during Season 1 Vs 42 during Season 2) is likely due to the inclusion of trapping.

4.4.4 Amphibians

Only one (Desert Tree Frog *Litoria rubella*) of the eight potentially occurring amphibians have been recorded to date within the Study Area (12.5%).

4.4.5 Introduced fauna

Six species of introduced mammals have been recorded at OB 31: House Mouse **Mus musculus*, Cow **Bos taurus,* Cat **Felis catus*, Camel **Camelus dromedaries*, Donkey **Equus asinus*, and Rabbit **Oryctolagus cuniculus*. The Dingo (*Canis lupus dingo*) is categorised as a native mammal in this report following Corbett (1995). However, it is highly likely that the individuals occurring in the area are hybrids with feral dogs.

4.5 Fauna habitats within the Study Area

Five major fauna habitats were identified within the Study Area during Season 2: Minor Drainage Line, Sand Plain, Crest/ Slope, Drainage Area and Gorge/ Gully. The 'Alluvial Plain' habitat identified by ENV (2011) was assigned to Sand Plain during the second survey season. The Low Hills in ENV (2011) largely overlaps the Crest/ Slope habitat. Habitat descriptions are presented in Table 4.3 and results of habitat assessments are presented in Appendix D. The habitat assessments were analysed to determine the key characteristics that differentiated each habitat (Table 3.3). The extent of each fauna habitat outside of the Study Area is provided where available. The habitats are mapped in Figure 4.2.

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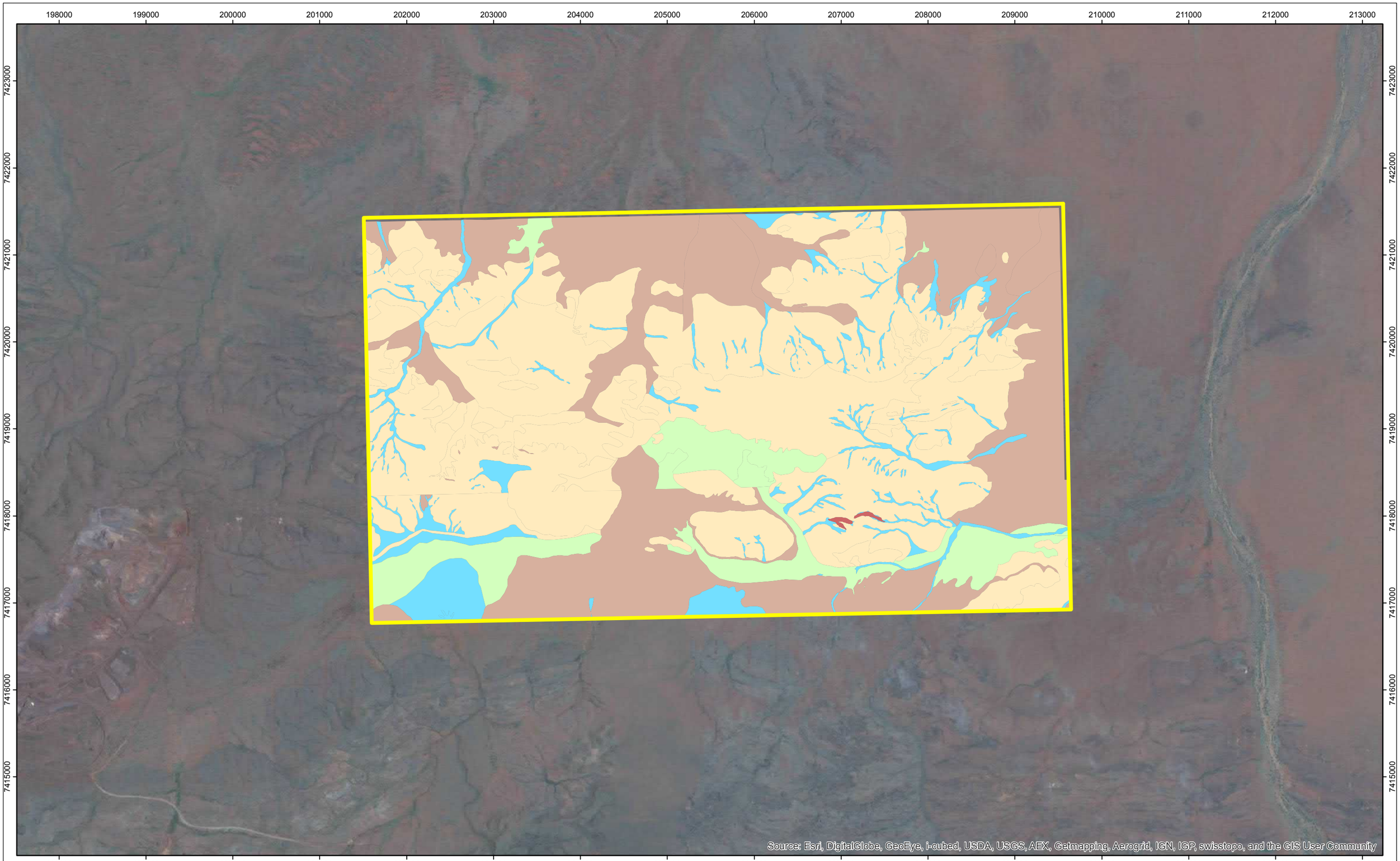

biologic

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OB 31
HABITATS OF THE SURVEY AREA

FIGURE 4.2

Legend

Study Area

Habitats

- Crest / Slope
- Drainage Area
- Gorge / Gully
- Minor Drainage Line
- Sand Plain

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Table 4.2 Major fauna habitat descriptions

Habitat	Description and habitat characteristics	Extent within the Study Area	Extent outside Study Area	Significant species associated with habitat	Photo
Crest/ Slope	The Crest/Slope habitats tend to be more open and structurally simple than other fauna habitats, and are dominated by varying species of spinifex. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. Crests and slopes are dominated by *Eucalyptus* woodlands, *Acacia* and *Grevillea* shrublands and *Triodia* spp. low hummock grasslands. Rocky outcrops are scattered within this habitat.	Span from north-west to the south-east of the Study Area and is the prominent habitat type in the central section of the Study Area.	Extensive areas of Crest/Slope habitat are common in the vicinity of the Study Area and throughout the Pilbara.	Crest/Slope habitat supports local populations of Western Pebble-mound Mouse which is largely restricted to this habitat type. The Pilbara Flat-headed Blindsnake, Australian Bustard and Long-tailed Dunnart may also utilize this habitat. Pilbara Olive Python may pass through this habitat during dispersal. Ghost Bats may forage in this habitat, as may Peregrine Falcons.	
Gorge/Gully	Gorges/Gullies are deeply incised rugged, steep-sided valleys cut into the surrounding landscape. Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	One Gorge/ Gully habitat occurs towards the south-eastern section of the Study Area. However, it is a shallow gorge.	Gorges (and gullies) are a common feature of the Pilbara (especially within the Hamersley Range), but because they tend to be narrow, linear features, they represent a small proportion of the total land area.	The Gorge/Gully habitat in the Study Area, could potentially provide habitat for the Ghost Bat, Pilbara Olive Python, Northern Quoll, and Long-tailed Dunnart. Minor Gullies could harbour Pilbara Olive Pythons and Pilbara Flat-headed Blindsnake.	
Minor Drainage Line	Characterised by low and sparse vegetation compared to Major Drainage Lines. Located within the minor gullies and depressions through the Crest/ Slope habitat. Consisted of *Acacia* low woodland sometimes with scattered *Eucalyptus xerothermica* and *Corymbia hamersleyana*. The understorey generally lacks density and often consists solely of sparse tussock grassland, often of *Cenchrus ciliaris* where it has been introduced. The substrate can be sandy in places but generally consists of a loam gravel or stone.	A prominent Minor Drainage Line occurs in the north-western corner of the Study Area.	A common habitat in the Hamersley Range adjacent to the Study Area.	Minor Drainage Lines provide habitat for a number of conservation significant fauna. Bush Stone-curlew may shelter during the day in areas of thicker vegetation associated with drainage areas and the Pilbara Flat-headed Blindsnake is likely to utilise this habitat type as living space.	
Sand Plains	Sand Plain habitat is characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse shrubs. This habitat transitions into patches of Mulga in places.	Areas of this habitat broadly occur horizontally across the northern and southern sections of the Study Area.	Large representations of this habitat are located at the border of the Hamersley and Fortescue subregions and then extensively within the Chichester subregion.	Mulgara and potentially Greater Bilby utilise finer sandy habitats for burrows and foraging. Australian Bustard is frequently encountered foraging in this habitat. The Pilbara Flat-headed Blindsnake also occurs in this habitat type.	

Habitat	Description and habitat characteristics	Extent within the Study Area	Extent outside Study Area	Significant species associated with habitat	Photo
Drainage Area	Characterised by low and sparse vegetation compared to Major Drainage Lines. Consisted of *Acacia* low woodland sometimes with scattered *Eucalyptus xerothermica* and *Corymbia hamersleyana*. The understorey generally lack density and often consists solely of sparse tussock grassland, often of *Cenchrus ciliaris* where it has been introduced. The substrate can be sandy in places but generally consists of a loam gravel or stone.	Drainage Areas are low lying, gently sloping areas at the base of Crest/ Slope habitats. Most patches occur along the southern section of the Study Area.	A common habitat in the Hamersley Range adjacent to the Study Area.	Drainage Areas provide habitat for a number of conservation significant fauna. Bush Stone-curlew may shelter during the day in areas of thicker vegetation associated with drainage areas and the Pilbara Flat-headed Blindsnake are likely to utilise this habitat type.	

5 CONSERVATION SIGNIFICANT FAUNA

Species are defined as 'Conservation Significant' if they are listed under agreements at international (e.g. IUCN, JAMBA, CAMBA, Bonn), regional (EPBC) or state (WCA, Priority list of DPaW) level. Explanations of conservation status under these Acts and Agreements are provided in Table 3.5 and Appendix B.

Based on the review of regional surveys, database searches (Section 3.2), and the habitats present in the Study Area, it was determined that 18 species (seven native mammals, nine birds and two reptiles) of conservation significance have the potential to occur in the Study Area. Of these species, only five have been recorded in the Study Area to date. These are:

- Brush-tailed Mulgara *Dasycercus blythi* - DPaW Priority 4 [status under review by DoE (DSEWPaC 2012)];
- Western Pebble-mound Mouse *Pseudomys chapmani* – DPaW Priority 4;
- Australian Bustard *Ardeotis australis* – DPaW Priority 4;
- Fork-tailed Swift *Apus pacificus* – EPBC Migratory, WCA Schedule 3; and
- Rainbow Bee-eater *Merops ornatus* – EPBC Migratory, WCA Schedule 3.

A further 13 species were identified by database and literature searches to have the potential to occur in the Study Area. These are:

Mammals

- Ghost Bat *Macroderma gigas* – DPaW Priority 4;
- Northern Quoll *Dasyurus hallucatus* – EPBC Endangered, WCA Schedule 1, IUCN Endangered;
- Greater Bilby *Macrotis lagotis* – EPBC Endangered, WCA Schedule 1, IUCN Vulnerable;
- Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* – EPBC Vulnerable, WCA Schedule 1;
- Northern Marsupial Mole *Notoryctes caurinus* – EPBC Endangered, WCA Schedule 1;

Birds

- Bush Stone-curlew *Burhinus grallarius* – DPaW Priority 4;
- Common Sandpiper *Actitis hypoleucos* – EPBC Migratory, WCA Schedule 3;
- Eastern Great Egret *Ardea modesta* – EPBC Migratory, WCA Schedule 3;

- Cattle Egret *Ardea ibis* – EPBC Migratory, WCA Schedule 3;
- Oriental Plover *Charadrius veredus* – EPBC Migratory, WCA Schedule 3.
- Star Finch *Neochmia ruficauda subclarescens* – DPaW Priority 4;

Reptile

- Pilbara Olive Python *Liasis olivaceus barroni* – EPBC Vulnerable, WCA Schedule 1; and
- Pilbara Flat-headed Blind Snake *Ramphotyphlops ganei* – DPaW Priority 1.

Table 5.1 shows the conservation significant species recorded from adjacent areas and those that potentially occur within the Study Area. Locations of conservation significant fauna recorded within the Study Area are presented in Figure 5.1 and Appendix E.

To simplify the classification of pebble mounds, they have been characterised as active/ recently active or inactive in the text below. Active or recently active indicates that the mounds are either currently used or the mound structure is clearly evident and therefore may be used again in the future. Inactive mounds are those that are weathered, flat and appear completely abandoned.

