WHEELARRA HILL NORTH FAUNA ASSESSMENT

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Prepared for

BHP Billiton Iron Ore

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Scope of Services

This environmental site assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV.Australia Pty Ltd (ENV) ("scope of services"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

On all sites, varying degrees of non-uniformity of the vertical and horizontal soil or groundwater conditions are encountered. Hence no monitoring, common testing or sampling technique can eliminate the possibility that monitoring or testing results/samples are not totally representative of soil and/or groundwater conditions encountered. The conclusions are based upon the data and the environmental field monitoring and/or testing and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions. Also it should be recognised that site conditions, including the extent and concentration of contaminants, can change with time.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

ENV.Australia Pty Ltd was commissioned by BHPBIO to undertake a two-season Level Two survey in accordance with the Environmental Protection Authority *Guidance Statement No. 56* and the Environmental Protection Authority – Department of Environment and Conservation *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*. The Wheelarra Hill North study area (497.2 km^2) is located 40 km east of Newman in the Pilbara region of Western Australia. The survey was conducted from 7th – 18th April (season one) and 4th – 13th October 2011 (season two).

The fauna field survey (habitats, birds, mammals, reptiles and frogs) was conducted at seven sites and consisted of 980 pitfall trap-nights, 1,960 funnel trap-nights, 176 Elliott trap-nights and 316 cage trap-nights (pooled over both surveys). A total of 49 person hours of systematic bird surveys, and 19 person hours of nocturnal spotlighting was conducted at the sites, with 1-2 nights of AnaBat acoustic recording at five locations, and 60 person hours searching for evidence of conservation significant fauna such as Western Pebble-mouse (*Pseudomys chapmani*) mounds, Northern Quoll (*Dasyurus hallucatus*) scats and searches for caves suitable for bats (e.g. Ghost Bats [*Macroderma gigas*]).

Four main fauna habitat types were identified in the study area and these are widespread throughout the Pilbara: Alluvial Plain, Drainage Line, Gorge and Hills, each habitat was rated as being of Moderate value for fauna. Two of the 10 land systems present occupy 82% of the study area, and more than 10% of the entire Pilbara bioregion. Majority of the habitats throughout the study area was rated as being in Good condition.

A total of 139 species were recorded during the survey: two amphibians (recorded in 1st season survey only), 55 reptile species (41 in 1st season, 45 in 2nd season), 59 bird species (50 in 1st season, 54 in 2nd season) and 23 mammal species (16 in 1st season, 16 in 2nd season). An additional 29 species (21% of total) were added during the second season survey (consisting of 14 reptiles, eight birds and seven mammals).

Species accumulation analyses based solely on systematic site data showed that 86.3% of the expected 63 reptile species were recorded and 89.5% of an expected 56 bird species were recorded. This analysis was not undertaken for amphibians and mammals as too few species were recorded. The addition of a second season survey increased the number of reptile and bird species recorded and improved the overall survey adequacy by recording a higher percentage of the 'expected' species. Each of the habitats in the study area hosts subtly different fauna assemblages associated with the relatively subdued environmental variation (soil type and rockiness/ruggedness of the terrain). Overall fauna species richness was similar in the Drainage Line, Alluvial Plain and Hill habitat types. Amphibians were recorded only in Drainage Lines; birds and reptiles were richest in Drainage Line and Alluvial Plain habitat; and, mammals were moderately rich in Drainage Line, Alluvial Plain and Hill habitat types.

The four most commonly recorded reptiles (Rock Ctenotus [*Ctenotus saxatilis*], Leopard Ctenotus [*C. pantherinus*], *Ctenotus duricola* and Bynoe's Gecko [*Heteronotia binoei*])

comprised 46% of all systematic records, and 44 of the remaining 50 reptile species were relatively uncommon and were represented by less than 10 captures and/or records.

The most frequently recorded birds were Painted Finch (*Emblema picta*), Cockatiel (*Nymphicus hollandicus*), Budgerigar (*Melopsittacus undulatus*), and Zebra Finch (*Taeniopygia guttata*): these comprised 54.5% (764 sightings) of all birds observed. The Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and Lesser Hairy-footed Dunnart (*Sminthopsis youngsonii*) were the most frequently captured small mammals.

A total of 286 species (10 amphibians, 86 reptiles, 151 birds and 39 mammals) were known to occur within the vicinity of the study area, suggesting that approximately 49% of the potentially occurring fauna were recorded during the field survey. Five species (*Delma elegans*, *D. haroldi*, *Lerista flamicauda*, *L. jacksoni* and Beccari's Freetailed Bat [*Mormopterus beccarii*]) were recorded during this survey that had not been recorded by previous surveys from the vicinity of the study area. All of these species occur in a wide range of habitats in the Pilbara and therefore their occurrence in the study area is not unexpected.

Fifteen conservation significant species have previously been recorded in or near the study area. Of these, nine species are considered as 'Possibly' occurring within the study area, three (Peregrine Falcon [*Falco peregrinus*], Bush Stone-curlew [*Burhinus grallarius*] and Fork-tailed Swift [*Apus pacificus*]) are considered as 'Likely' to occur, and three species were recorded during the survey (discussed below).

During the survey, the Australian Bustard (*Ardeotis australis*) (Priority 4) was recorded in Alluvial Plain habitat, the Western Pebble-mouse (*Pseudomys chapmani*) (Priority 4) was recorded in Hill habitat, and the Rainbow Bee-eater (*Merops ornatus*, listed as Migratory on the *Environment Protection and Biodiversity Conservation [EPBC] Act*) was recorded in Drainage Line, Hill and Alluvial Plain habitats. The Australian Bustard is a highly mobile and nomadic species which is unlikely to be locally dependent on the habitats within the study area. The Rainbow Bee-eater is one of the most common and widespread birds in Australia which occurs in a variety of habitat types across the region. The Western Pebble-mouse is a sedentary species with a small home-range and occurs commonly across much of the Pilbara.

1 INTRODUCTION

1.1 THE PROJECT

1.1.1 Objectives

ENV.Australia Pty Ltd (ENV) was commissioned by BHP Billiton Iron Ore (BHPBIO), in January 2011, to obtain baseline information on the vertebrate fauna in the Wheelarra Hill North area (497.2 km^2), located in the eastern Ophthalmia Range approximately 40 km east of Newman in the Pilbara region of Western Australia (Figure 1). The assessment involved a two-season Level Two vertebrate fauna survey following, as appropriate, the Environmental Protection Authority (EPA) *Guidance Statement No. 56* and the EPA-Department of Environment and Conservation (DEC) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*.

The survey comprised a:

- comprehensive fauna literature and database review;
- fauna habitat assessment;
- two-season Level Two survey within the study area;
- trapping programme to document faunal species richness; and
- targeted surveying for conservation significant fauna.

1.2 ENVIRONMENTAL ATTRIBUTES

1.2.1 Climate

The study area is located in the Pilbara region of Western Australia. The nearest accessible climate data available from the Bureau of Meteorology (BoM) is the Newman Aero weather station located approximately 35 km west of the study area.

The Pilbara has an arid-tropical climate with two distinct seasons, a hot summer from October to April and a mild winter from May to September. The area experiences a wide temperature range, with an average annual maximum daytime temperature of 32°C (1996-2011). In summer, maximum daytime temperatures may reach 47°C, whilst in winter, minimum night time temperatures may fall to -2°C (BoM 2011).

Rainfall in the Pilbara is often sporadic, and occurs throughout the year (in summer and winter). The Newman area has an average annual rainfall of 310.7 millimetres (mm) (1971-2011) (BoM 2011) with the majority of rainfall occurring during the summer months (Figure 2).

Summer rainfall is typically associated with tropical storms in the north, or tropical cyclones that cross the coast and move inland. Winter rainfall is commonly the result of cold fronts moving north-easterly across the State.

For the three months preceding the first season survey Newman received 230 mm, and 32.4 mm was recorded in the three months prior to the second season, compared with the long-term average of 170.1 mm (January to March) and 27.4 mm (July-September) (1971-2010) for the same period (BoM 2011).

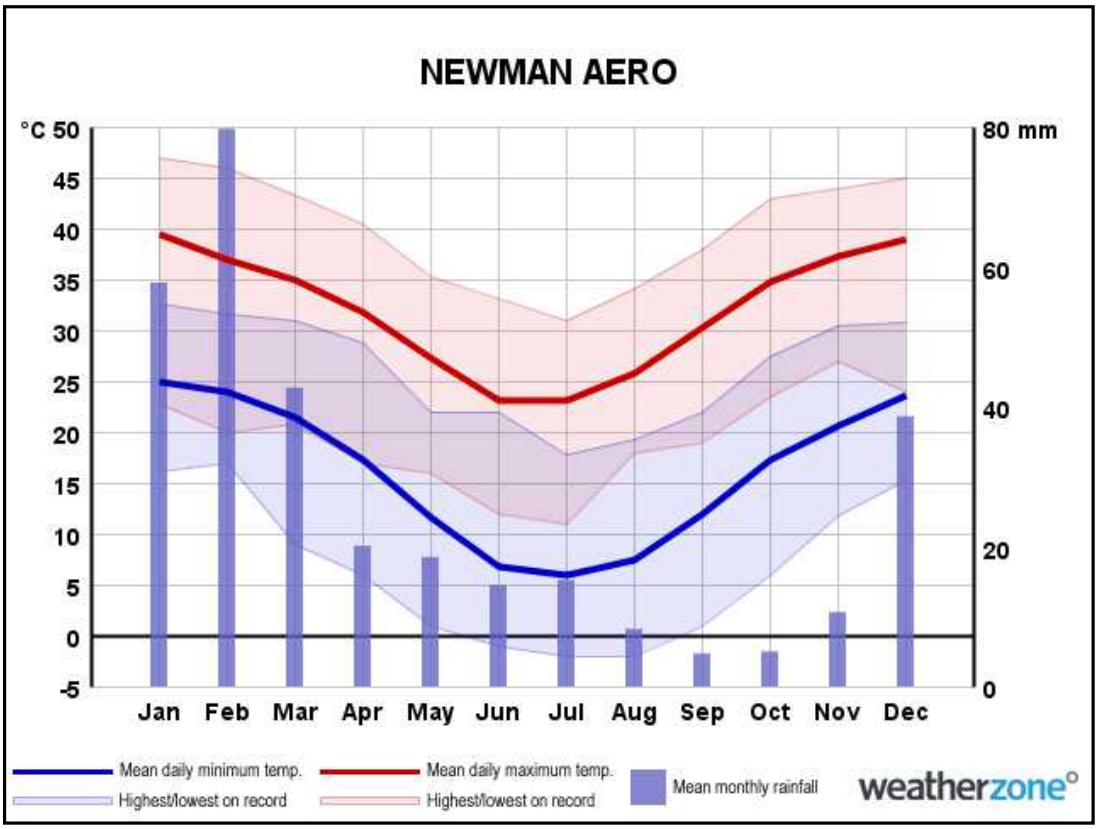

Figure 2: Average long-term (1971-2011) Monthly Rainfall and average Maximum and Minimum Temperatures at Newman Airport (Weatherzone.com.au, based on data in BOM 2011).

1.2.2 Biogeographic Regionalisation of Australia

The Biogeographic Regionalisation of Australia (BRA) is a landscape based approach which classifies Australia into 85 bioregions based on major climatic, biological (flora and fauna distribution) and geographical/ geological attributes (Thackway and Cresswell 1995). These bioregions are subdivided into 403 subregions, as part of a refinement of the BRA framework (DSEWPaC 2011a).

The study area is located in the Pilbara bioregion which is divided into four subregions. Most of the study area is located in the Fortescue subregion (PIL2: 70% of study area) which is characterised by Alluvial plains and river frontage, mulga-bunch grass, and short grass communities on alluvial plains and deeply incised gorges (Kendrick 2001a). The remainder of the study area (30%) lies in the Hamersley subregion which is characterised by mountain ranges and plateaux of Proterozoic sedimentary rock, dissected by gorges (Thackway and Cresswell 1995, Kendrick 2001b). The vegetation of the Hamersley subregion is characterised by Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Snappy Gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001b).

1.2.3 Land Systems

Land system mapping is based on regional patterns in topography, soils and vegetation. The land system mapping of the Pilbara region was completed by van Vreeswyk *et al.* (2004). The mapping classifies the Pilbara region into 102 land systems. The study area comprises six land systems (Table 1). The area occupied by each of the land systems within the study area comprises less than 0.2% of the total area that each land system occupies within the Pilbara region.

Table 1: Land Systems of the Study Area

		Land System within Pilbara Region		Land System within study area		
Land System	Description	Area (km²)	As a proportion of the Pilbara Region (%)	Area (km²)	As a proportion of the study area (%)	As a proportion of the Pilbara Region (%)
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard Spinifex grasslands	14,580	8.0	270.0	54.3%	1.34%
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft Spinifex grasslands and Mulga scrublands	7,748	4.3	141.0	28.4%	1.40%
Washplain	Hardpan plains supporting groved Mulga shrublands	917	0.5	30	6.0%	3.23%

		Land System within Pilbara Region		Land System within study area		
Land System	Description	Area (km²)	As a proportion of the Pilbara Region (%)	Area (km²)	As a proportion of the study area (%)	As a proportion of the Pilbara Region (%)
Divide	Sandplains and occasional dunes supporting shrubby hard Spinifex grasslands	5,293	2.9	2.0	0.004%	0.02%
McKay	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard Spinifex grasslands	4,202	2.3	46.0	9.2%	1.07%
River	Active flood plains and major rivers supporting grassy Eucalypt woodlands, tussock grasslands and soft Spinifex grasslands	7,088	2.3	9.0	0.018%	0.14%

1.2.4 Geology

The following geological units occur in the study area, based on mapping by the Geological Survey of Western Australia (2007):

JEERINAH FORMATION: Pillowed and massive basaltic flows; and basaltic breccia; metamorphosed.

WITTENOOM FORMATION: Thin- to medium-bedded dolomite, dolomitic mudstone, chert, and felsic to mafic volcanic sandstone; metamorphosed.

MARRA MAMBA IRON FORMATION: Chert, banded iron-formation, mudstone, and siltstone; metamorphosed.

MOUNT McRAE SHALE and MOUNT SYLVIA FORMATION: Mudstone, siltstone, chert, banded iron-formation, and dolomite; metamorphosed.

BROCKMAN IRON FORMATION: Banded iron-formation, chert, mudstone, and siltstone; metamorphosed.

WEELI WOLLI FORMATION: Banded iron-formation (often jaspilitic), mudstone, siltstone, and numerous dolerite sills; metamorphosed.

BOOLGEEDA IRON FORMATION: Fine-grained, finely laminated banded iron-formation; mudstone, siltstone and chert; metamorphosed.

WOONGARRA RHYOLITE: Rhyolite, rhyodacite, rhyolitic breccia, and banded iron-formation; metamorphosed.

1.2.5 Soils

The following soil units occur in the study area, based on mapping by Tille (2006):

- Alluvium in drainage channels, floodplains, and deltas;
- Slope deposits, including colluvium and sheetwash;
- Exposed rock, saprolite, and saprock; and
- Sandplain, mainly eolian, including some residual deposits.

1.2.6 Vegetation Mapping

Vegetation mapping of the Pilbara region was completed on a broad scale (1:1,000,000) by Beard (1975). The study area is situated in the Hamersley Plateau which forms a part of the Fortescue Botanical Province in the Eremaean Botanical Province of Western Australia (Beard 1975). Beard mapped the study area as follows:

a_1Li (216): Low woodland; Mulga (with Spinifex) on rises (176 km^2 in study area);

e_{16}Lr t_3Hi (82): Hummock grasslands, low tree steppe; Snappy Gum over *Triodia wiseana* (308 km^2 in study area); and

e_{25}Sr t_2Hi (111): Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard Spinifex (13 km^2 in study area).

Shepherd *et al.* (2001) re-assessed the mapping of Beard (1975), and updated vegetation boundaries to account for clearing in the intensive land use zone, and divided some larger vegetation units into smaller units. The vegetation types described by Shepherd *et al.* (2001) as occurring in the study area correspond to those of Beard (1975) as indicated above in brackets.

1.3 PREVIOUS BIOLOGICAL STUDIES

In recent decades, an increase in resource development projects has resulted in a significant amount of site-specific (i.e. local scale) biological survey work being carried out, most of which is undertaken for approvals under the *Environmental Protection Act 1986* (WA). A comprehensive bibliography of biological survey work undertaken in the Pilbara is available at the DEC website (DEC 2011a). The vertebrate fauna of the Pilbara consists of about 636 species including 14 frogs, 202 reptiles, about 348 birds (including 160 resident landbirds excluding waterbirds, seabirds and visiting species) and about 60 native mammals (Churchill 2009, Gibson and McKenzie 2009, Atlas of Living Australia 2011). Few studies have focussed on individual Pilbara fauna species, but a series of community-level studies including birds, small non-volant mammals and bats have examined patterns of species composition, richness and habitat use across the entire bioregion (Gibson and McKenzie 2009, Burbidge *et al.* 2010, McKenzie and Bullen 2009). None of the frogs, reptiles or birds is known to have been extirpated from the Pilbara since European settlement, but 12 mammal species have gone extinct (Gibson and McKenzie 2009, Baynes and McDowell 2010). New species of amphibians and reptiles have been discovered during these recent surveys. This includes *Cryptoblepharus* skinks (Horner and Adams 2007), and *Lerista* skinks (Smith and Adams (2007). A new species of frog (Pilbara Toadlet *Uperoleia saxatilis*) was described during the survey period, with some specimens being collected at Wheelarra Hill North (Catullo *et al*. 2011).

There have been a number of fauna surveys in the vicinity of the study area (i.e. within 50 km) in the last fifteen years; these are discussed in Section 2.2.

2 METHODS

2.1 BACKGROUND TO SURVEY METHODS

2.1.1 Protection of Fauna and Fauna Habitat

Fauna, habitat, and faunal ecological communities are protected formally and informally by various legislative and non-legislative measures, which are outlined below. Species listed under these acts and other non-legislative measures are considered 'conservation significant' in this assessment.

Legislative Protection

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Western Australia *Wildlife Conservation Act 1950* (WC Act).
- Western Australia *Environmental Protection Act 1986* (EP Act).

Non-Legislative Protection

- Western Australian DEC Priority lists.
- Informal recognition of fauna of interest.

