360 environmental

Atlas Tenement

# Level 2 Vertebrate Fauna Survey (Single Phase) – North Perth Mineral Sands Project

Prepared for:

Image Resources (IMA)

January 2012

people planet professional

| Document Reference | Revision | Prepared by | Reviewed by | Submitted to Client | |
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| EBS133 AC | B CLIENT DRAFT | AH | MR | 1 Electronic (email) | 27/1/2012 |

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# Executive Summary

## Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Image Resources NL (IMA) to undertake baseline surveys for the Atlas Tenement. The baseline surveys included a Level 2 Vertebrate Fauna Survey and a Level 2 Flora and Vegetation Survey. A Level 2 Vertebrate Fauna Survey is usually conducted over two seasons, the following report details the results of the first spring survey. The Atlas Tenement survey area is located approximately 18 km east-southeast of Cervantes and 33 km southeast of Jurien Bay, Western Australia (the Project).

## Methods

A total of ten (10) survey sites were established to monitor five (5) broad fauna habitat types. Intensive trapping and passive detection methods were implemented to identify all vertebrate fauna species across the survey area. Emphasis was placed on detecting fauna species of conservation significance that may occur within the Project area.

## Results

Five broad fauna habitat types were identified within the Project area. This included *Banksia* woodland, *Melaleuca*, Heath, Samphire and Pasture.

During the survey a total of sixty three (63) bird species, fourteen (14) mammal species, twenty two (22) reptile and seven (7) amphibians were recorded within the Project area.

A desktop study revealed twenty six (26) bird, five (5) native mammal and one (1) reptile species currently listed as conservation significant under State and/or Commonwealth legislation and/or the Department of Environment and Conservation (DEC) Priority list predicted to occur within the Project area.

The survey results confirmed that one species of mammal and two species of bird observed during the spring survey are listed as species of elevated conservation significance under State and Commonwealth legislation. This included two sightings of Western Brush Wallaby (*Macropus Irma*) recorded in *Banksia* woodland within the south of the study area, a single Australian Bustard (*Ardeotis australis*) recorded in open samphire within the north-west of the study area and a single Rainbow Bee-eater recorded within the heath habitat.

## Discussion

Fauna habitat within the Atlas Tenement is well represented within the surrounding area. This includes privately owned remnant bushland to the west and south, pasture land to the north and east and DEC owned Nambung National Park to the west of the Project area.

All significant species recorded within the Project area are likely and capable of utilising habitat that is well represented within the surrounding area.

The Western Brush Wallaby was recorded both inside and outside the Project area. The species is likely to be utilising a large area of banksia woodland that extends to both the east and south of the Project area. The Australian Bustard is a nomadic species with a wide distribution and is indifferent to a wide variety of habitats (Pizzey & Knight, 1997). The Rainbow Bee-eater also has a wide distribution and indifference to a wide variety of habitats (Morcombe 2003).

It is considered unlikely that clearing associated within the Atlas Tenement would significantly impact the conservation status of these species.

# Recommendations

The following recommendations arise from the Fauna Survey of the Atlas Tenement:

- Based on the tenement layout provided, IMA should maximise the use of existing cleared and disturbed habitat to the north. This should include utilising cleared areas associated with agricultural pursuits for any additional laydown requirements, storage of equipment or any other ancillary use.
- Any clearing of native vegetation should be minimised when possible. This includes minimising the creation of new roads within the tenement.
- All members of the work force on site should be provided with an environmental induction to ensure that they are made aware of any Schedule and Priority fauna occurring in the area. This should include driving speed restrictions and ensuring that off-road driving is minimised, in addition to fire risk minimisation and clearing limit controls.
- It is recommended that a seasonal survey phase be completed as outlined by the Environmental Protection Authority (EPA). Guidance Statement 56 states that a seasonal survey should be conducted to meet the requirements of a Level 2 Fauna Survey. In addition a phase two survey is important to augment the species inventory recorded for the study area.

# 1 Introduction

## 1.1 Background

Image Resources NL (IMA) is actively exploring in the northern Swan Coastal Plain region near Cervantes in Western Australia. IMA have a number of mineral sands resources referred to as the North Perth Basin Project. The initial resource that IMA propose to mine is located within the Atlas Tenement (Figure 1), which is approximately 957 hectares in size, and comprises areas of natural vegetation and cleared pasture (Project area).

## 1.2 Study Objectives

The objectives of the Level 2 Vertebrate Fauna Survey are as follows:

- Provide an inventory of the fauna habitats and assemblage of the study area;
- To identify significant constraints associated with the faunal values within the Project area;
- To assist IMA with the evaluation of potential impacts on vertebrate fauna and/ or habitat of conservation significance; and
- Provide recommendations to mitigate fauna impacts.

## 1.3 Scope of Work

In order to achieve the objective, 360 Environmental undertook a Level 2 Vertebrate Fauna Survey for the Project area. The scope of works for the fauna survey included a desktop study followed by a detailed site visit which included fauna trapping.

The purpose of the desktop study was to gather background information relevant to the Project area by searching literature, data sources and map based information. The reconnaissance and trapping survey aimed to verify the accuracy of the desktop study, delineate and characterise fauna and faunal assemblages present within the Project area and identify potential impacts.

The Level 2 Fauna Survey was planned and implemented in accordance with the EPA 'Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection' (EPA 2002) and 'Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004). To ensure adequate data of a high standard the survey was conducted with reference to the 'Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment' to meet the EPA and DEC's expectations for undertaking a Level 2 Vertebrate Fauna Survey (EPA 2010).

## 1.4 Report Format

This Report has been structured in the following format:

- Section 1. Introduction;
- Section 2. Existing Environment;
- Section 3. Survey Methods;
- Section 4. Results;
- Section 5. Significant Fauna Species;
- Section 6. Conclusion and Recommendations;
- Section 7. References; and
- Section 8. Report Limitations.

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HILL
Molah Hill Lookout
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Kinenabbra
29 RD
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FRED WESTON RD
WINJA RD
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CERVANTES
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BIBBY
Black Pt
Bibby
Ronsard Bay
Winja
RD
NAMBUNG
CERVANTES
Thirsty Pt
Lake Thetis
Hansen Bay
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Hansen Head
NAMBUNG RD
Bibby Ck
Nambung R
Dead Man Thicket
PINNACLES
Pudding Hill
Nambung River
Mount Jetty
Nambung Bay
MUNBINEA
Frederick
WONGONDERRAH
Kangaroo Pt
NAMBUNG NATIONAL PARK
Hangover Bay
JURIEN BAY MARINE PARK
DR
Saddle Hill
Smith Creek
Boggy Bay
Limey Lookout
North Hummock
GREY
South Hummock
The Pinnacles
Buller Island
4WD only
Whittell Island
Grey
Green Islands
Tombstone Rocks
N

## Legend

- Site Boundary

**IBRA Region**

- Geraldton Sandplains
- Swan Coastal Plain

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED FROM LANDGATE 2006

## LOCALITY MAP


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0 500 1,000 2,000 3,000 4,000 Meters

| DRAWING ID | DATE |
|---|---|
| EBS133_1.01 | 16/01/2012 |

**HORIZONTAL DATUM AND PROJECTION**

GDA 1994 MGA Zone 50

| CREATED | CHECKED | APPROVED | REVISION |
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**Image Resources Pty. Ltd.**
**Atlas Mineral Sands Mine Site**
**Cervantes**

**Level 2 Vertebrate Fauna Survey**
**Site Location Overview**
**Figure 1**

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# 2 Existing Environment

## 2.1 Regional Context

The Project area lies within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion (Figure 1). The Swan Coastal Plain Bioregion is comprised of two subregions: the Dandaragan Plateau (SWA1) and Perth Coastal Plain (SWA2) (Appendix A). The Project area is located in the Swan Coastal Plain subregion (SWA2). The Swan Coastal Plain subregion is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwashed plains, and paperbark in swampy areas. The subregional area is 1,333,901 ha (Mitchell et. al. 2002).

## 2.2 Climate

The climate is classified as Warm Mediterranean and rainfall ranges between 600 and 1000 mm annually. The closest official Bureau of Meteorology (BoM) weather station currently operating is Jurien Bay, where climate data is available between 1968 and 2011. The annual average rainfall within the Project area is approximately 536.3 mm per annum (based on the average annual rainfall at Jurien Bay, approximately 33 km north-west of the Atlas Tenement). Recorded climate information is summarised below (Figure 2).

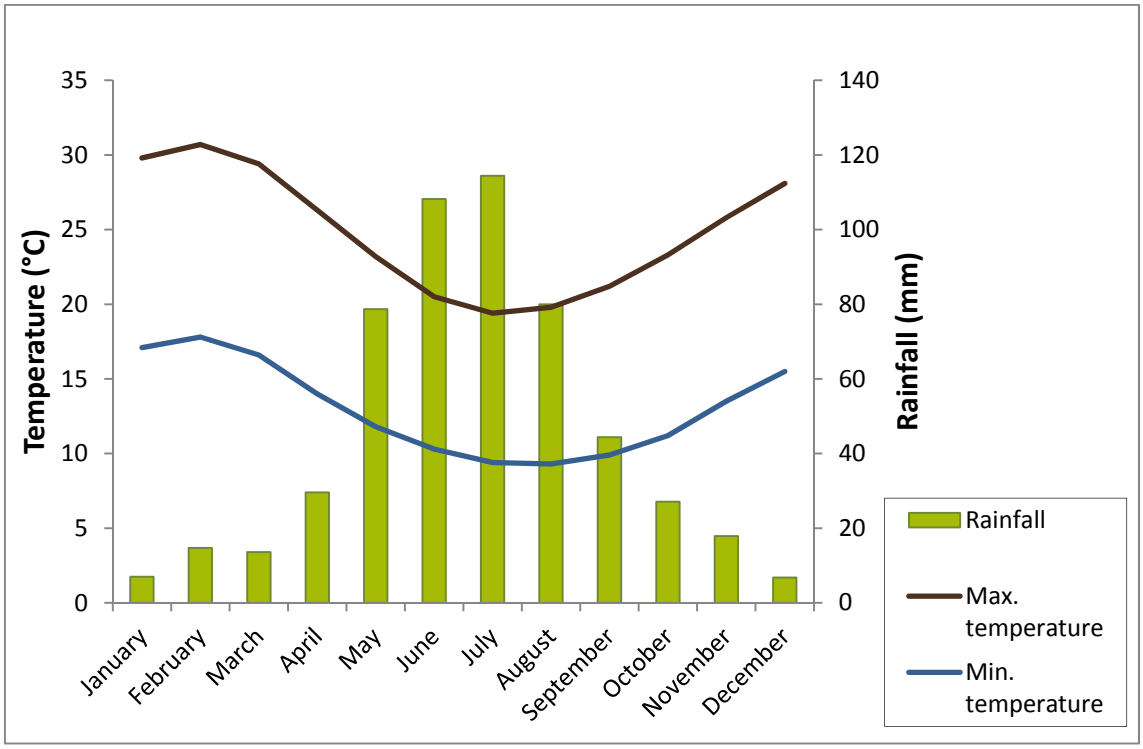



Figure 2: Mean rainfall and temperature for Jurien Bay recorded between 1968 and

2011 (Bureau of Meteorology 2011).

## 2.3 Geology

The Project area is located west of the Gingin scarp, which represents the eastern limit of the deposition of beach sediments formed along fossil shorelines during the Pleistocene (Leandri 2011). The bedrock present within the Project area is shallow (<20m) although no outcropping present. The substrates consist primarily of dark-grey to black micaceous siltstone or shale, with rare sandstone. The basement bedrock underlying the Project area predominantly comprises intercalated siltstone and sandstone (Leandri 2011).

The surface geology of the Project area consists of light-coloured sands with intercalated clay strands. Weathering and groundwater fluctuation has produced ferricrete and calcrete horizons in occasional places within the Survey area (Leandri 2011).

## 2.4 Hydrology

The area contains two main regional groundwater flow systems (aquifers), which are locally interconnected (Water and Rivers Commission 1997). The region is drained by watercourses which originate in the Arrowsmith region. The hydrology of the area consists of a superficial aquifer at up to 60m depth which overlies the deeper Yarragadee aquifer (EPA 2000). The Project area is west sloping and contains a single westerly flowing drainage system with minor tributaries (Leandri 2011).

## 2.5 Rare Flora and Vegetation

There were no threatened (declared Rare) flora listed in the DEC database search results for the Project area and surrounds (DEC 2011). One Priority taxon was listed in the database search for the Project area, being:

- *Schoenus griffinianus* (P3), (K.L. Wilson 1997)

A level 2 Flora and Vegetation Survey was conducted in conjunction with the Vertebrate Fauna Survey. Refer to (360 Environmental 2012) for detailed results of the flora and vegetation survey.

## 2.6 Previous Fauna Surveys

A previous Level 2 Fauna survey was conducted at Cooljarloo approximately 15 km from the Project area. The survey was conducted within Tiwest Joint Ventures Falcon Lease in December 2006. The Project area was smaller than the Atlas Tenement. The survey revealed two species of conservation significance. This included the Bold-striped Four-toed Lerista (*Lerista christinae*) and Southern Emu-wren (*Stipiturus malachurus*). The details of the survey are displayed in Table 1. A water bird survey was also conducted at Jurien Bay gypsum mine in 2006. Details of the survey are presented herein.

Table 1: Other surveys in the area

| SURVEY | TIWEST JOINT VENTURE COOLJARLOO MINE | JURIEN GYPSUM MINE |
|---|---|---|
| Consultant | M.J. & A.R. Bamford Consulting Ecologists | M.J. & A.R. Bamford Consulting Ecologists |
| Duration | 7 – 12 December 2006 | November 2005 – January 2006 |
| Type | Level 2 Survey | Bird Survey |
| Approx. Distance from Current Survey | 23 km SE | - |
| No. of Trapping Sites | 3 | - |
| Site Type | Linear transect: 20 pit traps | - |
| Trapping Nights | Average of 4.25, range 3-5 | - |
| Total Trap Nights | 250 | - |
| Bird Survey Method | Opportunistic | Visual count |
| Amphibians | 3 | - |
| Reptiles | 10 | - |
| Mammals | 4 | - |
| Birds | 22 | 13 |
| Total species | 39 | 13 |
| Conservation significant species recorded | Bold-striped Four-toed Lerista, Southern Emu-wren. | Hooded Plover, Red-necked Stint, |
| No. Conservation significant species | 2 | 2 |
| Notes | Wetlands in the vicinity not sampled | Waterbird survey only |

- Indicates data not available.

# 3 Survey Methods

## 3.1 Desktop Study

A desktop review was undertaken to collect current data relevant to the Project area and its surrounds. This involved a search of available literature and survey data, web based mapping tools and map-based information (Table 2). A desktop survey of species potentially occurring within the Project area was performed using data from:

- Searches of the Department of Environment and *Conservation (DEC*) databases;
- Search of the Environment Protection and Biodiversity Conservation (EPBC) Act *Protected Matters database*;
- Search of the International Union for Conservation of Nature (IUCN) Red-list;
- Search of Birds Australia *Birdata database*;
- Review of publicly-available information for vertebrate fauna for the northern Swan Coastal Plain region surrounding Cervantes(Table 1); and
- Various reference books (Wilson and Swan 2003; Pizzey and Knight, 1997; Morcombe, 2003; Simpson and Day, 1996; Van Dyke and Strahan 2008; Menkhorst and Knight 2004).

All species of elevated conservation significance recorded or expected to occur in the Project area were cross-checked against the Federal EPBC Threatened Matters Database (SEWPaC 2011a) and the Government Gazette Number 12 (Government of Western Australia 2010) for their status under the EPBC Act and WC Act.

Table 2: Database sources

| PROVIDER | DATABASE | PARAMETERS |
|---|---|---|
| Department of Sustainability, Environment, Water, Population and Communities | Protected Matters Database Search Tool. Accessed 25 October 2011 | Buffer of 10 km from the area bounded by coordinates<br>-30.50694 115.24861<br>-30.50667 115.25556<br>-30.56944 115.25556<br>-30.56944 115.23417<br>-30.50694 115.24861 |
| Department of Environment and Conservation | NatureMap. Accessed 25 October 2011 | Radial buffer of 20 km from the point 115°14' 54" E,30°32' 16" S |
| Department of Environment and Conservation | Threatened and Priority Fauna Database. Accessed 8 November 2011 | North-east of Mundinea Road and Wongonderrah Rd intersection. |
| Birds Australia | Birdata. Accessed 25 October 2011 | One degree square containing the point 115.15507, -30.526 |

## 3.2 Survey Timing and Weather

The primary objectives of the survey were to verify the presence, and provide site-specific descriptions, of fauna habitats and verify the likelihood of the occurrence of EPBC Act and WC Act listed fauna species within the Project area.

