RED HILL FLORA, VEGETATION AND FAUNA ASSESSMENT

MMWC Environmental PTY LTD

ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT

RED HILL FLORA, VEGETATION AND FAUNA ASSESSMENT

Prepared for

Quarrytech Consulting Pty Ltd

Prepared by

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ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT

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The flora survey was conducted under the following licences issued by the Department of Environment and Conservation; Licence to take flora for scientific or other prescribed purposes: SL010744 issued to Bridget Watkins.

DISCLAIMER AND RESTRICTIONS ON USE

EXECUTIVE SUMMARY

MMWC Environmental Pty Ltd was commissioned by Quarrytech Consulting Pty Ltd (Quarrytech), in September 2013, to undertake a Level 2 flora and vegetation assessment and Level 1 fauna assessment of the proposed Red Hill Sand Quarry (the study area). The study area is comprised of E47/2971 and a portion of E47/2961. The study area is located approximately 75 km south west of Port Hedland in Western Australia and covers an area of 1318.8 ha. The purpose of the assessment is to provide the baseline data for the Mining Proposal prepared in order to support a Mining Lease Application. The field survey was undertaken from the 10th to the 12th of October 2013.

No species of flora listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth), or gazetted as Threatened Flora under the *Wildlife Conservation Act 1950* (Western Australia) were recorded. No Threatened flora is expected to occur in the study area due to the absence of suitable habitat.

One Priority 1 flora taxon was recorded during the current survey: *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095).

A total of 112 taxa were recorded from 71 genera and 31 families during the survey.

Six introduced flora species were recorded in the study area. None of these species are listed as Weeds on National Significance by the Australian Government. None of these species are listed as Declared Plants under the *Biosecurity and Agriculture Management Act 2013* (Western Australia).

Eight vegetation associations were mapped in the study area. None of the vegetation associations are listed as a Threatened Ecological Community under the *Environment Protection and Biodiversity Conservation Act 1999,* as an Environmentally Sensitive Area under the *Environmental Protection Act 1986* or as a Priority Ecological Community by the Department of Parks and Wildlife.

The fauna habitat assessment of the study area defined six habitat types present. Database searches indicated a total of 296 vertebrate fauna species have been previously recorded within the vicinity of the study area. Of these 296 species, 60 are conservation significant fauna species.

Two species of conservation significance were recorded during the fauna assessment: Rainbow Bee-eater (*Merops ornatus*; Migratory) and Australian Bustard (*Ardeotis australis*; Priority 4).

1 INTRODUCTION

1.1 PROJECT BACKGROUND

MMWC Environmental (MEC) was commissioned by Quarrytech in September 2013 to undertake a Level 2 flora and vegetation assessment and a Level 1 fauna assessment for the proposed Red Hill Sand Quarry area, approximately 75 km south west of Port Hedland in Western Australia (the study area). The study area covers an area of 1318.8 ha and is comprised of Exploration Licence E47/2971 and a portion of Exploration Licence E47/2961.

The purpose of the assessment is to provide the baseline data for the Mining Proposal prepared in order to support a Mining Lease application. Quarrytech propose to extract sand from the two sand dunes and a section of the river line within the study area.

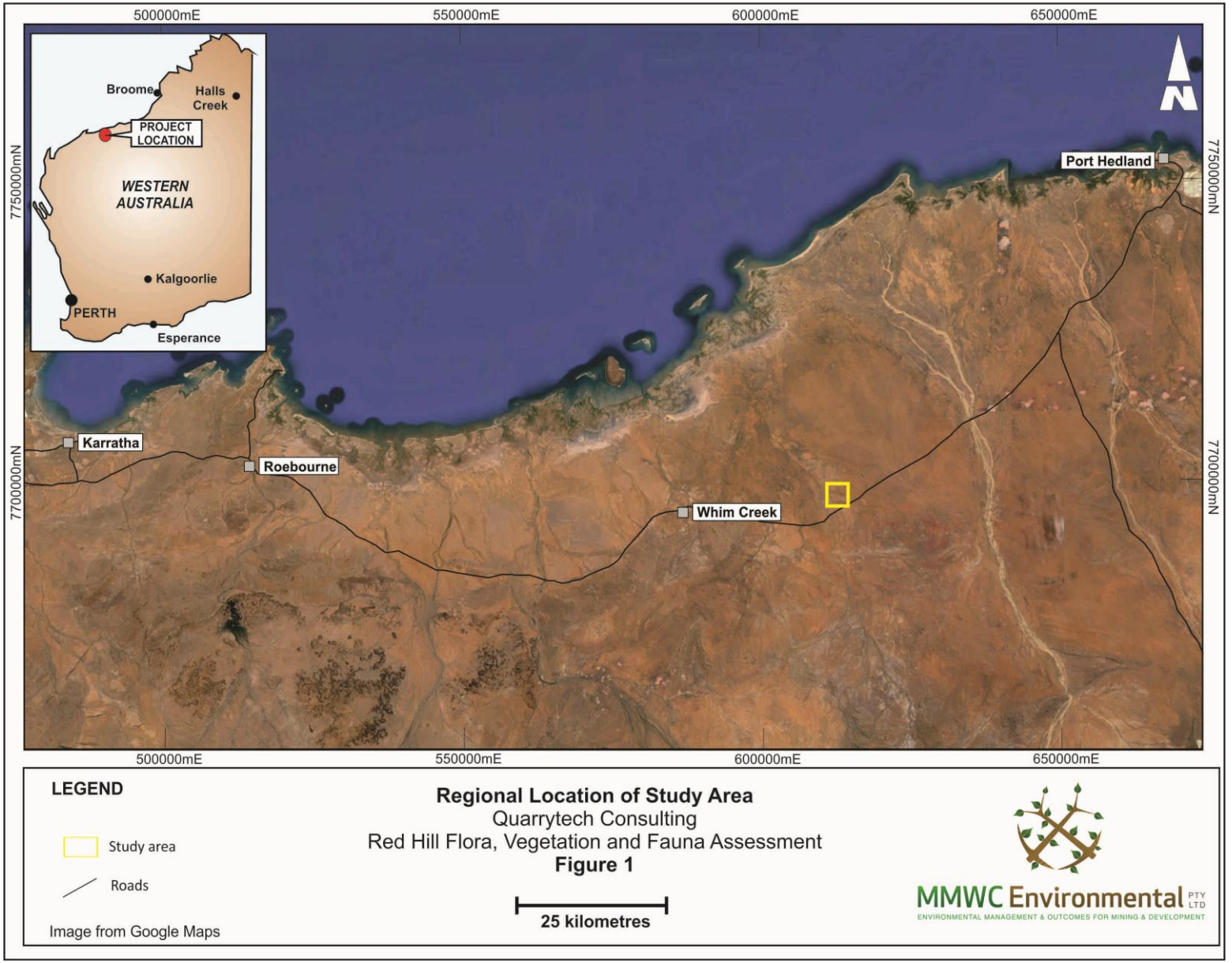
1.1.1 Objectives

The objectives of the flora, vegetation and fauna assessment were to:

- Conduct a flora, vegetation and fauna database and literature review;
- Undertake a field survey to identify and describe vegetation associations and fauna habitats present and conduct searches for conservation significant flora and fauna;
- Compile an inventory of vascular plant species present;
- Record the occurrence of introduced plant species;
- Assess and map the vegetation associations, vegetation condition and fauna habitats;
- Assess the potential impact of clearing on any significant vegetation or flora relevant to fauna habitat; and
- Assess the proposed development against the ten Native Vegetation Clearing Principles as detailed in Schedule 5.0 of the *Environmental Protection Act 1986*.

1.1.2 Location

The study area is 1318.8 ha in size and is located approximately 75 km south west of Port Hedland, (north of and adjacent to the North West Coastal Highway) in the Pilbara of Western Australia (Figure 1). The study area is approximately 3.7 km in length and 3.5 km in width.


500000mE
550000mE
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650000mE
7750000mN
7700000mN
Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
Port Hedland
Karratha
Roebourne
Whim Creek
N
LEGEND
Study area
Roads
Image from Google Maps
Regional Location of Study Area
Quarrytech Consulting
Red Hill Flora, Vegetation and Fauna Assessment
Figure 1
25 kilometres
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2 EXISTING ENVIRONMENT

2.1 CLIMATE

The study area is in the Pilbara region of Western Australia. The Pilbara has an arid-tropical climate with two distinct seasons, a hot and wet summer from October to April and a mild winter from May to September. Summer rainfall is typically associated with tropical storms in the north, or tropical cyclones that cross the coast and move inland. Winter rainfall is commonly the result of cold fronts moving north-easterly across the State (Bureau of Meteorology (BoM) 2013).

The nearest reliable public climate data is available from the BoM Port Hedland airport weather station located approximately 73 km north east of the study area. Long term rainfall data has been recorded at Port Hedland airport since 1942 and long term temperature data has been recorded since 1948.

The average annual maximum temperature for Port Hedland is 33.2°C and the average annual minimum temperature is 19.4°C. In summer, mean maximum temperatures reach 36.6°C, while in winter, mean minimum temperatures fall to 12.3°C. Port Hedland receives an average annual rainfall of 256.3 mm. While rainfall is often sporadic, and can occur throughout the year, Port Hedland receives 63% of its total annual rainfall during the wet season from December to March (BoM 2013) (Figure 2).

For the three months preceding the survey (July to September 2013), Port Hedland received 0.4 mm of rainfall, compared with the long-term average rainfall of 17 mm (1942-2013) for the same period. However, Port Hedland received 262 mm during the month of June with 140 mm recorded on the 25th of June, less than four months preceding the survey.

Rainfall for the 12 months before the survey (October 2012 to September 2013) at Port Hedland was 577.6 mm compared with 256.3 mm for the long-term average for the same period. This constitutes 321.3 mm and 125% more rainfall than the long term average.

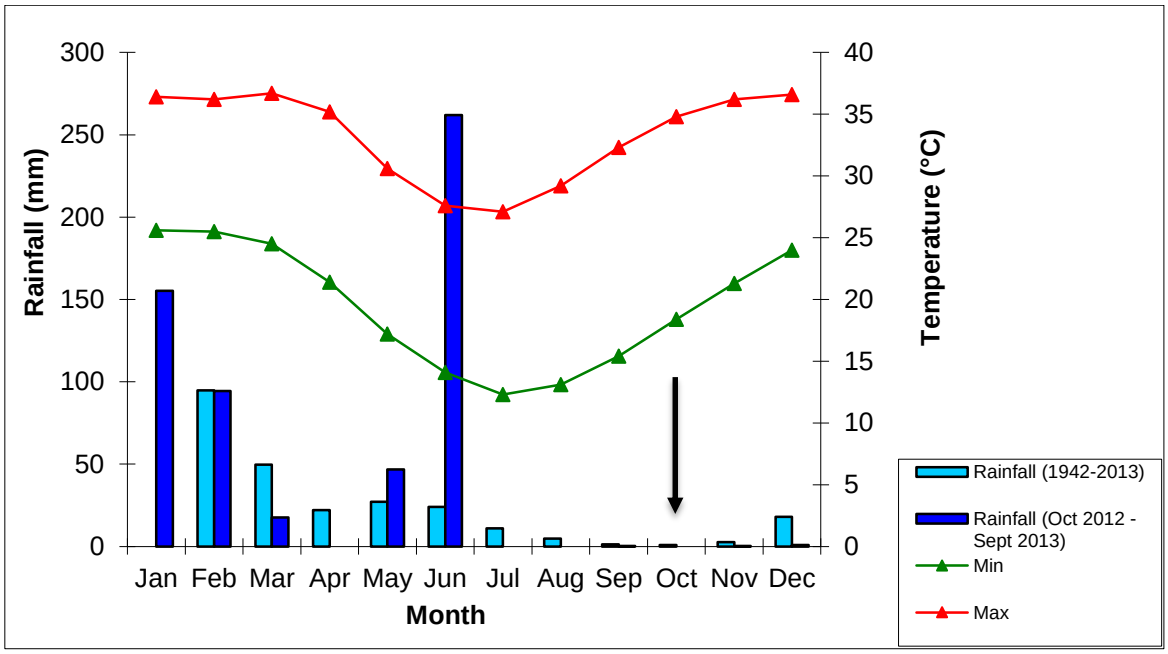

Figure 2: Average long-term (1942-2013) and 2012/13 Monthly Rainfall and Average Maximum and Minimum Temperatures (1948-2012) for Port Hedland Airport (BoM 2013). Arrow indicates survey time.

2.2 GEOLOGY AND SOILS

The study area occurs in association with five geological formations, based on mapping by the Geological Survey of Western Australia (2000) captured at a scale of 1:250 000:

- Qs: Eolian sand – red-yellow, wind-blown sand; local ridges;
- Qao: Alluvial sand, silt, and clay on floodplains;
- Qaoc: Mixed floodplain deposits with numerous small claypans;
- AgPam: Alkali granite, medium-grained; pyroxene-bearing; foliated to massive; and
- Czrk: Residual calcrete; massive, nodular, and cavernous limestone; mainly silicified.

The soils of the study area were mapped by Tille (2006). The study area is situated in the Fortescue Province, in the DeGrey-Roebourne Lowlands Zone. The DeGrey-Roebourne Lowlands Zone is characterised by:

> *"Alluvial plains and sandplains (and some floodplains and stony plains) on alluvial and marine deposits over rocks of the northern Pilbara Craton. Red deep sandy duplexes with red loamy earths and some red/brown non-cracking clays, cracking clays, red sandy earths and red deep loamy duplexes. Spinifex grasslands with kanji and tussock grasslands. Located in the northern Pilbara between Karratha and the De Grey River* (Tille 2006)."

2.3 LANDFORMS AND HYDROLOGY

The study area is primarily situated on sandplains with two prominent sand dunes aligned east to west and parallel to each other. The sand dunes are approximately 2 km in length and 100-200 m in width. The remainder of the study area is flat sand plains with the East Peewah River running along the inside western boundary and south west corner of the study area. The river flows north towards the ocean and there are scattered areas of granite outcropping throughout the study area.

2.4 BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The Biogeographic Regionalisation for Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical/ geological attributes. These bioregions are subdivided into 419 subregions, as part of a refinement of the IBRA framework (DSEWPaC 2013a).

The study area is located within the Roebourne subregion (PIL4) of the Pilbara bioregion (DSEWPaC 2013b). The Roebourne subregion is characterised by coastal and sub-coastal alluvial and older colluvial plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera* (Kendrick and Stanley 2001).

The entire study area is located with the Roebourne subregion. However, the southern boundary of the study area is situated 2.1 km north of the northern boundary of the Chichester subregion (PIL1). The Chichester subregion is characterised by Archaean granite and basalt plains with a shrub steppe of *Acacia inaequilatera* over *Triodia wiseana* hummock grassland and *Eucalyptus leucophloia* tree steppe on the ranges (Kendrick and McKenzie 2001).

2.5 LANDSYTEMS

Land system mapping is based on regional patterns in topography, soils and vegetation. The Pilbara bioregion ("Pilbara") as defined by IBRA (DSEWPaC 2013a) covers an area of approximately 178,088 km^2. Land system mapping classifies the Pilbara into 106 land systems captured across three studies (Payne, Mitchell & Holman 1988; Payne & Tille 1992; van Vreeswyk, Payne, Leighton & Hennig 2004).

The study area occurs in association with three land systems: Mallina, Uaroo and Gregory. The Mallina land system extends across the western half of the study area and the Uaroo land system extends across eastern half of the study area. The Gregory land system defines the sand dunes. Further details of these land systems are presented in Table 1.

Table 1: Land Systems of the Study Area (van Vreeswyk *et al.* 2004)

Land System	Description	Area of Land System in the Pilbara Bioregion	
		Area (km²)	% of Pilbara Bioregion
Mallina	Sandy surfaced alluvial plains supporting soft spinifex (and occasionally hard spinifex) grasslands	2,557	1.4
Uaroo	Broad sandy plains supporting shrubby hard and soft spinifex grassland	7,681	4.2
Gregory	Linear dunes and restricted sandplains supporting shrubby hard spinifex (and occasionally soft spinifex) grasslands	113	0.06

2.6 CONSERVATION ESTATE

National Parks, Nature Reserves and other Protected Areas

The closest Department of Parks and Wildlife (DPaW) managed conservation estate is Mungaroona Range Nature Reserve, which is approximately 50 km south of the study area. Millstream-Chichester National Park is situated approximately 65 km south west of the study area.

Environmentally Sensitive Areas

Section 51B of the *Environment Protection Act 1986* (EP Act) allows the Minister to declare an Environmentally Sensitive Area (ESA). Once declared, the exemptions to clear native vegetation under the regulations do not apply in these areas. TECs and areas within 50 m of any Threatened Flora constitute ESAs. However, a number of other areas of environmental significance are also listed. Current declared ESAs are listed in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005*.

There are no ESAs within or adjacent to the study area. In addition, there are no TECs recorded within 50 km of the study area.

2.7 PREVIOUS BIOLOGICAL STUDIES

Four previous biological assessments conducted in the vicinity of the study area were utilised to add further information to the database searches:

- Balla balla Magnetite Project, Ferro Metals Australia, Report and Recommendations of the Environment Protection Authority (EPA) (EPA 2009) – 25 km west of the study area;

- Whim Creek Copper Project Biological Survey (ecologia 2004) – 24 km west of the study area;
- Terrestrial Fauna Survey for the Balla Balla Magnetite Project Barge Loading Facility, Draft (Phoenix Environmental Sciences 2013) – 36 km west of the study area; and
- Mt Dove DSO Project Significant Species Management Plan, Draft (Coffey Environments Australia Pty Ltd 2011) – 40 km south east of the study area.

It should be noted that differences in survey timing, extent and the size and locations of each study area will influence the results of each survey. For further details of specific survey methods and timing please refer to the original report.

Flora and Vegetation

The desktop review identified 13 Priority flora previously recorded within 50 km of the study area. These 13 taxa comprise five Priority 1 taxa, two Priority 2 taxa and six Priority 3 taxa (Table 2; DPaW 2013a and Phoenix 2013). No taxa listed under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) or listed as Threatened by DPaW were identified by the database searches. Definitions of flora conservation codes are presented in Appendix A.

Table 2: Priority Flora Previously Recorded within 50 km of the Study Area

Species	Conservation Status	Habitat (WAH 2013)
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	P1	Sandplain, sand dunes, coastal estuaries, floodplain.
Heliotropium muticum	P1	Sandplains. Bedrock outcrop with steep slope. Calcareous plain.
Sporobolus pulchellus	P1	Deep sands, sandstone, sandy ironstone. Rocky hillsides, roadsides.
Tephrosia andrewii	P1	Hillside, sandplain, Pindan shrubland.
Tephrosia rosea var. Port Hedland (A.S. George 1114)	P1	Coastal sand dunes, sandplains, roadsides.
Euphorbia clementii	P2	Gravelly hillsides. Stony grounds.
Gomphrena cucullata	P2	Red sandy loam, clayey sand. Open floodplains.
Acacia glaucocaesia	P3	Red loam, sandy loam, clay. Floodplains.
Gomphrena leptophylla	P3	Open flats, sandy creek beds, edges salt pans and marshes, stony hillsides.
Phragmites karka	P3	Margins of perennial pools and permanently wet springs.
Polymeria distigma	P3	Sandplains, coastal plains, crabbhole clay flats, between sand dunes.
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Red clay, clay pan, grass plain.
Vigna sp. rockpiles (R. Butcher *et al.* RB 1400)	P3	Base of high rockpile ridge, hillslopes.

Dominant vegetation previously recorded in the vicinity includes *Triodia* hummock grasslands, shrublands and woodlands (EPA 2009). There are no records of Threatened Ecological Communities (TECs) within 50 km of the study area. One Priority Ecological Community (PEC) has been recorded within 50 km of the study area (DPaW 2013b): Horseflat Land System of the Roebourne Plains (Priority 3). The nearest point of the buffer zone around the Horseflat Land System PEC is 24.4 km west of the study area.