A short description of these legislative and non-legislative measures is given below, and definitions of the species conservation codes and ecological community categories they use, and those used by the DEC, are provided in Appendix A.

Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act aims to protect matters of national environmental significance, which are detailed in Appendix A. Under the EPBC Act, the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) lists protected species and Threatened Ecological Communities (TECs) by criteria set out in the Act. Species are considered to be conservation significant if they are listed as Threatened (i.e. Critically Endangered, Endangered and Vulnerable, etc.), or Migratory.

Bird species protected as Migratory under the EPBC Act include those listed under international migratory bird agreements relating to the protection of birds which migrate between Australia and other countries, for which Australia has agreed. This includes the: Japan-Australia Migratory Bird Agreement (JAMBA); China-Australia Migratory Bird Agreement (CAMBA); Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA); and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Some marine fauna or terrestrial fauna that use marine habitats are listed as Marine under the EPBC Act. These species are only considered conservation significant when a proposed development occurs in a Commonwealth marine area (i.e. any Commonwealth Waters or Commonwealth Marine Protected Area). Outside of such areas the EPBC Act does not consider these species to be matters of national environmental significance, so are not protected under the Act. As such species only listed as Marine under the EPBC Act have not been considered to be conservation significant in this assessment.

Wildlife Conservation Act 1950

The DEC, lists taxa under the provisions of the WC Act as protected and are classified as Schedule 1 to Schedule 4 according to their need for protection (see Appendix A). The WC Act makes it an offence to 'take' threatened species without an appropriate licence.

Environmental Protection Act 1986

Significant habitat necessary for the maintenance of fauna indigenous to Western Australia as well as TECs are given special consideration in environmental impact assessment, and areas covered by TECs have special status as Environmentally Sensitive Areas (ESAs) under the EP Act, and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

DEC Priority Lists

The DEC produces a list of Priority species that have not been assigned statutory protection under the WC Act. Priority Fauna are under consideration as 'Scheduled' fauna, but are in urgent need for further survey or require regular monitoring, and although not currently threatened may become so in the future. Appendix A provides definitions of Priority codes.

In addition, the DEC maintains a list of Priority Ecological Communities (PECs) which identifies those communities that need further investigation before possible nomination for TEC status.

Although DEC Priority species and communities have no formal legal protection, they are under consideration as 'Scheduled' taxa under the WC Act or as ESAs under the EP Act.

Informal Recognition of Threatened Fauna

Certain populations or communities may be of local significance or interest because of their patterns of distribution and abundance. For example, fauna may be locally significant because they are range extensions to the previously known distribution or are newly discovered taxa and therefore have the potential to be listed as Threatened in the future. In addition, many species are in decline as a result of threatening processes, and relict populations of such species may assume local importance.

2.1.2 EPA Requirements for Fauna Surveys

The survey was carried out in a manner compliant with the EPA requirements for the environmental surveying and reporting of fauna surveys in Western Australia, as documented in:

- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002).
- *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56* (EPA 2004).
- *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA-DEC 2010).

According to the EPA *Guidance Statement No. 56* (EPA 2004), a baseline field fauna survey for environmental impact assessment should at the very least provide a comprehensive list of species occurring within a given area. There are two levels of fauna survey as delineated by the EPA:

- *Level One:* desktop study to collate historical knowledge, in conjunction with a reconnaissance survey (site inspection).
- *Level Two:* trapping and opportunistic field survey to characterise the fauna present, combined with a Level One survey. Where the scale and nature of the proposed impact is moderate to high, a Level Two survey will be required in most areas of the State, and is typically required for resource development projects.

EPBC Act Referral Guidelines

The significant impact guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance protected by the EPBC Act. In the Pilbara region, the only vertebrate fauna species that has specific referral guidelines is the Northern Quoll (*Dasyurus hallucatus*).

2.2 DESKTOP REVIEW

The purpose of the desktop review was to collate faunal records from previous surveys in the study area, and in the vicinity of the study area. The search area (whether a radial distance or a grid encompassing the study area) varies according to the different databases which are produced by various institutions because they have their own idiosyncrasies. This involved a search of the following sources:

- WAM and DEC combined biological database *NatureMap* (DEC 2011b). An area search was conducted based on an approximate 40 km radius from the study area.
- Birds Australia's Birdata (Birdata 2011). An area search based on an approximate 1 degree grid cell (*c*. 10,000 km^2) encompassing the study area.
- DEC Threatened and Priority Fauna database (DEC 2011c). An area search was conducted based on an approximate 40 km radius from the study area.
- DSEWPaC *Protected Matters Search Tool* (DSEWPaC 2011b), known as an EPBC Act search. An area search based on an approximately 10 km radius from a central point in the study area.
- Previous fauna surveys as summarised in Table 2.

Collectively, these sources were used to compile a list of species that have been previously recorded in the region (Appendix B). This list will invariably include some species that do not occur in the study area, because they have patchy distributions, a high level of habitat specificity, or are locally extinct. Some records were excluded from this list, such as extinct species and clearly erroneous records.

A summary of the survey type, methods and results of fauna surveys conducted in the vicinity of the study area is presented in Table 2.

A total of eight Level Two fauna surveys have been conducted in the vicinity of the study area (Outback Ecology 2009a,b,c; ENV.Australia 2007a; Ecologia 1995, 2006a and 2004, BHBIO 1994), and recorded a total of 60, 92, 158, 108, 94, 165, 107 and 63 fauna taxa respectively. It should be noted that differences in survey timing, survey personnel and skills, the areal extent and habitat diversity of the study areas will have influenced these results. Seven conservation significant species were recorded within the vicinity of the study area from these previous surveys:

- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (Vulnerable EPBC Act and Schedule 1 WC Act) - located by Ecologia (2006a).
- Unnamed Blind Snake (*Ramphotyphlops ganei*) (Priority 1, DEC) - captured by Outback Ecology (2009c).
- Ghost Bat (*Macroderma gigas*) (Priority 4, DEC) – recorded by Ecologia (2006a).
- Western Pebble-mouse (*Pseudomys chapmani*) (Priority 4, DEC) – recorded by Outback Ecology (2009b, c).
- Australian Bustard (*Ardeotis australis*) (Priority 4, DEC) - recorded by Outback Ecology (2009b, c) and Ecologia (2006a).

- Western Star Finch (*Neochmia ruficauda subclarescens*) (Priority 4, DEC) - recorded by Outback Ecology (2009c).
- Rainbow Bee-eater (*Merops ornatus*) (Migratory under *EPBC Act*) - observed by Outback Ecology (2009b and 2009c) and Ecologia (2004).
- Bush Stone-curlew (*Burhinus grallarius*) (Priority 4, DEC) - recorded by Outback Ecology (2009b).
- Fork-tailed Swift (*Apus pacificus*) (Migratory under EPBC Act) - observed by ENV.Australia (2011).

Table 2: Summary of previous terrestrial fauna surveys in the vicinity of the study area.

Survey	Survey Type	Dates	Methods	Number of fauna species	Key findings: significant species
Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology 2009a)	Level 2	9th - 13th February then 24th-1st March 2009	Systematic - Bucket, pipe, cage, funnel and Elliott traps, spotlighting, bird census and searching. Non Systematic-habitat assessments, opportunistic sampling and targeted searching.	F: 0, R: 21, B: 26, M: 13	• Rainbow Bee-eater (*Merops ornatus*) • Western Pebble-mouse (*Pseudomys chapmani*)
Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback ecology 2009b)	Level 2	6th - 15th June then 26th September – 3rd October 2009	Systematic - bucket, cage, funnel and Elliott traps, spotlighting, bird census and searching. Non Systematic-habitat assessments, opportunistic sampling and targeted searching.	F: 2, R: 27, B: 47, M: 16	• Australian Bustard (*Ardeotis australis*) • Rainbow Bee-eater (*Merops ornatus*) • Bush Stone-curlew (*Burhinus grallarius*) • Western Pebble-mouse (*Pseudomys chapmani*)
Jimblebar Linear Development Fauna Assessment (Outback ecology 2009c)	Level 2	22nd September-4th October 2008 and 3rd - 11th April 2009	Systematic - bucket, cage, funnel and Elliott traps, spotlighting, bird census and searching. Non Systematic-habitat assessments, opportunistic sampling and targeted searching.	F: 4, R: 49, B: 82, M: 23	• Blind snake *Ramphotyphlops gainei* • Rainbow Bee-eater (*Merops ornatus*) • Australian Bustard (*Ardeotis australis*) • Western Star Finch (*Neochmia ruficauda subclarescens*) • Western Pebble-mouse (*Pseudomys chapmani*)
Jimblebar West fauna Assessment (ENV 2007a)	Level 2	14th - 21st May 2007	Systematic- pot, bucket, cage, funnel and Elliott traps, spotlighting, bird census and searching. Non Systematic-habitat assessments, opportunistic sampling, AnaBat recordings and targeted searching.	F: 0, R: 27, B: 72, M: 9	• Australian Bustard (*Ardeotis australis*) • Rainbow Bee-eater (*Merops ornatus*)
Jimblebar Hashimoto Vertebrate Fauna	Level 2	26th August – 16th	Systematic - bucket, cage, funnel and Elliott traps,	F: 5, R: 52, B: 85, M: 23	• Australian Bustard (*Ardeotis australis*) • Pilbara Leaf-nosed Bat (*Rhinonicteris*

Survey	Survey Type	Dates	Methods	Number of fauna species	Key findings: significant species
Assessment (Ecologia 2006a)		September 2005 and 6th - 15th February 2006	spotlighting, bird census and searching. Non Systematic-habitat assessments, opportunistic sampling, AnaBat recordings and targeted searching.		*aurantia*) • Ghost Bat (*Macroderma gigas*)
Jimblebar Wheelarra Hill Expansion Biological Survey (Ecologia 2004)	Level 2	9th – 13th February and 23rd – February – 1st March 2004	Systematic - pit, funnel and Elliott traps, spotlighting, bird census and searching. Non Systematic- habitat assessments, opportunistic sampling, and AnaBat recordings.	F: 5, R: 31, B: 62, M: 9	• Rainbow Bee-eater (*Merops ornatus*) • Western Pebble-mouse (*Pseudomys chapmani*)
OB18 Biological Assessment Survey (Ecologia 1995)	Level 2	10th – 19th August 1995	Systematic - pit and Elliott traps, spotlighting, bird census and searching. Non Systematic-habitat assessments, opportunistic sampling, and Mist netting for bats.	F: 5, R: 31, B: 44, M: 14	• Australian Bustard (*Ardeotis australis*) • Western Pebble-mouse (*Pseudomys chapmani*)
Jimblebar Biological Survey (BHPBIO 1994)	Level 2 equivalent	11th - 22nd June 1994	Systematic - pit and Elliott traps, bird census and searching. Non Systematic-habitat assessments and opportunistic sampling.	F: 0, R: 11, B: 40, M: 12	• Western Pebble-mouse (*Pseudomys chapmani*)
Orebody 31 Fauna Assessment (ENV 2011)	Level 1	29th March – 1st Apr 2011	Active searching, bird survey	F:1; R: 9; B: 42; M: 7	• Rainbow Bee-eater (*Merops ornatus*) • Fork-tailed Swift (*Apus pacificus*) • Western Pebble-mouse (*Pseudomys chapmani*)
Jimblebar Marra Mamba Exploration Biological Survey (Ecologia 2006b)	Level 1	22nd – 28th May 2006	Bird census, hand foraging, opportunistic observations, AnaBat recording, habitat assessments	F: 1, R: 24, B: 64, M: 10	• Australian Bustard (*Ardeotis australis*) • Western Pebble-mouse (*Pseudomys chapmani*)
East Jimblebar	Level 1	8th – 14th	Bird census, hand foraging,	F: 1, R: 19, B: 41, M: 10	• Australian Bustard (*Ardeotis australis*)

Survey	Survey Type	Dates	Methods	Number of fauna species	Key findings: significant species
Exploration Project Biological Survey (Ecologia 2005)		February 2005	Opportunistic observations, Spotlighting, AnaBat recording, habitat assessments		• Rainbow Bee-eater (*Merops ornatus*)

Number of fauna species codes: F= frog, R= reptile, B= bird, M= mammal.

2.3 FIELD SURVEY

2.3.1 Habitat Assessment

Vegetation communities and landforms were used to identify the broad fauna habitats in the study area. The habitat complexity and quality for vertebrate fauna was assessed. The vertebrate habitat assessments were documented systematically for each habitat type on standardised field sheets (Appendix C).

Each broad habitat type description includes information on:

- Location of the broad habitat type within the study area (GPS co-ordinate);
- Habitat condition based on Keighery (1994);
- Landscape position;
- Dominant vegetation and structure e.g. number of vegetation strata;
- Hollow-bearing trees and dead stags (e.g. average size and abundance of hollows);
- Description of any rock and rocky outcrops;
- Logs (e.g. abundance and size);
- Substrate (e.g. leaf litter);
- Wetlands, creeks, rivers, dams and other water bodies;
- Description of any observed nests and roosts;
- Subterranean roosts (e.g. caves, disused mineshafts and or adits);
- Associated fauna observed using the habitat;
- Disturbance e.g. cows, fire; and,

At locations considered suitable for conservation significant fauna the coordinates, vegetation description and a photograph was taken.

2.3.2 Trapping Programme

A total of seven sites were sampled in Drainage Line, Alluvial Plain, Hill and Gorge habitats (Figure 3, Appendix F). Data collected systematically (i.e. where methods and effort are the same per sample unit) can be analysed to determine patterns in the richness, abundance and composition of the fauna. Sites were selected to obtain a broad coverage

of the habitats in the study area and readily accessible in order to check traps in a timely manner.

The trapping programme was conducted over seven nights, during each season, at each of the sites with the same survey effort (time, number of traps and search effort defined as person hours). Each trap site contained ten individual trapping grids. Each grid consisted of a 7 metre (m) drift fence with a 20 litre (L) bucket at the centre of the fence, and a funnel trap at each end (20 funnel traps per site). Trap grids were spaced 20-30 m apart over a 200-300 m long transect. Ten Elliott traps and two cage traps were spaced equidistantly across the trap site.

Overall trap effort for each site was 70 pitfall trap nights, 140 funnel trap nights, 14 cage trap nights and 70 Elliott trap nights. Total trap effort was 490 pitfall trap nights, 980 funnel trap nights, 98 cage trap nights and 140 Elliott trap nights for both seasonal surveys. In addition, a small Gorge was trapped with 20 cage traps (spaced approximately 50 m apart) for four nights in season one, and with 10 cage traps and nine Elliott traps during the season two survey (a total of 120 cage trap nights and 36 Elliott trap nights). AnaBat and Song Meter (SM2) acoustic recording units, motion sensitive cameras and opportunistic searches were conducted in the Gorge habitat targeting Northern Quoll, bats and other fauna.

When a threatened or priority species was recorded, the following data was noted: coordinate locations and number of individuals (including sex where possible) and habitat type.

2.3.3 Opportunistic Searches

The opportunistic data supplements the systematic data collected on sites. A total of 60 person hours (pooled over both seasons) of opportunistic searches was undertaken and involved targeted searches of habitats such as plains, hills, drainage lines and gorges that potentially support fauna of conservation significance. During the opportunistic searches the following techniques were used: raking through leaf litter, overturning rocks, looking under decorticating bark, investigating burrows, tracks and scats, and searching for evidence of conservation significant species (such as, mounds of Western Pebble-mouse [*Pseudomys chapmani*] and Northern Quoll scats). In addition, opportunistic records of fauna species encountered while travelling between sites was documented. Opportunistic data comprises records of fauna species by location (coordinates taken with a GPS as in the case of Western Pebble-mouse mounds and other species of conservation significance) and habitat type, and is typically summarized in the overall species list (Appendix B).

2.3.4 Bird Survey

Systematic bird surveys at the seven sites was undertaken for 15 minutes (by two field team members) in the morning (3.5 person hours each site) and each site was surveyed nocturnally for a total of 0.5 person hours (during both the seasonal surveys).

2.3.5 Nocturnal Spotlighting

Spotlighting and head torching at night from vehicles and on foot is an important survey tool as much of the fauna is nocturnal and/or crepuscular, particularly conservation significant species such as the Northern Quoll. At each of the seven sites a total of 0.5 person hours of nocturnal searches was conducted (two field team members searching for 15 mins each, for a total of seven person hours) during the season one and season two surveys. In addition spotlighting was conducted from vehicles while driving between the sites (12 person hours in total) during the season one and season two surveys.

2.3.6 Acoustic Bat Recording

Bat recordings were undertaken from dusk until dawn, using AnaBat SD1 and Song Meter (SM2) recording units to document bat species in the area. Where possible, methodology follows recommendations in the EPBC Act *Survey Guidelines for Australia's Threatened Bats* (Department of the Environment, Water, Heritage and the Arts 2009). The recording units convert ultrasonic echolocation signals produced by bats into audible electronic signals, which are later analysed to identify species-specific calls. AnaBat SD1 and Song Meter (SM2) recording units were set up at five locations (for one to two nights each location) which were identified as potential bat roosting or foraging sites. The coordinates of AnaBat SD1 and Song Meter (SM2) locations were recorded with a GPS (Appendix F). Bat survey location information and the species recorded are presented in Appendix D.

2.4 STATISTICAL ANALYSIS

In order to assess the adequacy of the field survey, species accumulation curves were generated for the vertebrate faunal groups with sufficient data (reptiles and birds). Note that this was done on systematic site data, but some additional reptiles and birds were recorded opportunistically, outside the sites, but within the study area. Too few mammal and amphibian species were recorded for statistical analysis. The species accumulation curve analyses the rate that newly encountered species are added (accumulated) during the survey. That is, as survey effort increases, the number of newly recorded species should increase initially and then decline when most species have been recorded (the species accumulation graph reaches a plateau or asymptote). This indicates that most species have been recorded and that the area has been adequately surveyed. Species accumulation curves can be useful in estimating total species richness and the proportion of species caught during the survey. If the fauna is dominated by many rare species

(recorded once or on few occasions) then the analysis will show that many additional species went unrecorded, and further survey effort would be needed to record additional species.

