OB31 Jimblebar Access Track VCP

Level 1 Flora & Vegetation Survey and Vertebrate Fauna Assessment

Prepared for BHP Billiton Iron Ore Pty Ltd
October 2015

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Executive Summary

Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) to undertake a single season Level 1 flora and vegetation survey and Level 1 vertebrate fauna assessment of a proposed 6.5 km long access track extending north from Orebody 31 (OB31) and on the western side of Jimblebar Creek (herein referred to as the study area) (Figure 1). The study area is situated approximately 40 km east of Newman.

Flora and Vegetation Assessment

No plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the *Wildlife Conservation Act 1950* (WC Act) or listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was recorded from the study area. Additionally no Priority flora taxon was recorded from the study area. *Acacia clelandii* represents a range extension 400 km north of the nearest known populations. One introduced weed species was recorded within the study area; **Cenchrus ciliaris.*

A total of six vegetation associations forming four broad floristic formations were described and mapped. None of these vegetation associations are listed as Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs). Vegetation condition within the entire study area was rated as *excellent.*

Vertebrate Fauna Assessment

Database searches, review of previous survey reports and results from the current survey indicated that 267 species of vertebrate fauna (excluding freshwater fish) may occur in the general area. Of these, 16 vertebrate fauna species comprising four species of introduced mammal, 11 species of birds and one species of reptile were recorded during the field survey. Further to this, it was determined that 18 species (six native mammals, nine birds and two reptiles) of conservation significance have the potential to occur in the study area. Only five of these are likely to occur in the study area, with two of these species recorded during the field survey; Rainbow Bee-eater (Schedule 3, S3) and Australian Bustard (Priority 4).

Two fauna habitat types were recorded from the study area, Sand Plain and Stony Plain. However, neither habitat was rated as high importance. The Sand Plain habitat may support the Brush-tailed Mulgara, however the area was thoroughly searched for burrows and none were detected.

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1.0 Introduction

1.1 Preamble

In June 2015 Onshore Environmental was commissioned by BHP Billiton Iron Ore to undertake a single season Level 1 flora and vegetation survey and Level 1 vertebrate survey along a proposed access track extending north from OB31 along the western fringe of Jimblebar Creek. The flora, vegetation and vertebrate fauna survey will be used to inform a Native Vegetation Clearing Permit (NVCP) for the access track. The study area is located approximately 40 km east of Newman (Figure 1).

1.2 Previous Flora and Vegetation Surveys

Onshore Environmental has recently completed a riparian flora and vegetation survey along Jimblebar Creek (Onshore Environmental 2015a). This area surveyed partially overlaps the study area and extends approximately 20 km downsteam and to the north. A second baseline survey was also recently undertaken in close proximity to the west at OB31 (Onshore Environmental 2014a).

Additionally, there have been at least 38 previous flora and vegetation surveys completed within a 20 km radius of the study area. These surveys are listed and described in more detail in Section 3.1.1.

1.3 Previous Fauna Surveys

Two existing vertebrate fauna surveys overlap with the current study area:

- Orebody 31 Vertebrate Fauna Survey (Biologic 2013); and
- Wheelarra Hill North Fauna Survey (ENV Australia 2012).

Additionally, there have been at least 13 relevant fauna surveys completed in close proximity (within a 7 km radius). These surveys are listed and described in more detail in Section 5.1.2.

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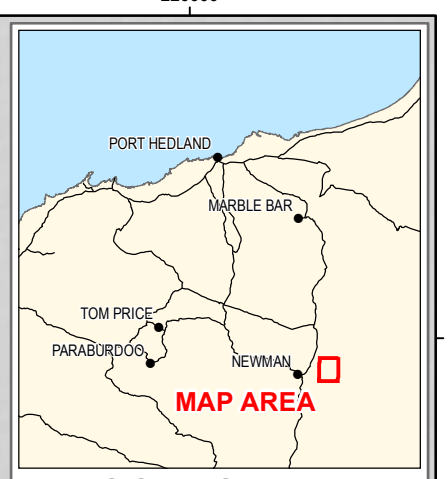
7435000 7430000 7425000 7420000 7415000 7410000 7405000

Fortescue River

Jimblebar Creek



LOCATION MAP

ML 244SA

Orebody 18

ML 244SA

Wheelarra 1-4

M 266SA

M 266SA

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LOCATION MAP

Jimblebar Creek Access Track

0 1 2 3 4 5
Kilometers

1:100,000

Datum: GDA94
Projection: MGA Zone 51

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Legend

- Study Area
- BHP Tenements
- Highway
- Secondary Road
- Minor Road
- Track
- Operating Minesites

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1.4 Climate

The climate of the south-eastern Pilbara is arid-tropical with hot summers extending from October to April and mild winters from May to September. The climate is dry and rainfall variable and unreliable. Rainfall occurs in both summer and winter months with the major falls received during summer months. Cyclones that develop over the Indian Ocean bring heavy summer rainfall, especially from January to March. Winter rainfall is generally lighter and typically associated with cold fronts extending from southern parts into the Pilbara region. Annual average rainfall for the Pilbara ranges from 180 mm to over 400 mm (Beard 1975) with a long-term average of 325.9 mm for the town of Newman (recorded from the years 1971 to 2013, Bureau of Meteorology [BOM] 2015).

Rainfall for the six months prior to the July 2015 field survey totalled 399 mm, which is well above the long-term average of 232 mm for the same period. Summer rainfall was relatively poor with December, January and February all recording below average falls. However good autumn rains were received in 2015 with above average falls in March, April and May. Rainfall was particularly high in March with more than four times the monthly average recorded (174.2 mm) (Figure 2). The autumn rains received prior to the field assessment resulted in excellent seasonal conditions at the time of survey in July 2015.

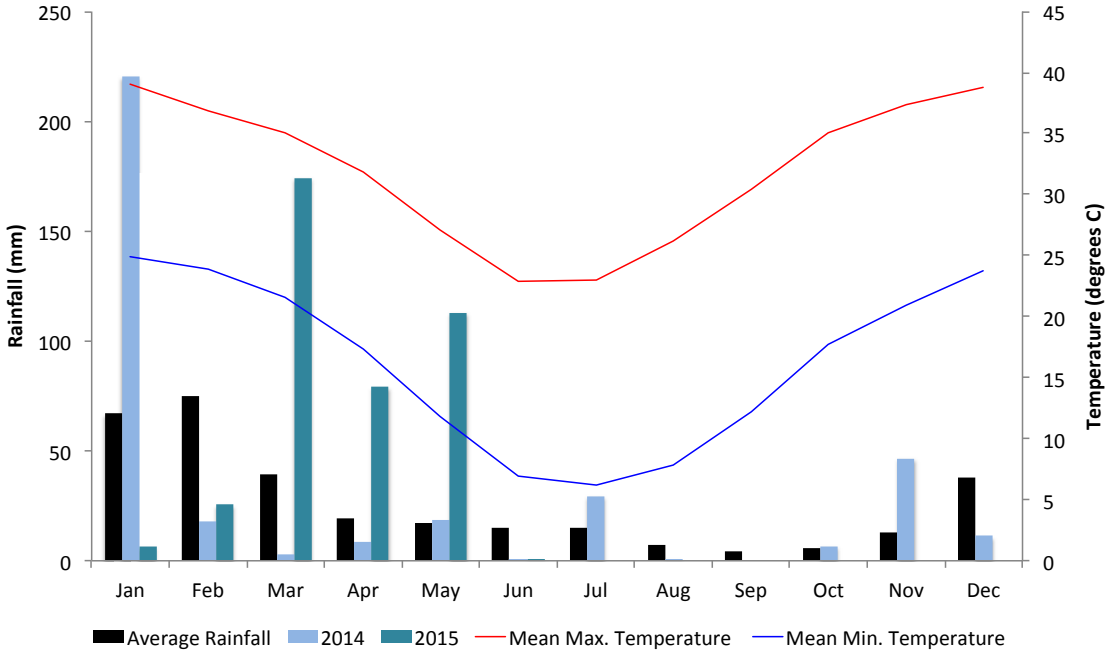

Figure 2 **Climate and rainfall data for Newman between January 2014 and June 2015, with long-term temperature (1996 to 2014) and long-term rainfall (1971 to 2014) figures (Bureau of Meteorology (BOM) 2015).**

1.5 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA) describes a system of 89 'biogeographic regions' (bioregions) and 419 subregions covering the entire Australian continent (IBRA7, Department of Environment 2014a). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna. The study area is located in the Pilbara bioregion. The Pilbara bioregion consists of four sub-regions: Chichester, Fortescue, Hamersley and Roebourne. The study area is located on the southern edge of the Fortescue sub-region (PIL2), adjacent to the boundary of the Hamersley sub-region (PIL3).

The Fortescue sub-region is described as alluvial plains and river frontage with extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east (Kendrick 2001a). Drainage lines are fringed by river gum woodlands and drain northwards in to the Fortescue Marsh. Jimblebar Creek forms part of the Fortescue River catchment and lies between the Fortescue River and Caramulla Creek.

The Hamersley sub-region is described as a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite) (Kendrick 2001b). It contains Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges.

1.6 Soils

Tille (2006) classified the most recent and detailed mapping of Western Australia's rangelands and arid Interior into a hierarchy of soil-landscape mapping units. The study area is located near the boundary of the following two soil units:

- 285 - Hamersley Plateaux Zone, located in the Fortescue Province is described as having stony soils with red shallow loams and some red/brown non-cracking clays and red loamy earths; and
- 290 - Bulloo Plains and Hills Zone, located in the Ashburton Province is described as having red shallow loams (often with hardpans), red loamy earths, stony soils and red deep sands with some red shallow sands.

The Australian Soil Resource Information System (ASRIS) provides soil and land resource information across Australia. The following soil type occurs within the study area (CSIRO 2014):

- Mz25- Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines.

1.7 Geology

The ancient continental Western Shield dominates the geology of Western Australia. The Pilbara region makes up a portion of the Western Shield and consists of pre-Cambrian, Proterozoic and Archaean rocks. The area contains some of the earth's oldest rock formations, thought to be around 3.5 billion years old (Australian Natural Resource Atlas 2008). Important mineral reserves, including iron ore, which is prevalent in the Pilbara, are associated with these rock formations.

The surface geology of the Jimblebar Creek area contains the geological formations outlined below (Williams and Tyler, 1991):

- Qa- This unit consists of alluvium; unconsolidated silt, sand and gravel within main drainage line of Jimblebar Creek;
- Qw- Sheetwash plains occurring adjacent to the northern parts of the Jimblebar creek; and
- Qs- Areas of windblown sand surrounding the Jimblebar Creek.

1.8 Flora and Vegetation

The study area is located within the Fortescue Botanical District and close to the border of the Hamersley Botanical District, (both within the Pilbara IBRA region) which is part of the Eremaean Province (Beard 1990). It is dominated by tree and shrub - steppe communities consisting mainly of *Eucalyptus* and *Acacia* species; *Triodia pungens* and *Triodia wiseana*

and some Mulga (*Acacia aneura*) occur within valley areas, and short grass plains occur on alluvia.

The original vegetation mapping was undertaken by Beard (1975) and refined by Shepherd *et al.* (2002). There were three vegetation associations described from the study area (Figure 3). While the Pre-European extent for each vegetation association is 100 percent, less than one percent of each association occurs within formal or informal reserves (Table 1).

Table 1 Pre-European extent of vegetation associations occurring within the study area (Shepherd *et al.* 2002).

Vegetation Sub-Association	Description	Pre-Euro. Extent Remaining (ha)	Remaining area in IUCN Class I-IV Reserves	% remaining Other Reserves	% remaining DPaW Managed PL
Fortescue Valley 82	Hummock grasslands, low tree steppe; Snappy gum over *Triodia wiseana*	2,290,910 (100 %)	8.9 ha	0.2	1.0
Fortescue Valley 216	Low woodland; mulga (with spinifex) on rises	298,549 (100 %)	0.0 ha	0.0	0.0
Fortescue Valley 111	Hummock grasslands, shrub steppe; *Eucalyptus gamophylla* over hard spinifex	814,103 (100%)	2.9 ha	0.0	0.0

204000 207000 210000 213000 216000

7428000 7425000 7422000 7419000 7416000 7413000

FORTESCUE VALLEY,111

FORTESCUE VALLEY,82

FORTESCUE VALLEY,216

FORTESCUE VALLEY,82

FORTESCUE VALLEY,29

FORTESCUE VALLEY,82

FORTESCUE VALLEY,216

204000 207000 210000 213000 216000

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FIGURE 3

Vegetation of the study area as mapped by Beard (1975)

0 500 1,000 1,500 2,000 2,500
Meters
1:50,000
Datum: GDA94
Projection: MGA Zone50

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Legend

Study Area

Pre-European Vegetation (Beard 1975)
System, Vegetation Association

- FORTESCUE VALLEY, 111
- FORTESCUE VALLEY, 216
- FORTESCUE VALLEY, 29
- FORTESCUE VALLEY, 82

N

1.9 Land Systems

The Department of Agriculture has conducted inventory and condition surveys of the Pilbara (van Vreeswyk *et al.* 2004) using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region as well as an evaluation on the condition of soils and vegetation. The mapping is based on patterns in topography, soils and vegetation.

A total of 102 land systems were defined in the Pilbara at a scale of 1:250,000 (van Vreeswyk *et al.* 2004), with three land systems occurring within the study area (Figure 4, Table 2). The three land systems occurring within the study area are well represented in the Pilbara covering between 2.3 percent and 4.3 percent of the Pilbara bioregion (Table 2).

Table 2 Land Systems occurring within the study area (descriptions from van Vreeswyk *et al.* 2004).

Land System	Description	Distribution in the Pilbara	Representation in the Pilbara
Boolgeeda	Stony plains with hard Spinifex grasslands or Mulga shrublands. The geology is quaternary colluvium.	Wide, very common	7,748 km^2 or 4.3 %
Divide	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands.	Mainly south-east, common	5,293km^2 2.9%
River	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands	Wide, common	4,088 km^2 or 2.3%

205000
210000
215000
7425000
7420000
7415000

RGENEW
RGENEW
RGEDIV
RGENEW
RGERIV
RGEDIV
RGENEW
RGENEW
RGEWSP
RGEBGD
RGEMCK
RGEWSP
RGEJAM
RGENEW
RGEBGD
RGEX_MINE
RGEBGD
RGEDIV
RGEWSP
RGESYL

Legend

Study Area

Land Systems

Mapping Unit, Land System

- RGEADR, Adrian Land System
- RGEBGD, Boolgeeda Land System
- RGEDIV, Divide Land System
- RGEJAM, Jamindie Land System
- RGEMCK, McKay Land System
- RGENEW, Newman Land System
- RGERIV, River Land System
- RGESYL, Sylvania Land System
- RGEWSP, Washplain Land System
- RGEX_MINE, Mine

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FIGURE 4

Land system represented within the study area

(as mapped by Van Vreeswyk et al 2004)

0 500 1,000 1,500 2,000 2,500

Meters

1:50,000

Datum: GDA94
Projection: MGA Zone 51

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2.0 Methodology - Flora and Vegetation

2.1 Guidance Statements

The flora survey and vegetation survey was carried out in a manner that was compliant with the following Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of flora and vegetation in Western Australia:

- Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas. Position Statement No. 2 (EPA 2000);
- Terrestrial Biological Surveys as an Element of Environmental Protection. Position Statement No. 3 (EPA 2002); and
- EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51 (EPA 2004).