Fauna

There are currently 44 declared Threatened (Critically Endangered, Endangered and Vulnerable) fauna in the Pilbara of Western Australia, as listed under the EPBC Act: 15 mammals, 14 birds, 11 reptiles and four fish. These 44 species are also listed as Schedule 1 fauna under the *Wildlife Conservation Act (WA) 1950* (WC Act). Of these 44 species, one is listed as Critically Endangered (Night Parrot, *Pezoporus occidentalis*) and three terrestrial vertebrate species are listed as Endangered: Northern Quoll (*Dasyurus hallucatus*), Rufous Hare Wallaby (*Lagorchestes hirsutus*) and Northern Marsupial Mole (*Notoryctes caurinus*).

Five species are listed as Schedule 4 under the WC Act for the Pilbara region. Of these, two are birds and one is a reptile: Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Peregrine Falcon (*Falco peregrinus*) and Woma Python (*Aspidites ramsayi*).

Thirty-three species are listed as Priority species in the Pilbara region by the DPaW: 10 mammals, seven birds, 15 reptiles and one fish (DPaW 2013e).

The combined literature review of background information included the DPaW database searches (DPaW 2013c), Naturemap (DPaW 2013d), EPBC Act Protected Matters Search Tool (DSEWPaC 2013b), and three reports based on previously conducted surveys in the vicinity of the study area (ecologia 2004; Phoenix 2013; and Coffey 2011). Definitions of fauna conservation codes are presented in Appendix B and definitions of TECs and PECs are presented in Appendix C.

A total of 296 vertebrate fauna species were compiled from the literature review. This comprised three species of amphibians, 181 species of birds, 42 species of mammals and 70 species of reptiles. Of the 296 species, 60 are listed as conservation significant: 49 species of birds, nine species of mammals and two species of reptiles (Appendix D).

Of the 60 conservation significant species, 12 are listed under the EPBC Act. Four of these are listed as Endangered under the EPBC Act:

- *Charadrius mongolus* (Lesser Sand Plover);
- *Rostratula australis* (Australian Painted Snipe);
- *Dasyurus hallucatus* (Northern Quoll); and
- *Notoryctes caurinus* (Northern Marsupial Mole).

The remaining eight species are listed as Vulnerable under the EPBC Act:

- *Falco hypoleucos* (Grey Falcon);
- *Calidris ferruginea* (Curlew Sandpiper);

- *Calidris tenuirostris* (Great Knot);
- *Numenius madagascariensis* (Eastern Curlew);
- *Rhinonicteris aurantius* (Orange Leafnosed-bat);
- *Petrogale lateralis lateralis* (Black-footed Rock-wallaby);
- *Macrotis lagotis* (Greater Bilby); and
- *Liasis olivaceus barroni* (Pilbara Olive Python).

In addition to the EPBC Act listed species, the 12 species listed above are also listed as Schedule 1 species under the WC Act. Schedule 1 fauna are considered rare and likely to become extinct (Appendix B).

Fauna habitats previously recorded in the vicinity of the study area include (Phoenix 2013):

- Samphire plains;
- Tussock and Hummock grasslands;
- Open shrubland;
- Rocky outcrops and boulder piles;
- Minor creeks and drainage lines;
- Salt flats;
- Coastal sand dunes;
- Mangrove thickets; and
- Intertidal mudflats.

Of these nine habitat types identified by Phoenix Environmental Sciences (2013), grassy plains dominated by *Triodia* hummock grasses was the dominant habitat type. Scattered areas of open shrubland were identified amongst the grasslands. Together, the areas of grass plains with open shrublands were identified as potential habitat for five conservation significant species: Bush Stone Curlew (P4), Australian Bustard (P4), Flock Bronzewing (P4), Short-tailed Mouse and Western Pebble-mound Mouse (P4) in areas with suitably rocky surfaces (Phoenix 2013).

3 METHODS

The flora, vegetation and fauna survey was conducted from the 10th to the 12th of October 2013, with six person-days invested in the field survey. The survey was conducted by Bridget Watkins (Senior Environmental Biologist) and James Jewson (Field Technician).

The survey was consistent with EPA requirements for environmental surveying and reporting for flora, vegetation and fauna in Western Australia, as set out in the following documents:

- *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 Biodiversity Protection. Position Statement No. 3* (EPA 2002);
- *EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51* (EPA 2004a);
- *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56* (EPA, 2004b); and
- *Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA-DEC, 2010).

3.1 DESKTOP ASSESSMENT

The desktop assessment provided background information on the flora, vegetation and fauna of the project area. A request for database searches was submitted to the DPaW on 13th September 2013. The following databases were searched using the coordinates 612760 mE, 7697763 mN Zone 50K with a 50 km radius around that point:

- DPaW Threatened and Priority Flora database, 50 km radial search (DPaW 2013a);
- DPaW Threatened and Priority Ecological Community database, 50 km radial search (DPaW 2013b);
- DPaW Threatened and Priority Fauna database, 50 km radial search (DPaW 2013c);
- DPaW combined biological database *NatureMap,* 40 km buffer (DPaW 2013d); and
- DSEWPaC Protected Matters Search Tool, 40 km buffer (DSEWPaC 2013b).

These sources were used to compile a list of flora and fauna that have been recorded, or that may potentially occur, in the region. These lists will invariably include some species that do not occur in the study area, as some species have a limited or patchy distribution, exhibit a high level of habitat specificity, are locally non-existent or were erroneously identified in previous surveys. Extinct species, obvious erroneous records and species with

a high level of habitat specificity for habitats not present in the study area were excluded from these lists.

3.2 FLORA AND VEGETATION

Flora and Vegetation Survey

The survey included the assessment of 16 sites, consisting of 11 quadrats and five relevés (Figure 3). Quadrats are vegetation survey plots which are accurately measured out as 50 x 50 m (or an area equivalent to 2500 m^2) and marked at the north-west corner using a handheld Garmin Global positioning System (GPS) unit. Relevés are 'unmarked quadrats', where a centre point is marked and an area equivalent to that of a quadrat is visually approximated around this point for the purpose of estimating species composition and cover in order to define the vegetation association.

The information recorded at each quadrat included landscape features, surface soil colour and texture, bare ground, litter cover, disturbance, fire age, aspect and vegetation condition. Each species of plant at each quadrat was recorded, including information on height and percentage cover.

Targeted Searches

Habitats and locations considered likely to support conservation significant flora were targeted for searches. Further opportunistic collections focused on the location of taxa not recorded in the quadrats and on locations of introduced species. For each population of significant flora identified the following was recorded:

- Co-ordinate locations (using handheld GPS units);
- Description of vegetation association present;
- Estimation of population size; and
- Photograph of plant *in situ*, where possible.

Taxonomy and Nomenclature

Where confirmed field identification of plant taxa was not possible, specimens were collected systematically for later identification utilising identification keys, relevant taxonomic papers published in journals and resources of the Western Australian Herbarium (WAH). In addition, specialist expertise was sort from Malcolm Trudgen (Pilbara specialist taxonomist) who confirmed the flora identifications.

The species list was checked against FloraBase (WAH 2013) to determine the species' conservation status. Threatened and Priority Flora were verified against the EPBC Act listing of threatened species to determine federal listing.

Introduced species were checked, to determine their ranking in terms of environmental impact, against the Environmental Weed Strategy for Western Australia (CALM 1999) the DEC Invasive Plant Prioritisation Process – Pilbara Weed Assessment List (DEC 2008), the *Biosecurity and Agriculture Management Act 2013* (BAM Act) Declared Plants list (January 2011) and the Weeds of National Significance (WONS) (Commonwealth of Australia 2013).

Vegetation Mapping

The vegetation associations were described based on their structure and species composition, as defined by quadrat data, and field observations. Vegetation was mapped in the field using handheld GPS (Garmin) units and high-resolution aerial photographs, then digitised as map figures using GIS software.

Once the vegetation associations were determined, they were checked against the listing of Federal and State TECs and State PECs. Vegetation condition was mapped in the field using handheld GPS units and high-resolution aerial photographs, then digitised as map figures using GIS software. Vegetation condition was assessed based on Trudgen (1991) (Appendix E).

3.3 FAUNA HABITAT ASSESSMENT

The purpose of the field survey was to verify the accuracy of the review and to further delineate and characterise the habitat and faunal assemblages in the study area. The fauna field survey consisted of a fauna habitat assessment and opportunistic observations.

Habitat Assessment

Twelve habitat assessments were completed during the field survey (Figure 4). Each habitat was assessed on the basis of the presence and complexity of fauna microhabitats including vegetation cover, presence of water, tree hollows, loose bark, leaf litter etc. In addition, the habitat assessment included the identification of landscape features such as soil type, rock type, and vegetation type and disturbance levels.

Opportunistic Observations

Conservation significant fauna were searched for opportunistically during the foot traverses and driving through the site. Field staff investigated scats, tracks, burrows and other traces of animals throughout the entire study area. Where conservation significant species were located, the coordinates were recorded using a handheld GPS.

Fauna Habitat Mapping

During the field survey broad fauna habitats were identified and mapped based on information gathered during the habitat assessments. Habitats are identified and mapped based on vegetation and landforms as well as the fauna assemblage which the habitat provides for. Habitat mapping was carried out in the field using handheld GPS units.

Habitat boundaries were drawn over aerial photographs and digitally mapped using GIS software.

3.4 SURVEY LIMITATIONS AND CONSTRAINTS

It is important to note the specific constraints imposed on surveys. Constraints are often difficult to predict, as is the extent to which they influence survey effort. Survey constraints are usually associated with timing of the survey, weather, season, accessibility and coverage of the study area. The survey timing and the season was considered to be acceptable with significant mid-winter rainfall (271 mm in June) extending the flowering season. Accessibility was very good with vehicle tracks throughout the site and terrain easily covered on foot. The study area was adequately covered with all vegetation and habitat types assessed.

It should be noted that the fauna survey did not include nocturnal observations or any targeted trapping programs.

4 RESULTS

4.1 FLORA OVERVIEW

A total of 112 taxa (including species, subspecies, varieties and forms) from 71 genera and 31 families were recorded in the study area. The commonly occurring families were; Fabaceae (21 taxa), Poaceae (16 taxa) and Malvaceae (15 taxa). The most frequently recorded genera were; *Acacia* (nine taxa) and *Euphorbia*, *Sida* and *Ptilotus* (four taxa each). An average of 17 species were recorded in each quadrat.

Quadrat and relevé data, including site photographs, is presented in Appendix F, the flora inventory is presented in Appendix G and a matrix showing species recorded in each site is presented in Appendix H.

4.2 FLORA OF CONSERVATION SIGNIFICANCE

No Threatened species pursuant to the EPBC Act and/or gazetted as Threatened pursuant to the WC Act were recorded during the survey.

One Priority species, as recognised by the DPaW, was recorded during the survey: *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1). Details of locations of this species are presented in Appendix I and Figure 5.

Abutilon sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1)

Abutilon sp. Pritzelianum (S. van Leeuwen 5095) (Plate 1) is an erect, spindly shrub to 2 m. It is currently known from 23 records occurring on sandplains, sand dunes, coastal estuaries and road verges (WAH 2013). *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) was recorded from 23 locations totalling 108 individuals. It was primarily recorded along the two main sand dunes within the study area, in vegetation type AsaAstTeEe. The locations it was recorded are presented in Appendix I and Figure 5.

Plate 1: *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1)

4.3 INTRODUCED FLORA

Six species of introduced flora were recorded from the study area:

- **Aerva javanica* (Kapok Bush) (Plate 2);
- **Cucumis melo* subsp. *agrestis* (Ulcardo Melon) (Plate 3);
- **Malvastrum americanum* (Spiked Malvastrum) (Plate 4);
- **Cenchrus ciliaris* (Buffel Grass) (Plate 5);
- **Cenchrus setiger* (Birdwood Grass) (Plate 6); and
- **Vachellia farnesiana* (Mimosa Bush) (Plate 7).

None of these species are registered as WONS (Commonwealth of Australia 2013). None of these species are listed as Declared Plants under the BAM Act. Five of the six species are listed as environmental weeds, as defined by the *Environmental Weed Strategy for Western Australia* (CALM 1999). The rating and criteria for these species' inclusion under this strategy, as well as their rating against the invasiveness criteria of the Invasive Plant Prioritisation Process (DEC 2008), is presented in Table 3.

Four of the six introduced species have a High rating (CALM 1999):

- **Aerva javanica* (Kapok Bush);
- **Cenchrus ciliaris* (Buffel Grass);
- **Cenchrus setiger* (Birdwood Grass) and
- **Malvastrum americanum* (Spiked Malvastrum);

The most dominant and commonly recorded introduced species within the study area was **Cenchrus ciliaris.* This species was recorded from six locations with densities of up to 10% cover.

Table 3: Introduced Flora Recorded in the Study Area, Including their Rating by the Environmental Weed Strategy (CALM 1999) and the Invasive Plant Prioritisation Process (DEC 2008)

Species (Common Name)	Rating (CALM 1999)	Criteria (DEC 2008)		
		Ecological Impact	Invasiveness	Feasibility of Control
**Aerva javanica* (Kapok Bush)	High	High	Rapid	High-Moderate
**Cenchrus ciliaris* (Buffel Grass)	High	High	Rapid	Low
**Cenchrus setiger* (Birdwood Grass)	High	High	Rapid	Low
**Vachellia farnesiana* (Mimosa Bush)	High	High	Rapid	Low
**Malvastrum americanum* (Spiked Malvastrum)	Moderate	High	Rapid	Low

Plate 2: **Aerva javanica* (Kapok Bush)

Plate 3: **Cucumis melo* subsp. *agrestis* (Ulcardo Melon) Source: ALA (2013)

Plate 4: **Malvastrum americanum* (Spiked Malvastrum)

Plate 5: **Cenchrus ciliaris* (Buffel Grass)

Plate 6: **Cenchrus setiger* (Birdwood Grass)

Plate 7: **Vachellia farnesiana* (Mimosa Bush)

4.4 VEGETATION ASSOCIATIONS

Eight vegetation associations were identified across the study area (Figure 6). The extent of each association is presented in Table 4.

The most widespread vegetation association was AssAtAstTe comprising 76.3% and 1,006.5 ha within the study area. This vegetation association occurs throughout the study area.

Table 4: Vegetation Associations and their Extent in the Study Area

Landform	Vegetation Code	Vegetation Association	Extent in Study Area (%)	Extent in Study Area (ha)
Sand Dune	AsaAstTeEe	High shrubland of *Acacia sabulosa* over low open shrubland of *Acacia stellaticeps* over hummock grassland of *Triodia epactia* over very open tussock grassland of *Eragrostis eriopoda*	5.6	74.4
Riverine	EcrMgMlAtTe*Cc*Cs	Low open woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over high open shrubland of *Melaleuca glomerata*, *Melaleuca linophylla* and *Acacia trachycarpa* over very open hummock grassland of *Triodia epactia* over open tussock grassland of **Cenchrus ciliaris* and **Cenchrus setiger*	2.4	31.2
Sand Plain	AssAtAstTe	Scattered low shrubs of *Acacia sclerosperma* subsp. *sclerosperma, Acacia trachycarpa* and *Acacia stellaticeps* over open hummock grassland of *Triodia epactia*	76.3	1,006.5
Open Woodland	EvClEaCfEb	Low woodland of *Eucalyptus victrix* over open shrubland of *Cullen leucanthum* over tussock grassland of *Eulalia aurea, Chrysopogon fallax* and *Eriachne benthamii*	0.3	4.5
	CzAstTeEePa	Low open woodland of *Corymbia zygophylla* over low open shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia* over open tussock grassland of *Eragrostis eriopoda* over very open herbland of *Ptilotus astrolasius*	0.3	3.7
Clay Plain	EbCfEa	Tussock grassland of *Eriachne benthamii*, *Chrysopogon fallax* and *Eulalia aurea*	3.9	51.4
	Ex	Open tussock grassland of *Eragrostis xerophila*	2.9	37.6
	ApTeCf*Cc*Cs	High open shrubland of *Acacia pyrifolia* over very open hummock grassland of *Triodia epactia* over open tussock grassland of *Chrysopogon fallax*, **Cenchrus ciliaris* and **Cenchrus setiger*	8.3	109.4
Total			100	1,318.8

4.5 VEGETATION CONDITION

Vegetation condition across the study area ranged from Excellent to Poor, with the majority of the study area (72%) in Very Good condition (Figure 7). Grazing from cattle, scattered weed species and unsealed tracks were the most frequently observed impacts on native vegetation. Weed species were recorded in relatively low densities across the majority of the site. However, areas with heavier cattle disturbance had higher densities of weeds, particularly in close proximity to the river line and around the water tank located between the sand dune and the river line towards the southern boundary of the study area.

Fire age was variable across the site and ranged between Moderate (4-8 years) to Very Old (greater than 12 years) with the majority of the study area considered to have a Very Old fire age.

4.6 VEGETATION OF CONSERVATION SIGNIFICANCE

None of the eight vegetation associations described for the study area were analogous to any known TECs, PECs or ESAs. The closest record of a TEC or PEC to the study area is the Priority 3 Ecological Community Horseflat Land System of the Roebourne Plains. The closest point of the buffer zone around this PEC is 24.5 km west of the study area.

4.7 FAUNA HABITATS

Six habitat types were defined within the study area. These are presented in Figure 8 and the habitat assessment sheets are detailed in Appendix J. Each of these habitats is common in the region, and each habitat is likely to host a subtly different fauna suite. The extent of each habitat within the study area is presented in Table 5.

Table 5: Fauna Habitats and their Extent within the Study Area

Habitat	Extent in Study Area (ha)	Extent in Study Area (%)
Sand Dune	127.3	9.7
Riverine	31.2	2.4
Sand Plain with Hummock Grassland	953.6	72.3
Clay Plain with Tussock Grassland	89.1	6.8
Clay Plain with *Acacia* Shrubland	109.4	8.3
Open Woodland	8.3	0.6

4.8 FAUNA OF CONSERVATION SIGNIFICANCE

Two species of conservation significant fauna were recorded during the survey: Rainbow Bee-eaters (*Merops ornatus*) and an Australian Bustard (*Ardeotis australis*).

The Rainbow Bee-eater (Plate 8) is listed as a Schedule 3, Migratory species and as such, is protected under an International Agreement. The Australian Bustard (Plate 9) is listed as a Priority 4 species by the DPaW. The location these species were sited at is indicated in Figure 9 and detailed in Table 6.

Table 6: Locations and Number of Individuals of Priority Fauna Recorded within the Study Area (WGS 84, Zone 50K)

Species	Number of Individuals	Easting	Northing
Rainbow Bee-eater (*Merops ornatus*)	3	611859	7696563
Australian Bustard (*Ardeotis australis*)	1	613152	7696189

Plate 8: Rainbow Bee-eater (Migratory) (Source: ALA 2013)

Plate 9: Australian Bustard (Priority 4)

5 DISCUSSION

5.1 FLORA

The survey recorded 112 taxa within a study area of 1318.8 ha, which is comparable to 85 taxa listed within a 25 km radius of a centre point within the study area from NatureMap (DPaW 2013d). The relatively considerable number of species for the size of the study area indicates the range of different habitats and vegetation associations.

The flora of the project area is typical of the Pilbara and in particular of the greater Port Hedland area.

5.2 FLORA OF CONSERVATION SIGNIFICANCE

Three species of Threatened flora are known to occur in the Pilbara: *Lepidium catapycnon*, *Aluta quadrata* and *Thryptomene wittweri*. It is highly unlikely for any of these species to occur in the study area due to a lack of suitable habitat.

One species of conservation significance was recorded during the survey *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1).

***Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (P1)** is an erect, spindly shrub to 2 m. It is currently known from 23 records occurring on sand plains, sand dunes, coastal estuaries and road verges (WAH 2013). It was recorded along the two main sand dunes within the study area, in vegetation type AsaAstTeEe, with 108 individuals from 23 locations. *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) is known from 23 vouchered collections at the Western Australian Herbarium. The majority of these records are from the Port Hedland area with scattered records from Karratha, Onslow and Carnarvon. It is not considered the proposed impacts will affect the greater population of this species.

