APPENDIX 1

Conservation Codes for Western Australian Flora

T: Threatened (Declared Rare) Flora - Extant Taxa

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

1: Priority One - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three - Poorly Known Taxa

Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four - Rare, Near Threatened and other taxa in need of monitoring

(a) **Rare.** Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
(b) **Near Threatened**. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
(c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five - Conservation Dependent taxa

Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

APPENDIX 2

Conservation categories for flora described under the EPBC Act

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

APPENDIX 3

Vegetation Classifications for the Pilbara based on Specht (1970), as modified by Aplin (1979) and Trudgen (2009)

Height Class	Canopy Cover				
	100 - 70%	70 - 30%	30 - 10%	10 - 2%	< 2%
Trees > 30 m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2 m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grass
Tussock Grass	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland	Scattered Tussock Grass
Bunch Grass	Closed Bunch Grassland	Bunch Grassland	Open Bunch Grassland	Very Open Bunch Grassland	Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

Source: S. Van Leeuwen (DPaW)

APPENDIX 4

Vegetation condition scale
(as developed by Keighery 1994)

Condition	Code	Description
Pristine	1	Pristine or nearly so, no obvious signs of disturbance.
Excellent	2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	3	Vegetation structure altered; obvious signs of disturbance.
Good	4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Completely Degraded	6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

APPENDIX 5

Location of introduced weed species within the Development Envelope

Species	Zone	GDA94 Easting	GDA94 Northing
**Bidens bipinnata*	50	783015	7419223
**Bidens bipinnata*	50	781817	7419500
**Bidens bipinnata*	50	783864	7419685
**Bidens bipinnata*	50	782385	7419213
**Bidens bipinnata*	50	782491	7419073
**Bidens bipinnata*	50	782704	7419160
**Bidens bipinnata*	50	781958	7420454
**Bidens bipinnata*	50	783098	7420088
**Bidens bipinnata*	50	782118	7419594
**Bidens bipinnata*	50	784077	7419183
**Cenchrus ciliaris*	50	783015	7419223
**Cenchrus ciliaris*	50	783864	7419685
**Cenchrus ciliaris*	50	782385	7419213
**Cenchrus ciliaris*	50	782175	7419041
**Cenchrus ciliaris*	50	782363	7419094
**Cenchrus ciliaris*	50	782419	7419010
**Cenchrus ciliaris*	50	782455	7419253
**Cenchrus ciliaris*	50	782563	7419228
**Cenchrus ciliaris*	50	782567	7419466
**Cenchrus ciliaris*	50	782615	7419085
**Cenchrus ciliaris*	50	782831	7419298
**Cenchrus ciliaris*	50	782846	7418906
**Cenchrus ciliaris*	50	783444	7418956
**Cenchrus ciliaris*	50	782704	7419160
**Cenchrus ciliaris*	50	781958	7420454
**Cenchrus ciliaris*	50	783098	7420088
**Cenchrus ciliaris*	50	782118	7419594
**Cenchrus setaceus*	50	782060	7420436
**Cenchrus setaceus*	50	784077	7419183
**Flaveria trinervia*	50	783864	7419685
**Malvastrum americanum*	50	783015	7419223
**Malvastrum americanum*	50	783864	7419685
**Malvastrum americanum*	50	782118	7419594
**Setaria verticillata*	50	783015	7419223
**Setaria verticillata*	50	783864	7419685

Orebody 32 East AWT
Vertebrate Fauna Environmental Impact Assessment

February 2015

Prepared for
BHP Billiton Iron Ore

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Report Reference: 2451-15-BISR-1Rev0_150505

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Reference: 2451-15-BISR-1Rev0_150505

Revision Status

Rev	Date	Description	Author(s)	Reviewer
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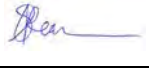
B	10/04/2015	Issued for Client Review	J. Oates	V. Clarke
0	05/05/2015	Issued for Information	J. Oates	V. Clarke

Approval

Rev	Date	Issued to	Authorised by	
			Name	Signature
A	05/03/2015	L. Boulden	S. Pearse	
B	10/04/2015	S. Brunt B. Menzies	S. Pearse	
0	05/05/2015	S. Brunt B. Menzies	S. Pearse	

Abbreviations

Abbreviation	Definition
AWT	Above water table
BHP Billiton Iron Ore	BHP Billiton Iron Ore Pty Ltd
BoM	Bureau of Meteorology
DoE	Department of the Environment (Commonwealth)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Commonwealth)
EIA	Environmental impact assessment
EPA	Environmental Protection Authority (State)
EP Act	*Environmental Protection Act 1986* (State)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
ha	Hectares
km	Kilometres
m	Metres
mm	Millimetre
Parks and Wildlife	Department of Parks and Wildlife (State)
The Project area	Orebody 32 East AWT, north of Newman in the Pilbara region of Western Australia, as shown in Figure 1.
WC Act	*Wildlife Conservation Act 1950* (State)

Executive Summary

BHP Billiton Iron Ore Pty is preparing referrals to the Environmental Protection Authority under Section 38 of the *Environmental Protection Act 1986*. The proposal to be referred is to develop new mining areas at Orebody 32 East for above water table mining ('the Project'). Astron has been engaged to undertake an environmental impact assessment of potential impacts to fauna and fauna habitats within the Project area. The purpose of the assessment was to review the survey information and to provide a project-specific assessment of the potential impacts of the proposed development on the fauna and fauna habitats in a local and regional context.

To date, two Level 2 terrestrial fauna surveys, three Level 1 terrestrial fauna surveys and one targeted fauna survey have been conducted over the entirety, or parts, of the Project area. These surveys provide detailed information on the fauna assemblages in the region. Astron considers that more than adequate information is available from the previous surveys conducted over the Project area to assess the risk of development on terrestrial vertebrate fauna.

Fauna habitats were remapped by Astron using previous fauna habitat and vegetation mapping, elevation data and aerial photography. Four broad fauna habitat types were subsequently mapped across the Project area; Low Hills, Stony Plain, Mulga and Minor Drainage Line. The Stony Plain (295.1 hectares) habitat was considered of low importance to fauna as it is extremely widespread and common throughout the Pilbara region. The areas of Low Hills (91.6 hectares), Mulga (11.5 hectares) and Minor Drainage Line (15.3 hectares) habitats within the Project area were considered to be of moderate importance to fauna due to their potential to support some conservation significant species, including the Western Pebble-mound Mouse, which has been recorded and is largely restricted to the Low Hills habitat of the Project area. However, these fauna habitat types are also widely represented and common throughout the Pilbara region.

A review of fauna databases and previous fauna surveys conducted within the Project area suggest that there are unlikely to be any characteristics of the amphibian, reptile, bird and mammal assemblages that are of particular significance in the region. A total of 320 terrestrial vertebrate fauna species, comprising eight amphibian species, 90 reptile species, 174 bird species and 48 mammal species (including 12 introduced) have been previously recorded within the vicinity of the Project area. This included 32 conservation significant species, of which two have been recorded within the Project area; the Western Pebble-mound Mouse and Rainbow Bee-eater.

It is considered that the impact of clearing in the Project area would not be significant within a regional context. The fauna habitats represented within the Project area are typical of the Pilbara region and therefore do not have high ecosystem functional value. Clearing of the Project area is unlikely to significantly affect connectivity of habitats given that the Project area is bounded by a rail spur to Orebodies 23/24/25 to the east, Mt Whaleback to the south and ranges to the north. In addition, no fauna habitats within the Project area act as major fauna corridors. Instead, the most likely corridor would be Homestead Creek, situated outside, but adjacent to the Project area.

The clearing of vegetation within the Project area will result in the loss of some terrestrial vertebrate species that are not highly mobile or have the ability to move away from disturbance, which may include some nesting species. The majority of fauna species present within the Project area will also be abundant in adjacent areas and have extended home ranges, and impacts on these species are considered to likely be negligible. Given habitat types for the Western Pebble-mound Mouse are well represented within the Pilbara, similar habitats exist adjacent to the Project area and pebble mounds were not recorded in abundance; disturbance to the Project area is not expected to have significant impact on this species. The Rainbow Bee-eater is also unlikely to be impacted as it is a highly mobile species and not restricted to any of the fauna habitats within the Project area.

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1 Introduction

1.1 Project Overview

BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) is preparing referrals to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986* (EP Act). The proposal to be referred is to develop new mining areas at Orebody 32 East for above water table (AWT) mining for a project known as Orebody 32 East AWT ('the Project').

The Project area is located approximately five kilometres (km) east of Newman Township in the Pilbara region of Western Australia, as shown in Figure 1. Orebody 32 East AWT is situated immediately to the west of BHP Billiton Iron Ore's existing Orebody 24 mining operations.

The proposal is to mine a new deposit of approximately 40 mega tonnes AWT. Ground disturbance (including clearing of native vegetation) is for mining, stockpiles and ancillary infrastructure. The proposal will utilise existing Orebody 24/25 processing infrastructure with transport of ore via haul truck.

1.2 Scope of Works

Astron has been engaged to undertake an environmental impact assessment (EIA) of potential impacts to fauna and fauna habitats within the Project area. A suite of baseline surveys have previously been conducted. The purpose of the EIA was to review the survey information and to provide a project-specific assessment of the potential impacts of the proposed development on the fauna and fauna habitats in a local and regional context.

The following technical components require review and assessment of their adequacy and comprehensiveness to support a Part IV referral under the EP Act:

1. fauna habitat types (including specific fauna habitat features)
2. threatened or priority fauna
3. fauna of interest (including species which are not listed as threatened or priority)
4. indirect impacts on fauna (such as, but not limited to noise and light)
5. introduced fauna.

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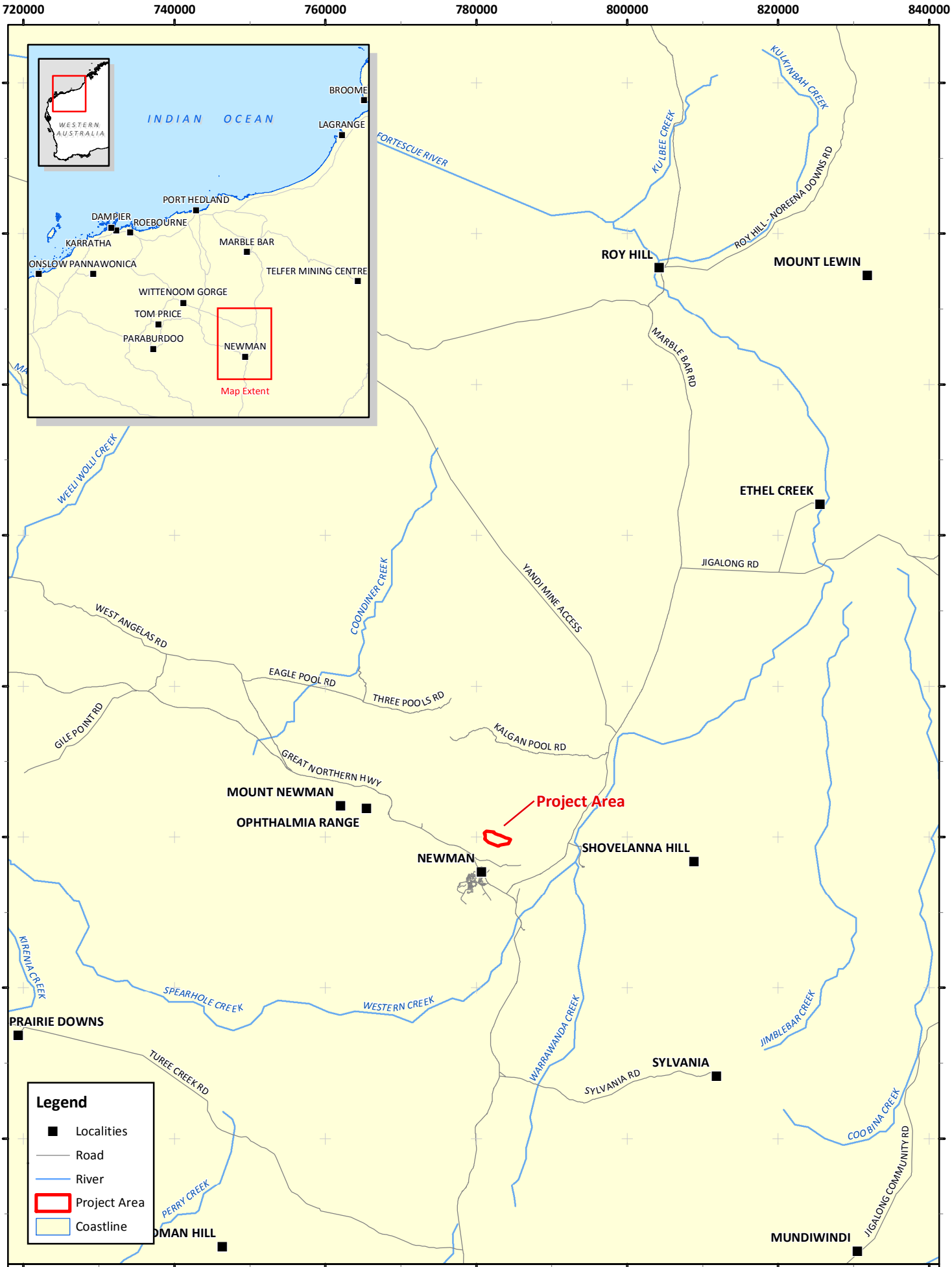

BHP Billiton Iron Ore

Orebody 32 East AWT - Vertebrate Fauna Environmental Impact Assessment

Figure 1: Orebody 32 East Project area location.

