

## **APPENDIX 1**

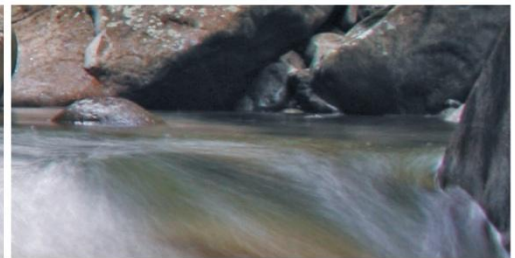
Fauna Assessment, Southern Extension of Dardanup  
Mineral Sands Project

**LEVEL 1 FAUNA ASSESSMENT, SOUTHERN  
EXTENSION OF DARDANUP MINERAL SANDS  
PROJECT**

**DORAL MINERAL SANDS PTY LTD**

**EP2011/022, V2**

**JUNE 2011**



**LEVEL 1 FAUNA ASSESSMENT,  
SOUTHERN EXTENSION OF DARDANUP  
MINERAL SANDS PROJECT**

Prepared for:

Doral Mineral Sands Pty Ltd  
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10 June 2011

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Lot 7 Harris Road  
PICTON WA 6229

**Attention: Craig Bovell**

Dear Craig

**RE: Level 1 Fauna Assessment, Southern Extension of the Dardanup Mineral Sands Project**

Please find attached the final version of the *Level 1 Terrestrial Fauna Assessment, Southern Extension of the Dardanup Mineral Sands Project* report. Should you have any queries regarding the report please do not hesitate to contact myself or Martine Scheltema in the office on 9355 7100.

For and on behalf of Coffey Environments Pty Ltd



Natassja Raymond  
Senior Consultant

Attachment A: Report EP2011/022, V2

## RECORD OF DISTRIBUTION

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## EXECUTIVE SUMMARY

Coffey Environments Pty Ltd was commissioned by Doral Mineral Sands to conduct a Level 1 Fauna Assessment at the proposed Southern Extension of Dardanup Mineral Sands Project, Western Australia.

Coffey Environments conducted a site reconnaissance in January 2011 to determine the types and values of fauna habitat within the project area and to confirm the presence of conservation significant terrestrial fauna species within the project area.

Five fauna habitats were recorded within the project area including:

1. Pasture with mature trees (P);
2. Woodland (W)
3. Open Woodland with Xanthorrhoea (OWX);
4. Linear Remnant Vegetation (LRV);
5. Riparian Vegetation (RP).

A high proportion of the project area was considered to be in highly degraded condition, and had low values for fauna.

A search of the DEC threatened fauna species database and the Commonwealth's online database for Protected Matters identified 32 conservation significant terrestrial species that may be recorded in the region. Twelve of these species either occur on site or have the possibility of occurring on site or in the nearby vicinity. The remainder of the species are not likely to occur within the project area due to a lack of recent records in the area or inappropriate habitat within the project area. Of the species that have the potential to occur within the project area, Western Ringtail Possums were recorded in the Linear Remnant Vegetation and Riparian Vegetation within the project area while Brush-tailed Phascogales were recorded in the Linear Remnant Vegetation within the project area. While no evidence of Black-Cockatoo feeding or breeding was recorded, these species have the potential to occur within the project area.

The EPA objective for terrestrial fauna is to maintain the abundance, species diversity and geographic distribution of terrestrial fauna and protect specially protected (Threatened) fauna consistent with the provisions of the *Wildlife Conservation Act (1950)*. If the recommendations proposed below are adopted, the potential impact to terrestrial fauna and the effect on the conservation status of specially protected and significant species should meet the EPA's objectives for terrestrial fauna. Therefore, Coffey Environments recommends that:

- All large trees should be retained where possible, particularly those containing hollows, to help reduce the impact of land clearing within the project area on species of conservation significance that may occur on site. These tall trees provide valuable feeding, roosting and nesting sites for locally common bird species (including conservation significant birds like Black-Cockatoo species) and aesthetic values for the public;
- Biannual monitoring of WRP population in the project area in conjunction with a control site adjacent to the project area for the project duration. This will assist in determining the secondary impacts of mining (e.g. noise, dust and vibration) on the WRP population;
- A robust feral predator control program should be undertaken in conjunction with surrounding farmers/land owners to reduce predation pressures on WRPs;