The survey was also conducted in accordance with BHP Billiton Iron Ore's *Guidance for Flora and Vegetation Surveys in the Pilbara* (BHP Billiton Iron Ore 2010).

2.2 Database Searches

Searches of three databases were completed for information relating to rare flora (DPaW 2014a), TECs and PECs (DPaW 2014b) previously recorded within, or in close proximity to, the study area. For this report, a database search covering the entire study area was completed. The search was extended beyond the immediate survey limits to place flora values into a local and regional context. The search co-ordinate used was a 50 km radius around the central point of the nearby OB31 tenement which includes the entire study area; 193000mE 7417000mN (Zone 51 GDA94). The State database search investigated three DPaW databases:

- The DPaW Threatened Flora Database (DPaW 2014a);
- The DPaW Threatened and Priority Flora List (DPaW 2014b); and
- The Western Australian Herbarium Specimen Database for priority species opportunistically collected in the area of interest.

A search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database was undertaken (DoE 2015), as well as a search of the International Union for Conservation of Nature (IUCN) database (IUCN 2015).

A comprehensive literature review of surveys previously completed within or in close proximity to the study area was also undertaken.

2.3 Field Survey Methodology

2.3.1 Timing and Personnel

The field survey was completed by Principal Botanist Dr Jerome Bull between the 15th and 16th July 2015.

2.3.2 Targeted Surveys for Conservation Significant Flora

The entire length of the study area was traversed walking on either side of the centreline to assess flora and vegetation values. One side of the centreline was surveyed on the outgoing walk with the other side surveyed on the return journey. This allowed for appropriate coverage of the study area and landforms.

2.3.3 Vegetation Mapping

The vegetation mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:10,000, with definition of vegetation polygons based on contrasting shading patterns. Ground-truthing of the study area was completed during the field survey and 56 relevé vegetation descriptions were made within vegetation polygons to confirm dominant structural layers and associated plant taxa.

Description of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Alpin (1979) and Trudgen (2009) (see Appendix 1). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account. Vegetation condition for each of the sampling sites was determined using a recognised rating scale (based on Keighery 1994, see Appendix 2).

2.3.4 Vouchering

Voucher specimens were taken for all plant taxa that could not be identified in the field, to verify identification utilising resources at the Western Australian Herbarium (WAH). Voucher specimens were provided to Mr Steve Dillon, BHP Billiton Iron Ore's sponsored botanist at the WAH. The species names were checked against FloraBase (WAH 2015) to ensure currency. Nomenclature follows the WAH census.

2.3.5 Field Survey Constraints

The EPA Guidance Statement for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004) list twelve potential constraints that field surveys may encounter. These constraints are addressed in Table 3.

Table 3 Relevance of constraints, as identified by EPA (2004), to the flora and vegetation survey.

Constraint	Relevance
Scope	The scope was established by BHP Billiton Iron Ore in compliance with relevant EPA Guidance Statements.
Proportion of flora collected and identified	The Level 1 field survey followed three months of very high autumn rainfall and seasonal conditions were rated as excellent. While this would have contributed to a relatively high speciues count, it is noted there were no formal assessment plots assessed.
Sources of information	Onshore Environmental has recently completed a Level 2 flora and vegetation survey of the nearby OB31 (immediately west) and Jimblebar Creek (immediately east) study areas (Onshore Environmental 2014a, 2015a). There has been additional high intensity sampling from at least 38 neighbouring BHP Billiton Iron Ore tenements (25 km radius around the study area), providing an extensive local database. This is confirmed by the intensity of records for the area on Florabase.
The proportion of the task achieved and further work which might be needed	A comprehensive desktop review of the previous survey work completed within, and in close proximity to the study area, supported an extensive targeted search within the study area. All allocated tasks were achieved during the investigation and no further work is needed at this site.
Timing / weather / season / cycle	The autumn rainfall recorded for months preceding the targeted survey were higher than the long-term annual average. This resulted in excellent seasonal conditions supporting a diverse suite of plant life forms. The timing of sampling was optimum.

Constraint	Relevance
Disturbances, e.g. fire, flood	Minor disturbances related to fire, exploration and grazing by domestic stock were noted within the study area, but did not impact on survey results.
Intensity	The entire study area was ground truthed at approximately 50 m intervals providing high intensity sampling. There were two broad landforms represented, stony plains and sand plains, and vegetation within each was relatively homogenous.
Completeness	Relevant tasks related to assessing the presence of conservation significant flora were completed.
Resources	Appropriate resources have been applied to surveying the study area during the July 2015 survey.
Access problems	The entire study area was accessed on foot walking from established tracks.
Availability of contextual information	At least 38 flora and vegetation surveys have been undertaken within a 25 km radius of the study area, providing an extensive local database.
Experience levels	The Principal Botanist working on the survey has over 15 years experience completing vegetation surveys and flora taxonomy in the Pilbara and has completed numerous surveys in close proximity to the study area.

2.4 Assessment of Conservation Significance

The conservation significance of flora and ecological communities are classified on a Commonwealth, State and Local level on the basis of various Acts and Agreements (EPA Guidance Statement No. 51, EPA 2004), including:

Commonwealth Level:

- EPBC Act: The Department of Environment (DoE) lists Threatened Flora and Ecological Communities, which are determined by the Western Australian Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 3).

State Level:

- WC Act: At a State level native flora species are protected under the WC Act – Wildlife Conservation (Rare Flora) Notice. A number of plant species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations. Species of the highest conservation significance are gazetted Declared Rare Flora (DRF) under subsection 2 of section 23F of the Act. It is an offence to take or damage DRF without Ministerial approval. Section 23F of the Act defines 'to take' as "to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means".
- DPaW Priority list: DPaW produces a list of Priority flora taxa and ecological communities (PECs) that have not been assigned statutory protection under the WC Act. Priority Flora are under consideration for declaration as 'Rare Flora', classified as in urgent need of further survey (Priority One to Three), require monitoring every 5-10 years (Priority Four) or require a specific conservation program to prevent the taxon becoming threatened within five years (Priority 5), see Appendix 4. The list of PECs identifies those that need further investigation before nomination for TEC status.

Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

3.0 Methodology - Vertebrate Fauna

3.1 Guidance Statements

The vertebrate fauna survey was carried out in a manner consistent with the Western Australian (WA) Environmental Protection Authority (EPA), WA Department of Parks and Wildlife (DPaW) and BHP Billiton Iron Ore's requirements for the environmental surveying and reporting of fauna, including the following documents:

- EPA (2002, or its revision) Position Statement No. 3, Terrestrial Biological Surveys as an Element of Biodiversity Protection;
- EPA Guidance No. 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004);
- Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (WA Department of Environment and Conservation [DEC]/EPA, 2010);
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Bats;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Birds;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Mammals;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Reptiles;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Frogs;
- BHP Billiton Iron Ore (2011) Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-012);
- BHP Billiton Iron Ore (2010) Terrestrial Fauna Habitat Assessment Proforma (FRM-IEN-EMS-003); and
- BHP Billiton Iron Ore (2013) Biological Survey Data and Digital Photography Requirements (SPR-IENEMS-015).

3.2 Database Searches

Two databases were searched to obtain information on species previously recorded during field surveys (NatureMap) or conservation significant species likely to occur within the study area (Protected Matters Database) (Table 4):

- DPaW's NatureMap database - to determine threatened fauna recorded from the region which also incorporates the results of the Pilbara Biological Survey (DPaW 2011); and
- Department of the Environment (DoE)'s Protected Matters Database - to determine matters of national environmental significance recorded from the area.

Table 4 Databases used for the vertebrate fauna review.

Provider	Database	Parameters
Department of Parks and Wildlife	NatureMap Accessed 6 July 2014	Circle of radius 5 km centred on the point - 120° 10' 14" E, 23° 18' 59" S
DoE	Protected Matters Database Search Tool. Accessed August 2015	Circle of radius 5 km centred on the point - -23.3166, 120.17092

3.3 Field Survey Methodology

The purpose of the survey was to verify data collated during the literature and database reviews, map and describe the fauna habitats present within the study area, and undertake a Level 1 survey for vertebrate fauna.

3.3.1 Timing and Personnel

The Level 1 vertebrate fauna field survey was completed between the 15th and 16th of July 2015 by Principal Zoologist Mr Morgan O'Connell. A total of two person days were spent in the field completing targeted significant fauna searches and fauna habitat mapping.

3.3.2 Targeted Transects

Targeted transect locations covered the entire study area. During the targeted transects all the vertebrate fauna species encountered were recorded, either from primary (*i.e.* direct observation) or secondary (*e.g*. burrows, scratchings, diggings and scats) evidence.

3.3.3 Opportunistic Records

Opportunistic records of vertebrate species encountered during the survey were documented. Birds were recorded on a presence/absence basis and were targeted during early morning transects. Presence was determined by call identification, visual identification and/or tracks and traces. Binoculars were used to determine species and to investigate potential nesting sites. Opportunistic reptile encounters were recorded during transects.

3.3.4 Fauna Habitat Mapping and Assessment

Eight fauna habitat assessments were conducted during this survey (Figure 5). Habitats in the study area were assessed using methodology and terminology adapted from the Australian Soil and Land Survey Field Handbook (Commonwealth Scientific and Industrial Research Organisation 2009) and modified to suit the survey requirements according to BHP Billiton Iron Ore guidelines.

Fauna habitats were also assessed for the likelihood that they may support conservation significant fauna. All major fauna habitats present within the study area were sampled and scored for importance (High, Medium or Low) according to the criteria shown in Table 5 below.

Table 5 Fauna habitat importance assessment criteria.

Score	Criteria
High	1) Habitat supports EPBC Act listed threatened fauna. OR 2) Habitat for species listed as above is present in the study area, and there are records of that species within 50 km of the study area. If limited surveys have been undertaken in the vicinity of the study area then a precautionary approach will be used and the species will be considered likely to be present. OR 3) Uncommon habitat is critical habitat for a population of DPaW listed Priority fauna. For example, if habitat is limited in the region and the habitat in the study area forms a significant portion of the known habitat for a Priority species, it would be scored as High significance. OR 4) Habitat that only occurs in small isolated geographic areas.
Medium	1) Habitat supports DPaW listed Priority fauna that are largely restricted to that habitat type within the study area. OR 2) Habitat supports EPBC Act listed Migratory fauna. OR 3) Habitat supports a particularly diverse and uncommon faunal assemblage. Habitat that occurs throughout region, and does not occur in small or isolated areas, is excluded.
Low	Habitat is widespread, common, and does not solely support any significant fauna.

Habitat assessments were undertaken to determine the quality of available fauna habitat and the likelihood of habitat to support species of conservation significance. Fauna habitats were identified and mapped using vegetation association mapping and aerial imagery of the study area.

209000 210000 211000 212000

7422000 7421000 7420000 7419000 7418000

JIMT1
JIMT2
JIMT3
JIMT4
JIMT5
JIMT6
JIMT7
JIMT8

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FIGURE 5

Location of fauna sites sampled within the study area

0 250 500 750
Meters

1:15,000

Datum: GDA94
Projection: MGA Zone 51

ONSHORE ENVIRONMENTAL

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Legend

- Study Area
- Fauna Sample Location

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3.3.5 Field Survey Constraints

The EPA *Guidance Statement for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b) list twelve potential constraints that field surveys may encounter. These constraints are addressed in Table 6 below.

Table 6 Relevance of constraints, as identified by EPA (2004b), to the fauna surveys.

Potential limitation or constraint	Applicability to the surveys
Experience of personnel	The Principal Zoologist that conducted this survey is regarded as suitably qalified with over 11 years experience.
Scope	The scope for the survey was established by BHP Billiton Iron Ore and is in compliance with relevant EPA Guidance Statements
Proportion of fauna identified.	All observed fauna were identified at the point of observation.
Sources of information (recent or historic) and availability of contextual information.	A number of surveys have been undertaken in the study area and the surrounding region. DPaW has also completed the Pilbara Biological Survey, which provided information on regional distribution of selected species. These reports were available at the time of reporting.
Proportion of the task achieved.	All allocated tasks have been achieved during the survey.
Disturbances (e.g. fire or flood).	Disturbances within the study area include introduced mammalian speciesand historical access track. None of these disturbances affected the ability to complete the survey. However, significantly cold conditions prevailed during the current study, which drastically reduce the activity of taxa such as reptiles.
Intensity of survey.	A level 1 survey was identified by BHP Billiton Iron Ore as the requirement for this survey and the survey was completed adequatley to this level.
Completeness of survey.	The survey was completed according to the requirements of the scope.
Resources (e.g. degree of expertise available).	All resources required to complete the survey were available.
Remoteness or access issues.	All areas in the tenement were accessible either by vehicle or on foot; all habitats within the study area have been surveyed and all habitats considered to be suitable for conservation significant species have been searched.

3.4 Taxonomy and Nomenclature

The latest checklist of mammals, reptiles and amphibians published by the WA Museum was used as a guide to the current taxonomy and nomenclature of these groups. This updated list in turn is formulated using up-to-date taxonomical literature. For birds, the current checklist of Australian birds, maintained by Birds Australia, was used. The bird list is based on the most recent review of the systematics and taxonomy of Australian birds by Christidis and Boles (2008).

3.5 Assessment of Conservation Significance

Within Western Australia, all native fauna is protected under the WC Act and any action that has the potential to impact on native fauna needs to be approved by relevant State and/or Federal departments as dictated by the State *Environmental Protection Act 1986* and the Federal EPBC Act.

Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are called *conservation significant species*. A summary of applicable legislation and status codes is provided in Table 7. Additional information on Status Codes is provided in Appendix 5.

A number of migratory bird and marine species are prioritised for conservation under the EPBC Act or international agreements. In addition the International Union for the Conservation of Nature (IUCN) compiles a 'Red List' upon which species at risk of extinction are listed. For some species there is insufficient information to determine their status. These species are generally considered by the EPA/DPaW as 'conservation significance' for all development related approvals and are listed on a 'Priority List' which is regularly reviewed and maintained by the DPaW.

DPaW also identifies TECs that are naturally occurring biological assemblages found to fit into one of the four categories (Table 7). Possible threatened ecological communities that do not meet these survey criteria are added to DPaWs PECs lists under Priorities 1, 2 and 3.

Table 7 Conservation significance assessment guidelines.