A reconnaissance and trapping survey was undertaken on the 15 - 24 November 2011 in accordance with the EPA's Guidance Statement 56 (EPA 2004).

Conditions for the field survey were warm and fine. Minimum temperatures ranged from 10 - 17°C and maximum temperatures ranged from 23.8 – 37.6°C (BoM 2011) (Table 3). Jurien Bay received a total of 53.4 mm of rain within the month leading up to the survey. During the survey Jurien Bay received one rainfall event with 1.5 mm of rain recorded on 18 November 2011. The Project area received a significant amount of dew overnight during the 18, 19 and 20 November.

**Table 3: Weather at time of survey**

| Date | Minimum Temperature (°C) | Maximum Temperature (°C) | Rainfall 24hrs to 9am (mm) |
|---|---|---|---|
| 15/11/2011 | 13.2 | 25.2 | 0 |
| 16/11/2011 | 10.0 | 24.0 | 0 |
| 17/11/2011 | 15.0 | 26.0 | 0 |
| 18/11/2011 | 16.0 | 23.8 | 1.5 |
| 19/11/2011 | 11.0 | 27.0 | 0 |
| 20/11/2011 | 11.0 | 32.0 | 0 |
| 21/11/2011 | 14.0 | 32.0 | 0 |
| 22/11/2011 | 14.0 | 35.4 | 0 |
| 23/11/2011 | 17.0 | 37.6 | 0 |
| 24/11/2011 | 16.9 | 33.0 | 0 |

## 3.3 Fauna Survey Team

360 Environmental's Senior Environmental Scientists Felicity Donaldson, Dr Phil Runham and Andrew Hide coordinated and operated the field survey and were responsible for fauna identification and documentation during the survey. Andrew Hide was the DEC Regulation 17 license holder for the survey work SF008326 (Appendix A). All staff members have appropriate tertiary qualifications and a minimum of five years of relevant field experience enabling them to competently satisfy EPA requirements for a Level 2 Vertebrate Fauna Survey.

## 3.4 Survey Locations

The survey team examined areas within the outlined Project area provided by IMA. Efforts were made to incorporate two trapping sites within each broad fauna habitat type within the Project area. At each survey site a combination of live trapping and passive detection were conducted to identify and record all species seen and heard in the area. A basic site habitat assessment was also conducted for each survey site. Coordinates for each site were recorded using a handheld Global Positioning System (GPS) unit (Figure 5 and Table 4).

Table 4: Survey Location, Including GPS Location (GDA 1994) and Broad Habitat Type

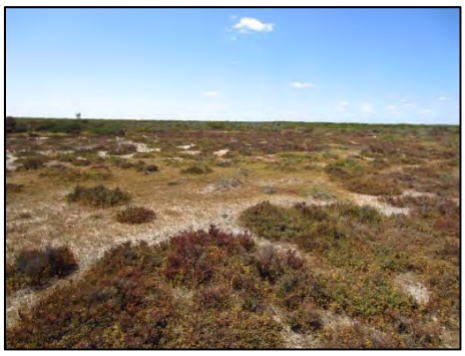
| | GPS LOCATION | | | | |
|---|---|---|---|---|---|
| SURVEY LOCATION | ZONE | EASTING | NORTHING | PLATE NO | BROAD HABITAT |
| CERA | 50J | 332215 | 6620788 | 1 | Heath |
| CERB | 50J | 331422 | 6617016 | 2 | Banksia Woodland |
| CERC | 50J | 331582 | 6620558 | 3 | Samphire |
| CERD | 50J | 332027 | 6620137 | 4 | Melaleuca |
| CERE | 50J | 332363 | 6618973 | 5 | Banksia Woodland |
| CERF | 50J | 331116 | 6619036 | 6 | Heath |
| CERG | 50J | 331726 | 6618065 | 7 | Banksia Woodlond |
| CERH | 50J | 332613 | 6617698 | 8 | Melaleuca |
| CERI | 50J | 331717 | 6621770 | 9 | Pasture |
| CERJ | 50J | 330329 | 6623055 | 10 | Pasture |

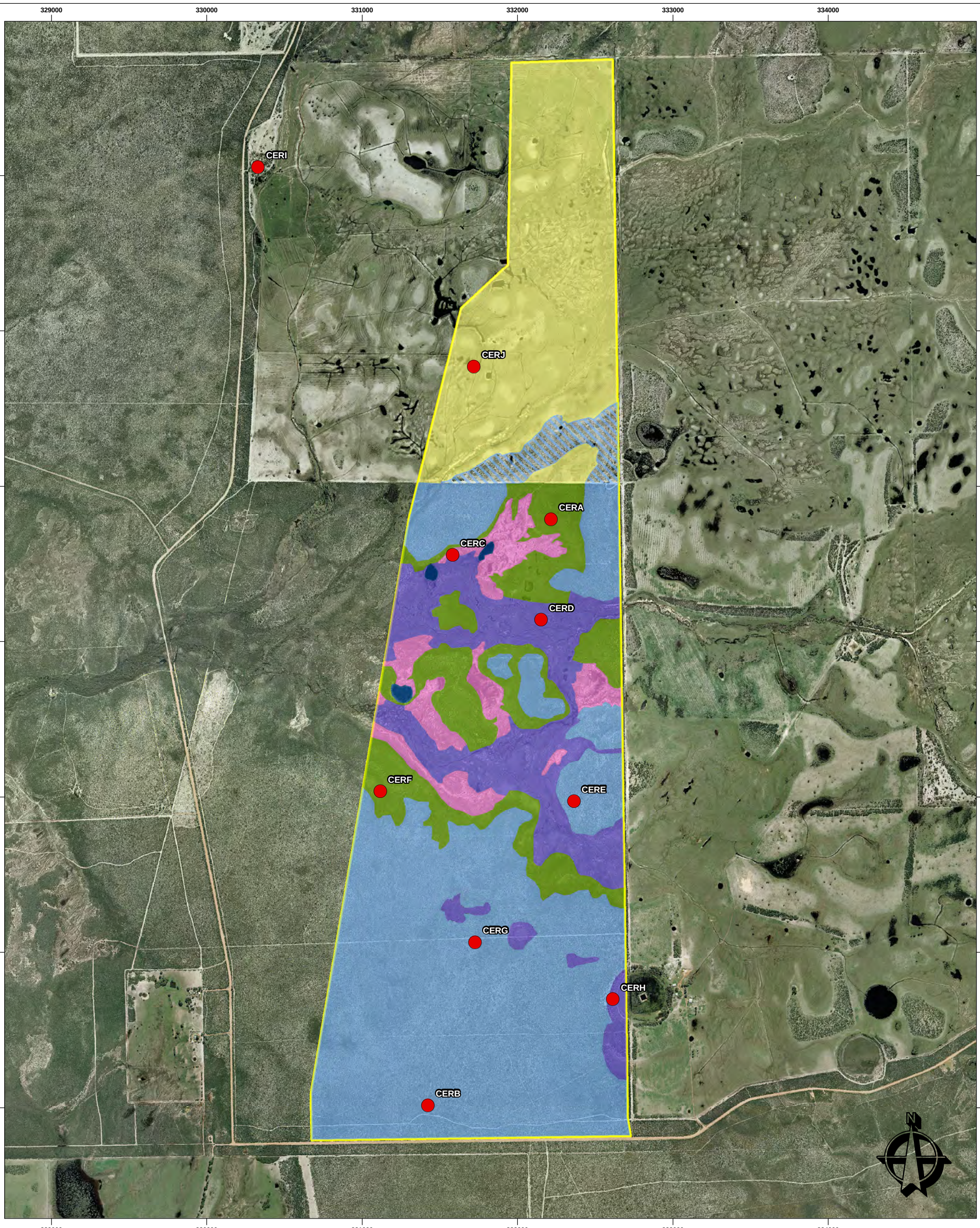
### 3.4.1 Fauna Habitat

A total of five broad fauna habitat types were recorded within the project area (Figure 3). The five broad fauna habitats are discussed in Table 5.

Table 5: Broad fauna habitats

| HABITAT TYPE | IMAGE |
|---|---|
| **Banksia Woodland**<br>The dominant vegetation within the Project area was Banksia Woodland. This habitat comprised most of the southern third of the Project area and patches of habitat throughout the centre. The habitat was comprised mainly of *Banksia attenuata* with Banksia menziesii low woodland. The habitat usually occurred on gentle slopes of low rise on margin of wetland with grey sand. Eucalypt species were positioned patchily throughout the *Banksia* woodland this included *Eucalyptus todtiana* and *Eucalyptus rudis* (360 Environmental 2012). Survey locations CERB, CERG, and CERE were positioned within this fauna habitat type. |  |
| **Heath**<br>This fauna habitat was spread patchily throughout the central regions of the Project area, commonly surrounding the edge of the *Banksia* Woodland. The habitat comprised *Regelia ciliata*, *Banksia telmatiaea*, *Hakea obliqua subsp. parviflora*, *Melaleuca seriata*, *Callitris arenaria* open to closed low heath (360 Environmental 2012). The habitat primarily occurs on winter-wet flats with yellow and grey sands, on the margins of samphire flats. Survey locations CERA and CERF were located within this broad fauna habitat type. |  |

| | |
|---|---|
| **Melaleuca shrubland**<br><br>This fauna habitat primarily occurred in the low lying area, along creek tributaries and ephemeral lakes. The Melaleuca shrubland was composed primarily of *Melaleuca viminea subsp. viminea* open to closed scrub over *Lepidosperma longitudinale* scattered sedges with **Lotus subbiflorus*, **Lolium perenne*, **Hordeum geniculatum* closed annual grassland/herbland (360 Environmental 2012). The habitat usually occurred within shallow flow lines with sandy soils. Within areas of Melaleuca Eucalyptus species were also present in small patches. Survey locations CERE and CERH were located within the fauna habitat |  |
| **Samphire**<br><br>This fauna habitat was patchily spread throughout the central region of the project area. The habitat usually occurred alongside heath or melaleuca shrubland. Samphire was also regularly present within the understorey of the *Melaleuca* shrubland. This habitat was composed of *Tecticornia ?syncarpa*, *Tecticornia indica subsp. bidens* , *Frankenia pauciflora*, *Verticordia plumosa* var. *brachyphylla*, low shrubland over *Angianthus pygmaeus*, *Brachyscome pusilla* low open herbland with grey clay sands (360 Environmental 2012). This habitat potentially occurred in areas within increased levels of salinity. Survey Location CERC was located within this fauna habitat. |  |
| **Pasture**<br><br>Degraded pasture land comprises the top third of the Project area. Survey Locations CERI and CERJ were located within the fauna habitat. The habitat contained little biological value and was composed primarily of exotic annual species. |  |




**Legend**

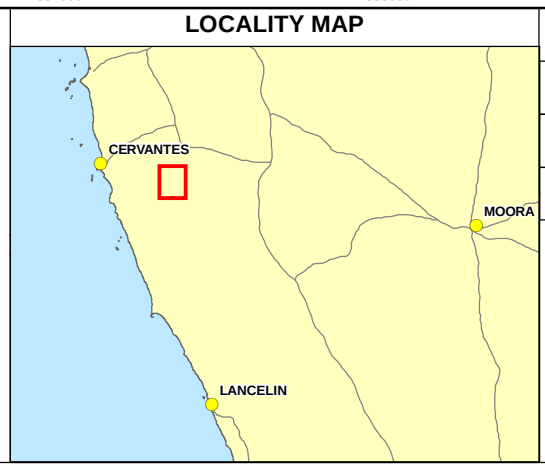
- Site Boundary
- Trapping Locations

**Habitat**

- Banksia Woodland
- Degraded Banksia Woodland
- Ephereal Lake
- Heath
- Melaleuca
- Pasture
- Samphire

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL IMAGERY SOURCED FROM GOOGLE EARTH 2011
- LOCALITY MAP SOURCED FROM LANDGATE 2006

**LOCALITY MAP**

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**HORIZONTAL DATUM AND PROJECTION**

GDA 1994 MGA Zone 50

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**Image Resources Pty. Ltd.**
**Atlas Mineral Sands Mine Site**
**Cervantes**

**Level 2 Vertebrate Fauna Survey**
**Fauna Habitats & Trapping Locations**
**Figure 3**

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Plate 1: Survey Location CERA – Heath habitat

Plate 2: Survey Location CERB – Banksia woodland habitat

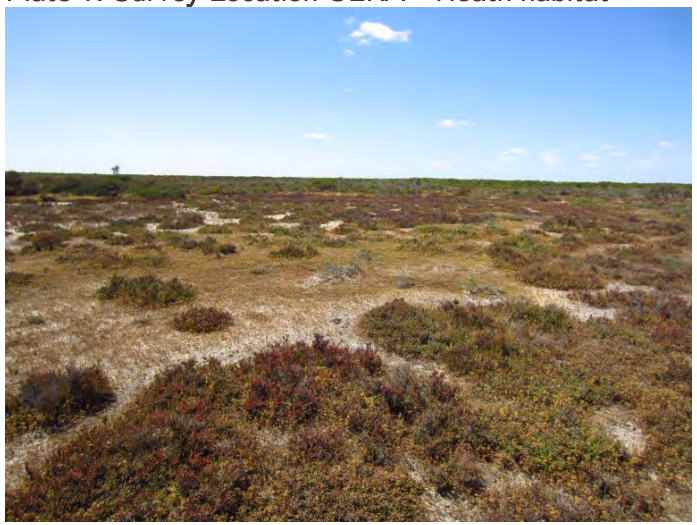


Plate 3: Survey Location CERC – Samphire habitat

Plate 4: Survey Location CERD – *Melaleuca* shrubland habitat

Plate 5: Survey Location CERE – *Banksia* woodland habitat

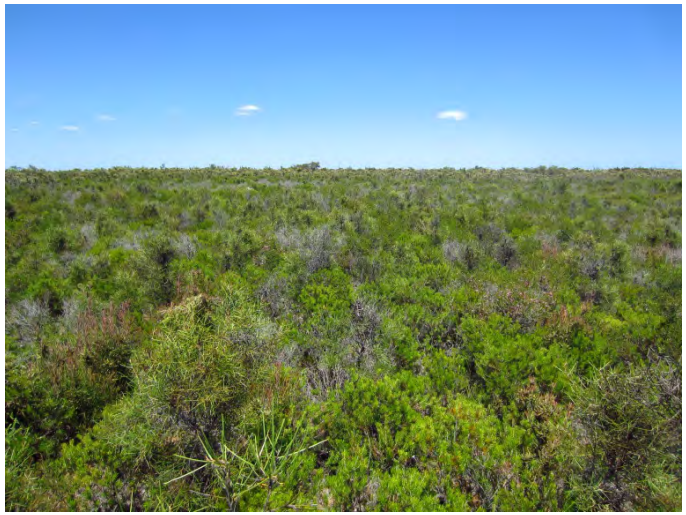


Plate 6: Survey Location CERF – Heath habitat

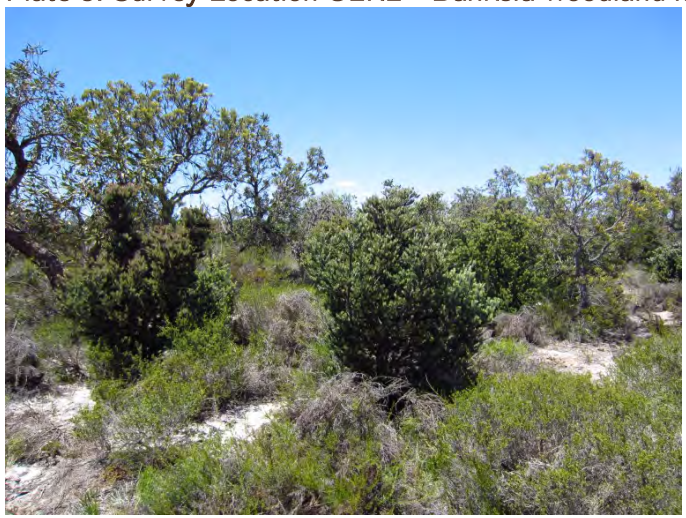


Plate 7: Survey Location CERG – *Banksia* woodland habitat

Plate 8: Survey Location CERH – *Melaleuca* shrubland habitat

Plate 9: Survey Location CERI – Disturbed pasture/paddock

Plate 10: Survey Location CERJ – Dam within disturbed native vegetation (pasture habitat)

## 3.5 Site Design and Survey Effort

The principal component of this survey comprised a total of ten (10) systematic survey sites (Figure 5). The standard trapping arrangement at each site comprised of three (3) pit-traps, three (3) funnel pairs, five (5) large Elliots, five (5) small Elliots and two (2) cages at each survey site (Figure 4). Systematic survey sites were positioned such that they sampled all major habitats available within the Project area, with provision for accessibility to ensure all traps could be checked on a regular basis.