## EXECUTIVE SUMMARY

- Peppermint trees (*A. flexuosa*) should be planted in strategic areas to increase the linkage between areas of WRP habitat;
- The proposal is referred to the DEWHA for consideration under the *EPBC Act 1999* due to the presence of WRPs and the anticipated loss of Carnaby's Black-Cockatoo preferred foraging habitat and potential breeding habitat;
- 'Fauna friendly' clearing protocols should be employed when clearing the vegetation;
- Any changes to the creek bed profiles during earth works and mining should be returned to pre-construction conditions;
- Road kills' should be removed as soon as possible.

## 1 INTRODUCTION

### 1.1 Background

The Dardanup Mine and Picton Dry Separation Plant are known collectively as the Dardanup Mineral Sands Project, located approximately 20km and 10km respectively east of the coastal city of Bunbury in the South West Region of Western Australia (Figure 1). The Dardanup Mineral Sands Project has been operating since June 2002. A western extension to the Dardanup Mineral Sands Project (to mine the Burekup Mineral Sands Deposit) was approved for implementation by Ministerial Statement 789, dated 4 March 2009. This western extension area, referred to as 'Burekup West', is now an operational part of the mine and is located on mining leases M70/652 and M70/720.

The proposed southern extension of the Dardanup Mineral Sands Project is located to the south of the existing Dardanup Mine within Mining lease M70/675, M70/643 and M70/893 (Figure 2). Doral wish to expand their mining operations to the south of their original Dardanup Mine to continue mining the Dardanup Mineral Sands Deposit. Doral will be referring the proposed southern extension to the Environmental Protection Authority (EPA) under Section 38 of the *Environmental Protection Act 1986*. Coffey Environments have conducted a Level 1 Terrestrial Fauna Assessment of the southern extension area to assess the environmental impacts of the proposed southern extension.

This report details the results of the Level 1 Terrestrial Fauna Assessment for the southern extension of the Dardanup Mineral Sands Project.

### 1.2 Objectives

The objectives of this Level 1 Terrestrial Fauna Assessment were to:

- Provide an indication of the reptile, amphibian, mammal and bird assemblages in the vicinity of the project area so that potential impacts on terrestrial fauna and on the functional value of ecosystems might be adequately assessed;
- Assess the fauna habitat types and quality available within the project area;
- Identify terrestrial species of conservation significance that are present or likely to be present in the project area;
- Assess the potential impact and environmental risks associated with the proposed development on the terrestrial fauna assemblage; and
- Make recommendations to minimise potential impacts on resident terrestrial fauna.

### 1.3 Scope of Works

This report addresses the proposed southern extension of the Dardanup Mineral Sands Project shown in Figure 2. This report includes:

- A search of the Department of Environment and Conservation's (DEC) NatureMap online database for fauna records predicted to occur in the region;
- A search of the DEC's Threatened and Priority Species database to identify potential scheduled and threatened species within the region;
- A search of the Commonwealth Government's database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the

*Environment Protection and Biodiversity Conservation (EPBC) Act 1999* or international migratory bird agreements (JAMBA/CAMBA);

- Results from a field investigation of the project area;
- Results from a targeted Black-Cockatoos survey;
- Results from a targeted Western Ringtail Possum survey;
- A review of previous fauna surveys conducted in the region;
- An assessment of the potential impacts and risks to fauna from the proposed vegetation clearing and construction of facilities;
- Recommendations on how to reduce or mitigate any impacts on conservation significant fauna; and
- Advice on the requirements of the Commonwealth *EPBC Act 1999* and State Legislation.

This report does not include an assessment of the impact of the Southern Extension of the Dardanup Mineral Sands Project on Short Range Endemic (SRE) invertebrates (e.g. millipedes, mygalomorphs, land snails and scorpions) or subterranean fauna such as stygofauna and troglifauna.

A separate report (Coffey, 2011) has been prepared to examine the impacts of the Southern Extension of the Dardanup Mineral Sands Project on aquatic fauna.

## 1.4 Project Area

The Southern Extension of the Dardanup Mineral Sands Project is approximately 344.7 hectares in size and is located approximately 150km south of Perth and 20km east of Bunbury (Figure 1 and Figure 2).