Level	Agreement, Act or List	Status Codes
International	The IUCN *Red List* lists species at risk under nine categories (listed under 'Status Codes').	IUCN Extinct IUCN Extinct in the Wild IUCN Critically Endangered IUCN Endangered IUCN Vulnerable IUCN Near Threatened IUCN Least Concern IUCN Data Deficient IUCN Not Evaluated

Level	Agreement, Act or List	Status Codes
	Migratory taxa listed under the following international conventions are generally listed as Migratory or Marine under the federal *Environment Protection and Biodiversity Conservation Act 1999* (see below): Japan-Australia Migratory Bird Agreement (JAMBA); China-Australia Migratory Bird Agreement (CAMBA); Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA); and, Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).	Generally listed as Migratory or Marine under the federal Environment Protection and Biodiversity Conservation Act 1999[1]
Federal	Environment Protection and Biodiversity Conservation Act 1999 (EPBC) DSEWPaC lists threatened fauna, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists fauna that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes').	Extinct Extinct in the Wild Critically Endangered Endangered Vulnerable Conservation Dependent Migratory Marine
State	Wildlife Conservation Act 1950 (WC Act) At a state level, native fauna are protected under the *Wildlife Conservation Act 1950*. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable.	Schedule 1 Schedule 2 Schedule 3 Schedule 4
State	DPaW Priority list (DPaW) The DPaW produces a list of Priority species and ecological communities (e.g. Priority Ecological Communities (PECs) or Threatened Ecological Communities (TECs)) that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. This system gives a ranking from Priority 1 to Priority 5.	Priority 1 Priority 2 Priority 3 Priority 4 Priority 5

[1] Species declared as 'Marine' under section s248 of the EPBC Act were not separately listed in this report.

4.0 Results- Flora and Vegetation

4.1 Desktop Review

4.1.1 Regional Surveys

The flora and vegetation of the Pilbara has been mapped and described at broad scale by Burbidge (1959) and Beard (1975). More recently, the Department of Agriculture compiled an inventory and condition survey of the Pilbara (van Vreeswyk *et al.* 2004), which provides an inventory of flora and a description of land resources in terms of land systems. Data from the Pilbara Region Biological Survey 2002-2009 by DPaW are currently being analysed. With the exception of the weed information (Keighery 2010), vegetation and native flora data have not yet been published. The DPaW survey will provide a regional context that is necessary to assess the likely impact of future development proposals. The survey will provide information on patterns in the distribution of flora and fauna to help stakeholders make decisions about conservation requirements and the sustainable use of natural resources.

4.1.2 Previous Flora and Vegetation Surveys

Since the 1970s, large-scale resource developments of iron ore projects have resulted in the collection of a significant amount of site-specific biological survey data in the region, most of which is undertaken for formal environmental impact assessment.

The survey area partially overlaps the riparian flora and vegetation survey of Jimblebar Creek (Onshore Environmental 2015a), with the recent baseline survey of the OB31 tenement occurring in close proximity to the west (Onshore Environmental 2014a).

Additionally a total of 39 previous surveys occurring within a 25 km radius of the study area were reviewed to provide local context and inform flora and vegetation values that may occur within the area of interest. Table 8 summarises the review findings including previous records for conservation significant flora and introduced weed species.

Previous flora and vegetation surveys within 25km of the study area are listed below:

- Onshore Environmental (2015b) Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey;
- Onshore Environmental (2014a) Orebody 31 Level 2 Flora and Vegetation Survey
- Onshore Environmental (2014b) Targeted Significant Flora Assessment Orebody 31;
- Onshore (2014c) Dynasty Flora and Vegetation Review;
- Onshore Environmental (2014d) Tenement E52/2238 Level 1 Flora & Vegetation and Vertebrate Fauna Survey;
- Onshore Environmental (2014e) Orebody 18 to Orebody 31 Proposed Infrastructure Corridor Targeted Flora Survey;
- Syrinx Environmental (2014) South West Jimblebar Flora and Vegetation Survey;
- Onshore Environmental (2013a) Orebody 19 Level 2 Flora and Vegetation Assessment;
- Onshore Environmental (2013b) Orebody 17/18 Derived Vegetation Association Mapping Report;
- Syrinx Environmental (2012) Wheelarra Hill North Level 2 Flora and Vegetation Assessment;
- Astron Environmental Services (2012) Eastern Mines Weed Survey, Jimblebar;
- Syrinx Environmental (2011) OB 31 Flora and Vegetation Assessment;
- ENV Australia (2010a) RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment;

- ENV Australia (2010b) Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment;
- Outback Ecology Services (2010) Jimblebar Iron Ore Project Flora and Vegetation Assessment;
- Outback Ecology Services (2009a) Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment;
- Outback Ecology Services (2009b) Jimblebar Linear Development Flora and Vegetation Assessment;
- Outback Ecology Services (2009c) Eastern Pilbara Accommodation Camp Flora and Fauna Assessment;
- ENV Australia (2009a) Jimblebar Spur 2 Flora and Vegetation Assessment;
- ENV Australia (2009b) Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment;
- ENV Australia (2009c) Ammonium Nitrate Storage Facility Flora and Vegetation Assessment;
- Pilbara Flora (2008) OB17 Flora and Vegetation Survey;
- GHD (2008a) Draft Report for Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification – *Goodenia hartiana;*
- GHD (2008b) Mesa Gap Biological Survey;
- ENV Australia (2008a) Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment;
- ENV Australia (2008b) Jimblebar Access Road Flora and Vegetation Assessment;
- ENV Australia (2007a) West Jimblebar Exploration Lease Flora and Vegetation Assessment – Management Recommendations;
- ENV Australia (2007b) Jimblebar Wye Rail Junction (Borrow Areas) Flora and Vegetation Assessment;
- ENV Australia (2007c) RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment;
- ENV Australia (2007d) OB 18 Flora and Vegetation Assessment Phase II;
- ENV Australia (2007e) Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments;
- Ecologia Environmental (2006) Jimblebar Marra Mamba Exploration Biological Survey;
- Ecologia Environmental (2004a) OB 18 Flora and Fauna Review;
- Ecologia Environmental (2004b) Jimblebar-Wheelarra Hill Expansion Biological Study;
- Biota (2004) Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment;
- Ecologia Environmental (1996) Jimblebar Rail Spur Biological Assessment Survey;
- BHPIO (1994) Jimblebar Mine Site Biological Survey; and
- Dames & Moore (1993) Ecological Observations Jimblebar Railway Line.

Table 8 Summary of background and results for previous flora and vegetation surveys completed within, or in close proximity to, the study area.

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore Environmental (2015a) Riparian Flora and Vegetation Baseline Survey Jimblebar Creek	Partially overlapping the study area	8th - 12th September 2014	19 vegetation associations and seven broad floristic formations	167 plant taxa from 39 families and 97 genera dominant families; Poaceae, Fabaceae, and Malvaceae, dominant genera; *Acacia* (15 taxa), followed by *Senna* (8 taxa), *Eragrostis* (5 taxa) and *Eremophila* (5 taxa) Three weed species; **Bidens bipinnata,* **Cenchrus setiger* and **Cenchrus ciliaris*	No Threatened or Priority flora Three range extensions; *Chamaecrista symonii, Eragrostis speciosa* and *Halgania erecta*
Onshore Environmental (2015b) Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey	Approx. 12km to the south west of the study area	23rd February – 1st March 2015	26 vegetation associations and 11 broad floristic formations	263 plant taxa (from 36 families and 106 genera, dominant families; Fabaceae, Poaceae, Malvaceae, Chenopodiaceae and Amaranthaceae, dominant genera *Acacia* (25 taxa), *Sida* (13 taxa), *Senna* (12 taxa), *Eremophila* (9 taxa) and *Ptilotus* (9 taxa)	No Threatened Flora Three priority species; *Ipomoea racemigera* (Priority 2*), Goodenia nuda* (Priority 4*) and Goodenia berringbinensis (*Priority 4*)* Five range extensions; *Eragrostis speciosa* (150 km south-east), *Hibiscus verdcourtii* (200 km east), *Goodenia berringbinensis* (250 km north), *Eleocharis pallens* (350 km south-east) and *Tribulus* cf. *eichlerianus* (950 km west)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore Environmental (2014a) Orebody 31 Level 2 Flora and Vegetation Survey	OB31 is located approximately 35km east-northeast of Newman Adjacent to the study area to the west	1st -14th October 2013 45 quadrats and 146 relevés	35 vegetation associations within 15 broad floristic formations	280 taxa from 35 families and 110 genera, dominant families; Fabaceae, Poaceae, Malvaceae and Chenopodiaceae, dominant genus; *Acacia* (40 taxa), *Senna* (11 taxa), *Sida* (11 taxa) and *Eremophila* (10 taxa), two weed species; **Cenchrus ciliaris* and **Malvastrum americanum*	No Threatened Flora Two priority species: *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), and one undescribed species; *Acacia* sp. nov (reticulate/anastomosing)[2]
Onshore Environmental (2014b) Targeted Significant Flora Assessment Orebody 31	OB31 is located approximately 35km east-northeast of Newman Adjacent to the study area to the west	24th- 30th April 2014	Not recorded	Not Recorded	No Threatened Flora Three priority species: *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), *Goodenia nuda* (P4) and one undescribed species; *Acacia* sp. nov (reticulate/anastomosing). One range extension *Acacia clelandii*

[2] Now known as *Acacia* sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (Priority 1)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore (2014c) Dynasty Flora and Vegetation Review	The Dynasty study area is located approximately 25km east of Newman. Approx. 12km to the south west of the study area	Desktop review (February 2014)	Nine vegetation associations, six broad floristic formations	Not reviewed	No Threatened Flora likely to occur; six Priority flora taxa that may occur on the basis of suitable habitat and previous records nearby; *Aristida jerichoensis* var. *subspinulifera* (P1), *Gymnanthera cunninghamii* (P3), *Goodenia nuda* (P4), *Josephinia* sp. Marandoo (M.E. Trudgen 1554) (P1), *Rhodanthe frenchii* (P2), *Rostellularia adscendens* var. *latifolia* (P3)
Onshore Environmental (2014d) Tenement E52/2238 Level 1 Flora and Vegetation and Vertebrate Fauna Survey	Approx. 9km south-west	8th - 10th July 2014	18 vegetation associations, 11 broad floristic formations	Not recorded	No Threatened or Priority flora
Onshore Environmental (2014e) Orebody 18 to Orebody 31 Proposed Infrastructure Corridor Targeted Flora Survey	Approx. 9km south-west	Targeted flora survey 13th September 2014	Not recorded	Not recorded One weed species; **Cenchrus ciliaris*	No Threatened Flora Two priority flora; *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), *Goodenia nuda* (P4)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Syrinx (2014) South West Jimblebar Flora and Vegetation Survey	South West Jimblebar is located approx. 40 km east of Newman, and is adjacent to the existing Jimblebar/Wheelarra Hill mine. Approx. 13km to the southwest of the study area	38 quadrats and four relevés. 14-18 March 2011, 27th August -4th September 2013	17 vegetation associations, 10 broad floristic formations	330 plant taxa from 33 families and 93 genera, dominant families; Poaceae, Fabaceae, and Malvaceae, dominant genera; *Acacia* (26 taxa), *Ptilotus* (13 taxa), *Eremophila* and *Senna* (both 11 taxa), Three weed species; **Bidens bipinnata,* *Cenchrus *ciliaris,* **Cenchrus setiger,* **Cucumis melo,* **Malvastrum americanum,* **Taraxacum officinale* and **Vachellia farnesiana*	No Threatened Flora. Three Priority flora taxa; *Aristida jerichoensis* var. *subspinulifera* (P1), *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (1) and *Euphorbia inappendiculata* var. *inappendiculata* (P2) Five range extensions: *Abutilon malvifolium, Brachyscome ciliaris* var. *ciliaris, Euphorbia porcata, Leptochloa fusca* subsp. *muelleri* and *Tephrosia sphaerospora*
Onshore Environmental (2013a) Orebody 19 Level 2 Flora and Vegetation Assessment	Approx. 12km to the west of the study area	19th - 27th March 2013, 9th- 22nd September 2013 30 quadrats	22 vegetation associations, 8 broad floristic formations	271 taxa, from 40 families and 108 genera, dominant families; Fabaceae (63 taxa), Poaceae (46 taxa) and Malvaceae (32 taxa) families, four weed species; **Bidens bipinnata,* **Cenchrus ciliaris,* **Cenchrus setaceus* and **Portulaca oleracea*[3]	No Threatened Flora Two priority flora species; *Isotropis parviflora* (P2) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3)

[3] *Portulaca oleracea* no longer considered to be a weed

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore (2013b) Orebody 17/18 Derived Vegetation Association Mapping Report	Small area of OB 17/18 located in the Eastern Pilbara, west of the Jimblebar/Wheelarra Hill mining operations. Approx. 10km west of the study area	Desktop survey	Five of the 27 vegetation associations described by ENV (2007d)	Not recorded	No Threatened or Priority Flora
Syrinx (2012) Wheelarra Hill North Level 2 Flora and Vegetation Assessment	Wheelarra Hill is located in the eastern Ophthalmia Range, approx. 40 km east of Newman, adjacent to the existing Jimblebar/Wheelarra Hill mine, south of the study area	83 quadrats First: 17th-29th May 2011 Second: 4th -12th October 2011 83 quadrats and 19 relevés	25 vegetation associations, 9 broad floristic formations	411 taxa from 49 families and 145 genera, dominant families; Fabaceae (78 taxa), Poaceae (58 taxa) and Malvaceae (47 taxa), dominant genera; *Acacia* (40 taxa), *Ptilotus* (16 taxa) and *Senna* (15 taxa), four weeds species; **Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum* and **Portulaca oleracea*	No Threatened Flora. One priority flora *Aristida ?jerichoensis* var. *subspinulifera* (P1) Nine range extensions: *Sclerolaena minuta, Eragrostis olida, Oldenlandia galioides, Evolvulus alsinoides* var. *decumbens, Phyllanthus erwinii, Phyllanthus maderaspatensis, Santalum spicatum, Cyperus ixiocarpus, Abutilon cunninghamii* and two possible range extensions; *Tephrosia* aff. *sphaerospora, Hibiscus* aff. *apodus*