Nomenclature for each bird species recorded was checked against the *Checklist of the birds of Western Australia* (Johnstone 2010).

Nomenclature for each mammal species recorded was checked against the *Checklist of the mammals of Western Australia* (How *et al.* 2009).

Nomenclature for each amphibian species recorded was checked against the *Checklist of the amphibians of Western Australia* (Doughty and Maryan 2010).

Nomenclature for each reptile species recorded was checked against the *Checklist of the reptiles of Western Australia* (Doughty and Maryan 2010).

### 3.5.1 Trapping Survey

Fauna trapping was conducted at each survey site, with the exception of the two sites comprising pasture (CERI and CERJ), where disturbance levels were considered to have removed the value of the area to native fauna. Trap configuration at each site involved a pair of 30 m long wire mesh drift fences. The standard arrangement comprised a 30 L bucket in the middle of the first drift fence, with PVC pipes of 150 mm diameter x 500 mm depth at each end. Three pairs of funnel traps (one trap either side of the fence) were evenly spaced along the second drift fence. Ten Elliot (five medium and five large) and two cage traps were positioned in a wide arc around the two drift fence lines at each trapping site. A Diagram of a typical site design is displayed in Figure 4. Cage and Elliott traps were baited with universal bait, a mixture of peanut butter, sardines and oats.

This standard arrangement differed slightly within the Samphire habitat (CERC) as pit-traps were likely to be subject to water ingress, thereby posing a risk to captured fauna. At this site, funnel traps were used in place of pit-traps. Additionally, a pair of funnel traps were substituted for a bucket trap at each of two sites, CERG and CERH.

All traps were checked within three hours of sunrise each day and Elliot and cage traps subsequently closed. Pit-traps were checked and Elliott and cage traps re-opened again in the afternoon.

The total survey effort at each site is displayed in Table 6.

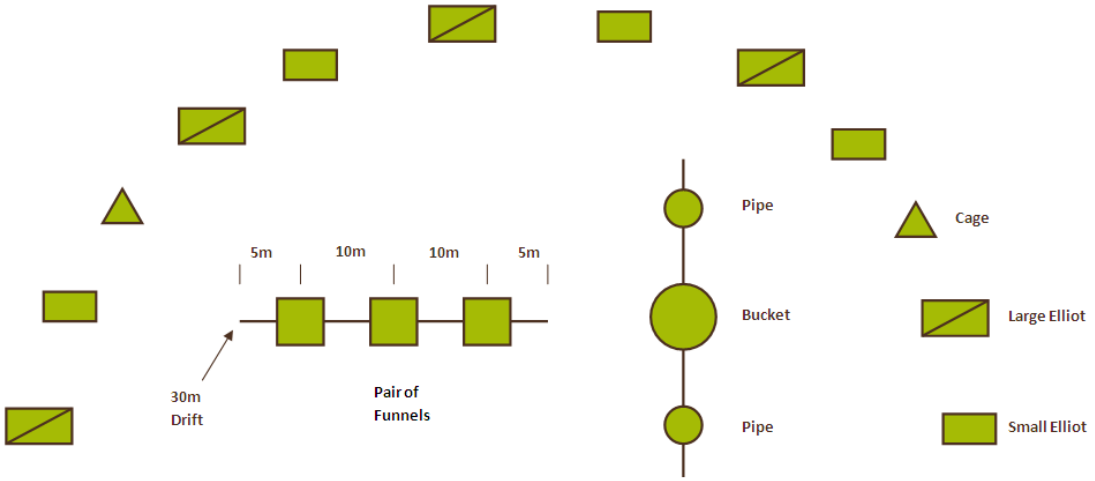



Figure 4: Site trapping design

### 3.5.2 Ornithological survey

At each survey site a dedicated bird survey was conducted to identifying bird species within a 2 ha area. This involved experienced staff members recording all species seen and heard during peak bird activity for a minimum of 30 minutes per session. Peak bird activity was between sunrise and 9 am and then between 4 pm and sunset. Each birding session was replicated at least once during the trip, resulting in a minimum of 60 birding minutes at each site. This resulted in a total of 24 hours of sampling across the Project area.

In addition opportunistic sightings of birds were also recorded at all times while traversing the site, either on foot or by vehicle around site.

### 3.5.3 Non-systematic Fauna Sampling

Within each broad fauna habitat type a non-systematic fauna search was conducted to identify and document additional species and any fauna indications of additional species such as scats, tracks and diggings. The search involved turning over rocks and logs, splitting fallen timber, sifting through soil and leaf litter and peeling off bark at survey sites (approximately one hectare per survey site). The search involved a minimum of 120 search minutes at each broad fauna habitat type. Survey effort was usually composed of 2-4 staff searching for 40 minutes at an individual survey site.

### 3.5.4 Nocturnal Survey

Night surveys were conducted at four survey sites representing three major habitat types in the study area. Two personnel used head torches and spotlights to search for fauna not documented by trapping. Head torching was conducted on foot for a minimum

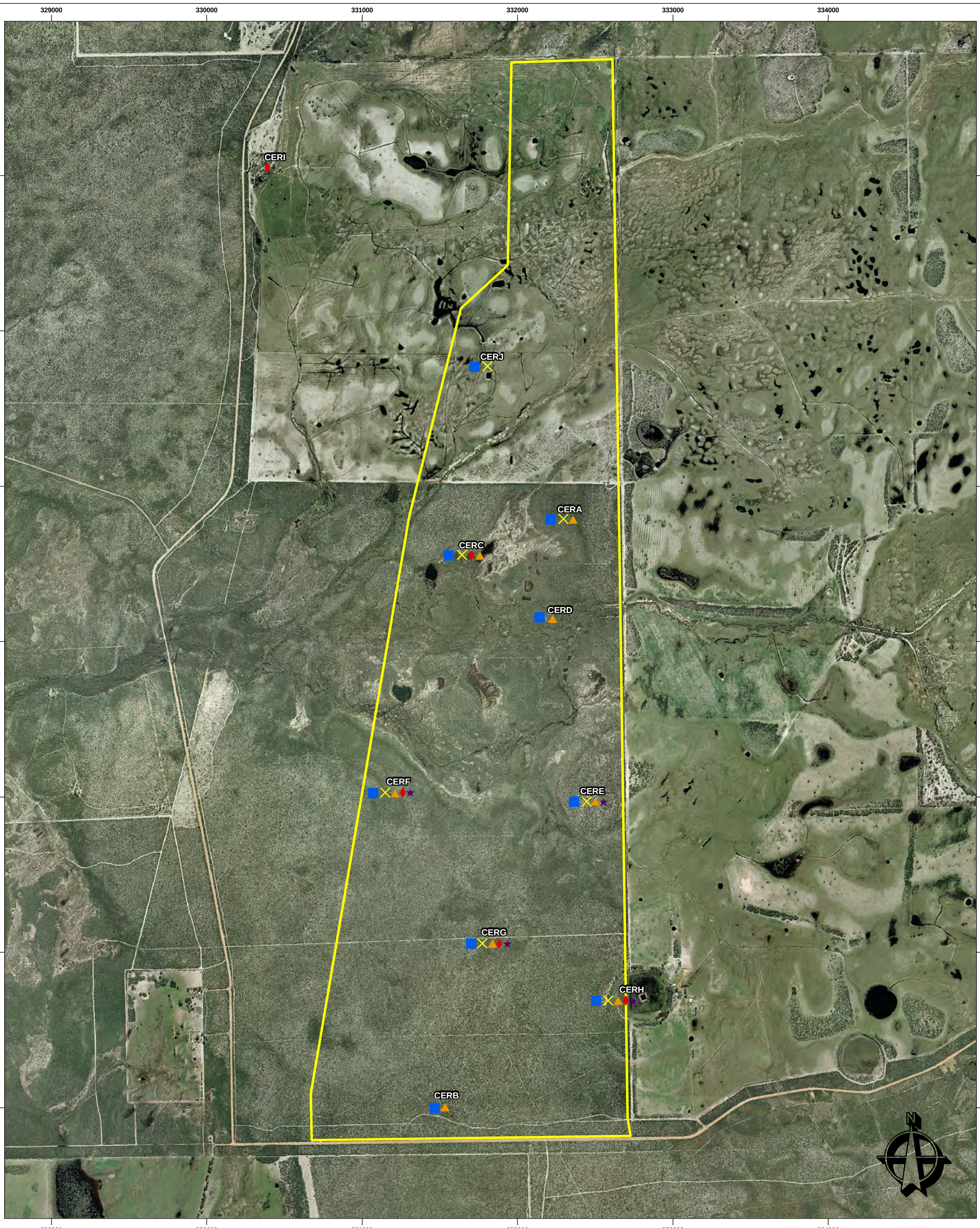
of 30 minutes (total 60 search minutes). Searches recorded geckos not caught in traps during the day.

Vehicle spotlighting traverses were also conducted throughout the Project area. This involved traversing the major vehicle tracks at approximately 25 km/h and recording any fauna sightings within the Project area.

### 3.5.5 Bat Survey

An Echolocation survey of bat activity was conducted within all broad fauna habitats over six (6) nights. The survey was conducted at survey site CERC, CERF, CERG, CERH and CERI. The recordings were made continuously between 5 pm and 6 am using an Anabat II Echolocation Call detector in conjunction with a digital recorder (LS11 series, Olympus Japan). The Anabat was set on the ground at each site with the microphone directed into open space on tracks, in flyways or over water.

The call recordings were used to identify individual bat species in the area, with call analysis completed by Bat Call WA. Calls were identified manually and only high quality calls were used. The echolocation analysis results conducted by Bat Call WA are available in Appendix C.






**Legend**

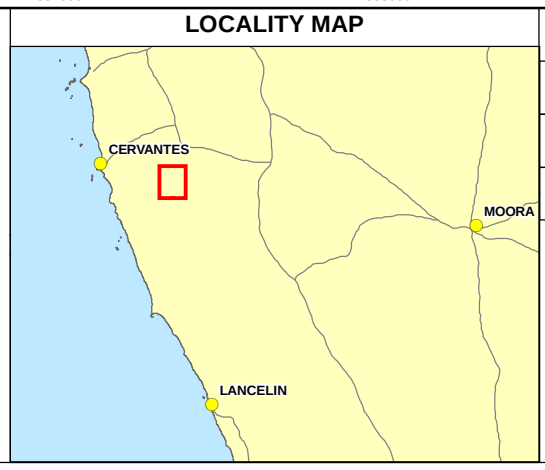
- Site Boundary
- CERI Trapping Locations

**Survey Effort at Each Site**

- Bird Survey
- Trapping
- Forage
- Night Survey
- Anabat

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL IMAGERY SOURCED FROM GOOGLE EARTH 2011
- LOCALITY MAP SOURCED FROM LANDGATE 2006

**LOCALITY MAP**




1:23,000 @ A3

0 125 250 500 750 1,000 Meters

| DRAWING ID | DATE |
|---|---|
| EBS133_1.05 | 19/01/2012 |

| HORIZONTAL DATUM AND PROJECTION |
|---|
| GDA 1994 MGA Zone 50 |

| CREATED | CHECKED | APPROVED | REVISION |
|---|---|---|---|
| TD | AH | AH | 1 |

**Image Resources Pty. Ltd.**
**Atlas Mineral Sands Mine Site**
**Cervantes**

**Level 2 Vertebrate Fauna Survey**
**Fauna Survey Methods**
**Figure 5**

360 environmental

K:\Projects\1.0 EBS\EBS133 Cervantes L2 Flora L2 Fauna\Figures\Fauna

Table 6: Survey Effort at Each Site

| Site | Pit Traps | | Funnel Traps | | Elliot Traps | | Cage Traps | | Bird Survey | Forage | Night Survey | Anabat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Trap Configuration | Trap nights | Trap Configuration | Trap Nights | Trap Configuration | Trap Nights | Trap Configuration | Trap Nights | Minutes | Minutes x No. of staff | Minutes | Nights |
| CERA *Heath* | 2 pipe + 1 Bucket over 7 nights | 21 | Pair of funnels x 3 over 7 nights | 21 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | 40 x 2 & 20x 2 | - | - |
| CERB *Banksia* | 2 pipe + 1 Bucket over 7 nights | 21 | Pair of funnels x 3 over 7 nights | 21 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | - | - | - |
| CERC *Samphire* | None. Substituted with funnels | 0 | Pair of funnels x 6 over 7 nights | 42 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | 30 x 4 | - | 1 |
| CERD *Melaleuca* | 2 pipe + 1 Bucket over 7 nights | 21 | Pair of funnels x 3 over 7 nights | 21 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | - | - | - |
| CERE *Banksia* | 2 pipe + 1 Bucket over 7 nights | 21 | Pair of funnels x 3 over 7 nights | 21 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | 40 x 4 | 60 | - |
| CERF *Heath* | 2 pipe + 1 Bucket over 7 nights | 21 | Pair of funnels x 3 over 7 nights | 21 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | 40 x 4 | 60 | 1 |
| CERG *Banksia* | 2 pipe + 2 Bucket over 7 nights | 28 | Pair of funnels x 2 over 7 nights | 14 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | 30 x 2 | 60 | 1 |
| CERH *Melaleuca* | 2 pipes + 2 Buckets in 7 nights | 28 | Pair of funnels x 2 over 7 nights | 14 | 5 small & 5 large over 7 nights | 70 | 2 cages over 7 nights | 14 | ≥80 over 2 phases | 40 x 4 | 60 | 2 |
| CERI Pasture | None | 0 | None | 0 | None | 0 | None | 0 | - | - | - | 1 |
| CERJ Pasture | None | 0 | None | 0 | None | 0 | None | 0 | ≥80 over 2 phases | 40 x 4 | - | - |

## 3.6 Survey Limitations

Table 7 addresses potential limitations and constraints associated with the Level 2 Fauna Survey. The following limitations have been addressed with reference to Guidance Statement 56.

**Table 7: Limitations and constraints**

| POTENTIAL LIMITATIONS | CONSTRAINT* | COMMENT |
|---|---|---|
| Competency and experience of the consultant (s) carrying out the survey | No | The 360 Environmental staff members who completed the field work and prepared this report have appropriate training and experience in conducting Level 2 Vertebrate Fauna Surveys (Table 4). |
| Scope | Negligible | The purpose of a Level 2 survey is to compile an inventory of fauna habitats and species and to identify any fauna of elevated conservation significance within the proposed Project area. A comprehensive and detailed species list was collated as a result of this survey. This comprised the first phase of a Level 2 Fauna Survey. The EPA would likely require a minimum of two Level 2 (trapping) Surveys over different seasons to demonstrate spatial and temporal variations in faunal assemblages (according to Guidance Statement 56). |
| Proportion of fauna identified, recorded and/ or collected | No | A high diversity of fauna species were recorded on the basis of those expected to occur and the available habitats. It is likely that additional species would be recorded should a seasonal survey phase be completed |
| Sources of Information | No | Vertebrate fauna information was accessed by searching available literature and survey data; web based mapping tools and map-based information. |
| Proportion of the task achieved | No | The field component fulfils EPA's requirements for a single phase Level 2 Fauna Survey. |
| Timing/ weather/season/ cycle | No | The survey was conducted in late spring after recent rainfall events and following sufficient winter rainfall. The weather for the survey was primarily fine and clear with warm conditions. These were ideal conditions for the survey of reptiles, mammals, birds and amphibians. The proportion of fauna recorded is considered acceptable for a Phase 1 Level 2 Fauna Survey. |
| Disturbances which affected results of the | No | Clearing for exploration drill lines has occurred throughout the site. However this impact was not recent and is limited to a small area. |

| Potential Limitations | Constraint* | Comment |
|---|---|---|
| survey | | |
| Intensity of survey effort | No | Details of the Survey effort at the Site are described in section 3.5. A total of five broad fauna habitats were surveyed, allowing replicated trapping sites within each Banksia woodland, Melaleuca and heath fauna habitat type. Table 6 details the survey effort at each site. Trapping effort over the project area consisted of 161 pit trap nights, 175 funnel pair trap nights, 560 Elliot trap nights, 112 cage trap nights, 12 bird survey hours, 15 foraging hours, 240 head torching minutes and 6 Anabat nights. The intensity of the survey effort was sufficient for the area surveyed and as part of a Phase 1 Level 2 Fauna Survey according to Guidance Statement 56 and the Technical Guide. |
| Completeness | Negligible | The survey was completed in detail, and replication was conducted in most cases throughout the five broad fauna habitat types within the Project area. The EPA guidelines state that it is preferable that Level 2 Fauna Surveys conduct a second season phase. Therefore it is recommended a second seasonal phase be conducted. |
| Resources | No | Adequate resources were available. |
| Remoteness and/ or access problems | No | Suitable access tracks were available throughout the site. Access to and around the site was not considered a problem. |
| Availability of contextual information on the region | No | 360 Environmental had adequate access to fauna databases to determine which species were likely to be identified within the Survey area. |

*Constraint (yes/ no); Significant – greater than 60%; Moderate – 20-60%; Negligible – less than 20%

# 4 Results

## 4.1 Desktop Study

### 4.1.1 Conservation Significant Fauna

A search of the DECs Threatened and Priority Fauna Database, NatureBase, the EPBC Protected Matters Database, Bird Australia *Birdata,* regional sources (Table 2) and the desktop survey was undertaken to identify fauna species predicted to occur within a buffer of between 10 and 20 km of the Project area.