## 1.5 Climate

The Bunbury region experiences a Mediterranean climate with hot, dry summers and mild, wet winters. Mean temperatures range between 13.9°C to 27.8°C in summer and from 8.4°C to 17.7°C in winter (Table 1). The average annual rainfall in the region is 722.9mm, 70% of which falls between May and August (Table 1; BOM, 2011).

**TABLE 1  
 CLIMATIC DETAILS FOR BUNBURY**

Kalgoorlie-Boulder	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	27.6	27.8	25.9	22.8	19.8	17.7	16.8	17.1	18.1	19.9	22.9	25.6	21.8
Mean minimum temperature (°C)	15.2	15.4	14.3	12.2	10.4	9.2	8.4	8.4	9.2	10.3	12.2	13.9	11.6
Mean rainfall (mm)	13.0	6.8	16.0	34.6	93.4	147.3	150.2	118.0	77.9	31.7	24.7	15.2	722.9

## 1.6 Land Form and Geology

The project area occurs within the Southern Swan Coastal Plain biogeographical region (SWA2) which is characterised by Fluvial deposits. The Guildford landform occurs in the project area and is made up of flat plains with medium textured deposits of yellow duplex soils (Churchward and McArthur, 1980).

## 1.7 Bioregional Context of Project Area

Western Australia supports 53 biogeographical subregions. The project area is located in the Perth Subregion of the Swan Coastal Plain Bioregion (SWA2). The Swan Coastal Plain Bioregion is a low-lying coastal plain, mainly covered with woodlands. It is dominated by Banksia (*Banksia* sp.) or Tuart on sandy soils, Swamp Sheoak (*Casuarina obesa*) on outwash plains and Paperbark (*Melaleuca* sp.) in swampy areas.

Several regional comparisons and surveys conducted in similar habitats in southern areas of the Swan Coastal Plain are available for the purpose of this Level 1 Terrestrial Fauna Assessment.

## 1.8 Vegetation and Flora

The project area is dominated by pasture with patches of degraded woodland and two ephemeral creeks with riparian vegetation. A flora survey by Mattiske Consulting (2010) identified 35 vegetation communities. Mattiske Consulting (2010) report the high number of communities is related to the lack of native species and the various combinations of a few dominant species.

## 2 METHODOLOGY

This Level 1 Terrestrial Fauna Assessment was undertaken in accordance with the Environmental Protection Authority (EPA) *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002), Coffey Environments' interpretation of the EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (EPA, 2004) and EPA (2010) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*.

This fauna assessment does not include a survey for Short-Range Endemic (SRE) invertebrates, however the site investigation illustrated that the project area did not contain unique or locally uncommon habitats and so is unlikely to support SRE fauna that are not found elsewhere in the immediate vicinity.

Aquatic species were also excluded from this assessment, as a separate assessment was undertaken to determine the baseline aquatic values of the project area (Coffey, 2011).

### 2.1 Desktop Search and Literature Review

A desktop search of the DEC Threatened Fauna Database database and NatureMap database (10 km buffer) was used to develop a list of potential bird, reptile, mammal and amphibian species in the general project area. The NatureMap search area was used to eliminate results from the Scarp and to maximise the similarity in fauna habitats encompassed by the search area. General texts were also used to provide supplementary information including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998; 2004) and Storr and Johnstone (1988) for birds; Strahan (1998) for mammals and consultant staff's personal experience.

A number of published and unpublished reports for fauna surveys on the Swan Coastal Plain have been used to provide a regional context for the small vertebrate assemblages sampled in the project area. The surveys include:

- ATA Environmental (2005). *Environmental Assessment Lot 1001, Mardo Avenue, Australind*. Unpublished Report for Marist Brothers.
- Bamford M.J. & Bamford A.R. Consulting Ecologists (2003). *Fauna values of Cape Bouvard Investments Pty Ltd land, Yalgorup*. Unpublished report for ATA Environmental, Perth.
- Biota Environmental Sciences (2006). *Perth – Bunbury Highway (Kwinana Freeway Extension and Peel Deviation) Targeted threatened fauna survey*. Unpublished report for Main Roads Western Australia, Perth.
- Bow, B. (1999). The biogeography of the ground vertebrate fauna of the southern Swan Coastal Plain, Bunbury, Western Australia. B.Sc(Hons) Thesis, School of Environmental Biology, Curtin University of Technology.
- Bullen, R.D. (2009). Binningup Bat Survey 2009. Echolocation Survey of Bat Activity in the Lake Clifton and Lake Preston Localities on the Swan Coastal Plain. Prepared for Department of Environment and Conservation by Bat Call WA. Hillarys, Western Australia.
- Coffey Environments (2007). *Vertebrate Fauna Assessment Preston Beach North*. Unpublished report for Mirvac (WA) Pty Ltd; Perth.