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Astron (2012) Eastern Mines Weed Survey, Jimblebar	Jimblebar Mine site, 30 km east of the Newman township Approx. 6 km to the south of the study area.	22nd -30th May 2012 25 project monitoring sites and 6 reference monitoring sites	Not recorded	12 weed species; **Acetosa vesicaria, *Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Chloris barbata, *Chloris virgata, *Citrullus colocynthis, *Cynodon dactylon, *Malvastrum americanum, *Solanum nigrum, *Sonchus asper, *Vachellia farnesiana*	Not recorded
Syrinx (2011) OB 31 Flora and Vegetation Assessment	OB 31 is located approx. 35 km east of Newman Adjacent to the study area to the west	10th -15th February and 9-13 March 2011 29 quadrats	21 vegetation associations, 12 broad floristic formations	206 taxa from 36 families and 93 genera, dominant families; Fabaceae (10 taxa), Malvaceae (20 taxa) and Chenopodiaceae (12 taxa), three weed species; **Bidens bipinnata*, **Cenchrus ciliaris*, **Malvastrum americanum*	No Threatened or Priority flora
ENV (2010a) RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment	Jimblebar Mine is located 30km east of Newman Approx. 6 km to the south of the study area	16 quadrats and seven relevés November 2009	Fourteen vegetation associations	166 taxa from 33 families and 81 genera, dominant families; Poaceae (29 taxa), Mimosaceae (25 taxa) and Malvaceae (15 taxa), dominant genera; *Acacia* (25 taxa), *Senna* (10 taxa) and *Ptilotus* (8 taxa), two weed species; **Cenchrus ciliaris* and **Malvastrum americanum*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2010b) Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment	The Jimblebar Wye Project area is approx. 14 km northeast of Newman Approx. 25 km west of the study area	3rd -5th March 2010 8th -11th June 2010 Transects in habitats known to support the targeted DRF and Priority Listed Flora	Not recorded	Not recorded	No Threatened flora One Priority flora; *Gymnanthera cunninghamii* (P3)
Outback Ecology (2010) Jimblebar Iron Ore Project Flora and Vegetation Assessment	The Jimblebar Mine is located 30km east of Newman Approx. 6 km to the south of the study area	128 quadrats July and September 2008, January and March 2009	21 vegetation associations, 12 broad floristic formations	326 taxa from 42 families and 111 genera, dominant genera; *Acacia* (43 taxa), *Senna* (15 taxa), *Ptilotus* (14 taxa), *Eremophila* (14 taxa) and *Sida* (10 taxa), six weed species; **Acetosa vesicaria, *Bidens bipinnata, *Cenchrus ciliaris, *Cucumis melo, *Cucumis myricarpus, *Malvastrum americanum*	No Threatened Flora Two current priority flora; *Josephinia* sp. Marandoo (P1), *Goodenia nuda* (P4)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Outback Ecology (2009a) Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	22 quadrats. This report documents the results of supplementary flora and vegetation surveys conducted in October and November 2008 and January 2009	Five vegetation associations	146 plant taxa from 29 families and 62 genera; one introduced weed species, **Cenchrus ciliaris*	No Threatened Flora One current Priority flora, *Goodenia nuda* (P4)
Outback Ecology (2009b) Jimblebar Linear Development Flora and Vegetation Assessment	The Jimblebar Linear development is located 15km east of Newman and extends east towards Jimblebar Approx. 25 km west of the study area	66 quadrats, 17 relevés October 2008, March 2009	Sixteen vegetation associations	275 taxa, from 41 families and 111 genera; dominant families; Acacia (33 taxa), Eremophila (14 taxa) and Senna (13 taxa), 11 weed species; **Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Cucumis melo* subsp. *agrestis, *Cynodon dactylon, *Echinochloa colona, *Malvastrum americanum, *Setaria verticillata, *Tribulus terrestris, *Vachellia farnesiana*	No Threatened Flora One priority flora *Aristida jerichoensis* var. *subspinulifera* (P1)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Outback Ecology (2009c) Eastern Pilbara Accommodation Camp Flora and Fauna Assessment	The East Pilbara accommodation camp is located approx. 30km east of Newman Approx. 22km west of the study area	15 quadrats 30th October – 4th November 2008	Sixteen vegetation associations	115 taxa from 23 families and 44 genera; dominant families; Mimosaceae, Poaceae, Caesalpinaceae, Myrtaceae, Papilionaceae, Myoporaceae, and Chenopodiaceae, dominant genera; *Acacia* (23 taxa), *Senna* (12 taxa) and *Eremophila* (8 taxa); no weed species	No Threatened or Priority flora
ENV (2009a) Jimblebar Spur 2 Flora and Vegetation Assessment	Approx. 15 km west southwest of the study area	10 quadrats and 3 relevés 14th - 18th September 2009	Ten vegetation associations	152 taxa from 33 families and 79 genera, dominant families; Poaceae (28 taxa), Mimosaceae (20 taxa) and Amaranthaceae (11 taxa), dominant genera; *Acacia* (20 taxa), *Ptilotus* (eight taxa), *Senna* and *Goodenia* (7 taxa each), three weed species; **Cenchrus ciliaris,* **Malvastrum americanum* and **Bidens bipinnata*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2009b) Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	23 quadrats and 8 relevés 17th September and 4th - 6th November 2009	Nineteen vegetation associations	213 taxa from 38 families and 91 genera, dominant families; Poaceae, Mimosaceae and Malvaceae, dominant genera; *Acacia* (32 taxa), *Senna* (11 taxa) and *Ptilotus* (10 taxa), two weed species; **Cenchrus ciliaris*, **Malvastrum americanum*	No Threatened Flora One current priority flora *Goodenia nuda* (P4)
ENV (2009c) Ammonium Nitrate Storage Facility Flora and Vegetation Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	7 quadrats and one relevé 17th September 2009	Eight vegetation associations	123 taxa from 34 families and 70 genera, dominant families; Poaceae (23 taxa), Mimosaceae (16 taxa), Malvaceae (10 taxa), dominant genera; *Acacia* (16 taxa), *Ptilotus* (7 taxa) and *Senna* (6 taxa), two weed species; **Cenchrus ciliaris* and **Portulaca oleracea*	No Threatened or Priority flora
Pilbara Flora (2008) OB17 Flora and Vegetation Survey	North-east corner of the OB 17/18 Study area 10km west of the study area	October 2008	Six vegetation associations from four landforms	61 taxa from 39 genera and 23 families, dominant families; Fabaceae (35 taxa), Poaceae (20 taxa) and Myrtaceae (8 taxa), no weed species	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
GHD (2008a) Draft Report for Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification - *Goodenia hartiana*	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	12 quadrats 25th -26th September 2007	Not recorded	Not recorded	No Threatened or Priority flora
GHD (2008b) Mesa Gap Biological Survey	Situated between OB 18 and Wheelarra Hill mine sites Approx. 10km south-west of the study area	40 quadrats October 2007	Eight vegetation associations from seven landforms	133 plant taxa from 32 families, dominant families; Fabaceae (15 taxa), Poaceae (9 taxa) and Myrtaceae (6 taxa), no weed species	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2008a) Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment	The Jimblebar Wye Project area is approx. 14 km northeast of Newman Approx. 30km west of the Study area	6 quadrats and 1 relevé 12th -13th June 2008	Six broad vegetation communities	163 taxa from 95 genera, dominant families; Poaceae (28 taxa), Mimosaceae (14 taxa), Amaranthaceae (11 taxa) and Malvaceae (11 taxa), dominant genera; *Acacia* (13 taxa), *Eremophila* (9 taxa) and *Senna* (7 taxa), 14 weed species; **Acetosa vesicaria*, **Aerva javanica*, **Brassica tournefortii*, **Cenchrus ciliaris*, **Citrullus lanatus*, **Cucumis melo* subsp. *agrestis*, **Cynodon dactylon*, **Datura leichhardtii*, **Malvastrum americanum*, **Portulaca oleracea, *Setaria verticillata*, **Sonchus asper*, **Sonchus oleraceus* and **Vachellia farnesiana*	No Threatened Flora recorded One current Priority flora species, *Rostellularia adscendens* var. *latifolia* (P3) A second Priority 1 flora recorded *Eremophila* sp. Ophthalmia Range (R. Brearley s.n. 20/3/2004) has since been renamed *Eremophila margarethae* (not Threatened)
ENV (2008b) Jimblebar Access Road Flora and Vegetation Assessment	Project area is 15 km east of Newman township Approx. 23km east of the study area	20th -23rd May 2007. 22 quadrats	Ten vegetation associations	112 taxa from 28 families, three weed species were recorded; **Cenchrus ciliaris*, **Aerva javanica* and **Citrullus lanatus*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2007a) West Jimblebar Exploration Lease Flora and Vegetation Assessment – Management Recommendations	West Jimblebar Exploration Lease area Approx. 15km to the south-west of the study area	29 quadrats 14th -18th May 2007	Not recorded	318 taxa from 113 genera and 44 families, dominant families; Poaceae, Mimosaceae and Malvaceae, three introduced weed species; **Cenchrus ciliaris, *Malvastrum americanum, *Bidens bipinnata*	No Threatened flora One current Priority flora species; *Goodenia nuda* (P4) One range extension; *Thyridolepis xerophila*
ENV (2007b) Jimblebar Wye Rail Junction (Borrow Areas) Flora and Vegetation Assessment	Approximately 30 km west of the study area	20 quadrats 21st -24th August 2007	Eleven vegetation associations	Three introduced weed species; **Cynodon dactylon, *Cenchrus ciliaris, *Vachellia farnesiana*	No Threatened or Priority flora
ENV (2007c) RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	4 quadrats 27th November - 1st December 2006	Four vegetation associations classified into three landform types; creekline, floodplain and plain	65 plant taxa (44 genera); dominant families; Poaceae (14 taxa), Mimosaceae (11 taxa) and Malvaceae (5 taxa); two introduced weed species; **Bidens bipinnata, *Cenchrus ciliaris*	No Threatened or Priority flora
ENV (2007d) OB 18 Flora and Vegetation Assessment Phase II	OB 18 is located 32 km east of the Newman townsite in the Ophthalmia Ranges Approx. 10km west of the study area	71 quadrats and relevés July and August 2006	A total of 27 vegetation associations classified into six broad landforms - Hill crests, Hill slopes, Gorges and Gullies, Drainage lines, Footslopes and Flood plains	276 taxa from 46 families; dominant families; Poaceae (41 taxa), Mimosaceae (30 taxa), Amaranthaceae (19 taxa) and Malvaceae (18 taxa); two weed species, **Acetosa vesicaria* and **Cenchrus ciliaris*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2007e) Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	4 quadrats April - June 2007	Six vegetation associations	103 taxa from 24 families, dominant families; Poaceae (30 species), Mimosaceae (17 species) and Papilionaceae (8 species), five weed species; **Cenchrus ciliaris*, **Cenchrus setiger*, **Citrullus lanatus*, **Bidens bipinnata* and **Cynodon dactylon*	No Threatened or Priority flora
Ecologia (2006) Jimblebar Marra Mamba Exploration Biological Survey	Approx. 13km south-west of the study area	105 quadrats 22nd -28th May 2006	Four vegetation associations	267 plant taxa, dominant families; Poaceae (33 species) and Malvaceae (22 species), two weed species; **Acetosa vesicaria* and **Cenchrus ciliaris*	No Threatened Flora recorded. One current priority flora *Goodenia nuda* (P4). A second Priority 3 flora recorded, *Triumfetta leptacantha* is no longer Threatened
Ecologia (2004a) OB 18 Flora and Fauna Review	OB 18 10km west of the study area	Targeted searches in July 2004	Not recorded	Not recorded	No Threatened Flora One priority flora *Rhodanthe frenchii* (P2) identified from one gorge site. It is noted that the original identification was not confirmed through the WAH and represents a 300 km range extension to the east. It has not been recorded locally during numerous surveys over a 17 year period since the original record

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Ecologia (2004b) Jimblebar-Wheelarra Hill Expansion Biological Study	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	44 quadrats (100 x 100 m) 9th February - 4th March 2004	Nine vegetation associations	181 plant species from 47 families and 80 genera; dominant genera were *Acacia* (30 species), *Senna* (10 species) and *Eremophila* (7 species), one weed species; **Cenchrus ciliaris*	No Threatened or Priority flora *Goodenia hartiana* (P2) recorded but this taxon later split and now determined to be *Goodenia* sp. Sandy Creek (not Threatened)
Biota (2004) Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	August 2003. The survey was conducted to review and update existing botanical information and recording supplementary floristic data	Six vegetation types described were based on the Ecologia (1999) flora survey of the area	227 taxa from 42 families and 99 genera, dominant genera were *Acacia* (29 taxa), *Senna* (15 taxa) and *Ptilotus* (9 taxa), one weed species was **Acetosa vesicaria*	No Threatened or Priority flora One Priority species, *Tephrosia* sp. Pilbara Ranges (P3). This species has been re-named *Tephrosia oxalidea* and is no longer Threatened

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Ecologia (1996) Jimblebar Rail Spur Biological Assessment Survey	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	2 quadrats (100 m x 100 m), with additional opportunistic vegetation sampling. 6th -8th June 1995	The survey area encompassed the breadth of a creekline, but did not extend to surrounding hills. Two vegetation types were recorded	106 taxa from 32 families and 71 genera, dominant families; Poaceae, Mimosaceae and Chenopodiaceae and Caesalpiniaceae and Malvaceae, dominant genera; Acacia (9 taxa), Senna (6 taxa), Eucalyptus (5 taxa) and Ptilotus (4 taxa), four weed species; **Cenchrus ciliaris, *Acetosa vesicaria, *Malvastrum americanum* and **Sonchus oleraceus*	No Threatened or Priority flora
BHPIO (1994) Jimblebar Mine Site Biological Survey	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area.	11th - 22nd June 1994 22 plotless sampling areas (covering approx. 100m^2 each)	Five broad vegetation associations	132 species, from 30 families, dominant families; Mimosaceae, Poaceae, Myrtaceae and Caesalpiniaceae, dominant genera; *Triodia, Acacia, Senna* and *Eremophila*, one weed species; **Acetosa vesicaria*	No Threatened Flora One Priority 3 taxon, *Cryptandra* sp. Mt Meharry (S. van Leeuwen 682). This is now known as *Cryptandra monticola* and no longer considered to be Threatened
Dames & Moore (1993) Ecological Observations Jimblebar Railway Line	Rail spur extending from Port Hedland – Newman and 32 km east to Jimblebar. Situated approximately 5 km directly south of the study area	19th - 22nd November 1992 39 borrow pits and 2 control areas	The report assessed disturbed borrow pit areas the vegetation data provided is not applicable	Not recorded	No Threatened or Priority Flora

4.1.3 Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters database was undertaken within a 50 km buffer of the study area (DoE 2015). The database search listed two Threatened Flora or their habitat as likely to occur within the study area; *Lepidium catapycnon* (Hamersley Lepidium) and *Pityrodia augustensis* (Mt Augustus Foxglove). No Threatened Ecological Communities (TECs) were recorded during the search.

4.1.4 Threatened Flora listed under the IUCN Red List Database

A search of the International Union for Conservation of Nature (IUCN) database was also conducted (IUCN 2015). No Threatened Flora was listed as likely to occur within the study area from this search.

4.1.5 Threatened Flora listed under the WA Wildlife Conservation (Rare Flora) Notice

The DPaW search identified one Threatened Flora as occurring within a 50 km radius of the study area; *Lepidium catapycnon* (DPaW 2014a).

4.1.6 Priority Flora recognised by DPaW

The DPaW rare flora database search (DPaW 2014a) identified 86 Priority flora taxa as potentially occurring within a 50 km radius of the study area (Table 9).