The relative rates of species accumulation (beta diversity) was evaluated with non-parametric species richness estimators (generated using EstimateS version 8.0: Colwell 2005), and a species rarefaction graph was prepared (based on the Cole rarefaction estimator). The mean of eight different estimators (Abundance-based Coverage Estimator of species richness, Incidence-based Coverage Estimator of species richness, the incidence-based estimator Chao1, Chao2 richness estimator, First-order Jackknife richness estimator, Second-order Jackknife richness estimator, and Bootstrap and Michaelis–Menten model based estimator) was used to generate 'expected' species richness. 'Expected' species richness is then compared to the actual or 'observed' species richness collected during the field survey.

The sampling unit for analysis was the seven sites. To increase the number of sample units for analysis, each day of survey for each site, was considered as a sample (e.g. 10 sites multiplied by 7 days = 70 samples). Analyses were done for all data pooled over both seasons, as well as separately for each seasonal dataset.

2.5 PERMITS

Fauna was trapped and collected in accordance with DEC Permit SF007961 issued to Matthew Love (ENV).

2.6 TAXONOMY

If there was any doubt about the taxonomy of a species identified in the desktop assessment (through subsequent name changes or taxonomic reviews), then an effort was made to determine the current scientific name for these species. In cases where correct taxonomy of an old record cannot be determined, old species names may be presented. Some species names may be followed by 'sp.', indicating that the species name was not provided in the original data source or the taxonomy is in doubt. If there was any doubt about the taxonomy of a species previously recorded, particularly species that have the potential to be a conservation significant species, they will be discussed specifically in the results section.

Species were identified in the field using standard field guides. Tyler *et al*. (2000) was used to identify frogs. Reptiles were identified with use of guides (Storr *et al*. 1999, 2002; Wilson and Swan 2010), as were birds (Pizzey and Knight 2007, Simpson and Day 2004). Mammals were identified with reference to Menkhorst and Knight (2004), Van Dyck and Strahan (2008) and Churchill (2009). Bat species were identified from acoustic recordings by a bat specialist (Bob Bullen).

Taxonomy and nomenclature of amphibians follows (Tyler *et al.* 2000, Catullo *et al*. 2011), reptile taxonomy and nomenclature follows Wilson and Swan (2010), mammal taxonomy and nomenclature follows Van Dyck and Strahan (2008), and bird taxonomy and nomenclature follows Christidis and Boles (2008).

3 RESULTS

3.1 SURVEY CONSTRAINTS AND LIMITATIONS

As per EPA *Guidance Statement No. 56* (EPA 2004), the limitations and constraints associated with a survey need to be documented. These constraints are detailed in Table 3.

Table 3: Limitations and context associated with the Fauna Assessment

Limitation	Impact on Survey Outcomes
Experience levels/ Resources	The biologists that conducted the Level Two surveys included practitioners that are regarded as suitably qualified in their respective fields: • Dr Ron Firth – Principal Zoologist (Season 1 & 2) • Dr Colin Trainor – Senior Zoologist (Season 1 & 2) • Mr Matthew Love – Senior Zoologist (Season 1) • Mr Mike Brown – Zoologist (Season 1) • Mr John Trainer – Zoologist (Season 2) • Mr James Sansom – Environmental Biologist (Season 2) • Mr Chris Knuckey – Field Assistant (Season 1) • Mr Josh Matthews – Field Assistant (Season 1)
Scope: sampling methods/ Intensity	This was a Level Two, two season survey, comprising a desktop review of secondary data and a field survey that included a habitat assessment, trapping, and bat acoustic survey, systematic and opportunistic observations.
Sources of Information	The desktop analysis used several sources to produce a list of fauna species previously recorded within the vicinity of the study area, e.g. records from the DEC threatened fauna database search, NatureMap (DEC 2011b), and DSEWPaC Protected Matters Search Tool (DSEWPaC 2011b).
Proportion of field survey completed	A total of 139 vertebrate fauna species were recorded during the survey. Species accumulation analyses indicated that the survey adequately recorded most species (86.3% of reptiles and 89.5% of bird species, pooled over both surveys) but too few frogs and mammals were recorded systematically to undertake this analysis. The average number of frogs (2.3 species, range 0-5 species) and mammals (15 species, range 9-23 species) recorded from seven Level Two surveys (Table 2) in the vicinity of the study area, suggests that the results obtained in the present survey are typical. The survey was conducted at seven sites and consisted of 980 pitfall trap-nights, 1,960 funnel trap-nights, 176 Elliott trap-nights and 316 cage trap-nights (pooled over both surveys). A total of 49 person hours of systematic

Limitation	Impact on Survey Outcomes
	bird surveys, and 19 person hours of nocturnal spotlighting was conducted at the sites, with 1-2 nights of AnaBat acoustic recording at five locations, and 60 person hours searching for evidence of conservation significant fauna (such as Western Pebble-mouse (*Pseudomys chapmani*) mounds and Northern Quoll (*Dasyurus hallucatus*) scats) as well as searches for caves suitable for bats.
Timing, weather, season.	The survey was undertaken from 7th – 18th April (season one) and 4th – 13th October 2011 (season two). The mean daily minimum temperature at Newman was 18.0 and 18.7 degrees Celsius (April and October 2011, respectively), which are similar to long-term means, and the mean maximum temperature over the same period was 31.5 and 34.4 degrees Celsius (April and October 2011, respectively) which are similar to the long-term average. The typical weather conditions encountered would limit faunal activity.

3.2 HABITAT ASSESSMENT

3.2.1 Habitat Types Present in the Study Area

Four main fauna habitat types were identified in the study area and are summarized in Table 4 and mapped in Figure 4. A total of seven fauna habitat assessments were conducted at the trap sites. These assessments document the fauna habitat types present and the features and characteristics available to faunal assemblages. The locations and details of the fauna habitat assessments can be seen in Appendix C.

Table 4: Area and value of the major habitat types in the study area

Habitat Type	Habitat Value	Area (ha) (% of study area)
Alluvial Plain	Moderate	1,634.4 (32.9%)
Drainage Line	Moderate	207.0 (4.1%)
Hill	Moderate	3,094.6 (62.2%)
Gorge	Moderate	36.2 (0.7%)
Total		4,972.2

Alluvial Plain

Alluvial Plain habitat occurred widely in the study area, particularly through the low-lying central parts of the study area (Table 4). The vegetation typically consisted of scattered *Acacia aneura*, *A. pruinocarpa* and *A. catenulata* subsp. *occidentalis* high open shrubland over low *Eremophila exilifolia* over *Triodia pungens* very open hummock grassland. Dense patches of Mulga occur sporadically, and these are typified by a poorly developed mid-storey layer, with extensive bare soil and few grasses.

A moderate diversity of microhabitats were present, but because tall Eucalypt trees are mostly absent (particularly important for birds that nest in hollows and forage in the canopy), there is a reduced range of vegetation strata, typically few if any tree hollows, limited woody debris (leaf litter and logs), except under denser stands of *Acacia*. Decorticating bark was abundant in dense stands of Mulga, and provided excellent habitat for a small range of reptiles such as Varanids, common and widespread geckos such as *Gehyra variegata*. The soils present in this habitat type are suitable for digging and burrowing animals, especially reptiles. Conservation significant fauna likely to utilise this habitat type include the Australian Bustard (*Ardeotis australis*), Bush Stone-curlew (*Burhinus grallarius*), and Rainbow Bee-eater (*Merops ornatus*). Overall it provides a diverse range of microhabitats, particularly for a rich reptile fauna and is considered to be of moderate habitat value.

Drainage Line

The Drainage Line habitat consisted of major and minor ephemeral creeks that dissect the landscape, and comprised 4.1% of the study area (Table 4). The vegetation of this habitat is highly variable, but frequently consist of *Eucalyptus victrix* low open woodland to open woodland over *Acacia citrinoviridis* high shrubland over *Triodia pungens* and *T. longiceps* scattered hummock grasses over *Eriachne tenuiculmis* open tussock grassland. This habitat type contained a wide range of microhabitats and resources important for vertebrate fauna that are mostly or entirely lacking from the other habitats in the study area. Taller trees with voluminous canopies, woody debris (logs and extensive leaf litter), soft alluvial soils, dense mid-storey vegetation as well as typically dense tussock or hummock grassland understorey. Tree hollows were mostly absent, but those available may be used for nesting and roosting by parrots, owls, nightjars as well as pythons, microbats and amphibians. Soft soils and extensive litter is favoured sheltering habitat for some frogs, snakes and lizards such as *Lerista* skinks and legless lizards. During the time of the survey there was only a single series of spring fed pools in one stream. The lack of standing water throughout the winter period probably regulate populations of large herbivores such as Red Kangaroo (*Macropus rufus*), Common Wallaroo (*Macropus robustus*), cattle, camel and horses in the study area, though signs of camel were noted. Eucalypt lined creeks provide greater cover and habitat complexity than other vegetation in the surrounding plains, and can be used as dispersal corridors for fauna.

Conservation significant fauna which may use this habitat include the Pilbara Olive Python (*Liasis olivaceus barroni*), Peregrine Falcon (*Falco peregrinus*), Bush Stone-curlew, Rainbow Bee-eater, Fork-tailed Swift (*Apus pacificus*), Northern Quoll and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). In the study area, Drainage Line habitat often occurs in close proximity to Hills, which may host caves suitable for bats of conservation significance. Due to its microhabitat complexity and the diversity of fauna that it can support, the Drainage Line habitat is considered to be of moderate value.

Hills

Rocky hills cover 62.2% of the study area. Hill habitat is typically comprised of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* scattered low trees over *Senna glutinosa* and *Eremophila cuneifolia* shrubland over *Triodia longiceps* and *T. pungens* hummock grassland. There was a lower diversity of microhabitats in this habitat with few large trees, few if any tree hollows, few logs, and little woody debris. The soil was hard and unsuitable for burrowing fauna. Extensive rock piles, and exposed bedrock provides cracks and crevices which are important for small ground dwelling reptiles and small mammals. The grass *Triodia* provides extensive spiny refuges for many terrestrial species especially reptiles, small mammals and some birds.

The Western Pebble-mouse (*Pseudomys chapmani*) is the most likely conservation significant fauna to use this habitat, though the Rainbow Bee-eater and Australian Bustard (*Ardeola australis*) might also occur. Western Pebble-mouse makes use of small surface rocks for mound building and are considered to be a specialist of habitats with this attribute. Habitat diversity is low, but extensive rock cover and *Triodia* are important resources for a diverse reptile fauna. This habitat is considered to be of moderate habitat value.

Gorge

Gorge habitat covered about 0.7% of the study area. Greater topographic relief including breakaways, cliffs, small gorges and a greater abundance of caves characterizes this habitat. This habitat typically consists of *Acacia aneura* and low open forest over *Ptilotus obovatus* occasional low scattered shrubs over *Paspalidium clementii* very open tussock grassland. Large rocks are often present as are piles of large boulders and scree beneath steep slopes, cliffs and within gorges. This habitat is capable of supporting a diverse reptile fauna, and moderately diverse avifauna. Several of the reptile species are rock specialists (e.g. Pygmy Spiny-tailed Skink [*Egernia depressa*], Desert Cave Gecko [*Heteronotia spelea*]) but few birds are tightly associated with this habitat.

The Western Bowerbird (*Chlamydera guttata*) is probably more common in rocky gorges and gullies. The small shallow caves observed in this habitat type do not appear to provide long-term roosting potential for conservation significant microbats, such as the Ghost bat (*Macroderma gigas*) or Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). The shallow caves provide temporary refuges for macropods such as the Common Wallaroo and the Rothschild's Rock-wallaby (*Petrogale rothschildi*). Conservation significant fauna that

might use this habitat include the blind snake *Ramphotyphlops ganei*, Rainbow Bee-eater, Northern Quoll, Western Pebble-mouse and Pilbara Leaf-nosed Bat. This habitat is considered to be of moderate habitat value because it supports a typically diverse fauna, potentially including several conservation significant species.

3.3 FAUNA ASSEMBLAGES

The overall fauna assemblage in the study area was compiled from surveys conducted within and surrounding the study area (see Appendix B) and records from the DEC NatureMap (DEC 2011b), DEC threatened fauna database search (DEC 2011c) and DSEWPaC Protected Matters Search Tool (DSEWPaC 2011b). All fauna species recorded previously in the region are listed in Appendix B, with conservation significant fauna potentially occurring and/or previously recorded for the study area listed in Appendix B. The species list (Appendix B) notes records separately for both survey seasons in the present study.

A total of 139 species (two amphibians, 55 reptiles, 59 birds and 23 mammals) were recorded (Appendix B). This included three conservation significant species: Australian Bustard, Rainbow Bee-eater and Western Pebble-mouse. One additional species, the Peregrine Falcon, was observed 2 km south of the study area while travelling between sections of the study area. Drainage Line and Alluvial Plain habitats were richest in fauna (77 and 71 species, respectively). Hill (63 species) and Gorge (54 species) habitats had slightly lower species richness (Figure 5).

A total of 286 vertebrate fauna species (10 amphibians, 86 reptiles, 151 birds and 39 mammals) have been previously recorded in the study area (DEC 2011b), suggesting that approximately 49% of the potentially occurring fauna were recorded during the field survey. However, this secondary data was recovered from a larger area, and therefore from a wider range of habitats than are included in the study area, and includes historical records. Some of these species may not occur in the study area because of lack of suitable habitat, or if they once occurred, they have become locally extinct.

3.3.1 Amphibians

Two species of frog (Mains Frog [*Litoria maini*] and Water-holding Frog [*Cyclorana platycephala*]) were recorded during the first season survey in Drainage Line habitats, and a further eight species were recovered from database search (Figure 5). No frogs were recorded during the second seasonal survey.

3.3.2 Reptiles

A total of 931 captures and sightings of 54 reptile species (40 species in first survey, and an additional 14 species in the second survey) were made at the seven sites and one additional species was recorded opportunistically. The four most commonly recorded species (Rock Ctenotus [*Ctenotus saxatilis*], Leopard Ctenotus [*C. pantherinus*], *Ctenotus duricola* and Bynoe's Gecko [*Heteronotia binoei*]) comprised 46% of all systematic records, and 44 of the remaining 50 reptile species were relatively uncommon and were represented by less than 10 captures/records (Figure 6). A few commonly encountered and uncommonly encountered reptiles are shown in Plate 1. Reptile species richness was relatively uniform across habitats (26-33 species) with the greatest richness in Drainage Line habitat (Figure 5). A further 32 reptile species have been recorded in the vicinity of the study area (Appendix B).

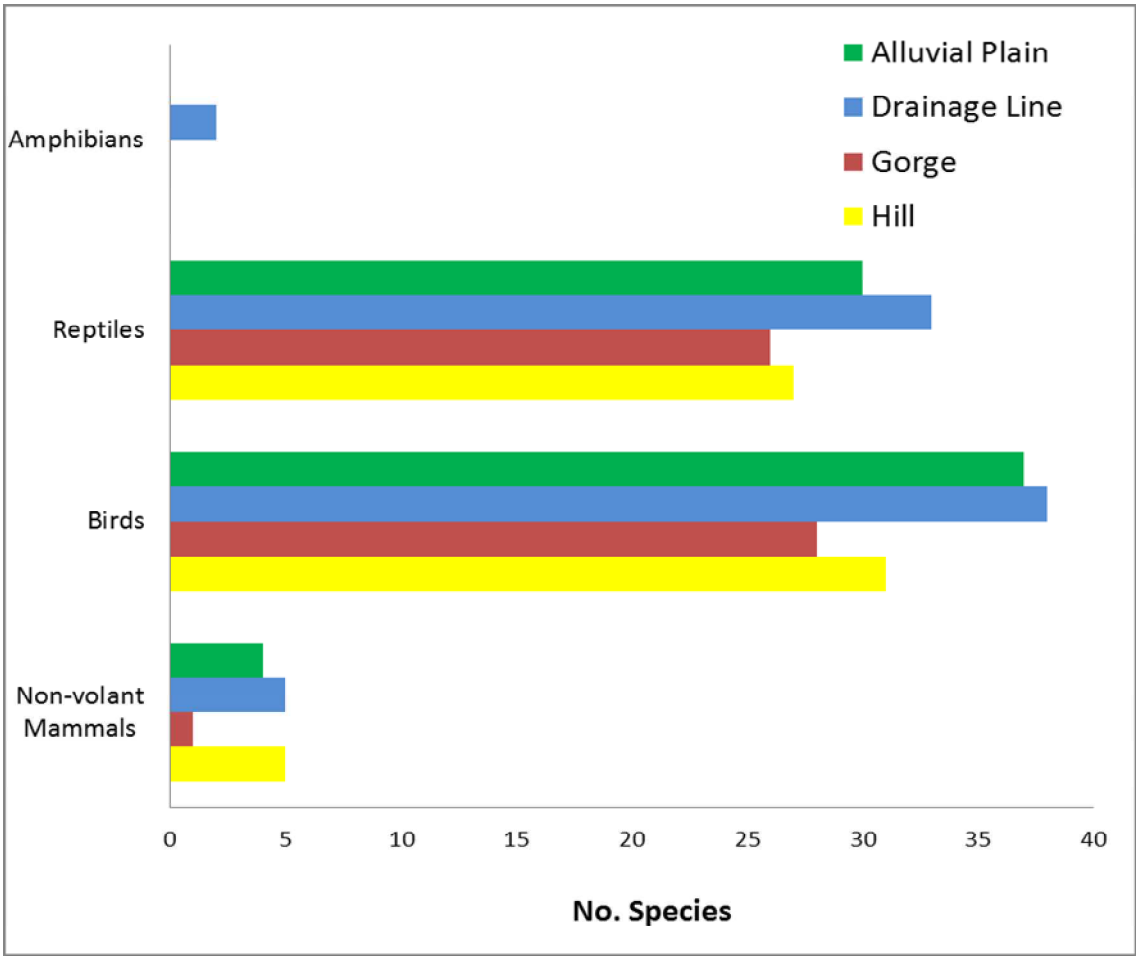

Figure 5. Patterns of faunal species richness (number of species) by habitat type.

3.3.3 Birds

A total of 1,404 sightings of 50 bird species (46 species in the first survey and an additional four species in the second survey) were recorded during systematic site surveys. An additional nine species were recorded opportunistically. The most frequently recorded birds were Painted Finch (*Emblema picta*), Cockatiel (*Nymphicus hollandicus*), Budgerigar (*Melopsittacus undulatus*), and Zebra Finch (*Taeniopygia guttata*): these comprised 54.5% (764 sightings) of all birds observed (Figure 7). Other common birds include Weebill (*Smicrornis brevirostris*), Singing Honeyeater (*Lichenostomus virescens*), Black-faced Woodswallow (*Artamus cinereus*), Diamond Dove (*Geopelia cuneata*) and Brown Honeyeater (*Lichmera indistincta*). Bird species richness was highest in Drainage Line and Alluvial Plain habitat, and was lower in Hill and Gorge habitat (Figure 5). A further 44 bird species have been recorded from the vicinity of the study area (Appendix B).