- Coffey Environments (2008). *Doral Mineral Sands Western Expansion, Burekup Level 1 Fauna Assessment*. Unpublished report for Doral Mineral Sands.
- Coffey Environments (2009). *Vertebrate Fauna Risk Assessment, Keralup*. Unpublished report for the Department of Housing.
- Coffey Environments (2010a). *Targeted Level 1 Fauna Assessment, Panorama New Dawesville*. Unpublished report for Beyond 3000.
- Coffey Environments (2010b) Western Ringtail Possum Monitoring Stage 12 - 14 Dalyellup Estate. Unpublished report Satterley Property Group.
- Coffey Environments (2010c) Western Ringtail Possum Monitoring Stage 13 - 16 Dalyellup Estate. Unpublished report Satterley Property Group.
- Dell, J. and Hyder, B. 2009. An Assessment of the Avifauna of the area between Dawesville and Binningup, Southern Swan Coastal Plain. Report prepared for Environmental Protection Authority, Perth.
- Ecologia Environmental Consultants (2001). *Part Lot 211 Barnes Avenue, Australind fauna survey*. Unpublished report for Marist Brothers Community, Perth.
- ENV (2008). *Lake Clifton Fauna Assessment*. Unpublished report for Cape Bouvard Investments Pty Ltd.
- ENV Australia Pty Ltd. (2009). Clifton Beach Public Environmental Review: Draft. Prepared for Cape Bouvard Investments.
- How, R. A., Maryan, B. and Stevenson, C. A. (2009). An Assessment of Herpetofauna on Near-Coastal Landforms between Dawesville and Binningup, Southern Swan Coastal Plain. Prepared for Department of Environment and Conservation. Welshpool, Western Australia.
- Hyder, B. and Dell, J. 2009. An Assessment of the Non-volant Mammal Fauna of the area between Dawesville and Binningup, Southern Swan Coastal Plain. Report prepared for Environmental Protection Authority, Perth.
- Metcalf, B & Bamford, M.J. (2008). *Fauna assessment of the proposed South Binningup development*. Unpublished report for RPS Bowman Bishaw Gorham, Perth.
- Morgan B & Dixon A (2008). *The flora, vegetation and fauna of Tims Thicket Reserve*. Unpublished report for the City of Mandurah.
- Ninnox Wildlife Consulting (2006). *A Vertebrate Fauna Assessment of the Burekup Mineral Sands Project Area*. Unpublished report for Iluka Resources Ltd.
- Turpin M C (1990). *Ecological appraisal of an isolated Banksia woodland reserve No. 3694 south of the Swan River*. Western Australian Naturalist 18: 131-138.
- Western Wildlife (2007). *Lot 801 and Lot 4 Preston Beach Fauna Survey 2007*. Unpublished report for RPS Bowman Bishaw Gorham; Perth.

Collectively these sources of information were used to create a list of terrestrial species expected to utilise the project area. It should be noted that these lists include species that have been recorded in the general region, but are vagrants, and are generally not found in the area because of a lack of suitable habitat. Vagrants can be recorded almost anywhere. In addition, because the data provided by the museum is based on historic records, it can include species that are now locally extinct. Many species

have specific habitat requirements that may be present in the general area but not in the actual project area (e.g. marine species). The ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the project area. As a consequence some species listed in these database searches will not be present in the project area. Where possible, any such species have been removed from the list.

A search of the Department of Environment and Conservation's Threatened and Priority Fauna database was undertaken to identify potential scheduled and threatened species in the region. A search of the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* online database was also undertaken for the area to identify species of national environmental significance.