Table 9 Significant flora species recorded in or around the survey area from the federal and state database searches, literature and local knowledge. SCC = State Conservation Code, FCC = Federal Conservation Code

Species	SCC	FCC
Acacia bromilowiana	4	
Acacia daweana	3	
Acacia effusa	3	
Acacia subtiliformis	3	
Adiantum capillus-veneris	2	
Amaranthus centralis	3	
Aristida jerichoensis var. *subspinulifera*	1	
Astrebla lappacea	3	
Atriplex flabelliformis	3	
Atriplex lindleyi subsp. *conduplicata*	3	
Barbula ehrenbergii	1	
Bothriochloa decipiens var. *cloncurrensis*	1	
Brachyscome sp. Wanna Munna Flats (S. van Leeuwen 4662)	1	
Calotis latiuscula	3	
Calotis squamigera	1	
Cochlospermum macnamarae	1	
Crotalaria smithiana	3	
Dampiera anonyma	3	
Dampiera metallorum	3	
Dicladanthera glabra	2	
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	1	
Eremophila appressa	1	
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	2	
Eremophila magnifica subsp. *magnifica*	4	
Eremophila magnifica subsp. *velutina*	3	
Eremophila pilosa	1	
Eremophila rigida	3	

Species	SCC	FCC
Eremophila sp. Hamersley Range (K. Walker KW 136) PN	1	
Eremophila sp. Rudall River (P.G. Wilson 10512) PN	2	
Eremophila sp. Snowy Mountain (S. van Leeuwen 3737)	1	
Eremophila sp. West Angelas (S. van Leeuwen 4068)	1	
Eucalyptus lucens	1	
Eucalyptus rowleyi	3	
Euphorbia parvicaruncula	1	
Fimbristylis sieberiana	3	
Geijera salicifolia	3	
Genus sp. Hamersley Range hilltops (S. van Leeuwen 4345)	1	
Glycine falcata	3	
Goodenia hartiana	2	
Goodenia lyrata	3	
Goodenia nuda	4	
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	3	
Grevillea sp. Turee (J. Bull & G. Hopkinson ONS JJ 01.01) PN	1	
Gymnanthera cunninghamii	3	
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	2	
Hibiscus sp. Mt Brockman (E. Thoma ET 1354) PN	1	
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)	3	
Indigofera sp. Gilesii (M.E. Trudgen 15869) PN	3	
Iotasperma sessilifolium	3	
Ipomoea racemigera	1	
Isotropis parviflora	2	
Lepidium catapycnon	T	V
Maireana prosthecochaeta	3	
Myriocephalus scalpellus	1	
Nicotiana heterantha	1	
Nicotiana umbratica	3	
*Oldenl*andi*a* sp. Hamersley Station (A.A. Mitchell PRP 1479)	3	
Olearia mucronata	3	
Oxalis sp. Pilbara (M.E. Trudgen 12725)	2	
Pentalepis trichodesmoides subsp*. hispida*	2	
Peplidium sp. fortescue marsh (S. van Leeuwen 4865)	1	
Pilbara trudgenii	2	
Polymeria distigma	3	
Ptilotus subspinescens	3	
Rhagodia sp. Hamersley (M. Trudgen 17794)	3	
Rhynchosia bungarensis	4	
Rostellularia adscendens var. *latifolia*	3	
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	2	
Sida sp. Barlee Range (S. van Leeuwen 1642)	3	
Sida sp. Hamersley Range (K. Newbey 10692)	1	
Solanum albostellatum	3	
Solanum sp. Gurinbiddy Range (M.E. Trudgen & M. Trudgen MET 12775) PN	3	
Spartothamnella puberula	2	
Stemodia sp. Battle Hill (A.L. Payne 1006*)*	1	
Swainsona thompsoniana	3	
Tecticornia medusa	3	

Species	SCC	FCC
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	1	
Tetratheca fordiana	1	
Teucrium pilbaranum	1	
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	3	
Thryptomene wittweri	T	V
Triodia sp. Karijini (S. van Leeuwen 4111) PN	1	
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3	
Triodia sp. Robe River (M.E. Trudgen et al. MET 12367)	3	
Triodia triticoides	1	
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	1	
Whiteochloa capillipes	3	

4.2 Conservation Significant Flora

4.2.1 Threatened Flora

No plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of section 23F of the WC Act or listed under the EPBC Act was recorded from the study area.

4.2.2 Priority Flora

No Priority flora taxon was recorded from the study area.

4.2.3 Range Extension

One plant recorded within the study area was determined to be a range extension. *Acacia clelandii* is a spreading shrub reaching 6 m in height and occurring in sandy soils on dunes or rocky hills (Plate 5). It has characteristic terete or subterete phyllodes, occasionally flat, straight or slightly curved. It is known from populations situated approximately 150 km east of Wiluna. This species was previously collected from OB31 situated immediately to the west (Onshore Environmental 2014a). Together these collections represent a 400 km range extension north of the nearest known populations.

Acacia clelandii was recorded from 24 point locations within the central sector of the study area (Figure 6), occurring as scattered shrubs between 2 m and 6 m in height and generally providing around 2 percent ground coverage. Plants were found on eroded slopes and plains and vegetation was described as:

- Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia clelandii, Acacia adsurgens* and *Acacia ancistrocarpa* and Open Shrubland of *Senna glutinosa* subsp. x *luerssenii* and;
- Low Open Woodland of *Acacia pruinocarpa* and *Acacia macraneura* over High Open Shrubland of *Acacia wanyu, Acacia kempeana* and *Acacia clelandii* over Open Shrubland of *Eremophila fraseri.*

4.3 Introduced Species

One introduced weed species was recorded from within the study area; **Cenchrus ciliaris* (Figure 6). It occurred as scattered plants under *Corymbia hamersleyana* trees throughout the study area.

4.4 Vegetation

A total of six vegetation associations from four broad floristic formations were described and mapped within the study area (Figure 7, Table 10).

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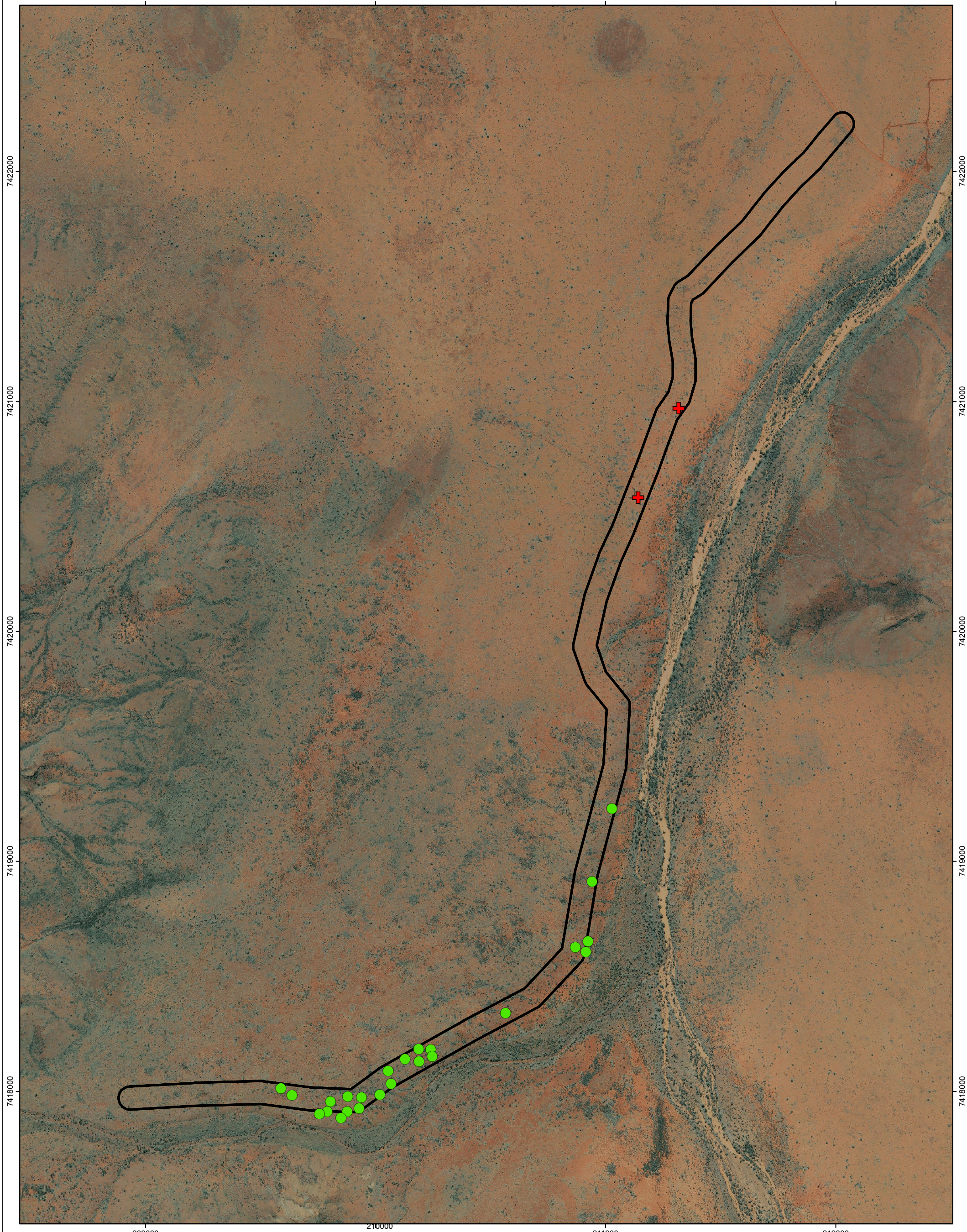

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FIGURE 6

Locations of range extension taxa and introduced weed species within the study area

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Projection: MGA Zone 51

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Figure:	6	Date:	20/08/2015
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Legend

- Study Area

Range Extension

- *Acacia clelandii*

Introduced Flora

- **Cenchrus ciliaris*

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Table 10 Descriptions for six vegetation associations mapped within the study area.

Code	Broad Floristic Formation	Vegetation Association	Characteristics	Condition
1	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia pruinocarpa*, *Acacia paraneura* and *Acacia macraneura* over High Open Shrubland of *Acacia sclerosperma* subsp. *sclerosperma, Acacia subcontorta* and *Acacia wanyu* over Open Shrubland of *Eremophila fraseri* on raised stony plains	Different species compared to normal eroded slopes including *Acacia sclerosperma* and *Acacia subcontorta*	Excellent
2	*Acacia* Open Scrub	Open Scrub of *Acacia ancistrocarpa, Acacia adsurgens* and *Acacia wanyu* over Hummock Grassland of *Triodia basedowii* and Very Open Tussock Grassland of *Cymbopogon obtectus* and *Chrysopogon fallax* on minor drainage lines dissecting stony plains	Dense high shrubland of *Acacia*	Excellent
3a	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia bivenosa* on stony plains	Dominated by *Acacia bivenosa*	Excellent
3b	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia pachyacra* and *Acacia ancistrocarpa* and Scattered Low Trees of *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* on stony sandplains	Sandy/stony plains with *Triodia basedowii*	Excellent
3c	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with High Shrubland of *Acacia ancistrocarpa, Acacia wanyu* and *Acacia kempeana* and Scattered Low Trees of *Corymbia hamersleyana* on sandplains	Denser Acacia shrublands with *Triodia basedowii*	Excellent
4	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii, Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Acacia macraneura* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia wanyu* and *Acacia kempeana* on eroded plains and slopes	Scrappy stony plains and slopes with various Acacia species	Excellent

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Legend

Study

Vegetation Type

Acacia Low Open Woodland

1 — Low Open Woodland of *Acacia pruinocarpa, Acacia paraneura* and *Acacia macraneura* over High Open Shrubland of *Acacia sclerosperma* subsp. *sclerosperma, Acacia subcontorta* and *Acacia wanyu* over Open Shrubland of *Eremophila fraseri* on raised stony plains

Acacia Open Scrub

2 — Open Scrub of *Acacia ancistrocarpa, Acacia adsurgens* and *Acacia wanyu* over Hummock Grassland of *Triodia basedowii* and Very Open Tussock Grassland of *Cymbopogon obtectus* and *Chrysopogon fallax* on minor drainage lines through stony plains

Triodia Humock Grassland

3a — Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia bivenosa* on stony plains

3b — Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia pachyacra* and *Acacia ancistrocarpa* and Scattered Low Trees of *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* on stony sandplains

3c — Hummock Grassland of *Triodia basedowii* with High Shrubland of *Acacia ancistrocarpa, Acacia wanyu* and *Acacia kempeana* and Scattered Low Trees of *Corymbia hamersleyana* on sandplains

Triodia Open Hummock Grassland

4 — Open Hummock Grassland of *Triodia basedowii, Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Acacia macraneura* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia wanyu* and *Acacia kempeana* on eroded plains and slopes

3b 2 3c 3c 3c 1 4 4 2 4 3a 3b

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FIGURE 7

Vegetation association map for the study area

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Datum: GDA94
Projection: MGA Zone 51

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Figure:	7	Date:	03/08/2015
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Broad Floristic Formation	1. *Acacia* Low Open Woodland
Vegetation Association	Low Open Woodland of *Acacia pruinocarpa*, *Acacia paraneura* and *Acacia macraneura* over High Open Shrubland of *Acacia sclerosperma* subsp. *sclerosperma, Acacia subcontorta* and *Acacia wanyu* over Open Shrubland of *Eremophila fraseri* on raised stony plains

Area Mapped	4.62 ha
Releves Sampled	C21, C22
Location	Central parts of the study area
Leaf Litter Cover (%)	2-10
Bare Ground (%)	50-70
Soils and Geology	Red clay loam with scattered cobbles and pebbles
Land System	Boolgeeda, River
Land Form	Raised stony plain
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Fire, livestock
Average Fire Age	Old (6+ years)
Characteristics	Different species compared to normal eroded slopes including *Acacia sclerosperma* and *Acacia subcontorta*

Broad Floristic Formation	*2. Acacia* Open Scrub
Vegetation Association	Open Scrub of *Acacia ancistrocarpa, Acacia adsurgens* and *Acacia wanyu* over Hummock Grassland of *Triodia basedowii* and Very Open Tussock Grassland of *Cymbopogon obtectus* and *Chrysopogon fallax* on minor drainage lines dissecting stony plains with red brown loamy sand

Area Mapped	0.88 ha
Releves Sampled	C30, C15
Location	Two small drainage lines within the central parts of the study area
Leaf Litter Cover (%)	2-10
Bare Ground (%)	10-50
Soils and Geology	Quartz/ironstone/chert cobbles with red brown loamy sand
Land System	Divide, Boolgeeda
Land Form	Minor drainage lines
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Erosion, livestock, weeds
Average Fire Age	Old (6+ years)
Characteristics	Dense high shrubland of *Acacia* is characteristic

Broad Floristic Formation	3a. *Triodia* Hummock Grassland
Vegetation Association	Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia bivenosa* on stony plains

Area Mapped	0.73 ha
Releves Sampled	-
Location	Far west of the study area
Leaf Litter Cover (%)	2-10
Bare Ground (%)	30-50
Soils and Geology	Red sandy loam with ironstone/quartz cobbles and pebbles
Land System	Boolgeeda
Land Form	Stony plains/sandplains
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Fire, access tracks nearby
Average Fire Age	Old (5-10 years)
Characteristics	Dominated by *Acacia bivenosa*

Broad Floristic Formation	3b. *Triodia* Hummock Grassland
Vegetation Association	Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia pachyacra* and *Acacia ancistrocarpa* and Scattered Low Trees of *Corymbia hamersleyana* and *Hakea lorea* subsp. *lorea* on stony sandplains

Area Mapped	38.89 ha
Releves Sampled	C28, C29, C8, C9, C13, C10, C7
Location	Northern and south-western parts of the study area
Leaf Litter Cover (%)	<2
Bare Ground (%)	30-40%
Soils and Geology	Red/orange loamy sand with ironstone and quartz pebbles
Land System	Divide, River
Land Form	Sandplain/stony sandplain
Priority Ecological Community	None
Rare Flora	*Acacia clelandii* (Range extension)
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Excellent
Disturbances	Camels, cattle grazing
Average Fire Age	Old (6+ yrs)
Characteristics	Sandy/stony plains with *Triodia basedowii*

Broad Floristic Formation	3c. *Triodia* Hummock Grassland
Vegetation Association	Hummock Grassland of *Triodia basedowii* with High Shrubland of *Acacia ancistrocarpa, Acacia wanyu* and *Acacia kempeana* and Scattered Low Trees of *Corymbia hamersleyana* on sandplains

Area Mapped	10.37 ha
Releves Sampled	C32, C27
Location	Situated along fringes of the study area
Leaf Litter Cover (%)	2-10
Bare Ground (%)	10-50
Soils and Geology	Quartz/ironstone/chert cobbles with red brown loamy sand
Land System	Divide, Newman, Fortescue
Land Form	Eroded sand plains and slopes
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Excellent
Disturbances	Erosion, livestock, weeds
Average Fire Age	Old (6+ years)
Characteristics	This unit is characterised by denser *Acacia* shrublands with *Triodia basedowii*

Broad Floristic Formation	4. *Triodia* Open Hummock Grassland
Vegetation Association	Open Hummock Grassland of *Triodia basedowii, Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Acacia macraneura* and *Acacia pruinocarpa* and High Open Shrubland of *Acacia wanyu* and *Acacia kempeana* on eroded plains and slopes

Area Mapped	7.04 ha
Quadrats Sampled	C18, C31, C32
Location	Central parts of the study area
Leaf Litter Cover (%)	2-10
Bare Ground (%)	50-70
Soils and Geology	Red clay loam with scattered cobbles and pebbles
Land System	Boolgeeda, River, Divide
Land Form	Raised stony plain
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Fire, livestock
Average Fire Age	Old (6+ years)
Characteristics	Scrappy stony plains and slopes with various *Acacia* species

4.5 Vegetation Condition

Vegetation condition was rated as *excellent* throughout the entire study area (Figure 8). The only evidence of disturbance were scattered plants of **Cenchrus ciliaris* (Buffel Grass) occurring under *Corymbia hamersleyana* trees (Figure 6).