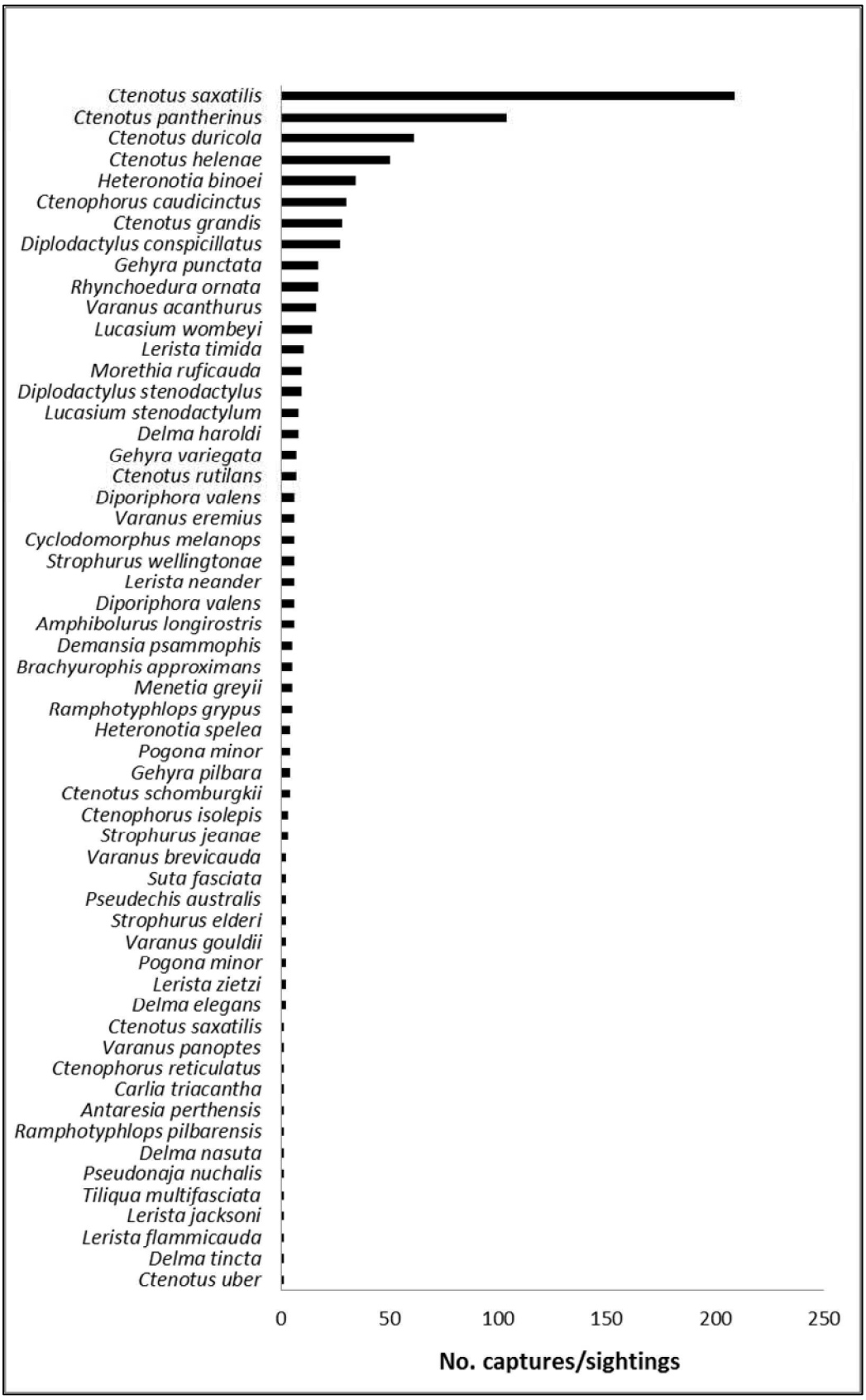

Figure 6. Patterns in the relative abundance of reptiles at sites.

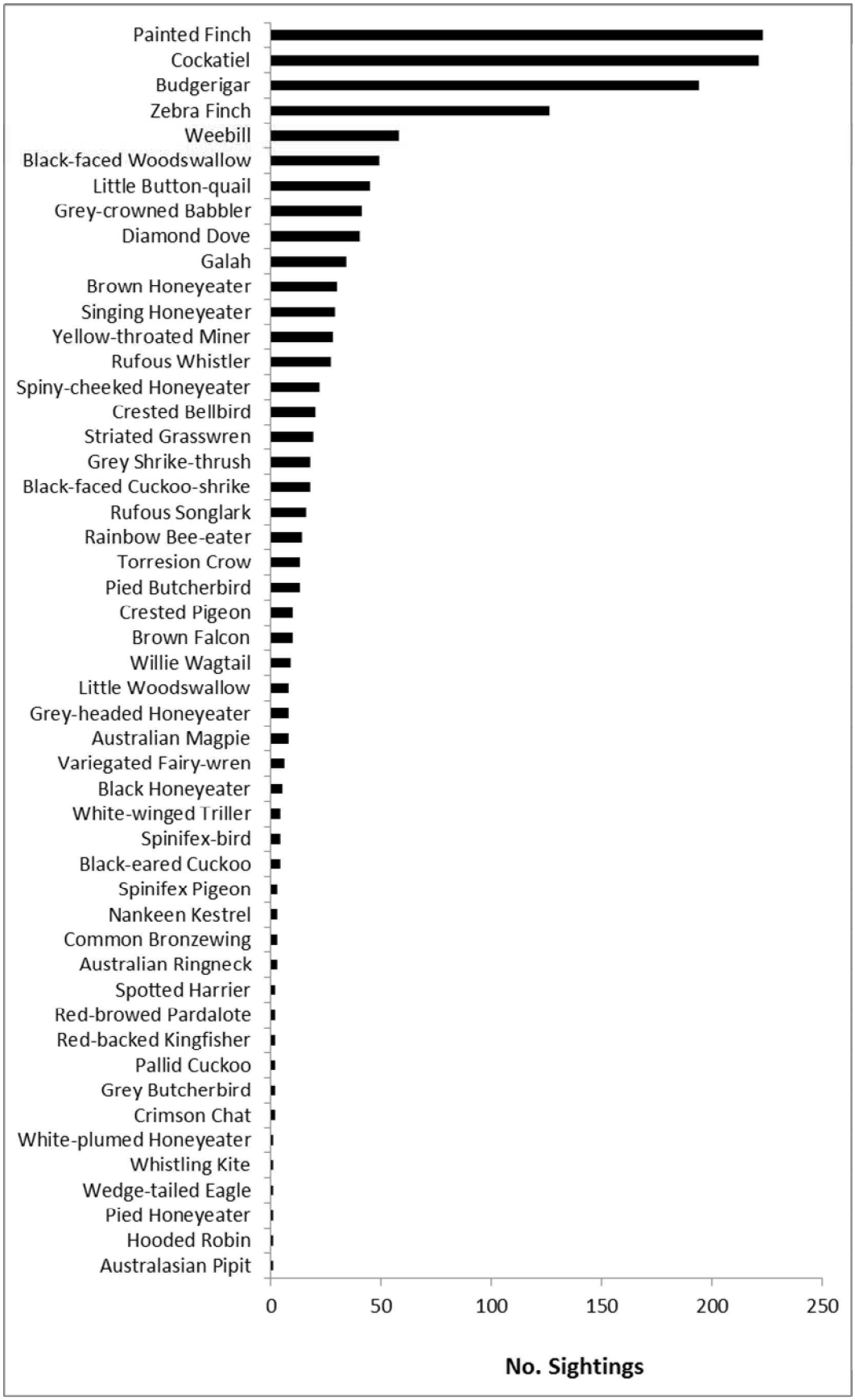

Figure 7. Patterns in the relative abundance of birds at sites.

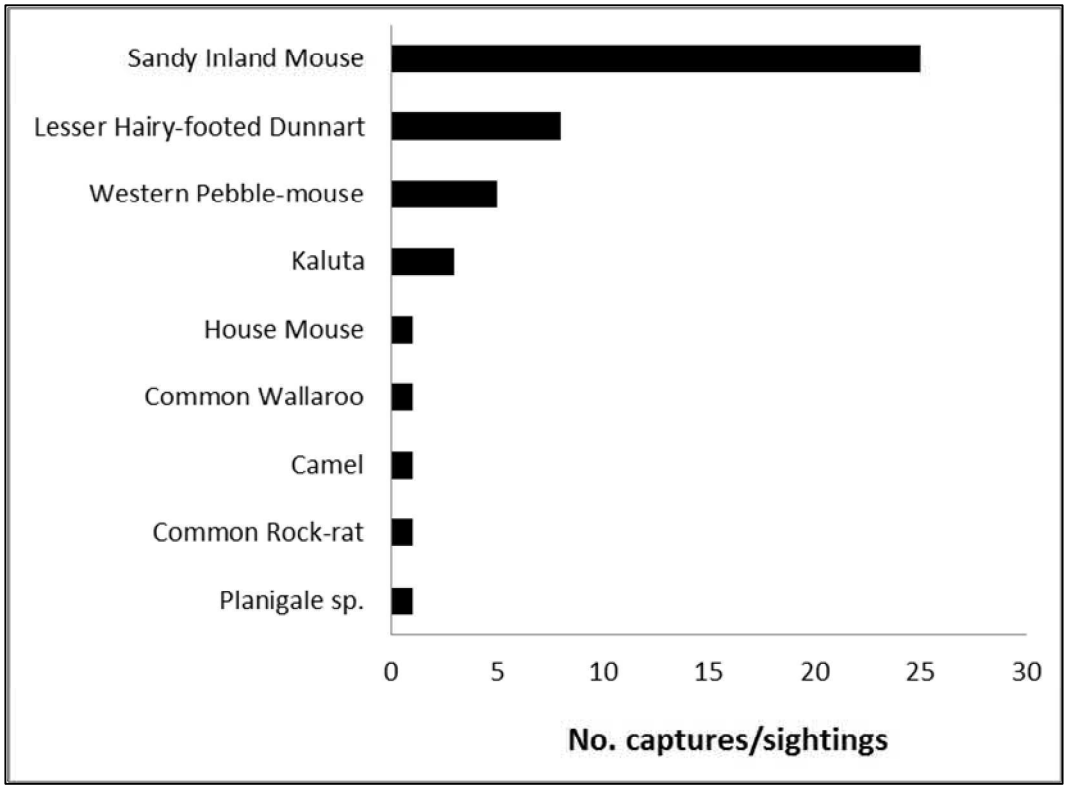

Figure 8. Patterns in the relative abundance of non-volant mammals at sites.

3.3.4 Mammals

A total of 23 mammal species were directly or indirectly recorded (Appendix B, Figure 8). The Gorge habitat was low in mammals (only a single Kaluta [*Dasykaluta rosamondae*] was captured: Plate 2) but there was little difference in the number of mammals captured or observed in other habitats (Figure 5). The Sandy Inland Mouse (*Pseudomys hermannsburgensis*) and Lesser Hairy-footed Dunnart (*Sminthopsis youngsonii*) were the most frequently captured small mammals (Figure 8, Plate 2). Macropods were uncommon with only a few observations of Red Kangaroo, Common Wallaroo and Rothschild`s Rock-wallaby (*Petrogale rothschildi*). No mammals were photographed with the Motion Sensitive Cameras during surveys. A total of eight bat species were recorded in the study area (Appendix B, D). A further 16 mammal species (mostly small dasyurid carnivores and microbats) have been recorded from the vicinity of the study area (Appendix B).

3.4 DATA ANALYSIS

Species accumulation curves for reptiles and birds are illustrated in Figure 9. The species accumulation curve for both reptiles and birds continued to accumulate throughout the survey with little evidence of data reaching an asymptote (Figure 9). The lack of an asymptote is caused by the preponderance of uncommonly recorded species (Figure 6, 7). The addition of a second season survey increased the number of reptile and bird species

recorded and the overall survey adequacy by recording a higher percentage of the expected species. The number of bird species (pooled for both surveys) recorded was 89.5% of the mean expected species richness (56) and the number of reptiles recorded at systematic sites (54 species) was 86.3% of the number of species expected to occur (63 species) at the sites.

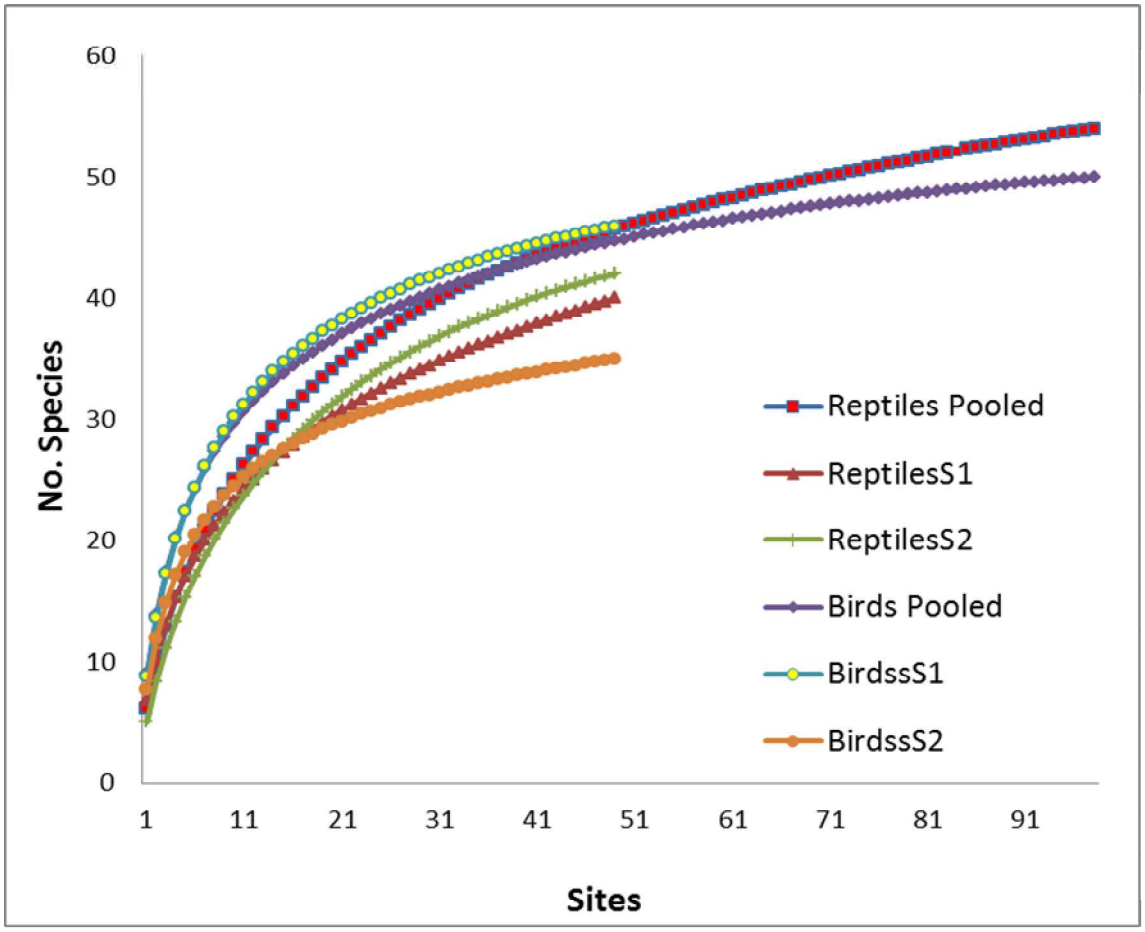

Figure 9. Species accumulation curves for reptiles and birds. Curves are shown for data pooled over both surveys, and then data for season one (S1) and season two (S2) shown separately.

Photo 1 Photo 2

Photo 3 Photo 4

Photo 5 Photo 6

Plate 1. Examples of reptile species recorded during the survey: Photo 1 Northern Spiny-tailed Gecko (*Strophurus ciliaris*), Photo 2 *Strophurus jeanae*, Photo 3 Centralian Blue-tongue (*Tiliqua multifasciata*), Photo 4 Spinifex Slender Blue-tongue (*Cyclodomorphus melanops*), Photo 5 Dwarf Bearded Dragon (*Pogona minor*), Photo 6 *Vermicella snelli*.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Plate 2. Examples of small mammal species recorded during the survey: Photo 1 Kaluta (*Dasykaluta rosamondae*), Photo 2 Planigale sp. (one of two undescribed Planigale species in the Pilbara), Photo 3 and Photo 4 Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*), Photo 5 Common Rock-rat (*Zyzomys argurus*), Photo 6 Sandy Inland Mouse (*Pseudomys hermannsburgensis*).

3.4.1 Potential Fauna of Conservation Significance

A list of previously recorded species has been compiled from the desktop review of previous surveys conducted in the area and database searches (Table 2, Appendix B). A total of 15 conservation significant species have previously been recorded within the vicinity of the study area and could potentially occur based on the available habitats of the study area and the species known distribution (Table 5). Of these, nine species are considered as 'Possibly' occurring within the study area, three are considered as 'Likely' (Peregrine Falcon [*Falco peregrinus*], Bush Stone-curlew [*Burhinus grallarius*] and Fork-tailed Swift [*Apus pacificus*]), to occur, and three species were recorded during the survey.

Six species, additional to those recorded, have been recorded previously in the vicinity of the study area (Table 2): Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (Ecologia 2006a), *Ramphotyphlops ganei* (Outback Ecology 2009c), Ghost Bat (*Macroderma gigas*) (Ecologia 2006a, ENV 2007b) and Bush Stone-curlew (*Burhinus grallarius*) (Outback Ecology 2009b), Fork-tailed Swift (*Apus pacificus*) (ENV 2011), and Western Star Finch (*Neochmia ruficauda subclarescens*) (Outback Ecology 2009c).