A total of one hundred and sixty (160) bird species, eleven (11) terrestrial mammal species, twenty-seven (27) reptile species, five (5) amphibian species and five (5) invasive species were identified as potentially occurring within the Project area.

The desktop fauna list was used to determine specially protected fauna under State and/or Commonwealth legislation that may occur within the Project area (Table 8). Table 8 lists the threatened and priority fauna species found in the region that may occur within the Project area, along with their conservation status.

Conservation significant fauna predicted to occur in the area comprised a total of twenty seven (26) bird species, five (5) terrestrial mammal species and one (1) reptile species. In addition two invertebrate species were also predicted to occur in the area. This included the Graceful Sun Moth *Synemon gratiosa* and a cricket *Austrosaga spinifer*.

### 4.1.1 Previous Fauna Surveys

Table 8: Desktop Study Results

| | | International | Federal | State | |
|---|---|---|---|---|---|
| Common Name | Scientific Name | IUCN | EPBC | DEC | WCA |
| **Birds** | | | | | |
| Australian Bustard | *Ardeotis australis* | Near Threatened | | Priority 4 | |
| Australasian Gannet | *Morus serrator* | | Migratory marine | | |
| Baudin's Cockatoo | *Calyptorhynchus baudinii* | Endangered | | | Schedule 1 |
| Black-tailed Godwit | *Limosa limosa* | Near Threatened | Migratory marine | | Schedule 3 |
| Brown Goshawk | *Accipiter fasciatus* | | Migratory marine | | |
| Buff-banded Rail | *Gallirallus philippensis* | | Endangered | | |
| Cattle Egret | *Ardea ibis* | | Migratory marine. Migratory wetland | | |
| Carnaby's Black Cockatoo | *Calyptorhynchus latirostris* | Endangered | Vulnerable | | Schedule 1 |
| Fork-tailed Swift | *Apus pacificus* | | Migratory marine | | |
| Glossy Ibis | *Plegadis falcinellus* | | Migratory marine | | Schedule 3 |
| Great Egret, White Egret | *Ardea alba* | | Migratory marine. Migratory wetland | | |
| Hooded Plover | *Thinornis rubricollis* | Near Threatened | Migratory marine | | |
| Malleefowl | *Leipoa ocellata* | Vulnerable | Vulnerable | | Schedule 1 |
| Nankeen Night-Heron | *Nycticorax caledonicus* | | Migratory marine | | |
| Painted Button-quail | *Turnix varius* | | Vulnerable | | |
| Peregrine Falcon | *Falco peregrinus* | | | | Schedule 4 |

| Common Name | Scientific Name | International | Federal | State | |
|---|---|---|---|---|---|
| | | IUCN | EPBC | DEC | WCA |
| Rainbow Bee-eater | *Merops ornatus* | | Migratory | | |
| Red-tailed Black-Cockatoo | *Calyptorhynchus banksii* | | Vulnerable | | Schedule 1 |
| Southern Emu-wren | *Stipiturus malachurus* | | Endangered, Migratory | | |
| Spotless Crake | *Porzana tabuensis* | | Migratory marine | | |
| Stubble Quail | Coturnix pectoralis | | Migratory marine | | |
| Western Corella | *Cacatua pastinator* | | Vulnerable, Migratory marine | | |
| Western Rosella | *Platycercus icterotis* | | | | Schedule 1 |
| Whistling Kite | *Haliastur sphenurus* | | Migratory marine | | |
| White-bellied Sea-Eagle | *Haliaeetus leucogaster* | | Migratory terrestrial | | |
| Wood Sandpiper | *Tringa glareola* | | Migratory marine | | Schedule 3 |
| **Mammals** | | | | | |
| Chuditch, Western Quoll | *Dasyurus geoffroii* | Near Threatened | Vulnerable | | |
| Woylie | *Bettongia penicillata subsp. ogilbyi* | Critically Endangered | Endangered | | Schedule 1 |
| Southern Brown Bandicoot | *Isoodon obesulus subsp. fusciventer* | | | Priority 5 | |
| Tammar Wallaby | *Macropus eugenii subsp. derbianus* | | | Priority 5 | |
| Western Brush Wallaby | *Macropus irma* | | | Priority 4 | |
| **Reptiles** | | | | | |
| Carpet Python | *Morelia spilota subsp. imbricate* | | | Priority 4 | Schedule 4 |

## 4.2 Fauna Survey

The following section summarises the mammals, birds, herpetofauna recorded during the survey. Table 9 summarises the total species recorded during the survey and Figure 6 shows the species accumulation curve for all fauna groups recorded over time.

Table 9: Total fauna captures

| Fauna Group | Survey |
|---|---|
| Birds | 63 |
| Native Mammals | 9 |
| Introduced Mammals | 5 |
| Bats | 6 |
| Reptiles | 22 |
| Amphibians | 7 |
| **Total** | **118** |

The species accumulation curve (Figure 6) represents the total number of species recorded as trapping and survey effort continues over time. The curve for both amphibians and reptiles has levelled out suggesting sufficient survey effort. However reptiles and birds are still on a slight upward trend, suggesting a small amount of survey effort is still required.

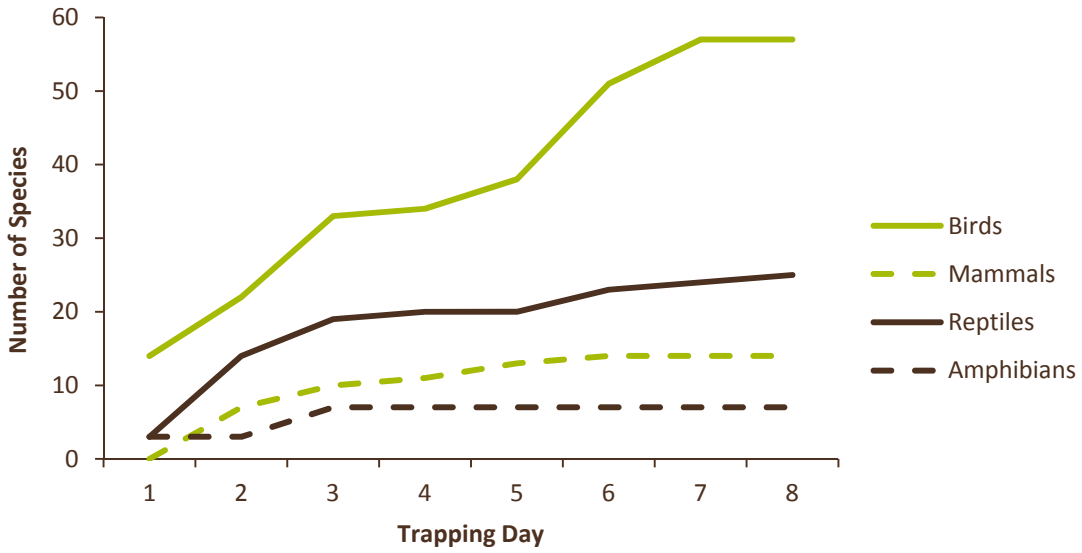



Figure 6: Species accumulation curve for all fauna

### 4.2.1 Avifauna

A total of 63 bird species were observed during the survey (Table 10), of the potential 160 predicted to occur in the area.

The highest number of species were recorded from Survey Location CERH (22 species), then Survey locations CERB and CERI (16 species at each) followed by Survey Location CERG (15 species) (Table 10).

Brown honeyeater (*Lichmera indistincta*) was recorded the most with 174 observations, followed by straw necked ibis (*Threskiornis spinicollis*) with 75 records and Silvereye (*Zosterops lateralis*) with 67 records.

Black cockatoos (*Calyptorhynchus sp.*) were also observed in a moderate to large sized flock in the wider area, approximately 30km from site. As a nomadic species, the Black Cockatoo uses Banksia as a food source at times of the year and may utilise part of the survey area for foraging.

The species accumulation curve below (Figure 7) is still on a slight upward trend. Suggesting more survey effort is required to record the majority of avian species in the area.

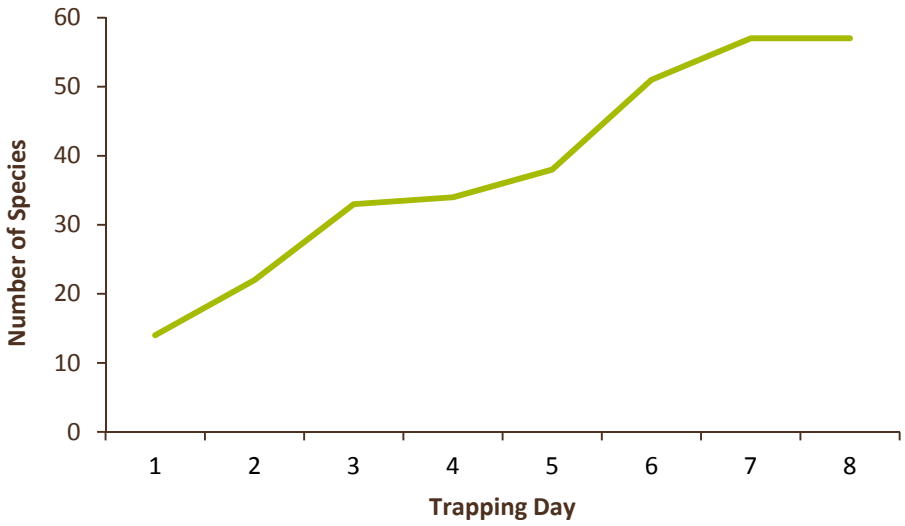



Figure 7: Avifauna species accumulation curve

#### 4.2.1.1 Avifauna of Cons sig

Two bird species observed in the Project area are of conservation significance based on the protected lists under State and Commonwealth legislation at the time of reporting. This included an Australian Bustard (Plate 11) and Rainbow Bee-eater.

A single male Australian Bustard was observed within the Samphire habitat to the north near CERC. A single individual Rainbow Bee-eater was observed overhead in the heath habitat at CERF (Figure 10).

Plate 11: Bustard (*Ardeotis australis*) Conservation Priority 4

## Table 10: Birds species recorded within Project area

| Common Name | Scientific Name | Cons Sig | CERA | CERB | CERC | CERD | CERE | CERF | CERG | CERH | CERI | Opp. Record |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Australian Bustard | *Ardeotis australis* | Priority 4 | | | | | | | | | | 1 |
| Australian Pipit | *Anthus novaeseecanadiae* | | | | 6 | | | | | | 4 | |
| Australian Kestrel | *Falco cenchroides* | | | | | | | | | | 1 | |
| Australian Magpie | *Cracticus tibicen* | | | 2 | | | 4 | | | 1 | | |
| Australian Magpie-lark | *Grallina cyanoleuca* | | | 3 | | | | | | 2 | | |
| Australian Magpie | *Gymnorhina tibicen* | | | | | | | | | | 4 | |
| Australian Pipit | *Anthus australis* | | | | 1 | | | | | | | |
| Australian Raven | *Corvus coronoides* | | 5 | 4 | 1 | | 3 | 2 | 8 | 8 | | |
| Australian White Ibis | *Threskiornis molucca* | | | | 2 | | | | | | | |
| Australasian Pipit | *Anthus novaeseelandiae* | | | | | 1 | | | | | | |
| Black Falcon | *Falco subniger* | | | | | 1 | | | | | | |
| Black-faced Cuckoo-Shrike | *Coracina novaehollandiae* | | | 1 | | | 3 | | | 2 | | |
| Black-faced Woodswallow | *Artamus cinereus* | | | | | | | | | 1 | 5 | |
| Blue-breasted Fairy-wren | *Malurus pucherrimus* | | 3 | 5 | 4 | | | 21 | | 4 | | |
| Boobook | *Ninox novaeseelandiae* | | | | | | | | | 1 | | |
| Brown Falcon | *Falco berigora* | | | 1 | | | | | | | | |
| Brown Honeyeater | *Lichmera indistincta* | | 1 | 30 | | | 23 | 34 | 58 | 28 | | |
| Brown Quail | *Coturnix ypsilophora* | | | | | | | 1 | | | | |
| Brown-headed Honeyeater | *Melithreptus brevirostris* | | | | | | 1 | | | | | |
| Cattle Ibis | | | | | 2 | | | | | | | |
| Crested Pigeon | *Ocyohaos lophotes* | | | 2 | | | 2 | | | | 9 | |
| Emu | *Dromaius novaehollandiae* | | | | | | | | 2 | | | |
| Female Wren (unknown) | *Malurus sp.* | | 4 | | 1 | | | | | | | |
| Galah | *Cacatua roseicapella* | | 3 | 3 | | | 4 | | 4 | 16 | 4 | |
| Grey Butcherbird | *Cracticus torquatus* | | 1 | 1 | | | | | | | | |
| Grey Fantail | *Rhipidura fuliginosa* | | | | | | | | | 1 | | |
| Horsefields' Bronze Cuckoo | *Chrysococcyx basalis* | | 3 | | | | 1 | | 3 | | | |
| Inland Thornbill | *Acanthiza apicalis* | | | | 4 | | 4 | | | | | |
| Jacky-winter | *Microeca fascinans* | | | | | | | | | 1 | | |
| Magpie Lark | *Grallina cyanoleuca* | | | | | | | | | | 2 | |
| Nankeen Kestrel | *Falco cenchroides* | | | | | 1 | | | | | | |
| Pallid Cuckoo | *Cuculus pallidus* | | 1 | 1 | | | | 2 | 2 | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Port-lincoln Parrot | *Platycercus zonarius* | | | | | | | | | 1 | | |
| Rainbow Bee-eater | *Merops ornatus* | Migratory | | | | | | 1 | | | | |
| Red Wattle-bird | *Anthochaera carunculata* | | | | | | 3 | | | | 1 | |
| Red-capped Robin | *Petroica goodenovii* | | | 1 | | | | | | | | |
| Rufous Field-wren | *Calamanthus campestris* | | | | | 1 | | | | | | |
| Rufous Songlark | *Cincloramphus mathewsi* | | | | | 2 | | | | | | |
| Rufous Whistler | *Pachycephala rufiventris* | | | | | | 4 | | 5 | 3 | | |
| Silvereye | *Zosterops lateralis* | | | | 5 | | 6 | 18 | 21 | 17 | | |
| Singing Honeyeater | *Lichenostomus virescens* | | | 1 | | | | | 4 | 5 | | |
| Splendid Fairy Wren | *Malurus splendens* | | | | | | | | 13 | 16 | | |
| Spotted Harrier | *Circus assimilis* | | 3 | | | | | | | | | |
| Straw-necked Ibis | *Threskiornis spinicollis* | | 60 | | | | | | | 10 | 5 | |
| Striated Pardalote | *Pardalotus striatus* | | | | | | | | | 4 | | |
| Stubble Quail | *Coturnix pectoralis* | | | | | | | | | | 3 | |
| Tree Martin | *Hirundo nigricans* | | | 1 | | | | | | | 8 | |
| Welcome Swallow | *Hirundo neoxena* | | | | | | | | | 3 | 3 | |
| Western Gerygone | *Gerygone fusca* | | | 3 | | | | | 1 | 7 | | |
| Western Thornbill | *Acanthiza inornata* | | | 1 | | | | 5 | 7 | | | |
| White Backed Swallow | *Cheramoeca leucosternus* | | | | 2 | | | | | | | |
| White Browed Scrub-wren | *Sericornis frontails* | | | | | | | | 6 | | | |
| White Cheeked Honeyeater | *Phylidonyris nigra* | | | | | | | | 4 | | | |
| White Fronted Chat | *Epthianura albifrons* | | | | | 1 | | | | | | |
| White-browed Scrub-wren | *Sericornis frontalis* | | | | | | | 2 | | 11 | | |
| White-cheeked Honeyeater | *Phylidonyris nigra* | | 1 | | | 1 | | 4 | | | | |
| White-Faced Heron | *Egretta novaehollaniae* | | | | | | | | | | 1 | |
| White-fronted Chat | *Epthianura albifrons* | | 28 | | 3 | | 2 | 1 | | | | |
| White-winged Fairy-wren | *Malurus Leucopterus* | | 2 | | | 2 | | | | | 2 | |
| Willie Wagtail | *Rhipidura leucophrys* | | | 1 | 2 | | | | | | 10 | |
| Yellow Spoonbill | *Platalea flavipes* | | | | 1 | | | | | | | |
| Yellow-rumped Thornbill | *Acanthiza chrysorrhoa* | | | | | | | | 4 | 18 | 8 | |
| Zebra Finches | *Taeniopygia guttata* | | | | | 20 | | | | | | |

### 4.2.2 Mammals

A total of nine native mammal species were observed during the survey (Table 11), of a potential 11 predicted to occur. Five introduced mammal species were recorded.