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FIGURE 8

Vegetation condition within the study area

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Legend

Study Area

Vegetation Condition

Excellent

N

5.0 Results - Vertebrate Fauna

5.1 Desktop Review

5.1.1 Previous Vertebrate Fauna Surveys in the Vicinity of the Study Area

A review of all relevant previous fauna surveys commissioned and held by BHP Billiton Iron Ore within the vicinity of the study area was undertaken. Parameters including surveyor (consultant), location, timing, methodology and findings (including conservation significant species recorded) for the previous surveys are summarised in Table 11.

5.1.2 Database Searches

The NatureMap search, based on a 5 km radius around the mid point of the study area, revealed the following conservation significant species may occur:

Mammals

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

Birds

- Rainbow Bee-eater *Merops ornatus* – EPBC Act Migratory, WC Act Schedule 3.

The EPBC Act Protected Matters database for a 10 km radius around the study area, identified four Threatened fauna species and five migratory species, or their habitats, as potentially occurring within the study area:

Threatened species

- Northern Quoll *Dasyurus hallucatus* – EPBC Act Endangered;
- Greater Bilby *Macrotis lagotis* – EPBC Act Vulnerable;
- Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Pilbara form) – EPBC Act Vulnerable; and
- Northern Marsupial Mole *Notoryctes caurinus* – EPBC Act Endangered[4].

Migratory Species

- Fork-tailed Swift *Apus pacificus*– EPBC Act Migratory; WC Act Schedule 3;
- Rainbow Bee-eater *Merops ornatus* – EPBC Act Migratory, WC Act Schedule 3;
- Great Egret *Ardea alba* – EPBC Act Migratory;
- Cattle Egret *Ardea ibis* – EPBC Act Migratory, and WC Act Schedule 3; and
- Oriental Plover *Charadrius veredus* – EPBC Act Migratory and WC Act Schedule 3.

[4] The habitat for this species (sand ridges) is not present within the study area, thus this species is not discussed further.

Table 11 Timing and methodologies followed during previous fauna surveys in the vicinity of the study area.

	Jimblebar Biological Survey	Orebody 18 Biological Assessment Survey	Jimblebar-Wheelarra Hill Expansion Biological Survey	Jimblebar Hashimoto Vertebrate Fauna Assessment	Jimblebar Marra Mamba Exploration Biological Survey	Orebody 18 Fauna Assessment Phase II	Jimblebar West Fauna Assessment	Jimblebar Wheelarra Hill Flora and Fauna Assessment	Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment	Orebody 31 Fauna Assessment	Wheelarra Hill North Fauna Assessment	Ore Body 19 Level 2 Vertebrate Fauna Survey	OB31Vetebrate Fauna Survey	Current Survey
Ob31	BHP Iron Ore	ecologia	ecologia	ecologia	ecologia	ENV Australia	ENV Australia	Outback Ecology	Outback Ecology	ENV Australia	ENV Australia	Biologic	Biologic	Biologic
Year	1994	1995	2004	2006	2006	2007	2007	2009	2009	2011	2012	2013	2013	2015
Type	1 season with trapping Level 2	1 season with trapping Level 2	1 season with trapping Level 2	2 season with trapping Level 2	1 season No trapping Level 1	1 season with trapping Level 2	1 season with trapping Level 2	2 season with trapping Level 2	2 season with trapping Level 2	1 season No trapping Level 1	2 season with trapping Level 2	2 season with trapping Level 2	1 season with trapping Level 2	1 season No trapping Level 1
Duration	11-22 Jun 1994	10 – 19 Aug 1995	9 Feb – 13 Mar 2004	26 Aug – 16 Sep 2005, 6 – 15 Feb 2006	2-28 May 2006	18 - 29 Sep 2006	14-21 May 2007	4-15 Jun 2008, 25 Sep – 2 Oct 2008	4 to 15 Jun 2008, 27 Sep -3 Oct 2008	28 Feb – 2 Mar 2011, 29 Mar – 1 Apr 2011	7 – 18 Apr, 4 –13 Oct 2011	24 May – 6 Jun 2013, 27 Aug – 6 Sep 2013	2-11 Oct 2013, 2-6 Dec 2013 (night work)	14-16 July 2015
No. of trapping sites	18	6	5	6	none	5	1	5	9	none	7	6	5	none
Site type	Varied. Most were 10 Medium Elliott and 5 pitfalls	2 lines of 10 medium Elliott traps plus 10 pitfalls open between 7 and 10 nights.	2 trap lines of 20 Elliott,10 pitfall, 4 funnel	trap lines of 20 Elliott,10 pitfall, 2 funnel, 2 cage traps	none	5 cage traps, 10 medium Elliott traps, 20 funnel traps, 20 pot traps open for 9 nights	10 Elliott and 10 funnel traps (Trap lines also opened at Coodiner)	2 trap lines of 5 buckets, 5 pipes20 Elliott, 20 funnel traps and 2 cage traps.	2 trap lines of 20 Elliott,10 pitfall, 4 funnel, 2 cage traps	none	trap lines of 10 Elliott,1 pitfall, 2 funnel, 2 cage traps	Each trap site with trap lines of 10 pitfall (5 buckets and 5 pipes), 20 funnel, 20 Elliot and 2 cage traps	Each trap site with trap lines of 10 pitfall (5 buckets and 5 pipes), 20 funnel, 20 Elliot and 2 cage traps	none
Trap nights	675 Elliott 175 Pitfall	840 Elliott trap 359 Pitfalls	620 Elliott 307 pitfall 260 funnel	2640 Elliott 1220 pitfall 1320 funnel 360 cage	none	225 cage 450 Elliott 675 Funnel 630 pots	30 Elliott, 30 Funnel	520 Elliott 260 Pitfall 216 Funnel 52 Cage	1330 Elliott 250 pitfall 322 funnel 126 cage	none	176 Elliott 980 pitfall 1,960 funnel 316 cage	1680 Elliott 840 pitfall 1680 funnel 168 cage	700 Elliott 350 pitfall 700 funnel 70 cage	none
Diurnal search (hrs)	18	Not specified	15	59	42	Not specified	35	12	22	Not specified	60	>500	>900	10
Nocturnal search (hours)	Not specified	Not specified	Not specified	19	19	5 nights (hours not specified)	12	5.5	18.75	Not specified	19	80	80	none
Bird surveys (hrs)	9	29	12.3	45	19.7	19 hours	34	8	19	Not specified	49	11	9.3	Incidental
Bird Survey method	30 minute census	1 hour census and opportunistic	20 minute census	20 minute census	20 minute census	opportunistic	Opportunistic	60 minute census	20 minute 100 m radius census	opportunistic	15 minute census	Four 20 min surveys at each site	Four 20 min surveys at seven sites	incidental
Bat recording nights	none	none	25	30	15	6	3	1	(By Specialized Zoology)	none	2	48	28	none
Bat recording hours	none	none	Not specified	Not specified	Not specified	13.7	4	6	none	none	5	576	336	none
Bat recording method	none	none	Anabat	Anabat	Anabat	Anabat	Anabat	Anabat	none	none	Anabat & SM2BAT	SM2BAT	SM2BAT	none
Mammals (native)	6	10	8	18	6	12	5	9	10	5	23	22	17	0
Mammals (intro)	6	4	1	5	4	3	4	4	6	2		2	5	4
Birds	40	44	62	85	64	55	72	26	47	42	59	64	39	11
Reptiles	11	31	31	57	24	42	27	21	27	9	55	48	42	1
Amphibians	0	0	5	5	1	0	0	0	2	1	2	1	0	0

	Jimblebar Biological Survey	Orebody 18 Biological Assessment Survey	Jimblebar-Wheelarra Hill Expansion Biological Survey	Jimblebar Hashimoto Vertebrate Fauna Assessment	Jimblebar Marra Mamba Exploration Biological Survey	Orebody 18 Fauna Assessment Phase II	Jimblebar West Fauna Assessment	Jimblebar Wheelarra Hill Flora and Fauna Assessment	Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment	Orebody 31 Fauna Assessment	Wheelarra Hill North Fauna Assessment	Ore Body 19 Level 2 Vertebrate Fauna Survey	OB31Vetebrate Fauna Survey	Current Survey
Conservation Significant Species	Western Pebble-mound Mouse, Australian Bustard	none	Bush Stone-Curlew, Rainbow Bee-eater	Australian Bustard, Rainbow Bee-eater	Western Pebble-mound Mouse, Australian Bustard, Rainbow Bee-eater	Common Sandpiper, Bush Stone-curlew, *Ramphotyphlops ganei*	Australian Bustard, Rainbow Bee-eater	Western Pebble-mound Mouse, Rainbow Bee-eater, *Ctenotus uber johnstonei*[5]	Western Pebble-mound Mouse, Australian Bustard, Bush Stone-Curlew, Rainbow Bee-eater	None	Western Pebble-mound Mouse, Australian Bustard, Rainbow Bee-eater	Brush-tailed Mulgara, Pilbara Olive Python, Western Pebble-mound Mouse, Rainbow Bee-eater, Pilbara Flat-headed Blindsnake	Brush-tailed Mulgara, Australian Bustard, Rainbow Bee-eater	Rainbow Bee-eater, Australian Bustard

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

5.2 Fauna Species

Database searches, review of previous survey reports and results from the current survey indicated that 267 species of vertebrate fauna (excluding freshwater fish) occur in the general area (Appendix 6). The number of species occurring in the study area would be significantly less due to the limited variation in habitat types. This list comprises 45 species of mammal, 122 species of birds, 93 species of reptiles and seven species of amphibians. Of these, 16 species comprising four species of introduced mammal, 11 species of birds and one species of reptile were recorded during the current survey. Due to the lack of precise geographic position data, it is impossible to ascertain whether additional species recorded in online databases actually fall within the study area.

A number of species recorded in the vicinity during previous studies have not been recorded to-date within the study area. The absence of these records may be due to a number of reasons, including: 1) the systematic sampling effort within the actual study area is low and thus some species will not have been recorded even if they were present; 2) some species are transient and may only be present on rare occasions; 3) these species occur in similar ecological niches to other species present within the study area, and thus are not present due to competition despite suitable habitat being available; and 4) suitable habitat for these species does not occur in the study area.

5.2.1 Native Mammals

Of the 45 mammals identified in the literature and database review, four species were recorded during the current survey (Appendix 6). The four species recorded during the current survey were all introduced and were detected by tracks or scats. Two species (Northern Quoll and Greater Bilby) were identified in online databases to occur in the area but were not recorded in any previous surveys completed in the general area.

Given recent taxonomic changes in Mulgara and investigations into distribution, it is generally accepted that *Dasycercus blythi* is the only Mulgara species in the Pilbara. Some of the previous surveys have placed records under Crest-tailed Mulgara (*Dasycercus cristicauda*). Recent surveys and genetic work (Biologic 2013d) from South West Jimblebar (8 km south west of the study area) indicate that *Dasycercus blythi* occurs in the area. Likewise, previous records of the Fat-Tailed Antechinus (*Pseudantechinus macdonnellensis*) are now placed under Rory's Antechinus (*Pseudantechinus roryi*).

5.2.2 Birds

One hundred and twenty two species of native birds potentially occur in the general area, of which 11 species were recorded during the current survey (Appendix 6). The most commonly recorded species in the vicinity include Diamond Dove, Australian Owlet-nightjar, Brown Falcon, Nankeen Kestrel, Galah, Variegated Fairy-wren, Singing Honeyeater, Black-faced Cuckoo-shrike, Rufous Whistler, Pied Butcherbird, Zebra Finch, Spinifex Pigeon, Little Button-quail, Red-backed Kingfisher, Striated Grasswren, Crested Bellbird, Little Woodswallow and Painted Finch.

5.2.3 Reptiles

Of the 93 reptiles that are likely to occur in the area, one species was recorded during the current survey (Appendix 6). The most commonly recorded species in the vicinity are *Ctenophorus caudicinctus, Gehyra punctata, Gehyra variegata, Ctenotus saxatilis* and *Varanus acanthurus*. The low number of reptiles recorded during the survey can be attributed to the cold weather and short survey duration.

5.2.4 Amphibians

Seven species of amphibians are likely to occur in the region, but none were recorded from the study area, likely due to the lack of water bodies. The Red Tree Frog, *Litoria rubella,* is the most commonly recorded species in the general area.

5.2.5 Introduced Species

Eight introduced species of mammals have been recorded from the general area with four of these recorded during the current survey (Appendix 6). These include the Cat (**Felis catus*) and Dog (**Canis lupus*). Note that the Dingo (*Canis lupus dingo*) is regarded as a native species in some literature on the basis that its introduction predates the arrival of Europeans, and that mutual adaptation between dingoes and the surrounding ecosystems has occurred. In the Pilbara, however, there has been hybridisation between dingoes and domestic dogs.

5.3 Fauna Habitats

Two major fauna habitats were identified within the study area: Sand Plain and Stony Plain (see Figure 9). Habitat descriptions are presented in Table 12. The extent of each fauna habitat outside of the study area is provided.

Table 12 Fauna habitat descriptions.