Table 5: Conservation Significant Fauna Potentially Occurring in the Study area

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
REPTILES				
Ramphotyphlops ganei	P1	Little is known of the habitat requirements of *Ramphotyphlops ganei*, with most records occurring in habitats with rocky or stony soils (Wilson and Swan 2010).	Limited records of this species make habitat relevance hard to assess. The rocky substrate of Hills, Gorges and the Alluvial Plain habitat types may provide suitable habitat for this species.	Possible
Pilbara Olive Python (*Liasis olivaceus barroni*)	VU,S1	Pilbara Olive Pythons are found in a range of habitats, including drier areas of woodland, escarpments, rocky gorges, gullies and around watercourses (Pearson 1993, Pearson 2003, Wilson and Swan 2010). It usually occurs in close proximity to water and rock outcrops that attract suitable sized prey species (Pearson 2003).	The Hill, Gorges and Drainage Lines may provide suitable habitat for this species as it includes areas of high topographic relief and occasional pools of semi-permanent water. This large snake tends to prefers larger gorges with permanent water.	Possible
BIRDS				
Fork-tailed Swift (*Apus pacificus*)	Mi	The Fork-tailed Swift is a summer migrant to Australia usually during the months of October-April. The Fork-tailed Swift is an aerial species which forages high above the tree canopy and is independent of terrestrial habitats. It occurs in flocks of up to 2000 birds and is often seen accompanying Tree Martins and Masked Wood swallows (Johnstone and Storr 1998).	This is migratory aerial species which is likely to occur throughout the study area during the migration period. There was a record of a few individuals from the neighbouring Orebody 31 area (ENV 2011).	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Peregrine Falcon (*Falco peregrinus*)	S4	The Peregrine Falcon is an uncommon but wide-ranging across Australia. It occurs mainly along rivers and ranges as well as wooded watercourses and lakes and nests primarily on cliffs, granite outcrops and quarries. They feed mostly on birds (Johnstone and Storr 1998).	The Drainage Line habitat in the study area probably provides suitable habitat for this species, and cliffs above Gorges and Hills might provide nesting sites. One bird was observed outside the study area while travelling from the central part of the study area to the southern part of the study area.	Likely
Australian Bustard (*Ardeotis australis*)	P4	The Australian Bustard remains widespread and locally common in parts of northern and central Australia (Ziembicki 2010). In Western Australia Australian Bustard prefers open habitats, ranging from open grassland plains to low shrublands, grassy open woodlands (Ziembicki 2010). This bird is nomadic, irruptive or completes partial movement to exploit favourable conditions, typically after rain (Ziembicki 2010). Invertebrates such as beetles, grasshoppers and as well as fruits and seeds are dominant dietary items (Ziembicki 2010). Habitat, hunting, introduced predators, habitat alteration and altered fire regimes are among the main threats to the bustard (Ziembicki 2010).	This species frequently occurs on Alluvial Plain habitat throughout the Pilbara, and was recorded from the Alluvial Plain habitat within the study area.	Recorded
Bush Stone-curlew (*Burhinus grallarius*)	P4	The Bush Stone-curlew inhabits dry open woodlands with groundcover of small sparse shrubs. It tends to avoids dense forest, closed-canopy habitats and often occurs near watercourses or swamps (Geering *et al.* 2007). Bush Stone-curlews have declined because of predation by foxes - the main concern for their regional decline (Johnstone and Storr 1998).	The Alluvial Plains habitat, especially habitat adjacent to Drainage Line may provide suitable habitat for this species.	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Common Sandpiper (*Tringa hypoleucos*)	Mi	The Common Sandpiper is found along all West Australian coasts and many islands (as far offshore as Ashmore Reef) through to much of the interior, excluding the arid east. This species prefers areas where low perches are available in fresh or saline waters such as creeks, rocky coasts, dams and sewage ponds (Johnstone and Storr 1998).	There is no natural habitat for this species though it could occur at standing water anywhere during the summer (migration) period.	Possible
Wood Sandpiper (*Tringa glareola*)	Mi	The Wood Sandpiper is a summer non-breeding migratory shorebird that occurs along the coastal inland regions of Western Australia (Geering *et al*. 2007). It primarily inhabits freshwater wetlands (often inland) and is rarely found on intertidal mudflats (Geering *et al*. 2007). This Migratory bird breeds from Eurasia to Siberia and migrates to Australian waters in September (Pizzey and Knight 2007). This species is mainly found in freshwater and occasionally brackish habitats (Simpson and Day 2004).	There is no natural habitat for this species though it could occur at standing water anywhere during the summer (migration) period.	Possible
Oriental Plover (*Charadrius veredus*)	Mi	The Oriental Plover occurs in the Kimberley and in the north-eastern interior at Lake Gregory and on the north-west coastal plains (Johnstone and Storr 1998). It is found on sparsely vegetated plains including Samphire, Spinifex plains (particularly after fire), as well as beaches and tidal flats (Johnstone and Storr 1998). This species often feeds on insects and congregates in huge numbers following outbreaks of grasshoppers (Johnstone and Storr 1998, Piersma and Hassell 2010).	The Alluvial Plain habitat in the study area has large areas of patchy bare ground that could provide suitable foraging, or staging (temporary site used briefly while on migration) habitat for this species, though it has mostly been recorded from coastal areas in the Pilbara (Geering *et al.* 2007).	Possible
Rainbow Bee-eater (*Merops ornatus*)	Mi	The Rainbow Bee-eater is a common and widespread species in Western Australia, except the drier interior of the State and the far south-west. It occurs in lightly wooded, often sandy country, preferring areas near water. The Rainbow Bee-eater feeds on airborne insects, and nests throughout	All habitat types in the study area potentially provide suitable habitat for this species. This species was recorded within Alluvial Plain, Drainage Line and Hill habitats.	Recorded

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
		its range in Western Australia in burrows excavated in sandy ground or banks, often at the margins of roads and tracks (Johnstone and Storr 1998). It can occur as a 'resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor' (Johnstone and Storr 1998). Populations from south-western Western Australia migrate north prior to the winter period (February-April) and return to breed in spring (Johnstone and Storr 1998).		
Western Star Finch (*Neochmia ruficauda subclarescens*	P4	The western subspecies of the Star Finch is confined to the Pilbara region of Western Australia (Pizzey and Knight 2007). This bird occurs in grasslands with sparse vegetation, and feeds mainly on grass seeds and some small insects (Johnstone and Storr 2004). Like most finches this species needs regular drinking water.	This finch requires access to permanent water, which is absent throughout the majority of the study area.	Possible
MAMMALS				
Northern Quoll (*Dasyurus hallucatus*)	EN, S1	In the Pilbara the Northern Quoll occurs mainly in areas of open eucalypt woodland within 200 km of the coast, although it has been recorded in a range of vegetation types, and is known to den in rock crevices and rock piles. It favours rocky areas, taking refuge in rock crevices, and utilises gullies and drainage lines (Van Dyck and Strahan 2008). The Northern Quoll can be locally common in northern Australia, but its former range has retracted considerably (Van Dyck and Strahan 2008).	Hill and Gorge habitat is extensive in the study area, but suitable areas with high relief and highly broken terrain preferred by this species is limited. No evidence of this species was recorded from within the study area.	Possible

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Ghost Bat (*Macroderma gigas*)	P4	The Ghost Bat occurs in a wide variety of habitats, and requires undisturbed caves, deep fissures or disused mine shafts in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance. Colonies range in size from 400-1,000 individuals (Van Dyck and Strahan 2008). The Ghost Bat inhabits areas of open woodland (Churchill 2009).	No suitable caves were discovered during the survey, however this species has been recorded at the nearby Hashimoto area (Ecologia 2006a, ENV 2007b).	Possible
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)	VU,S1	The Pilbara Leaf-nosed Bat requires deep caves or disused mine shafts in which to roost (Van Dyck and Strahan 2008), at least in the dry season. These bats have been recorded in isolated populations in the Pilbara, and are present only where suitable roosting niches are available. They are generally sparsely distributed. The Pilbara Leaf-nosed Bat inhabits areas of open woodland (Churchill 2009).	No suitable caves were discovered during the survey, however there are records of this bat from nearby Hashimoto (Ecologia 2006a).	Possible
Western Pebble-mouse (*Pseudomys chapmani*)	P4	The Western Pebble-mouse is endemic to the Pilbara. Abandoned mounds to the east of its current range indicate a decline in distribution (Menkhorst and Knight 2004). Abandoned mounds in disturbed areas suggest that the species is sensitive to disturbance and is under threat by grazing and mining activities. The construction of extensive pebble mounds, built from small stones, which typically cover areas from 0.5-9.0 square metres, is characteristic of this species. Mounds are restricted to suitable-class stones, and are usually found on gentle slopes and spurs (Ford and Johnson 2007).	The Hill habitat type in the study area provides suitable habitat for this species.	Recorded

KEY:	
En	Listed as Endangered under the *EBPC Act 1999*.
Vu	Listed as Vulnerable under the *EBPC Act 1999*.
Mi	Listed as Migratory under the *EBPC Act 1999*.
S	Scheduled under the *WC Act 1950*. Schedule 1 and 2 fauna are also protected by the *EBPC Act 1999*.
P	Listed as Priority by the DEC.
Recorded	Recorded during the field survey or site reconnaissance.
Likely	Suitable habitat is present in the study area and the study area is in the species' known distribution.
Possible	Limited or no suitable habitat is present in study area but is nearby. The species has good dispersal abilities and is known from the general area.
Unlikely	No suitable habitat is present in study area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however the study area is outside of the species' known distribution.

3.4.2 Recorded Fauna of Conservation Significance

Australian Bustard (*Ardeotis australis*) – DEC Priority 4

This species probably ranges widely throughout the study area, particularly using the Alluvial Plains habitat. None were directly observed, but tracks were observed and photographed near site 5 (Alluvial Plain habitat) (Appendix E, Figure 10).

Rainbow Bee-eater (*Merops ornatus*) – EPBC Act Migratory

The Rainbow Bee-eater was regularly encountered in small flocks in Alluvial Plain, Drainage Line and Hill habitat throughout the study area (Appendix E, Figure 10).

Western Pebble-mouse (*Pseudomys chapmani*) – DEC Priority 4

A total of six individuals of the Western Pebble-mouse were captured in pitfall traps, and two mounds were recorded (Appendix E, Figure 10). Records were from Hill habitat and a Drainage Line adjacent to Hill habitat.

4 DISCUSSION

Compared to other bioregions in Australia, the vertebrate fauna of the Pilbara is characterised by a low amphibian fauna richness; however, it is one of the richest bioregions for reptiles (c.200 species), and has moderate levels of bird and mammal species richness (Atlas of Living Australia 2011). The Pilbara is the richest region in Australia for geckos (including legless lizards) and one of the richest regions for dragon lizards (Powney *et al.* 2010) as well as hosting high numbers of varanoid monitors, blind snakes, elapid snakes and marine snakes. Since European settlement, the amphibian, reptile and bird faunas have remained intact, but 12 mammal species have become extinct, two species persist only on its coastal islands (Western Chestnut Mouse [*Pseudomys nanus*] and Pale Field-rat [*Rattus tunneyi*]) and one (Water Rat [*Hydromys chrysogaster*]) has contracted to the coast (Burbidge *et al*. 2009, Baynes and McDowell 2010). Habitat loss is considered to be the main threat to fauna species in the Pilbara (Evans *et al.* 2011). However, habitat degradation by cattle grazing and changed fire regimes (van Vreeswyk et *al.* 2004), and predation by introduced predators such as cats and foxes, are also typically implicated in the decline of many conservation significant species occurring in the Pilbara (Abbott 2009).

Species accumulation curves are used to estimate total species richness and the proportion of species caught or encountered during fauna surveys. The two-season sampling in this survey significantly improved overall survey adequacy (an additional 21% of species) with an additional 14 reptile species, eight bird species and seven mammals recorded in the second season survey. A high proportion of the 'expected' reptiles (86.3%) and birds (89.5%) were recorded, but there were too few frogs and mammals recorded during the study to subject this data to species estimation analysis. However, the average number of frogs (2.3 species, range 0-5 species) and mammals (15 species, range 9-23 species) recorded from seven Level Two surveys (Table 2) in the vicinity of the study area, suggests that the results obtained in the present survey are typical. Most reptile and bird species were recorded on few occasions (Figure 6, 7) suggesting that much greater survey effort (e.g. repeated surveys or monitoring) is needed to record an even higher proportion (>90%) of these fauna groups. Most mammals were recorded infrequently (Figure 8). This is a typical result in regions with rich faunas. To record about 80% of the small mammals on the Abydos Plain (Pilbara), about 10,000 Elliott and pitfall trap-nights was needed (How and Cooper 2002). However, typical Level Two consulting studies in the Pilbara involve only about 1,000-2,000 (pitfall and Elliott) trap nights of effort, over a 7 day period. Examining patterns of species accumulation is a useful way to quantify survey adequacy, but in short-term studies in the Pilbara (where most species occur infrequently) it invariably shows that much greater survey effort is required to record most species.

Totals of 35-50 reptile species and 45-70 bird species (especially in areas where wetlands are absent) are frequently recorded during Level Two surveys in the Pilbara (Table 2), suggesting that overall species richness recorded in this study is typical. The mean number of species recorded from Level Two surveys in the vicinity of the study area is 106 (range 63-165 species) and 76 species from Level One surveys (Table 2). A relatively limited number of

conservation significant species have been recorded consistently within the vicinity of the study area, with the Western Pebble-mouse recorded from six of eight Level Two studies, and the Australian Bustard and the Rainbow Bee-eater both listed from five of eight Level Two studies (Table 2, Appendix B).

A total of five fauna species recorded during this survey (*Delma elegans*, *D. haroldi*, *Lerista flamicauda*, *L. jacksoni* and Beccari's Freetailed Bat [*Mormopterus beccarii*]) had not been recorded by previous surveys from the vicinity of the study area. All of these species occur widely in the Pilbara and their presence in the study area is not surprising and none are conservation significant species. The skink *Lerista jacksoni* was previously included within the *Lerista muelleri* complex (Smith and Adams 2007), and may have been recorded previously under that name.

Habitat Types

Four main habitats (Alluvial Plain, Drainage Line, Hill and Gorge) were recorded within the study area. Hill habitat was covered in low shrubland over *Triodia* sp. hummock grassland and occupied 62% of the study area. The broad habitats mapped in the study area occur widely in the Pilbara. The study area covers two BRA subregions (Fortescue subregion 70% of study area and Hamersley subregion covering 30%) and 10 land systems. Two of the 10 land systems (Newman and Boolgeeda) occupy 82% of the study area, and more than 10% of the entire Pilbara bioregion (van Vreeswyk *et al*. 2004). Habitats therefore comprised a typical range of the major habitats in the Pilbara bioregion.

Habitats were mostly in good condition and were ranked as providing Moderate fauna habitat value. Locally some habitats (especially Alluvial Plain) that have been disturbed in the study area by vehicle tracks, drill pads, and regular natural wildfires still maintain good quality habitat for fauna. Drainage Line and Alluvial Plain were the richest habitats for fauna, but these patterns are partly caused by differences in survey effort (number of sites sampled) between habitats. Relatively few species appear to be strongly associated with particular habitats, a pattern which appears to be repeated throughout the Pilbara. Small mammals have been shown to partition their habitat based on broad substrate categories (sandy, clayey and rocks) with distance to coast (a surrogate for a climate gradient) important for some species (Gibson and McKenzie 2009).

The Alluvial Plain fauna was typical of much of the Pilbara – it was relatively rich in reptiles many of which burrow, or use *Triodia* and other grasses as shelter. The avifauna is typically dominated by a small range of granivorous grass or shrub-dwelling birds, and species dependent on trees are either uncommon or absent. Dense stands of Mulga can host a distinctive fauna, which can include small passerines such as the Inland Thornbill (*Acanthiza apicalis*) which are uncommon or absent from other habitats. Loose bark on Mulga can provide important habitat for some reptiles such as the Stripe-tailed Monitor (*Varanus caudolineatus*). Conservation significant species such as the Australian Bustard, Bush Stone-

Curlew and Rainbow Bee-eater frequently use similar Alluvial Plain habitat throughout the Pilbara.

Drainage Line habitat contrasts with other habitats in the study area and are characterized by the presence of large Eucalypt trees, which produce a wide range of microhabitats (larger and denser tree canopies, hollows, bark, branches, and seasonally flower profusely) and moister and shadier conditions occasionally with free-standing water. Drainage Line habitat occurs widely throughout the Pilbara bioregion but is limited in areal extent. Free standing water was absent, except during the first survey. Water can provide drinking opportunities for birds (especially granivorous finches, parrots and honeyeaters) and mammals, especially macropods and microbats, and breeding sites for amphibians. In the Pilbara distinctive microbat communities are associated with permanent water sources particularly in close proximity to rocky ranges (McKenzie and Bullen 2009). Amphibians were restricted to Drainage Line habitat in this survey. Dense hummock and tussock grassland along Drainage Lines, combined with friable alluvial soil provides refuges for a wide range of reptiles including *Delma* sp. legless lizards. The Northern Quoll may use this habitat if large hollows are present and which are suitable for dens, but at least in the areas surveyed, there appeared to be few large tree hollows. Drainage lines are also provide important corridors for fauna movement because they provide increased cover from predators, and are richer in resources (e.g. vegetation structural diversity, hollows and flowers) than surrounding habitats.

Hills and Gorges in the study area are typical of much of the Pilbara bioregion, but were of relatively low relief (with few large cliffs and poorly developed overhangs and caves). Extensive rock cover, and hummock grassland provides the most important microhabitat resources for a rich reptile fauna including a few rock specialist species such as the *Gehyra punctata*, Ring-tailed Dragon (*Ctenophorous caudocinctus*) and Spiny-tailed Monitor (*Varanus acanthurus*). There are few rock-specialized birds, but the Western Bowerbird (*Chlamydera guttata*) and Grey Shrike-thrush (*Colluricincla harmonica*) may be more common in this habitat. Fauna of conservation significance most likely in Hill habitat are Northern Quoll, Western Pebble-mouse, Rainbow Bee-eater, Pilbara Olive Python, *Ramphotyphlops ganei*, and Pilbara Leaf-nosed Bat.