Taxonomy and nomenclature for fauna species used in this report generally follow the Western Australia Museum which is based on Aplin and Smith (2001) for amphibians and reptiles, How *et al.* (2001) for mammals and Johnstone (2001) and Christidis and Boles (2008) for birds.

## **2.2 Site Reconnaissance**

Dr Graeme Finlayson and Dr Paul Mitrovski (Coffey Environments) undertook a site assessment on 17 and 18 February 2011. The site assessment included an inspection of the major fauna habitats/land systems within the project area and the adjacent areas. The primary purpose of this reconnaissance survey was to identify fauna habitats and assess the potential for conservation significant terrestrial fauna species to occur within the project area.

### **2.2.1 Black Cockatoos**

The targeted assessment for Black-Cockatoos was conducted using Coffey Environments' current advice from the DEC and DSEWPC regarding significant trees for Black-Cockatoos. DSEWPC guidelines, which are due to be released soon, are likely to stipulate that any clearing over 1ha is likely to constitute a significant impact and therefore warrant referral under the EPBC Act. The definition of breeding habitat is likely to be any patch of woodland of greater than 0.5ha in size that contains three or more alive or dead trees with a diameter at breast height of greater than 500mm.

The Black-Cockatoo assessment consisted of:

- A day-time search of the project area for evidence of Black-Cockatoo foraging (e.g.. chewed Marri nuts); and
- A day-time search for potential breeding hollows and evidence of breeding (e.g. scratching below tree hollows).

Locations of potential breeding hollows were recorded using a GPS and mapped.

Recommendations on the potential impact of the proposed expansion on Black-Cockatoos were included in this fauna assessment.

### **2.2.2 Western Ringtail Possums**

A targeted survey for Western Ringtail Possums (WRPs) was conducted during the site reconnaissance. The WRP Assessment consisted of:

- A daytime search for WRP dreys or suitable hollows that may be used by WRPs as daytime retreats; and
- A one-night spotlight survey to determine the presence of WRPs across the site.



Locations of WRP dreys and WRPs were recorded using a hand-held GPS and mapped.

Recommendations on the potential impact of the proposed expansion on WRPs were included in this fauna assessment.

## 2.3 Fauna Habitat Quality

The fauna habitat quality was assessed based on the size of the habitat, the level of habitat connectivity, availability of specific resources (e.g. tree hollows) and overall vegetation quality. Coffey Environments rated the fauna habitat quality using the following criteria:

*High quality fauna habitat (H)* – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.

*Very good fauna habitat (VG)* - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, and weeds) and generally retains many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.

*Good fauna habitat (G)* – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.

*Disturbed fauna habitat (D)* – These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing contain weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.

*Highly degraded fauna habitat (HD)* – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Faunal assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.

## 2.4 Limitations

A comprehensive terrestrial and avian survey has not been undertaken for this assessment. Conclusions and management recommendations have therefore been made based on data collated from various surveys and reports for adjacent areas and the bioregion. It is acknowledged that repeated surveys at multiple sites over several years are necessary to describe the spatial and temporal variations in the faunal assemblage within a project area. However, in this circumstance it is Coffey Environments' opinion that given the limited amount of intact remnant vegetation available, previous anthropogenic activity on site and the availability of survey data within similar habitats within the bioregion, adequate data has been collected to assess any potential impacts of the project on terrestrial vertebrate fauna.

The EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (EPA, 2004) suggests that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 2.

**TABLE 2  
FAUNA ASSESSMENT LIMITATIONS AND CONSTRAINTS**

Possible limitations	Constraint	Comment
Competency and experience of the consultant carrying out the survey	No	Zoologists undertaking this survey have appropriate training and experience in conducting Level 1 vertebrate fauna assessments.
Scope	No	All components required for a Level 1 fauna assessment have been completed.
Proportion of fauna identified, recorded and/or collected	(N/A)	An onsite terrestrial fauna survey has not been undertaken within the project area as part of the scope of this fauna assessment.
Sources of information	No	Vertebrate fauna information was available from appropriate database searches and both published and unpublished reports.
Proportion of the task achieved	No	The assessment fulfils all of the objectives.
Timing/weather/season/cycle	No	The reconnaissance site visit was undertaken in weather conditions which were appropriate for this type of assessment.
Disturbances which affected results of the survey	No	A portion of the site is disturbed or cleared pastoral vegetation. This impact has been taken into account in this assessment.
Intensity of survey effort	No	The intensity of the assessment is sufficient for a Level 1 assessment.
Completeness	No	All major habitat types were visited.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	Yes, negligible	A section within the centre of the project area (Figure 2) was not surveyed due to site access restrictions. This area is unlikely to contain fauna or fauna habitat dissimilar to those surveyed for the project.
Availability of contextual information for the region	No	WA Museum database, DEC Threatened and Priority species lists, EPBC Act Protected Matters Search and results of previous surveys in both the surrounding area and the bioregion were available to provide comparison at both a local and regional level.