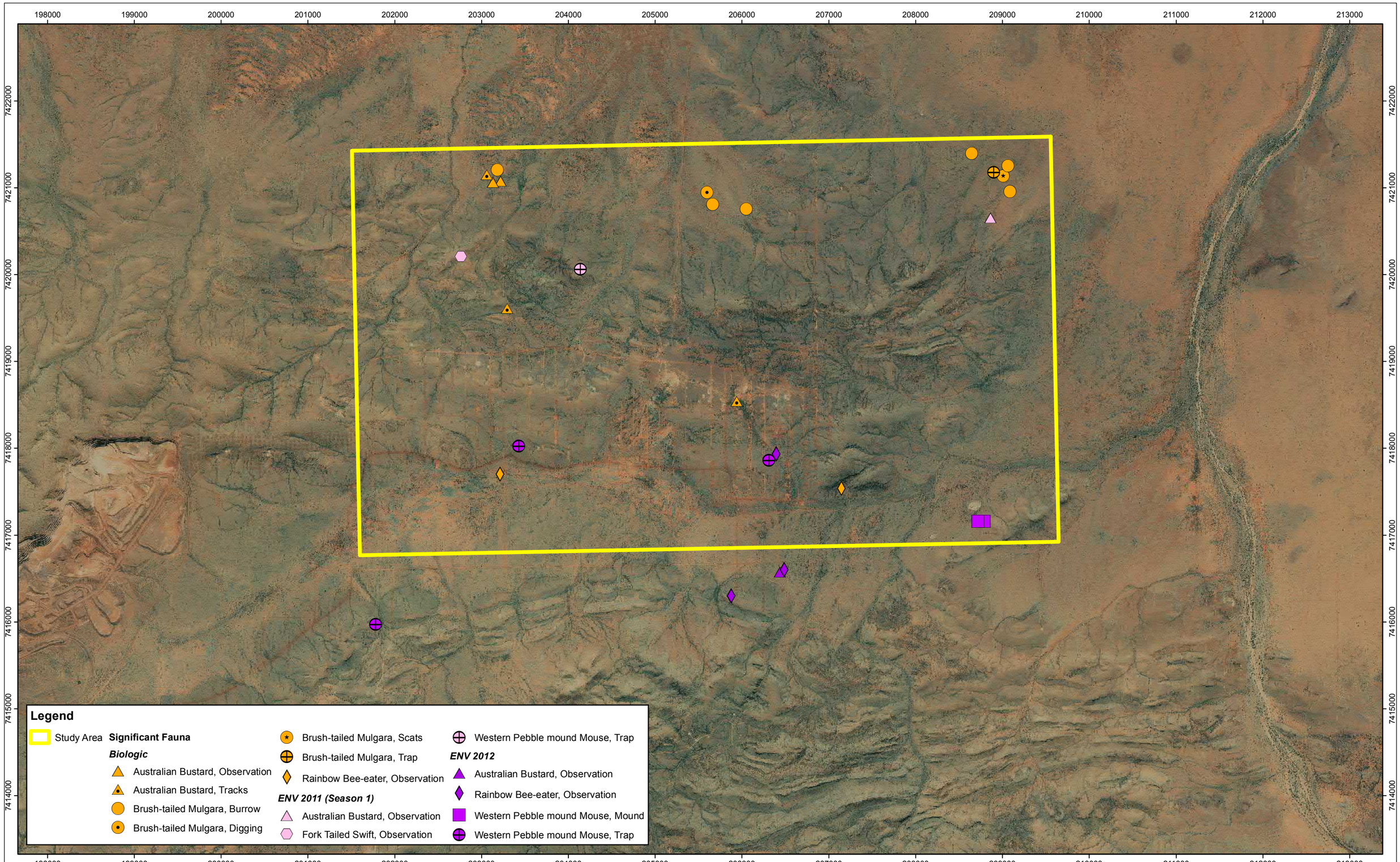
Table 5.1 Summary of conservation significant fauna recorded in or adjacent to the Study Area and those that may potentially occur in the Study Area.

		CONSERVATION STATUS				DATABASE SEARCHES			SURVEYS														
Species	**Common Name**	**EPBC**	**WCA**	**DPaW**	**IUCN**	**Nature Map**	**EPBC**	**DPaW Threat. species**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**
Mammalia																						
Dasycercus blythi	Brush-tailed Mulgara			P4																	●	●
Dasyurus hallucatus	Northern Quoll	EN	S 1		EN		●															
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S 1				●										●*					
Pseudomys chapmani	Western Pebble-mound Mouse			P4		●		●		●			●	●	●			●		●	●	
Macroderma gigas	Ghost Bat			P4		●											●*					
Macrotis lagotis	Greater Bilby	VU	S 1		VU		●															
Notoryctes caurinus	Northern Marsupial Mole	EN	S1				●															
Aves																						
Ardea alba	Eastern Great Egret	MI	S 3				●															
Ardea ibis	Cattle Egret	MI	S 3				●															
Ardeotis australis	Australian Bustard			P4					●	●			●	●	●		●	●	●	●		●
Burhinus grallarius	Bush Stone-curlew			P4		●						●			●	●						
Charadrius veredus	Oriental Plover	MI	S 3				●															
Actitis hypoleucos	Common Sandpiper	MI	S 3			●						●										
Merops ornatus	Rainbow Bee-eater	MI	S 3			●	●		●	●					●	●	●		●	●	●	●
Apus pacifica	Fork-tailed Swift	MI	S 3				●						●									
Neochmia ruficauda subclarescens	Star Finch (Western subspecies)			P4																●		
Reptilia																						
Liasis olivaceus barroni	Pilbara Olive Python	VU	S 1																		●	
Ramphotyplops ganei	Pilbara Flat-headed Blindsnake			P1				●				●								●	●	

* These bat records from Hashimoto may be erroneous (Specialised Zoological 2008)

Database Searches
DPaW Naturemap search within 5 km buffer
EPBC Protected Matters search with 5 km buffer
DPaW Threatened Species Database search records within the Study Area

Surveys
A West Jimblebar Fauna Assessment (ENV Australia 2007)
B Wheelarra Hill North Fauna Assessment (ENV Australia 2012)
C Orebody 18 Biological Assessment Survey (ecologia Environmental 1995)
D Orebody 18 Fauna Assessment Phase II. E (ENV 2007a)
E Orebody 31 Fauna Assessment –Season 1 of current survey (ENV 2011)
F Jimblebar Mine Site Biological Survey. BHP (BHP Iron Ore Pty Ltd 1994)
G Jimblebar Iron Ore Project: Terrestrial Vertebrate Fauna Assessment. (Outback Ecology Services 2009a)
H Jimblebar - Wheelara Hill Biological Survey. (ecologia Environmental 2004)
I BHPBIO Hashimoto Terrestrial Vertebrate Fauna Assessment. (ecologia Environmental 2006a)
J Jimblebar Marra Mamba Exploration Biological Survey. (ecologia Environmental 2006b)
K Jimblebar East Exploration Project Biological Survey (ecologia Environmental 2005)
L Jimblebar Linear Development Terrestrial Vertebrate Assessment. (Outback Ecology Services 2009b)
M Orebody 19 Vertebrate Fauna Survey (Biologic, 2013)
N Season 2 of current survey



biologic

FIGURE:	5.1	Date:	26/02/2014
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Drawn by GSM	Requested by RS	GSM Reference OB31_SigFauna	

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0 250 500 750 1,000

Meters

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Datum: GDA94

Projection: MGA Zone 51

BHPBIO
OB 31
SIGNIFICANT FAUNA LOCALITIES

FIGURE 5.1

GRIFFIN SPATIAL & MAPPING

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5.1 Conservation Significant Fauna Recorded from the Study Area

Five species of conservation significant fauna have been recorded in the Study Area to-date. Each of the species recorded is presented in taxonomic order and discussed in the following section. Significant fauna species localities are shown on Figure 5.1 and presented in Appendix E.

5.1.1 Mammals

Brush-tailed Mulgara (*Dasycercus blythi*)

Brush-tailed Mulgara (*Dasycercus blythi*) is closely associated with *Triodia* Sand Plains and swales between low dunes from south-western Queensland across the Simpson, Tanami, and Great Sandy Deserts of southern and central Northern Territory and central Western Australia, including parts of the Pilbara (DSEWPaC 2011b; Pavey et al. 2012). Brush-tailed Mulgara is currently listed as Priority 4 by the DPaW; however it is currently under consideration for listing under the EPBC (DSEWPaC 2012). A possible outcome of this is that both species of Mulgara (*Dasycercus blythi* and *D. cristicauda*) will have the same status of Vulnerable under the EPBC.

Five individuals were caught in traps at two locations in the Sand Plain habitat along the northern border of the Study Area (Figure 5.1). These include a female with a litter of six. Secondary evidences for Mulgara (burrows, scat and diggings) were found along the Sand Plains in the northern part of the Study Area. The OB 31 Study Area contains extensive areas of Sand Plain habitat suitable for this species. Seven burrows of the Brush-tailed Mulgara were located in Sand Plain habitat along the southern section of OB 19, ~7 km west of the Study Area (Biologic, 2013) but no individuals were trapped during the survey. Mulgara were not recorded in any of the previous surveys in the immediate vicinity of the Study Area, but Biologic also recorded the species at South Jimblebar and OB 24 located approximately 7 km south and 25 km west of the Study Area, respectively (Biologic 2013b,c).

Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse is currently listed as Priority 4 by the DPaW. This species has experienced a significant decline in their range through the Gascoyne and Murchison, and is now considered endemic to the Pilbara (Van Dyck & Strahan 2008). This species almost exclusively 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 (Van Dyck & Strahan 2008).

ENV (2011) recorded one active mound in Crest/ Slope habitat at the central-west section of the Study Area and ENV (2012) recorded two mounds and caught five individuals at three locations in the southern section of the Study Area (Figure 5.1). None were recorded during Season 2 of the current survey. Four active and one inactive mounds were recorded and 13 individuals were caught in the traps at OB 19, ~7 km west of the Study Area (Biologic, 2013). A total of 91 mounds, of which less than a fifth of which were active, were located during a previous study at OB 18, immediately west of the Study Area (ecologia 1995). However, no captures were recorded during a more recent trapping survey at OB 18 (ENV 2007a). There are several records from other areas in the vicinity of the Study Area (see Table 5.1).

5.1.2 Birds

Australian Bustard (*Ardeotis australis*)

The Australian Bustard is listed as Priority 4 by the DPaW and as Least Concern by the IUCN. It occurs across most of mainland Australia, but is listed in WA primarily due to a decline in its range in the south of the state. It is a nomadic species occurring in a wide variety of habitats including Sand Plains, gravel plains, riverine habitats and open or lightly wooded grasslands (Johnstone & Storr 1998).

Two individuals and three tracks were observed in the Sand Plain habitat in the northern section and the Crest/ Slope habitats in the central section of the Study Area during the current study (Figure 5.1). ENV (2011) recorded one individual flying over Alluvial Plains south of the Study Area. This species was recorded in numerous surveys in the vicinity of the Study Area (Table 5.1).

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is listed as Migratory under the EPBC and Schedule 3 under the WCA. This species has broad habitat preferences and lives almost anywhere suitable for hawking insects. The demographics of the species are complex, with populations in WA being resident, breeding visitors, post-nuptial nomads, passage migrants and winter visitors (Johnstone & Storr 1998). Many individuals move northwards to overwinter in Indonesia.

Three individuals were recorded during the current survey, two close to Mulga habitat and the other in Crest/ Slope habitat in the southern part of the Study Area. Ten individuals were recorded at two locations during the Wheelarra North survey, south of the Study Area (ENV, 2012) (Figure 5.1). Potential nesting habitat for this ground-nesting species exists in the Study Area, where this species is most likely to nest in the banks of the drainage lines. However no evidence of nesting was observed. There are several records of this species from other areas in the vicinity of the Study Area (see Table 5.1).

Fork-tailed Swift (*Apus pacificus)*

This species is entirely aerial within the Pilbara and thus does not utilise the terrestrial surface. It is listed as Migratory under the EPBC and Schedule 3 under the WCA, as it breeds in north-east and east Asia, wintering in Australia and southern New Guinea (Johnstone & Storr 1998).

Fifteen individuals were recorded flying overhead in the north-western section of the Study Area during Season 1 of the survey (ENV, 2011) (Figure 5.1). This species is expected to utilise the skies above the Study Area sporadically in the summer months, being attracted to thunderstorms and cyclonic systems (Johnstone & Storr 1998).

Table 5.2 Conservation significant fauna occurring in the Study Area.