Conservation Significant Fauna Recorded in the Study Area

Three vertebrate species of conservation significance were recorded within the study area: the Australian Bustard (*Ardeola australis*: recorded in Alluvial Plain habitat), Rainbow Bee-eater (*Merops ornatus*: recorded in Alluvial Plain, Drainage Line and Hill habitats) and Western Pebble-mouse (*Pseudomys chapmani*: recorded in Hill and Drainage Line habitat adjacent to Hill habitat). The Australian Bustard and the Western Pebble-mouse are listed as Priority 4 on the DEC priority list and the Rainbow Bee-eater is listed as Migratory under the EPBC Act. Of the 11 studies listed in Table 2, the Rainbow Bee-eater was recorded in seven, the Australian Bustard was recorded in seven, and the Western Pebble-mouse was recorded

in eight indicating that these are the most frequently recorded species of conservation significance in the vicinity of the study area.

The Australian Bustard occurs widely over the majority of northern and central Australia with a preference for open habitats, ranging from open grassland plains to low shrublands and grassy open woodlands (Barrett *et al.* 2003; Ziembicki 2010). It is a highly mobile species, which appears to be irruptive in relation to rainfall patterns and bushfires (Ziembicki 2010).

The Rainbow Bee-eater is one of the most common and widespread birds in Australia and was a commonly recorded species during surveys in the Pilbara (Burbidge *et al.* 2010). The Rainbow Bee-eater is a highly mobile species and therefore is not locally dependent on the habitats within the study area.

The Western Pebble-mouse is a relatively poorly known species. There were records of this rodent from seven of nine surveys in the vicinity of the study area (Table 2, Appendix B). The number of pitfall trap captures of these small rodents, in addition to a couple of mound records suggests that they are relatively common in the study area. This species has a high level of social complexity and mound fidelity and a small core home range size of less than one hectare (Anstee *et al.* 1997). This species is found broadly across much of the Pilbara (Gibson and McKenzie 2009).

'Likely' and 'Possible' Conservation Significant Fauna in the Study Area

Three conservation significant species are considered as 'Likely' to occur in the study area.

The Peregrine Falcon (*Falco peregrinus*) is listed as Migratory on the EPBC Act, although the two Australian subspecies (*macropus* and *submelongenys*) are resident breeding forms (Barrett *et al.* 2003). This bird occurs widely throughout the Pilbara, though there are no published breeding records (Barrett *et al.* 2003). The Peregrine Falcon was observed approximately 2 km south of the study area and would be expected to occur in the study area. Potentially it could breed on cliffs associated with the small Gorges in the study area. It prefers to nest on cliffs, granite outcrops and quarries, and feeds mostly on birds (Johnstone and Storr 1998).

The Bush Stone-curlew (*Burhinus grallarius* – Priority 4) occurs across much of Australia and inhabits a broad range of habitats including dry open woodlands, but may prefer habitat such as Drainage Lines (Geering *et al.* 2007). The only record known from the vicinity of the study area was at Prairie Downs (ENV 2007a).

The Fork-tailed Swift (*Apus pacificus*) is listed on the EPBC Act as a Migratory species. This bird visits Australia during the northern hemisphere winter, but it is an aerial species that does not perch on land (or trees). Consequently, it is independent of habitats within the study area. There was a record of a few individuals from the neighbouring Orebody 31 area (ENV 2011).

A total of nine species are considered as 'Possibly' occurring within the study area, which is supported by the absence of records of these species from recent studies in the vicinity of the study area (Table 2, Appendix B).

The ecology and habitat requirement of the blind snake *Ramphotyphlops ganei* are poorly known, but it is a Pilbara endemic with records between Newman and Pannawonica (Wilson and Swan 2010). Like the Pilbara Olive Python, it is mostly associated with moist gorges and gullies (Wilson and Swan 2010), and thus might be present in Hill or Gorge habitat in the study area. There has been a record of this species from Alluvial Plain habitat in the vicinity of the study area (Outback Ecology 2009c, Appendix B).

The Pilbara Olive Python occurs in the rocky ranges of the Pilbara where it is thought to be threatened because it has a small distribution and may be affected by disturbances such as grazing, fire and loss of habitat (Pearson 1993, 2003). There are few large gorges suitable for this species in the study area, and none of these appear to retain water throughout the dry season. There are no recent records from the vicinity of the study area (Table 2, Appendix B) but because it occurs in low populations densities it can be difficult to detect.

Three shorebirds listed as Migratory on the EPBC Act could possibly occur in the study area, but in the Pilbara are more likely to be associated with major wetlands such as the Fortescue Marsh and Ophthalmia Dam. The Common Sandpiper (*Actitus hypoleucos*) and Wood Sandpiper (*Tringa glareola*) are two of the most common Palearctic migrant shorebirds that visit Australia during the northern hemisphere winter (Geering *et al.* 2007). These birds could occur anywhere during the wet season when pools of standing water are available. The Oriental Plover (*Charadrius veredus*) is another Palaearctic shorebird migrant that feeds (often on grasshoppers) and roosts on short grass and samphire plains (Geering *et al.* 2007, Piersma and Hassell 2010). During the migration season (August-March) this bird could occur anywhere in the study area.

The Western Star Finch (*Neochmia ruficauda subclarescens*) is confined to the Pilbara region of Western Australia (Pizzey and Knight 2007) and typically inhabits areas of permanent water because it needs to drink daily. It occurs regularly at the Ophthalmia Dam, but the lack of standing water in the study area probably greatly reduces the potential for this species to occur in the study area.

The Northern Quoll (*Dasyurus hallucatus*) prefers rocky areas, taking refuge in rock crevices, and utilises gullies and drainage lines (Van Dyck and Strahan 2008). The Northern Quoll can be locally common, but its former range has retracted considerably (Van Dyck and Strahan 2008). There was no evidence of Northern Quoll from the study area and there are no recent records from the vicinity of the study area (Appendix B), or near Newman. However, the study area does occur in the Northern Quoll's known and modelled distribution (near the southernmost boundary) (DSEWPaC 2011c). Rocky habitat is present in the study area, but this would be more suitable if it was of higher relief, if the gorges were larger and maintained permanent waterbodies.

The Ghost Bat (*Macroderma gigas*) occurs widely throughout the Pilbara (Armstrong and Anstee 2000). There are records from caves at nearby Hashimoto to the east of the study area (Ecologia 2006a, ENV 2007b), but caves suitable for Ghost Bat appear to be absent from the study area. Ghost Bats are known to forage up to about 2 km from roost sites (Tidemann *et al.* 1985) which might constrain their capacity to disperse into the study site, but young Ghost Bats might fly through the study area.

The Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) is dependent on caves and mines with very hot and humid roost sites (28-32ºC and 96-100% humidity) during the dry season (Armstrong 2000; Churchill 2009). Without these conditions caves and mines which have these specific characteristics are uncommon. During the survey no deep caves were located in the study area but this species has been recorded from nearby Hashimoto mine about 15 km east of Wheelarra Hill (Ecologia 2006a). Little information is available on movements of the Pilbara Leaf-nosed Bat (Churchill 2009) but young bats might disperse into the study area from colonies nearby. The Pilbara Leaf-nosed Bat prefers suitable caves particularly those in close proximity to well-developed permanent or semi-permanent waterbodies (McKenzie and Bullen 2009) but this habitat is absent from the study area.

5 SUMMARY OF SURVEY FINDINGS

The survey and assessment of the study area found the following:

- Four fauna habitats were recorded in the study area: Alluvial Plain, Drainage Line, Hill and Gorge;
- A total of 286 vertebrate species have been recorded within the vicinity of study area including 10 amphibian, 86 reptile, 151 bird and 39 mammal species;
- During the field habitat survey, two amphibians, 55 reptiles, 59 birds, and 23 mammal species were recorded (139 species in total);
- An additional 29 species (21% of the overall total) were added during the second season survey (no frogs, 14 reptiles, eight birds and seven mammals);
- Three species of conservation significance were recorded during the survey: Australian Bustard, Rainbow Bee-eater and Western Pebble-mouse; and
- Additional to the three recorded species of conservation significant, three species (Peregrine Falcon, Bush Stone-curlew, and Fork-tailed Swift) are considered as 'Likely' to occur and nine conservation significant species were considered as 'Possibly' occurring in the study area.

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FIGURES

150,000 160,000 170,000 180,000 190,000 200,000 210,000 220,000 230,000 240,000 250,000 260,000

7,450,000 7,440,000 7,430,000 7,420,000 7,410,000 7,400,000 7,390,000 7,380,000

HAMERSLEY RANGE

Great Northern Highway

Mt Newman Railway

Fortescue River

Mt Whaleback Mine

Newman

Wheelarra Hill North

CLIENT		JOB NO.	
BHPBIO		J100434	
AUTHOR	DRAWN	DATE	
C. Trainor	M. Mikkonen	21-11-2011	
SCALE	PROJECTION		
1:300,000 @ A3	GDA 94 MGA 51		

N

0 5 10

Kilometres

Legend

Survey Area

Regional Location

Wheelarra Hill North Fauna Assessment

FIGURE **1**

202,000 204,000 206,000 208,000 210,000 212,000

7,418,000

7,416,000

7,414,000

7
1
2
3
4
5
6
Anabat 2
Camera 3
Camera 4
Camera 6
Anabat 1
Camera 1
Camera 5
Anabat 3
Gorge Trapline
Anabat 5
Camera 2
Anabat 4
AS1
AS2
AS3
AS4
AS5
AS6
AS7

N

0 250 500 1,000

Metres

Legend

- Survey Area
- Active Search Area
- Trap Site Location
- Motion Sensitive Camera
- Gorge Trapline
- Anabat Unit

env Australia

CLIENT BHPBIO		**JOB NO.** J100434
AUTHOR C. Trainor	**DRAWN** M. Mikkonen	**DATE** 21-11-2011
SCALE 1:30,000 @ A3	**PROJECTION** GDA 94 MGA 51	

Study Sites

Wheelarra Hill North Fauna Assessment

FIGURE 3

202,000 204,000 206,000 208,000 210,000 212,000

7,418,000

7,416,000

7,414,000

7,412,000

Site 7
Site 4
Site 3
Site 1
Site 5
Site 2
Site 6

Australia

CLIENT
BHPBIO

JOB NO.
J100434

AUTHOR
C. Trainor

DRAWN
M. Mikkonen

DATE
18-11-2011

SCALE
1:30,000 @ A3

PROJECTION
GDA 94 MGA 51

N

0 250 500 1,000
Metres

Legend
Survey Area
Trap Site Location/ Habitat Assessment

Vegetation
Alluvial Plain
Drainage Line
Hill
Gorge

Fauna Habitat Types

Wheelarra Hill North Fauna Assessment

FIGURE 4

202,000 204,000 206,000 208,000 210,000 212,000

7,418,000

7,416,000

7,414,000

7,412,000

Western Pebble-mouse (x3)

Rainbow Bee-eater (x2)
Western Pebble-mouse

Western Pebble-mouse (mound)

Rainbow Bee-eater (x7)
Australian Bustard

Rainbow Bee-eater

Western Pebble-mouse

CLIENT
BHPBIO

JOB NO.
J100434

AUTHOR
C. Trainor

DRAWN
M. Mikkonen

DATE
18-11-2011

SCALE
1:30,000 @ A3

PROJECTION
GDA 94 MGA 51

N

0 250 500 1,000
Metres

Legend

Survey Area

Species

Australian Bustard (*Ardeotis australis*)

Rainbow Bee-eater (*Merops ornatus*)

Western Pebble-mouse (*Pseudomys chapmani*)

Western Pebble-mouse (mound)

Location of Conservation Significant Fauna

Wheelarra Hill North Fauna Assessment

FIGURE 10

APPENDIX A

DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

WHEELARA HILL NORTH FAUNA ASSESSMENT

APPENDIX A

DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

B1: *Environment Protection and Biodiversity Conservation Act 1999* (*Cth*): Threatened Species and Threatened Ecological Communities Codes

The *EPBC Act* prescribes seven matters of national environmental significance:-

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance;
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Species in the categories ExW, CE, E, V and M (see below), and Threatened Ecological Communities in the CE and E categories are protected as matters of national environmental significance under the *EPBC Act*.

Category	Code	Category
Extinct	Ex	Taxa for which there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	ExW	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not recorded in its known and/or expected habitat at appropriate seasons anywhere in its past range despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
Critically Endangered	CE	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	E	Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Vulnerable	V	Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	CD	Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.

Category	Code	Category
Migratory	Mi	Taxa that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations, that are included in an international agreement approved by the Minister for the Environment, Heritage and the Arts and that have been placed on the national List of Migratory Species under the provisions of the EPBC Act. At present there are four such agreements: • the Bonn Convention • the China-Australia Migratory Bird Agreement (CAMBA) • the Japan-Australia Migratory Bird Agreement (JAMBA) • the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
Marine	Ma	Taxa protected in a Commonwealth Marine Protected Area by virtue of section 248 of the *EPBC Act*. These taxa include certain seals, crocodiles, turtles and birds, as well as various marine fish. Commonwealth marine areas are matters of national environmental significance under the *EPBC Act*. An action will require approval if the: • action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment, or • action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area[1] The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters. The Commonwealth marine area stretches from 3 to 200 nautical miles (approximately 5-370 km) from the coast. Marine protected areas are marine areas which are recognised to have high conservation value.

B2: Western Australian Threatened Fauna Categories

Wildlife Conservation Act 1950 (WA)

Category	Code	Description
Schedule 1	S1	Rare or likely to become extinct.
Schedule 2	S2	Presumed extinct.
Schedule 3	S3	Birds subject to an agreement between the governments of Australia and Japan, the People's Republic of China & the Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Other specially protected fauna.

B3: Department of Environment and Conservation Fauna Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring: not currently threatened or in need of special protection, but could become so. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring: not considered threatened, but the subject of a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

APPENDIX B

PREVIOUSLY RECORDED FAUNA SPECIES AND THOSE RECORDED DURING THE SURVEY

APPENDIX B

B1: AMPHIBIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, IUCN = IUCN Redlist Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPaC Protected Matters Search Tool, E= Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology 2009a), F= Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback ecology 2009b), G= Jimblebar Linear Develpoment Fauna Assessment (Outback ecology 2009c), H= Jimblebar West fauna Assessment (ENV. Australia 2007),I = Jimblebar Hashimoto Vertebrate Fauna Assessment (ecologia 2006a), J= Jimblebar Marra Mamba Exploration Biological Survey (ecologia 2006b),K = East Jimblebar Exploration Project Biological Survey (ecologia 2005), L= Jimblebar Wheelarra Hill Expansion Biological Survey (ecologia 2004), M= OB18 Biological Assessment Survey (ecologia 1995), N= Jimblebar Biological Survey (BHPIO 1994), O= Orebody 31 Fauna Assessment (ENV.Australia 2011), P= Current Survey, Season 1, Q= Current Survey, Season 2.

Note: For Definitions of Conservation Codes see Appendix A.

AMPHIBIANS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
HYLIDAE																						
Cyclorana maini	Main's Frog				LC									x							x	
Cyclorana platycephala	Water-holding Frog				LC									x							x	
Litoria rubella	Red Tree Frog				LC						x	x		x	x	x	x			x		
LIMNODYNASTIDAE																						
Neobatrachus centralis	Desert Trilling Frog				LC												x					
Neobatrachus kunapalari	Kunapalari Frog				LC							x										
Notaden nichollsi	Desert Spadefoot				LC												x					
Platyplectum spenceri	Centralian Burrowing Frog				LC									x			x					
MYOBATRACHIDAE																						
Uperoleia saxatilis	Pilbara Toadlet				LC																	
Uperoleia russelli	Northwest Toadlet				LC						x	x		x			x					
Pseudophryne douglasi	Douglas Toadlet				LC							x										

[X] fauna species recorded from the project area.
[*] denotes introduced species.

APPENDIX B

B2: REPTILE SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, IUCN = IUCN Redlist Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPaC Protected Matters Search Tool, E= Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology 2009a), F= Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback ecology 2009b), G= Jimblebar Linear Develpoment Fauna Assessment (Outback ecology 2009c), H= Jimblebar West fauna Assessment (ENV. Australia 2007),I = Jimblebar Hashimoto Vertebrate Fauna Assessment (ecologia 2006a), J= Jimblebar Marra Mamba Exploration Biological Survey (ecologia 2006b),K = East Jimblebar Exploration Project Biological Survey (ecologia 2005), L= Jimblebar Wheelarra Hill Expansion Biological Survey (ecologia 2004), M= OB18 Biological Assessment Survey (ecologia 1995), N= Jimblebar Biological Survey (BHPIO 1994), O= Orebody 31 Fauna Assessment (ENV.Australia 2011), P= Current Survey, Season 1, Q= Current Survey, Season 2.

Note: For Definitions of Conservation Codes see Appendix A.