Author: J. Oates	Date: 05-05-2015
Drawn: C. Dyde	Figure Ref: 2451-15-BIDR-1Rev0_150505_Fig01_Locn

Datum: GDA 1994 - Projection: MGA Zone 50

0 5 10 15 20 25 Km

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1.3 Previous Technical Studies

BHP Billiton Iron Ore has commissioned a number of terrestrial fauna surveys over both the Project area and surrounding tenements. Survey reports over, and within proximity to the Project area, are summarised in Table 1 and shown in Figure 2.

Table 1 Fauna survey reports relevant to the Project area.

Report title	Author	Year	Content
Surveys over Project area			
Eastern Ridge (Orebody 23/24/25) Fauna Assessment	ENV	2011	A Level 1 fauna assessment of the Eastern Ridge study area, located ~8 km northeast of Newman and covers 88.31 km^2
Biological Survey Myopic Exploration Leases	Onshore/ Biologic	2009	Level 1 fauna assessment at the VCP_36 study area; and targeted significant fauna habitat search along proposed exploration corridors (access tracks, drill lines and drill pads) within the VCP_Myopic study area (State Agreement Lease 70/270)
Report for Myopic Project Area, Newman Flora and Fauna Assessment	GHD	2008	Level 1 fauna survey over the Myopic Project Area; covers approximately 3,600 ha
Orebody 24 Flora And Fauna Assessment Phase II	ENV	2006	A systematic trapping program at five major representative habitats; opportunistic area searches of all major habitats in the project area. Fauna surveys for priority species encompassed five trapping grids located within the main area of proposed impact (covering the length of the OB 24 range) and opportunistic survey throughout the entire project area
Orebody 24 Expansion Biological Survey	ecologia	2004	Systematic fauna surveys were conducted at six sites, representing five fauna habitat types
Baseline Biological & Soil Surveys and Mapping for ML244SA West of the Fortescue River	Biota Environmental Sciences	2001	Baseline survey of the vegetation, flora, fauna and soils of the remainder of the western section of ML244SA west of the Fortescue River. It includes the Mt. Whaleback mine and a number of satellite Orebodies (23 to 26, 28 to 30, 32, 33, 35, 37 & 38)
Surveys within the vicinity of the Project area			
Orebody 24 Targeted Vertebrate Fauna Survey	Biologic	2014	Level 1 fauna and targeted assessment
Orebody 25 Targeted Vertebrate Fauna Survey	Biologic	2014	Level 1 fauna and targeted assessment
Mt Whaleback AML 7/244 Flora & Vegetation And Vertebrate Fauna Review	Onshore	2013	Review and summary of previous terrestrial fauna survey reports for Mt Whaleback project area
Ninga Level 1 Vertebrate Fauna Assessment	Eco Logical	2013	Level 1 fauna and targeted assessment
Orebody 37 Level 1 Vertebrate Fauna Assessment	Eco Logical	2012	Level 1 fauna survey

Report title	Author	Year	Content
Surveys within the vicinity of the Project area			
Orebody 35 and Western Ridge Vertebrate Fauna Survey	Biologic	2011	Level 2 two-season survey
Orebody 42/43 Flora, Vegetation and Fauna Assessment Summary Letter and Recommendations	ENV	2011	Level 1 fauna survey
Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment	Outback Ecology	2009	Level 2 fauna survey
Jimblebar Rail Spur Biological Assessment Survey	ecologia	1996	Level 2 fauna survey

765000 770000 775000 780000 785000 790000 795000

7430000 7425000 7420000 7415000 7410000

Legend

Development Envelope

Surveys over the Project area

- ENV (2011) Eastern Ridge (OB23/24/25) Fauna Assessment
- Biologic (2014) Orebody 25 Targeted Fauna Survey
- Onshore and Biologic (2009) Biological Survey Myopic Exploration Leases
- GHD (2008) Report for Myopic Project Area, Newman Flora and Fauna Assessment
- ENV (2006) OB24 Flora And Fauna Assessment Phase 2
- ecologia (2004) OB 24 Expansion Biological SurveyENV2006
- Biota (2001) Baseline Biological & Soil Surveys and Mapping for ML244SA West of the Fortescue River

Surveys within the vicinity of the Project area

- Biologic (2014) Ore Body 24 Targeted Vertebrate Fauna Survey
- Onshore (2013) Mt Whaleback AML 7/244 Flora & Vegetation And Vertebrate Fauna Review
- Eco Logical (2013) Ninga Level 1 Vertebrate Fauna Assessment
- Eco Logical (2012) Orebody 37 Level 1 Vertebrate Fauna Assessment
- Biologic (2011) Orebody 25 and Western Ridge Vertebrate Fauna Survey
- ENV (2011) Orebody 42/43 Flora, Vegetation and Fauna Assessment Summary Letter and Recommendations
- Outback Ecology (2009) Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment
- ecologia (1996) Jimblebar Rail Spur Biological Assessment Survey

BHP Billiton Iron Ore

Orebody 32 East AWT - Vertebrate Fauna Environmental Impact Assessment

Figure 2: Location of previous fauna surveys within and in the vicinity of the Project area.

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:80,000 (A3)

0 1 2 3 4 5 Kilometers

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astron

Author: J. Oates | Drawn: C. Dyde | Date: 05-05-2015 | Figure Ref: 2451-15-BIDR-1Rev0_150505_Fig02_Surveys

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2 Legislative Context

2.1 Environmental Impact Assessment for Fauna

The EP Act provides for the referral and EIA of proposals and schemes likely, if implemented, to have a significant effect on the environment. The Act requires the EPA to provide, in its report to the Minister for Environment, what it considers to be the key environmental factors identified in the course of an assessment.

The EPA uses environmental factors and associated objectives as the basis for assessing whether a proposal or scheme's impact on the environment is acceptable.

2.1.1 EPA Objective for Fauna

The EPA's objective for terrestrial fauna according to the *Environmental Assessment Guideline for Environmental factors and objectives* is "to maintain representation, diversity, viability and ecological function at the species, population and assemblage level" (EPA 2013).

2.1.2 Relevant State and Federal Legislation

A suite of legislation is relevant to biodiversity conservation in Western Australia. This includes the EP Act, the *Conservation and Land Management Act 1984*, and, in particular, the *Wildlife Conservation Act 1950* (WC Act).

Under the provisions of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), proposed actions which have the potential to have a significant impact on a matter of national environmental significance must be referred to the Commonwealth Minister for the Environment for a decision as to whether assessment is required under the provisions of that Act.

Assessments must adequately address the potential impacts on matters of national environmental significance in order to comply with the provisions of the EP Act and be accredited under the EPBC Act.

The following guidance and policy documents were considered during this environmental impact assessment:

- EPA (2013) *Environmental Assessment Guideline for Environmental factors and objectives*, Environmental Assessment Guidelines No. 8
- EPA (2004) *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Guidance Statements No. 56
- EPA (2002) *Terrestrial Biological Surveys as an Element of Biodiversity Protection*, Position Statements No. 3
- EPA and Department of Conservation and Environment (DEC) (2010) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.*

3 Environmental Context

3.1 Physical Environment

3.1.1 Climate

The Project area is located in the Pilbara region of Western Australia. 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 nearest accessible climate data is available from the Bureau of Meteorology (BoM) Newman Aero weather station located approximately 9 km south-east of the Project area. The area experiences a wide temperature range, with an average annual maximum daytime temperature of 32°C (1996 to 2014; BoM 2015). The hottest month is January, with average maximum temperatures of 39.1°C and the coolest month is June with average maximum temperatures of 22.9°C (Figure 3; BoM 2015).

The Newman area has an average annual rainfall of 317.1 millimetres (mm) (1971 to 2015) (BoM 2015) with the majority of rainfall occurring during the summer months. February typically has the highest average monthly rainfall of 74.9 mm (Figure 3; BoM 2015). 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.

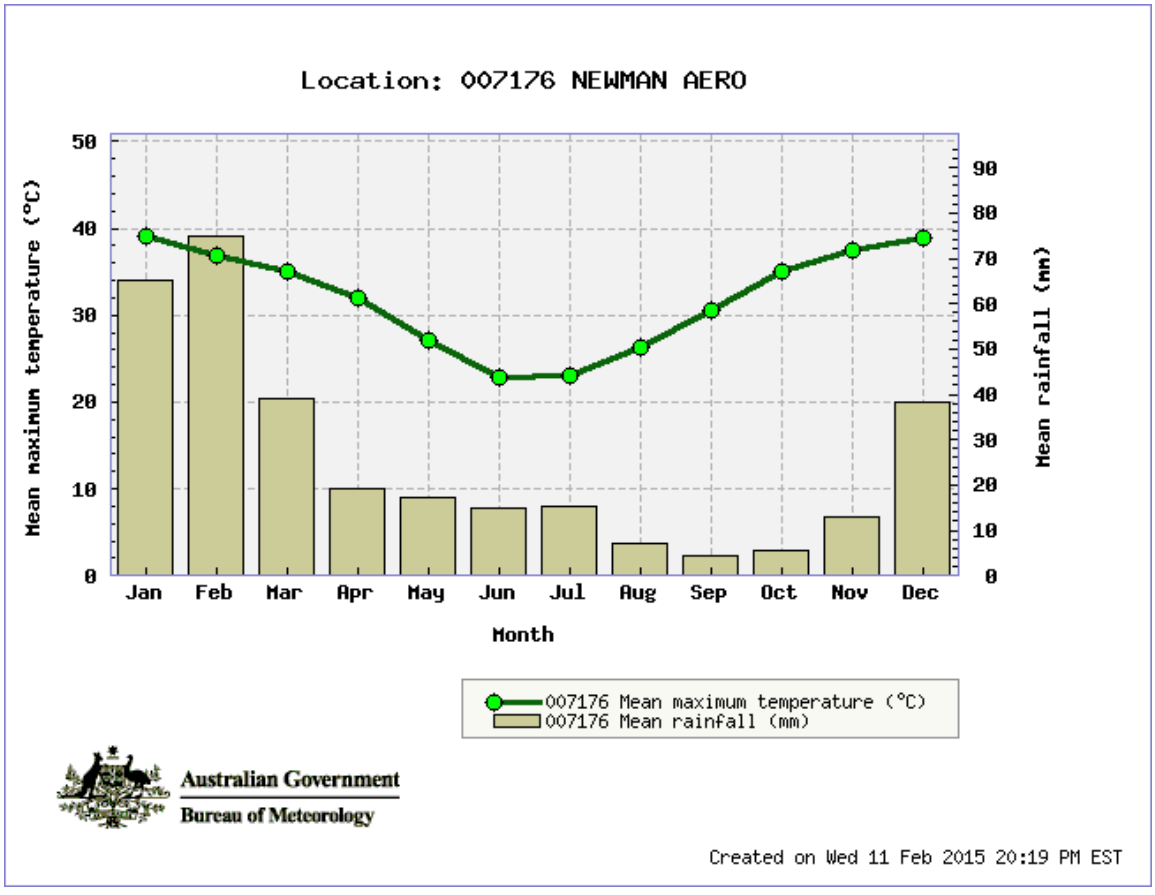

Figure 3: Climate data for Newman Aero Station (Station 7176). Average annual rainfall data has been calculated from 1971 to 2015 and average maximum temperature has been calculated from 1996 to 2014 (BoM 2015).

3.1.2 Geology, Landforms and Soils

Three geological units occur in the Project area (Table 2), based largely on mapping at a scale of 1:250,000 and augmented by more recent 1:1,000,000 scale and regional compilation maps (Stewart et al. (2008).

Table 2: Geological units present within the Project area (Stewart et al. 2008).

Unit	Description	Area (ha)
Achm	Marra Mamba Iron Formation: Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	244.72
Lch	Hamersley Group: Undivided chert, banded iron-formation, jaspilite, dolomite, mudstone, siltstone.	146.62
Qa	Alluvium 38485: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	21.77

The soils within the Project area have been mapped by Northcote et al. (1968) as:

- **Fa13:** Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are gravel-strewn loamy red duplex soils (Dr2.33 and Dr2.32) on the limited areas of dissected pediments, while deep uniform loams (Um5.52) and earthy clay soils (Uf6.71) occur on the valley plains.