5.3 VEGETATION OF CONSERVATION SIGNIFICANCE

There are no currently recognised TECs, PECs or ESAs situated within the study area. None of the eight vegetation associations described for the study area were analogous to any known TECs, PECs or ESAs. The closest record of a TEC or PEC to the study area is the Priority 3 Ecological Community Horseflat Land System of the Roebourne Plains. The closest point of the buffer zone around this PEC is 24.5 km west of the study area.

The Roebourne subregion includes nine recognised Ecosystems at Risk which are subject to a range of threatening processes (Kendrick and Stanley 2001). None of these ecosystems are relevant to the study area.

In addition, the Roebourne subregion comprises Wetlands of Subregional Significance. This includes permanent pools along major rivers within 40 km of the coast and the mangroves

associated with numerous river mouths around Port Hedland. The study area does not contain any permanent pools or mangroves.

5.4 VEGETATION CONDITION AND INTRODUCED FLORA

Six introduced species were recorded from the study area, 5% of the total taxa recorded. None of these six species are considered Declared Plants under the BAM Act or listed as WONS by the federal government. Of the six introduced species recorded in the study area, four species have a High rating under the Environmental Weed Strategy for Western Australia (CALM 1999). These are: **Aerva javanica, *Cenchrus ciliaris, *Cenchrus setiger* and **Malvastrum americanum.* Control of these introduced species may therefore be desirable.

The most dominant and commonly recorded introduced species within the study area was **Cenchrus ciliaris.* This species was recorded from six locations with densities of up to 10% cover.

The majority of the study area was considered to be in Very Good condition. The areas associated with the river line had heavier cattle disturbance and higher densities of weeds.

5.5 REGIONAL REPRESENTATION

The study area is characterised by three land systems: Mallina, Uaroo and Gregory (van Vreeswyk *et al.* 2004). The Mallina and Uaroo land systems are not considered to be restricted, comprising 1.4% and 4.2% of the Pilbara bioregion respectively. However, the Gregory land system is considered to be restricted with a total area of 113km^2 (0.06% of the Pilbara bioregion).

5.6 FAUNA HABITATS

Six fauna habitats were defined across the study area: Sand Dune, Riverine, Sand Plain with Hummock Grassland, Open Woodland, Clay Plain with Open *Acacia* Shrubland and Clay Plain with Tussock Grassland. Each habitat is likely to host a subtly different fauna suite. A broad range of microhabitats are provided by the range of features across the study area leading to a diverse range of fauna being supported by the habitats present.

Five of the six habitats are considered to be widespread throughout the region. The Sand Dune habitat is less common in the region than the other habitat types. The proposed clearing of this habitat may impact the regional representation of these habitats and the fauna that they support.

The proposed clearing of the remaining habitats in the study area is unlikely to impact significantly on the regional representation of these habitats or the fauna that they support.

5.7 FAUNA OF CONSERVATION SIGNIFICANCE

Two conservation significant species was recorded during the survey: Rainbow Bee-eaters (*Merops ornatus*) and an Australian Bustard (*Ardeotis australis*).

The Rainbow Bee-eater is listed as a Migratory species and is protected under the Japan-Australia Migratory Bird Agreement (JAMBA). It is distributed across much of mainland Australia and its population size is assumed to be reasonably large based on high reports of numbers through Australia (DSEWPaC 2013c).

The Australian Bustard is listed as a Priority 4 species by the DPaW and is known from 2016 records throughout Western Australia (DPaW 2013d). It is a widespread, mobile species and the proposed impacts are not considered to have a significant effect on the population of this species.

Database searches revealed that 60 conservation significant fauna species have been previously recorded within the vicinity of the study area (Appendix D). These 60 conservation significant species comprised 49 birds, nine mammals and two reptiles. Of the 60 species, 12 are listed under the EPBC Act. Four species are listed as Endangered under the EPBC Act (two birds and two mammals):

- Lesser Sand Plover (*Charadrius mongolus*);
- Australian Painted Snipe (*Rostratula australis*);
- Northern Quoll (*Dasyurus hallucatus*); and
- Northern Marsupial Mole (*Notoryctes caurinus*)

Eight species are listed as Vulnerable under the EPBC Act (four birds, three mammals and one reptile):

- Grey Falcon (*Falco hypoleucos*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Great Knot (*Calidris tenuirostris*);
- Eastern Curlew (*Numenius madagascariensis*);
- Orange Leaf-nosed Bat (*Rhinonicteris aurantius*);
- Black-footed Rock-wallaby (*Petrogale lateralis lateralis*);
- Greater Bilby (*Macrotis lagotis*); and
- Pilbara Olive Python (*Liasis olivaceus barroni*).

Due to the mobility of the bird species, the proposed impacts are not likely to have a significant effect on their populations. Of the remaining six species, two have previously been recorded in the vicinity of the study area during nearby surveys: Northern Quoll and Orange Leaf-nosed Bat. Both species were recorded 40 km south east of the study area at the Atlas Iron Mt Dove project (Coffey 2011). However, the study area does not provide

particularly suitable habitat for either of these species so it is considered unlikely for them to occur.

It is considered that the study area provides suitable habitat for three of the 12 EPBC Act listed species, and as such they all have a Moderate likelihood of occurring in the study area: Northern Marsupial Mole, Greater Bilby and Pilbara Olive Python.

The Northern Marsupial Mole is known to live underground, primarily in sand dunes and sandy soils along river flats (DSEWPaC 2013d). The Greater Bilby is known from a wide range of soil and vegetation types including open woodlands and hummock grasslands where burrowing is suitable (DSEWPaC 2013e). The Olive Python is known to inhabit areas in close proximity to water and rock outcrops that attract suitable sized prey species (DSEWPaC 2013f).

6 RECOMMENDATIONS

MEC makes the following recommendations:

- As a matter of principle, any clearing should be clearly identified and clearing of native vegetation should be kept to a minimum;
- Clearing of large *Eucalyptus* trees should be avoided where possible;
- Populations of recorded weed species should be controlled as soon as possible in order to prevent further spread;
- A weed management plan should be implemented to prevent the further spread of weed species;
- Management measures should be implemented to ensure clearing does not cause appreciable land degradation, including preventing erosion from the cleared areas;
- Disturbance of natural drainage channels should be minimised;
- Management measures should be implemented to prevent impacts on adjacent fauna from pollution, such as litter and oil spills;
- Implement measures to reduce the risk of fire starting from activities at site; and
- Destruction of fauna habitat should be minimised during clearing. Dead, standing or fallen timber should be retained as habitat, wherever possible. Where micro-habitats, such as logs and other debris, must be disturbed for construction, these should be retained and used in rehabilitation.

7 ASSESSMENT OF FINDINGS AGAINST THE CLEARING PRINCIPLES

Any clearing of native vegetation requires a permit under Part V Division 2 of the *EP Act*, except where an exemption applies under Schedule 6 of the *EP Act*, or where the clearing is prescribed by regulations in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Exemptions do not apply in an ESA.

Each of the ten clearing principles, as outlined in the *EP Act*, have been individually assessed within the scope and knowledge of this flora, vegetation and fauna assessment.

Principle A – Native vegetation should not be cleared if it comprises a high level of biological diversity.

The survey of the study area identified 112 species of flora from 81 genera and 37 families. Of these 112 species, one represented a conservation significant taxon: *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1). Two species of conservation significant fauna were recorded within the study area: Rainbow Bee-eater (*Merops ornatus*) and Australian Bustard (*Ardeotis australis*). Numerous weed species occur throughout the study area and unsealed tracks are already located throughout the study area. Large areas surrounding the study area are considered to comprise a similar level of biological diversity to the study area.

Therefore, the proposal is not likely to be at variance with this principle.

Principle B - Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

The fauna habitats within the study area are mostly well represented elsewhere within the local area. However, the Sand Dune habitat (defined as the Gregory land system) is considered to be restricted and, as such, may represent significant habitat. There are other similar sand dunes surrounding the study area, however they are not considered to be particularly common in the landscape.

Therefore, the proposal may be at variance with this principle.

Principle C - Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

One species of Priority flora was recorded during the survey of the study area: *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1). No Threatened flora was recorded from the study area and no species of Threatened flora are considered likely to occur within the study area due to a lack of suitable habitat.

Therefore, the proposal is not likely to be at variance with this principle.

Principle D - Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.

No records of a TEC occur within a 50 km radius of the study area and none of the vegetation associations within the study area are considered to represent a TEC.

Therefore, the proposal is not likely to be at variance with this principle.

Principle E - Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The majority of the native vegetation surrounding the study area remains in a relatively natural state and is predominantly uncleared. The area comprises station leases with cattle and only basic associated infrastructure (cleared light vehicle tracks, tanks, troughs and occasional holding and loading yards).

Therefore, the proposal is not likely to be at variance with this principle.

Principle F - Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

The east branch of the Peewah River extends through the length of the study area and comprises approximately 5 km of river line within the study area. The river line is proposed to be impacted as sand is to be excavated from the river bed. However, the precise area of disturbance within the river line is currently unknown.

Therefore, the proposal is likely to be at variance with this principle.

Principle G - Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

The proposed impacts have the potential to affect soil surfaces resulting in a level of land degradation. However, with appropriate management actions, impacts are considered to be minor. The study area occurs across three land systems: Uaroo, Mallina and Gregory (van Vreeswyk *et al.* 2004). The Mallina land system has some records of erosion over 13% of the land system. The Uraoo land system has records of slight erosion over 1% of the land system. The Gregory land system has no record of erosion throughout its extent.

There are records of weed species throughout the site, predominantly associated with the river line where cattle disturbance to the vegetation is noticeable. The spread of weeds further within and outside of the study area can be prevented with the implementation of the weed management program and if appropriate precautions are undertaken.

Therefore, the proposal is not likely to be at variance with this principle.

Principle H - Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

The study area is not located within or adjacent to any conservation reserves. The closest DPaW-managed conservation estate is Mungaroona Range Nature Reserve, which is approximately 50 km south of the study area. Millstream-Chichester National Park is situated approximately 65 km south west of the study area.

Therefore, the proposal is not likely to be at variance with this principle.

Principle I - Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

The study area is not situated within a Proposed Drinking Water Source Area (DoW 2012). Clearing of native vegetation may temporarily cause runoff and sedimentation. However, with appropriate management actions, impacts on hydrology and drainage are considered to be minor. Existing vegetation within the study area is sparse and average annual rainfall for the area is 256 mm (BoM 2013).

Therefore, the proposal is not likely to be at variance with this principle.

Principle J - Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

The east branch of the Peewah River running along the length of the study area carries an annual water flow, only flooding during summer months with high rainfall. There do not appear to be any perennial pools along the length of the river within the study area.

Port Hedland airport receives an average annual rainfall of 256 mm, with an annual evapotranspiration rate of between 300-400 mm (BoM 2013). With appropriate drainage control and water management it is unlikely that the proposed clearing will cause or exacerbate the incidence or intensity of flooding.

Therefore, the proposal is not likely to be at variance with this principle.