Species	Significance	Preferred habitat	Extent of the habitat in the Study Area and the region	Records
Brush-tailed Mulgara *Dasycercus blythi*	DPaW: Priority 4 (under review by DoE)	Arid, sandy areas, preferring mature spinifex on sandy soils. Brush-tailed Mulgara inhabit spinifex grasslands with medium to dense cover.	Extensive areas of Sand Plain habitat broadly occur horizontally across the northern and southern sections of the Study Area. They are also widespread in the adjoining areas.	• Five individuals caught in traps at two locations along the northern border of the Study Area (Biologic 2013). • Secondary evidences (burrows, scat and diggings) found along in the same area (Biologic 2013). • Seven burrows located along the southern section of OB 19, ~7 km west of the Study Area (ENV 2011).
Western Pebble Mound Mouse *Pseudomys chapmani*	DPaW: Priority 4	Gentler slopes of rocky ranges where ground is covered with a stony mantle and vegetated by spinifex, often with sparse overstorey of eucalypts and scattered shrubs (Van Dyck and Strahan, 2008).	Span from north-west to the south-east of the Study Area. It is also one of the most common habitat types in the surrounding areas.	• One active mound in at the central-west section (ENV 2011). • Two mounds and five individuals at three locations in the Southern section (ENV 2012). • Four active and one inactive mound and 13 individuals caught in the traps at OB 19 (Biologic, 2013). • 91 mounds, of which less than fifth of which were active, located during a previous study at OB 18 (ecologia 1995).
Australian Bustard *Ardeotis australis*	DPaW: Priority 4 IUCN: LC	Open or lightly wooded grasslands (Johnstone and Storr, 1998).	Extensive areas of Sand Plain habitat broadly occur horizontally across the northern and southern sections of the Study Area. They are also widespread in the adjoining areas. This species also	• Two individuals and three tracks observed in the northern and central sections (Biologic 2013). • One individual flying over south of the Study Area (ENV 2011). • Recorded in numerous surveys in the vicinity

Species	Significance	Preferred habitat	Extent of the habitat in the Study Area and the region	Records
			occur in other habitat types including Stony Plains.	of the Study Area.
Fork-tailed Swift *Apus pacificus*	EPBC: Migratory WCA: Schedule 3	This species is entirely aerial within the Pilbara. Fork-tailed Swifts may forage above many habitat types.	It is likely that this species forage in most of the habitat types in the area. This species is expected to utilise the skies above the Study Area sporadically in the summer months, being attracted to thunderstorms and cyclonic systems (Johnstone and Storr 1998)	• Fifteen individuals recorded flying overhead in the north-western section of the Study (ENV, 2011).
Rainbow Bee-eater *Merops ornatus*	EPBC: Migratory WCA: Schedule 3	Lightly wooded, preferably sandy country near water (Johnstone and Storr, 1998).	Suitable habitat common within the Study Area and surrounding region. Potential nesting habitat for this ground-nesting species exists in the Study Area, with this species is most likely to nest in the banks of the drainage lines.	• Three individuals recorded in the southern part of the Study Area (Biologic 2013). • Ten individuals recorded at two locations during the Wheelara North survey (ENV, 2012).

5.2 Conservation Significant Fauna potentially occurring in the Study Area

5.2.1 Mammals

Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll is listed as Endangered under the EPBC, on Schedule 1 under the WCA and as Endangered by the IUCN. Northern Quolls have experienced significant declines in eastern and northern Australia, mainly due to an expansion of the Cane Toad's (**Rhinella marina*) range; these are ingested resulting in death (Tidemann et al. 1985). At present Northern Quolls are locally common in the northern part of the Pilbara region (generally within 150 km of the coast) but are uncommon in more southern areas.

Northern Quolls favour rocky areas such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, Major Drainage Lines and treed creek lines, as well as structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs (DSEWPaC 2011a). Rocky habitats are usually of high relief, often rugged and dissected but can also include tor fields or caves in low lying areas such as in Western Australia. Dens are made in rock crevices, tree holes or occasionally termite mounds (Oakwood 2008). In the Pilbara region, the species tends to prefer the Rocklea, Macroy and Robe Land Systems (Biota Environmental Science 2008). The Northern Quoll has also been recorded in other Land Systems which comprise sandstone and dolomite hills and ridges, shrublands, sandy plains, clay plans and tussock grasslands and coastal fringes including dunes islands and beaches.

Online databases identify the Northern Quoll to occur in the general area. No signs of Northern Quolls were located during the present survey, and given the small areas of creek and rocky hill habitat, it is highly unlikely that the area could support a population. No records of this species were made in any survey in the vicinity of the Study Area. However, the DoE Species Profile and Threats Database (SPRAT) predicts habitat occurs throughout the area.

Greater Bilby (*Macrotis lagotis*)

The Greater Bilby is listed as Vulnerable under the EPBC, on Schedule 1 under the WCA and as Vulnerable by the IUCN due to range reduction; it now occupies less than 20% of its original range (Southgate 1990a), inhabiting arid and semi-arid regions throughout most of the Australian mainland in disjunct populations (Johnson 2008). The Greater Bilby utilises a variety of habitats, usually on landforms with level to slow slope topography and light to medium soils (Worthington Wilmer et al. 1999). Three major vegetation types associated with the Greater Bilby are listed by Southgate (1990b) including: open tussock grassland on uplands and hills,

Mulga woodland/ scrubland on ridges and rises, and hummock grassland in plains and alluvial areas. Other habitats used by the species include stony downs, cracking clays, desert Sand Plains and dune fields, spinifex grassland, and *Acacia* spp. scrublands on red earths (Johnson, 2008). Home ranges may be temporary, and there is some suggestion that Greater Bilbies are nomadic, following food availability (Johnson, 2008).

There are no recent records in the vicinity of the Study Area and no traces were found during the current survey, despite suitable habitat (Sand Plain) occurring in the Study Area. The nearest record is from the vicinity of Jiggalong nearly 65 km to the east. Given the lack of records in the vicinity (although suitable habitats are present in the general area), it is highly unlikely that the species occurs within the Study Area.

Northern Marsupial Mole (*Notoryctes caurinus*)

The Northern Marsupial Mole is listed as Endangered under the EPBC. It is a blind marsupial which is adapted to living underground. It occasionally comes to the surface, apparently more frequently after rain (Maxwell et al. 1996).

The Northern Marsupial Mole lives underground in sand dunes, inter-dunel flats and sandy soils along river flats. These preferred sandy habitats do not occur within the Study Area. Therefore despite online databases predicting its occurrence in the area, there are no confirmed records of this species in the Study Area or the surrounds and no preferred habitat within the Study Area.

Ghost Bat (*Macroderma gigas*)

Ghost Bats are listed as a Priority 4 species under the DPaW Priority list and Vulnerable under the IUCN Red List. They formerly occurred over a wide area of central, northern and southern Australia but have declined significantly in the southern parts of their range in the last 200 years (van Dyck and Strahan, 2008). Within W.A., Ghost Bats are now confined to the Kimberley and Pilbara regions.

The distribution of Ghost Bats is influenced by the availability of suitable caves and mine adits for roost sites. The preferred roosting habitats of Ghost Bats in the Pilbara are deep, complex caves beneath bluffs of low rounded hills composed of Marra Mamba Iron Formation, Brockman Iron Formation, granite rock piles and abandoned mines (Armstrong and Anstee, 2000). Armstrong and Anstee (2000) note that most caves used by Ghost Bats have narrow entrances (less than 0.5 m^2) that open into larger chambers. Ghost Bats move between a number of caves seasonally, or as dictated by weather changes, and roost either individually or

in colonies of up to 1500 (Churchill 2008). During breeding, female Ghost Bats congregate in maternity roosts, generally selecting very warm caves during pregnancy and lactation (Hutson et al. 2001).

This species has been recorded at the nearby Hashimoto area, ~4.2 km south-east of the Study Area (ecologia 2006). Several Ghost Bats were present at the Pilbara Leaf-nosed Bat roost in the mine adit (ecologia 2006). Nevertheless, Specialised Zoological (2008) found no evidences for the existence of this species in the adit, thus Outback Ecology (2009) mentioned that the previous record could be erroneous. No suitable roost sites occur in the Study Area or its immediate vicinity though this species may utilise a foraging home range that extends over the Study Area.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara Leaf-nosed Bat is classified as Vulnerable under the EPBC and on Schedule 1 under the WCA. This species requires warm (28 – 32 ºC) and highly humid (96 – 100%) roost sites in caves and/ or mine shafts. This is a result of their limited ability to conserve heat and water (Armstrong 2001). Such caves are relatively uncommon in the Pilbara (Armstrong & Anstee 2000; Armstrong 2001), which limits the availability of diurnal roosts for this species. The few known roosts of this species are concentrated in mine shafts in the eastern Pilbara, and at Barlee Range Nature Reserve (Department of Environment 2010) which are thought to contain most of the region's population.

This species has been recorded at the nearby Hashimoto area, ~4.2 km south-east of the Study Area (ecologia 2006). Several individuals were recorded at a mine adit at Hashimoto area, which is one of the south-eastern most roosts of this species in the Pilbara (ecologia 2006). Nevertheless, Specialised Zoological (2008) found no evidences for the existence of this species in the adit, thus Outback Ecology (2009) mentioned that the previous record could be erroneous. No suitable roost sites occur in the Study Area or its immediate vicinity though this species may utilise a foraging home range that extends over the Study Area.

5.2.2 Birds

Bush Stone-curlew (*Burhinus grallarius*)

The Bush Stone-curlew is listed as Priority 4 by DPaW. It is patchily distributed across much of mainland Australia; inhabiting areas of open forest and woodland with open areas, fallen dead timber or leaf litter {del Hoyo, 2006 #369}. Inland, this species is associated with watercourses. Bush Stone-curlews are nocturnal and often difficult to detect, being highly cryptic.

Suitable habitat in the Study Area includes Mulga and mixed Acacia woodland and open areas fringed by denser riparian vegetation. The species was recorded immediately west of the Study Area at OB18 (ENV 2007a).

Cattle Egret (*Ardea ibis*)

Cattle Egrets are listed as Migratory under the EPBC and Schedule 3 under the WCA. It is a widespread and common species according to migration movements and surveys of breeding localities. Two major distributions have been located; from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. In Western Australia and the Northern Territory, the Cattle Egret is located from Wyndham to Arnhem Land. The Cattle Egret utilises a variety of natural and anthropogenic habitats and occurs in tropical and temperate grasslands, inland wetlands, wooded lands and farm lands. It has also been seen in arid and semi-arid regions; however this is extremely rare. This species has a symbiotic relationship with grazers.

Online databases identified this species as likely to occur in the area. This species could occur within the Study Area as a foraging visitor or a temporary resident during the wet season when temporary water pools provide suitable habitat.

Eastern Great Egret (*Ardea modesta)*

The Eastern Great Egret is listed as Migratory under the EPBC and Schedule 3 under the WCA. This species is described as dispersive and migratory in parts of its range (DEWHA, 2010d), with some regular seasonal movements. Non-breeding birds have been recorded across most of Australia, but avoid the driest regions of the western and central deserts (Marchant & Higgins 1993). Favoured breeding habitat relevant to the Study Area includes wooded swamps and river pools with *Eucalyptus camaldulensis* and *Melaleuca argentea* (Johnstone & Storr 1998). During the wet season and after heavy rain, however, egrets could be attracted to temporary pools throughout the Study Area, including man-made water bodies.

Online databases identified this species as likely to occur in the area. This species could occur within the Study Area as a foraging visitor or a temporary resident during the wet season when temporary water pools provide suitable habitats.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover is listed as Migratory under the EPBC and Schedule 3 under the WCA. It is a non-breeding visitor to Australia, where it occurs in both coastal and inland areas. Along the coast the Oriental Plover inhabits estuarine mudflats, beaches and near coastal grasslands.

Inland it occurs in flat, open, semi-arid or arid grasslands (DEWHA, 2010). On migration to Northern Australia (September – November), Oriental Plovers gather in flocks on open, thinly vegetated, grassland plains (Morcombe 2004).

Online databases identified this species as likely to occur in the area. There are few records of the Oriental Plover in the Pilbara (Johnston et al. 2013) and it is possible that this species may be an infrequent transient visitor to the Study Area.

Common Sandpiper (*Actitis hypoleucos*)

The Common Sandpiper breeds across most of temperate and subtropical Europe and Asia, and migrates to Africa, southern Asia and Australia in winter. In Australia, this species is mainly found in muddy edges or rocky shores in coastal or inland wetlands. During the breeding season in the northern hemisphere, it prefers freshwater lakes and shallow rivers. It is a gregarious bird and is usually seen in large flocks. No large water bodies are found in the vicinity of the Study Area; the nearest being the Ophthalmia Dam 14 km to the north-west. However small water bodies may occur along Minor Drainage Lines and at overflowing bores (such as the Painkiller Bore within the Study Area).