The most commonly recorded native mammal species was the Western Grey Kangaroo (*Macropus fuliginosus*) recorded on 29 occasions. The next most commonly recorded mammal species was the House Mouse (*Mus musculus*) captured on 24 occasions.

Honey Possums (*Tarsipes rostratus*) were caught on two occasions – once in Banksia woodland and once in Heath. Both were females carrying pouch young (Plate 11).

A microbat assemblage of six insectivorous species was confirmed as present within the Project area. Characteristics of the calls recorded are presented in Table 2 of Appendix C. Each of these species is common in the region. Overall species activity levels were relatively low, with the exception of *Vespadelus regulus*. Detailed results of the Bat survey report produced by Bat Call Australia can be viewed in Appendix C.

High densities of Fox tracks were observed during the survey (Plate 12).

The species accumulation curve for mammals within the project area is beginning to reach a plateau (Figure 8). Suggesting the survey effort is suitable.

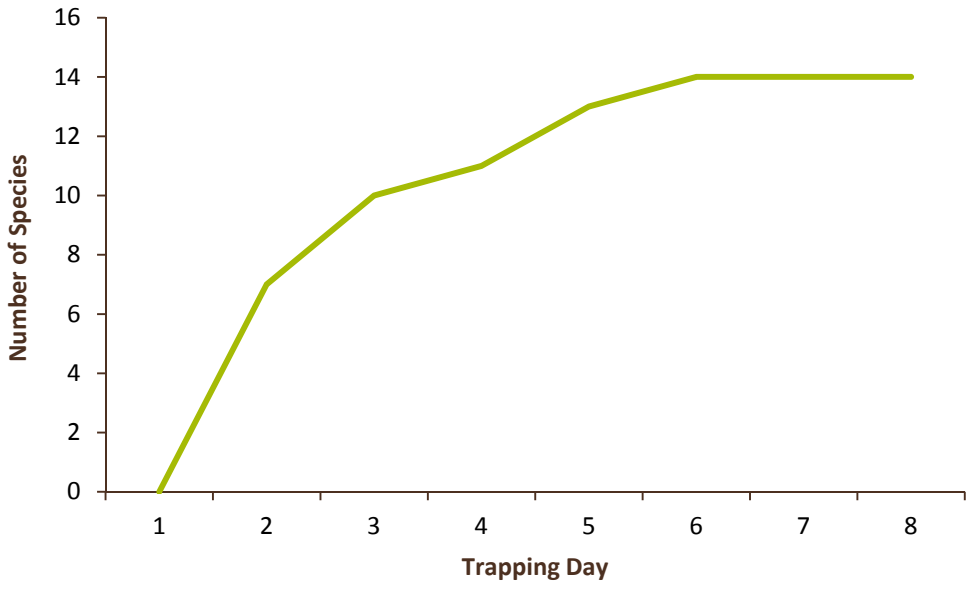



Figure 8: Mammal species accumulation curve

Plate 11: Honey Possum (*Tarsipes rostratus*) captured at CERF

Plate 12: Numerous Red Fox (*Vulpes vulpes*) tracks observed within the Project area

#### 4.2.2.1 Mammals of Conservation Significance

No priority species of insectivorous bat were detected.

Only one species of mammal recorded is of conservation significance, listed as Priority Fauna and protected under State legislation at the time of reporting. This was a Western Brush Wallaby (*Macropus irma*). The species was recorded on two occasions within *Banksia* habitat. One sighting was made near CERB and the other was made outside the project area crossing Munbinea road to the west (Figure 10).

## Table 11: Mammal species recorded within Project area

| Species | | Cons Sig | CERA | CERB | CERC | CERD | CERE | CERF | CERG | CERH | CERI | Opp. Record |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cat | *Felis catus* | | | 1 | | | | | | | | 1 |
| Chocolate Wattled Bat | *Chalinolobus morio* | | | | | | | | | * | | |
| Cow | *Bos sp.* | | | | | | | 1 | | | | |
| Fox | *Vulpes vulpes* | | 1 | | | | 2 | | | | | 10 |
| Gould's Wattled Bat | *Chalinolobus gouldii* | | | | * | | | * | | * | * | |
| Honey Possum | *Tarsipes rostratus* | | | | | | | 1 | 1 | | | |
| House mouse | *Mus musculus* | | 4 | | 2 | 9 | | 2 | 4 | 3 | | |
| Lesser Long-eared Bat | *Nyctophilus geoffroyi* | | | | * | | | * | * | * | * | |
| Rabbit | *Oryctolagus cuniculus* | | 1 | | | | 4 | | | | | |
| Southern Forest Bat | *Vespadelus regulus* | | | | * | | | * | * | * | * | |
| Western Brush Wallaby | *Macropus irma* | Priority 4 | | 2 | | | | | | | | |
| Western Grey Kangaroo | *Macropus fuliginosus* | | 1 | 1 | | | 2 | 1 | | | | 24 |
| White-striped freetail Bat | *Tadarida australis* | | | | * | | | | | * | | |
| | *Mormopterus sp. 4* | | | | | | | * | | * | | |

* Recorded during Anabat survey

### 4.2.1 Herpetofauna

A total of 22 species of reptile were observed during the survey (Table 12), of a potential 27 predicted to occur in the area. The most frequently recorded species was the West Coast Laterite *Ctenotus* (*Ctenotus fallens*) with 51 captures, followed by the West Coast Four-toed Lerista (*Lerista elegans*) with 14 captures. Three Gould's Monitors (*Varanus gouldii*) were sighted during the survey, one of these had a burrow at survey site CERH.

A total of seven amphibian species were observed during the survey (Table 12), this is more than the five predicted to occur in the area. Frog densities were particularly high during the survey (Plate 13). No species found in the Project area are of conservation significance based on the protected lists under State or Commonwealth legislation or under the DEC's Priority list at the time of reporting. The Crawling Toadlet (*Pseudophryne guenther)* was the most commonly recorded species with 713 records. This comprised nearly 72% of individual amphibians recorded. A Turtle Frog (*Myobatrachus gouldii*) which is known to be a specialist myrmecophage was recorded once at survey site CERF (Doughty and Tyler 2009). Moist overnight weather conditions with heavy dew on November 18-20 were particularly conducive to increased frog activity, and these days showed higher trapping rates.

Head torching resulted in six Soft Spiny-tailed Gecko (*Strophurus spinigerus*) being observed (Plate 14). These would otherwise have not been recorded in trapping efforts.

A dead Mulga snake (*Pseudechis australis*) was opportunistically found on the road bounding the property, having been killed by vehicular collision. This confirms their presence in the area despite no recorded trappings or sightings within the Project area.

The species accumulation curve for herpetofauna species within the project area (Figure 9) was not level. This suggests further trapping may be required for reptile species.

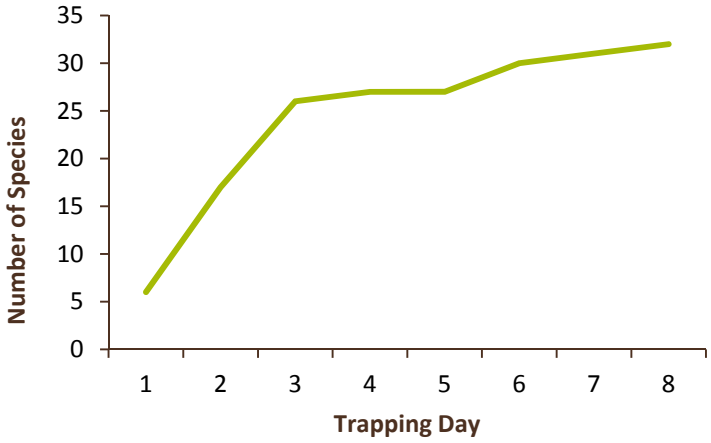



Figure 9: Herpetofauna species accumulation curve

Plate 13: Bucket with high number of amphibian captures

Plate 14: Soft Spiny-tailed Gecko (*Strophurus spinigerus*) observed during spotlighting

#### 4.2.1.1 Herpetofauna of Conservation Significance

No species found in the Project area are of conservation significance based on the protected lists under State or Commonwealth legislation or under the DEC's Priority list at the time of reporting. The only reptile of conservation significance that is predicted to occur within the Project area is the Carpet Python (*Morelia spilota subsp. imbricate*).

## Table 12: Reptile species recorded within Project area

| Species | | Cons Sig | CERA | CERB | CERC | CERD | CERE | CERF | CERG | CERH | CERI | Opp. Record |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue-tongued skink | *Tiliqua rugosa* | | 1 | 1 | 1 | | 1 | 3 | 5 | 1 | | |
| Buchanan's snake-eyed Skink | *Cryptobelpharus buchanaii* | | | | | 1 | | | | | | |
| Burton's Legless Lizard | *Lialis burtonis* | | 1 | 1 | | 1 | 1 | 1 | 5 | | | |
| Common Dwarf Skink | *Menetia greyii* | | | | 1 | 1 | | 1 | | 1 | | |
| Common Scaly-Foot | *Pygopus lepidopodus* | | 1 | 1 | | | | 1 | | | | |
| Dwarf Bearded Dragon | *Pogona minor minor* | | 3 | 2 | 1 | | 3 | | 1 | | | |
| Gould's Hooded Snake | *Parasuta gouldii* | | | | | | 1 | | | 1 | | |
| Goulds' Monitor | *Varanus gouldii* | | | | | | | | | 1 | | 2 |
| Keeled Legless Lizard | *Pletholax gracilis* | | 1 | 2 | | | 2 | | | | | |
| Morethia Skink | *Morethia obscura* | | | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | |
| Péron's snake-eyed Skink | *Cryptoblepharus plagiocephalus* | | | | | | | | | 1 | | |
| Soft spiny-tailed gecko | *Strophurus spinigerus* | | 1 | | | | | 3 | | 1 | | 1 |
| Southern Blind Snake | *Ramphotyphlops australis* | | | | | 2 | | 1 | 1 | 1 | | |
| South-western crevice- skink | *Egernia napoleonis* | | | | | 1 | | | | | | |
| West-coast Laterite Ctenotus | *Ctenotus fallens* | | 9 | 12 | 3 | 12 | 16 | 1 | 2 | 7 | | |
| West Coast Four-toed Lerista | *Lerista elegans* | | | 2 | | | 3 | 7 | | 2 | | |
| Western Heath Dragon | *Ctenophorus adelaidenisis* | | | 3 | | | 5 | | 4 | | | |
| Western Slender Blue-tongue | *Cyclodomorphus celatus* | | 1 | 1 | | 3 | | | | 1 | | |
| Western Worm Lerista | *Lerista praepedita* | | 2 | | | | | 1 | | | | |
| Yellow-faced Whip-Snake | *Demansia psammophis* | | | | | 2 | | | | 1 | | |
| | *Ctenotus insignificans* | | 1 | | | | | | | | | |
| | *Morethia lineocellata* | | | | | | | 1 | | | | |

Table 13: Amphibian species recorded within Project area

| Species | | Cons Sig | CERA | CERB | CERC | CERD | CERE | CERF | CERG | CERH | CERI | Opp. Record |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Western Banjo Frog | *Limnodynastes dorsalis* | | | | | | | | | 5 | | |
| Glauerts' Froglet | *Crinia glauerti* | | | | | | | | 1 | 9 | | |
| Moaning Frog | *Heleioporus eyrei* | | 47 | 8 | 17 | 36 | 22 | 11 | 43 | 9 | | 3 |
| Crawling Toadlet | *Pseudophryne guentheri* | | 79 | 85 | 84 | 213 | 26 | 25 | 90 | 111 | | |
| Sand Frog | *Heleioporous psammophilus* | | 5 | 1 | 2 | 2 | 3 | 3 | | | | |
| South-west Froglet | *Crinia insignifera* | | 2 | 1 | 1 | 25 | 3 | 7 | 1 | 10 | | |
| Turtle Frog | *Myobatrachus gouldii* | | | | | | | 1 | | | | |

### 4.2.2 Conservation Significant Fauna

Three species of conservation significance were recorded during the survey and a further 29 may be expected to occur on the basis of DEC, EPBC and other database searches.

One of the bird species observed within the Project area is of international conservation significance based on the IUCN Red list, and is also protected by State legislation. This species was:

- Australian Bustard (*Ardeotis australis*) – Priority 4 (DEC 2010) and Near Threatened IUCN.

A second bird species observed in the Project area is protected by Commonwealth legislation under the JAMBA agreement. This species was:

- Rainbow Bee-eater (*Merops ornatus*) – Migratory: Terrestrial (DSEWPAC 2009) protected under the JAMBA Agreement.

A single native mammal species observed during the Survey is protected under State legislation. This species was:

- Western Brush Wallaby (*Macropus irma*) - Priority 4 (DEC 2010).

The potential impact the proposed Atlas Tenement development may have on the three species is discussed in detail in Section 5.

# 5 Significant Fauna Species

## 5.1 Threatened Fauna Statutory Framework

A total of twenty six (26) bird species, five (5) native mammal species and one (1) reptiles species listed under State and/or Commonwealth legislation are predicted to occur within the project area. No amphibians of conservation significance are predicted to occur within the area.

During the reconnaissance and trapping survey a total of three fauna species of conservation significance were observed. This included:

- Australian Bustard *Ardeotis australis*;
- Rainbow Bee-eater *Merops ornatus*; and
- Western Brush Wallaby *Macropus irma*.

### 5.1.1 Key Statutory Requirements

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the *Western Australian Wildlife Conservation Act 1950-1979*. In addition, many of these species are listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

### 5.1.2 Federal Legislation

Fauna species are protected at a Federal level under *the Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act was developed to provide for the protection of the environment, with specific regard to those aspects of the environment that are matters of national environmental significance (NES). The EPBC Act promotes the conservation of biodiversity through ecologically sustainable development practices and the ecologically sustainable use of natural resources.

The EPBC Act includes provisions to protect native species (and in particular prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species protected under international agreements (JAMBA, CAMBA, RoKAMBA).

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). Table 14 outlines the categories of significance levels.