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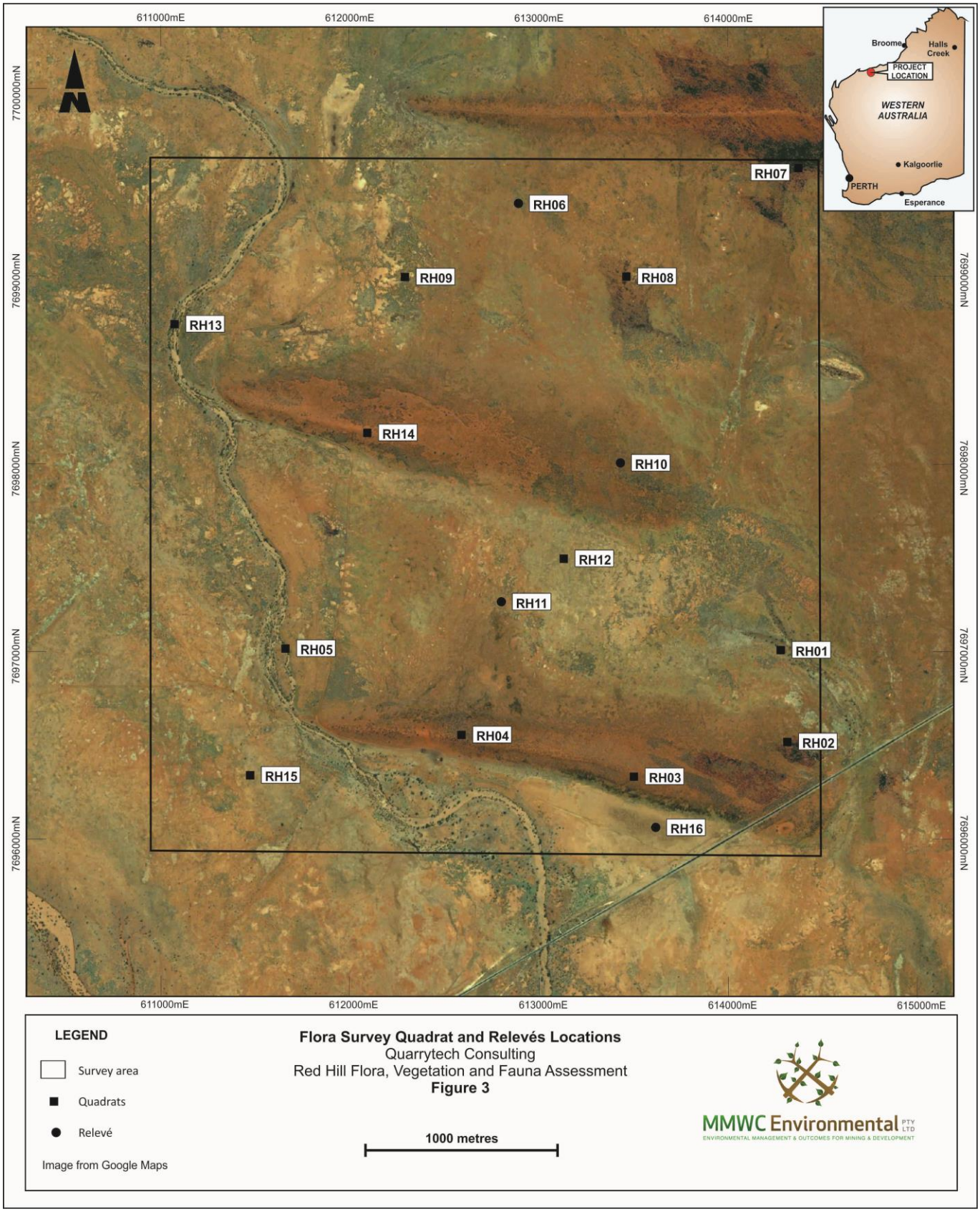
FIGURES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Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
LEGEND
Survey area
Quadrats
Relevé
Image from Google Maps
Flora Survey Quadrat and Relevés Locations
Quarrytech Consulting
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Figure 3
1000 metres
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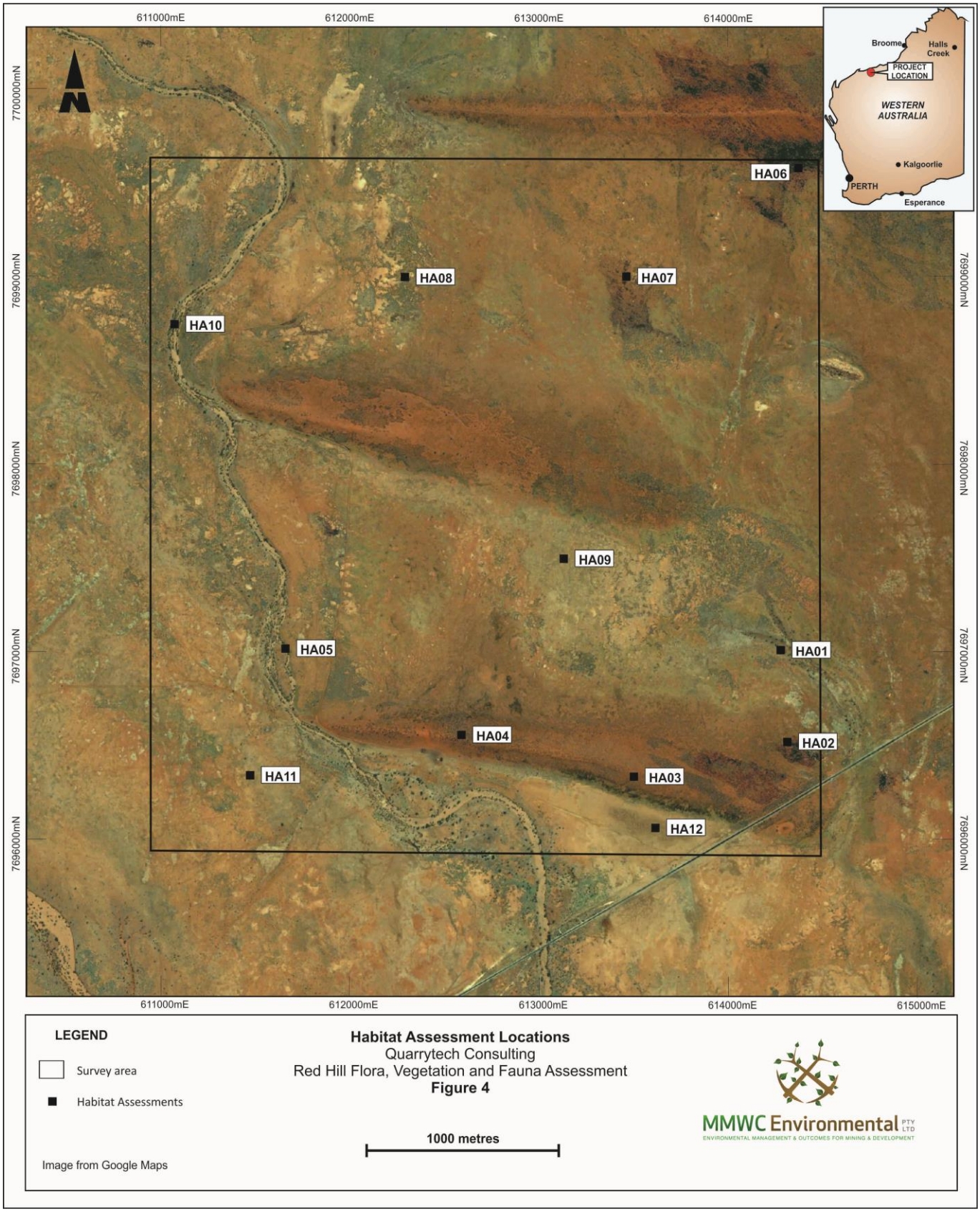
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PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
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Survey area
Habitat Assessments
Image from Google Maps
Habitat Assessment Locations
Quarrytech Consulting
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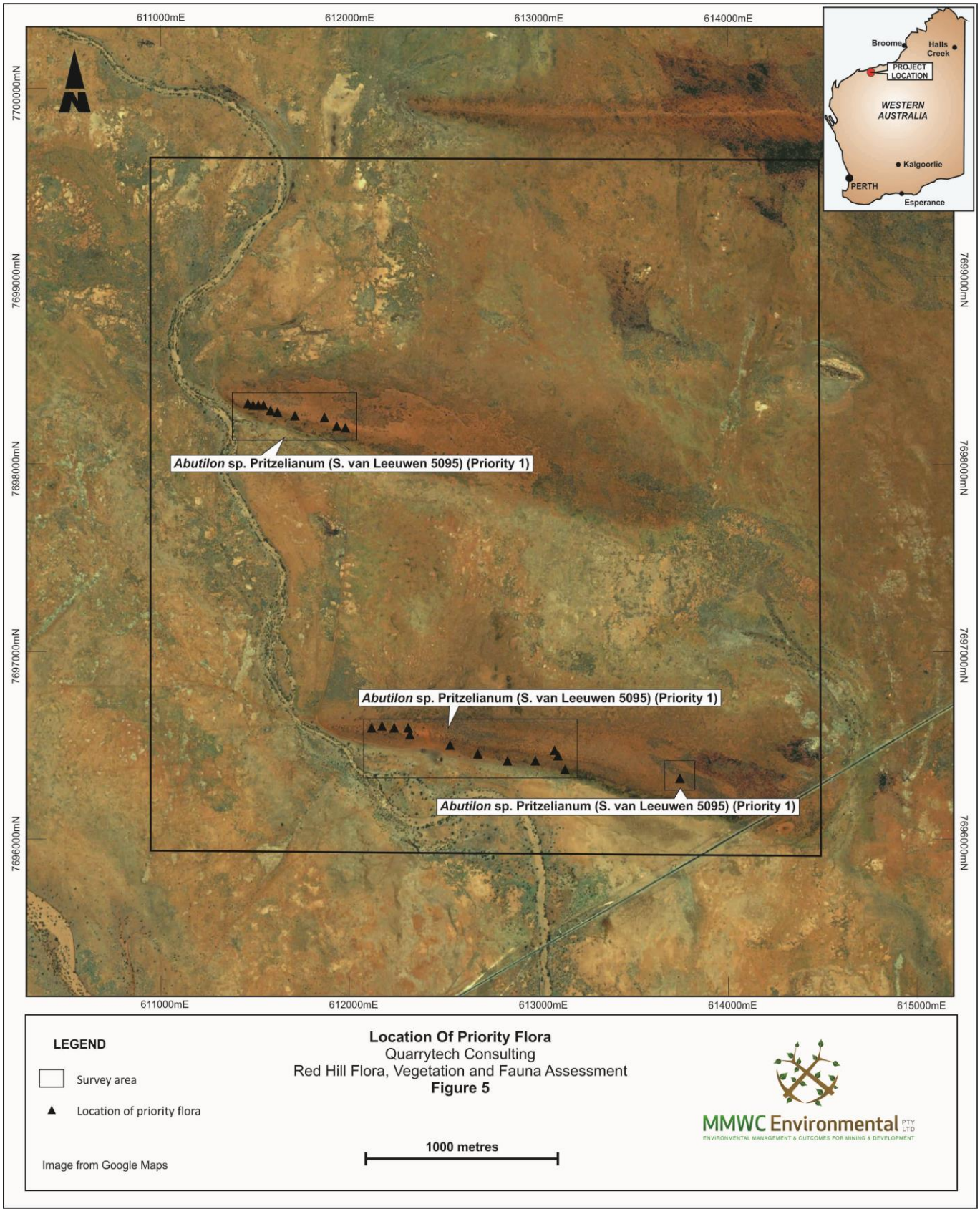
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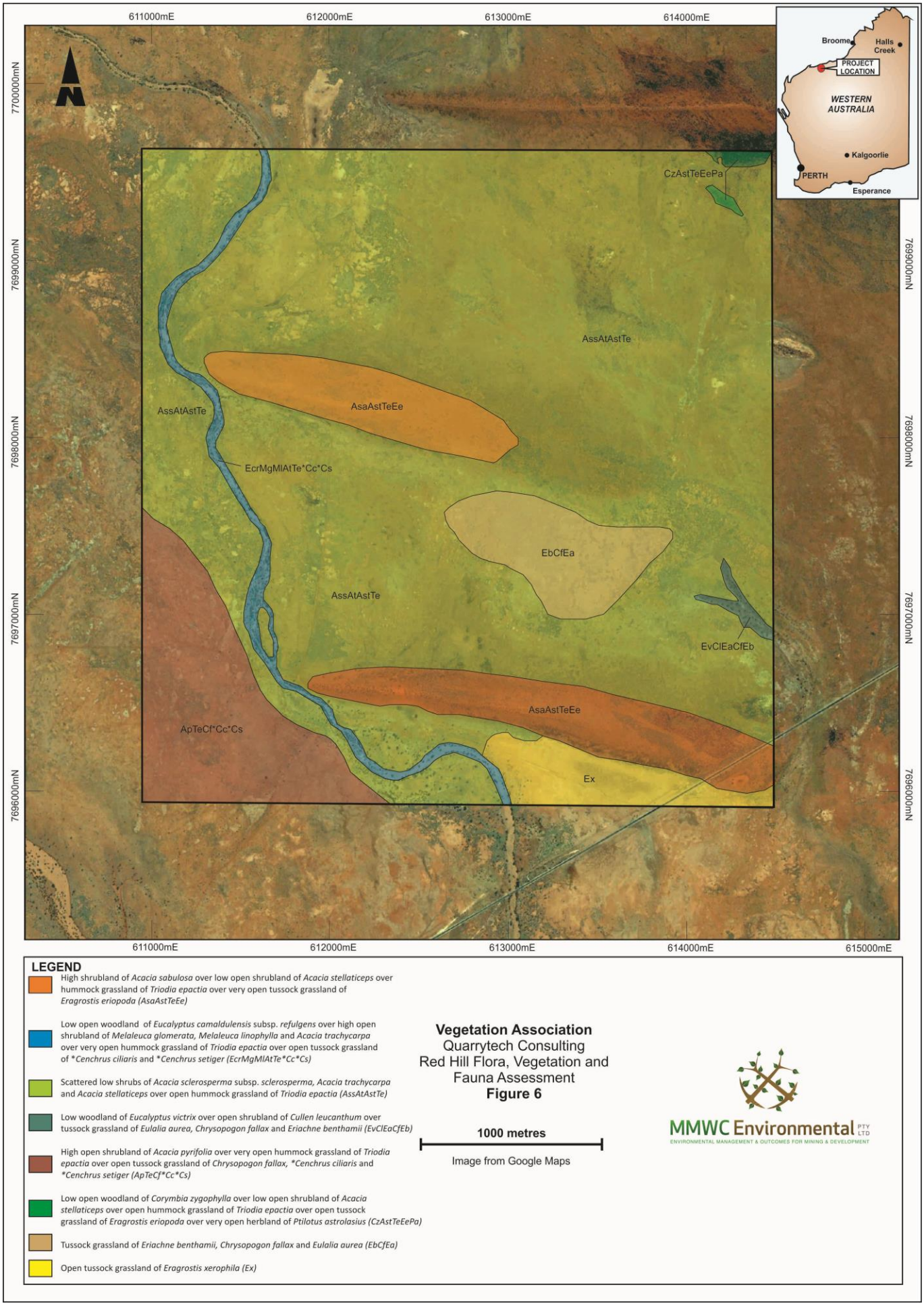
7700000mN
7699000mN
7698000mN
7697000mN
7696000mN
Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
Abutilon sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1)
Abutilon sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1)
Abutilon sp. Pritzelianum (S. van Leeuwen 5095) (Priority 1)
LEGEND
Survey area
Location of priority flora
Image from Google Maps
Location Of Priority Flora
Quarrytech Consulting
Red Hill Flora, Vegetation and Fauna Assessment
Figure 5
1000 metres
MMWC Environmental PTY LTD
ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT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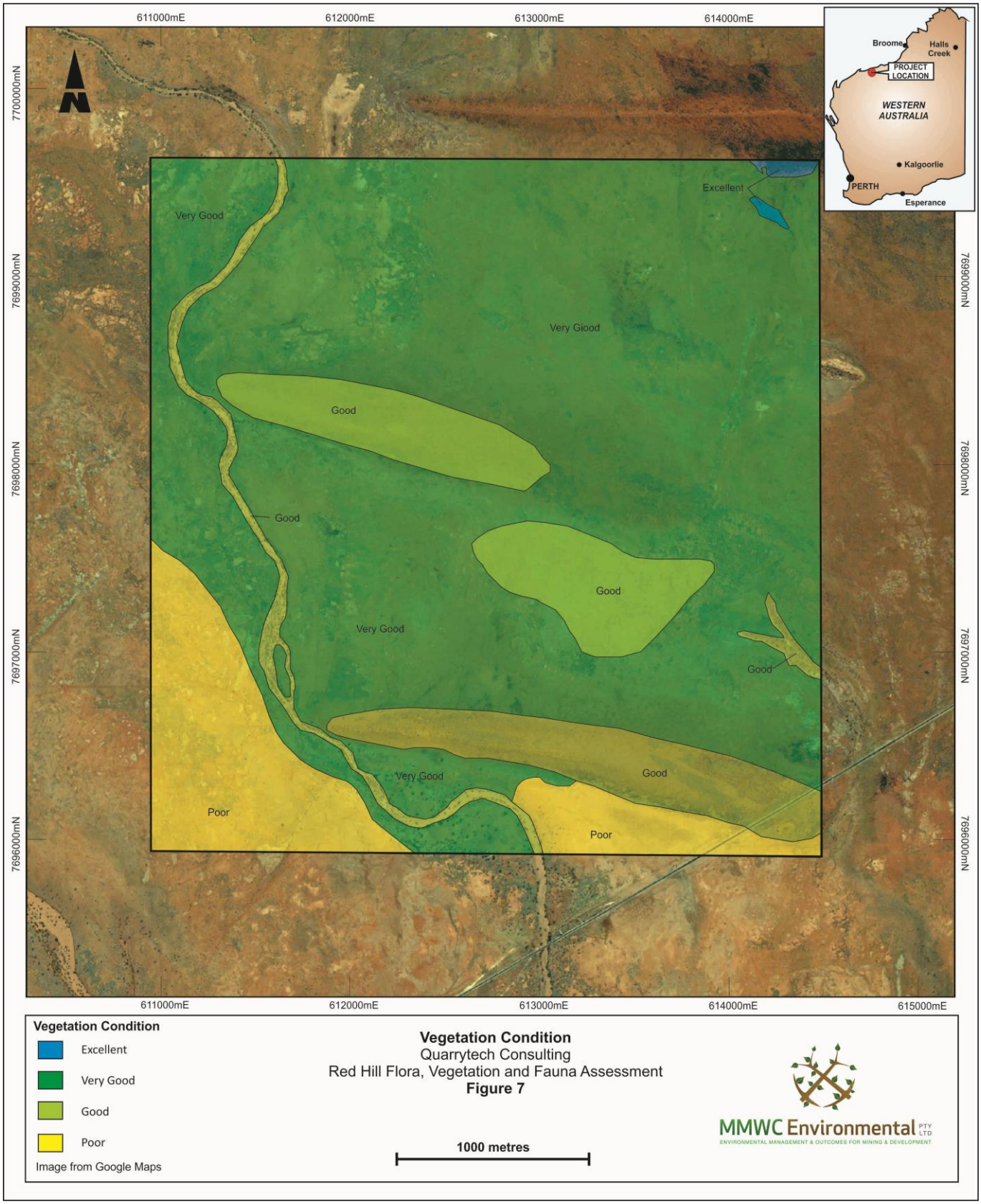
Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
CzAstTeEePa
AssAtAstTe
AsaAstTeEe
EcrMgMlAtTe*Cc*Cs
EbCfEa
EvClEaCfEb
ApTeCf*Cc*Cs
Ex
LEGEND
High shrubland of Acacia sabulosa over low open shrubland of Acacia stellaticeps over hummock grassland of Triodia epactia over very open tussock grassland of Eragrostis eriopoda (AsaAstTeEe)
Low open woodland of Eucalyptus camaldulensis subsp. refulgens over high open shrubland of Melaleuca glomerata, Melaleuca linophylla and Acacia trachycarpa over very open hummock grassland of Triodia epactia over open tussock grassland of *Cenchrus ciliaris and *Cenchrus setiger (EcrMgMlAtTe*Cc*Cs)
Scattered low shrubs of Acacia sclerosperma subsp. sclerosperma, Acacia trachycarpa and Acacia stellaticeps over open hummock grassland of Triodia epactia (AssAtAstTe)
Low woodland of Eucalyptus victrix over open shrubland of Cullen leucanthum over tussock grassland of Eulalia aurea, Chrysopogon fallax and Eriachne benthamii (EvClEaCfEb)
High open shrubland of Acacia pyrifolia over very open hummock grassland of Triodia epactia over open tussock grassland of Chrysopogon fallax, *Cenchrus ciliaris and *Cenchrus setiger (ApTeCf*Cc*Cs)
Low open woodland of Corymbia zygophylla over low open shrubland of Acacia stellaticeps over open hummock grassland of Triodia epactia over open tussock grassland of Eragrostis eriopoda over very open herbland of Ptilotus astrolasius (CzAstTeEePa)
Tussock grassland of Eriachne benthamii, Chrysopogon fallax and Eulalia aurea (EbCfEa)
Open tussock grassland of Eragrostis xerophila (Ex)
Vegetation Association
Quarrytech Consulting
Red Hill Flora, Vegetation and Fauna Assessment
Figure 6
1000 metres
Image from Google Maps
MMWC Environmental PTY LTD
ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT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7699000mN
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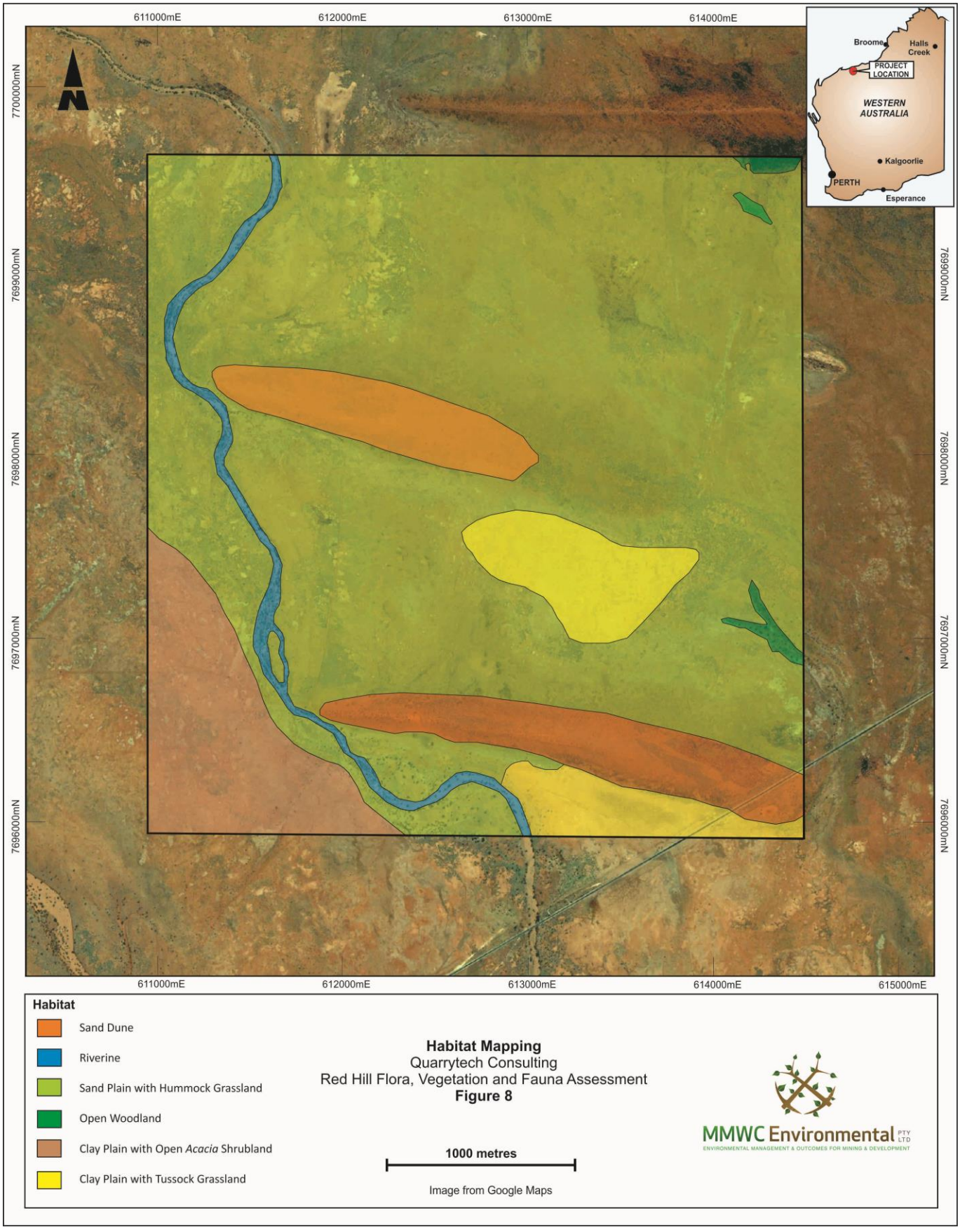
7697000mN
7696000mN
Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
Excellent
Very Good
Very Giood
Good
Good
Good
Very Good
Good
Very Good
Good
Poor
Poor
Vegetation Condition
Excellent
Very Good
Good
Poor
Image from Google Maps
Vegetation Condition
Quarrytech Consulting
Red Hill Flora, Vegetation and Fauna Assessment
Figure 7
1000 metres
MMWC Environmental PTY LTD
ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT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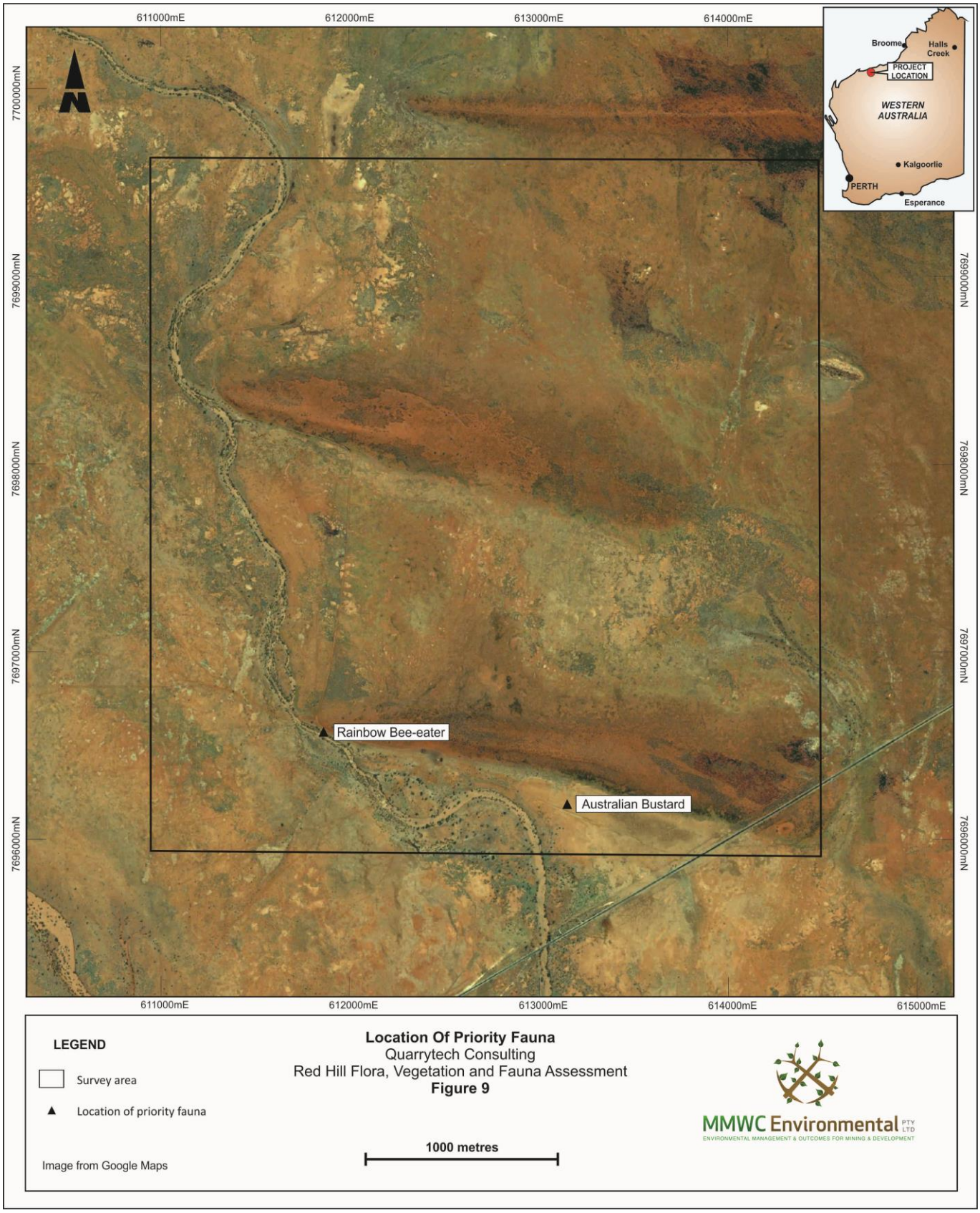
7700000mN
7699000mN
7698000mN
7697000mN
7696000mN
Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
Habitat
Sand Dune
Riverine
Sand Plain with Hummock Grassland
Open Woodland
Clay Plain with Open Acacia Shrubland
Clay Plain with Tussock Grassland
Habitat Mapping
Quarrytech Consulting
Red Hill Flora, Vegetation and Fauna Assessment
Figure 8
1000 metres
Image from Google Maps
MMWC Environmental PTY LTD
ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT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7696000mN
Broome
Halls Creek
PROJECT LOCATION
WESTERN AUSTRALIA
Kalgoorlie
PERTH
Esperance
Rainbow Bee-eater
Australian Bustard
LEGEND
Survey area
Location of priority fauna
Image from Google Maps
Location Of Priority Fauna
Quarrytech Consulting
Red Hill Flora, Vegetation and Fauna Assessment
Figure 9
1000 metres
MMWC Environmental PTY LTD
ENVIRONMENTAL MANAGEMENT & OUTCOMES FOR MINING & DEVELOPMENT

APPENDIX A

DEFINITION OF CONSERVATION CODES FOR THREATENED AND PRIORITY FLORA

A1: Categories of Threatened and Priority Flora (WC Act)

Conservation Code	Category
X	**Presumed Extinct Flora (Declared Rare Flora – Extinct)** "Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*)."
T	**Threatened Flora (Declared Rare Flora – Extant)** "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 (Schedule 1 under the *Wildlife Conservation Act 1950*)." "Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: • CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild; • EN: Endangered – considered to be facing a very high risk of extinction in the wild; • VU: Vulnerable – considered to be facing a high risk of extinction in the wild."
P1	**Priority One: Poorly-known taxa** "Taxa which are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes."
P2	**Priority Two: Poorly-known taxa** "Taxa which are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes."
P3	**Priority Three: Poorly-known taxa** "Taxa which are known from collections or sight records from several localities not under imminent threat, or 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."