A single individual was recorded immediately east of the Study Area at OB 18 (ENV 2007a). This species is unlikely to utilise the Study Area to any great extent due to lack of suitable habitats, but may occasionally occur on a transient basis within the Study Area.

Star Finch (western subspecies) (*Neochmia ruficauda subclarescens*)

The 'western' population of the Star Finch (western subspecies) is considered by the DPaW to represent a separate subspecies (*N r subclarescens*), distinct from Kimberley and Northern Territory birds (*N. r. clarescens*). These birds are generally uncommon and patchily distributed in the Pilbara and are listed as Priority 4 by the DPaW and as Near Threatened by the IUCN. The Star Finch prefers areas of dense vegetation, such as reedbeds {Johnstone, 2004 #367} and woodlands near water (Armstrong & Anstee 2000).

This species was recorded near the Ophthalmia Dam (~20 km west), and in mulga south of the Study Area (Outback Ecology Services 2009a). Suitable habitat for this species may be available at the Minor Drainage Lines in the Study Area.

5.2.3 Reptiles

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the EPBC and Schedule 1 under the WCA. This species is primarily nocturnal and tends to shelter in small caves or under vegetation during the day, although it is occasionally active after sunrise, particularly in the warmer summer months (DSEWPaC 2011a). The Pilbara Olive Python is known from a number of sites throughout the Pilbara and is associated with drainage systems, including areas with localised drainage and semi-permanent watercourses (DSEWPaC 2011a). In the Hamersley subregion, the Pilbara Olive Python is most often encountered in the vicinity of permanent waterholes in rocky ranges or among riverine vegetation (Pearson 1993); DSEWPaC 2011a).

This species occurs throughout the Pilbara (Bush & Maryan 2011) and was also recorded at OB 19, east of the Study Area (Biologic 2013a). At OB 19, an individual was found in a rock pool within the Gorge/ Gully habitat in the western side of the Study Area and scat of this species was observed in a cave close-by. Another individual was recorded ~500 m south from this location within the same Gorge/ Gully habitat during a field visit (Paul Taylor, pers. comm.). During night sampling at OB 19 in December 2013, two individuals each were found at two water holes at Gorge/ Gully habitats in the northern section of the Study Area. It is noteworthy that these were among the only water bodies left in the area at the time of sampling. During the same period of time, nocturnal searches were done in prospective habitats at OB 31 but no individuals were recorded. It is possibly due to the lack of water holes within OB 31 during the peak of the dry season. It is likely that individuals (if present) either aestivate or move to other prospective areas during the dry season. However, suitable habitat for this species occurs within the Gorge/ Gully and Minor Drainage Line habitats within the OB 31 Study Area and individuals may occupy these during the wet season.

Pilbara Flat-headed Blindsnake *Ramphotyphlops ganei*

The Pilbara Flat-headed Blindsnake *Ramphotyphlops ganei* is listed as Priority 1 by the DPaW and is endemic to the Pilbara. Given its cryptic fossorial habit, this species is rarely encountered. Little is known of this species' ecology but like most other blind snakes, it is insectivorous, feeding on termites and their eggs, and larvae and pupae of ants (Wilson & Swan 2010). *Ramphotyphlops ganei* is associated with moist gorges and gullies (Wilson & Swan 2010), and potentially with a wide range of other stony habitats.

Two individuals were caught in funnel traps within at the central section of OB 19 (Biologic 2013a) and at OB 18 (ENV 2007), recorded it within the same rocky hilltop habitat. It has been also recorded within Alluvial Plain habitat at Jimblebar, south of the Study Area (Outback Ecology 2009). Suitable habitat for this species is present in the Crest/ Slope and Gorge/ Gully habitats within the Study Area.

Table 5.3 Conservation significant fauna potentially occurring in the Study Area.

Species	Conservation Significance	Preferred Habitat	Extent of the habitat in the Study Area	Likelihood
Northern Quoll *Dasyurus hallucatus*	EPBC: Endangered WCA: Schedule 1 IUCN Endangered	Northern Quolls favour rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, Major Drainage Lines and treed creek lines, as well as structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs (DSEWPaC 2011a).	The Study Area does not contain any Major Drainage Lines or substantial Gorge/ Gully habitats that would be suitable habitats for the Northern Quoll. However, the small Gorge/ Gully habitat in the south-east contain breakaways and mesas that would provide foraging and suboptimal denning habitat. The Minor Drainage Lines may provide transient habitats.	**Unlikely-** very little optimal habitat present and at the southern extent of the species' range.
Greater Bilby *Macrotis lagotis*	EPBC: Vulnerable WCA: Schedule 1	Greater Bilbies prefer landforms with level to low slope topography and light to medium soils. Habitats include open tussock grassland on uplands and hills, Mulga woodland/ scrubland on ridges and rises and hummock grassland in plains and alluvial areas. Other habitats used by the species include stony downs, cracking clays, desert Sand Plains and dune fields, spinifex grassland and *Acacia* spp. scrublands on red earths (Southgate 1990a; Johnson 2008).	Sand Plains, Stony Plains and Mulga / *Acacia* woodlands are all potential habitat. These habitats are widespread in the region.	**Unlikely-** this is at the southern end of the species' range.
Pilbara Leaf-nosed Bat *Rhinonicteris aurantius*	EPBC: Vulnerable WCA: Schedule 1	This species requires warm (28–32 ºC) and highly humid (96–100%) roost sites in caves and/or mine shafts. This is a result of their limited ability to conserve heat and water (Armstrong 2001).	No suitable roosting caves exist within the Study Area and this species has not been recorded in the immediate vicinity.	**Unlikely-** no known roost sites suitable for this species in the vicinity.
Ghost Bat *Macroderma gigas*	DPaW: Priority 4	Roosts in deep complex caves beneath bluffs of low rounded hills, granite rock piles and abandoned mines (Armstrong and Anstee, 2000).	No suitable roosting caves exist within the Study Area and this species has not been recorded in the immediate vicinity.	**Unlikely-** no known roost sites suitable for this species in the vicinity.
Northern Marsupial Mole *Notoryctes caurinus*	EPBC: Endangered WCA: Schedule 1	Sand dunes, inter-dunel flats and sandy soils along river flats.	No suitable habitat within the Study Area, though suitable habitat does occur further to the east.	**Very unlikely-** no suitable habitat present
Bush Stone-curlew *Burhinus grallarius*	DPaW: Priority 4 IUCN: Near threatened	Inhabits areas of open forest and woodland with open areas, fallen dead timber or leaf litter. Inland, it is associated with watercourses.	Suitable habitat in the Study Area includes drainage lines and open areas fringed by denser woodland, such as the grooved Mulga woodlands within the Crest/Slope habitats.	**Likely**- suitable habitat present. The species was recorded immediately east of the Study Area at OB18 (ENV 2007a).
Cattle Egret *Bubulcus ibis*	EPBC: Migratory WCA: Schedule 3	Prefers inundated grasslands and wetlands and occasionally use swamps with tall emergent vegetation, e.g. *Typha* sp. or wooded swamps (Johnstone & Storr 1998).	Preferred habitat of inundated grasslands and wetlands for this species are uncommon in the surrounding region. The nearest major water body is Ophthalmia Dam ~20 km west of the Study Area.	**Unlikely-** suitable habitat not present.
Eastern Great Egret *Ardea modesta*	EPBC: Migratory WCA: Schedule 3	This species occurs in shallows of rivers and freshwater wetlands, breeding in wooded swamps and river pools with *Eucalyptus camaldulensis* and *Melaleuca argentea* (Johnstone & Storr 1998).	The drainage lines across the Study Area do not have suitable pools or wooded swamps.	**Unlikely-** suitable habitat not present.
Oriental Plover *Charadrius veredus*	EPBC: Migratory WCA: Schedule 3	Inhabits dry grassland and thinly vegetated plains with much hard bare ground in inland. This includes areas that have been recently burnt, and areas of hard, stony, bare ground (Johnstone & Storr 1998).	The sparsely-vegetated open Stony Plains in the Study Area are marginally suitable for this species. Such habitat is widespread within the Chichester sub region.	**Possible-** marginally suitable habitat present, and there is a single record within 30 km in the DPaW Threatened Species Database
Common Sandpiper *Actitis hypoleucos*	EPBC: Migratory WCA: Schedule 3	Mainly found in muddy edges or rocky shores in coastal or inland wetlands (Johnstone & Storr 1998).	No large water bodies are found in the vicinity of the Study Area; however small water pools may occur along drainage lines after rain.	**Unlikely-** suitable habitat not present. However, a single individual was recorded immediately east of the Study Area at OB 18 (ENV 2007).

Species	Conservation Significance	Preferred Habitat	Extent of the habitat in the Study Area	Likelihood
Star Finch (western subspecies) *Neochmia ruficauda subclarescens*	DPaW: Priority 4 IUCN: Near Threatened	Prefers areas of dense vegetation, such as reed beds and woodlands near water {Johnstone, 2004 #367}.	The preferred habitat is not present within the Study Area.	**Unlikely-** suitable habitat not present. Recorded near Ophthalmia Dam, and in mulga to the south-west of the Study Area (Outback Ecology Services 2009a).
Pilbara Olive Python *Liasis olivaceus barroni*	EPBC: Vulnerable WCA: Schedule 1	Associated with drainage systems, including areas with localised drainage and semi-permanent watercourses (Bush & Maryan 2011).	Suboptimal habitat occurs within gorges and drainage lines but permanent rock pools are extremely rare or do not exist in the Study Area.	**Unlikely but possible-** suitable habitat very limited but suboptimal habitat present within Gorge/ Gully habitats.
Pilbara Flat-headed Blindsnake *Ramphotyphlops ganei*	DPaW: Priority 4	Associated with moist gorges and gullies (Wilson & Swan 2010) and potentially with a wide range of other stony habitats. Recently found on an alluvial plain north of Ophthalmia dam (Outback Ecology Services 2009a) and on hillside in OB 17 (Biologic unpublished).	As this species can apparently live in a range of habitats from alluvial plains to hillsides, its range may potentially include the Study Area and vicinity.	**Likely-** Suitable habitat occurs within the Crest/ Slope as well as Gorge/ Gully habitats.

6 IMPORTANT FAUNA HABITATS

The expected faunal richness in an area is proportional to the amount of habitat variation and floristic diversity, since both of these factors influence the number of different habitats available for fauna. Accordingly, an area with high variation of habitat types is likely to harbour a higher diversity of fauna and *vice versa*. The OB 31 Study Area has relatively low habitat diversity with five different habitats described.

Each of the fauna habitats identified in Section 4.5 was given a significance score of High, Medium or Low based on criteria outlined in Table 3.3. Sand Plains and Gorge/ Gully habitats were considered to be of High significance because they are most likely to support or provide areas of core habitat for a number of conservation significant species (Table 6.1). The important fauna habitats within the Study Area are shown on Figure 6.1.

Table 6.1 Fauna Habitats with high significance scores.

Fauna habitat	Score	Rationale
Sand Plain	High	Brush-tailed Mulgara was recorded in this habitat and it could provide potential habitat for the Greater Bilby. The large, mature spinifex grasslands that characterise some of the sandplain areas within the Study Area also provide potential habitat for Night Parrot. Sandplains are also used extensively by Australian Bustard.
Crest/slope	Low	Western Pebble-mound Mouse is largely restricted to this habitat type within the Study Area. The blindsnake *Ramphotyphlops ganei* also could occur in this habitat type, but is not restricted to it. This habitat is common in the region.
Gorge/ Gully	High	Gorge/Gully habitat could provide potential breeding, shelter and foraging sites for Pilbara Olive Python, Northern Quoll, and Ghost Bat and possibly Pilbara Leaf-nosed Bat. They could also provide temporary roosts and transitional habitats for other bats. Gorge/Gully areas provide habitat for the blindsnake, *Ramphotyphlops ganei* and Rainbow Bee-eater, although neither of these species is restricted to this habitat type. Furthermore gorges and gullies could be day time retreats for other larger mammals and reptiles. However, no significant Gorge/Gully habitats are present in the Study Area and the available ones represent a small proportion of the Study Area.
Minor Drainage Lines	Medium	Drainage Lines have the potential to provide habitat for a number of conservation significant fauna, such as the blindsnake *Ramphotyphlops ganei* and Australian Bustard, but these species are not restricted to this habitat type. Pilbara Olive Python is likely to utilise Drainage Lines transiently, as corridors during dispersal. Drainage Lines may be used by Rainbow Bee-eater as well, but this species

Fauna habitat	Score	Rationale
		is widespread and not restricted to this habitat type.
Drainage Area	Medium	Drainage Areas have the potential to provide habitat for a number of conservation significant fauna, such as the blindsnake *Ramphotyphlops ganei* and Australian Bustard, but these species are not restricted to this habitat type. Pilbara Olive Python is likely to utilise Drainage Areas transiently, as corridors during dispersal. Drainage Areas may be used by Rainbow Bee-eater as well, but this species is widespread and not restricted to this habitat type.