Habitat	Description and habitat characteristics	Extent within the study area	Extent outside study area	Significant species associated with habitat	Photo
Sandplain	Sand Plain habitat is characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse shrubs. Within the study area, this habitat transitions into Stony Plain.	Represents a large proportion of the study area (approximately 49 ha).	This habitat is extensive in the surrounding area. Further, large representations of this habitat are located at the border of the Hamersley and Fortescue subregions and then extensively within the Chichester subregion. Habitat extends to the east of Jimblebar Creek into the Little Sandy Desert	The Brush-tailed Mulgara may utilise the habitat within the study area from time to time, currently there is no indication of their presence. Whilst the habitat is suitable for Greater Bilby, there are no records of this species in the general area. Australian Bustard is frequently encountered foraging in this habitat. The Pilbara Flat-headed Blindsnake also occurs in this habitat type.	
Stony Plain	These are erosional surfaces of gently undulating plains. Mainly support hard spinifex (and occasionally soft spinifex) with a mantle of gravel and pebbles. Within this habitat type there are small patches of sand.	Represents approximately 14 ha within the study area.	Common habitat throughout the Pilbara, especially in the north. Occurs within National Parks in the Pilbara.	This habitat may support the Pilbara Flat-headed Blindsnake and the Australian Bustard are known from this habitat type.	

209000 210000 211000 212000

7422000 7421000 7420000 7419000 7418000

Ardeotis australis

Ardeotis australis

Merops ornatus

Merops ornatus

209000 210000 211000 212000

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FIGURE 9

Fauna habitats and significant fauna within the study area

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Legend

Study Area

Fauna Habitat

Sand Plain

Stony Plain

Significant Fauna

Ardeotis australis

Merops ornatus

N

5.4 Conservation Significant Fauna

Species are defined as 'Conservation Significant' if they are listed under agreements at international (e.g. IUCN, JAMBA, CAMBA, Bonn), regional (EPBC Act) or state (WC Act, Priority list of DPaW) level. Explanations of conservation status under these Acts and Agreements are provided in Appendix 5.

Based on the results of previous surveys, a review of regional surveys, and database searches, it was determined that 18 species (six native mammals, nine birds and two reptiles) of conservation significance have the potential to occur in the study area (Table 13). Two were recorded during the current survey.

Table 13 shows conservation significant species recorded from adjacent areas and those that potentially occur within the study area.

Table 13 Summary of conservation significant fauna recorded adjacent to the study area and those potentially occur in the study area.

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	DPaW Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Mammals																			
Dascycercus blythi	Brush-tailed Mulgara																●	●	
Dasyurus hallucatus	Northern Quoll	EN	S1		EN		●												
Macrotis lagotis	Bilby, Dalgyte	VU	S1		VU		●												
Notoryctes caurinus	Northern Marsupial Mole	EN	S1		EN		●												
Macroderma gigas	Ghost Bat			P4	VU										●*				
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1				●								●*				
Pseudomys chapmani	Western Pebble-mound Mouse			P4		●					●	●	●	●		●	●		
Birds																			
Apus pacificus	Fork-tailed Swift	MG	S3				●				●								
Ardea ibis	Cattle Egret	MG	S3				●												
Ardea modesta	Eastern Great Egret	MG	S3				●												
Falco peregrinus	Peregrine Falcon		S4					●											
Ardeotis australis	Australian Bustard			P4	NT			●	●		●		●		●	●		●	●
Charadrius veredus	Oriental Plover	MG	S3				●												
Actitis hypoleucos	Common Sandpiper	MG	S3							●									
Merops ornatus	Rainbow Bee-eater	MG	S3			●	●	●				●	●	●	●	●	●	●	●
Reptiles																			
Ctenotus uber johnstonei			P2																
Ramphotyphlops ganei	Pilbara Flat-headed Blindsnake			P1						●							●		
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1														●		

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

Database Searches

DPaW Threatened Species Database search within 5 km buffer

EPBC Protected Matters search with 10 km buffer

Surveys

A) West Jimblebar Fauna Assessment (ENV Australia 2007)

B) Orebody 18 Biological Assessment Survey (ecologia Environmental 1995)

C) Orebody 18 Fauna Assessment Phase II {ENV Australia, 2007 #317}

D) Orebody 31 Fauna Assessment. {ENV Australia, 2011 #322}

E) Wheelara Hill Iron Ore Mine Modification: Fauna and Flora Assessment, {Outback Ecology Services, 2009 #326}

F) Jimblebar Iron Ore Project: Terrestrial Vertebrate Fauna Assessment. {Outback Ecology Services, 2009 #327}

G) Jimblebar - Wheelara Hill Biological Survey. {ecologia Environmental, 2004 #328}

H) BHPBIO Hashimoto Terrestrial Vertebrate Fauna Assessment. {ecologia Environmental, 2006 #329}

I) Jimblebar Marra Mamba Exploration Biological Survey. {ecologia Environmental, 2006 #330}

J) Orebody 19 Vertebrate Fauna Survey. (Biologic 2013a)

K) OB31 Vertebrate Fauna Survey (Biologic, 2013)

L) Current Survey

5.5 Conservation Significant Fauna Potentially Within the Study Area

Eighteen species of conservation significant fauna have been recorded during surveys in the vicinity of the study area, or were identified as potentially occurring in the area (Table 13). Those significant species recorded or expected to occur within the study area on the basis of suitable habitat are discussed below.

5.5.1 Mammals

Brush-tailed Mulgara (*Dasycercus blythi*)

Brush-tailed Mulgara (*Dasycercus blythi*) is closely associated with *Triodia* Sand Plains and swales between low dunes from south-western Queensland across the Simpson, Tanami, and Great Sandy Deserts of southern and central Northern Territory and central Western Australia, including parts of the Pilbara (DSEWPaC 2011b; Pavey et al. 2012). Brush-tailed Mulgara is currently listed as Priority 4 by the DPaW.

No signs of their presence were recorded during the survey but it is possible they would utilise the Sand Plain habitat within the study area. During the survey of OB31, five individuals were caught in traps at two locations in the Sand Plain habitat, approximately 5 km to the north-west (Biologic 2013c). Seven burrows of the Brush-tailed Mulgara were located in Sand Plain habitat along the southern section of OB19, approximately 16 km to the west (Biologic 2013b).

Due to the small size of the Sand Plain habitat within the study area it is highly unlikely these areas solely support a population however this species may utilise the area.

5.5.2 Birds

Australian Bustard (*Ardeotis australis*)

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

Tracks of this species were recorded on two occasions in the north half of the study area (see Figure 9).

Rainbow Bee-eater (*Merops ornatus*)

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

This species was recorded twice within the study area, although it is likely these individuals spend more time in the adjacent Jimblebar Creek hawking for insects (see Figure 9).

Fork-tailed Swift (*Apus pacificus)*

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

Like any study area in the Pilbara, this species may occur as a flyover.

5.5.3 Reptiles

Pilbara Flat-headed Blindsnake (*Anilios ganei*)

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

It is considered likely that this species would be recorded during a trapping survey of the study area due to presence of suitable habitat.

5.6 Important Fauna Habitats

The expected faunal richness in an area is proportional to the amount of habitat variation and floristic diversity, since both of these factors influence the number of different habitats available for fauna. Accordingly, an area with high variation of habitat types could harbour a higher diversity of fauna and vice versa. Across the study area, only two different habitats were encountered. Sand Plain habitat was deemed as medium to high importance for the potential to support Brush-tailed Mulgara and Stony Plain was deemed as low importance.

6.0 Summary

Flora and Vegetation

A Principal Botanist completed a Level 1 flora and vegetation survey of the study area in late July 2015. Under excellent seasonal conditions there were no Threatened or Priority flora recorded from the study area. A total of six vegetation associations were described and mapped within the study area. None of the vegetation associations are currently listed TECs or PECs and all appear to be well represented regionally.

Vertebrate Fauna

A Principal Zoologist completed a Level 1 vertebrate fauna surey of the study area in late July 2015. There were a total of 16 fauna species recorded comprising four species of introduced mammal, 11 species of birds and one species of reptile. It was determined that 18 species (six native mammals, nine birds and two reptiles) of conservation significance have the potential to occur in the study area. Only four of these are likely to occur in the study area, and only two species were recorded during the field survey.

Two fauna habitat types were recorded, Sand Plain and Stony Plain. Neither habitat was rated as high importance. The Sand Plain habitat may support the Brush-tailed Mulgara, however the area was thoroughly searched for burrows and none were detected.

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8.0 Study Team

The Level 1 flora and vegetation survey and Level 1 vertebrate fauna survey was planned, coordinated and executed by the following personnel:

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Mr Morgan O'Connel	BSc	Principal Zooligist (Biologic)
Ms Jessica Waters	Bsc	Botanist
Mrs Kerry Keenan		Data Analyst
Mr Todd Griffin		GIS Specialist

Licences
The field survey was conducted under the authorisation of the following licences issued by the Department of Parks and Wildlife:

- Jerome Bull, Onshore Environmental Consultants 'Licence to take flora for scientific & other prescribed purposes' Licence No. SL009579

APPENDIX 1

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 (DEC)

APPENDIX 2

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 3

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 4

Conservation Codes for Western Australia 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 5

Conservation Codes for Fauna

International Union for Conservation of Nature

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

Environment Protection and Biodiversity Conservation Act 1999

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

Wildlife Conservation Act 1950

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

Department of Environment and Conservation Priority Codes

Category	Definition
Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4 (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

APPENDIX 6

Fauna recorded from the study area and immediate vicinity

EPBC Protected Matters search with 10 km buffer
DPaW Threatened Species Database search within 5 km buffer

Surveys

A West Jimblebar Fauna Assessment (ENV Australia 2007)
B Orebody 18 Biological Assessment Survey (ecologia Environmental 1995)
C Orebody 18 Fauna Assessment Phase II {ENV Australia, 2007 #317}
D Orebody 31 Fauna Assessment. {ENV Australia, 2011 #322}
E Wheelara Hill Iron Ore Mine Modification: Fauna and Flora Assessment {Outback Ecology Services, 2009 #326}
F Jimblebar Iron Ore Project: Terrestrial Vertebrate Fauna Assessment {Outback Ecology Services, 2009 #327}
G Jimblebar - Wheelara Hill Biological Survey {ecologia Environmental, 2004 #328}
H BHPBIO Hashimoto Terrestrial Vertebrate Fauna Assessment {ecologia Environmental, 2006 #329}
I Jimblebar Marra Mamba Exploration Biological Survey {ecologia Environmental, 2006 #330}
J Orebody 19 Vertebrate Fauna Survey (Biologic 2013a)
K OB31 Vertebrate Fauna Survey (Biologic, 2013)
L Current Survey

Mammals

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
TACHYGLOSSIDAE																			
Tachyglossus aculeatus	Echidna												●				●		
DASYURIDAE																			
Dascycercus blythi	Brush-tailed Mulgara																●	●	
Dasykaluta rosamondae	Little Red Kaluta					●						●	●	●	●		●		
Dasyurus hallucatus	Northern Quoll	EN	S1		EN		●												
Ningaui timealeyi	Pilbara Ningaui								●					●	●		●		
Planigale maculata	Common Planigale								●										
Pseudantechinus roryi	Rory's Pseudantechinus																		
Pseudantechinus macdonnellensis	Fat-tailed Antechinus								●										
Pseudantechinus woolleyae	Woolley's Pseudantechinus																●		
Sminthopsis crassicaudata	Fat-tailed Dunnart											●	●		●		●		
Sminthopsis macroura	Stripe-faced Dunnart											●	●		●		●		
Sminthopsis ooldea	Ooldea Dunnart																	●	
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					●						●	●				●	●	
THYLACOMYIDAE																			
Macrotis lagotis	Bilby, Dalgyte	VU	S1		VU		●												
NOTORYCIDAE																			
Notoryctes caurinus	Northern Marsupial Mole	EN	S1		EN		●												
MACROPODIDAE																			
Macropus robustus	Common Wallaroo							●	●	●		●	●	●	●	●	●	●	
Macropus rufus	Red Kangaroo, Marlu							●			●	●	●		●	●			
Petrogale sp.	Rock-wallaby													●					
Petrogale rothschildi	Rothschild's Rock-wallaby								●	●							●		
MEGADERMATIDAE																			
Macroderma gigas	Ghost Bat			P4	VU										●				
HIPPOSIDERIDAE																			

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J		K	L
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1				●								●					
EMBALLONURIDAE																				
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat														●				●	
Taphozous georgianus	Common Sheathtail-bat									●					●		●		●	
Taphozous hilli	Hill's Sheathtail-bat																●		●	
MOLOSSIDAE																				
Chaerephon jobensis	Northern Freetail-bat																●		●	
Mormopterus beccarii	Beccari's Freetail-bat					●				●					●				●	
VESPERTILIONIDAE																				
Chalinolobus gouldii	Gould's Wattled Bat									●	●				●	●	●		●	
Nyctophilus geoffroyi	Lesser Long-eared Bat					●				●					●				●	
Scotorepens greyii	Little Broad-nosed Bat					●				●	●				●	●	●		●	
Vespadelus finlaysoni	Finlayson's Cave Bat							●		●	●	●			●	●	●		●	
MURIDAE																				
**Mus musculus*	House Mouse					●	●	●	●	●		●	●	●	●				●	
Notomys alexis	Spinifex Hopping-mouse									●					●		●			
Pseudomys chapmani	Western Pebble-mound Mouse			P4							●	●	●	●		●	●			
Pseudomys desertor	Desert Mouse									●				●	●		●		●	
Pseudomys hermannsburgensis	Sandy Inland Mouse								●	●		●	●	●	●		●		●	
Zyzomys argurus	Common Rock-rat					●		●	●	●			●	●	●		●		●	
BOVIDAE																				
**Bos taurus*	European Cattle							●			●	●	●		●	●			●	
CANIDAE																				
Canis lupus dingo	Dingo											●	●		●	●	●		●	
**Canis lupus*	Dog						●	●												●
**Vulpes vulpes*	Red Fox						●			●										
CAMELIDAE																				
**Camelus dromedarius*	Dromedary, Camel						●	●								●			●	●
EQUIDAE																				

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J		K	L
**Equus asinus*	Donkey						●				●		●		●				●	●
**Equus caballus*	Horse						●	●					●							
FELIDAE																				
**Felis catus*	Cat					●	●			●		●	●		●	●	●			●
LEPORIDAE																				
**Oryctolagus cuniculus*	Rabbit						●												●	

Birds

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
CASUARIIDAE																			
Dromaius novaehollandiae	Emu					●		●	●	●									
PHASIANIDAE																			
Coturnix ypsilophora	Brown Quail														●				
ANATIDAE																			
Chenonetta jubata	Australian Wood Duck														●				
Cygnus atratus	Black Swan													●					
Tadorna tadornoides	Australian Shelduck														●				
RALLIDAE																			
Gallinula ventralis	Black-tailed Native-hen														●				
COLUMBIDAE																			
Geophaps plumifera	Spinifex Pigeon					●		●	●	●	●	●	●	●	●	●	●	●	
Geopelia cuneata	Diamond Dove					●		●	●	●	●			●	●	●	●	●	
Geopelia humeralis	Bar-shouldered Dove																		
Geopelia striata	Peaceful Dove					●									●				
Ocyphaps lophotes	Crested Pigeon					●		●		●	●		●	●	●	●	●	●	
Phaps chalcoptera	Common Bronzewing					●		●		●	●			●	●		●	●	
PODARGIDAE																			
Podargus strigoides	Tawny Frogmouth					●				●				●	●				
EUROSTOPODIDAE																			
Eurostopodus argus	Spotted Nightjar					●		●	●	●	●				●	●			
AEGOTHELIDAE																			
Aegotheles cristatus	Australian Owlet-nightjar					●			●	●	●				●		●	●	
APODIDAE																			
Apus pacificus	Fork-tailed Swift	MG	S3				●				●								
PHALACROCORACIDAE																			
Phalacrocorax sulcirostris	Little Black Cormorant														●				
ARDEIDAE																			