Land systems of the Western Australian rangelands were mapped by the Department of Agriculture outlining the distributions, and providing comprehensive descriptions of, biophysical resources including soil and vegetation condition (van Vreeswyk et al. 2004). Three land systems occur in the survey (Table 3).

Table 3: Land systems present within the Project area (van Vreeswyk et al. 2004).

Land system	Description	Extent in Project area (ha)	Total area within Pilbara bioregion (ha)	Proportion within Project area (%)
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands	268.37	1,339,252.86	0.02
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands	142.34	434,645.54	0.03
River	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex	2.38	31,571.31	<0.01

3.1.3 Surface Water and Hydrology

The major rivers of the region are the De Grey, Ashburton, Fortescue, Yule, Sherlock, Cane, Robe, Harding, Maitland, and Turner. Stream flows in the Pilbara region are mostly a direct response to rainfall; as such they are highly seasonal and variable.

There are no permanent watercourses, wetlands nor major creek lines within the Project area. There is one minor drainage line (Homestead Creek) that runs adjacent to the western edge of the Project area.

3.2 Biological Environment

3.2.1 Vegetation

Pre-European vegetation was mapped across the Pilbara region at a scale of 1: 1,000,000 (Beard 1975). The Project area is located in the Hamersley Plateau physiographic unit of the Fortescue Botanical District. Two broad vegetation units are found within the Project area (Table 4).

Table 4: Broad vegetation units present within the Project area (Beard 1975).

Vegetation association	Description	Extent in Project area (ha)	Current extent in Pilbara bioregion (ha)	Proportion within Project area (%)
82	Hummock grassland; low tree steppe; Snappy Gum over *Triodia wiseana*	379.85	2,169.996.59	0.02
18	Low woodland; Mulga (*Acacia aneura*)	32.95	580,556.01	<0.01

A number of flora and vegetation surveys have been conducted within the Project area (Biota 2001; ecologia 2004a; ENV 2006; Onshore 2009). Consolidated vegetation associations within the Project area provided by BHP Billiton Iron Ore are presented in Table 5.

Table 5: Vegetation associations recorded within the Project area.

Vegetation code	Vegetation description
Plains	
SA Tb ChEg SpBeKp	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over Low Open Shrubland of *Scaevola parvifolia, Bonamia erecta* and *Kennedia prorepens* on red loamy sand on sand plains
Hillcrests and hillslopes	
HC TpTs El AaAkAsi	Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Tall Shrubs of *Acacia aptaneura*, *Acacia kempeana* and *Acacia sibirica* on red brown loam on hill crests, hill slopes and breakaway slopes
HS Tw ElChHc AanAbAa	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* and *Hakea chordophylla* and Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia aptaneura* on red sandy loam on hill slopes
HS TsTwTp ElCh AhiAad	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* var. *adoxa* on red brown sandy loam on hill slopes
HC TwTbrTp ElCh AmaGwAb	Hummock Grassland of *Triodia wiseana*, *Triodia brizoides* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over High Open Shrubland of *Acacia maitlandii*, *Grevilllea wickhamii* subsp. *hispidula* and *Acacia bivenosa* on red brown sandy loam on hill crests and upper hill slopes
Drainage lines and associated floodplains	
ME TtEaEte ApyAtpPl EvCh	Tussock Grassland of *Themeda triandra, Eulalia aurea* and *Eriachne tenuiculmis* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* and Open Woodland of *Eucalyptus victrix* and *Corymbia hamersleyana* on red brown silty loam on medium drainage lines and flood plains
MI AmoAanPl ChEl TtAin	Shrubland of *Acacia monticola, Acacia ancistrocarpa* and *Petalostylis labicheoides* with Scattered Low Trees of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Tussock Grassland of *Themeda triandra* and *Aristida inaequilatera* on red loamy sand on minor drainage lines

3.2.2 Fauna Habitat

3.2.2.1 *Fauna Habitat Mapping and Extents*

Previous surveys have mapped the fauna habitats over parts, or the entirety of the Project area (Table 6).

Table 6: Fauna habitats previously mapped in or within the vicinity of the Orebody32 East Project area.

Previous survey	Fauna habitats
ENV (2011a) Eastern Ridge	• Low hill • Minor drainage line • Alluvial plain
GHD (2008) Myopic*	• Ridges and scree slopes • Breakaways • Mixed woodlands and shrublands • Drainage lines
ENV (2006) Orebody 24*	• Range crests • Range slopes • Breakaways • Gorges and gullies • Minor drainage lines • Valley plains
ecologia (2004) Orebody 24 Expansion*	• Ridge top • Gully • Hummock grassland • Grassy plain • Minor drainage line

*These surveys covered an area larger than the Project area and due to no fauna habitat mapping in these reports, not all fauna habitats listed are expected to occur within the Project area.

2015 Mapping of Fauna Habitats across the Project Area

Fauna habitats were re-mapped by Astron using previous fauna survey site data and habitat mapping, vegetation mapping, elevation data and aerial photography. The classification of the mapped units were aligned with current BHP Billiton Iron Ore fauna habitat type classifications (BHP Billiton Iron Ore 2014). Four broad fauna habitat types were subsequently mapped across the Project area (Table 7 and Figure 4). Importance to fauna rating criteria for fauna habitats is detailed in Appendix B.

Low Hills habitat is considered to generally have low habitat value as a result of its decreased vegetation complexity, low diversity of microhabitats and the few conservation significant fauna that most likely utilise it. However, the Western Pebble-mound Mouse is somewhat restricted to this habitat type, it is considered to be of moderate value for fauna according to the criteria in Appendix B.

Stony Plain habitat is widespread and common throughout the Pilbara region and there are few species of conservation significance that may utilise this habitat type, resulting in low value to fauna.

Mulga habitat is considered to have moderate value for fauna, as it supports a relatively unique and diverse faunal assemblage, with some species largely restricted to this habitat type. A number of conservation significant species are likely to occur within Mulga habitat but are not restricted to this habitat type.

Minor Drainage Line habitat is considered to be of moderate value due to the micro niche diversity and therefore the ability to support a wide suite of species, including species of conservation significance, although most of these species are not restricted to this habitat type.

3.2.2.2 *Fauna Movement and Corridors*

The minor drainage line habitat is likely to act as a wildlife corridor, as the denser vegetation structure and potential pools of surface water following a significant rainfall event, allow species to increased dispersal opportunities. A number of bird and bat species are also likely to forage within and along the length of the drainage line, however, they are also likely to forage in the larger Homestead Creek which is adjacent to the Project area.

Table 7: Consolidated fauna habitats within the Project area.

Fauna habitat	Description	Importance rating	Extent within the Project area (ha)
Stony Plain	Stony Plain habitat typically occurs in the low lying parts of the Project area at the base of the low hills. Generally consists of low open woodlands or shrublands over hummock grassland. There are localised depositions of sand within this habitat.	Low - Few species of conservation significance that may utilise this habitat type.	295.1
Low Hills	Low Hills habitat is characterised by low undulating hills, typically consisting of hummock grassland over scattered eucalypt trees.	Moderate- there was a low diversity of microhabitats, with little woody debris (few logs and hollow trees) provided by the vegetation and the soil was hard and unsuitable for burrowing fauna. However, the Western Pebble-mound Mouse typically inhabits (and recorded in) this habitat type as it contains the rocky scree with which it builds its mounds. The species is somewhat restricted to this habitat type with the Project area	91.6
Minor Drainage Line	Minor Drainage Line habitat is linear, occurring from the hill slopes extending to the surrounding plains, or small tributaries that flow into more major drainage lines.	Moderate - minor drainage lines have the potential to provide habitat for a number of conservation significant fauna, such as the Australian Bustard and Rainbow Bee-eater, but these species are not restricted to this habitat type. Minor drainage line habitat is likely to act as a wildlife corridor for dispersal and movement of fauna.	15.3
Mulga	Mulga habitat typically occurs in the lower lying parts of the Project area and includes Mulga groves on stony soils with spinifex.	Moderate - Mulga habitat potentially supports species such as the blindsnake *Ramphotyphlops ganei* and Australian Bustard. Mulga also supports a relatively unique and diverse faunal assemblage, with some species largely restricted to this habitat type.	11.5

781000 781500 782000 782500 783000 783500 784000 784500

7421000 7420500 7420000 7419500 7419000 7418500

StP StP StP M MiDL LH LH LH M MiDL MiDL M LH LH StP

Legend

Conservation Significant Fauna Species

- Rainbow Bee-eater

Western Pebble-mound Mouse

- Mound (active)
- Mound (inactive)
- Status unknown

Habitat Mapping

- **LH**: Low Hills
- **M**: Mulga
- **MiDL**: Minor Drainage Line
- **StP**: Stony Plain
- Development Envelope

BHP Billiton Iron Ore

Orebody 32 East AWT - Vertebrate Fauna Environmental Impact Assessment

Figure 4: Fauna habitat mapping and conservation significant fauna species records within the Project area

Datum: GDA 1994 - Projection: MGA Zone 50 - Scale: 1:10,000 (A3)

0 100 200 300 400 500 Metres

N

astron

Author: J. Oates | Drawn: C. Dyde | Date: 05-05-2015 | Figure Ref: 2451-15-BIDR-1Rev0_150505_Fig04_Habitat

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3.2.3 Fauna Species

3.2.3.1 *Fauna Assemblages*

Fauna assemblages in the Project area have been compiled from surveys conducted within and surrounding the Project area and records from *NatureMap* (Department of Parks and Wildlife (Parks and Wildlife) 2015), and EPBC Act *Protected Matters Search Tool* (Department of the Environment (DoE) 2015) (Table 8 and Appendix A).

A total of 320 terrestrial vertebrate fauna species have been previously recorded within the vicinity of the Project area. This includes eight amphibian species, 90 reptile species, 174 bird species and 48 mammal species (including 12 introduced mammal species). Many of these species are unlikely to occur in the Project area on a regular basis since these records are from a large area encompassing a wide range of habitats, particularly the waterbird species.

Of those species previously recorded, 32 are species of conservation significance, including three reptiles, 21 birds and eight mammals have the potential to occur within the Project area (Table 9 and Appendix A). The conservation significant fauna previously recorded in the Project area and those that are likely to occur are discussed in Section 3.2.3.2 and 3.2.3.3. The criteria for determining the likelihood of conservation significant species occurring within the Project area is detailed in Appendix B.

Table 8: Survey effort and results of surveys where part or all of the survey area occurs within the Orebody 32 East Project area.

Report		**Eastern Ridge (Orebody 23/24/25) Fauna Assessment**	**Biological Survey Myopic Exploration Leases**	**Report for Myopic Project Area, Newman Flora and Fauna Assessment**	**Orebody 24 Flora And Fauna Assessment Phase II**	**Orebody 24 Expansion Biological Survey**	**Baseline Biological & Soil Surveys and Mapping for ML244SA West of the Fortescue River**
Author		ENV	Onshore/ Biologic	GHD	ENV	ecologia	Biota
Year		2011	2009	2008	2006	2004	2001
Survey type		Level 1 fauna survey	Level 1 fauna and targeted survey	Level 1 fauna survey	One season Level 2 fauna survey	One season Level 2 fauna survey	Desktop review and ground-truthing of fauna habitat
Type of sampling		Habitat assessments Active searches Bird censuses Bat recordings Opportunistic searches	Habitat assessments Active searches Bird censuses Bat recordings Opportunistic searches	Habitat assessments Opportunistic searches	Habitat assessments Bird censuses Bat recordings Trapping Active searches Opportunistic searches	Habitat assessments Bird censuses Bat recordings Trapping Active searches Opportunistic searches	Habitat assessments
Results	**Amphibians**	2	0	0	3	0	3
	Reptiles	13	7	6	34	22	55
	Birds	46	48	37	67	65	109
	Mammals	10	10	8	16	16	26

Report		Eastern Ridge (Orebody 23/24/25) Fauna Assessment	Biological Survey Myopic Exploration Leases	Report for Myopic Project Area, Newman Flora and Fauna Assessment	Orebody 24 Flora And Fauna Assessment Phase II	Orebody 24 Expansion Biological Survey	Baseline Biological & Soil Surveys and Mapping for ML244SA West of the Fortescue River
	Conservation significant species	• Western Pebble-mound Mouse • Australian Bustard • Rainbow Bee-eater • Pilbara Olive Python	• Western Pebble-mound Mouse • Australian Bustard	• Western Pebble-mound Mouse • Peregrine Falcon	• Ghost Bat • Western Pebble-mound Mouse • Western Star Finch • Pilbara Olive Python	• Rainbow Bee-eater	• Pilbara Leaf-nosed Bat • Ghost Bat • Western Pebble-mound Mouse • Long-tailed Dunnart • Peregrine Falcon • Pilbara Olive Python

3.2.3.2 *Conservation Significant Species Recorded*

Two species of conservation significance have been recorded within the Project area (Table 9) and the locations of these records are presented in Figure 4.

Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse is listed as Priority 4 by Parks and Wildlife. Although suitable habitat is patchy, extant populations are widespread in the extensive ranges of the central and southern Pilbara region (Van Dyck and Strahan 2008). The persistence of abandoned mounds in the Gascoyne and Murchison regions and small, isolated, coastal ranges in the Pilbara, indicates considerable recent decline (Van Dyck and Strahan 2008).

Colonies occur on the gentler slopes of rocky ranges where the ground is covered by stony mulch and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs, typically *Senna, Acacia* and *Ptilotus* (Van Dyck and Strahan 2008). Mounds, however, are also sited close to narrow ribbons of *Acacia* dominated scrub that grow along incised drainage lines (Van Dyck and Strahan 2008).

There are 11 records of Western Pebble-mound Mouse mounds; one active, five inactive and five of status unknown, within the Project area from four previous surveys (ENV 2011a, Onshore & Biologic 2009, GHD 2008, ecologia 2004a). Records were from low hills (ENV 2011a) or spinifex covered scree slopes and ridge tops (GHD 2008).

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. The Rainbow Bee-eater is one of the most common and widespread birds in Australia and was a commonly recorded species during bioregional surveys in the Pilbara (Burbidge et al. 2010). The species winters from the Gascoyne north to Indonesia, moving south mainly in late September and early October and north from February to April (Johnstone and Storr 1998). Rainbow Bee-eaters tend to prefer lightly wooded, preferably sandy country near water (Johnstone and Storr 1998).

Two Rainbow Bee-eaters were recorded by ecologia (2004a) at one of their trapping sites for the Orebody 24 Expansion biological survey. The individuals were recorded within grassy plain habitat of scattered *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aneura* over *Themeda triandra, Ptilotus helipteroides* and *Goodenia* species (ecologia 2004a).

Table 9: Likelihood of conservation significant species occurring within the Project area.

Species	Significance	Preferred habitat	Extent of the habitat in the Project area	Records	Likelihood of occurring in the Project area
Mammals					
Northern Quoll *Dasyurus hallucatus*	EPBC Act Endangered WC Act Schedule 1	Northern Quolls favour rocky areas such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines and treed creek lines, as well as structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs (DSEWPaC 2011)	Preferred habitat for this species is not present within the Project area	Closest record is from the main access bridge into Whaleback	Unlikely
Long-tailed Dunnart *Sminthopsis longicaudata*	Parks & Wildlife Priority 4	Its habitat includes *Acacia*, rocky screes with hummock grass and shrubs, and tall open shrubland and woodlands (Van Dyck and Strahan 2008)	The Low Hill habitats of the Project area contain the rocky substrate preferred by this species	Previous records in Whaleback area, south-west of the Project area (ecologia 1998)	Possible
Greater Bilby *Macrotis lagotis*	EPBC Act Vulnerable WC Act Schedule 1	Vegetation types associated with the Greater Bilby including: open tussock grassland on uplands and hills, Mulga woodland/scrubland on ridges and rises and hummock grassland in plains and alluvial areas (Southgate 1990). Other habitats used by the species include stony downs, cracking clays, desert sand plains and dune fields, spinifex grassland and *Acacia* spp. scrublands on red earths (Johnson 2008)	The Low Hill, Stony Plain and Minor Drainage Line habitats are considered suitable habitat within the Project area	No confirmed records in the Project area or surrounds	Unlikely
Black-footed Rock-wallaby *Petrogale lateralis lateralis*	EBPC Act Vulnerable WC Act Schedule 1	Habitat varies between colonies but always includes grassland for feeding in close proximity to cliff, rock-pile, talus or escarpment refuge habitat	Preferred habitat for this species is not present within the Project area	No confirmed records in the Project area or surrounds	Unlikely

Species	Significance	Preferred habitat	Extent of the habitat in the Project area	Records	Likelihood of occurring in the Project area
Northern Marsupial Mole *Notoryctes caurinus*	EPBC Act Endangered	Lives underground in sand dunes, inter-dunal flats and sandy soils along river flats	No suitable habitat is present within the Project area	No confirmed records in the Project area or surrounds	Unlikely
Ghost Bat *Macroderma gigas*	Parks & Wildlife Priority 4	Roosts in deep complex caves beneath bluffs of low rounded hills, granite rock piles and abandoned mines (Armstrong and Anstee 2000)	There is no habitat within the Project area that supports the caves preferred by this species	No confirmed records within the Project area. Ghost bats have been recorded at three caves in the southern Orebody 24 area (ENV 2006), ~2 km north east of the Project Area. Recent and old scats (200 to 500 in number) were found in a cave to the north of the Project area (Biologic 2014a)	Unlikely
Pilbara Leaf- nosed Bat *Rhinonicteris aurantia*	EPBC Act Vulnerable WC Act Schedule 1	Hot, humid roost caves. Forages in gorge/ gully habitat and along watercourses, particularly where water is present	There is no habitat within the Project area that supports the caves preferred by this species	No confirmed records within the Project area. Calls of this species have been recorded from gorge/ gully and minor drainage line habitats ~2 km north of the Project area (Biologic 2014a)	Unlikely

Species	Significance	Preferred habitat	Extent of the habitat in the Project area	Records	Likelihood of occurring in the Project area
Western Pebble Mound Mouse *Pseudomys chapmani*	Parks & Wildlife Priority 4	Gentler slopes of rocky ranges where ground is covered with a stony mantle and vegetated by spinifex, often with sparse overstorey of eucalypts and scattered shrubs (Van Dyck and Strahan 2008)	Suitable Low Hill habitat exists within the Project area	Five inactive mounds (ENV 2011a), five mounds (status unknown) (Onshore & Biologic 2009, GHD 2008) and one active mound (ecologia 2004a) recorded within the Project area	Recorded
Birds					
Fork-tailed Swift *Apus pacificus*	EPBC Act Migratory WC Act Schedule 3	Entirely aerial within the Pilbara region	Entirely aerial so will not utilise habitats within the Project area	Recorded from Eastern Ophthalmia Range (ecologia 2004b) and Orebody 31 (ENV 2011c)	Likely
Eastern Great Egret *Ardea modesta*	EPBC Act Migratory WC Act Schedule 3	Favoured breeding habitat includes wooded swamps and river pools with *Eucalyptus camaldulensis* and *Melaleuca argentea* (Johnstone and Storr 1998)	Preferred habitats do not permanently occur in the Project area	Nearest record is from Ophthalmia Dam (Parks and Wildlife 2015)	Unlikely
Cattle Egret *Ardea ibis*	EPBC Act Migratory WC Act Schedule 3	Utilises a variety of natural and anthropogenic habitats and occurs in tropical and temperate grasslands, inland wetlands, wooded lands and farm land	Preferred habitats do not permanently occur in the Project area.	Nearest record is from Ophthalmia Dam (Parks and Wildlife 2015)	Unlikely
Glossy Ibis *Plegadis falcinellus*	EPBC Act Migratory WC Act Schedule 3	Preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood plains, wet meadows, swamps, reservoirs, sewage ponds, rice fields and cultivated areas under irrigation	Preferred habitats do not permanently occur in the Project area	Nearest record is from Ophthalmia Dam (Parks and Wildlife 2015)	Unlikely

Species	Significance	Preferred habitat	Extent of the habitat in the Project area	Records	Likelihood of occurring in the Project area
White-bellied Sea Eagle *Haliaeetus leucogaster*	EPBC Act Migratory WC Act Schedule 3	Moderately common in Pilbara islands as well as in large inland water bodies. This species also visits near-coastal wetlands and other lotic waters in the region	Preferred habitats do not occur in the Project area	Nearest record is from Ophthalmia Dam (Parks and Wildlife 2015)	Unlikely
Peregrine Falcon *Falco peregrinus*	WC Act Schedule 4	Cosmopolitan, will hunt in any habitat, soaring at height or from a perch; often near cliffs (Armstrong and Anstee 2000). Nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines	All habitats of the Project area are suitable for hunting, but no habitat suitable for nesting occurs	A single individual was observed in crest/ slope habitat ~4 km to the north east of the Project area (Biologic 2014a)	Likely
Australian Bustard *Ardeotis australis*	Parks & Wildlife Priority 4	Open or lightly wooded grasslands (Johnstone and Storr 1998)	Suitable habitat common within the Project area and surrounding region	ENV (2011) recorded an individual from the alluvial plain (sand plain) habitat ~5 km to the north-east of the Project area	Likely
Australian Painted Snipe *Rostratula australis*	EPBC Act Endangered & Migratory WC Act Schedule 1	Inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans	No suitable habitat is present within the Project area	No confirmed records in the Project area or surrounds	Unlikely

Species	Significance	Preferred habitat	Extent of the habitat in the Project area	Records	Likelihood of occurring in the Project area
Migratory waders (Oriental Plover *Charadrius veredus*, Common Sandpiper *Actitis hypoleucos*, Sharp-tailed Sandpiper *Calidris acuminata*, Curlew Sandpiper *Calidris ferruginea*, Pectoral Sandpiper *Calidris melanotus*, Red-necked Stint *Charadrius ruficollis*, Long-toed Stint *Calidris subminuta*, Wood Sandpiper *Tringa glareola*, Common Greenshank *Tringa nebularia*, Common Redshank *Tringa totanus*)	EPBC Act Migratory WC Act Schedule 3	Water edges including coastal, saline and fresh water bodies. Also inland water bodies including bore overflows (Johnstone and Storr 1998)	No large water bodies are found within the Project area	Records of these species are from outside the Project area at Ophthalmia Dam, Fortescue River and the tailings dam at Mt Whaleback (ecologia 1998, ENV 2012)	Unlikely
Princess Parrot *Polytelis alexandrae*	EPBC Act Vulnerable Parks & Wildlife Priority 4	Occurs in open savanna woodlands and shrublands that usually consist of scattered stands of *Eucalyptus*, *Casuarina* or *Allocasuarina* trees, an understorey of shrubs such as *Acacia* (especially *A. aneura*), *Cassia*, *Eremophila*, *Grevillea*, *Hakea* and *Senna*; and a ground cover dominated by *Triodia* species (Johnstone and Storr 1998)	Suitable habitat is present within the Project area	Nearest record is ~45 km to the north of the Project area from 2012 (Parks and Wildlife 2015)	Unlikely
Rainbow Bee- eater *Merops ornatus*	EPBC Act Migratory WC Act Schedule 3	Lightly wooded, preferably sandy country near water (Johnstone and Storr 1998)	Suitable habitat common within the Project area and surrounding region	Two individuals recorded from grassy plain habitat within the Project area (ecologia 2004a).	Recorded
Star Finch (Western) *Neochmia ruficauda subclarescens*	Parks & Wildlife Priority 4	Prefers areas of dense vegetation, such as reed beds (Johnstone and Storr 2004) and woodlands near water (Armstrong and Anstee 2000)	No suitable habitat is present within the Project area	Recorded from Orebody 24 (ENV 2006) within 5 km of the Project area	Unlikely

Species	Significance	Preferred habitat	Extent of the habitat in the Project area	Records	Likelihood of occurring in the Project area
Reptiles					
Spotted Ctenotus[1] *Ctenotus uber johnstonei*	Parks & Wildlife Priority 2	Chenopod, hummock grass, and snakewood habitats scattered across Pilbara region	Suitable habitat common within the Project area and surrounding region	Nearest record is ~20 km to the east of the Project area from 2009 (Parks and Wildlife 2015)	Likely
Unpatterned Robust Slider (Central Interior) *Lerista macropisthopus remota*	Parks & Wildlife Priority 2	Loose soil under leaf litter at base of shrubs in woodlands (Wilson and Swan 2010)	Suitable habitat common within the Project area and surrounding region	Nearest records are ~15 km to the south-west of the Project area from 2010 (Parks and Wildlife 2015)	Likely
Pilbara Olive Python *Liasis olivaceus barroni*	EPBC Act Vulnerable WC Act Schedule 1	Associated with drainage systems, including areas with localised drainage and semi-permanent watercourses (Bush and Maryan 2011)	Preferred habitat for this species does not occur within the Project area. May utilise the Minor Drainage Line habitat within the Project area for dispersal	Records within 1.5 km of Project area from rock pool at Orebody 35 (Biologic 2014b) and within the ranges ~ 3 km to the north (Orebody 24) of the Project area (Biologic 2014a, ENV 2006)	Possible

[1] This species is listed as P2 and known from the Kimberley but the taxonomy of this subspecies and its occurrence in the Pilbara is not confirmed. However, taking the precautionary approach, it will be treated as a P2 species.

3.2.3.3 *Conservation Significant Species Considered Likely to Occur*

Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act, as it breeds in north-east and East Asia, wintering in Australia and southern New Guinea (Johnstone and Storr 1998). This species is entirely aerial within the Pilbara region and is attracted to any thunderstorms and cyclonic systems (Johnstone and Storr 1998).