198000 199000 200000 201000 202000 203000 204000 205000 206000 207000 208000 209000 210000 211000 212000 213000

7423000 7422000 7421000 7420000 7419000 7418000 7417000 7416000 7415000

Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

biologic

FIGURE:	5.2	Date:	11 Feb. 2014
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BHPBIO
OB 31
IMPORTANT HABITATS OF THE SURVEY AREA

FIGURE 6.1

Legend

- Study Area

Important Habitats

- Sand Plain
- Gorge / Gully

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7 SUMMARY

The present survey is one of the 15 faunal studies conducted at and in the immediate vicinity of OB 31. There have been several additional faunal surveys in the general area surrounding the Jimblebar Hub and Mt Newman Orebodies and a number of significant species have been recorded in the general area.

Upon completion of the current study, a total of 120 native vertebrate taxa have been recorded within the Study Area. This comprises 20 native mammal species, 56 bird species, 43 reptile species and one amphibian species. A further six species of introduced mammals have also been recorded.

Five conservation significant species have been recorded within the Study Area: Brush-tailed Mulgara *Dasycercus blythi*, Western Pebble-mound Mouse *Pseudomys chapmani,* Australian Bustard *Ardeotis australis*, Rainbow Bee-eater *Merops ornatus* and Fork-tailed Swift *Apus pacificus.* Based on records from the adjoining areas, an additional 13 species of conservation significant species comprising five species of mammals, six species of birds and two species of reptiles, may occur within the Study Area. However, of these 13 conservation significant species, only four of these (Bush Stone-curlew (likely), Pilbara Flat-headed Blindsnake (likely), Oriental Plover (possible) and Pilbara Olive Python (unlikely but possible)) may potentially occur within the Study Area due to the availability of suitable habitats for the taxon.

Of the five fauna habitats described, the most important were considered to be the Gorge/ Gully and Sand Plain habitats due to their importance for a number of conservation significant species. However, neither habitats are restricted to the Study Area and are widespread in the Pilbara region. Also none of the conservation significant species recorded are restricted to the given habitats or the Study Area.

Sufficient survey work has been undertaken to gain a good understanding of the species communities and habitats present within the Study Area. As with any fauna survey, a proportion of species that use the Study Area would not have been recorded, due to temporal and spatial changes in their distribution and the efficacy of survey techniques used. It is considered very likely that there are additional conservation significant species that use the Study Area, either permanently or seasonally, that have not yet been recorded. Additional surveys over a range or seasonal conditions are likely to determine the presence, and importance of the habitat for these species, within the Study Area.

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Appendix A Survey site locations

Location		Methodology	Consultant
-23.31859	120.09977	Bat Detector	Biologic
-23.31506	120.11703	Bat Detector	Biologic
-23.30617	120.10145	Bat Detector	Biologic
-23.30511	120.13380	Bat Detector	Biologic
-23.29634	120.12615	Bat Detector	Biologic
-23.29388	120.09378	Bat Detector	Biologic
-23.32634	120.14527	Bat Detector	Biologic
-23.32497	120.13775	Bat Detector	Biologic
-23.32475	120.13697	Bat Detector	Biologic
-23.30617	120.10145	Birding	Biologic
-23.31859	120.09977	Birding	Biologic
-23.32474	120.14565	Birding	Biologic
-23.29296	120.09862	Birding	Biologic
-23.32342	120.09789	Birding	Biologic
-23.32217	120.13382	Birding	Biologic
-23.30263	120.09910	Birding	Biologic
-23.32115	120.13693	Motion Camera	Biologic
-23.31935	120.09406	Motion Camera	Biologic
-23.31859	120.09975	Motion Camera	Biologic
-23.31508	120.11704	Motion Camera	Biologic
-23.30625	120.10139	Motion Camera	Biologic
-23.30511	120.13379	Motion Camera	Biologic
-23.30507	120.13377	Motion Camera	Biologic
-23.30454	120.13754	Motion Camera	Biologic
-23.29633	120.12615	Motion Camera	Biologic
-23.29388	120.09378	Motion Camera	Biologic
-23.29238	120.09512	Motion Camera	Biologic
-23.32634	120.14527	Motion Camera	Biologic
-23.32497	120.13775	Motion Camera	Biologic
-23.32475	120.13697	Motion Camera	Biologic
-23.32444	120.13665	Motion Camera	Biologic
-23.32496	120.13774	Motion Camera	Biologic
-23.32192	120.13538	Motion Camera	Biologic
-23.32205	120.13600	Motion Camera	Biologic
-23.32204	120.13571	Motion Camera	Biologic
-23.32638	120.14458	Motion Camera	Biologic
-23.33148	120.09781	Motion Camera	Biologic
-23.32398	120.09840	Motion Camera	Biologic
-23.33148	120.09781	Motion Camera	Biologic
-23.29633	120.12618	Trapping Site	Biologic
-23.29296	120.09862	Trapping Site	Biologic

Location		Methodology	Consultant
-23.32342	120.09789	Trapping Site	Biologic
-23.32217	120.13382	Trapping Site	Biologic
-23.30263	120.09910	Trapping Site	Biologic
-23.32887	120.12441	Habitat Assessment	Biologic
-23.32670	120.12840	Habitat Assessment	Biologic
-23.32476	120.14567	Habitat Assessment	Biologic
-23.32291	120.12473	Habitat Assessment	Biologic
-23.32134	120.13695	Habitat Assessment	Biologic
-23.31933	120.09406	Habitat Assessment	Biologic
-23.31861	120.09975	Habitat Assessment	Biologic
-23.31508	120.11710	Habitat Assessment	Biologic
-23.31445	120.15553	Habitat Assessment	Biologic
-23.31210	120.11903	Habitat Assessment	Biologic
-23.31064	120.15470	Habitat Assessment	Biologic
-23.30923	120.14999	Habitat Assessment	Biologic
-23.30617	120.10163	Habitat Assessment	Biologic
-23.30505	120.13376	Habitat Assessment	Biologic
-23.30455	120.13754	Habitat Assessment	Biologic
-23.29388	120.09380	Habitat Assessment	Biologic
-23.29633	120.12618	Habitat Assessment	Biologic
-23.33274	120.11287	Habitat Assessment	Biologic
-23.28599	120.08890	Habitat Assessment	Biologic
-23.32474	120.13700	Habitat Assessment	Biologic
-23.33148	120.09781	Habitat Assessment	Biologic
-23.33000	120.12095	Habitat Assessment	Biologic
-23.29277	120.10508	Habitat Assessment	Biologic
-23.29144	120.09866	Habitat Assessment	Biologic
-23.32838	120.14118	Habitat Assessment	Biologic
-23.32398	120.09840	Habitat Assessment	Biologic
-23.29296	120.09862	Habitat Assessment	Biologic
-23.32342	120.09789	Habitat Assessment	Biologic
-23.32217	120.13382	Habitat Assessment	Biologic
-23.30263	120.09910	Habitat Assessment	Biologic
-23.294182	120.131035	Habitat Assessment	Biologic
-23.296171	120.102867	Habitat Assessment	Biologic
-23.329418	120.124496	Habitat Assessment	Biologic
-23.287333	120.146744	Habitat Assessment	Biologic
-23.290215	120.150764	Habitat Assessment	Biologic
-23.303809	120.103593	Habitat Assessment	ENV, 2011
-23.307583	120.084672	Habitat Assessment	ENV, 2011
-23.296209	120.092336	Habitat Assessment	ENV, 2011
-23.320022	120.117959	Habitat Assessment	ENV, 2011
-23.332063	120.75282	Habitat Assessment	ENV, 2011

Location		Methodology	Consultant
-23.321315	120.137809	Habitat Assessment	ENV, 2011
-23.321999	120.135703	Habitat Assessment	ENV, 2011
-23.300199	120.141427	Habitat Assessment	ENV, 2011
-23.296699	120.152914	Habitat Assessment	ENV, 2011
-23.300974	120.155227	Habitat Assessment	ENV, 2011
-23.302994	120.145716	Habitat Assessment	ENV, 2011
-23.333077	120.107484	Trapping Site	ENV, 2012
-23.336552	120.123642	Trapping Site	ENV, 2012
-23.321947	120.133349	Trapping Site	ENV, 2012
-23.321999	120.128794	Trapping Site	ENV, 2012
-23.333502	120.130032	Trapping Site	ENV, 2012
-23.3388	120.084147	Trapping Site	ENV, 2012
-23.320486	120.100075	Trapping Site	ENV, 2012
-23.325496	120.134924	Motion Camera	ENV, 2012
-23.358447	120.098204	Motion Camera	ENV, 2012
-23.321883	120.135305	Motion Camera	ENV, 2012
-23.32425	120.138352	Motion Camera	ENV, 2012
-23.345321	120.121987	Motion Camera	ENV, 2012
-23.322589	120.129494	Motion Camera	ENV, 2012
-23.355913	120.09737	Trapping Site	ENV, 2012
-23.32425	120.138352	Bat Detector	ENV, 2012
-23.321999	120.128794	Bat Detector	ENV, 2012
-23.345321	120.121987	Bat Detector	ENV, 2012
-23.358275	120.098179	Bat Detector	ENV, 2012
-23.355913	120.09737	Bat Detector	ENV, 2012
-23.333077	120.107484	Habitat Assessment	ENV, 2012
-23.336552	120.123642	Habitat Assessment	ENV, 2012
-23.321947	120.133349	Habitat Assessment	ENV, 2012
-23.321999	120.128794	Habitat Assessment	ENV, 2012
-23.333502	120.130032	Habitat Assessment	ENV, 2012
-23.3388	120.084147	Habitat Assessment	ENV, 2012
-23.320486	120.100075	Habitat Assessment	ENV, 2012

Appendix B **Conservation status codes**

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 (EW)	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 (CE)	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
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CE)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Migratory (MG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention)

Wildlife Conservation Act 1950

Category	Definition
Schedule 1 (S1)	Rare and Likely to become Extinct.
Schedule 2 (S2)	Extinct.
Schedule 3 (S3)	Migratory species listed under international treaties.
Schedule 4 (S4)	Other Specially Protected Fauna.

Department of Environment and Conservation Priority codes

Category	Definition
Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4 (P4)	Taxa in need of monitoring. Taxa which 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.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix C Fauna recorded in the Study Area and region

EPBC Protected Matters search with 5 km buffer
DPaW Threatened Species Database search within 5 km buffer

Surveys

A West Jimblebar Fauna Assessment (ENV Australia 2007)
B Orebody 18 Biological Assessment Survey (ecologia Environmental 1995)
C Orebody 18 Fauna Assessment Phase II {ENV Australia, 2007 #317}
D Orebody 31 Fauna Assessment. {ENV Australia, 2011 #322}
E Jimblebar Mine Site Biological Survey. BHP (BHP Iron Ore Pty Ltd 1994)
F Wheelara Hill Iron Ore Mine Modification: Fauna and Flora Assessment, {Outback Ecology Services, 2009 #326}
G Jimblebar Iron Ore Project: Terrestrial Vertebrate Fauna Assessment. {Outback Ecology Services, 2009 #327}
H Jimblebar - Wheelara Hill Biological Survey. {ecologia Environmental, 2004 #328}
I BHPBIO Hashimoto Terrestrial Vertebrate Fauna Assessment. {ecologia Environmental, 2006 #329}
J Jimblebar Marra Mamba Exploration Biological Survey. {ecologia Environmental, 2006 #330}
K East Jimblebar Exploration Project Biological Survey. {ecologia Environmental, 2005 #332}
L Orebody 19 Vertebrate Fauna Survey. (Biologic 2013a)
M Current Survey (Season 2 conducted by Biologic)

Mammals

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	DPaW Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L	M
TACHYGLOSSIDAE																				
Tachyglossus aculeatus	Echidna													●					●	
DASYURIDAE																				
Dascycercus blythi	Brush-tailed Mulgara																		●	●
Dasykaluta rosamondae	Little Red Kaluta					●						●	●	●	●	●			●	
Dasyurus hallucatus	Northern Quoll	EN	S1		EN		●													
Ningaui timealeyi	Pilbara Ningaui					●			●						●	●			●	
Planigale maculata	Common Planigale								●											
Pseudantechinus roryi	Rory's Pseudantechinus					●														
Pseudantechinus macdonnellensis	Fat-tailed Antechinus								●			●								
Pseudantechinus woolleyae	Woolley's Pseudantechinus					●													●	
Sminthopsis crassicaudata	Fat-tailed Dunnart												●	●		●			●	
Sminthopsis macroura	Stripe-faced Dunnart												●	●		●			●	
Sminthopsis ooldea	Ooldea Dunnart																			●
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					●							●	●					●	●
THYLACOMYIDAE																				