Conservation Code	Category
P4	**Priority Four: Rare, Near Threatened and other taxa in need of monitoring** a. Rare. "Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands." b. Near Threatened. "Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable." c. "Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy."
P5	**Priority Five: Conservation Dependent taxa** "Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years."

A2: Categories of Threatened Flora Species (EPBC Act)

Category Code	Category
Ex	**Extinct** Taxa which at a particular time if, at the time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, 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 B

DEFINITION OF CONSERVATION CODES FOR THREATENED AND PRIORITY FAUNA

B1: *Environment Protection and Biodiversity Conservation Act 1999* (*Cth*):

Threatened Species and Threatened Ecological Communities Codes

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

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

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

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

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

B2: Western Australian Threatened Fauna Categories

Wildlife Conservation Act 1950 (WA)

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

B3: Department of Parks and Wildlife Fauna Priority Codes

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

APPENDIX C

DEFINITION OF THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

C1: Threatened Ecological Communities

Presumed Totally Destroyed (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B);

A) Records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats **or**

B) All occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and **either or both** of the following apply (i or ii)

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years)

ii) modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, and **one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years)

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years)

Endangered (EN)

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting **any one or more** of the following (A, B, C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and **either or both** of the following apply (i or ii)

i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years)

ii) modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, and **one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years)

ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes

iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).

Vulnerable (VU)

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is facing a high risk of total destruction in the medium to long term future. This will be determined by it meeting **any one or more** of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

C2: Priority Ecological Communities

Priority One

Poorly known ecological communities Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two

Poorly known ecological communities. Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three - Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;

(iii) Communities made up of large, and/or widespread occurrences that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four
Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (a) Rare. Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. (b) Near Threatened. Ecological communities 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) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority Five
Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Source: Department of Parks and Wildlife (2013). *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*.

APPENDIX D

FAUNA PREVIOUSLY RECORDED IN THE REGION

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Amphibians											
Hylidae	*Cyclorana maini*	Sheep Frog					✓				
	Litoria rubella	Little Red Tree Frog					✓		✓		
Myobatrachidae	*Notaden nichollsi*	Desert Spadefoot					✓				
Birds											
Acanthizidae	*Gerygone tenebrosa*	Dusky Gerygone							✓		
	Smicrornis brevirostris	Weebill							✓		
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk					✓				
	Accipiter fasciatus	Brown Goshawk					✓				
	Aquila audax	Wedge-tailed Eagle					✓		✓		
	Circus approximans	Swamp Harrier					✓		✓		
	Circus assimilis	Spotted Harrier					✓		✓		
	Elanus axillaris	Black-shouldered Kite							✓		
	Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi	S3		✓	✓	✓	✓		
	Haliastur indus	Brahminy Kite					✓		✓		
	Haliastur sphenurus	Whistling Kite					✓		✓		
	Milvus migrans	Black Kite					✓				
	Pandion cristatus	Eastern Osprey	Mi	S3					✓		
Acrocephalidae	*Acrocephalus australis*	Australian Reed Warbler					✓				
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar					✓				
Alaudidae	*Mirafra javanica*	Singing Bushlark					✓		✓		
Alcedinidae	*Dacelo leachii*	Blue-winged Kookaburra					✓		✓		
	Todiramphus chloris	Collared Kingfisher							✓		
	Todiramphus pyrrhopygius	Red-backed Kingfisher					✓		✓		
	Todiramphus sanctus	Sacred Kingfisher					✓		✓		
Anatidae	*Anas gracilis*	Grey Teal					✓				

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Anatidae	*Anas rhynchotis*	Australasian Shoveler					✓				
	Anas superciliosa	Pacific Black Duck					✓				
	Chenonetta jubata	Australian Wood Duck					✓				
	Cygnus atratus	Black Swan					✓		✓		
	Dendrocygna eytoni	Plumed Whistling Duck					✓				
	Malacorhynchus membranaceus	Pink-eared Duck					✓				
Apodidae	*Apus pacificus*	Fork-tailed Swift	Mi	S3				✓			
Ardeidae	*Ardea alba*	Great Egret, White Egret	Mi	S3				✓			
	Ardea ibis	Cattle Egret	Mi	S3		✓	✓	✓			
	Ardea intermedia	Intermediate Egret					✓				
	Ardea modesta	Eastern Great Egret	Mi	S3		✓	✓		✓		
	Ardea pacifica	White-necked Heron					✓				
	Egretta garzetta	Little Egret							✓		
	Egretta novaehollandiae	White-faced Heron							✓		
	Egretta sacra	Eastern Reef Egret	Mi	S3		✓					
	Nycticorax caledonicus	Rufous Night Heron					✓				
Artamidae	*Artamus cinereus*	Black-faced Woodswallow					✓		✓		
	Artamus leucorynchus	White-breasted Woodswallow					✓		✓		
	Artamus minor	Little Woodswallow					✓				
	Artamus personatus	Masked Woodswallow					✓				
	Artamus superciliosus	White-browed Woodswallow							✓		
	Cracticus nigrogularis	Pied Butcherbird					✓		✓		
	Cracticus tibicen	Australian Magpie					✓		✓		
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew			P4	✓	✓				
	Esacus magnirostris	Beach Stone-curlew							✓		
Cacatuidae	*Cacatua sanguinea*	Little Corella					✓		✓		
	Eolophus roseicapillus	Galah							✓		
	Nymphicus hollandicus	Cockatiel					✓				
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike					✓		✓		
	Lalage sueurii	White-winged Triller							✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Casuariidae	*Dromaius novaehollandiae*	Emu					✓		✓		
Centropodidae	*Centropus phasianinus*	Pheasant Coucal					✓				
	Centropus phasianinus highami	Pheasant Coucal					✓				
Charadriidae	*Charadrius leschenaultii*	Greater Sand Plover	Mi	S3		✓			✓		
	Charadrius melanops	Black-fronted Dotterel					✓		✓		
	Charadrius mongolus	Lesser Sand Plover	EN	S1		✓			✓		
	Charadrius ruficapillus	Red-capped Plover					✓		✓		
	Charadrius veredus	Oriental Plover	Mi	S3				✓			
	Erythrogonys cinctus	Red-kneed Dotterel					✓				
	Pluvialis fulva	Pacific Golden Plover	Mi	S3		✓					
	Pluvialis squatarola	Grey Plover	Mi	S3		✓					
	Vanellus miles	Masked Lapwing					✓				
	Vanellus tricolor	Banded Lapwing					✓		✓		
Ciconiiformes	*Ephippiorhynchus asiaticus*	Black-necked Stork					✓				
Columbidae	**Columba livia*	Domestic Pigeon						✓			
	Geopelia cuneata	Diamond Dove					✓		✓		
	Geopelia humeralis	Bar-shouldered Dove					✓				
	Geopelia striata	Zebra Dove					✓		✓		
	Geopelia striata placida	Peaceful Dove					✓				
	Geophaps plumifera	Spinifex Pigeon					✓		✓		
	Ocyphaps lophotes	Crested Pigeon					✓		✓		
	Phaps histrionica	Flock Bronzewing			P4	✓			✓		
Corvidae	*Corvus bennetti*	Little Crow					✓				
	Corvus orru	Torresian Crow					✓		✓		
Cuculidae	*Cacomantis pallidus*	Pallid Cuckoo					✓				
	Chalcites basalis	Horsfield's Bronze-Cuckoo							✓		
Estrildidae	*Emblema pictum*	Painted Finch					✓				
	Neochmia ruficauda	Star Finch					✓				
	Taeniopygia guttata	Zebra Finch					✓		✓		
Eurostopodidae	*Eurostopodus argus*	Spotted Nightjar							✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Falconidae	*Falco berigora*	Brown Falcon					✓		✓		
	Falco cenchroides	Australian Kestrel					✓				
	Falco hypoleucos	Grey Falcon	VU	S1		✓	✓				
	Falco longipennis	Australian Hobby					✓				
	Falco peregrinus	Peregrine Falcon		S4		✓					
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	Mi	S3		✓	✓	✓			
	Stiltia isabella	Australian Pratincole					✓				
Haematopodidae	*Haematopus fuliginosus ophtalmicus*	Sooty Oystercatcher							✓		
	Haematopus longirostris	Australian Pied Oystercatcher							✓		
Hirundinidae	*Hirundo neoxena*	Welcome Swallow					✓				
	Hirundo rustica	Barn Swallow	Mi	S3				✓			
	Petrochelidon nigricans	Tree Martin							✓		
Laridae	*Chlidonias hybrida*	Whiskered Tern							✓		
	Chlidonias leucopterus	White-winged Black Tern	Mi	S3		✓					
	Chroicocephalus novaehollandiae	Silver Gull							✓		
	Gelochelidon nilotica	Gull-billed Tern							✓		
	Sternula albifrons	Little Tern	Mi; Ma	S3					✓		
	Sterna anaethetus	Bridled Tern	Mi	S3		✓					
	Sterna bengalensis	Lesser Crested Tern	Mi	S3		✓					
	Sterna caspia	Caspian Tern	Mi	S3		✓			✓		
	Sterna dougallii	Roseate Tern	Mi	S3		✓			✓		
	Sterna hirundo	Common Tern	Mi	S3		✓			✓		
	Thalasseus bergii	Crested Tern							✓		
Maluridae	*Malurus lamberti*	Variegated Fairy-wren					✓		✓		
	Malurus leucopterus	White-winged Fairy-wren					✓		✓		
	Malurus melanocephalus	Red-backed Fairy-wren					✓				
Megaluridae	*Cincloramphus cruralis*	Brown Songlark							✓		
	Cincloramphus mathewsi	Rufous Songlark					✓		✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Megaluridae	*Eremiornis carteri*	Spinifex-bird					✓				
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater							✓		
	Certhionyx variegatus	Pied Honeyeater							✓		
	Epthianura tricolor	Crimson Chat					✓		✓		
	Lichenostomus penicillatus	White-plumed Honeyeater							✓		
	Lichenostomus virescens	Singing Honeyeater							✓		
	Lichmera indistincta	Brown Honeyeater					✓		✓		
	Manorina flavigula	Yellow-throated Miner					✓		✓		
	Melithreptus gularis	Black-chinned Honeyeater					✓				
	Sugomel niger	Black Honeyeater							✓		
Meropidae	*Merops ornatus*	Rainbow Bee-eater	Mi	S3		✓	✓	✓	✓		✓
Monarchidae	*Grallina cyanoleuca*	Magpie-lark					✓		✓		
Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit							✓		
Otididae	*Ardeotis australis*	Australian Bustard			P4	✓	✓		✓		✓
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush					✓		✓		
	Oreoica gutturalis	Crested Bellbird					✓				
	Pachycephala lanioides	White-breasted Whistler							✓		
	Pachycephala rufiventris	Rufous Whistler					✓		✓		
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote					✓				
	Pardalotus striatus	Striated Pardalote					✓				
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican					✓				
Petroicidae	*Peneonanthe pulverulenta*	Mangrove Robin							✓		
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant					✓				
	Phalacrocorax sulcirostris	Little Black Cormorant					✓				
	Phalacrocorax varius	Pied Cormorant					✓				
Phasianidae	*Coturnix ypsilophora*	Brown Quail					✓				
Podargidae	*Podargus strigoides*	Tawny Frogmouth					✓				
Podicipedidae	*Podiceps cristatus*	Great Crested Grebe					✓				
	Poliocephalus poliocephalus	Hoary-headed Grebe					✓				
	Tachybaptus novaehollandiae	Australasian Grebe					✓				

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler					✓		✓		
	Pomatostomus temporalis rubeculus	Grey-crowned Babbler					✓				
Procellariidae	*Puffinus pacificus*	Wedge-tailed Shearwater	Mi	S3		✓					
Psittacidae	*Barnardius zonarius*	Australian Ringneck							✓		
	Melopsittacus undulatus	Budgerigar					✓		✓		
Rallidae	*Fulica atra*	Eurasian Coot					✓				
	Gallirallus philippensis	Buff-banded Rail					✓				
Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt							✓		
	Himantopus himantopus	Black-winged Stilt					✓		✓		
	Recurvirostra novaehollandiae	Red-necked Avocet					✓				
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail							✓		
	Rhipidura leucophrys	Willie Wagtail					✓		✓		
	Rhipidura phasiana	Mangrove Grey Fantail					✓		✓		
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	EN	S1				✓			
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	Mi	S3		✓	✓		✓		
	Arenaria interpres	Ruddy Turnstone	Mi	S3		✓			✓		
	Calidris acuminata	Sharp-tailed Sandpiper	Mi	S3		✓	✓				
	Calidris alba	Sanderling	Mi	S3		✓			✓		
	Calidris canutus	Red Knot	Mi	S3		✓			✓		
	Calidris ferruginea	Curlew Sandpiper	VU	S1		✓					
	Calidris melanotos	Pectoral Sandpiper	Mi	S3		✓					
	Calidris ruficollis	Red-necked Stint	Mi	S3		✓	✓		✓		
	Calidris subminuta	Long-toed Stint	Mi	S3		✓	✓		✓		
	Calidris tenuirostris	Great Knot	VU	S1		✓			✓		
	Limosa lapponica	Bar-tailed Godwit	Mi	S3		✓			✓		
	Limosa limosa	Black-tailed Godwit	Mi	S3		✓					
	Numenius madagascariensis	Eastern Curlew	VU	S1		✓			✓		
	Numenius phaeopus	Whimbrel	Mi	S3		✓			✓		
	Tringa brevipes	Grey-tailed Tattler	Mi	S3		✓			✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Scolopacidae	*Tringa cinerea*	Terek Sandpiper	Mi	S3		✓			✓		
	Tringa glareola	Wood Sandpiper	Mi	S3		✓	✓				
	Tringa nebularia	Common Greenshank	Mi	S3		✓	✓				
	Tringa stagnatilis	Marsh Sandpiper	Mi	S3		✓	✓				
Strigidae	*Ninox connivens*	Barking Owl					✓				
	Ninox novaeseelandiae	Boobook Owl					✓				
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill					✓				
	Platalea regia	Royal Spoonbill					✓				
	Plegadis falcinellus	Glossy Ibis	Mi	S3		✓	✓				
	Threskiornis molucca	Australian White Ibis					✓				
	Threskiornis spinicollis	Straw-necked Ibis					✓				
Timaliidae	*Zosterops luteus*	Yellow White-eye					✓		✓		
Turnicidae	*Turnix velox*	Little Button-quail					✓		✓		
Mammals											
Bovidae	*Bos taurus*	European Cattle							✓		
Camelidae	**Camelus dromedarius*	Camel						✓			
Canidae	*Canis lupus*	Dog; Dingo							✓		
	**Vulpes vulpes*	Fox						✓	✓		
Dasyuridae	*Dasykaluta rosamondae*	Little Red Kaluta					✓				
	Dasyurus hallucatus	Northern Quoll	EN	S1		✓	✓	✓			✓
	Ningaui timealeyi	Pilbara Ningaui					✓		✓		
	Pseudantechinus roryi	Rory's Pseudantechinus					✓				
	Pseudantechinus woolleyae	Woolley's Pseudantechinus					✓				
	Sminthopsis macroura	Stripe-faced Dunnart					✓		✓		
	Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					✓		✓		
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat							✓		
	Taphozous georgianus	Common Sheathtail-bat					✓		✓	✓	
Equidae	**Equus asinus*	Donkey						✓			
	**Equus caballus*	Horse						✓	✓		
Felidae	**Felis catus*	Feral Cat						✓	✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Hipposideridae	*Rhinonicteris aurantius*	Orange Leafnosed-bat	VU	S1		✓		✓			✓
Leporidae	**Oryctolagus cuniculus*	European Rabbit						✓			
Macropodidae	*Macropus robustus erubescens*	Euro					✓		✓		
	Macropus rufus	Red Kangaroo					✓		✓		
	Petrogale lateralis lateralis	Black-footed Rock-wallaby	VU	S1		✓					
Megadermatidae	*Macroderma gigas*	Ghost Bat			P4	✓	✓			✓	✓
Molossidae	*Mormopterus loriae cobourgiana*	Little North-western Mastiff Bat			P1						
Muridae	*Hydromys chrysogaster*	Water-rat			P4	✓					
	**Mus musculus*	House Mouse					✓	✓	✓		
	Notomys alexis	Spinifex Hopping-mouse					✓				
	Pseudomys chapmani	Western Pebble-mound Mouse			P4	✓	✓			✓	
	Pseudomys delicatulus	Delicate Mouse							✓		
	Pseudomys desertor	Desert Mouse							✓		
	Pseudomys hermannsburgensis	Sandy Inland Mouse					✓		✓		
	**Rattus rattus*	Black Rat							✓		
	Zyzomys argurus	Common Rock-rat					✓				
Notoryctidae	*Notoryctes caurinus*	Northern Marsupial Mole	EN	S1				✓			
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna								✓	
Thylacomyidae	*Macrotis lagotis*	Greater Bilby	VU	S1				✓			
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat							✓		
	Nyctophilus arnhemensis	Arnhem Land Long-eared Bat							✓		
	Nyctophilus geoffroyi geoffroyi								✓	✓	
	Nyctophilus geoffroyi palescens								✓		
	Scotorepens greyii	Little Broad-nosed Bat							✓		
	Vespadelus baverstocki	Inland Forest Bat								✓	
	Vespadelus finlaysoni	Finlayson's Cave Bat					✓		✓	✓	
Reptiles											
Agamidae	*Ctenophorus caudicinctus caudicinctus*	Ring-tailed Dragon					✓		✓	✓	
	Ctenophorus isolepis isolepis	Crested Dragon; Military Dragon					✓		✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Agamidae	*Ctenophorus nuchalis*	Central Netted Dragon					✓		✓		
	Diporiphora vescus	Northern Pilbara Tree Dragon					✓		✓		
	Lophognathus gilberti	Gilbert's Dragon							✓		
	Lophognathus longirostris	Long nosed Dragon							✓		
	Pogona minor minor	Dwarf Bearded Dragon					✓		✓		
	Pogona minor mitchelli	Mitchell's Bearded Dragon					✓		✓		
	Tympanocryptis cephalus	Pebble Dragon							✓		
Anatidae	*Aythya australis*	Hardhead					✓				
Boidae	*Antaresia perthensis*	Pygmy Python							✓		
	Antaresia stimsoni stimsoni	Stimson's Python					✓			✓	
	Aspidites ramsayi	Woma		S4		✓	✓				
	Liasis olivaceus barroni	Pilbara Olive Python	VU	S1		✓	✓	✓			
Carphodactylidae	*Nephrurus levis pilbarensis*						✓				
Diplodactylidae	*Diplodactylus conspicillatus*	Fat-tailed Gecko					✓				
	Diplodactylus galaxias	Northern Pilbara Beak-faced Gecko					✓				
	Rhynchoedura ornata	Western Beaked Gecko					✓		✓		
	Strophurus elderi						✓				
	Strophurus jeanae						✓				
Elapidae	*Pseudechis australis*	Mulga Snake					✓		✓		
	Pseudonaja mengdeni	Western Brown Snake					✓				
	Pseudonaja modesta	Ringed Brown Snake					✓				
	Simoselaps anomalus	Desert Banded Snake					✓				
	Suta fasciata	Rosen's Snake					✓				
	Suta punctata	Spotted Snake					✓				
	Vermicella snelli	Pilbara Bandy-bandy					✓				
Gekkonidae	*Gehyra punctata*	Spotted Dtella					✓		✓		
	Gehyra purpurascens						✓				
	Gehyra variegata	Variegated Tree Dtella					✓		✓		
	Heteronotia binoei	Bynoe's Gecko					✓		✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Gekkonidae	*Heteronotia spelea*	Desert Cave Gecko					✓				
	Lucasium stenodactylum	Crowned Gecko					✓		✓	✓	
	Lucasium wombeyi	Pilbara Ground Gecko					✓				
	Rhynchoedura ornata	Western Beaked Gecko								✓	
Pygopodidae	*Delma pax*						✓				
	Delma tincta						✓				
	Lialis burtonis						✓				
	Pygopus nigriceps	Hooded Scaly-foot Snake					✓				
Scincidae	*Carlia triacantha*	Desert Rainbow Skink							✓		
	Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink							✓		
	Ctenotus duricola						✓				
	Ctenotus grandis titan						✓				
	Ctenotus helenae						✓		✓		
	Ctenotus pantherinus ocellifer	Leopard Ctenotus					✓		✓		
	Ctenotus saxatilis	Rock Ctenotus					✓		✓	✓	
	Ctenotus serventyi						✓				
	Ctenotus schomburgkii								✓		
	Egernia cygnitos	Western Pilbara Spiny-tailed Skink					✓		✓		
	Eremiascincus fasciolatus	Narrow-banded Sand Swimmer					✓				
	Eremiascincus isolepis	Northern Bar-lipped Skink							✓		
	Lerista bipes	North-western Sand-slider					✓		✓		
	Lerista clara						✓		✓		
	Lerista jacksoni						✓				
	Lerista verhmens						✓				
	Menetia greyii	Common Dwarf Skink					✓		✓		
	Morethia ruficauda exquisita	Lined Fire-tailed Skink					✓		✓		
	Notoscincus ornatus ornatus	Ornate Soil-crevice Skink							✓		
	Proablepharus reginae	Snake-eyed Skink					✓				
	Tiliqua multifasciata	Central Blue-tongue							✓		