This species has previously been recorded at Eastern Ophthalmia Range (ecologia 2004b) and Orebody 31 (ENV 2011c) approximately 15-20 km to the east of the Project area. It is expected to utilise the skies above the Project area sporadically in the summer months.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as Schedule 4 under the WC Act, and is considered rare or scarce over much of its range, including the Pilbara (Johnstone and Storr 1998). Inland it is most often encountered along cliffs above rivers, ranges and wooded watercourses and lakes, where it hunts (Johnstone and Storr 1998). It nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines.

A single individual has been recorded at Orebody 24 (Biologic 2014a) approximately 4 km to the north east of the Project area. It is likely that this species utilises all habitats within the Project area periodically for foraging. However, no suitable nesting habitat is available within the Project area.

Australian Bustard (*Ardeotis australis*)

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

Although it has not been recorded within the Project area, large areas of suitable habitat exists and is one of the more widespread and commonly recorded conservation significant species within the Pilbara region. ENV (2011) recorded an individual from the alluvial plain habitat in the Eastern Ridge study area, approximately 5 km to the north east of the Project area. Other numerous records of this species are within the vicinity of the Project area (Parks and Wildlife 2015). Therefore, this species is considered likely to occur within the Project area, particularly within the Stony Plain and Minor Drainage Line habitats.

Spotted Ctenotus (*Ctenotus uber johnstonei*)

This species is listed as Priority 2 by Parks and Wildlife and generally inhabits chenopod, hummock grass, and snakewood habitats scattered across the Pilbara region. Little is known of its habitat requirements with few specimens having been collected. There is uncertainty with the taxonomy of this subspecies, which is known to occur in the Kimberley region but its occurrence in the Pilbara is not confirmed. The Pilbara records of this species may be an undescribed subspecies. However, taking the precautionary approach, it has been included in this report.

The nearest record is located 20 km to the east of the Project area in 2009 (Parks and Wildlife 2015). Suitable habitats within the Project area include Stony Plains, Low Hills and Minor Drainage Line habitats and it is likely to be resident within the Project area.

Unpatterned Robust Slider (central interior) (*Lerista macropisthopus remota*)

This species is listed as Priority 2 by Parks and Wildlife and is found in shrublands in loose soil under leaf litter at the base of shrubs (Wilson and Swan 2010). Little is known of its habitat requirements with few specimens having been collected.

The nearest record is located approximately 15 km to the south-west of the Project area in 2010 (Parks and Wildlife 2015). All habitats within the Project area are considered suitable for this species and therefore it is likely to be resident within the Project area.

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. The Pilbara Olive Python is known from a number of sites throughout the Pilbara and is associated with drainage systems, including areas with localised drainage and semi-permanent watercourses (Pearson 1993). In the Hamersley subregion, the Pilbara Olive Python is most often encountered in the vicinity of permanent waterholes in rocky ranges or among riverine vegetation (Pearson 2003). Microhabitat preferences are under rock piles, on top of rocks or under spinifex (Tutt et al. 2004).

This species has been recorded from a rock pool at Orebody 35 (Biologic 2014b), 1.5 km to the south of the Project area, as well as gorge habitat approximately 3 km to the north (Orebody 24) of the Project area (Biologic 2014a, ENV 2006). Although preferred habitat for this species does not occur within the Project area, it may utilise the Minor Drainage Line habitat within the Project area intermittently for dispersal.

4 Impact Assessment

4.1 Fauna Habitat

4.1.1 Local Context

The clearing of native vegetation required within the Project area will result in a loss of fauna habitat. The majority of the Project area is Stony Plain habitat (295.1 hectares (ha)), followed by Low Hills habitat (91.6 ha), Minor Drainage Line habitat (15.3 ha) and Mulga habitat (11.5 ha). The Stony Plain and Low Hills habitat are common habitats within the vicinity of the Project area and throughout the Pilbara region. Minor Drainage Line habitats, although not large in area as they are a linear habitat, are a common habitat found in the Hamersley Ranges adjacent to the Project area. The Mulga habitat occurs as only small isolated pockets within the north and east of the Project area and more extensive groves of Mulga occur outside the Project area.

Fragmentation of habitat is another potential impact resulting from the clearing of vegetation within the Project area. However, clearing of the Project area is unlikely to restrict fauna movements given that the Project area is already bounded by a rail spur to Orebodies 23/24/25 to the east and ranges to the north. In addition, there are no fauna habitats within the Project area that would act as major movement corridors. Instead, the most likely dispersal/movement corridor is Homestead Creek, situated just to the west of the Project area. Homestead Creek will not be affected by the proposed Project and will continue to function as a movement corridor for fauna.

4.1.2 Regional Context

The fauna habitats within the Project area were considered of low to moderate importance for fauna. The Stony Plain habitat was considered to be of low importance for fauna as it is extremely widespread and common throughout the Pilbara region. The small areas of Mulga, Low Hills and Minor Drainage Line habitats within the Project area were considered to be of moderate importance, due to their potential to support some conservation significant species, and the ability of the Minor Drainage Line habitat to act as a wildlife corridor. However, these fauna habitat types are also widely represented and common throughout the Pilbara region.

Given that the four fauna habitat types recorded within the Project area are well represented in the region and the small size of the Project area, it is considered that the impact of clearing the Project area within a regional context would not be significant. The fauna habitats represented within the Project area are typical of the Pilbara region and therefore do not have high ecosystem functional value.

4.2 Fauna Species

4.2.1 Local Context

The clearing of vegetation within the Project area will result in the loss of some terrestrial vertebrate species in specific locations. Birds are generally highly mobile and only a few sedentary species (e.g. fairy-wrens) and nocturnal roosting species will be impacted during initial clearing. Less mobile species such as some of the mammals, reptiles and amphibians will be lost in areas of direct impact.

The majority of fauna species present within the Project area will also be abundant in adjacent areas and have extended home ranges, and impacts on these species are considered likely to be negligible.

4.2.2 Regional Context

The small area required to be cleared for the proposed Project is not likely to impact on conservation significant fauna species or required habitat. It is considered that vegetation clearing within the Project area is unlikely to significantly impact on any terrestrial species listed as conservation significant under the EPBC Act or the WC Act.

The Western Pebble-mound Mouse and Rainbow Bee-eater have previously been recorded in the Project area. The Western Pebble-mound Mouse has been found in the Low Hills and Stony Plain habitats of the Project area. Given that these habitat types are well represented within the Pilbara region, similar habitats exist adjacent to the Project area, and pebble mounds were not recorded in abundance, the proposed Project is unlikely to significantly impact this species. The Rainbow Bee-eater is unlikely to be impacted as it is a highly mobile species and not restricted to any of the fauna habitats within the Project area.

4.3 Indirect Impacts

Indirect impacts from clearing include displacement of fauna into adjacent habitat, habitat fragmentation and/or further habitat degradation associated with the construction processes (e.g. dust and weeds) or the increased level of human activity (e.g. feral animals and rubbish).

All mobile fauna within future development areas that are able to avoid direct impact will be displaced into adjacent habitat. A characteristic of many arid zone species is their ability to move long distances, for example, some native rodents can move long distances, up to 14 km (Dickman et al. 1995). The displacement of fauna into adjacent areas can result in the local area exceeding its carrying capacity, with a subsequent reduction of available resources, and potential mortality or displacement of individuals. The outcome will be that either the same species assemblage will establish a new equilibrium, based on the original carrying capacity of the area, or the excess pressure of local clearing will disrupt the interactions of all species, resulting in the displacement of less robust species.

Habitat degradation may also occur through factors associated with construction activity or increased human activity but can be managed to occur within the disturbance footprint only.

The transmission of weeds into remaining habitat within the Project area or habitat adjacent to the Project area may occur if weed hygiene measures are not implemented. The spread of weeds is most likely to occur along gullies or drainage lines. It is likely to have an adverse impact on the diversity of flora but there is little quantitative data on the effects of weeds on native fauna species. Limited studies indicate that fauna communities are affected by invasive plant species, but these responses may differ according to the taxonomic group in that some species may increase in numbers while others decrease (Grice 2006).

Dust has generally been considered a potential indirect impact on fauna due to the potential to affect vegetation health and ultimately fauna habitat condition. However, recent studies show that dust accumulation from mining projects in semi-arid Australia did not have any impacts on the mortality and recruitment of a threatened flora species or community composition (Matsuki et al. in prep) and therefore unlikely to impact fauna.

An increase in human activity is often associated with an increase in the abundance of introduced species such as the house mouse and feral cat, which in turn, increases the competition or predation pressure on native fauna species. This increase in human activity may be due to a decline in habitat health, increased road kills and poor waste disposal practices.

Little is known about competitive interactions between feral and native species (Dickman 1996) and it is difficult to predict what the impact to native species might be over the life of the proposed Project. It is unclear whether the relative numbers of predator and prey will establish a stable equilibrium over the life of the project, or whether the increase in feral predators will result in local extinction of small native species.

An increase in road fauna deaths may also occur with increased vehicle traffic; in particular impacting on species such as kangaroos, reptiles and nocturnal birds.

These indirect impacts have the potential to affect individual species and local species assemblages; however, they are unlikely to have a significant impact on terrestrial fauna assemblages in a regional context, conservation significant fauna species and ecosystems of high functional value or that are regionally important. These indirect impacts will continue to be managed as per existing adjacent operations.

4.4 Cumulative Impacts

Cumulatively, direct and indirect impacts on native vegetation from mining projects will result in an increased overall loss or modification of remnant vegetation and habitat for species of conservation significance. In addition to further reduction in the extent of fauna habitat, mining and linear infrastructure projects can also block connectivity between major areas of habitat. A reduction in habitat connectivity may restrict opportunities for fauna to successfully seek food and water, breed and colonise new territories.

No fauna habitats occurring within the Project area are restricted to the three land systems that are mapped over the Project area. Clearing of the entire Project area represents no more than 0.03% of the total area within the Pilbara bioregion for any of the three land systems recorded within the Project area. Similarly, clearing of the Project area will only represent 0.02% and <0.01% of the total area within the Pilbara region for the two vegetation units (as per Beard 1975) recorded within the Project area.

There are a number of existing BHP Billiton Iron Ore projects in proximity to the current Project area; namely Orebodies 23/24/25 to the east and Mt Whaleback to the south west. Clearing of the Project area is unlikely to significantly affect connectivity of habitats given that the Project area is already bounded by a rail spur to Orebodies 23/24/25 to the east, Mt Whaleback further to the south and ranges to the north. In addition, there are no fauna habitats within the Project area that would act as major movement corridors. Instead, the most likely dispersal/movement corridor would be Homestead Creek, situated outside of the Project area to the west.

4.5 Residual Impacts

There will be minimal residual impacts on fauna as BHP Billiton Iron Ore have advised there is no permanent infrastructure and all ground disturbance associated with the Project will be rehabilitated.

5 Discussion

5.1 Adequacy of Surveys

The EPA has indicated that the level of terrestrial fauna survey (i.e. Level 1 or Level 2) required for a development area is assessed on a consideration of ten characteristics (EPA 2004). Astron considers that the proposed Project would be considered to have an overall low impact, as seven characteristics had a low impact, two had a moderate impact and one had a high impact (Table 10).

Table 10: Assessment of characteristics in defining the scale and nature of impacts on biodiversity (EPA 2004) for the proposed Project and level of survey required.

Area characteristic	Scale and nature of impact from the proposed Project
Degree of habitat degradation and clearing within region	**LOW** - In either the local area or region: i) in fragmented ecosystems with more than 50% native vegetation or natural areas remaining; or ii) in more extensive ecosystems with more than 50% of vegetation in better condition
Size/scale of proposal/impact	**HIGH** >10 ha - Bioregion Group 1 >50 ha – Bioregion Groups 2-3 >75 ha - Bioregion Group 4
Rarity of vegetation and landforms	**LOW** - Vegetation and landforms that are naturally more Widespread than 10% of local area (15 km radius) and the bioregion.
Significant habitats	**LOW** - Significant habitats are not known from the area or found by reconnaissance survey.
Refugia	**LOW** - Refugia are not known from the area or are not found by reconnaissance survey.
Fauna protected under international agreements or treaties, Specially Protected or Priority fauna	**MODERATE** i) Priority Fauna species are found in the area or in similar habitats in its immediate vicinity during reconnaissance survey; and/or ii) the habitat and area characteristics indicate that Priority Fauna species may occur. Cumulative impact on the total number of populations should be considered.
Other significant fauna or fauna assemblages	**LOW** - Significant species or taxa are not found or likely to be found in the area or in similar habitat in its immediate vicinity.
Size of remnant and condition/intactness of habitat and faunal assemblage	**LOW** - Area is not in a fragmented environment or an environment with extensive areas of otherwise degraded habitats or faunal assemblages, such as some rangeland environments.
Ecological linkage	**MODERATE** - The area is not directly connected to adjoining areas but is part of a minor ecological linkage.
Heterogeneity or complexity of the habitat and faunal assemblage	**LOW** - The area and its immediate surrounds are less complex relative to the characteristics of the local and regional scale.