Macrotis lagotis	Bilby, Dalgyte	VU	S1		VU		●													
NOTORYCIDAE																				
Notoryctes caurinus	Northern Marsupial Mole	EN	S1		EN		●													
MACROPODIDAE																				
Macropus robustus	Common Wallaroo							●	●	●		●	●	●	●	●	●	●	●	●
Macropus rufus	Red Kangaroo, Marlu							●			●		●	●		●	●	●		
Petrogale lateralis lateralis	Black-footed Rock Wallaby																			
Petrogale sp.	Rock-wallaby														●					
Petrogale rothschildi	Rothschild's Rock-wallaby								●	●									●	
MEGADERMATIDAE																				
Macroderma gigas	Ghost Bat			P4	VU											●				
HIPPOSIDERIDAE																				
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1				●									●				
EMBALLONURIDAE																				
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat															●		●		●
Taphozous georgianus	Common Sheathtail-bat									●						●			●	●
Taphozous hilli	Hill's Sheathtail-bat																		●	●
MOLOSSIDAE																				
Chaerephon jobensis	Northern Freetail-bat																	●	●	●
Mormopterus beccarii	Beccari's Freetail-bat									●						●				●
VESPERTILIONIDAE																				
Chalinolobus gouldii	Gould's Wattled Bat									●	●					●	●	●	●	●
Nyctophilus geoffroyi	Lesser Long-eared Bat									●						●		●		●
Scotorepens greyii	Little Broad-nosed Bat									●	●					●	●	●	●	●
Vespadelus finlaysoni	Finlayson's Cave Bat							●		●	●		●			●	●	●	●	●
MURIDAE																				
**Mus musculus*	House Mouse						●	●	●	●		●	●	●	●	●				●
Notomys alexis	Spinifex Hopping-mouse									●						●			●	
Pseudomys chapmani	Western Pebble-mound Mouse			P4		●					●	●	●	●	●		●		●	
Pseudomys desertor	Desert Mouse									●					●	●			●	●
Pseudomys hermannsburgensis	Sandy Inland Mouse					●			●	●		●	●	●	●	●			●	●
Zyzomys argurus	Common Rock-rat					●		●	●	●		●		●	●	●			●	●
BOVIDAE																				
**Bos taurus*	European Cattle					●		●			●		●	●		●	●			●
CANIDAE																				
Canis lupus dingo	Dingo											●	●	●		●	●	●	●	●
**Canis lupus*	Dog						●	●												
**Vulpes vulpes*	Red Fox						●			●										
CAMELIDAE																				

**Camelus dromedarius*	Dromedary, Camel						●	●									●			●
EQUIDAE																				
**Equus asinus*	Donkey						●				●			●		●				●
**Equus caballus*	Horse						●	●				●		●						
FELIDAE																				
**Felis catus*	Cat						●			●			●	●		●	●	●	●	
LEPORIDAE																				
**Oryctolagus cuniculus*	Rabbit						●					●								●

Birds

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	DPaW Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L	M
CASUARIIDAE																				
Dromaius novaehollandiae	Emu					●		●	●	●		●								
PHASIANIDAE																				
Coturnix pectoralis	Stubble Quail																	●		
Coturnix ypsilophora	Brown Quail															●				
ANATIDAE																				
Anas gracilis	Grey Teal																			
Anas querquedula	Garganey																			
Anas rhynchotis	Australasian Shoveler																			
Anas superciliosa	Pacific Black Duck																			
Anseranas semipalmata	Magpie Goose																			
Aythya australis	Hardhead																			
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 Shelduck															●				
RALLIDAE																				
Fulica atra	Eurasian coot																			
Gallinula ventralis	Black-tailed Native-hen															●				

Gallirallus philippensis	Buff-banded Rail																		
Porphyrio porphyrio	Purple Swamp Hen																		
Porzana pusilla	Baillon's Crake																		
Porzana tabuensis	Spotless Crake																		
GLAREOLIDAE																			
Stiltia isabella	Australian Pratincole																		
PODICIPEDIDAE																			
Podiceps cristatus	Great Crested Grebe																		
Poliocephalus poliocephalus	Hoary-headed Grebe																		
Tachybaptus novaehollandiae	Australasian Grebe																		
COLUMBIDAE																			
Geophaps plumifera	Spinifex Pigeon					●		●	●	●	●	●	●	●	●	●		●	●
Geopelia cuneata	Diamond Dove					●		●	●	●	●	●			●	●	●	●	●	●
Geopelia humeralis	Bar-shouldered Dove																		
Geopelia striata	Peaceful Dove					●										●			
Ocyphaps lophotes	Crested Pigeon					●		●		●	●	●		●	●	●	●	●	●	●
Phaps chalcoptera	Common Bronzewing					●		●		●	●	●			●	●		●	●	●
PODARGIDAE																			
Podargus strigoides	Tawny Frogmouth					●				●					●	●		●		
EUROSTOPODIDAE																			
Eurostopodus argus	Spotted Nightjar					●		●	●	●	●					●	●	●		
AEGOTHELIDAE																			
Aegotheles cristatus	Australian Owlet-nightjar					●			●	●	●	●				●		●	●	●
APODIDAE																			
Apus pacificus	Fork-tailed Swift	MG	S3				●				●									
ANHINGIDAE																			
Anhinga novaehollandiae	Australasian Darter																		
PHALACROCORACIDAE																			
Phalacrocorax carbo	Great Cormorant																		
Phalacrocorax sulcirostris	Little Black Cormorant															●			
Phalacrocorax varius hypoleucos	Pied Cormorant																		
PELECANIDAE																			
Pelecanus conspicillatus	Australian Pelican																		
ARDEIDAE																			
Ardea alba	Great Egret																		
Ardea ibis	Cattle Egret	MG	S3				●												
Ardea intermedia	Intermediate Egret																		
Ardea modesta	Eastern Great Egret	MG	S3				●												

Ardea pacifica	White-necked Heron															●				
Egretta novaehollandiae	White-faced Heron														●	●				
Nycticorax caledonicus	Nankeen Night-Heron																			
CICONIIDAE																				
Ephippiorhynchus asiaticus australis	Black-necked Stork				NT															
THRESKIORNITHIDAE																				
Platalea flavipes	Yellow-billed Spoonbill																			
Platalea regia	Royal Spoonbill																			
Plegadis falinellus	Glossy Ibis																			
Threskiornis molucca	Australian White Ibis																			
Threskiornis spinicollis	Straw-necked Ibis																			
ACCIPITRIDAE																				
Aquila audax	Wedge-tailed Eagle					●		●		●	●		●	●	●	●	●		●	
Haliaeetus leucogaster	White-bellied Sea-eagle																			
Accipiter cirrocephalus	Collared Sparrowhawk							●											●	
Accipiter fasciatus	Brown Goshawk					●		●							●	●	●		●	
Circus approximans	Swamp Harrier																			
Circus assimilis	Spotted Harrier								●							●	●		●	
Elanus axillaris	Black-shouldered Kite							●	●	●							●		●	●
Haliastur sphenurus	Whistling Kite					●		●	●	●				●		●	●		●	●
Lophoictinia isura	Square-tailed Kite																			
Milvus migrans	Black Kite					●				●				●			●		●	
Hamirostra melanosternon	Black-breasted Buzzard					●				●				●		●	●	●	●	●
Hieraaetus morphnoides	Little Eagle							●						●		●		●		
FALCONIDAE																				
Falco berigora	Brown Falcon					●		●	●	●	●		●	●	●	●	●	●	●	●
Falco cenchroides	Nankeen Kestrel					●		●	●	●	●	●		●	●	●	●	●	●	●
Falco longipennis	Australian Hobby														●	●		●	●	
Falco peregrinus	Peregrine Falcon		S4					●												
Falco subniger	Black Falcon																			
OTIDIDAE																				
Ardeotis australis	Australian Bustard			P4	NT			●	●		●			●		●	●	●		●
BURHINIDAE																				
Burhinus grallarius	Bush Stone-curlew			P4	NT	●				●				●	●					
RECURVIROSTRIDAE																				
Cladorhynchus leucocephalus	Banded Stilt																			
Himantopus himantopus	Black-winged Stilt																			

Recurvirostra novaehollandiae	Red-necked Avocet																			
CHARADRIIDAE																				
Charadrius ruficapillus	Red-capped Plover																			
Charadrius veredus	Oriental Plover	MG	S3				●													
Elseyornis melanops	Black-fronted Dotterel															●				
SCOLOPACIDAE																				
Calidris acuminata	Sharp-tailed Sandpiper	MG	S3																	
Calidris ferruginea	Curlew Sandpiper	MG	S3																	
Calidris melanotos	Pectoral Sandpiper	MG	S3																	
Calidris ruficollis	Red-necked Stint	MG	S3																	
Calidris subminuta	Long-toed Stint	MG	S3																	
Tringa glareola	Wood Sandpiper	MG	S3																	
Tringa nebularia	Common Greenshank	MG	S3																	
Tringa stagnatilis	Marsh Sandpiper	MG	S3																	
Actitis hypoleucos	Common Sandpiper	MG	S3			●				●										
LARIDAE																				
Larus novaehollandiae	Silver Gull																			
TURNICIDAE																				
Turnix velox	Little Button-quail					●		●	●	●	●					●	●		●	●
CACATUIDAE																				
Eolophus roseicapillus	Galah					●		●	●	●	●	●			●	●	●	●	●	●
Cacatua sanguinea	Little Corella							●	●					●	●	●				
Nymphicus hollandicus	Cockatiel					●		●		●	●					●	●			
PSITTACIDAE																				
Barnardius zonarius	Australian Ringneck							●	●					●	●	●	●	●	●	●
Psephotus varius	Mulga Parrot							●												●
Melopsittacus undulatus	Budgerigar					●		●	●	●	●	●		●		●	●	●	●	
Neopsephotus bourkii	Bourke's Parrot							●								●				
CUCULIDAE																				
Centropus phasianinus	Pheasant Coucal															●				
Chalcites basalis	Horsfield's Bronze-Cuckoo					●		●	●		●		●		●	●	●			
Chalcites osculans	Black-eared Cuckoo															●				
Cacomantis falbelliformis	Fan-tailed Cuckoo																			
Cacomantis pallidus	Pallid Cuckoo					●		●	●	●	●					●	●			
STRIGIDAE																				
Ninox connivens	Barking Owl																		●	
Ninox novaeseelandiae	Southern Boobook							●				●		●		●				●
TYTONIDAE																				

Tyto alba	Barn Owl													●	●				●	
HALCYONIDAE																				
Dacelo leachii	Blue-winged Kookaburra															●				
Todiramphus chloris	Collared Kingfisher																			
Todiramphus pyrrhopygius	Red-backed Kingfisher					●		●	●	●	●			●	●	●	●		●	●
Todiramphus sanctus	Sacred Kingfisher															●		●		
MEROPIDAE																				
Merops ornatus	Rainbow Bee-eater	MG	S3			●	●	●					●	●	●	●	●	●	●	●
CLIMACTERIDAE																				
Climacteris melanura	Black-tailed Treecreeper															●				
PTILINORHYNCHIDAE																				
Ptilonorhynchus guttatus	Western Bowerbird							●							●	●			●	●
MALURIDAE																				
Amytornis striatus whitei	Striated Grasswren					●			●	●	●	●		●	●	●			●	●
Malurus lamberti	Variegated Fairy-wren					●		●	●	●	●	●	●	●	●	●	●	●	●	●
Malurus leucopterus	White-winged Fairy-wren					●		●						●	●	●	●	●	●	
Malurus splendens	Splendid Fairy-wren							●												
Stipiturus ruficeps	Rufous-crowned Emu-wren															●				
ACANTHIZIDAE																				
Pyrrholaemus brunneus	Redthroat							●												●
Smicrornis brevirostris	Weebill					●		●		●	●	●	●	●	●	●	●		●	●
Gerygone fusca	Western Gerygone					●		●		●			●	●			●		●	
Acanthiza apicalis	Inland Thornbill							●					●	●			●	●		●
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					●		●								●	●			
Acanthiza robustirostris	Slaty-backed Thornbill							●								●				●
Acanthiza uropygialis	Chestnut-rumped Thornbill					●		●				●			●	●	●			●
Aphelocephala leucopsis	Southern Whiteface							●												
PARDALOTIDAE																				
Pardalotus rubricatus	Red-browed Pardalote					●				●					●	●	●		●	●
Pardalotus striatus	Striated Pardalote								●						●				●	
MELIPHAGIDAE																				
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					●		●		●	●	●	●		●	●	●	●	●	
Certhionyx niger	Black Honeyeater							●	●							●				
Certhionyx variegatus	Pied Honeyeater							●	●							●	●			
Conopophila whitei	Grey Honeyeater					●		●												
Lichenostomus keartlandi	Grey-headed Honeyeater							●	●	●		●		●	●		●		●	
Lichenostomus penicillatus	White-plumed Honeyeater							●		●		●		●	●	●	●	●	●	
Lichenostomus plumulus	Grey-fronted Honeyeater											●								