Family	Scientific Name	Common Name	Conservation Codes			DPaW (2013c)	DPaW (2013d)	DSEWPaC (2013b)	Phoenix (2013)	Ecologia (2004)	Coffey (2011)
			EPBC	WC	DPaW						
Typhlopidae	*Ramphotyphlops ammodytes*						✓		✓		
	Ramphotyphlops grypus						✓				
	Ramphotyphlops pilbarensis						✓				
Varanidae	*Varanus acanthurus*	Spiny-tailed Monitor					✓		✓		
	Varanus brevicauda	Short-tailed Pygmy Monitor					✓				
	Varanus eremius	Pygmy Desert Monitor					✓				
	Varanus gouldii	Bungarra or Sand Monitor					✓		✓		
	Varanus panoptes rubidus	Yellow-spotted Monitor							✓		
	Varanus tristis	Racehorse Monitor					✓				
	Varanus tristis tristis	Black-headed Monitor							✓		

APPENDIX E

VEGETATION CONDITION SCALE

Condition Code	Definition
E	**Excellent** Pristine or nearly so, no obvious signs of damage caused by the activities of European man.
VG	**Very Good** Some relatively slight signs of damage caused by the activities of European man, e.g. some signs of damage to tree trunks caused by repeated fire and the presence of some relatively non-aggressive weeds such as *Ursinia anthemoides* or *Briza* species, or occasional vehicle tracks.
G	**Good** More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones.
P	**Poor** Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man such as grazing or partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as *Ehrharta* species.
VP	**Very Poor** Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but, not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.
D	**Completely Degraded** Areas that are completely or almost completely without native species in the structure of their vegetation, e.g. areas that are cleared or "parkland cleared" with their flora comprising weed or crop species with isolated native trees or shrubs.

Source: Trudgen, ME (1991). *Vegetation Condition Scale*. In: *National Trust (WA) 1993 Urban Bushland Policy*. National trust of Australia (WA), Wildflower Society of Western Australia Inc. & the Tree Society Inc. Perth, Western Australia.

APPENDIX F

FLORA QUADRAT AND RELEVÉ DATA SHEETS

Quarrytech Red Hill Oct 2013 **Site** RH01

Described by BW **Date** 10/10/2013 **Type** Quadrat 60 x 40 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 614274 **mE** 7697009 **mN**
Habitat Broad shallow gully
Soil Brown silty clay
Rock Type Nil

Vegetation Low woodland of *Eucalyptus victrix* over open shrubland of *Cullen leucanthum* over tussock grassland of *Eulalia aurea*, *Chrysopogon fallax*, *Eriachne benthamii* and *Panicum decompositum*.

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: + % Logs; 2% Twigs; 10% Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	1-2 m	NC
Acacia trachycarpa	+	1 m	RH01.02
Alternanthera nodiflora	+	0.2 m	RH01.06
Centipeda minima subsp. *macrocephala*	+	0.1 m	RH01.04
Chrysopogon fallax	10%	0.6 m	RH01.20
Cullen leucanthum	2%	1 m	RH01.09
Cullen pogonocarpum	+	0.2 m	RH01.18
Eriachne benthamii	10%	0.5 m	RH01.13
Eucalyptus victrix	15%	6-10 m	RH01.19
Eulalia aurea	15%	0.7 m	RH01.21
Goodenia lamprosperma	+	0.4 m	RH01.07
Ipomoea muelleri	+	creeper	RH01.11
Marsilea hirsuta	+	0.05 m	RH01.03
Panicum decompositum	2%	0.7 m	RH01.15
Phyllanthus maderaspatensis	+	0.2 m	RH01.12
Pluchea rubelliflora	+	0.2 m	RH01.08
Polymeria calycina	+	0.2 m	RH01.16
Schenkia clementii	+	0.1 m	RH01.14
Sesbania cannabina	+	0.5 m	RH01.10
Sporobolus australasicus	+	0.1 m	RH01.01
**Vachellia farnesiana*	+	0.6 m	NC
Waltheria indica	+	0.6 m	RH01.05

Quarrytech Red Hill Oct 2013 **Site** RH02

Described by BW **Date** 10/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 614308 **mE** 7696521 **mN**
Habitat Sand plain
Soil Red brown sand
Rock Type Nil

Vegetation Low shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia*

Veg Condition Very Good
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: - % Logs; + % Twigs; 1% Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	0.4 m	NC
Acacia stellaticeps	20%	0.8 m	RH02.01
Bonamia linearis	+	creeper	RH02.03
Cleome uncifera subsp. *uncifera*	+	0.2 m	RH02.10
Corchorus aff. *parviflorus*	+	0.4 m	RH02.07
Crotalaria ramosissima	+	0.2 m	RH02.11
Euphorbia australis var. *australis*	+	prostrate	RH02.13
Euphorbia coghlanii	+	0.4 m	RH02.12
Grevillea wickhamii	+	1.5 m	RH02.05
Ptilotus astrolasius	+	0.4 m	RH02.06
Ptilotus axillaris	+	creeper	NC
Senna notabilis	+	0.4 m	RH02.09
Sida clementii	+	0.4 m	RH02.08
Triodia epactia	20%	0.4 m	RH02.14
Triumfetta ramosa	+	0.4 m	RH02.04

Quarrytech Red Hill Oct 2013 **Site** RH03

Described by BW **Date** 10/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 613499 **mE** 7696326 **mN**
Habitat Sand dune
Soil Red sand
Rock Type Nil

Vegetation High shrubland of *Acacia sabulosa* over low open shrubland of *Acacia stellaticeps* over hummock grassland of *Triodia epactia* over very open tussock grassland of *Eragrostis eriopoda*

Veg Condition Very Good
Fire Age Very Old
Notes Bare ground: 55%
Litter cover: - % Logs; + % Twigs; 5% Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen	Notes
Acacia inaequilatera	+	1.5 m	NC	
Acacia sabulosa	15%	2-3 m	RH03.15	
Acacia stellaticeps	5%	0.6 m	RH02.01	
Aristida holathera var. *holathera*	+	0.6 m	RH03.01	
Bonamia linearis	+	creeper	RH02.03	
Bonamia rosea	+	0.5 m	RH03.14	
Bulbostylis barbata	+	0.1 m	RH03.07	
Carissa lanceolata	+	0.4 m	RH03.09	
**Cenchrus ciliaris*	+	0.4 m	NC	
Cleome uncifera subsp. *uncifera*	+	0.4 m	RH02.10	
Corchorus incanus subsp. *incanus*	+	0.4 m	RH03.10	
Corchorus sp.	+	0.4 m	RH03.11	
Crotalaria ramosissima	+	0.2 m	RH02.11	
Cullen martinii	+	0.2 m	RH03.16	
Dysphania rhadinostachya subsp. *rhadinostachya*	(+)	0.1 m	NC	
Eragrostis eriopoda	2%	0.6 m	RH03.17	
Euphorbia australis var. australis	+	prostrate	RH02.13	
Euphorbia sp.	+	0.4 m	RH03.18	
Goodenia microptera	+	0.4 m	NC	
Heliotropium transforme	+	0.5 m	RH03.13	
Hibiscus leptocladus	+	0.6 m	RH03.08	
Indigofera monophylla	+	0.4 m	NC	
Ipomoea muelleri	+	creeper	RH03.06	
Paraneurachne muelleri	+	0.5 m	RH03.04	
Pluchea tetranthera	+	0.3 m	RH03.05	
Ptilotus axillaris	+	creeper	NC	
Scaevola parvifolia subsp. *pilbarae*	+	0.4 m	RH03.12	
Senna notabilis	+	0.4 m	RH02.09	
Solanum diversiflorum	+	0.2 m	NC	
Sporobolus australasicus	+	0.1 m	RH01.01	

Triodia epactia	35%	0.6 m	RH02.14
Triumfetta chaetocarpa	+	0.6 m	RH03.02
**Vachellia farnesiana*	+	1.2 m	NC

Quarrytech Red Hill Oct 2013 **Site** RH04

Described by BW **Date** 10/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 612585 **mE** 7696553 **mN**
Habitat Sand dune
Soil Red sand
Rock Type Nil

Vegetation High open shrubland of *Acacia sabulosa* over low open shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia*

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: - % Logs; + % Twigs; 2% Leaves
Disturbance: Weeds, cattle

SPECIES LIST:

	Cover	Height	Specimen	Notes
Acacia sabulosa	5%	2-3 m	RH03.15	
Acacia stellaticeps	2%	0.6 m	RH02.01	
Bonamia rosea	+	0.3 m	RH03.14	
Bulbostylis barbata	+	0.1 m	RH03.07	
Carissa lanceolata	+	2-3 m	RH03.09	
**Cenchrus ciliaris*	+	0.2 m	NC	
**Cenchrus setiger*	+	0.4 m	NC	
Cleome uncifera subsp. *uncifera*	+	0.4 m	RH02.10	
Corchorus incanus subsp. *incanus*	+	0.6 m	RH03.19	
Corynotheca pungens	+	0.2 m	RH04.05	
Crotalaria ramosissima	+	0.2 m	RH02.11	
Cullen martinii	+	0.5 m	RH03.16	
Eragrostis eriopoda	+	0.1 m	RH04.02	
Euphorbia sp.	+	0.4 m	RH03.18	
Hibiscus leptocladus	+	1.5 m	RH03.08	
Ipomoea muelleri	+	creeper	RH03.06	
Paraneurachne muelleri	+	0.2 m	RH03.04	
Ptilotus arthrolasius	+	0.6 m	RH04.03	
Scaevola parvifolia subsp. *pilbarae*	+	0.4 m	RH03.12	
Sida arenicola	+	0.7 m	RH04.01	
Tribulus occidentalis	+	prostrate	RH04.04	
Triodia epactia	20%	0.6 m	RH02.14	
Triumfetta chaetocarpa	+	0.6 m	RH03.02	
Triumfetta ramosa	+	0.4 m	RH02.04	

Quarrytech Red Hill Oct 2013 **Site** RH05

Described by BW **Date** 10/10/2013 **Type** Quadrat 70 x 30 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 611661 **mE** 7697012 **mN**
Habitat River line
Soil Pale brown sand
Rock Type River stones and gravel

Vegetation Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over high open shrubland of *Melaleuca glomerata*, *Melaleuca linophylla* and *Acacia trachycarpa* over very open hummock grassland of *Triodia epactia* over open tussock grassland of **Cenchrus ciliaris* and **Cenchrus setiger*

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: + % Logs; 1% Twigs; 10% Leaves
Disturbance: Cattle, weeds

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	0.6 m	NC
Acacia trachycarpa	2%	2-3 m	RH05.08
Carissa lanceolata	+	2-3 m	RH03.09
**Cenchrus ciliaris*	8%	0.4 m	NC
**Cenchrus setiger*	8%	0.4 m	NC
Eriachne benthamii	+	0.4 m	RH01.13
Eucalyptus camaldulensis subsp. *refulgens*	15%	4-10 m	RH05.01
Euphorbia australis var. *australis*	+	prostrate	RH05.05
Euphorbia coghlanii	+	0.4 m	RH02.12
Goodenia lamprosperma	+	0.4 m	RH01.07
Melaleuca glomerata	4%	2-3 m	RH05.02
Melaleuca linophylla	2%	2-3 m	RH05.03
Pluchea tetranthera	+	0.2 m	RH03.05
Rhynchosia minima	+	0.1 m	RH05.07
Sesbania cannabina	+	2 m	RH05.09
Sporobolus australasicus	+	0.1 m	RH01.01
Triodia epactia	5%	0.6 m	RH02.14
Vigna lanceolata var. *lanceolata*	+	creeper	RH05.06

Quarrytech Red Hill Oct 2013 **Site** RH06

Described by BW **Date** 11/10/2013 **Type** Relevé ~ 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 612891 **mE** 7699387 **mN**
Habitat Sand plain
Soil Red brown sand
Rock Type Nil

Vegetation Scattered low shrubs of *Acacia trachycarpa* over open hummock grassland of *Triodia epactia*

Veg Condition Very Good
Fire Age Very Old
Notes Bare ground: 80%
Litter cover: - % Logs; + % Twigs; + % Leaves
Disturbance:

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	0.7 m	NC
Acacia trachycarpa	1%	0.8 m	RH08.03
Byblis liniflora	+	0.1 m	RH06.01
Corchorus incanus subsp. *incanus*	+	0.5 m	RH03.19
Crotalaria ramosissima	+	0.1 m	RH02.11
Cullen martinii	+	0.4 m	RH03.16
Eriachne mucronata	+	0.4 m	NC
Euphorbia coghlanii	+	0.4 m	RH02.12
Goodenia lamprosperma	+	0.3 m	RH01.07
Grevillea pyramidalis	+	0.5-2 m	NC
Grevillea wickhamii	+	1-2 m	RH02.05
Hybanthus aurantiacus	+	0.4 m	NC
Indigofera monophylla	+	0.4 m	NC
Polycarpaea longiflora	(+)	0.1 m	NC
Stemodia grossa	+	0.3 m	RH06.03
Stylidium adenophorum	+	0.05 m	RH06.02
Triodia epactia	20%	0.4 m	RH02.14
Triumfetta ramosa	+	0.4 m	RH02.04

Quarrytech Red Hill Oct 2013 **Site** RH07

Described by BW **Date** 11/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 614378 **mE** 7699575 **mN**
Habitat Sand plain
Soil Red sand
Rock Type Nil

Vegetation Low open woodland of *Corymbia zygophylla* over low open shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia* over open tussock grassland of *Eragrostis eriopoda* and *Aristida holathera* var. *holathera* over very open herbland of *Ptilotus astrolasius* and *Corchorus* aff. *parviflorus*

Veg Condition Excellent
Fire Age Moderate
Notes Bare ground: 80%
Litter cover: + % Logs; 1% Twigs; 10% Leaves
Disturbance: Nil

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	0.8 m	NC
Acacia sericophylla	+	1.5 m	RH07.07
Acacia stellaticeps	4%	0.5 m	RH07.01
Aristida holathera var. *holathera*	1%	0.3 m	RH03.01
Bonamia rosea	+	0.4 m	RH03.14
Chrysopogon fallax	+	0.4 m	RH01.20
Cleome uncifera subsp. *uncifera*	+	0.2 m	RH02.10
Clerodendrum floribundum var. *angustifolium*	+	0.4 m	RH07.12
Corchorus aff. *parviflorus*	2%	0.6 m	RH07.10
Corymbia zygophylla	3%	2-4 m	RH07.09
Eragrostis eriopoda	10%	0.3 m	RH03.17
Euphorbia tannensis subsp. *eremophila*	+	0.4 m	RH07.06
Goodenia microptera	+	0.4 m	NC
Gossypium australe	+	0.6 m	RH07.05
Hakea chordophylla	+	1.2 m	NC
Indigofera monophylla	+	0.4 m	NC
Mollugo molluginea	+	0.1 m	RH07.02
Ptilotus astrolasius	7%	0.5 m	NC
Ptilotus fusiformis	+	0.4 m	RH07.11
Sida clementii	+	0.8 m	RH07.03
Solanum beaugleholei	+	0.2 m	RH07.08
Trachymene oleracea	+	0.2 m	NC
Triodia epactia	15%	0.5 m	RH02.14

Quarrytech Red Hill Oct 2013 **Site** RH08

Described by BW **Date** 11/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 613462 **mE** 7698996 **mN**
Habitat Sand plain
Soil Red sand
Rock Type Scattered granite outcropping

Vegetation Scattered shrubs of *Grevillea wickhamii* over low open shrubland of *Acacia stellaticeps*, *Acacia trachycarpa* and *Indigofera monophylla* over open hummock grassland of *Triodia epactia* over very open tussock grassland of *Eragrostis eriopoda* over scattered herbs of *Corchorus* aff. *parviflorus*

Veg Condition Very Good
Fire Age Old
Notes Bare ground: 75%
Litter cover: - % Logs; 5% Twigs; 5% Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	0.6 m	NC
Acacia stellaticeps	3%	0.5 m	RH02.01
Acacia trachycarpa	1%	0.8 m	RH08.03
Adriana tomentosa var. *tomentosa*	+	0.7 m	RH08.05
Bonamia linearis	+	creeper	RH02.03
Corchorus aff. *parviflorus*	1%	0.5 m	RH07.10
Crotalaria ramosissima	+	0.2 m	RH02.11
Eragrostis eriopoda	2%	0.3 m	RH03.17
Euphorbia australis var. *australis*	+	prostrate	RH08.01
Goodenia microptera	+	0.4 m	NC
Grevillea wickhamii	+	1-3 m	NC
Hakea lorea	+	1.2 m	NC
Hybanthus aurantiacus	+	0.4 m	NC
Indigofera monophylla	1%	0.4 m	NC
Mollugo molluginea	+	0.2 m	RH07.02
Polymeria calycina	+	creeper	RH08.06
Ptilotus astrolasius	+	0.4 m	NC
Ptilotus axillaris	+	creeper	NC
Scaevola amblyanthera var. *centralis*	+	0.4 m	RH08.02
Senna notabilis	+	0.4 m	RH02.09
Tephrosia rosea var. *rosea*	+	0.6 m	RH08.04
Trachymene oleracea	+	0.2 m	NC
Triodia epactia	25%	0.5 m	RH02.14
Triumfetta ramosa	+	0.5 m	RH02.04