REPTILES		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
CHELUIDAE																						
Chelodina steindachneri	Plate-shelled Turtle											x					x					
DIPLODACTYLIDAE																						
Diplodactylus conspicillatus	Fat-tailed Gecko					x				x	x	x				x		x			x	x
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko					x						x										
Lucasium stenodactylum	Sand-plain Gecko					x				x	x	x	x	x		x	x				x	x
Lucasium wombeyi													x	x			x				x	x
Oedura marmorata	Marbled Velvet Gecko											x	x							x		x
Rhynchoedura ornata	Beaked Gecko											x				x		x			x	x
Strophurus ciliaris	Northern Spiny-tailed Gecko															x						
Strophurus elderi	Jewelled Gecko											x				x	x					x
Strophurus jeanae																x					x	x
Strophurus wellingtonae												x	x	x		x					x	x

REPTILES		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
CARPHODACTYLIDAE																						
Nephrurus wheeleri	Banded Knob-tailed Gecko														x							
GEKKONIDAE																						
Gehyra pilbara													x	x				x			x	x
Gehyra punctata											x	x	x	x	x			x	x	x	x	x
Gehyra variegata						x				x	x	x	x	x	x	x	x	x	x	x	x	x
Heteronotia binoei	Bynoe's Gecko					x					x	x	x	x		x	x	x		x	x	x
Heteronotia spelea	Desert Cave Gecko																x			x	x	x
PYGOPODIDAE																						
Delma elegans																						x
Delma haroldi																					x	x
Delma nasuta																	x	x			x	
Delma pax						x				x	x	x	x	x	x		x	x				
Delma tincta											x											x
Lialis burtonis	Burton's Snake-lizard										x		x	x	x		x					
Pygopus nigriceps	Western Hooded Scaly-foot					x				x		x										
SCINCIDAE																						
Carlia munda						x						x			x							
Carlia triacantha						x				x		x					x					x
Cryptoblepharus sp.	[*ustulatus* or *buchanani*]																	x				
Ctenotus duricola						x				x	x	x					x				x	x
Ctenotus grandis						x				x	x	x									x	x
Ctenotus helenae						x				x	x	x	x	x			x	x			x	
Ctenotus leonhardii												x				x	x	x	x			
Ctenotus pantherinus	Leopard Ctenotus					x				x	x	x			x		x	x			x	x
Ctenotus quattuordecimlineatus	Fourteen-lined Ctenotus																	x				
Ctenotus rutilans																					x	x
Ctenotus saxatilis	Rock Ctenotus					x				x	x	x	x	x	x		x	x		x	x	x
Ctenotus schomburgkii																					x	
Ctenotus serventyi													x	x								
Ctenotus uber						x				x	x	x									x	
Cyclodomorphus branchialis	Gunther's Skink																	x				
Cyclodomorphus melanops	Spinifex Slender Blue-tongue											x			x						x	
Egernia depressa	Pygmy Spiny-tailed Skink					x				x		x										

REPTILES		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
Eremiascincus richardsonii	Broad-banded Sand-swimmer													x		x	x					
Lerista bipes						x						x	x	x								
Lerista flamicauda																						x
Lerista frostii																			x			
Lerista jacksoni																						x
Lerista muelleri										x	x	x	x	x	x			x			x	x
Lerista neander						x					x	x			x		x	x				
Lerista timida																					x	x
Lerista zietzi						x						x					x				x	
Menetia greyii						x					x	x			x			x			x	x
Morethia ruficauda						x						x	x	x				x	x			
Tiliqua multifasciata	Centralian Blue-tongue									x	x	x			x	x	x				x	
AGAMIDAE																						
Amphibolurus longirostris	Long-nosed Dragon					x						x	x	x	x	x	x				x	x
Ctenophorus caudicinctus	Ring-tailed Dragon					x				x	x	x	x	x	x	x	x	x		x	x	x
Ctenophorus isolepis	Central Military Dragon					x						x			x	x		x		x	x	x
Ctenophorus nuchalis	Central Netted Dragon									x	x	x	x	x				x				
Ctenophorus reticulatus	Western Netted Dragon														x							x
Diporiphora valens																					x	x
Pogona minor	Dwarf Bearded Dragon												x	x	x			x			x	x
VARANIDAE																						
Varanus acanthurus	Spiny-tailed Monitor					x					x	x	x	x	x		x	x		x	x	x
Varanus brevicauda	Short-tailed Monitor																					x
Varanus caudolineatus	Striped-tailed Monitor										x	x	x	x	x							x
Varanus eremius	Desert Pygmy Monitor												x	x							x	x
Varanus giganteus	Perentie																	x			x	
Varanus gouldii	Gould's Goanna					x					x	x	x	x					x			x
Varanus panoptes	Yellow-spotted Monitor												x	x		x	x				x	
Varanus pilbarensis	Pilbara Rock Monitor																	x				
Varanus tristis	Black-headed Monitor					x					x	x			x		x	x	x			
TYPHLOPIDAE																						
Ramphotyphlops ammodytes												x	x	x							x	x
Ramphotyphlops hamatus						x				x	x	x										
Ramphotyphlops gainei				P1								x										
Ramphotyphlops grypus	Beaked Blind Snake											x					x	x				x
BOIDAE																						
Antaresia perthensis	Pygmy Python											x					x	x			x	
Antaresia stimsoni	Stimson's Python					x						x				x	x					
Liasis olivaceus barroni	Pilbara Olive Python																					
Aspidites melanocephalus	Black-headed Python													x								
ELAPIDAE																						
Brachyurophis approximans	North-western Shovel-nosed Snake											x					x				x	x
Demansia psammophis	Yellow-faced Whipsnake					x						x	x	x	x	x					x	x
Furina ornata	Moon Snake												x	x								
Pseudechis australis	Mulga Snake										x			x	x		x					

REPTILES		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
Pseudonaja mengdeni	Gwardar					x				x	x	x		x		x					x	
Pseudonaja modesta	Ringed Brown Snake													x								
Suta fasciata	Rosen's Snake																					x
Suta punctata	Little Spotted Snake														x							
Vermicella snelli												x										x

[X] fauna species recorded from the project area.
[*] denotes introduced species.

APPENDIX B

B3: AVIAN SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, IUCN = IUCN Redlist Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPaC Protected Matters Search Tool, E= Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology 2009a), F= Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback ecology 2009b), G= Jimblebar Linear Develpoment Fauna Assessment (Outback ecology 2009c), H= Jimblebar West fauna Assessment (ENV. Australia 2007), I = Jimblebar Hashimoto Vertebrate Fauna Assessment (ecologia 2006a), J= Jimblebar Marra Mamba Exploration Biological Survey (ecologia 2006b), K = East Jimblebar Exploration Project Biological Survey (ecologia 2005), L= Jimblebar Wheelarra Hill Expansion Biological Survey (ecologia 2004), M= OB18 Biological Assessment Survey (ecologia 1995), N= Jimblebar Biological Survey (BHPIO 1994), O= Orebody 31 Fauna Assessment (ENV.Australia 2011), P= Current Survey, Season 1, Q= Current Survey, Season 2.

Note: For Definitions of Conservation Codes see Appendix A.

BIRDS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
CASUARIIDAE																						
Dromaius novaehollandiae	Emu				LC	x	x					x	x					x	x			
PHASIANIDAE																						
Coturnix pectoralis	Stubble Quail				LC		x															x
Coturnix ypsilophora	Brown Quail				LC		x							x		x						
ANATIDAE																						
Anas gracilis	Grey Teal				LC		x															
Anas superciliosa	Pacific Black Duck				LC	x	x															
Aythya australis	Hardhead				LC		x															
Chenonetta jubata	Australian Wood Duck				LC		x							x								
Cygnus atratus	Black Swan				LC		x															
Dendrocygna arcuata	Wandering Whistling Duck				LC		x					x										
Malacorhynchus membranaceus	Pink-eared Duck				LC		x															
Tadorna tadornoides	Australian Shelduck				LC	x	x							x								
PODICIPEDIDAE																						
Podiceps cristatus	Great Crested Grebe				LC		x															
Poliocephalus poliocephalus	Hoary-headed Grebe				LC		x															
Tachybaptus novaehollandiae	Australasian Grebe				LC		x															
COLUMBIDAE																						
Geopelia cuneata	Diamond Dove				LC	x	x					x	x	x	x	x	x	x	x	x	x	x
Geopelia striata	Peaceful Dove				LC	x	x					x		x								
Geophaps plumifera	Spinifex Pigeon				LC	x	x			x	x	x	x	x	x		x	x	x	x	x	x
Ocyphaps lophotes	Crested Pigeon				LC	x	x				x	x	x	x	x	x	x		x	x	x	x
Phaps chalcoptera	Common Bronzewing				LC	x	x					x	x	x		x	x		x	x	x	x
PODARGIDAE																						
Podargus strigoides	Tawny Frogmouth				LC	x	x							x		x	x					x

BIRDS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
CAPRIMULGIDAE																						
Eurostopodus argus	Spotted Nightjar				LC	x							x	x	x	x		x		x	x	x
AEGOTHELIDAE																						
Aegotheles cristatus	Australian Owlet-nightjar				LC	x	x					x		x		x		x	x	x	x	x
APODIDAE																						
Apus pacificus	Fork-tailed Swift	Mi																		x		
ANHINGIDAE																						
Anhinga novaehollandiae	Australasian Darter				LC	x	x					x										
PHALACROCORACIDAE																						
Microcarbo melanoleucos	Little Pied Cormorant				LC	x	x															
Phalacrocorax carbo	Great Cormorant				LC	x																
Phalacrocorax sulcirostris	Little Black Cormorant				LC	x	x					x		x								
PELECANIDAE																						
Pelecanus conspicillatus	Australian Pelican				LC		x															
ARDEIDAE																						
Ardea ibis	Cattle Egret	Mi			LC		x		x													
Ardea modesta	Eastern Great Egret	Mi			LC	x	x		x													
Ardea pacifica	White-necked Heron				LC	x	x					x		x								
Egretta garzetta	Little Egret				LC	x	x															
Egretta novaehollandiae	White-faced Heron				LC	x	x					x		x								
Nycticorax caledonicus	Nankeen Night-Heron				LC	x	x															
THRESKIORNITHIDAE																						
Platalea flavipes	Yellow-billed Spoonbill				LC	x	x					x										
Plegadis falcinellus	Glossy Ibis	Mi			LC		x															
Threskiornis molucca	Australian White Ibis				LC		x															
Threskiornis spinicollis	Straw-necked Ibis				LC	x	x															
ACCIPITRIDAE																						
Accipiter cirrhocephalus	Collared Sparrowhawk				LC	x	x						x									
Accipiter fasciatus	Brown Goshawk				LC	x	x					x	x	x	x		x					
Aquila audax	Wedge-tailed Eagle				LC	x	x			x	x	x	x	x	x					x		x
Circus assimilis	Spotted Harrier				LC	x	x							x	x			x				x
Elanus axillaris	Black-shouldered Kite				LC	x	x						x		x							
Haliastur sphenurus	Whistling Kite				LC	x	x				x	x	x	x	x			x			x	x
Hamirostra melanosternon	Black-breasted Buzzard				LC	x	x				x	x		x	x	x					x	
Hieraaetus morphnoides	Little Eagle				LC	x	x				x		x	x		x						
Lophoictinia isura	Square-tailed Kite				LC	x																
Milvus migrans	Black Kite				LC	x	x				x	x			x			x				
FALCONIDAE																						
Falco berigora	Brown Falcon					x	x			x	x	x	x	x	x	x	x	x		x	x	x
Falco cenchroides	Nankeen Kestrel					x	x				x	x	x	x	x	x	x	x	x	x	x	x
Falco longipennis	Australian Hobby					x	x					x		x		x					x	
Falco peregrinus	Peregrine Falcon		S4		LC		x						x									

BIRDS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
RALLIDAE																						
Fulica atra	Eurasian Coot				LC		x															
Porphyrio porphyrio	Purple Swamphen				LC		x															
Tribonyx ventralis	Black-tailed Native-hen				LC	x	x							x								
OTIDIDAE																						
Ardeotis australis	Australian Bustard			P4	NT	x	x	x			x	x	x	x	x	x		x		x		x
BURHINIDAE																						
Burhinus grallarius	Bush Stone-curlew			P4	NT	x		x			x											
RECURVIROSTRIDAE																						
Cladorhynchus leucocephalus	Banded Stilt				LC		x															
Himantopus himantopus	Black-winged Stilt				LC		x															
CHARADRIIDAE																						
Charadrius ruficapillus	Red-capped Plover				LC		x															
Charadrius veredus	Oriental Plover	Mi			LC				x													
Elseyornis melanops	Black-fronted Dotterel				LC	x	x					x		x								
SCOLOPACIDAE																						
Actitus hypoleucos	Common Sandpiper	Mi			LC	x	x															
Tringa glareola	Wood Sandpiper	Mi			LC		x															
TURNICIDAE																						
Turnix velox	Little Button-quail				LC	x	x					x	x	x	x			x		x	x	x
LARIDAE																						
Childonias hybrida	Whiskered Tern						x															
CACATUIDAE																						
Cacatua sanguinea	Little Corella				LC	x	x				x	x	x	x			x			x		
Eolophus roseicapilla	Galah					x	x					x	x	x	x	x	x	x	x	x	x	x
Psephotus varius	Mulga Parrot				LC		x						x									
Nymphicus hollandicus	Cockatiel				LC	x	x					x	x	x				x			x	x
PSITTACIDAE																						
Barnardius zonarius	Australian Ringneck				LC	x	x				x	x	x	x	x	x	x	x				x
Melopsittacus undulatus	Budgerigar				LC	x	x				x	x	x	x	x	x		x	x	x	x	x
Neopsephotus bourkii	Bourke's Parrot				LC								x	x								
CUCULIDAE																						
Centropus phasianinus	Pheasant Coucal				LC	x						x		x								
Cacomantis pallidus	Pallid Cuckoo					x	x					x	x	x	x			x		x		x
Chalcites basalis	Horsfield's Bronze-Cuckoo					x	x			x		x	x	x	x		x	x		x		
Chalcites osculans	Black-eared Cuckoo											x									x	x

BIRDS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
STRIGIDAE																						
Ninox connivens	Barking Owl				LC	x	x															
Ninox novaeseelandiae	Southern Boobook				LC	x	x				x	x	x	x					x		x	x
TYTONIDAE																						
Tyto javanica	Eastern Barn Owl				LC	x	x				x						x					
HALCYONIDAE																						
Dacelo leachii	Blue-winged Kookaburra				LC	x	x					x		x								
Todiramphus pyrrhopygius	Red-backed Kingfisher				LC	x	x				x	x	x	x	x		x	x		x	x	x
Todiramphus sanctus	Sacred Kingfisher				LC	x	x					x		x		x						
MEROPIDAE																						
Merops ornatus	Rainbow Bee-eater	Mi			LC	x	x		x	x	x	x	x	x	x	x	x				x	x
CLIMACTERIDAE																						
Climacteris melanura	Black-tailed Treecreeper				LC	x	x							x								
PTILONORHYNCHIDAE																						
Ptilonorhynchus guttatus	Western Bowerbird					x	x						x	x			x					x
MALURIDAE																						
Amytornis striatus	Striated Grasswren					x					x	x		x			x	x	x	x	x	x
Malurus splendens	Splendid Fairy-wren				LC	x						x	x									
Malurus lamberti	Variegated Fairy-wren					x	x			x	x	x	x	x	x	x	x	x	x	x	x	x
Malurus leucopterus	White-winged Fairy-wren				LC	x	x				x	x	x	x	x	x	x					x
Stipiturus ruficeps	Rufous-crowned Emu-wren				LC	x								x								
ACANTHIZIDAE																						
Acanthiza apicalis	Inland Thornbill				LC	x				x	x	x	x		x	x						x
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				LC	x						x	x	x	x				x			
Acanthiza robustirostris	Slaty-backed Thornbill				LC		x						x	x								
Acanthiza uropygialis	Chestnut-rumped Thornbill				LC	x	x					x	x	x	x		x					
Gerygone fusca	Western Gerygone					x	x			x	x	x	x		x							
Smicrornis brevirostris	Weebill				LC	x	x			x	x	x	x	x	x		x		x	x	x	x
PARDALOTIDAE																						
Pardalotus rubricatus	Red-browed Pardalote				LC	x	x					x		x	x		x				x	x
Pardalotus striatus	Striated Pardalote				LC	x	x					x					x	x				
MELIPHAGIDAE																						
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				LC	x	x			x		x	x	x	x	x	x			x	x	x
Sugomel niger	Black Honeyeater											x	x	x	x			x			x	
Certhionyx variegatus	Pied Honeyeater				LC	x							x	x	x			x				
Conopophila whitei	Grey Honeyeater				LC	x						x	x									
Epthianura tricolor	Crimson Chat				LC	x	x					x	x	x	x			x				
Lichenostomus keartlandi	Grey-headed Honeyeater				LC	x	x				x	x	x		x		x				x	x
Lichenostomus penicillatus	White-plumed Honeyeater				LC	x	x				x	x	x	x	x	x	x	x			x	x
Lichenostomus plumulus	Grey-fronted Honeyeater				LC																	
Lichenostomus virescens	Singing Honeyeater				LC	x	x			x	x	x	x	x	x	x	x	x		x	x	x
Lichmera indistincta	Brown Honeyeater				LC	x	x					x	x	x	x	x	x	x		x	x	
Manorina flavigula	Yellow-throated Miner				LC	x	x			x	x	x	x	x	x	x	x			x	x	x
Melithreptus gularis	Black-chinned Honeyeater				LC		x					x					x					
Purnella albifrons	White-fronted Honeyeater												x					x				
POMATOSTOMIDAE																						
Pomatostomus temporalis	Grey-crowned Babbler				LC	x	x			x	x	x	x	x	x		x			x	x	x
Pomatostomus superciliosus	White-browed Babbler				LC		x						x		x							

BIRDS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
EUPETIDAE																						
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush				LC											x						
Psophodes occidentalis	Chiming Wedgebill				LC		x									x						
CAMPEPHAGIDAE																						
Coracina maxima	Ground Cuckoo-shrike				LC	x								x			x					
Coracina novaehollandiae	Black-faced Cuckoo-shrike				LC	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x
Lalage sueurii	White-winged Triller				LC	x	x					x	x	x	x		x	x		x	x	
PACHYCEPHALIDAE																						
Colluricincla harmonica	Grey Shrike-thrush				LC	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x
Oreoica gutturalis	Crested Bellbird					x	x			x		x	x	x	x		x	x	x	x	x	x
Pachycephala rufiventris	Rufous Whistler				LC	x	x				x	x	x	x	x	x	x	x		x	x	x
ARTAMIDAE																						
Artamus cinereus	Black-faced Woodswallow				LC	x	x			x	x	x	x	x	x	x	x		x	x	x	x
Artamus superciliosus	White-browed Woodswallow				LC		x															
Artamus minor	Little Woodswallow				LC	x	x						x				x	x	x	x	x	x
Artamus personatus	Masked Woodswallow				LC	x				x	x				x							
Cracticus torquatus	Grey Butcherbird				LC		x						x	x	x	x	x		x	x	x	x
Cracticus nigrogularis	Pied Butcherbird				LC	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x
Gymnorhina tibicen	Australian Magpie				LC	x	x			x	x	x	x		x		x		x	x	x	x
RHIPIDURIDAE																						
Rhipidura albiscapa	Grey Fantail				LC		x						x									
Rhipidura leucophrys	Willie Wagtail				LC	x	x			x	x	x	x	x	x	x	x	x	x		x	x
CORVIDAE																						
Corvus bennetti	Little Crow				LC	x	x							x								
Corvus coronoides	Australian Raven				LC											x						
Corvus orru	Torresian Crow				LC	x	x			x	x	x	x	x	x	x	x		x		x	x
MONARCHIDAE																						
Grallina cyanoleuca	Magpie-Lark				LC	x	x			x	x	x	x	x	x	x	x					
PETROICIDAE																						
Melanodryas cucullata	Hooded Robin				LC	x	x				x		x	x	x		x	x	x	x	x	
Petroica goodenovii	Red-capped Robin				LC	x	x			x	x	x	x	x	x	x			x			
ALAUDIDAE																						
Mirafra javanica	Horsefield's Bushlark				LC	x	x			x	x		x	x						x		
ACROCEPHALIDAE																						
Acrocephalus australis	Australian Reed-Warbler				LC		x					x										
MEGALURIDAE																						
Cincloramphus mathewsi	Rufous Songlark				LC	x	x					x	x	x	x		x			x	x	x
Cincloramphus cruralis	Brown Songlark				LC		x						x				x			x		
Eremiornis carteri	Spinifexbird				LC	x					x		x		x		x	x			x	x
HIRUNDINIDAE																						
Cheramoeca leucosterna	White-backed Swallow				LC	x	x				x	x		x	x		x		x			
Hirundo neoxena	Welcome Swallow				LC		x															
Petrochelidon ariel	Fairy Martin					x	x					x										
Petrochelidon nigricans	Tree Martin					x	x					x										
NECTARINIIDAE																						
Dicaeum hirundinaceum	Mistletoebird				LC	x	x					x		x	x		x	x				
ESTRILDIDAE																						
Emblema pictum	Painted Finch				LC	x	x					x	x	x	x		x	x		x	x	x
Neochmia ruficauda subclarescens	Western Star Finch			P4	NT		x					x										
Taeniopygia guttata	Zebra Finch				LC	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x
MOTACILLIDAE																						
Anthus novaeseelandiae	Australasian Pipit				LC	x	x				x	x	x	x	x	x	x	x	x	x	x	x

BIRDS		Conservation Codes																				
Scientific Name	Common Name	EPBC	WC	DEC	IUCN	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q

[X] fauna species recorded from the project area.
[*] denotes introduced species.