Lichenostomus virescens	Singing Honeyeater							●	●	●	●	●	●	●	●	●	●	●	●	●
Lichmera indistincta	Brown Honeyeater					●		●	●	●	●	●			●	●	●	●	●	
Melithreptus gularis	Black-chinned Honeyeater														●				●	
Purnella albifrons	White-fronted Honeyeater							●	●			●								
Sugomel niger	Black Honeyeater																●			
Manorina flavigula	Yellow-throated Miner					●		●		●	●	●	●	●	●	●	●	●	●	●
Epthianura tricolor	Crimson Chat					●		●	●	●						●	●		●	
Epthianura aurifrons	Orange Chat																			
POMATOSTOMIDAE																				
Pomatostomus superciliosus	White-browed Babbler							●									●			
Pomatostomus temporalis	Grey-crowned Babbler					●		●		●	●		●	●	●	●	●		●	●
CINCLOSOMATIDAE																				
Cinclosoma castanotus	Chestnut Quail-thrush																	●		
Psophodes occidentalis	Chiming Wedgebill																	●		
CAMPEPHAGIDAE																				
Coracina maxima	Ground Cuckoo-shrike														●	●				
Coracina novaehollandiae	Black-faced Cuckoo-shrike					●		●	●	●	●	●	●	●	●	●	●	●	●	●
Lalage leucomela	Varied Triller																		●	
Lalage tricolor	White-winged Triller							●	●	●	●				●	●	●		●	
PACHYCEPHALIDAE																				
Pachycephala rufiventris	Rufous Whistler					●		●	●	●	●			●	●	●	●	●	●	●
Colluricincla harmonica	Grey Shrike-thrush					●		●	●	●	●	●	●	●	●	●	●	●	●	
Oreoica gutturalis	Crested Bellbird					●		●	●	●	●	●	●		●	●	●		●	
ARTAMIDAE																				
Artamus cinereus	Black-faced Woodswallow					●		●		●	●	●	●	●	●	●	●	●	●	●
Artamus minor	Little Woodswallow					●		●	●	●	●	●			●	●			●	●
Artamus personatus	Masked Woodswallow												●	●			●		●	
Cracticus nigrogularis	Pied Butcherbird					●		●	●	●	●	●	●	●	●	●	●	●	●	●
Cracticus tibicen	Australian Magpie					●		●		●	●	●	●	●	●		●		●	
Cracticus tibicen tibicen	Black-backed Magpie																			
Cracticus torquatus	Grey Butcherbird							●			●	●			●	●	●	●		
RHIPIDURIDAE																				
Rhipidura albiscapa	Grey Fantail							●												
Rhipidura leucophrys	Willie Wagtail					●		●	●	●		●	●	●	●	●	●	●	●	●
Rhipidura phasiana	Mangrove Grey Fantail																			
CORVIDAE																				
Corvus bennetti	Little Crow															●				
Corvus coronoides	Australian Raven																	●		

Corvus orru	Torresian Crow					●		●		●		●	●	●	●	●	●	●	●	●
MONARCHIDAE																				
Grallina cyanoleuca	Magpie-lark					●		●		●			●	●	●	●	●	●	●	
PETROICIDAE																				
Petroica goodenovii	Red-capped Robin					●		●				●	●	●		●	●	●	●	
Melanodryas cucullata	Hooded Robin							●	●	●	●	●		●	●	●	●		●	
ALAUDIDAE																				
Mirafra javanica	Horsfield's Bushlark							●					●	●		●				
ACROCEPHALIDAE																				
Acrocephalus australis	Australian Reed-Warbler																			
MEGALURIDAE																				
Cincloramphus cruralis	Brown Songlark							●			●				●					
Cincloramphus mathewsi	Rufous Songlark					●		●		●	●				●	●	●		●	
Eremiornis carteri	Spinifexbird					●		●	●	●		●		●	●		●		●	
Megalurus gramineus	Little Grassbird																			
HIRUNDINIDAE																				
Cheramoeca leucosterna	White-backed Swallow											●		●	●	●	●			
Hirundo neoxena	Welcome Swallow																			
Petrochelidon ariel	Fairy Martin									●									●	
Petrochelidon nigricans	Tree Martin																			
CLIMACTERIDAE																				
Climacteris melanura	Black-tailed tree creeper																			
NECTARINIIDAE																				
Dicaeum hirundinaceum	Mistletoebird								●						●	●	●		●	
ESTRILDIDAE																				
Emblema pictum	Painted Finch					●		●	●	●	●				●	●	●		●	●
Heteromunia pectoralis	Pictorella Mannikin																			
Neochmia ruficauda subclarescens	Star Finch (western subspecies)			P4																
Taeniopygia guttata	Zebra Finch					●		●	●	●	●	●	●	●	●	●	●	●	●	●
MOTACILLIDAE																				
Anthus australis	Australasian Pipit																●		●	
Anthus novaeseelandiae	Richard's Pipit							●	●	●		●		●	●	●				

Reptiles

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	DPaW Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L	M
CHELUIDAE																				
Chelodina steindachneri	Flat-shelled Turtle														●	●				
AGAMIDAE																				
Caimanops amphiboluroides	Mulga Dragon																			
Ctenophorus caudicinctus	Ring-tailed Dragon							●	●	●	●		●	●	●	●	●	●	●	●
Ctenophorus isolepis	Crested Dragon					●			●		●						●	●		●
Ctenophorus nuchalis	Central Netted Dragon							●	●				●	●		●				
Ctenophorus reticulatus	Western Netted Dragon									●							●			
Diporiphora valens										●										
Diporiphora winneckei	Blue-lined Dragon																			
Lophognathus longirostris	Long-nosed Dragon							●							●	●	●	●		●
Moloch horridus	Thorny Devil																			●
Pogona minor								●	●	●						●	●		●	●
DIPLODACTYLIDAE																				
Diplodactylus conspicillatus	Fat-tailed Gecko					●			●				●	●		●		●	●	●
Diplodactylus mitchelli																				
Diplodactylus savagei	Yellow-spotted Pilbara Gecko									●									●	
Lucasium stenodactylum	Pale-snouted Ground Gecko					●		●		●			●	●	●	●		●	●	●
Lucasium wombeyi								●		●					●	●			●	●
Oedura marmorata	Marbled Velvet Gecko							●			●								●	●
Rhynchoedura ornata	Beaked Gecko					●			●	●						●		●		
Strophurus ciliaris																		●		
Strophurus elderi										●					●			●		
Strophurus jeanae																		●		●
Strophurus wellingtonae								●		●						●		●	●	●
CARPHODACTYLIDAE																				
Nephrurus wheeleri																	●			
GEKKONIDAE																				
Gehyra pilbara						●		●	●											
Gehyra punctata	Spotted Rock Dtella					●		●	●	●	●	●		●		●	●		●	●
Gehyra purpurascens																●				
Gehyra variegata	Tree Dtella					●		●	●	●	●	●	●	●	●	●	●	●	●	●

Heteronotia binoei	Bynoe's Gecko					●		●	●	●	●			●	●	●		●	●	
Heteronotia spelea	Desert Cave Gecko									●	●				●	●				●
PYGOPODIDAE																				
Delma butleri	Unbanded Delma									●									●	
Delma elegans	Pilbara Delma															●			●	
Delma haroldi																●				
Delma nasuta						●			●	●					●				●	
Delma pax						●		●	●	●			●	●	●	●	●		●	●
Delma tincta														●						
Lialis burtonis	Burton's legless lizard							●						●	●	●	●			●
Pygopus nigriceps	Hooded Scaly foot												●			●				
SCINCIDAE																				
Carlia munda																●	●			●
Carlia triacantha	Desert Rainbow Skink					●				●			●		●					●
Cryptoblepharus carnabyi										●										
Cryptoblepharus plagiocephalus	Fence Skink								●	●										
Cryptoblepharus ustulatus						●													●	
Ctenotus ariadnae						●				●									●	
Ctenotus duricola						●				●			●	●	●	●			●	●
Ctenotus grandis						●				●			●	●		●				
Ctenotus hanloni																				
Ctenotus helenae						●		●	●	●			●	●	●	●			●	●
Ctenotus leonhardii									●	●		●			●			●		
Ctenotus pantherinus	Leopard Ctenotus					●			●	●			●	●	●	●	●		●	●
Ctenotus quattuordecimlineatus	Fourteen-lined Ctenotus								●											
Ctenotus rubicundus																			●	
Ctenotus rutilans	Pilbara Rusty Ctenotus															●			●	
Ctenotus saxatilis	Rock Ctenotus					●		●	●	●	●		●	●	●	●	●		●	●
Ctenotus schomburgkii	Barred wedge-tailed Ctenotus															●				
Ctenotus serventyi								●												
Ctenotus uber													●	●		●				●
Ctenotus uber johnstonei			P2			●														
Cyclodomorphus branchialis	Gunther's Skink								●			●								
Cyclodomorphus melanops	Slender Blue-tongue					●										●	●		●	●
Egernia cygnitos	Pygmy Spiny-tailed Skink (western)																		●	●
Egernia depressa	Pygmy Spiny-tailed Skink												●			●				
Egernia formosa	Crevice Skink																			

Eremiascincus richardsonii	Broad-banded Sand Swimmer														●	●		●		
Lerista bipes								●								●				●
Lerista chalybura									●											
Lerista flammicauda																				
Lerista muelleri						●		●	●	●			●	●		●	●		●	
Lerista neander						●			●	●				●	●	●	●		●	●
Lerista timida																				●
Lerista zietzi						●				●					●	●			●	
Menetia greyii	Dwarf Skink					●			●	●				●		●	●		●	●
Menetia surda																				
Morethia ruficauda	Fire-tailed Skink					●		●	●	●		●			●	●			●	●
Tiliqua multifasciata	Central Blue-tongue									●			●	●	●	●	●	●	●	●
VARANIDAE																				
Varanus acanthurus	Spiny-tailed Monitor					●		●	●	●	●			●	●	●	●		●	●
Varanus brevicauda	Short-tailed Pygmy Monitor																			
Varanus caudolineatus	Stripe-tailed Monitor							●					●	●			●			
Varanus eremius	Desert Pygmy Monitor							●		●										●
Varanus giganteus	Perentie								●							●			●	
Varanus gouldii	Bungarra or Sand Monitor					●		●		●				●		●				●
Varanus panoptes	Yellow-spotted Monitor							●							●	●		●		●
Varanus pilbarensis	Pilbara Rock Monitor					●			●									●	●	
Varanus tristis	Black-headed Monitor								●	●		●	●	●	●	●	●		●	●
TYPHLOPIDAE																				
Ramphotyphlops ammodytes								●												
Ramphotyphlops ganei	Pilbara Flat-headed Blindsnake			P1		●				●									●	
Ramphotyphlops grypus						●			●	●					●	●			●	
Ramphotyphlops hamatus													●	●		●			●	●
Ramphotyphlops pilbarensis																				
Ramphotyphlops waitii																			●	
BOIDAE																				
Antaresia perthensis	Pygmy Python								●						●	●				
Antaresia stimsoni	Stimson's Python														●			●		
Aspidites melanocephalus	Black-headed Python															●				
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1																●	
ELAPIDAE																				
Acanthophis pyrrhus	Desert Death Adder																			
Brachyurophis approximans										●					●					●

Demansia psammophis	Yellow-faced Whipsnake					●		●		●						●	●	●	●	●
Demansia rufescens	Rufous Whipsnake									●									●	
Furina ornata	Moon Snake							●											●	
Parasuta monachus	Inland Hooded Snake																			
Pseudechis australis	Mulga Snake													●	●	●	●		●	
Pseudonaja modesta	Ringed Brown Snake															●			●	●
Pseudonaja mengdeni													●	●		●		●	●	●
Suta fasciata	Rosen's Snake																			
Suta punctata	Spotted Snake																●			●
Vermicella snelli																				