Quarrytech Red Hill Oct 2013 **Site** RH09

Described by BW **Date** 11/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 612287 **mE** 7698996 **mN**

Habitat Sand plain

Soil Pale brown silty clay - hard setting

Rock Type Nil

Vegetation Open shrubland of *Acacia sclerosperma* subsp. *sclerosperma* and **Vachellia farnesiana* over open hummock grassland of *Triodia epactia* over very open tussock grassland of **Cenchrus ciliaris*

Veg Condition Good

Fire Age Very Old

Notes Bare ground: 80%
Litter cover: - % Logs; + % Twigs; 1% Leaves
Disturbance: Weeds

SPECIES LIST:

	Cover	Height	Specimen
Acacia sclerosperma subsp. *sclerosperma*	2%	1-2 m	RH09.01
Acacia synchronicia	+	1 m	RH09.04
**Cenchrus ciliaris*	2%	0.4 m	NC
**Cenchrus setiger*	+	0.4 m	RH09.02
Corchorus aff. *parviflorus*	+	0.4 m	RH07.10
Cullen pogonocarpum	+	0.3 m	RH09.07
Eriachne benthamii	+	0.4 m	RH01.13
Euphorbia coghlanii	+	0.2 m	RH02.12
Gomphrena affinis subsp. *pilbarensis*	+	0.3 m	RH09.03
Ipomoea muelleri	+	creeper	RH03.06
Pluchea ferdinandi-muelleri	+	0.5 m	RH09.10
Sclerolaena hostilis	+	0.6 m	RH09.06
Senna artemisioides subsp. *oligophylla*	+	0.3 m	NC
Sporobolus australasicus	+	0.05 m	RH09.09
Triodia epactia	20%	0.5 m	RH02.14
**Vachellia farnesiana*	1%	1-2 m	NC

Quarrytech Red Hill Oct 2013 **Site** RH10

Described by BW **Date** 11/10/2013 **Type** Relevé ~ 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 613429 **mE** 7698009 **mN**
Habitat Sand plain
Soil Red sand
Rock Type Nil

Vegetation Low open shrubland of *Acacia stellaticeps* over hummock grassland of *Triodia epactia*

Veg Condition Very Good
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: - % Logs; + % Twigs; 1% Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Acacia stellaticeps	7%	0.6 m	NC
Corchorus aff. *parviflorus*	+	0.5 m	RH07.10
Eragrostis eriopoda	+	0.4 m	RH03.17
Senna notabilis	+	0.2 m	RH02.09
Triodia epactia	40%	0.6 m	RH02.14
Triumfetta ramosa	+	0.4 m	RH02.04

Quarrytech Red Hill Oct 2013 **Site** RH11

Described by BW **Date** 11/10/2013 **Type** Relevé ~ 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 612797 **mE** 7697269 **mN**
Habitat Sand plain
Soil Pale brown silty sand
Rock Type Nil

Vegetation Scattered low shrubs of *Acacia sclerosperma* subsp. *sclerosperma* over open hummock grassland of *Triodia epactia* over scattered herbs of *Corchorus* aff. *parviflorus*

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 80%
Litter cover: - % Logs; + % Twigs; + % Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Acacia sclerosperma subsp. *sclerosperma*	1%	0.8 m	RH09.01
Corchorus aff. *parviflorus*	1%	0.5 m	RH07.10
Triodia epactia	15%	0.6 m	RH02.14
Triumfetta chaetocarpa	+	0.3 m	RH03.02

Quarrytech Red Hill Oct 2013 **Site** RH12

Described by BW **Date** 11/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 613122 **mE** 7697489 **mN**
Habitat Grass plain / clay plain
Soil Red brown clay - hard setting
Rock Type Nil

Vegetation Tussock grassland of *Eriachne benthamii*, *Chrysopogon fallax* and *Eulalia aurea*

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 50%
Litter cover: - % Logs; - % Twigs; + % Leaves
Disturbance: Cattle, weeds

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	+	1 m	NC
Acacia sclerosperma subsp. *sclerosperma*	+	0.6 m	RH09.01
Chrysopogon fallax	2%	0.4 m	RH01.20
Corchorus aff. *parviflorus*	+	0.6 m	RH07.10
Cullen leucanthum	+	0.6 m	RH12.03
Eriachne benthamii	40%	0.5 m	RH12.01
Eulalia aurea	2%	0.5 m	RH01.21
Goodenia lamprosperma	+	0.4 m	RH01.07
Pluchea ferdinandi-muelleri	+	0.6 m	RH09.10
Senna artemisioides subsp. *oligophylla*	+	0.5 m	NC
Streptoglossa bubakii	+	0.3 m	RH12.02

Quarrytech Red Hill Oct 2013 **Site** RH13

Described by BW **Date** 12/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 611066 **mE** 7698738 **mN**
Habitat River line
Soil Red brown coarse river sand
Rock Type River stones and gravel

Vegetation Low open woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over open scrub of *Melaleuca glomerata*, *Melaleuca linophylla*, *Acacia trachycarpa* and **Vachellia farnesiana* over very open hummock grassland of *Triodia epactia* over open tussock grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Eulalia aurea*

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 85%
Litter cover: + % Logs; 5 % Twigs; 10 % Leaves
Disturbance: Cattle, weeds

SPECIES LIST:

	Cover	Height	Specimen
Acacia colei var. *colei*	+	0.6 m	RH13.09
Acacia pyrifolia	+	0.6 m	NC
Acacia trachycarpa	3%	2-3 m	RH05.08
Alternanthera nodiflora	+	0.3 m	RH13.14
Carissa lanceolata	+	2 m	RH03.09
**Cenchrus ciliaris*	10%	0.4 m	NC
**Cenchrus setiger*	10%	0.4 m	NC
Chrysopogon fallax	+	0.4 m	RH01.20
**Cucumis melo* subsp. *agrestis*	+	creeper	RH13.05
Cynanchum pedunculatum	+	0.2 m	RH13.04
Eragrostis cumingii	+	0.2 m	RH13.12
Eucalyptus camaldulensis subsp. *refulgens*	8%	6-10 m	RH13.02
Eulalia aurea	1%	0.6 m	RH13.10
Euphorbia coghlanii	+	0.4 m	RH02.12
Goodenia lamprosperma	+	0.4 m	RH01.07
Hibiscus austrinus var. *austrinus*	+	1 m	RH13.01
Melaleuca glomerata	30%	2-3 m	RH13.07
Melaleuca linophylla	10%	2-3 m	RH13.13
Rhynchosia minima	+	creeper	RH13.06
Sesbania cannabina	+	0.6 m	RH01.10
Sporobolus australasicus	+	0.2 m	RH13.03
Triodia epactia	2%	0.4 m	RH02.14
**Vachellia farnesiana*	1%	2-3 m	NC
Vigna lanceolata var. *lanceolata*	+	0.2 m	RH13.11

Quarrytech Red Hill Oct 2013 **Site** RH14

Described by BW **Date** 12/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 612080 **mE** 7698164 **mN**
Habitat Sand dune
Soil Red sand
Rock Type Nil

Vegetation High shrubland of *Acacia sabulosa* over hummock grassland of *Triodia epactia* over very open tussock grassland of *Eragrostis eriopoda*

Veg Condition Good
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: - % Logs; + % Twigs; 2% Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Acacia sabulosa	12%	2-3 m	RH03.15
Aristida holathera var. *holathera*	+	0.6 m	RH03.01
Bonamia rosea	+	0.5 m	RH03.14
Bulbostylis barbata	+	0.1 m	RH03.07
Cleome uncifera subsp. *uncifera*	+	0.4 m	RH02.10
Eragrostis eriopoda	2%	0.6 m	RH03.17
Indigofera monophylla	+	0.4 m	NC
Triodia epactia	35%	0.6 m	RH02.14
Triumfetta chaetocarpa	+	0.4 m	RH03.02

Quarrytech Red Hill Oct 2013 **Site** RH15

Described by BW **Date** 12/10/2013 **Type** Quadrat 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 611473 **mE** 7696344 **mN**
Habitat Clay plain / flood plain
Soil Red brown silty clay
Rock Type Nil - some granite outcropping

Vegetation High open shrubland of *Acacia pyrifolia* over very open hummock grassland of *Triodia epactia* over open tussock grassland of *Chrysopogon fallax*, **Cenchrus ciliaris* and **Cenchrus setiger*

Veg Condition Poor
Fire Age Very Old
Notes Bare ground: 70%
Litter cover: - % Logs; + % Twigs; 5% Leaves
Disturbance: Cattle, weeds

SPECIES LIST:

	Cover	Height	Specimen
Acacia pyrifolia	4%	2-3 m	NC
Aristida contorta	(+)	0.2 m	RH15.04
**Cenchrus ciliaris*	5%	0.6 m	NC
**Cenchrus setiger*	5%	0.6 m	NC
Chrysopogon fallax	10%	0.7 m	RH01.20
Eriachne benthamii	Assoc.	0.4 m	RH01.13
Euphorbia australis var. *australis*	+	prostrate	RH05.05
Evolvulus alsinoides var. *villosicalyx*	+	0.05 m	NC
Goodenia lamprosperma	+	0.4 m	RH01.07
Ipomoea muelleri	+	creeper	RH15.01
Ptilotus axillaris	+	creeper	NC
Sclerolaena hostilis	+	0.5 m	RH09.06
Senna notabilis	+	0.4 m	RH02.09
Sida arsiniata	+	0.4 m	RH15.03
Sida rohlenae subsp. *rohlenae*	+	0.4 m	RH15.02
Streptoglossa bubakii	+	0.4 m	RH12.02
Triodia epactia	5%	0.6 m	RH02.14
Triodia wiseana	+	0.6 m	NC
**Vachellia farnesiana*	+	2-3 m	NC

Quarrytech Red Hill Oct 2013 **Site** RH16

Described by BW **Date** 12/10/2013 **Type** Relevé ~ 50 x 50 m

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

MGA Zone 50 613615 **mE** 7696054 **mN**
Habitat Clay plain / Grass plain
Soil Brown silty clay
Rock Type Nil

Vegetation Open tussock grassland of *Eragrostis xerophila*

Veg Condition Poor
Fire Age Very Old
Notes Bare ground: 85%
Litter cover: - % Logs; - % Twigs; + % Leaves
Disturbance: Cattle

SPECIES LIST:

	Cover	Height	Specimen
Eragrostis xerophila	15%	0.4 m	RH16.03
Eriachne mucronata	(+)	0.3 m	NC
Mimulus gracilis	+	0.05 m	RH16.02
Streptoglossa cylindriceps	+	0.05 m	RH16.01

Quarrytech Red Hill Oct 2013 **Site** RH OP COLL

Described by BW **Date** 11/10/2013 **Type** Opportunistic Observations

Location 75 km south west of Port Hedland, north of the North West Coastal Highway, east of the Peewah River.

SPECIES LIST:

	Cover	Height	Specimen	Notes
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	10 ind.	1.5-2.5 m	RHOP02	612176 mE, 7696608 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	5 ind.	1.5-2.5 m	RHOP02	611471 mE, 7698325 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	3 ind.	1.5-2.5 m	RHOP02	611493 mE, 7698309 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	1 ind.	1.5-2.5 m	RHOP02	611522 mE, 7698311 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	3 ind.	1.5-2.5 m	RHOP02	611546 mE, 7698310 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	2 ind.	1.5-2.5 m	RHOP02	611586 mE, 7698289 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	10 ind.	1.5-2.5 m	RHOP02	611622 mE, 7698278 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	1 ind.	1.5-2.5 m	RHOP02	611714 mE, 7698260 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	10 ind.	1.5-2.5 m	RHOP02	611873 mE, 7698246 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	5 ind.	1.5-2.5 m	RHOP02	611940 mE, 7698205 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	5 ind.	1.5-2.5 m	RHOP02	612121 mE, 7696593 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	8 ind.	1.5-2.5 m	RHOP02	612236 mE, 7696593 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	4 ind.	1.5-2.5 m	RHOP02	612987 mE, 7696421 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	1 ind.	1.5-2.5 m	RHOP02	613755 mE, 7696328 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	2 ind.	1.5-2.5 m	RHOP02	613143 mE, 7696369 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	1 ind.	1.5-2.5 m	RHOP02	611985 mE, 7698189 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	1 ind.	1.5-2.5 m	RHOP02	613091 mE, 7696476 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	9 ind.	1.5-2.5 m	RHOP02	612314 mE, 7696593 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	4 ind.	1.5-2.5 m	RHOP02	612837 mE, 7696422 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	5 ind.	1.5-2.5 m	RHOP02	612681 mE, 7696459 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	6 ind.	1.5-2.5 m	RHOP02	612536 mE, 7696504 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	8 ind.	1.5-2.5 m	RHOP02	612325 mE, 7696553 mN
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	4 ind.	1.5-2.5 m	RHOP02	613106 mE, 7696447 mN
**Aerva javanica*	+	0.4 m	NC	
**Malvastrum americanum*	+	0.4 m	NC	
Sporobolus australasicus	5 ind.	0.2 m	RHOP01	613883 mE, 7696151 mN
Sporobolus australasicus	10 ind.	0.2 m	RHOP01	611188 mE, 7698428 mN
Sporobolus australasicus	5 ind.	0.2 m	RHOP01	613819 mE, 7696125 mN

APPENDIX G

FLORA INVENTORY

Family	Species	Conservation Status
Amaranthaceae	**Aerva javanica*	
	Alternanthera nodiflora	
	Gomphrena affinis subsp. *pilbarensis*	
	Ptilotus arthrolasius	
	Ptilotus astrolasius	
	Ptilotus axillaris	
	Ptilotus fusiformis	
Apocynaceae	*Carissa lanceolata*	
	Cynanchum pedunculatum	
Araliaceae	*Trachymene oleracea*	
Asteraceae	*Centipeda minima* subsp. *macrocephala*	
	Pluchea ferdinandi-muelleri	
	Pluchea rubelliflora	
	Pluchea tetranthera	
	Streptoglossa bubakii	
	Streptoglossa cylindriceps	
Boraginaceae	*Heliotropium transforme*	
Byblidaceae	*Byblis liniflora*	
Caryophyllaceae	*Polycarpaea longiflora*	
Chenopodiaceae	*Dysphania rhadinostachya* subsp. *rhadinostachya*	
	Sclerolaena hostilis	
Cleomaceae	*Cleome uncifera* subsp. *uncifera*	
Convolvulaceae	*Bonamia linearis*	
	Bonamia rosea	
	Evolvulus alsinoides var. *villosicalyx*	
	Ipomoea muelleri	
	Polymeria calycina	
Cucurbitaceae	**Cucumis melo* subsp. *agrestis*	
Cyperaceae	*Bulbostylis barbata*	
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*	
	Euphorbia australis var. *australis*	
	Euphorbia coghlanii	
	Euphorbia sp.	
	Euphorbia tannensis subsp. *eremophila*	
Fabaceae	*Acacia colei* var. *colei*	
	Acacia inaequilatera	

Family	Species	Conservation Status
Fabaceae	*Acacia pyrifolia*	
	Acacia sabulosa	
	Acacia sclerosperma subsp. *sclerosperma*	
	Acacia sericophylla	
	Acacia stellaticeps	
	Acacia synchronicia	
	Acacia trachycarpa	
	Crotalaria ramosissima	
	Cullen leucanthum	
	Cullen martinii	
	Cullen pogonocarpum	
	Indigofera monophylla	
	Rhynchosia minima	
	Senna artemisioides subsp. *oligophylla*	
	Senna notabilis	
	Sesbania cannabina	
	Tephrosia rosea var. *rosea*	
	**Vachellia farnesiana*	
	Vigna lanceolata var. *lanceolata*	
Gentianaceae	*Schenkia clementii*	
Goodeniaceae	*Goodenia lamprosperma*	
	Goodenia microptera	
	Scaevola amblyanthera var. *centralis*	
	Scaevola parvifolia subsp. *pilbarae*	
Hemerocallidaceae	*Corynotheca pungens*	
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*	
Malvaceae	*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095)	Priority 1
	Corchorus aff. *parviflorus*	
	Corchorus incanus subsp. *incanus*	
	Corchorus sp.	
	Gossypium australe	
	Hibiscus austrinus var. *austrinus*	
	Hibiscus leptocladus	
	**Malvastrum americanum*	
	Sida arenicola	
	Sida arsiniata	
	Sida clementii	
	Sida rohlenae subsp. *rohlenae*	
	Triumfetta chaetocarpa	

Family	Species	Conservation Status
Malvaceae	*Triumfetta ramosa*	
	Waltheria indica	
Marsileaceae	*Marsilea hirsuta*	
Molluginaceae	*Mollugo molluginea*	
Myrtaceae	*Corymbia zygophylla*	
	Eucalyptus camaldulensis subsp. *refulgens*	
	Eucalyptus victrix	
	Melaleuca glomerata	
	Melaleuca linophylla	
Phrymaceae	*Mimulus gracilis*	
Phyllanthaceae	*Phyllanthus maderaspatensis*	
Plantaginaceae	*Stemodia grossa*	
Poaceae	*Aristida contorta*	
	Aristida holathera var. *holathera*	
	**Cenchrus ciliaris*	
	**Cenchrus setiger*	
	Chrysopogon fallax	
	Eragrostis cumingii	
	Eragrostis eriopoda	
	Eragrostis xerophila	
	Eriachne benthamii	
	Eriachne mucronata	
	Eulalia aurea	
	Panicum decompositum	
	Paraneurachne muelleri	
	Sporobolus australasicus	
	Triodia epactia	
	Triodia wiseana	
Proteaceae	*Grevillea pyramidalis*	
	Grevillea wickhamii	
	Hakea chordophylla	
	Hakea lorea	
Solanaceae	*Solanum beaugleholei*	
	Solanum diversiflorum	
Stylidiaceae	*Stylidium adenophorum*	
Violaceae	*Hybanthus aurantiacus*	
Zygophyllaceae	*Tribulus occidentalis*	

APPENDIX H

FLORA MATRIX OF SPECIES RECORDED AT EACH SITE

Species	RH01	RH02	RH03	RH04	RH05	RH06	RH07	RH08	RH09	RH10	RH11	RH12	RH13	RH14	RH15	RH16	Op. Coll.
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)																	+
Acacia colei var. *colei*													+				
Acacia inaequilatera			+														
Acacia pyrifolia	+	+			+	+	+	+				+	+		4%		
Acacia sabulosa			15%	5%										12%			
Acacia sclerosperma subsp. *sclerosperma*									2%		1%	+					
Acacia sericophylla							+										
Acacia stellaticeps		20%	5%	2%			4%	3%		7%							
Acacia synchronicia									+								
Acacia trachycarpa	+				2%	1%		1%					3%				
Adriana tomentosa var. *tomentosa*								+									
**Aerva javanica*																	+
Alternanthera nodiflora	+												+				
Aristida contorta															(+)		
Aristida holathera var. *holathera*			+				1%							+			
Bonamia linearis		+	+					+									
Bonamia rosea			+	+			+							+			
Bulbostylis barbata			+	+										+			
Byblis liniflora						+											
Carissa lanceolata			+	+	+								+				
**Cenchrus ciliaris*			+	+	8%				2%				10%		5%		
**Cenchrus setiger*				+	8%				+				10%		5%		
Centipeda minima subsp. *macrocephala*	+																
Chrysopogon fallax	10%						+					2%	+		10%		
Cleome uncifera subsp. *uncifera*		+	+	+			+							+			
Clerodendrum floribundum var. *angustifolium*							+										