To date, two Level 2 terrestrial fauna surveys, three Level 1 terrestrial fauna surveys and one targeted fauna survey have been conducted over the entirety, or parts, of the Project area. These surveys provide detailed information on the fauna assemblages in the region. EPA (2004) suggests a Level 1 terrestrial fauna survey should be conducted if the majority of characteristics are low

potential impact. Therefore, Astron considers that more than adequate information is available from the previous surveys conducted over the Project area to assess the risk of development on terrestrial vertebrate fauna.

5.2 Biodiversity Values

The EPA *Position Statement No. 3* indicates an ecological assessment of a site must consider its biodiversity value at the genetic, species and ecosystem levels, and its ecological functional value at the ecosystem level (EPA 2002). Due to lack of data it is not possible to comment on the biodiversity value at the genetic level, however, it is unlikely to be of relevance to the suite of vertebrate fauna within the Project area.

Terrestrial vertebrate fauna species present or likely to be present in the Project area are generally present elsewhere in the region. A review of fauna databases and previous fauna surveys conducted within the vicinity of the Project area showed that there are unlikely to be any characteristics of the reptile, bird and mammal assemblages that are of particular significance in the region. The fauna assemblages that have been recorded and that are predicted to occur within the Project area are unlikely to be unique for the available habitat types. All vertebrate species likely to occur within the Project area are distributed widely throughout the region and have been recorded in various other surveys in the bioregion (Appendix A) and are unlikely to be impacted at a regional level should the Project proceed.

Only two of the 32 species of conservation significance have been recorded in the Project area; the Western Pebble-mound Mouse and Rainbow Bee-eater. The Western Pebble-mound Mouse prefers gentle rocky slopes, hills and spurs, which is found in the Low Hills and Stony Plain habitats of the Project area. Given habitat types are well represented within the Pilbara, similar habitats exist adjacent to the Project area and pebble mounds were not recorded in abundance, disturbance to the Project area is not expected to have significant impact on this species. The Rainbow Bee-eater is unlikely to be impacted as it is a highly mobile species and not restricted to any of the fauna habitats within the Project area.

An additional six conservation significant species were considered likely to occur within the Project area. Three are bird species that are highly mobile and generally less reliant on specific habitats within the Project area. The Pilbara Olive Python may utilise the Minor Drainage Line habitat intermittently for dispersal but is unlikely to be resident in the Project area. The other two species are priority listed reptile species that may be resident within the Project area. Little is known of their habitat requirements with few specimens recorded. However, the habitats that they have been recorded in are common and widespread throughout the region and if these species do utilise the Project area, they are not likely to be dependent on any specific habitat contained within it.

The fauna habitats represented within the Project area are typical to the Pilbara region and therefore do not have high ecosystem functional value. Clearing associated with the proposed Project is unlikely to have any impact on an ecosystem of high functional value or that is regionally significant.

Therefore, vegetation clearing with the Project area is unlikely to have a significant impact on the biodiversity value at the genetic, species and ecosystem levels.

5.3 Conclusions

Astron considers that more than adequate information is available from the previous surveys conducted over the Project area to assess the risk of development on terrestrial vertebrate fauna.

Given that the four fauna habitat types recorded within the Project area are typical and well represented in the region, the impact of clearing the Project area is unlikely to have any impact on an ecosystem of high functional value or that is regionally significant.

A review of fauna databases and previous fauna surveys conducted within the vicinity of the Project area indicate that the faunal assemblages expected within the Project area are typical of the Pilbara region and are unlikely to be unique for the available habitat types. All vertebrate species likely to occur within the Project area are distributed widely throughout the region and are unlikely to be impacted at a regional level should the Project proceed.

Only two conservation significant species have been recorded in the Project area; the Western Pebble-mound Mouse and Rainbow Bee-eater. Given habitat types for the Western Pebble-mound Mouse are well represented within the Pilbara, similar habitats exist adjacent to the Project area and pebble mounds were not recorded in abundance; disturbance to the Project area is not expected to have significant impact on this species. The Rainbow Bee-eater is also unlikely to be impacted as it is a highly mobile species and not restricted to any of the fauna habitats within the Project area.

6 References

Armstrong, K and Anstee , S 2000, 'The ghost bat in the Pilbara: 100 years on', *Australian Mammalogy,* vol. 22, pp. 93-101.

Beard, JS 1975, *Pilbara - The Vegetation of the Pilbara Area 1:100 000 Vegetation Series*, University of Western Australia Press, Perth.

BHP Billiton Iron Ore 2014, *Biodiversity Survey Spatial Data and Digital Photography Requirements Procedure*, Version 5.0, SPR-IEN-EMS-015.

Biologic 2011, 'Orebody 35 and Western Ridge Vertebrate Fauna Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Biologic 2014a, 'Orebody 24 Targeted Vertebrate Fauna Survey', unpublished report to BHP Billiton Pty Ltd, Perth.

Biologic 2014b, 'Orebody 25 Targeted Vertebrate Fauna Survey', unpublished report to BHP Billiton Pty Ltd, Perth.

Biota Environmental Sciences 2001, 'Baseline Biological and Soil Surveys and Mapping for ML244SA West of the Fortescue River', unpublished report to BHP Iron Ore Pty Ltd, Perth.

Burbidge, AH, Johnstone, RE and Pearson, DJ 2010, 'Birds in a vast arid upland: avian biogeographical patterns in the Pilbara region of Western Australia', *Records of the Western Australian Museum Supplement*, vol. 78, pp. 247-270.

Bureau of Meteorology (BoM) 2015, *Climate Averages for Newman Aero*, viewed February 2015, http://www.bom.gov.au.

Bush, B and Maryan, B 2011, *Field Guide to Snakes of the Pilbara*, Western Australian Museum, Welshpool.

Perth: Western Australian Museum Department of Parks and Wildlife 2015, *NatureMap*, viewed February 2015, http://naturemap.dpaw.wa.gov.au/default.aspx.

Department of the Environment (DoE) 2015, *EPBC Act Protected Matters Search Tool*, viewed February 2015, http://www.environment.gov.au/epbc/pmst/index.html.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011, *Environment Protection and Biodiversity Conservation Act 1999 referral guidelines for the endangered northern quoll, Dasyurus hallucatus, EPBC Act policy statement 3.25,* Commonwealth of Australia, Canberra.

Dickman, CR 1996, *Overview of the Impact of Feral Cats on Australian Native Fauna,* Australian Nature Conservation Agency, Canberra.

Dickman, CR, Predavec, M and Downey, FJ 1995, 'Long range movements of small mammals in arid Australia: implications for land management', *Journal of Arid Environments,* vol. 31, pp. 441-452.

ecologia 1996, 'Jimblebar Rail Spur Biological Assessment Survey', unpublished report to BHP Iron Ore Pty Ltd, Perth.

ecologia 1998, 'Orebody 23 Extension Biological Assessment Survey', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

ecologia 2004a, 'OB24 Expansion Biological Survey', unpublished report to Mine and Port Development Joint Venture, Perth.

ecologia 2004b, 'Eastern Ophthalmia Range Expansion Biological Survey', unpublished report to BHP Billiton Pty Ltd Perth.

Eco Logical Australia 2012, 'Orebody 37 Level 1 Vertebrate Fauna Assessment', unpublished report to BHP Billiton Iron Ore, Perth.

Eco Logical Australia 2013, 'Ninga Level 1 Vertebrate Fauna Assessment', unpublished report to BHP Billiton Iron Ore, Perth.

ENV Australia 2006, 'OB24 Flora and Fauna Assessment Phase II', unpublished report to Mine and Ports Development Joint Venture Asset Development Projects, Perth.

ENV Australia 2011a, 'Eastern Ridge (OB23/24/25) Fauna Assessment', unpublished report to BHP Billiton Iron Ore, Perth.

ENV Australia 2011b, Orebody 42/43 Flora, Vegetation and Fauna Assessment Summary Letter and Recommendations', unpublished report to BHP Billiton Iron Ore, Perth.

ENV Australia 2011c, 'OB31 Fauna Assessment', unpublished report to BHP Billiton Iron Ore, Perth.

ENV Australia 2012, 'Mount Whaleback Fauna Review and Fauna Assessment', unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth.

Environmental Protection Authority (EPA) 2002, *Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement 3*, EPA, Perth.

EPA 2004, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, Guidance Statement 56*, EPA, Perth.

EPA 2013, *Environmental Assessment Guideline for Environmental factors and objectives*, *Environmental Assessment Guidelines No. 8*, EPA, Perth.

EPA and Department of Environment and Conservation (DEC) 2010, *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (eds. BM Hyder, J Dell, and MA Cowan), Perth.

GHD 2008, 'Report for Myopic Project Area, Newman Flora and Fauna Assessment', unpublished report to BHP Billiton Iron Ore, Perth.

Grice, AC 2006, 'The impacts of invasive plant species on the biodiversity of Australian rangelands', *The Rangeland Journal,* vol. 28, pp. 2735.

Johnson, K.A 2008, 'Bilby *Macrotis lagotis* (Reid, 1837)', in S Van Dyck and R Strahan (eds.), *The Mammals of Australia 3rd Edition,* New Reed Holland, Sydney, pp. 191-193.

Johnstone, R and Storr, GM 1998, *Handbook of Western Australian Birds Volume 1 - Non-passerines (Emu to Dollarbird)*, Western Australian Museum, Perth.

Johnstone, R and Storr, GM 2004, *Handbook of Western Australian Birds. Volume II - Passerines (Blue-winged Pitta to Goldfinch)*, Western Australian Museum, Perth.

Matsuki, M, Gardener, MR, Smith, A, Howard RK and Gove, A in prep, 'Impacts of dust on plant health, survivorship and plant communities in semi-arid environments'.

Northcote, KH, Beckmann, GG, Bettenay, E, Churchward, HM, Van Dijk, DC, Dimmock, GM, Hubble, GD, Isbell, RF, McArthur, WM, Murtha, GG, Nicolls, KD, Paton, TR, Thompson, CH, Webb, AA and Wright, MJ 1968, *Atlas of Australian Soils, Sheets 1 to 10 with explanatory data,* CSIRO Australia and Melbourne University Press, Melbourne.

Onshore 2013, 'Mt Whaleback AML 7/244 Flora and Vegetation and Vertebrate Fauna Review', unpublished report to BHP Billiton Iron Ore, Perth.

Onshore and Biologic 2009, 'Biological Survey Myopic Exploration Leases', unpublished report for BHP Billiton Iron Ore, Perth.

Outback Ecology 2009, 'Jimblebar Linear Development Terrestrial Vertebrate Fauna Assessment', unpublished report to BHP Billiton Iron Ore, Perth.

Pearson, D 1993, 'Distribution, status and conservation of pythons in Western Australia', in: D Lunney and D Ayers (eds.), *Herpetology in Australia: A Diverse Discipline*, Royal Zoological Society of NSW, Sydney, pp. 383-395.

Pearson, D 2003, 'Giant pythons of the Pilbara', *Landscope*, vol. 19(1).

Southgate, R 1990, 'Habitat and diet of the greater bilby *Macrotis lagotis* Reid (Marsupialia: Peramelidae)', in JH Seeback, PR Brown, RL Wallis and CM Kemper (eds.), *Bandicoots and Bilbies*, Surrey Beatty & Sons, Sydney, pp. 303-309.

Stewart, AJ, Sweet, IP, Needham, RS, Raymond, OL, Whitaker, AJ, Liu, SF, Phillips, D, Retter, AJ, Connolly, DP, Stewart, G 2008, *Surface Geology of Australia 1:1,000,000 Scale, Western Australia [Digital Dataset]*, The Commonwealth of Australia, Geoscience Australia, Canberra, http://www.ga.gov.au.

Tutt, M, Fekete, S, Mitchell, S, Brace, P and Pearson, D 2004, 'Unravelling the mysteries of Pilbara Olive Python ecology', *Threatened Species Network Community Grants Final Report – Project WA11/101*, Nickol Bay Naturalists Club and WA CALM, Karratha.

Van Dyck, S and Strahan, R (eds.) 2008, *Mammals of Australia 3rd Edition*, Reed New Holland, Sydney.

Van Vreeswyk, AME, Payne, AL, Leighon, KA, and Hennig, P 2004*, An Inventory and Condition Survey of the Pilbara Region, Western Australia, Technical Bulletin 92*, Department of Agriculture, Perth.

Wilson, S and Swan, G 2010, *A complete Guide to Reptiles of Australia*, New Holland Publishers, Sydney.

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Appendix A: Terrestrial Vertebrate Fauna List

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Table A.1: List of amphibian species recorded from database searches or previous surveys in the vicinity of the Project area.