Table 14: EPBC Act Categories of Threatened Fauna Species

| CONSERVATION CODE | CATEGORY |
|---|---|
| Ex | Extinct - Taxa not defiantly located in the wild during the past 50 years |
| ExW | Extinct in the Wild - Taxa known to survive only in captivity |
| CE | Critically Endangered - Taxa facing an extremely high risk of extinction in the wild in the immediate future |
| E | Endangered - Taxa facing a very high risk of extinction in the wild in the near future |
| V | Vulnerable - Taxa facing a high risk of extinction in the wild in the medium-term |
| NT | Near Threatened - Taxa that risk becoming Vulnerable in the wild |
| CD | Conservation Dependent - Taxa whose survival depends upon ongoing conservation measures. Without these measures. A conservation dependent taxon would be classified as Vulnerable or more severely threatened. |
| DD | Data Deficient (Insufficiently Known) - Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information. |

### 5.1.3 State Legislation

Western Australia's biodiversity is supported and protected by the following legislation:

- The *Conservation and Land Management Act 1984* (CALM Act);
- The *Environmental Protection Act 1986* (EP Act);
- The *Wildlife Conservation Act 1950*;
- The *Wildlife Conservation Regulations 1970*; and

The Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2) describes categories for fauna classified as Specially Protected in a series of Schedules (Table 15). The DEC produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the WC Act but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered as potentially significant and the species need further survey and evaluation of their conservation status before consideration can be given to declaration as Threatened Fauna. Levels of Priority are described in Table 16.

Table 15: WC Act Codes for Threatened Fauna

| Conservation Code | Category |
|---|---|
| Schedule 1 | Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection. |
| Schedule 2 | Fauna that is presumed to be extinct are declared to be fauna that is in need of special protection. |
| Schedule 3 | Birds that are identified in the agreement between the governments of Australia and Japan relating to the protection of migratory birds, and birds in danger of extinction, are declared to be fauna that is in need of special protection. |
| Schedule 4 | Fauna that is in need of special protection, otherwise than for the reasons mentioned (in Schedule 1 – 3). |

Table 16: DEC Priority Fauna Conservation Codes (DEC, 2010).

| Conservation Code | Category |
|---|---|
| P1 | **Priority One**<br>Taxa with few, poorly known populations on threatened lands. |
| P2 | **Priority Two**<br>Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc. |
| P3 | **Priority Three**<br>Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation. |
| P4 | **Priority Four**<br>Rare taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years. |
| P5 | **Priority Five**<br>Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years. |

### 5.1.4 International Agreements

The EPBC Act also includes management of migratory species that are recognised under international treaties such as the *China Australia Migratory Bird Agreement* (CAMBA), the *Japan Australia Migratory Bird Agreement* (JAMBA), *Republic of Korea-Australia Migratory Bird Agreement* (ROKAMBA) and *The Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention). Species included in these agreements are considered to be significant at the global level.

## 5.2 Threatened Fauna

### 5.2.1 Predicted Significant Fauna

An assessment was conducted to determine the likelihood of each of the predicted conservation significant species listed in Table 17 occurring within the Project area. This involved determining background and habitat preference for each of the fauna species, along with the likelihood of each occurring within the Project area (Table 17). Based on this information it was determined that there is a total of twelve (12) predicted conservation species with a moderate possibility of occurring within the Project area. No predicted conservation species were determined as having a high likelihood of occurring in the area. In total three of the species of moderate likelihood of occurrence were observed during the Phase 1 Vertebrate Fauna Survey.

Table 17: Likelihood of predicted conservation significant species occurring in Project Area

| Species | Conservation Status | Preferred Habitat | Extent of Habitat in the Study Area and Region | Expected Likelihood of Occurrence |
|---|---|---|---|---|
| **Birds** | | | | |
| Australian Bustard (*Ardeotis australis*) | IUCN: Near Threatened<br>DEC: Priority 4 | Found in grasslands, especially tussock grassland, *Triodia* hummock grassland, grassy woodland, low shrublands, Spinifex, open dry woodland of mulga, mallee, heath (Pizzey and Knight 1997; Morcombe 2003). | Small amounts of this habitat occur within the samphire habitat. Grassland habitat is extensive within the pasture area. | **Moderate**<br>One individual Australian Bustard was observed during the survey. |
| Australasian Gannet (*Morus serrator*) | EPBC: Migratory marine | This species inhabits oceans and bays (Simpson & Day 1996) | This habitat does not occur with the study area. | **Low** |
| Baudin's Cockatoo (*Calyptorhynchus baudinii)* | IUCN: Endangered<br>WCA: Schedule 1 | Inhabits forests, woodlands, pine plantations and orchids. Occasionally recorded in farmland, and grassland (Pizzey & Knight 1997; SEWPaC 2011b). | No forests occur within the study area. However they may make use of the Woodland or farmland for foraging. No nesting habitat is present | **Low**<br>The project area is in the northern extent of the species range. |
| Black-tailed Godwit (*Limosa limosa*) | IUCN: Near Threatened<br>WCA: Schedule 3<br>EPBC: Migratory marine | Inhabits tidal mudflats, estuaries, sandspits, shallow river margins, sewage ponds and inland on large shallow fresh or brackish waters (Pizzey and Knight 1997). | This habitat does not occur with the study area. | **Low** |
| Brown Goshawk *(Accipiter fasciatus)* | EPBC: Migratory marine | Occurs in open forests, woodlands, scrublands and margins, farmlands, parks, and sewage farms (Pizzey and Knight 1997). | Woodland, Scrublands and farming land occurs within the project area. | **Moderate** |
| Buff-banded Rail *(Gallirallus philippensis)* | EPBC: Endangered | Occurs in fringes of rainforest, swamps, marshes, creeks, wet paddocks, scrubby woodlands, heathland and crops (Pizzey and Knight 1997). | The Project area does not contain any suitable swamp habitat. However there is suitable woodland heathland and crop. | **Low** |
| Cattle Egret *(Ardea ibis*) | EPBC: Migratory marine.<br>Migratory wetland | Inhabits paddocks, pastures, croplands, wetlands, tidal mudflats and drains (Pizzey & Knight 1997). Occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands (SEWPaC 2011b). | The Project area does not contain a significant amount of suitable wetland habitat. This may occur with the pasture habitat to the north | **Moderate** |

| Species | Conservation Status | Preferred Habitat | Extent of Habitat in the Study Area and Region | Expected Likelihood of Occurrence |
|---|---|---|---|---|
| Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) | IUCN: Endangered<br>WCA: Schedule 1<br>EPBC: Vulnerable | Forests, woodlands, heathlands, farms. It feeds on banksias, hakeas, dryandras (often on ground) and also exploits pine plantations (Morcombe 2003). | No forests occur within the study area. However they may make use of the Woodland or farmland for foraging. No nesting habitat is present. | **Moderate**<br>May visit Project area sporadically. |
| Fork-tailed Swift (*Apus pacificus*) | EPBC: Migratory marine | The Fork-tailed Swift makes use of low to very high airspace over varied habitat, rainforest to semi-desert; most active just ahead of summer storm fronts (Morcombe 2003). | Due to the species broad habitat preference it is possible the project area contains suitable habitat for the species. | **Moderate** |
| Glossy Ibis *(Plegadis falcinellus)* | WCA: Schedule 3<br>EPBC: Migratory marine | Occurs in well vegetated wetlands, wet pastures, rice fields, floodwaters, floodplains, brackish wetlands, mangroves and mudflats (Pizzey and Knight 1997). | The project area does not contain suitable wetlands. | **Low** |
| Great Egret, White Egret (*Ardea alba*) | EPBC: Migratory marine.<br>Migratory wetland | Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997). | The project area contains few suitable permanent wetlands. | **Low** |
| Hooded Plover *(Thinornis rubricollis)* | IUCN: Near Threatened<br>EPBC: Migratory marine | Occurs on broad sandy ocean beaches, adjacent dune wilderness, tidal flats, and coastal and inland salt lakes (Pizzey and Knight 1997). | The Project area does not contain any beaches, tidal flats or Inland salt lakes. | **Low** |
| Malleefowl *(Leipoa ocellata)* | IUCN: Vulnerable<br>WCA: Schedule 1<br>EPBC: Vulnerable | Malleefowl occur within mallee, *Acacia*, paperbark, sheoak, and other scrubs; eucalypt woodland; coastal heaths; mostly on sand or gravel soils with abundant litter and low scrub (Pizzey and Knight 1997; Morcombe 2003). | The Project area does contain coastal heaths with sandy soils. However it contain very little of the species preferred habitat of Mallee, *Acacia* or Eucalypt. | **Low** |
| Nankeen Night-Heron *(Nycticorax caledonicus)* | EPBC: Migratory marine | Inhabits the shallow margins of rivers, wetlands, mangrove-lined estuaries and floodwaters (Pizzey and Knight 1997). | The Project are contains little suitable wetland habitat. | **Low** |
| Painted Button-quail *(Turnix varius)* | EPBC: Vulnerable | Occurs in scrublands, open woodlands, heathlands, farm regrowth and mallee woodlands (Pizzey and Knight 1997). | The project area contains suitable heathlands and open Banksia woodlands. | **Moderate**<br>May occur in Project area. |

| Species | Conservation Status | Preferred Habitat | Extent of Habitat in the Study Area and Region | Expected Likelihood of Occurrence |
|---|---|---|---|---|
| Peregrine Falcon (*Falco peregrinus*) | WCA: Schedule 4 | Rocky ledges, cliffs, watercourses, open woodland or margins with cleared land (Pizzey and Knight 1997). | The Project area contains patches of suitable foraging habitat. However it does not contain suitable nesting habitat such as rocky ledges, cliffs or large hollows. | **Low** May visit Project area sporadically for foraging. |
| Rainbow Bee-eater (*Merops ornatus*) | EPBC: Migratory JAMBA | Occurs in open forests and woodlands, shrublands, sandridges, sandspits, riverbanks, mangroves and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). | The species has a broad habitat preference. The Project area contains suitable foraging habitat for the species. However it does not contain the preferred open woodland with riverbanks required for nesting. | **Moderate** One Rainbow bee-eater was observed during the survey |
| Red-tailed Black-Cockatoo *(Calyptorhynchus banksii)* | WCA: Schedule 1 EPBC: Vulnerable | Inhabits tall open forests, woodlands, grasslands, scrublands, floodplains, river margins, wetlands and river red gums on water courses (Pizzey and Knight 1997). | No forests occur within the study area. However they may make use of the Woodland or farmland for foraging. No nesting habitat is present. | **Moderate** May visit project area sporadically. |
| Spotless Crake *(Porzana tabuensis)* | EPBC: Migratory marine | Occurs in well vegetated freshwater wetlands, reeds, saltmarsh and mangroves (Pizzey and Knight 1997). | The Project area contains few permanent wetlands | **Low** |
| Stubble Quail (Coturnix pectoralis) | EPBC: Migratory marine | Inhabits overgrown pastures and grasslands, saltbush, bluebush, Spinifex, weedy margins of wetlands, irrigation channels and roadsides (Pizzey and Knight 1997). | The Project area contains little suitable habitat for the species. | **Low** |
| Western Corella (*Cacatua pastinator)* | EPBS: Vulnerable, Migratory marine | Inhabits sheep farming country with remnant native forest, woodland, scrubland and sand plain heath (Pizzey and Knight 1997). | The Project area contains woodland, scrubland and sandplain heath. The Project area does not contain any suitable nesting habitat due to the lack of hollows or cropping habitat for foraging. | **Moderate** May visit project area sporadically. |
| Western Rosella *(Platycercus icterotis)* | WCA: Schedule 1 | Inhabits open forest, woodland with grassy clearings, trees on watercourses, farmlands, crops and roadsides (Pizzey and Knight 1997). | The Project area does not contain any grassy clearings or crops. It contains a limited amount of suitable habitat. | **Low** |
| Whistling Kite (*Haliastur sphenurus*) | EPBC: Migratory marine | Occurs in open forests and foothills, timbered watercourses, lakes, swamps, tidal inlets, estuaries and mudflats (Pizzey and Knight 1997). | The Project area does not contain suitable habitat for the species. | **Low** |
| White-bellied Sea-Eagle (*Haliaeetus leucogaster*) | EPBC: Migratory terrestrial | This species occurs mainly around coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs (Pizzey and Knight 1997). This species is also found around terrestrial wetlands in tropical and temperate | The Project area does not contain any suitable habitat for the species. | **Low** |

| Species | Conservation Status | Preferred Habitat | Extent of Habitat in the Study Area and Region | Expected Likelihood of Occurrence |
|---|---|---|---|---|
| | | regions (SWEPAC 2011b). | | |
| Wood Sandpiper (*Tringa glareola*) | WCA: Schedule 3<br>EPBC: Migratory marine | Occurs in muddy margins of wetlands, tidal mangroves, margins of tidal mudflats, saltmarshes and sewage ponds (Pizzey and Knight 1997). | The Project area does not contain any suitable habitat for the species. | Low |
| **Mammals** | | | | |
| Chuditch, Western Quoll (*Dasyurus geoffroii*) | IUCN: Near Threatened<br>EPBC: Vulnerable | This species is able to exist in a variety of environments from denser eucalypt forests and open woodlands to sparser, semi-arid and low-lying scrub (Van Dyck & Strahan 2008). The only remaining habitat suitable for supporting Chuditch numbers is through the cooler south-west corner of the state, in areas with significant concentrations of prey and sufficient logs and hollows for nests (Van Dyck & Strahan 2008). | The Project area contains little suitable habitat, with low numbers of suitable hollows within the Banksia woodland. The species may have previously occurred in the area. However high fox numbers is likely to have eliminated the species from the Project area. | Low |
| Brush-tailed Bettong, Woylie (*Bettongia penicillata subsp. ogilbyi*) | IUCN: Critically Endangered<br>WCA: Schedule 1<br>EPBC: Endangered | This species is restricted to remnant patches of habitat in the south-west of WA. Its main habitats are dry sclerophyll forest with dense understorey (Menkhorst & Knight 2004). This species makes use of dense undergrowth including *Gastrolobium* thickets, logs and rock-cavities for shelter during the day (SEWPaC 2011b). | The Project area contains some habitat that may be suitable for Woylie. However with the Woylies recent dramatic decline and high fox abundance within the site it is very unlikely the species occurs within the Project area. | Low |
| Southern Brown Bandicoot (*Isoodon obesulus subsp. fusciventer*) | DEC: Priority 5 | Southern Brown Bandicoots inhabit heathy forest, heath, and coastal scrub (Menkhorst & Knight 2004). The southern brown bandicoot often feeds in forest and woodland that is burnt on a regular basis and also in areas of pasture and cropland adjacent to dense cover. | There is suitable heath area within the Project area. However without a regular feral predator control program this species is unlikely to occur within the Project area | Low |
| Tammar (*Macropus eugenii subsp. derbianus*) | DEC: Priority 5 | This species inhabits dense coastal heath and scrub, sometimes inhabiting dry sclerophyll forest with dense cover (Menkhorst & Knight 2004). This species makes use of dense, low vegetation for shelter during the day and open grassy areas for feeding. | There is suitable vegetation within the project area. However without a regular feral predator control program this species is unlikely to occur within the Project area. | Low |
| Western Brush Wallaby (*Macropus irma*) | DEC: Priority 4 | This species inhabits dry sclerophyll forest and woodland in the south-west of Western Australia, including some mallee areas (Menkhorst & Knight 2004). The preferred | The southern third of the Project area contains extensive areas of suitable Banksia woodland. However high fox | Moderate<br>This species was sighted on two |

| Species | Conservation Status | Preferred Habitat | Extent of Habitat in the Study Area and Region | Expected Likelihood of Occurrence |
|---|---|---|---|---|
| | | habitat type for this species is open forest or woodland. | activity in the area it is likely to suppress the population within the area is low due to predation. | occasions during the survey. |
| **Reptiles** | | | | |
| Carpet Python (*Morelia spilota subsp. imbricate*) | WCA: Schedule 4 | This carpet python is found in temperate areas in the south-west of Western Australia. It inhabits semi-arid coastal and inland *Banksia* woodland, eucalypt woodland and grasslands. | The bottom third of the Project are contains extensive areas of suitable Banksia woodland. | **Moderate** This species may occur within the Project area. |

### 5.2.2 Recorded Significant Fauna

Australian Bustard *(Ardeotis australis)*

*Priority 4 with the DEC*

*Near Threatened with the EPBC Act*

The Australian Bustard is a large nomadic bird inhabiting grasslands, grassy woodlands, open inland plains and open scrubland throughout much of Australia (Pizzey & Knight 1997) (Morcombe 2003). Resting unseen in tall grass during the day and moving out to feed at night, the Bustard feeds on invertebrates, small vertebrates and seeds, often favouring recently burnt areas where grasshoppers or house mice are abundant (Pizzey & Knight, 1997).

Breeding occurs from March to August, with eggs laid on bare ground in clutches of one to three (Johnstone & Storr 1998). Formerly widespread, its presence has declined in the south-western part of Western Australia, and its abundance varies both locally and seasonally (Johnstone & Storr 1998). The species has been listed as a Priority 4 species by the DEC and as near threatened on the IUCN red list.