Species	RH01	RH02	RH03	RH04	RH05	RH06	RH07	RH08	RH09	RH10	RH11	RH12	RH13	RH14	RH15	RH16	Op. Coll.
Corchorus aff. *parviflorus*		+					2%	1%	+	+	1%	+					
Corchorus incanus subsp. *incanus*			+	+		+											
Corchorus sp.			+														
Corymbia zygophylla							3%										
Corynotheca pungens				+													
Crotalaria ramosissima		+	+	+		+		+									
**Cucumis melo* subsp. *agrestis*													+				
Cullen leucanthum	2%											+					
Cullen martinii			+	+		+											
Cullen pogonocarpum	+								+								
Cynanchum pedunculatum													+				
Dysphania rhadinostachya subsp. *rhadinostachya*			(+)														
Eragrostis cumingii													+				
Eragrostis eriopoda			2%	+			10%	2%		+				2%			
Eragrostis xerophila																15%	
Eriachne benthamii	10%				+				+			40%			Assoc.		
Eriachne mucronata						+										(+)	
Eucalyptus camaldulensis subsp. *refulgens*					15%								8%				
Eucalyptus victrix	15%																
Eulalia aurea	15%											2%	1%				
Euphorbia australis var. *australis*		+	+		+			+							+		
Euphorbia coghlanii		+			+	+			+				+				
Euphorbia sp.			+	+													
Euphorbia tannensis subsp. *eremophila*							+										
Evolvulus alsinoides var. *villosicalyx*															+		
Gomphrena affinis subsp. *pilbarensis*									+								
Goodenia lamprosperma	+				+	+						+	+		+		
Goodenia microptera			+				+	+									
Gossypium australe							+										

Species	RH01	RH02	RH03	RH04	RH05	RH06	RH07	RH08	RH09	RH10	RH11	RH12	RH13	RH14	RH15	RH16	Op. Coll.
Grevillea pyramidalis						+											
Grevillea wickhamii		+				+		+									
Hakea chordophylla							+										
Hakea lorea								+									
Heliotropium transforme			+														
Hibiscus austrinus var. *austrinus*													+				
Hibiscus leptocladus			+	+													
Hybanthus aurantiacus						+		+									
Indigofera monophylla			+			+	+	1%						+			
Ipomoea muelleri	+		+	+					+						+		
**Malvastrum americanum*																	+
Marsilea hirsuta	+																
Melaleuca glomerata					4%								30%				
Melaleuca linophylla					2%								10%				
Mimulus gracilis																+	
Mollugo molluginea							+	+									
Panicum decompositum	2%																
Paraneurachne muelleri			+	+													
Phyllanthus maderaspatensis	+																
Pluchea ferdinandi-muelleri									+			+					
Pluchea rubelliflora	+																
Pluchea tetranthera			+		+												
Polycarpaea longiflora						(+)											
Polymeria calycina	+							+									
Ptilotus arthrolasius				+													
Ptilotus astrolasius		+					7%	+									
Ptilotus axillaris		+	+					+							+		
Ptilotus fusiformis							+										
Rhynchosia minima					+								+				
Scaevola amblyanthera var. *centralis*								+									
Scaevola parvifolia subsp. *pilbarae*			+	+													
Schenkia clementii	+																

Species	RH01	RH02	RH03	RH04	RH05	RH06	RH07	RH08	RH09	RH10	RH11	RH12	RH13	RH14	RH15	RH16	Op. Coll.
Sclerolaena hostilis									+						+		
Senna artemisioides subsp. *oligophylla*									+			+					
Senna notabilis		+	+					+		+					+		
Sesbania cannabina	+				+								+				
Sida arenicola				+													
Sida arsiniata															+		
Sida clementii		+					+										
Sida rohlenae subsp. *rohlenae*															+		
Solanum beaugleholei							+										
Solanum diversiflorum			+														
Sporobolus australasicus	+		+		+				+				+				+
Stemodia grossa						+											
Streptoglossa bubakii												+			+		
Streptoglossa cylindriceps																+	
Stylidium adenophorum						+											
Tephrosia rosea var. *rosea*								+									
Trachymene oleracea							+	+									
Tribulus occidentalis				+													
Triodia epactia		20%	35%	20%	5%	20%	15%	25%	20%	40%	15%		2%	35%	5%		
Triodia wiseana															+		
Triumfetta chaetocarpa			+	+							+			+			
Triumfetta ramosa		+		+		+		+		+							
**Vachellia farnesiana*	+		+						1%				1%		+		
Vigna lanceolata var. *lanceolata*					+								+				
Waltheria indica	+																

APPENDIX I

LOCATION OF PRIORITY FLORA

Note: All coordinates are based on Datum WGS84 and Zone 50K

Species	Number of Individuals	Height	Easting	Northing
Abutilon sp. Pritzelianum (S. van Leeuwen 5095)	5	1.5-2.5 m	611471	7698325
(Priority 1)	3	1.5-2.5 m	611493	7698309
	1	1.5-2.5 m	611522	7698311
	3	1.5-2.5 m	611546	7698310
	2	1.5-2.5 m	611586	7698289
	10	1.5-2.5 m	611622	7698278
	1	1.5-2.5 m	611714	7698260
	10	1.5-2.5 m	611873	7698246
	5	1.5-2.5 m	611940	7698205
	1	1.5-2.5 m	611985	7698189
	5	1.5-2.5 m	612121	7696593
	10	1.5-2.5 m	612176	7696608
	8	1.5-2.5 m	612236	7696593
	9	1.5-2.5 m	612314	7696593
	8	1.5-2.5 m	612325	7696553
	6	1.5-2.5 m	612536	7696504
	5	1.5-2.5 m	612681	7696459
	4	1.5-2.5 m	612837	7696422
	4	1.5-2.5 m	612987	7696421
	1	1.5-2.5 m	613091	7696476
	4	1.5-2.5 m	613106	7696447
	2	1.5-2.5 m	613143	7696369
	1	1.5-2.5 m	613755	7696328

APPENDIX J

HABITAT ASSESSMENT DATASHEETS

Habitat Assessment Site	HA01

Date:	10/10/2013	
Fauna Habitat:	Open Woodland	
UTM Co-ordinates:	614273	mE
	7697008	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Brown silty clay	
Landform:	Drainage line / Gully	
Vegetation Description:	Low woodland of *Eucalyptus victrix* over open shrubland of *Cullen leucanthum* over tussock grassland of *Eulalia aurea*, *Chrysopogon fallax*, *Eriachne benthamii* and *Panicum decompositum*.	

Vegetation Condition:	Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Heavy	**Disturbance (other):**	Mild

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Eucalyptus victrix*	6-10 m	15%
Midstorey:	*Acacia pyrifolia, Acacia trachycarpa, Cullen leucanthum,*	1-2 m	3%
Ground Cover:	*Chrysopogon fallax, Eriachne benthamii, Eulalia aurea, Goodenia lamprosperma, Panicum decompositum*	< 1 m	37%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Nil - Moderate	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	Rare
Leaf Litter	5-20%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	Moderate
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	< 5%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	20-60%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	5-20%	**Suitability for Bats**	None	**Woody debris**	Rare

Further Notes

Habitat Assessment Site	HA02

Date:	10/10/2013	
Fauna Habitat:	Sand Plain with Hummock Grassland	
UTM Co-ordinates:	614308	mE
	7696521	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Red brown sand	
Landform:	Sand plain	
Vegetation Description:	Low shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia*	

Vegetation Condition:	Very Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Mild	**Disturbance (other):**	None

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Grevillea wickhamii*	1.5 m	+
Midstorey:	*Acacia stellaticeps, Acacia pyrifolia*	0.4 – 0.8 m	20%
Ground Cover:	*Triodia epactia, Ptilotus astrolasius, Senna notabilis, Triumfetta ramosa*	< 0.5 m	1%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	20-60%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	< 5%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes

Habitat Assessment Site	HA03

Date:	10/10/2013	
Fauna Habitat:	Sand Dune	
UTM Co-ordinates:	613499	mE
	7696326	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Red sand	
Landform:	Sand dune	
Vegetation Description:	High shrubland of *Acacia sabulosa* over low open shrubland of *Acacia stellaticeps* over hummock grassland of *Triodia epactia* over very open tussock grassland of *Eragrostis eriopoda*	

Vegetation Condition:	Very Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Mild	**Disturbance (other):**	Mild

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Acacia sabulosa*	2 - 3 m	15%
Midstorey:	*Acacia inaequilatera, Acacia stellaticeps, Triumfetta chaetocarpa , *Vachellia farnesiana*	0.6 – 1.5 m	+
Ground Cover:	*Eragrostis eriopoda, Triodia epactia, *Cenchrus ciliaris, Ptilotus axillaris, Sporobolus australasicus*	0.6 m	37%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	Moderate
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	5-20%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	Rare
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	20-60%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	< 5%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes

Habitat Assessment Site	HA04

Date:	10/10/2013	
Fauna Habitat:	Sand Dune	
UTM Co-ordinates:	612585	mE
	7696553	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Red sand	
Landform:	Sand dune	
Vegetation Description:	High open shrubland of *Acacia sabulosa* over low open shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia*	

Vegetation Condition:	Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Medium	**Disturbance (other):**	Medium

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Acacia sabulosa, Carissa lanceolata*	2 – 3 m	5%
Midstorey:	*Acacia stellaticeps, Corchorus incanus* subsp. *incanus, Ptilotus arthrolasius, Scaevola parvifolia* subsp. *pilbarae, Triumfetta chaetocarpa*	0.6 m	3%
Ground Cover:	**Cenchrus ciliaris, *Cenchrus setiger, Eragrostis eriopoda, Paraneurachne muelleri, Triodia epactia*	< 0.5 m	22%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	Rare
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	20-60%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	< 5%	**No. of Caves**	None	**Termite Mounds**	Rare
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes

Habitat Assessment Site	HA05

Date:	10/10/2013	
Fauna Habitat:	Riverine	
UTM Co-ordinates:	611661	mE
	7697012	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Pale brown sand	
Landform:	Drainage line / River	
Vegetation Description:	Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over high open shrubland of *Melaleuca glomerata*, *Melaleuca linophylla* and *Acacia trachycarpa* over very open hummock grassland of *Triodia epactia* over open tussock grassland of **Cenchrus ciliaris* and **Cenchrus setiger*	

Vegetation Condition:	Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Medium	**Disturbance (other):**	Medium

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Eucalyptus camaldulensis* subsp. *refulgens*	4 – 10 m	15%
Midstorey:	*Acacia trachycarpa, Carissa lanceolata, Melaleuca glomerata, Melaleuca linophylla, Sesbania cannabina*	2 – 3 m	8%
Ground Cover:	**Cenchrus ciliaris, *Cenchrus setiger, Eriachne benthamii, Goodenia lamprosperma, Sporobolus australasicus, Triodia epactia*	< 0.6 m	22%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	Rare
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	Moderate
Leaf Litter	20-60%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	Moderate
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	< 5%	**Boulders**	None	**Distance to Water**	< 0.5 km
Other Grass	5-20%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	Moderate

Further Notes

Habitat Assessment Site	HA06

Date:	11/10/2013	
Fauna Habitat:	Open Woodland	
UTM Co-ordinates:	614378	mE
	7699575	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Red sand	
Landform:	Sand plain	
Vegetation Description:	Low open woodland of *Corymbia zygophylla* over low open shrubland of *Acacia stellaticeps* over open hummock grassland of *Triodia epactia* over open tussock grassland of *Eragrostis eriopoda* and *Aristida holathera* var. *holathera* over very open herbland of *Ptilotus astrolasius* and *Corchorus* aff. *parviflorus*	

Vegetation Condition:	Excellent	**Fire Age:**	4-5 years ago	**Disturbance (cattle):**	None	**Disturbance (other):**	None

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Corymbia zygophylla*	2 – 4 m	3%
Midstorey:	*Acacia pyrifolia, Acacia sericophylla, Acacia stellaticeps, Hakea chordophylla*	0.5 – 1.5 m	5%
Ground Cover:	*Aristida holathera* var. *holathera, Chrysopogon fallax, Eragrostis eriopoda, Triodia epactia*	< 0.5 m	27%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	Rare
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	Rare
Leaf Litter	5-20%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	Moderate
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	5-20%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	5-20%	**No. of Caves**	None	**Termite Mounds**	Rare
Herbs	20-60%	**Suitability for Bats**	None	**Woody debris**	Moderate

Further Notes

Habitat Assessment Site	HA07

Date:	11/10/2013	
Fauna Habitat:	Sand Plain with Hummock Grassland	
UTM Co-ordinates:	613462	mE
	7698996	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Red sand	
Landform:	Sand plain	
Vegetation Description:	Scattered shrubs of *Grevillea wickhamii* over low open shrubland of *Acacia stellaticeps*, *Acacia trachycarpa* and *Indigofera monophylla* over open hummock grassland of *Triodia epactia* over very open tussock grassland of *Eragrostis eriopoda* over scattered herbs of *Corchorus* aff. *parviflorus*	

Vegetation Condition:	Very Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Mild	**Disturbance (other):**	None

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Grevillea wickhamii, Hakea lorea*	1.2 – 3 m	+
Midstorey:	*Acacia pyrifolia, Acacia stellaticeps, Acacia trachycarpa, Adriana tomentosa* var. *tomentosa, Corchorus* aff. *parviflorus, Indigofera monophylla, Tephrosia rosea* var. *rosea*	0.4 – 0.7 m	7%
Ground Cover:	*Eragrostis eriopoda, Mollugo molluginea, Ptilotus axillaris, Triodia epactia*	< 0.5 m	28%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	0-30%	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	0-30%	**Water Presence**	None
Hummock Grass	20-60%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	5-20%	**No. of Caves**	None	**Termite Mounds**	Moderate
Herbs	5-20%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes

Habitat Assessment Site	HA08

Date:	11/10/2013	
Fauna Habitat:	Sand Plain with Hummock Grassland	
UTM Co-ordinates:	612287	mE
	7698996	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Pale brown sand	
Landform:	Sand plain	
Vegetation Description:	Open shrubland of *Acacia sclerosperma* subsp. *sclerosperma* and **Vachellia farnesiana* over open hummock grassland of *Triodia epactia* over very open tussock grassland of **Cenchrus ciliaris*	

Vegetation Condition:	Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Medium	**Disturbance (other):**	Mild

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Acacia sclerosperma* subsp. *sclerosperma, Acacia synchronicia, *Vachellia farnesiana*	1 – 2 m	3%
Midstorey:	*Corchorus* aff. *parviflorus, Cullen pogonocarpum, Gomphrena affinis* subsp. *pilbarensis, Sclerolaena hostilis, Senna artemisioides* subsp. *oligophylla*	0.3 – 0.6 m	1%
Ground Cover:	*Eriachne benthamii, Ipomoea muelleri, Sporobolus australasicus, Triodia epactia*	< 0.5 m	20%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	20-60%	**Boulders**	None	**Distance to Water**	0.5 km
Other Grass	< 5%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	Rare

Further Notes

Habitat Assessment Site	HA09

Date:	11/10/2013	
Fauna Habitat:		
UTM Co-ordinates:	613122	mE
	7697489	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Pale brown clay	
Landform:	Clay plain	
Vegetation Description:	Tussock grassland of *Eriachne benthamii*, *Chrysopogon fallax* and *Eulalia aurea*	

Vegetation Condition:	Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Medium	**Disturbance (other):**	Mild

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Acacia pyrifolia*	1 m	+
Midstorey:	*Acacia sclerosperma* subsp. *sclerosperma, Goodenia lamprosperma, Pluchea ferdinandi-muelleri, Senna artemisioides* subsp. *oligophylla, Streptoglossa bubakii*	0.3 – 0.6 m	+
Ground Cover:	*Chrysopogon fallax, Eriachne benthamii, Eulalia aurea*	0.4 – 0.5 m	44%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	None	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	< 5%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	20-60%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes

Habitat Assessment Site	HA10

Date:	12/10/2013	
Fauna Habitat:	Riverine	
UTM Co-ordinates:	611066	mE
	7698738	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Pale brown sand	
Landform:	Drainage line / River	
Vegetation Description:	Low open woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over open scrub of *Melaleuca glomerata*, *Melaleuca linophylla*, *Acacia trachycarpa* and **Vachellia farnesiana* over very open hummock grassland of *Triodia epactia* over open tussock grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Eulalia aurea*	

Vegetation Condition:	Good	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Heavy	**Disturbance (other):**	Mild

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Eucalyptus camaldulensis* subsp. *refulgens*	6 – 10 m	8%
Midstorey:	*Acacia trachycarpa, Carissa lanceolata, Melaleuca glomerata, Melaleuca linophylla, *Vachellia farnesiana*	2 – 3 m	44%
Ground Cover:	**Cenchrus ciliaris, *Cenchrus setiger, Chrysopogon fallax, Eragrostis cumingii, Eulalia aurea, Sporobolus australasicus, Triodia epactia*	< 0.5 m	23%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	Good - sand	**Peeling Bark**	Rare
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	0-30%	**Large Tree Hollows** (>10cm diameter)	Moderate
Leaf Litter	5-20%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	Moderate
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	< 5%	**Boulders**	None	**Distance to Water**	< 0.5 km
Other Grass	20-60%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	Moderate

Further Notes

Habitat Assessment Site	HA11

Date:	12/10/2013	
Fauna Habitat:	Clay Plain with Open *Acacia* Shrubland	
UTM Co-ordinates:	611473	mE
	7696344	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Pale brown silty clay	
Landform:	Clay plain	
Vegetation Description:	High open shrubland of *Acacia pyrifolia* over very open hummock grassland of *Triodia epactia* over open tussock grassland of *Chrysopogon fallax*, **Cenchrus ciliaris* and **Cenchrus setiger*	

Vegetation Condition:	Poor	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Heavy	**Disturbance (other):**	Medium

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	*Acacia pyrifolia, *Vachellia farnesiana*	2 – 3 m	4%
Midstorey:	*Goodenia lamprosperma, Sclerolaena hostilis, Senna notabilis, Sida arsiniata, Sida rohlenae* subsp. *rohlenae, Streptoglossa bubakii*	0.5 m	+
Ground Cover:	**Cenchrus ciliaris, *Cenchrus setiger, Chrysopogon fallax, Triodia epactia, Triodia wiseana*	0.6 m	25%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	None	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	5-20%	**Boulders**	None	**Distance to Water**	< 0.5 km
Other Grass	20-60%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	5-20%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes

Habitat Assessment Site	HA12

Date:	12/10/2013	
Fauna Habitat:	Clay Plain with Tussock Grassland	
UTM Co-ordinates:	613615	mE
	7696054	mN
Zone:	50K	
Quadrat Size:	100 x 100 m	
Aspect:	N/A	
Soil:	Pale brown clay	
Landform:	Clay plain	
Vegetation Description:	Open tussock grassland of *Eragrostis xerophila*	

Vegetation Condition:	Poor	**Fire Age:**	Long unburnt	**Disturbance (cattle):**	Heavy	**Disturbance (other):**	Medium

Vegetation

	Species	**Average Height (m)**	**Cover**
Overstorey:	-	-	-
Midstorey:	-	-	-
Ground Cover:	*Eragrostis xerophila, Eriachne mucronata*	0.3 m	15%

Ground Cover		**Microhabitats**			
Bare ground	60-100%	**Burrowing Suitability**	None	**Peeling Bark**	None
Rock	< 5%	**Pebbles/Stones** (0-200 mm)	None	**Large Tree Hollows** (>10cm diameter)	None
Leaf Litter	< 5%	**Exfoliating Slabs**	None	**Small Tree Hollows** (<10cm diameter)	None
Logs	< 5%	**Rock Crevices**	None	**Water Presence**	None
Hummock Grass	< 5%	**Boulders**	None	**Distance to Water**	0.5-2 km
Other Grass	5-20%	**No. of Caves**	None	**Termite Mounds**	None
Herbs	< 5%	**Suitability for Bats**	None	**Woody debris**	None

Further Notes