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
HYLIDAE												
Cyclorana maini	Main's Frog				x		x		x			
Cyclorana platycephala	Water-Holding Frog								x			
Litoria rubella	Desert Tree Frog				x		x		x			
MYOBATRACHIDA												
Pseudophryne douglasi	Douglas' Toadlet				x							
Uperoleia russelli	Russell's Toadlet				x							
Uperoleia saxatilis	Pilbara Toadlet				x							
LIMNODYNASTIDAE												
Neobatrachus kunapalari	Kunapalari Frog				x							
BUFONIDAE												
Platyplectrum spenceri	Centralian Burrowing Frog				x		x					

Table A.2: List of reptile species recorded from database searches or previous surveys in the vicinity of the Project area.

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
CHELUIDAE												
Chelodina steindachneri	Flat-shelled Turtle				x		x					
AGAMIDAE												
Ctenophorus caudicinctus	Ring-tailed Dragon				x		x	x	x	x	x	x
Ctenophorus isolepis	Crested Dragon				x		x				x	x
Ctenophorus maculatus					x							
Ctenophorus nuchalis	Central Netted Dragon				x							
Ctenophorus reticulatus	Western Netted Dragon				x		x					
Lophognathus longirostris					x		x		x		x	x
Pogona minor					x		x			x	x	
Tympanocryptis cephalus	Pebble Dragon				x							
DIPLODACTYLIDAE												
Diplodactylus conspicillatus	Fat-tailed Gecko				x		x	x				
Diplodactylus mitchelli					x							
Diplodactylus savagei	Yellow-spotted Pilbara Gecko				x		x	x				
Lucasium stenodactylum	Pale-snouted Ground Gecko				x		x	x	x			
Lucasium wombeyi					x		x	x				
Oedura marmorata	Marbled Velvet Gecko				x		x		x		x	
Rhynchoedura ornata	Beaked Gecko				x		x	x				
Strophurus elderi					x							
Strophurus wellingtonae					x		x		x			
CARPHODACTYLIDAE												
Nephrurus wheeleri	Banded Knob-tailed Gecko				x		x	x	x			
GEKKONIDAE												
Gehyra pilbara					x							
Gehyra punctata	Spotted Rock Dtella				x		x		x			
Gehyra variegata	Tree Dtella				x		x					x
Heteronotia binoei	Bynoe's Gecko				x		x		x			
Heteronotia planiceps					x							
Heteronotia spelea	Desert Cave Gecko				x		x		x			
PYGOPODIDAE												
Delma butleri	Unbanded Delma				x							
Delma elegans	Pilbara Delma				x							
Delma haroldi					x		x					
Delma nasuta					x		x	x				
Delma pax					x		x	x				
Lialis burtonis	Burton's legless lizard				x		x		x			x
Pygopus nigriceps	Hooded Scaly foot						x		x			

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
SCINCIDAE												
Carlia munda					x		x	x	x			x
Carlia triacantha	Desert Rainbow Skink				x		x					x
Cryptoblepharus buchananii					x							
Cryptoblepharus ustulatus					x		x					
Ctenotus ariadnae					x							
Ctenotus duricola					x			x		x		
Ctenotus grandis					x			x				
Ctenotus helenae					x		x	x	x			
Ctenotus leonhardii					x		x					
Ctenotus pantherinus	Leopard Ctenotus				x		x	x				x
Ctenotus rubicundus					x		x	x				
Ctenotus rutilans	Pilbara Rusty Ctenotus				x							
Ctenotus saxatilis	Rock Ctenotus				x		x	x	x			x
Ctenotus schomburgkii	Barred Wedge-tailed Ctenotus											x
Ctenotus uber					x				x			
Ctenotus uber johnstonei	Spotted Ctenotus			P2	x							
Cyclodomorphus melanops	Slender Blue-tongue				x		x					
Egernia cygnitos	Pygmy Spiny-tailed Skink (western)				x							
Egernia depressa	Pygmy Spiny-tailed Skink				x		x	x				x
Egernia formosa	Crevice Skink				x			x	x			
Eremiascincus richardsonii	Broad-banded Sand Swimmer				x		x					
Lerista bipes					x							
Lerista macropisthopus remota	Unpatterned Robust Slider (central interior)			P2	x							
Lerista muelleri					x							
Lerista neander					x		x					
Lerista zietzi					x		x		x			
Menetia greyii	Dwarf Skink				x							
Menetia surda					x							
Morethia ruficauda	Fire-tailed Skink				x		x		x	x		x
Proablepharus reginae												x
Tiliqua occipitalis	Western Blue-tongue								x			
Tiliqua multifasciata	Central Blue-tongue				x							
VARANIDAE												
Varanus acanthurus	Spiny-tailed Monitor				x		x	x	x		x	
Varanus brevicauda	Short-tailed Pygmy Monitor				x							
Varanus bushi	Pilbara Mulga Monitor				x							
Varanus caudolineatus	Stripe-tailed Monitor				x		x					
Varanus giganteus	Perentie				x		x		x			
Varanus gouldii	Bungarra or Sand Monitor				x						x	

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
Varanus panoptes	Yellow-spotted Monitor				x		x					
Varanus pilbarensis	Pilbara Rock Monitor				x		x		x			
Varanus tristis	Black-headed Monitor				x		x	x	x			
TYPHLOPIDAE												
Ramphotyphlops grypus							x					
BOIDAE												
Antaresia perthensis	Pygmy Python				x		x	x	x			
Antaresia stimsoni	Stimson's Python				x				x			
Aspidites melanocephalus	Black-headed Python				x							
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1		x	x						
ELAPIDAE												
Acanthophis wellsi	Pilbara Death Adder				x		x		x			
Brachyurophis approximans	Shovel-nosed Snake				x		x		x			
Demansia psammophis	Yellow-faced Whipsnake				x							
Demansia rufescens	Rufous Whipsnake				x		x					
Furina ornata	Moon Snake				x				x			
Parasuta monachus	Inland Hooded Snake				x		x					
Pseudechis australis	Mulga Snake				x		x		x			
Pseudonaja mengdeni	Western Brown Snake				x			x	x			
Pseudonaja modesta	Ringed Brown Snake				x				x			
Suta fasciata	Rosen's Snake				x		x					
Suta punctata	Spotted Snake				x							
Vermicella snelli	Bandy bandy				x							

Table A.3: List of bird species recorded from database searches or previous surveys in the vicinity of the Project area.

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
CASUARIIDAE												
Dromaius novaehollandiae	Emu				x							
PHASIANIDAE												
Coturnix pectoralis	Stubble Quail				x							
Coturnix ypsilophora	Brown Quail				x							
ANSERANATIDAE												
Anseranas semipalmata	Magpie Goose				x							
ANATIDAE												
Anas gracilis	Grey Teal				x		x					
Anas rhynchotis	Australasian Shoveler				x							
Anas superciliosa	Pacific Black Duck				x		x					
Aythya australis	Hardhead				x							
Chenonetta jubata	Australian Wood Duck				x							
Cygnus atratus	Black Swan				x		x					
Dendrocygna arcuata	Wandering Whistling Duck				x							
Dendrocygna eytoni	Plumed Whistling-duck				x							
Malacorhynchus membranaceus	Pink-eared Duck				x		x					
Stictonetta naevosa	Freckled Duck				x							
Tadorna tadornoides	Australian Shelduck				x		x					
RALLIDAE												
Fulica atra	Eurasian Coot				x		x					
Gallirallus philippensis	Buff-banded Rail				x							
Porphyrio porphyrio	Purple Swamphen				x							
Porzana pusilla	Baillon's Crake				x							
Porzana tabuensis	Spotless Crake				x							
PODICIPEDIDAE												
Podiceps cristatus	Great Crested Grebe				x							
Poliocephalus poliocephalus	Hoary-headed Grebe				x							
Tachybaptus novaehollandiae	Australasian Grebe				x		x					
COLUMBIDAE												
Geophaps plumifera	Spinifex Pigeon				x		x	x	x	x	x	x
Geopelia cuneata	Diamond Dove				x		x	x	x		x	
Geopelia humeralis	Bar-shouldered Dove				x							
Geopelia striata	Peaceful Dove				x						x	
Ocyphaps lophotes	Crested Pigeon				x		x	x	x	x	x	x
Phaps chalcoptera	Common Bronzewing				x		x			x		
PODARGIDAE												

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
Podargus strigoides	Tawny Frogmouth				x				x			
EUROSTOPODIDAE												
Eurostopodus argus	Spotted Nightjar				x		x	x	x	x	x	
AEGOTHELIDAE												
Aegotheles cristatus	Australian Owlet-nightjar				x		x	x				
APODIDAE												
Apus pacificus	Fork-tailed Swift	Mi	S3			x						
PHALACROCORACIDAE												
Phalacrocorax carbo	Great Cormorant				x							
Phalacrocorax melanoleucos	Little Pied Cormorant						x					
Phalacrocorax sulcirostris	Little Black Cormorant				x							
Phalacrocorax varius hypoleucos	Pied Cormorant				x							
PELECANIDAE												
Pelecanus conspicillatus	Australian Pelican				x							
CICONIIDAE												
Ephippiorhynchus asiaticus	Black-necked Stork				x							
ARDEIDAE												
Ardea ibis	Cattle Egret	Mi	S3		x	x						
Ardea intermedia	Intermediate Egret				x							
Ardea modesta	Eastern Great Egret	Mi	S3			x	x					
Ardea pacifica	White-necked Heron				x		x					
Egretta novaehollandiae	White-faced Heron				x		x					
Nycticorax caledonicus	Rufous Night-Heron				x							
THRESKIORNITHIDAE												
Platalea flavipes	Yellow-billed Spoonbill				x							
Platalea regia	Royal Spoonbill				x		x					
Plegadis falcinellus	Glossy Ibis	Mi	S3		x							
Threskiornis molucca	Australian White Ibis				x							
Threskiornis spinicollis	Straw-necked Ibis				x							
ACCIPITRIDAE												
Aquila audax	Wedge-tailed Eagle				x		x	x	x	x	x	
Haliaeetus leucogaster	White-bellied Sea-eagle	Mi	S3		x							
Accipiter cirrocephalus	Collared Sparrowhawk				x		x	x				
Accipiter fasciatus	Brown Goshawk				x		x					
Circus approximans	Swamp Harrier				x							
Circus assimilis	Spotted Harrier				x		x	x			x	

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
Elanus axillaris	Black-shouldered Kite				x		x	x				
Haliastur sphenurus	Whistling Kite				x		x	x	x	x	x	x
Milvus migrans	Black Kite				x		x			x		
Hamirostra melanosternon	Black-breasted Buzzard				x				x			
Hieraaetus morphnoides	Little Eagle				x		x		x		x	x
FALCONIDAE												
Falco berigora	Brown Falcon				x		x	x	x		x	x
Falco cenchroides	Australian Kestrel				x		x	x	x	x	x	x
Falco longipennis	Australian Hobby				x		x	x	x			x
Falco peregrinus	Peregrine Falcon		S4		x		x			x		
BURHINIDAE												
Burhinus grallarius	Bush Stone-curlew				x							
OTIDIDAE												
Ardeotis australis	Australian Bustard			P4	x		x				x	x
RECURVIROSTRIDAE												
Cladorhynchus leucocephalus	Banded Stilt				x							
Himantopus himantopus	Black-winged Stilt				x		x					
Recurvirostra novaehollandiae	Red-necked Avocet				x		x					
CHARADRIIDAE												
Charadrius ruficapillus	Red-capped Plover				x							
Charadrius veredus	Oriental Plover	Mi	S3			x						
Elseyornis melanops	Black-fronted Dotterel				x		x					
ROSTRATULIDAE												
Rostratula australis	Australian Painted Snipe	En, Mi	S1			x						
SCOLOPACIDAE												
Actitis hypoleucos	Common Sandpiper	Mi	S3		x							
Calidris acuminata	Sharp-tailed Sandpiper	Mi	S3		x							
Calidris ferruginea	Curlew Sandpiper	Mi	S1		x							
Calidris melanotos	Pectoral Sandpiper	Mi	S3		x							
Calidris ruficollis	Red-necked Stint	Mi	S3		x							
Calidris subminuta	Long-toed Stint	Mi	S3		x							
Tringa glareola	Wood Sandpiper	Mi	S3		x		x					
Tringa nebularia	Common Greenshank	Mi	S3		x		x					
Tringa totanus	Common Redshank	Mi	S3		x							
LARIDAE												
Larus novaehollandiae	Silver Gull				x							
TURNICIDAE												
Turnix velox	Little Button-quail				x		x				x	x