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Ardea ibis	Cattle Egret	MG	S3				●												
Ardea modesta	Eastern Great Egret	MG	S3				●												
Ardea pacifica	White-necked Heron														●				
Egretta novaehollandiae	White-faced Heron													●	●				
ACCIPITRIDAE																			
Aquila audax	Wedge-tailed Eagle					●		●		●	●	●	●	●	●	●	●		
Accipiter cirrocephalus	Collared Sparrowhawk							●									●		
Accipiter fasciatus	Brown Goshawk					●		●						●	●	●	●		
Circus assimilis	Spotted Harrier								●						●	●	●		
Elanus axillaris	Black-shouldered Kite							●	●	●						●	●	●	
Haliastur sphenurus	Whistling Kite					●		●	●	●			●		●	●	●	●	
Milvus migrans	Black Kite					●				●			●			●	●		
Hamirostra melanosternon	Black-breasted Buzzard					●				●			●		●	●	●	●	
Hieraaetus morphnoides	Little Eagle							●					●		●				
FALCONIDAE																			
Falco berigora	Brown Falcon					●		●	●	●	●	●	●	●	●	●	●	●	
Falco cenchroides	Nankeen Kestrel					●		●	●	●	●		●	●	●	●	●	●	
Falco longipennis	Australian Hobby													●	●		●		
Falco peregrinus	Peregrine Falcon		S4					●											
OTIDIDAE																			
Ardeotis australis	Australian Bustard			P4	NT			●	●		●		●		●	●		●	●
BURHINIDAE																			
Burhinus grallarius	Bush Stone-Curlew			P4	NT	●				●			●	●					
CHARADRIIDAE																			
Charadrius veredus	Oriental Plover	MG	S3				●												
Elseyornis melanops	Black-fronted Dotterel														●				
SCOLOPACIDAE																			
Actitis hypoleucos	Common Sandpiper	MG	S3			●				●									
TURNICIDAE																			

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Turnix velox	Little Button-quail					●		●	●	●	●				●	●	●	●	
CACATUIDAE																			
Eolophus roseicapillus	Galah					●		●	●	●	●			●	●	●	●	●	
Cacatua sanguinea	Little Corella							●	●				●	●	●				
Nymphicus hollandicus	Cockatiel					●		●		●	●				●	●			
PSITTACIDAE																			
Barnardius zonarius	Australian Ringneck							●	●				●	●	●	●	●	●	
Psephotus varius	Mulga Parrot							●										●	
Melopsittacus undulatus	Budgerigar					●		●	●	●	●		●		●	●	●		●
Neopsephotus bourkii	Bourke's Parrot							●							●				
CUCULIDAE																			
Centropus phasianinus	Pheasant Coucal														●				
Chalcites basalis	Horsfield's Bronze-Cuckoo					●		●	●		●	●		●	●	●			
Chalcites osculans	Black-eared Cuckoo														●				
Cacomantis pallidus	Pallid Cuckoo					●		●	●	●	●				●	●			
STRIGIDAE																			
Ninox connivens	Barking Owl																●		
Ninox novaeseelandiae	Southern Boobook							●					●		●			●	
TYTONIDAE																			
Tyto alba	Barn Owl												●	●			●		
HALCYONIDAE																			
Dacelo leachii	Blue-winged Kookaburra														●				
Todiramphus pyrrhopygius	Red-backed Kingfisher					●		●	●	●	●		●	●	●	●	●	●	
Todiramphus sanctus	Sacred Kingfisher														●				
MEROPIDAE																			
Merops ornatus	Rainbow Bee-eater	MG	S3			●	●	●				●	●	●	●	●	●	●	●
CLIMACTERIDAE																			
Climacteris melanura	Black-tailed Treecreeper														●				
PTILINORHYNCHIDAE																			

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Ptilonorhynchus guttatus	Western Bowerbird							●						●	●		●	●	
MALURIDAE																			
Amytornis striatus whitei	Striated Grasswren					●			●	●	●		●	●	●		●	●	
Malurus lamberti	Variegated Fairy-wren					●		●	●	●	●	●	●	●	●	●	●	●	
Malurus leucopterus	White-winged Fairy-wren					●		●					●	●	●	●	●		●
Malurus splendens	Splendid Fairy-wren							●											
Stipiturus ruficeps	Rufous-crowned Emu-wren														●				
ACANTHIZIDAE																			
Pyrrholaemus brunneus	Redthroat							●										●	
Smicrornis brevirostris	Weebill					●		●		●	●	●	●	●	●	●	●	●	
Gerygone fusca	Western Gerygone					●		●		●		●	●			●	●		
Acanthiza apicalis	Inland Thornbill							●				●	●			●		●	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					●		●							●	●			
Acanthiza robustirostris	Slaty-backed Thornbill							●							●			●	
Acanthiza uropygialis	Chestnut-rumped Thornbill					●		●						●	●	●		●	
Aphelocephala leucopsis	Southern Whiteface							●											
PARDALOTIDAE																			
Pardalotus rubricatus	Red-browed Pardalote					●				●				●	●	●	●	●	
Pardalotus striatus	Striated Pardalote								●					●			●		
MELIPHAGIDAE																			
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					●		●		●	●	●		●	●	●	●		
Certhionyx niger	Black Honeyeater							●	●						●				●
Certhionyx variegatus	Pied Honeyeater							●	●						●	●			
Conopophila whitei	Grey Honeyeater					●		●											
Lichenostomus keartlandi	Grey-headed Honeyeater							●	●	●			●	●		●	●		
Lichenostomus penicillatus	White-plumed Honeyeater							●		●			●	●	●	●	●		
Lichenostomus plumulus	Grey-fronted Honeyeater																		
Lichenostomus virescens	Singing Honeyeater							●	●	●	●	●	●	●	●	●	●	●	●
Lichmera indistincta	Brown Honeyeater					●		●	●	●	●			●	●	●	●		

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Melithreptus gularis	Black-chinned Honeyeater													●			●		
Purnella albifrons	White-fronted Honeyeater							●	●										●
Sugomel niger	Black Honeyeater															●			
Manorina flavigula	Yellow-throated Miner					●		●		●	●	●	●	●	●	●	●	●	●
Epthianura tricolor	Crimson Chat					●		●	●	●					●	●	●		
POMATOSTOMIDAE																			
Pomatostomus superciliosus	White-browed Babbler							●								●			
Pomatostomus temporalis	Grey-crowned Babbler					●		●		●	●	●	●	●	●	●	●	●	
CAMPEPHAGIDAE																			
Coracina maxima	Ground Cuckoo-shrike													●	●				
Coracina novaehollandiae	Black-faced Cuckoo-shrike					●		●	●	●	●	●	●	●	●	●	●	●	
Lalage leucomela	Varied Triller																●		
Lalage tricolor	White-winged Triller							●	●	●	●			●	●	●	●		
PACHYCEPHALIDAE																			
Pachycephala rufiventris	Rufous Whistler					●		●	●	●	●		●	●	●	●	●	●	
Colluricincla harmonica	Grey Shrike-thrush					●		●	●	●	●	●	●	●	●	●	●		
Oreoica gutturalis	Crested Bellbird					●		●	●	●	●	●		●	●	●	●		
ARTAMIDAE																			
Artamus cinereus	Black-faced Woodswallow					●		●		●	●	●	●	●	●	●	●	●	
Artamus minor	Little Woodswallow					●		●	●	●	●			●	●		●	●	
Artamus personatus	Masked Woodswallow											●	●			●	●		
Cracticus nigrogularis	Pied Butcherbird					●		●	●	●	●	●	●	●	●	●	●	●	
Cracticus tibicen	Australian Magpie					●		●		●	●	●	●	●		●	●		
Cracticus torquatus	Grey Butcherbird							●			●			●	●	●			
RHIPIDURIDAE																			
Rhipidura albiscapa	Grey Fantail							●											
Rhipidura leucophrys	Willie Wagtail					●		●	●	●		●	●	●	●	●	●	●	
CORVIDAE																			
Corvus bennetti	Little Crow														●				

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Corvus orru	Torresian Crow					●		●		●		●	●	●	●	●	●	●	
MONARCHIDAE																			
Grallina cyanoleuca	Magpie-lark					●		●		●		●	●	●	●	●	●		
PETROICIDAE																			
Petroica goodenovii	Red-capped Robin					●		●				●	●		●	●	●		
Melanodryas cucullata	Hooded Robin							●	●	●	●		●	●	●	●	●		
ALAUDIDAE																			
Mirafra javanica	Horsfield's Bushlark							●				●	●		●				
MEGALURIDAE																			
Cincloramphus cruralis	Brown Songlark							●			●			●					
Cincloramphus mathewsi	Rufous Songlark					●		●		●	●			●	●	●	●		
Eremiornis carteri	Spinifexbird					●		●	●	●			●	●		●	●		
HIRUNDINIDAE																			
Cheramoeca leucosterna	White-backed Swallow												●	●	●	●			
Petrochelidon ariel	Fairy Martin									●							●		
NECTARINIIDAE																			
Dicaeum hirundinaceum	Mistletoebird								●					●	●	●	●		●
ESTRILDIDAE																			
Emblema pictum	Painted Finch					●		●	●	●	●			●	●	●	●	●	●
Taeniopygia guttata	Zebra Finch					●		●	●	●	●	●	●	●	●	●	●	●	●
MOTACILLIDAE																			
Anthus australis	Australasian Pipit															●	●		
Anthus novaeseelandiae	Richard's Pipit							●	●	●			●	●	●				

Reptiles

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

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Gehyra variegata	Tree Dtella					●		●	●	●	●	●	●	●	●	●	●	●	
Heteronotia binoei	Bynoe's Gecko					●		●	●	●	●		●	●	●		●		
Heteronotia spelea	Desert Cave Gecko					●				●	●			●	●			●	
PYGOPODIDAE																			
Delma butleri	Unbanded Delma									●							●		
Delma elegans	Pilbara Delma					●									●		●		
Delma haroldi						●									●				
Delma nasuta						●			●	●				●			●		
Delma pax								●	●	●		●	●	●	●	●	●	●	
Delma tincta						●							●						
Lialis burtonis	Burton's legless lizard							●					●	●	●	●		●	
Pygopus nigriceps	Hooded Scaly foot											●			●				
SCINCIDAE																			
Carlia munda															●	●		●	
Carlia triacantha	Desert Rainbow Skink									●		●		●				●	
Cryptoblepharus carnabyi										●									
Cryptoblepharus plagiocephalus	Fence Skink								●	●									
Cryptoblepharus ustulatus																	●		
Ctenotus ariadnae										●							●		
Ctenotus duricola						●				●		●	●	●	●		●	●	
Ctenotus grandis						●				●		●	●		●				
Ctenotus helenae						●		●	●	●		●	●	●	●		●	●	
Ctenotus leonhardii									●	●				●					
Ctenotus pantherinus	Leopard Ctenotus					●			●	●		●	●	●	●	●	●	●	
Ctenotus quattuordecimlineatus	Fourteen-lined Ctenotus								●										
Ctenotus rubicundus																	●		
Ctenotus rutilans	Pilbara Rusty Ctenotus					●									●		●		
Ctenotus saxatilis	Rock Ctenotus					●		●	●	●	●	●	●	●	●	●	●	●	
Ctenotus schomburgkii	Barred wedge-tailed Ctenotus					●									●				

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Ctenotus serventyi								●											
Ctenotus uber						●						●	●		●			●	
Cyclodomorphus branchialis	Gunther's Skink								●										
Cyclodomorphus melanops	Slender Blue-tongue					●									●	●	●	●	
Egernia cygnitos	Pygmy Spiny-tailed Skink (western)																●	●	
Egernia depressa	Pygmy Spiny-tailed Skink											●			●				
Eremiascincus richardsonii	Broad-banded Sand Swimmer													●	●				
Lerista bipes								●							●			●	
Lerista chalybura									●										
Lerista flammicauda						●													
Lerista muelleri						●		●	●	●		●	●		●	●	●		
Lerista neander						●			●	●			●	●	●	●	●	●	
Lerista timida																		●	
Lerista zietzi						●				●				●	●		●		
Menetia greyii	Dwarf Skink					●			●	●			●		●	●	●	●	
Morethia ruficauda	Fire-tailed Skink					●		●	●	●				●	●		●	●	
Tiliqua multifasciata	Central Blue-tongue									●		●	●	●	●	●	●	●	
VARANIDAE																			
Varanus acanthurus	Spiny-tailed Monitor					●		●	●	●	●		●	●	●	●	●	●	
Varanus brevicauda	Short-tailed Pygmy Monitor					●													
Varanus caudolineatus	Stripe-tailed Monitor							●				●	●			●			
Varanus eremius	Desert Pygmy Monitor					●		●		●								●	
Varanus giganteus	Perentie					●			●						●		●		
Varanus gouldii	Bungarra or Sand Monitor					●		●		●			●		●			●	
Varanus panoptes	Yellow-spotted Monitor					●		●						●	●			●	
Varanus pilbarensis	Pilbara Rock Monitor								●								●		
Varanus tristis	Black-headed Monitor								●	●		●	●	●	●	●	●	●	
TYPHLOPIDAE																			
Ramphotyphlops ammodytes								●											

Family and Species	Common Name	EPBC	WCA	DPaW	IUCN	Nature Map	EPBC Protected Matters	A	B	C	D	E	F	G	H	I	J	K	L
Ramphotyphlops ganei	Pilbara Flat-headed Blindsnake			P1						●							●		
Ramphotyphlops grypus									●	●				●	●		●		
Ramphotyphlops hamatus												●	●		●		●	●	
Ramphotyphlops waitii																	●		
BOIDAE																			
Antaresia perthensis	Pygmy Python					●			●					●	●				
Antaresia stimsoni	Stimson's Python													●					
Aspidites melanocephalus	Black-headed Python														●				
Liasis olivaceus barroni	Pilbara Olive Python	VU	S1														●		
ELAPIDAE																			
Brachyurophis approximans	North-western Shovel-nosed Snake					●				●				●				●	
Demansia psammophis	Yellow-faced Whipsnake					●		●		●					●	●	●	●	
Demansia rufescens	Rufous Whipsnake									●							●		
Furina ornata	Moon Snake							●									●		
Pseudechis australis	Mulga Snake					●							●	●	●	●	●		
Pseudonaja modesta	Ringed Brown Snake														●		●	●	
Pseudonaja mengdeni						●						●	●		●		●	●	
Suta fasciata	Rosen's Snake					●													
Suta punctata	Spotted Snake															●		●	

Amphibians

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