One individual Australian Bustard was observed within the Project area during the survey (Figure 10). This was an opportunistic sighting of a male made near survey site CERC. The sighting was within the open samphire fauna habitat. The species has a nomadic nature, and the samphire fauna habitat extends extensively to the east outside the Project area. Therefore it is considered that clearing associated with the Atlas Tenement Project is unlikely to significantly impact the species.

Rainbow Bee-eater *(Merops ornatus)*

*Listed Migratory Species* JAMBA under the *EPBC Act*

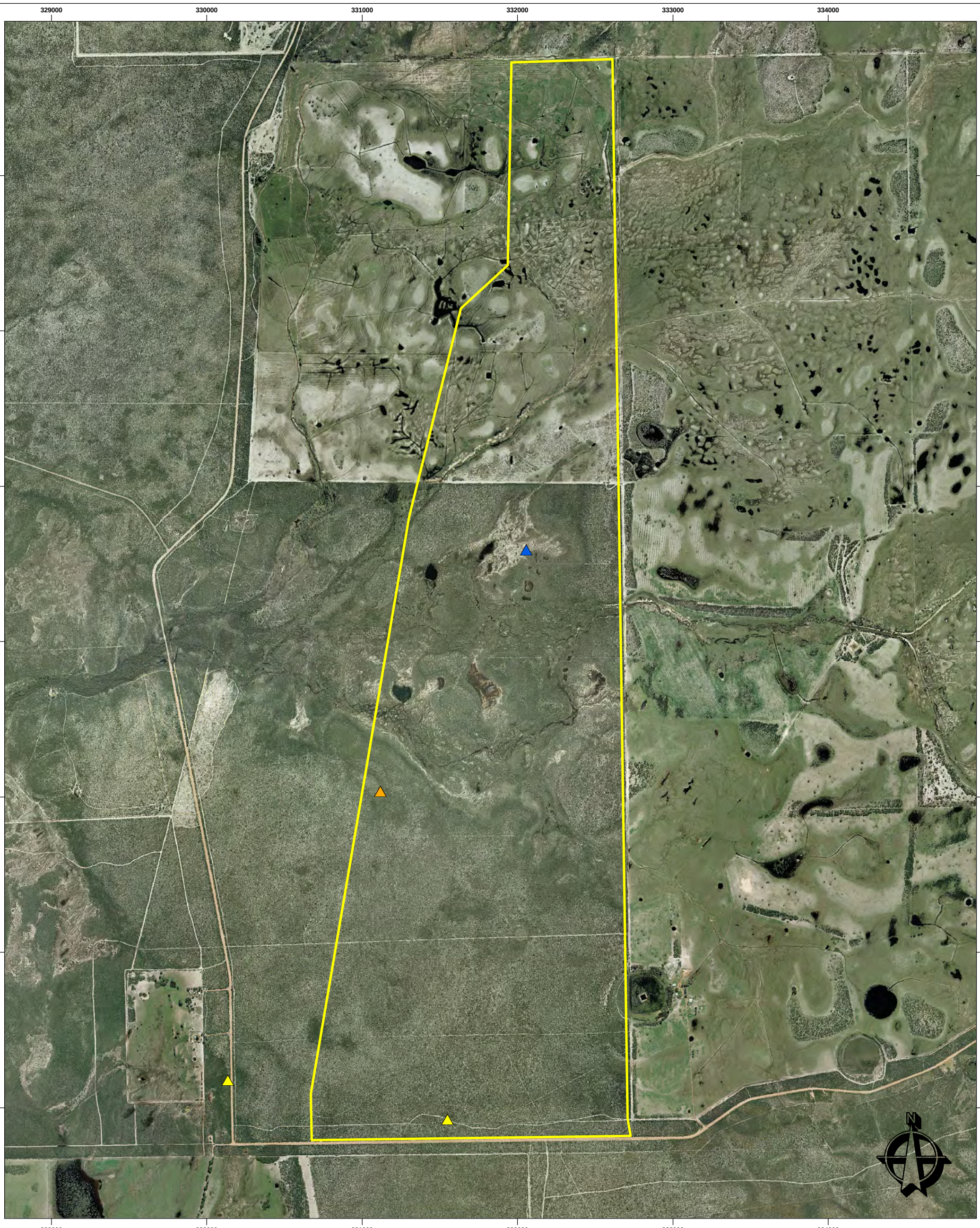
The Rainbow Bee-eater favours open forests and woodlands, shrublands, and cleared or semi-cleared habitats (Higgins 1999). In Australia, the breeding season extends from August to January (Boland 2004; Higgins 1999). The nest is located in an enlarged chamber at the end of long burrow or tunnel that is excavated (Comrie-Smith 1930; Fry 1984; Morris 1977) in flat or sloping sand (Boland 2004; Forshaw & Cooper 1987; Fry 1984; Higgins 1999; Lill 1993). Nests of the Rainbow Bee-eater are presumably susceptible to predation, flooding and trampling because they are located on the ground and in river banks (SEWPaC 2011b). One Rainbow Bee-eater was recorded at a single Survey Location (CERF) (Figure 10).

As a result of its wide distribution and ability to utilise a variety of habitats, it is considered that clearing associated within the Atlas Tenement is unlikely to significantly impact the species.

### Western Brush Wallaby *(Macropus irma)*
***Priority 4 with the DEC***

This species inhabits dry, open sclerophyll forest and woodland in the south-west of Western Australia (Menkhorst & Knight 2004).

Two individual Western Brush Wallabies were observed during the survey (Figure 10). One was observed within the tenement and the other was observed outside the tenement area to the west crossing Munbinea Road. Both sightings were observed within the Banksia woodland habitat. This habitat is extensive in the local area, comprising the southern half of the tenement and within the bushland remnant to the west and south of the Atlas Tenement. Brush wallabies are likely to be resident throughout the remnant bushland outside the Atlas Tenement and throughout the DEC Nambung National Park to the west.






**Legend**

- Site Boundary

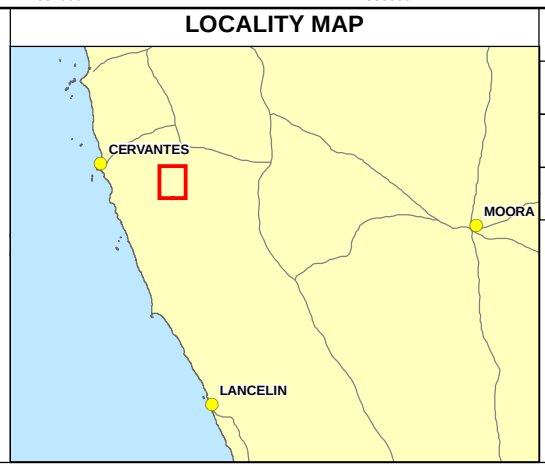
**Conservation Significant Fauna**

**Species Name**

- Australian Bustard
- Rainbow Bee-eater
- Western Brush Wallaby

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL IMAGERY SOURCED FROM GOOGLE EARTH 2011
- LOCALITY MAP SOURCED FROM LANDGATE 2006

**LOCALITY MAP**




1:23,000 @ A3

0 125 250 500 750 1,000 Meters

| DRAWING ID | DATE |
|---|---|
| EBS133_1.10 | 19/01/2012 |

**HORIZONTAL DATUM AND PROJECTION**

GDA 1994 MGA Zone 50

| CREATED | CHECKED | APPROVED | REVISION |
|---|---|---|---|
| TD | AH | AH | 0 |

**Image Resources Pty. Ltd.**
**Atlas Mineral Sands Mine Site**
**Cervantes**

**Level 2 Vertebrate Fauna Survey**
**Conservation Significant Fauna**
**Figure 10**

K:\Projects\1.0 EBS\EBS133 Cervantes L2 Flora L2 Fauna\Figures\Fauna

# 6 Conclusion and Recommendations

## 6.1 Discussion

The broad fauna habitat types identified during the reconnaissance survey are well represented within the local and regional area. On a local scale extensive areas of Banksia woodland continue outside the project area to the west and south within the private remnant bushland. This is also true for the Samphire flats, which occur extensively to the north and east in association with salt lakes. Melaleuca habitats are known to fringe Samphire shrublands and are therefore also likely to be extensive throughout the wider area. Both heath shrublands and Banksia woodland areas characterise large portions of the Swan Coastal Plain, particularly in the north. Pasture habitat is well represented within the surrounding area to the north-east and is, in any case, of limited values to the majority of native fauna species.

During the survey no unique fauna habitats were located within the Project area and all the habitats appear to be well represented within the surrounding remnant bushland. On a regional scale, extensive areas of remnant bushland on private land and in conservation reserves surrounding the Project area. Less than a kilometre from the Project area is the eastern edge of the Nambung National Park. This is a large extensive National Park positioned on the coastline with an area >17,000 hectares. It is likely that any flora or fauna species within the Project area are well represented within the National Park. Additionally, Beekeepers Reserve and Mount Leseur National Park to the north and Badgingarra Conservation Reserve to the northeast represent extensive areas of habitat that is similar in nature to that found in the 957 hectare Atlas Tenement.

A total of three species of conservation significance were recorded within the Project area during the survey. These are listed under State and/or Commonwealth legislation and included an individual Australian Bustard, individual Rainbow Bee-eater and two Western Brush Wallabies. All species have a wide distribution in the area and the ability to utilise a wide variety of habitats. Additionally, several vertebrate fauna species of conservation significance where ranked as a moderately likely to occur within the Project area. However, these likely occur in naturally low abundance, only rarely recorded, or migratory as they were not observed during Phase 1 of the survey.

Clearing of native vegetation for the proposed development within the project area is considered likely to directly impact only individual animals within the clearing footprint and efforts should be made to minimise the amount of habitat that is cleared. However due to the fauna habitat within the project area being well represented by comparable habitats within the surrounding remnant bushland and conservation estate it is unlikely that the proposed works will adversely impact on the conservation status of any significant fauna species.

## 6.2 Recommendations

The following recommendations arise from the Fauna Survey of the Atlas Tenement:

- Based on the tenement layout provided, IMA should maximise the use of existing cleared and disturbed habitat to the north. This should include utilising the cleared areas associated with the previous agricultural use for any additional laydown requirements, storage of equipment or any other ancillary use. If it is possible to put infrastructure in already cleared or disturbed areas then this should be considered rather than clearing new areas of remnant undisturbed vegetation;
- Any clearing of native vegetation should be minimised when possible. This includes minimising the creation of new roads within the tenement. If it is necessary to drive off road, all vehicles should aim to limit damage to shrubs and understorey vegetation;
- Consider the implementation of a feral management plan to minimise the impact of invasive species occurring within the Project area;
- All members of the work force on site should be provided with an environmental induction to ensure that they are made aware of any Schedule and Priority fauna occurring in the area. This should include driving speed restrictions and ensuring that off-road driving is minimised, in addition to fire risk minimisation and clearing limit controls.
- It is recommended that IMA conducts a Graceful Sun Moth survey in March 2012 as the species is listed as conservation significant and likely to occur in the area. The Project area is in the species distribution and contains suitable *Banksia* Habitat with *Lomandra* species within the understorey.
- It is recommended that a seasonal survey phase be completed in autumn 2012 as outlined by the EPA. Guidance Statement 56 states that a seasonal survey should be conducted to meet the requirements of a Level 2 Fauna Survey.

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# 8 Report Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of environmental aspects discussed in this report other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

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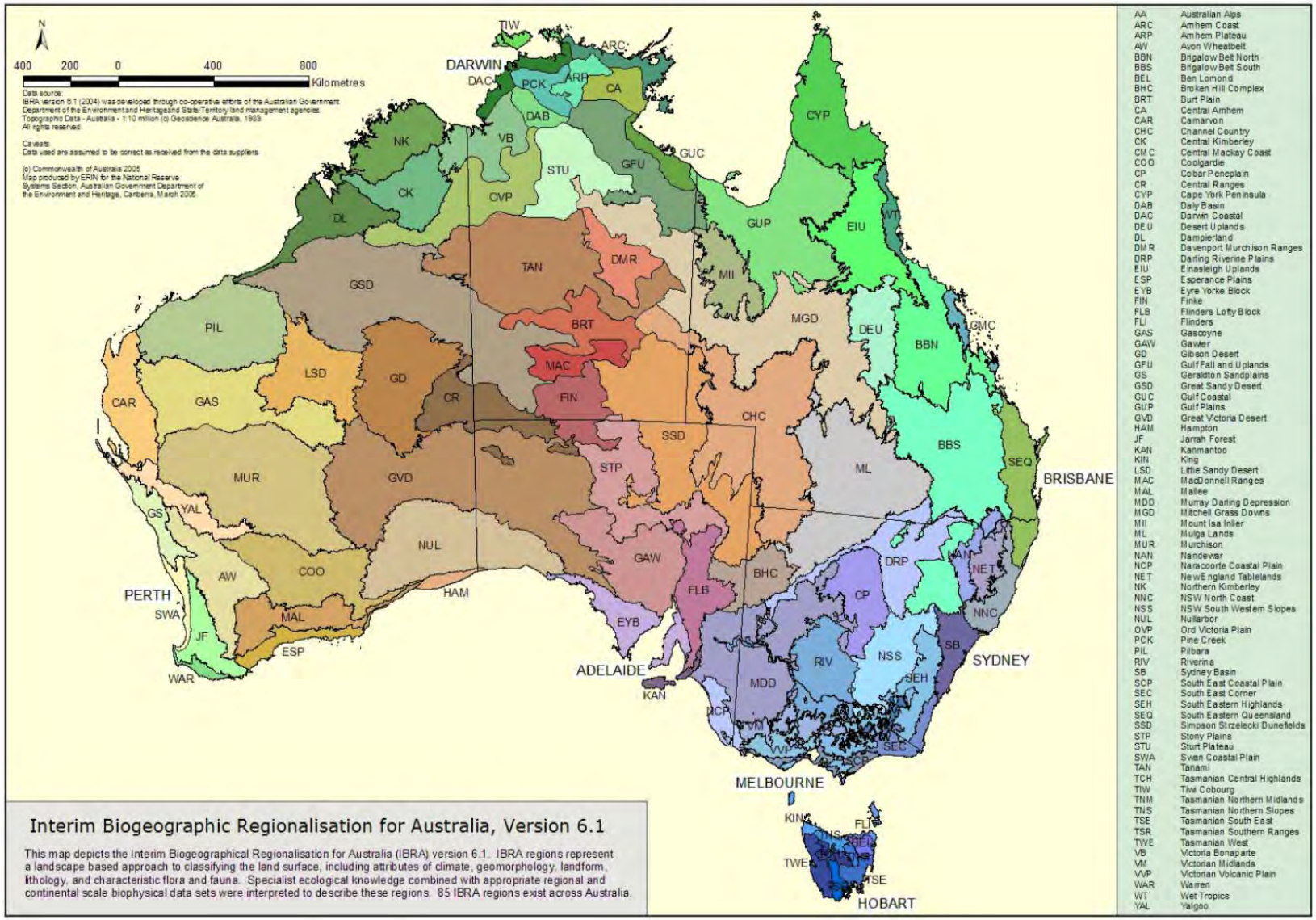
# APPENDIX A: IBRA MAP

Figure 11: IBRA Bioregions



# APPENDIX B: DEC LICENSE

## DEPARTMENT OF ENVIRONMENT AND CONSERVATION

Enquiries: 17 DICK PERRY AVE, KENSINGTON, WESTERN AUSTRALIA
Telephone: 08 9334 0333
Facsimile: 08 9334 0242

Correspondence: **Locked Bag 30**
**Bentley Delivery Centre WA 6983**




**NO.** SF008326
**PERSON NO.** 151067

| RECEIPT NO. | AMOUNT |
|---|---|
| | $0.00 |

**WILDLIFE CONSERVATION ACT 1950**
**REGULATION 17**

# LICENCE TO TAKE FAUNA FOR SCIENTIFIC PURPOSES

**THE UNDERMENTIONED PERSON MAY TAKE FAUNA FOR RESEARCH OR OTHER SCIENTIFIC PURPOSES AND WHERE AUTHORISED, KEEP IT IN CAPTIVITY, SUBJECT TO THE FOLLOWING AND ATTACHED CONDITIONS, WHICH MAY BE ADDED TO, SUSPENDED OR OTHERWISE VARIED AS CONSIDERED FIT.**

**DIRECTOR GENERAL**

## CONDITIONS

1 THE LICENSEE SHALL COMPLY WITH THE PROVISIONS OF THE WILDLIFE CONSERVATION ACT AND REGULATIONS AND ANY NOTICES IN FORCE UNDER THIS ACT AND REGULATIONS.