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
GLAROLIDAE												
Stiltia isabella	Australian Pratincole				x							
CACATUIDAE												
Eolophus roseicapillus	Galah				x		x		x	x	x	x
Cacatua sanguinea	Little Corella				x		x		x	x		x
Nymphicus hollandicus	Cockatiel				x		x	x	x		x	x
PSITTACIDAE												
Barnardius zonarius	Australian Ringneck				x		x	x	x	x	x	x
Psephotus varius	Mulga Parrot				x		x					
Polytelis alexandrae	Princess Parrot			P4	x							
Melopsittacus undulatus	Budgerigar				x		x	x	x	x	x	x
Neopsephotus bourkii	Bourke's Parrot				x							
CUCULIDAE												
Centropus phasianinus	Pheasant Coucal				x			x	x			
Chalcites basalis	Horsfield's Bronze Cuckoo				x		x	x	x			
Chalcites osculans	Black-eared Cuckoo				x		x					x
Cacomantis pallidus	Pallid Cuckoo				x		x	x	x			x
STRIGIDAE												
Ninox connivens	Barking Owl				x							
Ninox novaeseelandiae	Southern Boobook				x		x	x	x			
TYTONIDAE												
Tyto javanica	Eastern Barn Owl				x		x	x				
HALCYONIDAE												
Dacelo leachii	Blue-winged Kookaburra				x		x	x	x			x
Todiramphus pyrrhopygius	Red-backed Kingfisher				x		x	x	x		x	x
Todiramphus sanctus	Sacred Kingfisher				x		x		x			
MEROPIDAE												
Merops ornatus	Rainbow Bee-eater	Mi	S3		x	x	x	x		x	x	x
CLIMACTERIDAE												
Climacteris melanura	Black-tailed Treecreeper				x							
PTILINORHYNCHIDAE												
Ptilonorhynchus guttatus	Western Bowerbird				x		x	x	x			x
MALURIDAE												
Amytornis striatus whitei	Striated Grasswren				x		x	x	x		x	
Malurus lamberti	Variegated Fairy-wren				x		x	x	x	x	x	x
Malurus leucopterus	White-winged Fairy-wren				x		x	x	x		x	x
Malurus splendens	Splendid Fairy-wren				x			x				
ACANTHIZIDAE												

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
Pyrrholaemus brunneus	Redthroat				x		x					
Smicrornis brevirostris	Weebill				x		x	x	x	x	x	x
Gerygone fusca	Western Gerygone				x		x	x	x	x		x
Gerygone mungi	Desert Gerygone				x							
Acanthiza apicalis	Inland Thornbill				x		x	x				
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				x		x					
Acanthiza robustirostris	Slaty-backed Thornbill				x		x					
Acanthiza uropygialis	Chestnut-rumped Thornbill				x		x		x			x
PARDALOTIDAE												
Pardalotus rubricatus	Red-browed Pardalote				x		x	x	x			
Pardalotus striatus	Striated Pardalote				x		x	x	x		x	
MELIPHAGIDAE												
Acanthagenys rufogularis	Spiny-cheeked Honeyeater				x		x	x	x	x	x	
Conopophila whitei	Grey Honeyeater				x		x					
Lichenostomus keartlandi	Grey-headed Honeyeater				x		x	x	x		x	x
Lichenostomus penicillatus	White-plumed Honeyeater						x	x	x		x	x
Lichenostomus plumulus	Grey-fronted Honeyeater						x					
Lichenostomus virescens	Singing Honeyeater						x	x	x	x	x	x
Lichmera indistincta	Brown Honeyeater				x		x	x	x		x	x
Melithreptus gularis	Black-chinned Honeyeater				x		x	x	x			
Purnella albifrons	White-fronted Honeyeater				x		x	x				
Sugomel niger	Black Honeyeater				x						x	x
Manorina flavigula	Yellow-throated Miner				x		x	x	x		x	x
Epthianura tricolor	Crimson Chat				x		x					
Epthianura aurifrons	Orange Chat				x							
POMATOSTOMIDAE												
Pomatostomus superciliosus	White-browed Babbler				x		x					
Pomatostomus temporalis	Grey-crowned Babbler				x		x	x	x		x	x
PSOPHODIDAE												
Psophodes occidentalis	Western Wedgebill				x							
CAMPEPHAGIDAE												
Coracina maxima	Ground Cuckoo-shrike				x			x			x	
Coracina novaehollandiae	Black-faced Cuckoo-shrike				x		x	x	x	x	x	
Lalage tricolor	White-winged Triller				x		x	x	x		x	
PACHYCEPHALIDAE												
Pachycephala rufiventris	Rufous Whistler				x		x	x	x	x	x	x
Colluricincla harmonica	Grey Shrike-thrush				x		x	x	x	x	x	x
Oreoica gutturalis	Crested Bellbird				x		x	x	x		x	x

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
ARTAMIDAE												
Artamus cinereus	Black-faced Woodswallow				x		x		x	x	x	x
Artamus cyanopterus	Dusky Woodswallow				x							
Artamus minor	Little Woodswallow				x		x	x	x	x		
Artamus personatus	Masked Woodswallow				x		x					
Artamus superciliosus	White-browed Woodswallow				x							
Cracticus nigrogularis	Pied Butcherbird				x		x	x	x	x	x	x
Cracticus tibicen	Australian Magpie				x		x	x	x	x	x	x
Cracticus torquatus	Grey Butcherbird				x		x		x	x		x
RHIPIDURIDAE												
Rhipidura albicauda	White-tailed Fantail				x							
Rhipidura fuliginosa	Grey Fantail				x		x				x	
Rhipidura leucophrys	Willie Wagtail				x		x	x	x	x	x	x
CORVIDAE												
Corvus bennetti	Little Crow				x		x					
Corvus orru	Torresian Crow				x			x	x	x	x	x
MONARCHIDAE												
Grallina cyanoleuca	Magpie-lark				x		x	x	x	x	x	x
PETROICIDAE												
Petroica goodenovii	Red-capped Robin				x		x					
Melanodryas cucullata	Hooded Robin				x		x	x	x		x	x
ALAUDIDAE												
Mirafra javanica	Horsfield's Bushlark				x				x			
ACROCEPHALIDAE												
Acrocephalus australis	Australian Reed-Warbler				x		x					
MEGALURIDAE												
Cincloramphus cruralis	Brown Songlark				x		x					x
Cincloramphus mathewsi	Rufous Songlark				x		x		x			
Eremiornis carteri	Spinifexbird				x		x	x	x		x	
Megalurus gramineus	Little Grassbird				x							
HIRUNDINIDAE												
Cheramoeca leucosterna	White-backed Swallow				x		x	x				
Hirundo neoxena	Welcome Swallow				x							
Petrochelidon ariel	Fairy Martin				x		x					
Petrochelidon nigricans	Tree Martin				x		x		x			
NECTARINIIDAE												
Dicaeum hirundinaceum	Mistletoebird				x		x	x	x			
ESTRILDIDAE												

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
Emblema pictum	Painted Finch				x		x	x	x	x	x	x
Neochmia ruficauda subclarescens	Star Finch (western)			P4	x				x			
Taeniopygia guttata	Zebra Finch				x		x	x	x	x	x	x
MOTACILLIDAE												
Anthus australis	Australasian Pipit				x		x	x				

Table A.4: List of mammal species recorded from database searches or previous surveys in the vicinity of the Project area.

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
TACHYGLOSSIDAE												
Tachyglossus aculeatus	Echidna				x		x		x			
DASYURIDAE												
Dasykaluta rosamondae	Little Red Kaluta				x		x	x				
Dasyurus hallucatus	Northern Quoll	EN	S1			x						
Ningaui timealeyi	Pilbara Ningaui				x		x					
Planigale maculata	Common Planigale				x		x					
Pseudantechinus roryi	Rory's Antechinus				x		x					
Pseudantechinus woolleyae	Woolley's Pseudantechinus				x		x					
Sminthopsis crassicaudata	Fat-tailed Dunnart				x							
Sminthopsis longicaudata	Long-tailed Dunnart			P4	x		x					
Sminthopsis macroura	Stripe-faced Dunnart				x		x					
Sminthopsis ooldea	Ooldea Dunnart				x		x					
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart				x							
THYLACOMYIDAE												
Macrotis lagotis	Bilby, Dalgyte	VU	S1			x						
MACROPODIDAE												
Macropus robustus	Common Wallaroo				x		x	x	x	x	x	
Macropus rufus	Red Kangaroo, Marlu				x		x			x	x	x
Petrogale lateralis lateralis	Black-footed Rock Wallaby	VU	S1		x							
Petrogale rothschildi	Rothschild's Rock-wallaby				x		x				x	
NOTORYCTIDAE												
Notoryctes caurinus	Northern Marsupial Mole	EN				x						
MEGADERMATIDAE												
Macroderma gigas	Ghost Bat			P4	x				x			
HIPPOSIDERIDAE												
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1		x	x						
EMBALLONURIDAE												
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat				x							x
Taphozous georgianus	Common Sheathtail-bat				x							x
Taphozous hilli	Hill's Sheathtail-bat				x		x					
MOLOSSIDAE												
Chaerephon jobensis	Northern Freetail-bat				x							x
Mormopterus beccarii	Beccari's Freetail-bat				x		x					x
Tadarida australis	White-striped Freetail-bat				x						x	x
VESPERTILIONIDAE												
Chalinolobus gouldii	Gould's Wattled Bat				x						x	x
Nyctophilus geoffroyi	Lesser Long-eared Bat				x							
Scotorepens balstoni	Inland Broad-nosed Bat						x					

Species name	Common name	Conservation status			Database results		Previous surveys					
		EPBC Act	WC Act	DPaW	NatureMap	EPBC Protected Matters	Biota (2001)	ecologia (2004)	ENV (2006)	GHD (2008)	Onshore/ Biologic (2009)	ENV (2011)
Scotorepens greyii	Little Broad-nosed Bat				x		x	x				x
Vespadelus finlaysoni	Finlayson's Cave Bat				x		x				x	x
MURIDAE												
**Mus musculus*	House Mouse				x	x	x	x	x			
Notomys alexis	Spinifex Hopping-mouse				x		x					
Pseudomys chapmani	Western Pebble-mound Mouse			P4	x		x	x		x	x	x
Pseudomys desertor	Desert Mouse				x		x		x			
Pseudomys hermannsburgensis	Sandy Inland Mouse				x		x		x			
**Rattus* sp.	Rat									x		
Zyzomys argurus	Common Rock-rat				x		x		x			
BOVIDAE												
**Bos taurus*	European Cattle				x							
**Capra hircus*	Goat									x		
CAMELIDAE												
**Camelus dromedarius*	Camel				x	x						
CANIDAE												
**Canis lupus familiaris*	Domestic Dog					x						
**Canis lupus dingo*	Dingo				x		x			x	x	
**Vulpes vulpes*	Red Fox					x			x			
EQUIDAE												
**Equus caballus*	Horse					x						
**Equus asinus*	Donkey				x	x						
FELIDAE												
**Felis catus*	Cat				x	x		x	x	x	x	
LEPORIDAE												
**Oryctolagus cuniculus*	Rabbit				x	x	x		x		x	

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Appendix B: Fauna Conservation Codes and Likelihood/Importance Criteria

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Table B.1: Categories and definitions for EPBC Act listed flora and fauna species.

Conservation category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the wild	Taxa known to survive only in captivity.
Critically endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium term.
Near threatened (NT)	Taxa that risk becoming Vulnerable in the wild.
Conservation dependent (CD)	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data deficient (insufficiently known) (DD)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least concern (LC)	Taxa that are not considered threatened.

Table B.2: Conservation codes for Western Australian flora and fauna.

Code	Conservation category	Definition
X	Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950*. Presumed Extinct Fauna	Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
T*	Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950.* Threatened Fauna (Fauna that is rare or is likely to become extinct)	Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
IA	Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950*. Birds protected under an international agreement	Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.
S	Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950.* Other specially protected fauna	Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.
*Threatened fauna (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: CR: Critically Endangered - considered to be facing an extremely high risk of extinction in the wild. EN: Endangered - considered to be facing a very high risk of extinction in the wild. VU: Vulnerable - considered to be facing a high risk of extinction in the wild.		

Table B.3: Priority species under Western Australian *Wildlife Conservation Act 1950*.

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Fauna List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These taxa require regular monitoring. Conservation Dependent species are placed in Priority 5.

P1: Priority One – Poorly known taxa
Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2: Priority Two – Poorly known taxa
Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly known taxa
Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
(a) Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5: Priority Five: Conservation dependent taxa
Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

Table B.4: Criteria used to define importance of fauna habitats.

Importance to fauna rating	Criteria
High	Habitat supports threatened fauna species. OR Habitat supports other conservation significant fauna species that are restricted to the habitat type within the Project area. OR Habitat that only occurs in small isolated areas and is not widespread in the region.
Moderate	Habitat supports conservation significant fauna species but that are not necessarily restricted to the habitat type within the Project area. OR Habitat supports a particularly diverse and uncommon faunal assemblage or that may act as a corridor for dispersal or movement of fauna.
Low	Habitat is widespread and common throughout the region and does not solely support any conservation significant fauna species.

Table B.5: Criteria used to define likelihood occurrence of conservation significant fauna species.

Likelihood of occurrence	Criteria
Recorded	Species has been recorded within the Project area.
Likely	Species has been recorded within 20 km of the Project area and preferred habitat appears to be present.
Possible	Species has not been recorded from within the Project area, however species has been recorded within 20 km of the Project area and suitable habitat appears to be present.
Unlikely	Species recorded within 20 km of the Project area but suitable habitat does not appear to be present.

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