APPENDIX B

B4: MAMMAL SPECIES PREVIOUSLY RECORDED IN THE REGION

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, IUCN = IUCN Redlist Code, A = Listed in Naturemap (2010), B = Listed by Birds Australia (2010), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the SEWPaC Protected Matters Search Tool, E= Jimblebar Wheelarra Hill Flora and Fauna Assessment (Outback Ecology 2009a), F= Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback ecology 2009b), G= Jimblebar Linear Develpoment Fauna Assessment (Outback ecology 2009c), H= Jimblebar West fauna Assessment (ENV. Australia 2007), I = Jimblebar Hashimoto Vertebrate Fauna Assessment (ecologia 2006a), J= Jimblebar Marra Mamba Exploration Biological Survey (ecologia 2006b),K = East Jimblebar Exploration Project Biological Survey (ecologia 2005), L= Jimblebar Wheelarra Hill Expansion Biological Survey (ecologia 2004), M= OB18 Biological Assessment Survey (ecologia 1995), N= Jimblebar Biological Survey (BHPIO 1994), O= Orebody 31 Fauna Assessment (ENV.Australia 2011), P= Current Survey, Season 1, Q= Current Survey, Season 2.

Note: For Definitions of Conservation Codes see Appendix A.

MAMMALS		Conservation Codes																				
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
TACHYGLOSSIDAE																						
Tachyglossus aculeatus	Short-beaked Echidna				LC							x										
DASYURIDAE																						
Dasykaluta rosamondae	Kaluta				LC	x				x	x	x					x		x		x	x
Dasyurus hallucatus	Northern Quoll	EN	S1		EN				x													
Ningaui timealeyi	Pilbara Ningaui				LC												x	x				
Planigale maculata	Common Planigale																	x				
Planigale sp.																					x	
Pseudantechinus roryi	Rory's Pseudantechinus					x																
Pseudantechinus woolleyae	Woolley's Pseudantechinus					x																
Pseudantechinus macdonnellensis	Fat-tailed Pseudantechinus																					
Sminthopsis crassicaudata	Fat-tailed Dunnart									x	x								x			
Sminthopsis macroura	Stripe-faced Dunnart				LC					x	x											
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					x				x	x	x									x	x
MACROPODIDAE																						
Macropus robustus	Common Wallaroo					x				x	x	x	x	x	x	x	x	x	x			x
Macropus rufus	Red Kangaroo				LC	x				x	x	x	x	x	x	x	x			x	x	
Petrogale rothschildi	Rothschild`s Rock-wallaby				LC			x				x						x				
EMBALLONURIDAE																						
Saccolaimus flaviventris	Yellow-bellied Sheath-tailed Bat				LC	x						x				x					x	x
Taphozous georgianus	Common Sheath-tailed Bat				LC	x						x										x
Taphozous sp.	Sheath-tail bat [*georgianus/hilli*]																				x	
MEGADERMATIDAE																						
Macroderma gigas	Ghost Bat			P4	VU			x						x								
HIPPOSIDERIDAE																						
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1		LC				x					x								

MAMMALS		Conservation Codes																			
Scientific Name	**Common Name**	**EPBC**	**WC**	**DEC**	**IUCN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**
VESPERTILIONIDAE																						
Chalinolobus gouldii	Gould's Wattled Bat				LC	x						x			x	x				x	x	x
Nyctophilus geoffroyi	Lesser Long-eared Bat				LC									x		x					x	x
Scotorepens greyii	Little Broad-nosed Bat				LC							x		x	x	x				x	x	x
Vespadelus finlaysoni	Finlayson's Cave Bat				LC	x				x		x	x	x	x	x				x	x	x
MOLOSSIDAE																						
Chaerephon jobensis	Northern Freetailed Bat				LC							x				x					x	
Mormopterus beccarii	Beccari's Freetailed Bat				LC																x	
MURIDAE																						
**Mus musculus*	House Mouse				-	x				x	x	x	x	x			x	x	x		x	
Notomys alexis	Spinifex Hopping-mouse				LC																	
Pseudomys chapmani	Western Pebble-mouse			P4	LC	x		x		x	x	x			x		x	x	x	x		x
Pseudomys desertor	Desert Mouse				LC												x					
Pseudomys hermannsburgensis	Sandy Inland Mouse				LC	x				x	x	x					x	x	x		x	x
Zyzomys argurus	Common Rock-rat				LC						x	x	x	x			x	x	x			x
LEPORIDAE																						
**Oryctolagus cuniculus*	Rabbit								x			x										
CANIDAE																						
Canis lupus	Dingo/Dog									x	x	x	x		x	x			x			x
**Vulpes vulpes*	Fox								x										x			
FELIDAE																						
**Felis catus*	Cat					x			x	x	x	x			x	x			x		x	
EQUIDAE																						
**Equus asinus*	Donkey					x					x	x		x						x		
**Equus caballus*	Horse										x		x						x			
CAMELIDAE																						
**Camelus dromedarius*	Camel					x						x	x		x							x
BOVIDAE																						
**Bos taurus*	Cattle					x				x	x	x	x		x				x	x		x

[X] fauna species recorded from the project area.

[*] denotes introduced species.

APPENDIX C
HABITAT ASSESSMENT DATA SHEETS

WHEELARA HILL FAUNA ASSESSMENT

APPENDIX C

FAUNA HABITAT DATA SHEETS

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA1
Easting	204216	**Northing**	7416649	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 1
Broad Habitat	Mulga Plain	**% of area**	-		
Landscape Position	Plain				
Broad Floristic Formation	Mulga Plain				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	0
Trees <10m	0	Mallee	0
Shrubs >2m	10-25	Shrubs <2m	25-50
Hummock grasses	50-75	Herbs	0
Tussock grasses	50-70		

Soil type & colour	Red Sandy Loam		
Rock type	Ironstone		
Rock size	<5cm		
Rocky outcrops	Nil		
Leaf litter (% cover)	10-25		
Twig litter (% cover)	10-25	Average size	-
Fallen logs (abundance)	-	Average size	-
Hollow-bearing trees (abundance)	-	Average size	-
Dead stags (abundance)	-	Average dimension	-

Water bodies (present/absent) Describe

Absent

Caves (present/absent) Describe

Absent

Nests or Roosts (present/absent) Describe

Absent

Disturbances (present/absent) Describe

Absent

Ecological processes important to habitat (present/absent) Describe

Absent

Terrestrial Fauna Habitat Assessment Proforma

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA2
Easting	205877	**Northing**	7416297	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 2
Broad Habitat	Hill Top	**% of area**	-		
Landscape Position	Hill Top				
Broad Floristic Formation	Triodia Hills				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	0
Trees <10m	0	Mallee	0
Shrubs >2m	25	Shrubs <2m	<5
Hummock grasses	50-70	Herbs	0
Tussock grasses	50-70		

Soil type & colour	Red Sandy Loam		
Rock type	Ironstone		
Rock size	0-20cm		
Rocky outcrops	0		
Leaf litter (% cover)	0		
Twig litter (% cover)	0	Average size	-
Fallen logs (abundance)	0	Average size	-
Hollow-bearing trees (abundance)	0	Average size	-
Dead stags (abundance)	0	Average dimension	-

Water bodies (present/absent) Describe

Absent

Caves (present/absent) Describe

Absent

Nests or Roosts (present/absent) Describe

Absent

Disturbances (present/absent) Describe

Drill Pads, Drill Holes

Ecological processes important to habitat (present/absent) Describe

Absent

Terrestrial Fauna Habitat Assessment Proforma

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA3
Easting	206838	**Northing**	7417935	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 3
Broad Habitat	Gorge/ Gully	**% of area**	-		
Landscape Position	Gully				
Broad Floristic Formation	Acacia over Triodia				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	0
Trees <10m	5-10	Mallee	0
Shrubs >2m	10-25	Shrubs <2m	10-25
Hummock grasses	50-75	Herbs	0
Tussock grasses	0		

Soil type & colour	Red Sandy Loam		
Rock type	Ironstone		
Rock size	0-100cm		
Rocky outcrops	Yes		
Leaf litter (% cover)	10-25		
Twig litter (% cover)	10-25	Average size	-
Fallen logs (abundance)	6	Average size	5-20cm
Hollow-bearing trees (abundance)	0	Average size	-
Dead stags (abundance)	22	Average dimension	5-20cm

Water bodies (present/absent) Describe

Absent.

Caves (present/absent) Describe

Present. Small shallow caves.

Nests or Roosts (present/absent) Describe

Absent

Disturbances (present/absent) Describe

Absent

Ecological processes important to habitat (present/absent) Describe

Absent

Terrestrial Fauna Habitat Assessment Proforma

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA4
Easting	206372	**Northing**	7417920	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 4
Broad Habitat	Minor Drainage Line	**% of area**	-		
Landscape Position	Drainage Line				
Broad Floristic Formation	Corymbia Open Woodland				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	0
Trees <10m	10	Mallee	0
Shrubs >2m	10-25	Shrubs <2m	10-25
Hummock grasses	50-75	Herbs	0
Tussock grasses	0		

Soil type & colour	Red Sandy Loam		
Rock type	-		
Rock size	-		
Rocky outcrops	-		
Leaf litter (% cover)	10-25		
Twig litter (% cover)	10-25	Average size	-
Fallen logs (abundance)	-	Average size	-
Hollow-bearing trees (abundance)	-	Average size	-
Dead stags (abundance)	-	Average dimension	-

Water bodies (present/absent) Describe

Absent

Caves (present/absent) Describe

Absent

Nests or Roosts (present/absent) Describe

Old Zebra Finch Nest Present

Disturbances (present/absent) Describe

Cattle, Horse Tracks, *Cenchrus ciliaris

Ecological processes important to habitat (present/absent) Describe

Absent

Terrestrial Fauna Habitat Assessment Proforma

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA5
Easting	206524	**Northing**	7416648	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 5
Broad Habitat	Mulga/ Stony Plain	**% of area**	-		
Landscape Position	Plain				
Broad Floristic Formation	Mulga				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	-
Trees <10m	5-10	Mallee	-
Shrubs >2m	10-25	Shrubs <2m	10-25
Hummock grasses	50-75	Herbs	0
Tussock grasses	50-75		

Soil type & colour	Red Sandy Loam		
Rock type	Ironstone		
Rock size	0-5cm		
Rocky outcrops	-		
Leaf litter (% cover)	10		
Twig litter (% cover)	10	Average size	-
Fallen logs (abundance)	-	Average size	-
Hollow-bearing trees (abundance)	-	Average size	-
Dead stags (abundance)	-	Average dimension	-

Water bodies (present/absent) Describe

Absent

Caves (present/absent) Describe

Absent

Nests or Roosts (present/absent) Describe

Grey Crowned Babbler Nest Present

Disturbances (present/absent) Describe

Horse, Cattle Tracks

Ecological processes important to habitat (present/absent) Describe

Absent

Terrestrial Fauna Habitat Assessment Proforma

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA6
Easting	201841	**Northing**	7415967	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 6
Broad Habitat	Minor Drainage Line	**% of area**	-		
Landscape Position	Minor Drainage				
Broad Floristic Formation	Acacia Shrubland				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	-
Trees <10m	<5	Mallee	-
Shrubs >2m	50-75	Shrubs <2m	25-50
Hummock grasses	5	Herbs	-
Tussock grasses	10		

Soil type & colour	Red Sandy Loam		
Rock type	Ironstone/ Sandstone		
Rock size	0-10cm		
Rocky outcrops	-		
Leaf litter (% cover)	10-25		
Twig litter (% cover)	10-25	Average size	-
Fallen logs (abundance)	0	Average size	-
Hollow-bearing trees (abundance)	2	Average size	20-50cm
Dead stags (abundance)	-	Average dimension	-

Water bodies (present/absent) Describe

Absent

Caves (present/absent) Describe

Absent

Nests or Roosts (present/absent) Describe

Absent

Disturbances (present/absent) Describe

*Cenchrus ciliaris

Ecological processes important to habitat (present/absent) Describe

Absent

Terrestrial Fauna Habitat Assessment Proforma

Project Name	Wheelara Hill	**Observer**	JT, RF	**Site #**	HA7
Easting	203430	**Northing**	7418029	**Date**	10/10/2011
Site Dimensions	-	**Search time**	-	**Photo #**	Site 7
Broad Habitat	Hill Top/ Hill Slope	**% of area**	-		
Landscape Position	Hill Slope/ Hill Top				
Broad Floristic Formation	Triodia Hill				

Vegetation (% cover)

Trees >30m	0	Trees 10-30m	0
Trees <10m	<5	Mallee	0
Shrubs >2m	<5	Shrubs <2m	5-10
Hummock grasses	25-50	Herbs	0
Tussock grasses	0		

Soil type & colour	Red Sandy Loam		
Rock type	Ironstone		
Rock size	0-5cm		
Rocky outcrops	Present		
Leaf litter (% cover)	5-10		
Twig litter (% cover)	10-25	Average size	-
Fallen logs (abundance)	0	Average size	-
Hollow-bearing trees (abundance)	0	Average size	-
Dead stags (abundance)	0	Average dimension	-

Water bodies (present/absent) Describe

Absent

Caves (present/absent) Describe

Absent

Nests or Roosts (present/absent) Describe

Absent

Disturbances (present/absent) Describe

Absent

Ecological processes important to habitat (present/absent) Describe

Absent

APPENDIX D

ANABAT LOCATIONS AND SPECIES RECORDED

APPENDIX D

ANABAT LOCATIONS AND SPECIES RECORDED

Name	Easting[#]	Northing[#]	Species Recorded
Anabat 1	207355	7417690	*Chaerephon jobensis* *Chalinolobus gouldii* *Mormopterus beccarii* *Nyctophilus geoffroyi* *Scotorepens greyii* *Taphozous georgianus/hilli.* *Vespadelus finlaysoni*
Anabat 2	206372	7417920	*Chalinolobus gouldii* *Nyctophilus geoffreyi* *Scotorepens greyii* *Vespadelus finlaysoni*
Anabat 3	205727	7415322	*Chalinolobus gouldii* *Nyctophilus geoffroyi* *Scotorepens greyii* *Taphozous georgianus/hilli* *Vespadelus finlaysoni*
Anabat 4	203320	7413838	*Chalinolobus gouldii* *Scotorepens greyii* *Taphozous georgianus/hilli* *Vespadelus finlaysoni*
Anabat 5	203232	7414098	*Chalinolobus gouldii* *Nyctophilus geoffroyi* *Saccolaimus flaviventris* *Scotorepens greyii* *Taphozous georgianus* *Vespadelus finlaysoni*

[#]Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX E
PRIORITY FAUNA LOCATIONS

APPENDIX E

PRIORITY FAUNA LOCATIONS

Species Name	Common Name	Listing	Easting#	Northing#	Photo
Ardeotis australis	Australian Bustard	Priority 4	206437	7416572	
Merops ornatus	Rainbow Bee-eater	Priority 4	205876	7416297	
Merops ornatus	Rainbow Bee-eater	Priority 4	206371	7417919	
Merops ornatus	Rainbow Bee-eater	Priority 4	206371	7417919	
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	

Species Name	Common Name	Listing	Easting#	Northing#	Photo
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	
Merops ornatus	Rainbow Bee-eater	Priority 4	206437	7416572	
Pseudomys chapmani (individual captured)	Western Pebble-mouse	Priority 4	206371	7417919	
Pseudomys chapmani (individual captured)	Western Pebble-mouse	Priority 4	201840	7415966	
Pseudomys chapmani (individual captured)	Western Pebble-mouse	Priority 4	203429	7418028	
Pseudomys chapmani (individual captured)	Western Pebble-mouse	Priority 4	203429	7418028	

Species Name	Common Name	Listing	Easting[#]	Northing[#]	Photo
Pseudomys chapmani (individual captured)	Western Pebble-mouse	Priority 4	203429	7418028	
Pseudomys chapmani (Mound)	Western Pebble-mouse	Priority 4	208791	7417163	
Pseudomys chapmani (Mound)	Western Pebble-mouse	Priority 4	208720	7417162	

[#]Australian Geocentric 1994 (GDA94) Zone 50K

APPENDIX F

TRAP SITES AND MOTION SENSITIVE CAMERA LOCATIONS

APPENDIX F

TRAP SITES AND MOTION SENSITIVE CAMERA LOCATIONS

Trapping Sites	Easting[#]	Northing[#]
1	204216	7416649
2	205877	7416297
3	206838	7417935
4	206372	7417920
5	206524	7416648
6	201841	7415967
7	203430	7418029
Trap line in Gorge	203232	7414098
Camera 1	207007	7417545
Camera 2	203323	7413819
Camera 3	207038	7417946
Camera 4	207355	7417690
Camera 5	205727	7415322
Camera 6	206445	7417856

[#]Australian Geocentric 1994 (GDA94) Zone 50K