Amphibians

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	DPaW Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L	M
HYLIDAE																				
Cyclorana maini	Main's Frog															●		●		
Cyclorana platycephala	Water-Holding Frog															●				
Litoria rubella	Desert Tree Frog										●			●	●	●	●	●		
MYOBATRACHIDAE																				
Pseudophryne douglasi	Douglas' Toadlet																			
Uperoleia russelli	Russell's Toadlet													●	●	●		●		
LIMNODYNASTIDAE																				
Neobatrachus kunapalari	Kunapalari Frog																			
Neobatrachus centralis	Desert Trilling Frog														●					
Notaden nichollsi	Desert Spadefoot														●					
Platyplectrum spenceri	Centralian Burrowing Frog														●	●		●		

Appendix D Habitat Assessment

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	1	-23.293880 120.093796	Minor drainage line	open acacia shrubland		0	2	6	6	6	20	2	0	0	1
2	2	-23.296329 120.126175	Sandplain	spinifex grassland		0	2	2	6	6	50	2	0	2	1
2	3	-23.315081 120.117104	Mulga	mulga shrubland		0	0	50	20	6	0	20	0	2	0
2	4	-23.306173 120.101631	Crest/slope	mulga open woodland		0	6	6	6	6	6	2	0	2	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	5	-23.319332 120.094063	Crest/slope	spinifex grassland		0	2	0	2	2	50	2	0	0	0
2	6	-23.314453 120.155533	Sandplain	soft grassland		0	0	0	6	6	2	20	0	2	0
2	7	-23.310640 120.154701	Stony plain	spinifex grassland		0	0	2	6	6	50	0	0	0	0
2	8	-23.309229 120.149986	Crest/slope	mulga woodland		0	20	2	2	2	2	2	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	9	-23.324760 120.145668	Minor drainage line	acacia shrubland		0	2	50	6	6	6	6	0	2	1
2	10	-23.321342 120.136948	Gorge/gully	spinifex grassland		0	0	0	6	6	50	0	0	0	0
2	11	-23.304554 120.137535	Crest/slope	acacia dense shrubland		0	0	85	6	6	2	0	0	0	0
2	12	-23.326700 120.128403	Sandplain	spinifex grassland		0	2	2	2	2	50	2	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	13	-23.328869 120.124413	Sandplain	spinifex grassland		0	0	2	2	2	50	2	0	0	0
2	14	-23.322905 120.124725	Crest/slope	spinifex grassland		0	0	0	2	2	50	0	0	0	0
2	15	-23.312098 120.119026	Stony plain	low sparse shrubland		0	0	0	0	6	0	0	0	0	0
2	16	-23.305054 120.133759	Gorge/gully	spinifex grassland		0	0	6	2	2	50	0	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	17	-23.318607 120.099754	Gorge/gully	spinifex grassland		0	0	2	6	6	50	6	0	0	0
2	18	-23.33274 120.11287	Stony Plain	Triodia hummock grassland and mixed Acacia		0	10	0	10	20	30	0	0	2	0
2	19	-23.28599 120.0889	Sand Plain	open Acacia woodland over grass on sandplain		5	5	5	10	5	2	40	0	0	0
2	20	-23.32474 120.137	Mulga	Triodia hummock grassland and mixed Acacia Mulga		5	30	0	25	15	50	0	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	21	-23.33148 120.09781	Sand Plain	Triodia, sparse hummock grassland		0	5	0	5	10	60	0	0	0	0
2	22	-23.33 120.12095	Stony Plain	Triodia hummock and tussock grassland		2	15	2	10	10	10	30	0	2	0
2	23	-23.29277 120.10508	Sand Plain	Triodia hummock grassland		5	0	5	10	2	40	10	0	0	0
2	24	-23.29144 120.09866	Mulga	Sparse Mulga shrubland		0	10	2	5	2	0	0	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	25	-23.32838 120.14118	Sandy Plain	Triodia hummock grassland		0	0	0	5	5	60	5	0	0	0
2	26	-23.32398 120.09840	Drainage Area	Mulga		30	20	5	25	10	0	25	0	5	0
2	27	-23.29296 120.09862	Crest/ Slope	Acacia shrubland over Triodia hummock grassland		5	15	30	30	10	40	5	0	0	0
2	28	-23.32342 120.09789	Mulga	Mulga woodland		10	5	0	5	5	0	80	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
2	29	-23.32217 120.13382	Crest/ Slope	Mixed Acacia Grevillea		5	10	5	10	2	10	70	0	0	0
2	30	-23.30263 120.0991	Mulga	Mulga woodland		50	10	10	10	5	50	2	0	0	1
3	31	-23.294182 120.131035	Stony plain			0	2	2	20	6	20	2	0	0	0
3	32	-23.296171 120.102867	Stony plain					6	2	2	20	0	0	0	0

Round	Site	Position	Fauna habitat type	Broad floristic formation	Photo	Density of trees (>5m)	Density of trees (2-5m)	Density of shrubs (2 m)	Density of shrubs (1-2 m)	Density of shrubs (0.5-1 m)	Density of spinifex	Density of soft grasses	Density of sedges	Density of herbs	Presence of mistletoes
3	33	-23.329418 120.124496	Stony/ sandplain	space grass and spinifex		0	0	6	20	20	85	50		6	0
3	34	-23.287333 120.146744	Stony plain			0	0	6	20	50	85	6			0
3	35	-23.290215 120.150764	Stony/ sandplain					2	6	50	85				0

Table contd.

Round	Site	Bare ground cover	Leaf litter cover	Twig litter cover	Logs cover	Hollow bearing trees	Landform	Soil type	Soil colour	Rock size	Rocky outcropping	Soil comments
2	1	2	2	0	0	2	Stream Bed (STB)	Sandy loam	Red	Small cobbles	Absent	mixed rock types mostly ironstone
2	2	2	2	0	0	2	Plain (PLA)	Sand	Red		Absent	
2	3	5	5	2	0	5	Drainage Depression	Clay loam	Orange		Absent	

Round	Site	Bare ground cover	Leaf litter cover	Twig litter cover	Logs cover	Hollow bearing trees	Landform	Soil type	Soil colour	Rock size	Rocky outcropping	Soil comments
							(DDE)					
2	4	0	0	0	0	0	Tor (TOR)	Silty loam	Red	Boulders	Present	ironstone
2	5	0	0	0	0	0	Hillslope (HSL)	Silty loam	Red	Boulders	Present	ironstone
2	6	2	2	0	0	2	Plain (PLA)	Sand	Red		Absent	
2	7	0	0	0	0	0	Plain (PLA)	Silty loam	Red	Small cobbles	Absent	ironstone
2	8	2	2	2	0	2	Hillcrest (HCR)	Silty loam	Red	Boulders	Present	ironstone
2	9	2	2	2	0	2	Bank (stream bank) (BAN)	Sand	Red	Coarse gravel	Absent	
2	10	2	0	0	0	2	Gully (GUL)	Silty loam	Red	Boulders	Present	ironstone
2	11	20	20	2	0	20	Hillslope (HSL)	Silty loam	Red	Coarse gravel	Absent	ironstone
2	12	2	2	0	0	2	Plain (PLA)	Sand	Red		Absent	
2	13	0	0	0	0	0	Plain (PLA)	Sand	Red		Absent	
2	14	0	0	0	0	0	Hillcrest (HCR)	Silty loam	Red	Small cobbles	Absent	ironstone
2	15	0	0	0	0	0	Plain (PLA)	Silty clay loam	Red	Coarse gravel	Absent	mixed rock types mostly ironstone
2	16	2	2	2	0	2	Gully (GUL)	Silty loam	Red	Coarse gravel	Present	ironstone
2	17	0	0	0	0	0	Gully (GUL)	Silty loam	Red	Boulders	Present	ironstone
2	18	40	5	0	0	0	Plain (PLA)	Clay loam	Red	Fine gravel	Absent	
2	19	40	2	2	5	10	Plain (PLA)	Sandy loam	Red	0	Absent	
2	20	40	10	10	0	0	Gully (GUL)	Silty loam	Red	small cobbles	Present	
2	21	40	0	2	0	0	Plain (PLA)	Clayey Sand	Red	0	Absent	
2	22	50	5	0	0	0	Plain (PLA)	Sand	Red	Medium gravel	Absent	
2	23	50	5	2	0		Plain (PLA)	Loamy Sand	Red	Fine gravel	Absent	
2	24	80	0	2	2	10	Plain (PLA)	Silty loam	Red	Medium gravel	Absent	
2	25	30	0	5	0		Hillcrest (HCR)	Loamy Sand	Red	Coarse gravel	Absent	
2	26	50	20	10	10	10	Plain (PLA)	Silty loam	Red	0	Absent	
2	27	30	15	15	15	5	Plain (PLA)	Sandy clay loam	Brown		Absent	
2	28	20	0	5	10	10	Plain (PLA)	Clay loam	Red		Absent	
2	29	5	10	2	2	10	Gully (GUL)	Silty loam	Brown	cobbles	Present	
2	30	30	0	5	5	8	Stream Channel (STC)	Clay loam, sandy	Brown	Medium gravel	Present	
3	31	30	2	2	0	0	Plain (PLA)	Sandy loam	Red	Fine gravel	Absent	
3	32	30	0	2	0	0	Plain (PLA)	Clay loam	Red	Coarse gravel	Absent	
3	33	30	2		0	0	Plain (PLA)	Sandy loam	Brown	Fine gravel	Absent	
3	34	40	2	2	0	0	Plain (PLA)	Clay loam	Red	Fine gravel	Absent	
3	35	20	2		0	0	Plain (PLA)	Loamy Sand	Orange	Fine gravel	Absent	

Appendix E Conservation significant fauna recorded within the Study Area

Location		Species	Evidence	Survey
-23.2977953	120.1536532	Australian Bustard	Observation	Orebody 31 Fauna Assessment
-23.33417164	120.129167	Australian Bustard	Observation	Wheelarra Hill North Fauna Assessment
-23.316338	120.12471	Australian Bustard	Tracks	Ore Body 31 Vertebrate Fauna Survey
-23.306177	120.099075	Australian Bustard	Tracks	Ore Body 31 Vertebrate Fauna Survey
-23.29296	120.09862	Australian Bustard	Observation	Ore Body 31 Vertebrate Fauna Survey
-23.292599	120.098763	Australian Bustard	Observation	Ore Body 31 Vertebrate Fauna Survey
-23.292236	120.097069	Australian Bustard	Tracks	Ore Body 31 Vertebrate Fauna Survey
-23.29633	120.12618	Brush-tailed Mulgara	Burrow	Ore Body 31 Vertebrate Fauna Survey
-23.295809	120.122414	Brush-tailed Mulgara	Burrow	Ore Body 31 Vertebrate Fauna Survey
-23.295105	120.155907	Brush-tailed Mulgara	Burrow	Ore Body 31 Vertebrate Fauna Survey
-23.294434	120.122185	Brush-tailed Mulgara	Digging	Ore Body 31 Vertebrate Fauna Survey
-23.293346	120.154869	Brush-tailed Mulgara	Scats	Ore Body 31 Vertebrate Fauna Survey
-23.293051	120.15461	Brush-tailed Mulgara	Trap	Ore Body 31 Vertebrate Fauna Survey
-23.29296	120.09862	Brush-tailed Mulgara	Burrow	Ore Body 31 Vertebrate Fauna Survey
-23.2929	120.154556	Brush-tailed Mulgara	Burrow	Ore Body 31 Vertebrate Fauna Survey
-23.291052	120.15168	Brush-tailed Mulgara	Burrow	Ore Body 31 Vertebrate Fauna Survey
-23.30072535	120.0939869	Fork-tailed Swift	Observation	Orebody 31 Fauna Assessment
-23.33655196	120.1236327	Rainbow Bee-eater	Observation	Wheelarra Hill North Fauna Assessment
-23.33417164	120.129167	Rainbow Bee-eater	Observation	Wheelarra Hill North Fauna Assessment
-23.325598	120.136299	Rainbow Bee-eater	Observation	Ore Body 31 Vertebrate Fauna Survey
-23.32342	120.09789	Rainbow Bee-eater	Observation	Ore Body 31 Vertebrate Fauna Survey
-23.32200761	120.1287836	Rainbow Bee-eater	Observation	Wheelarra Hill North Fauna Assessment
-23.33880835	120.084137	Western Pebble-mound Mouse	Trap	Wheelarra Hill North Fauna Assessment
-23.32925987	120.1522791	Western Pebble-mound Mouse	Mound	Wheelarra Hill North Fauna Assessment
-23.32925628	120.1515852	Western Pebble-mound Mouse	Mound	Wheelarra Hill North Fauna Assessment
-23.32200761	120.1287836	Western Pebble-mound Mouse	Trap	Wheelarra Hill North Fauna Assessment
-23.32049463	120.1000653	Western Pebble-mound Mouse	Trap	Wheelarra Hill North Fauna Assessment
-23.30223724	120.1074088	Western Pebble-mound Mouse	Trap	Orebody 31 Fauna Assessment