2 UNLESS SPECIFICALLY AUTHORISED IN THE CONDITIONS OF THIS LICENCE OR OTHERWISE IN WRITING BY THE DIRECTOR GENERAL, SPECIES OF FAUNA DECLARED AS LIKELY TO BECOME EXTINCT, RARE OR OTHERWISE IN NEED OF SPECIAL PROTECTION SHALL NOT BE CAPTURED OR OTHERWISE TAKEN.

3 NO FAUNA SHALL BE TAKEN FROM ANY NATURE RESERVE, WILDLIFE SANCTUARY, NATIONAL PARK, MARINE PARK, TIMBER RESERVE OR STATE FOREST WITHOUT PRIOR WRITTEN APPROVAL OF THE DIRECTOR GENERAL. NO FAUNA SHALL BE TAKEN FROM ANY OTHER PUBLIC LAND WITHOUT THE WRITTEN APPROVAL OF THE GOVERNMENT AUTHORITY MANAGING THAT LAND.

4 NO ENTRY OR COLLECTION OF FAUNA TO BE UNDERTAKEN ON ANY PRIVATE PROPERTY OR PASTORAL LEASE WITHOUT THE CONSENT IN WRITING OF THE OWNER OR OCCUPIER, OR FROM ANY ABORIGINAL RESERVE WITHOUT THE WRITTEN APPROVAL OF THE DEPARTMENT OF INDIGENOUS AFFAIRS.

5 NO FAUNA OR THEIR PROGENY SHALL BE RELEASED IN ANY AREA WHERE IT DOES NOT NATURALLY OCCUR, NOR BE HANDED OVER TO ANY OTHER PERSON OR AUTHORITY UNLESS APPROVED BY THE DIRECTOR GENERAL, NOR SHALL THE REMAINS OF SUCH FAUNA BE DISPOSED OF IN SUCH MANNER AS TO CONFUSE THE NATURAL OR PRESENT DAY DISTRIBUTION OF THE SPECIES.

6 THIS LICENCE AND THE WRITTEN PERMISSION REFERRED TO AT CONDITIONS 3 & 4 MUST BE CARRIED BY THE LICENSEE OR AUTHORISED AGENT AT ALL TIMES FOR THE PURPOSE OF PROVING THEIR AUTHORITY TO TAKE FAUNA WHEN QUESTIONED AS TO THEIR RIGHT TO DO SO BY A WILDLIFE OFFICER, ANY OTHER STATE OR LOCAL GOVERNMENT EMPLOYEE OR ANY MEMBER OF THE PUBLIC.

7 **********ANY INTERACTION INVOLVING GAZETTED THREATENED FAUNA THAT MAY BE HARMFUL AND/OR INVASIVE MAY REQUIRE APPROVAL FROM THE COMMONWEALTH DEPT OF THE ENVIRONMENT AND WATER RESOURCES, PHONE 02 6274 1900. INTERACTION WITH SUCH SPECIES IS CONTROLLED BY THE COMMONWEALTH GOVERNMENT'S "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999" & "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION REGULATIONS 2000" AS WELL AS DEC'S WILDLIFE CONSERVATION ACT & REGULATIONS.**********

8 NO BIOPROSPECTING INVOLVING THE REMOVAL OF SAMPLE AQUATIC AND TERRESTRIAL ORGANISMS (BOTH FLORA AND FAUNA) FOR CHEMICAL EXTRACTION AND BIOACTIVITY SCREENING IS PERMITTED TO BE CONDUCTED WITHOUT SPECIFIC WRITTEN APPROVAL BY THE DIRECTOR GENERAL OF DEC.

9 FURTHER CONDITIONS (NUMBERED 1 TO 9) ARE ATTACHED.

**PURPOSE** LEVEL 2 FAUNA SURVEY 20KM EAST OF CERVANTES. FAUNA SAMPLING WILL BE VIA CAGE, ELLIOTT, DRY PITFALL AND FUNNEL TRAPS. FAUNA SPECIES WILL BE IDENTIFIED AND RELEASED IMMEDIATELY AT POINT OF CAPTURE.

**AUTHORISED PERSONS** DR PHIL RUNHAM
FELICITY DONALDSON

# DEPARTMENT OF ENVIRONMENT AND CONSERVATION

Enquiries: 17 DICK PERRY AVE, KENSINGTON, WESTERN AUSTRALIA
Telephone: 08 9334 0333
Facsimile: 08 9334 0242

Correspondence: **Locked Bag 30**
**Bentley Delivery Centre WA 6983**


**NO.** SF008326
**PERSON NO.** 151067

**DATE OF ISSUE** 15/11/2011
**VALID FROM** 15/11/2011
**DATE OF EXPIRY** 24/11/2011

**LICENSING OFFICER**

(ANDREW DOUGLAS)

**LICENSEE:** MR A HIDE
**ADDRESS** 360 ENVIRONMENTAL PTY LTD
PO BOX 14
WEST PERTH WA 6872

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# WILDLIFE CONSERVATION REGULATIONS 1970

## Regulation 17:- Licence to Take Fauna for Scientific Purposes

FURTHER CONDITIONS (OF LICENCE NUMBER SF 8326)

1. The licensee shall take fauna only in the manner stated on the endorsed Regulation 17 licence application form and endorsed related correspondence.

2. Except in the case of approved lethal traps, the licensee shall ensure that measures are taken in the capture and handling of fauna to prevent injury or mortality resulting from that capture or handling. Where traps or other mechanical means or devices are used to capture fauna these shall be deployed so as to prevent exposure of trapped animals to ants and debilitating weather conditions and inspected at regular intervals throughout each day of their use. At the conclusion of research all markers etc and signs erected by the licensee and all traps shall be removed, all pitfalls shall be refilled or capped and the study area returned to the condition it was in prior to the research/capture program. During any break in research, cage traps should be removed and pitfalls either removed, capped or filled with sand.

3. No collecting is to be undertaken in areas where it would impinge on pre-existing scientific research programs.

4. Any form of colour marking of birds or bats shall only be undertaken in accordance with the requirements of the Australian Bird and Bat Banding Scheme.

5. Any inadvertently captured specimen of fauna which is declared as likely to become extinct, rare or otherwise in need of special protection is to be released immediately at the point of capture. Where such a specimen is injured or deceased, the licensee shall contact Department of Environment and Conservation licensing staff at Kensington (08 9423 2434) for advice on disposal. Records are to be kept of any fauna so captured and details included in the report required under further condition 6 below.

6. Within one month of the expiration of this licence, the holder shall submit an electronic return detailing the locality, site, geocode, date and number of each species captured, sighted or vouchered during the currency of the licence, into the Department of Environment and Conservation Fauna Survey Database (DECFSD). A copy of any paper, report or thesis resulting from the research shall on completion be lodged with the Director General. If a renewal of this licence is required, the licensee shall submit a written progress report for activities undertaken during this licence period prior to the expiry of this licence.

7. Not more than ten specimens of any one protected species shall be taken and removed from any location less than 20km apart. Where exceptional circumstances make it necessary to take large series in order to obtain adequate statistical data the collector will proceed with circumspection and justify their actions to the Director General in advance.

8. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence shall be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected which represents a significant extension of geographic range shall be donated on request to the Western Australian Museum.

9. To prevent any unnecessary collecting in this State, all specimens and material collected under the authority of this license shall, on request, be loaned to the Western Australian Museum. Also, the unused portion or portions of any specimen collected under the authority of this license shall be offered for donation to the Western Australian Museum or made available to other scientific workers if so required.

# APPENDIX C: BAT ECHOLOCATION SURVEY

# Cervantes Project, WA,
# Fauna Survey,
# November 2011

# Echolocation Survey of Bat Activity.

Prepared for 360 Environmental

Bat Call WA Pty Ltd
ABN 26 146 117 839
43 Murray Drive
Hillarys Western Australia 6025
bullen2@bigpond.com
+61 8 9402 1987
+61 488 930 735

Prepared by:
R. D. Bullen – Bat Call WA
Issue 1
6 January 2012

## Document Revision History

| Date | Issue | Revision History |
|---|---|---|
| 15 Dec 2011 | Issue A | Initial draft issue prepared for client |
| 6 Jan 2012 | Issue 1 | Issue 1 incorporating client review comments |

## Summary

Chiroptera species presence, with an estimate of activity level, is presented for five sites at the Cervantes project, approximately 10 km east of the town of Cervantes, WA. 360 Environmental (360E) carried out an echolocation based survey during November of 2011. Bat Call WA has reviewed the recordings made and provided species lists for the bats present.

Six species of insectivorous microbats were recorded.

## Habitats

Sites for the Chiroptera survey were chosen by 360E. The survey was carried out over six recording nights in Nov 2011. Details of the sites are presented in Table 1. The general locations of the sites are shown in relation to the local features in Figure 1.

Habitats sampled include open samphire, open heathland, two woodland sites and a dam on an open pasture.


**Figure 1. Detector Sites in relation to features in the study area**

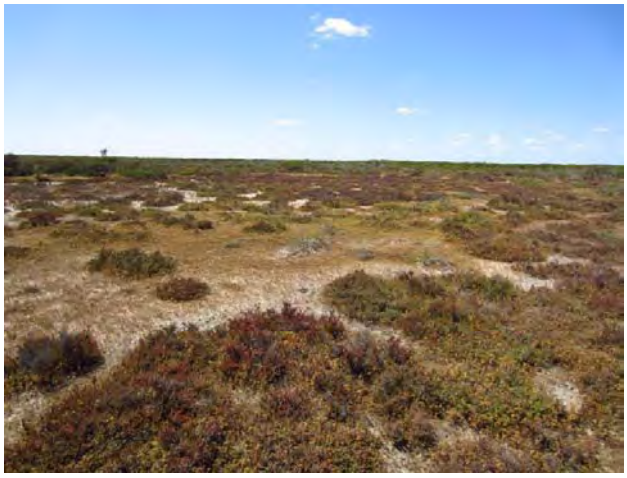

**Plate 1: Survey Location CERC – Samphire habitat**

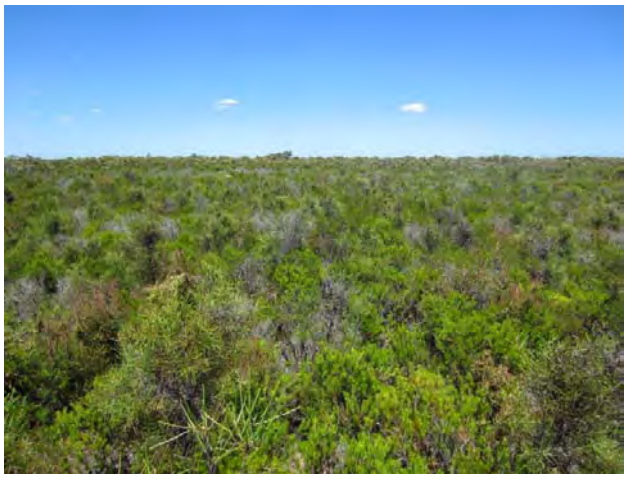

**Plate 2: Survey Location CERF – Heath habitat**

**Plate 3: Survey Location CERG – *Banksia* woodland with *Eucalypt* overstorey habitat**

**Plate 4: Survey Location CERH – *Melaleuca* shrubland with *Eucalypt* overstorey habitat**

**Plate 5: Survey Location CERI – Disturbed pasture and paddock dam habitat**

## Bat Fauna

A microbat assemblage of six insectivorous species was confirmed as present at the study sites in November. Characteristics of the calls recorded are presented in Table 2. Each of these species is common in the region. No priority species of insectivorous bat was detected

Species activity levels were generally low overall (Table 3); except for *V. regulus* that had a high activity level, which is expected for the study area habitats and the time of year, see criteria below.

## Survey Timing, Moon Phase and Weather

The echolocation survey was conducted between 17$^{th}$ and 22$^{nd}$ November 2011. Sampling evenings were fine and cool with minimum overnight temperatures between 10 and 15$^{O}$C. The moon in this period was between last quarter and full. These conditions correspond to normal levels of bat echolocation activity for the season.

## Survey Team

A team of 360E ecologists conducted the bat sampling work. Bob Bullen of Bat Call WA completed analysis of echolocation recordings.

## Systematic Sampling

The survey consisted of completing six overnight bat sound recordings, beginning at twilight, at locations within the survey area. The recordings were “continuous” (Hyder *et al.* 2010) made using an Anabat II detector in conjunction with a digital recorder (LS11 series, Olympus Japan). Table 2 provides details of the methods used by date and site.

For the recordings, once reformatted as .wav files, COOL EDIT 2000 (Now available as AUDITION from Adobe Systems Inc.) was used to display each sequence for identification. Calls were identified manually. Only good quality call sequences were used. Details of calls analysed are provided in Table 2 as recommended by Australasian Bat Society (ABS 2006). Reference data for the species identified are available in Bullen and McKenzie 2002, McKenzie and Bullen 2003 and McKenzie and Bullen 2009.

Bat activity was then characterised as “Low”, “Medium” or “High” based on the rate of call sequences recorded.

- Low species activity is referred when a species is recorded with call spacing less often than ten minutes,
- Medium species activity refers to call recordings more often than 10 minutes but less often than two minutes apart for a significant time period followed by sporadic records for the remainder of the session.
- High species activity refers to call recording more often than two minutes apart for significant periods followed by reasonably regular records for the remainder of the session.

Further details of the calls analysed including graphical presentations are available from Bat Call WA on request.

**Survey Limitations**

The sites surveyed were accessible on foot and the Anabat, was set on the ground with the microphone vertical. Species are unlikely to be under-represented as a result.

Bat species density is impossible to estimate from echolocation records. Bat activity is therefore substituted as an approximate guide to the relative numbers of each species using the study area.

## References

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## Table 1 Site Specific details.

| Site | Recording Time | Habitat | Easting Note 1 | Northing Note 1 |
|---|---|---|---|---|
| CERC | One overnight recording | Samphire lake | 331582 | 6620558 |
| CERF | One overnight recording | Heath | 331116 | 6619036 |
| CERG | One overnight recording | *Banksia* woodland with *Eucalypt* overstorey | 331726 | 6618065 |
| CERH | Two overnight recordings | *Melaleuca* shrubland with *Eucalypt* overstorey | 332613 | 6617698 |
| CERI | One overnight recording | Paddock Dam | 330329 | 6623055 |

Note 1: Coordinates are GDA94 Zone 50K

## Table 2: Summary of Echolocation call characteristics for microbat species present.

| Genus species Authority | Common name | Typical $F_{peakC}$ kHz | Ave. $Q$ | Typical Duration msec | Typical Call Shape |
|---|---|---|---|---|---|
| *Chalinolobus gouldii* (Grey 1841) | Gould's wattled bat | 32 | 10 | 7 - 11 | FM |
| *Chalinolobus morio* (Grey 1841) | Chocolate wattled bat | 50 | 10 | 7 | FM |
| *Mormopterus species 4* (form sp. 4, population O in Adams et al. 1988) | South-western free-tailed bat | 25 | 10 | 7 - 14 | Shallow FM |
| *Nyctophilus geoffroyi* Leach 1821 | Lesser long-eared bat | 47 | 2.5 | 5 | Steep FM |
| *Tadarida australis* (Grey 1838) | White-striped free-tailed bat | 11 | 7 | 12 - 23 | CF– shallow FM |
| *Vespadelus regulus* (Thomas 1906) | Southern forest bat | 43 | 10 | 4 - 10 | FM |

Note: FpeakC and Q are defined in McKenzie and Bullen 2003, 2009.

**Table 3. Microbat lists obtained presented by site and night.**

| Site | Date | *Chalinolobus gouldii* | *Chalinolobus morio* | *Mormopterus sp. 4* | *Nyctophilus geoffroyi* | *Tadarida australis* | *Vespadelus regulus* |
|---|---|---|---|---|---|---|---|
| CERH | 17 Nov | Low | | Low | Low | Low | High |
| CERG | 18 Nov | | | | Low | | High |
| CERF | 19 Nov | Low | | Low | Low | | Med |
| CERC | 20 Nov | Low | | | Low | Low | High |
| CERH | 21 Nov | Low | Low | | Low | Low | Med |
| CERI | 22 Nov | Low | | | Low | | High |