### 3 RESULTS

#### 3.1 Fauna Habitat in the Project area

Five fauna habitats were identified within the project area (Figure 2; Plates 1 – 5), including:

1. Pasture with mature trees (P);
2. Woodland (W)
3. Open Woodland with *Xanthorrhoea* (OWX);
4. Linear Remnant Vegetation (LRV);
5. Riparian Vegetation (RP).

The majority of the project area has been cleared for agricultural practices and consists of Pasture (P) with various species of mature trees. Vegetation clearing and grazing have led to large areas of bare ground with invading weeds and is considered highly degraded fauna habitat (HD) (Figure 2; Plate 1). The mature trees located in the pasture consist of *Eucalyptus rudis*, *E. marginata*, *Corymbia calophylla* and *Melaleuca* species. Several large, mature trees contain hollows of varying size (Plate 2) and were suitable for roosting birds or potential foraging habitat.

Three patches of Woodland (W) occur along the eastern boundary of the project area (Figure 2; Plate 3). The Woodland is dominated by *E. marginata*, *C. calophylla* and *Banksia grandis*. The Woodland is classified as disturbed fauna habitat (D) as the habitat is fragmented, the understorey has been cleared and significant grazing occurs.

Open Woodland with *Xanthorrhoea* species (OWX) habitat was recorded in the central area of the project area (Figure 2; Plate 4). *Agonis flexuosa*, *C. Corymbia* and *E. marginata* and *E. rudis* were the dominant tree species in the Open Woodland. The Open Woodland with *Xanthorrhoea* habitat is classified as disturbed fauna habitat (D) as the habitat is contains many weeds, the understorey has been cleared and significant grazing occurs.

Linear Remnant Vegetation (LRV) was recorded along the roadside verge (Figure 2; Plate 5) on Simpson Road, Dowdells Road and Giumelli Road. *Agonis flexuosa*, *C. Corymbia* and *E. marginata* dominate this linear remnant vegetation. The Linear Remnant Vegetation is considered disturbed fauna habitat (D) as there is limited connectivity and the presence of numerous weeds.

Riparian Vegetation (RP) was recorded along Paradise Creek (Figure 2; Plate 6). Paradise Creek is an ephemeral watercourse, which flows parallel to Giumelli Road on the south side and is dominated by *E. rudis* and *A. flexuosa*. The Riparian Vegetation is considered disturbed fauna habitat (D) as there is limited connectivity, numerous weeds are present and significant grazing occurs within the habitat.

**Plate 1. Pasture with Mature Trees (P)**



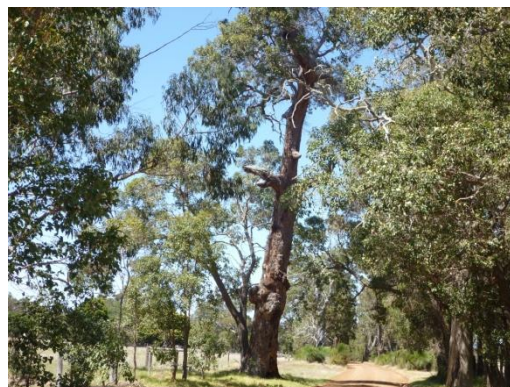
**Plate 2. Woodland (W)**



**Plate 3. Open Woodland with *Xanthorrhoea* (OWX)**



**Plate 4. Linear Remnant Vegetation (LRV)**



**Plate 5. Riparian Vegetation**



**Plate 6. Tree Hollows**



### **3.2 Potential Vertebrate Fauna in the Project area**

Appendix A lists terrestrial species previously recorded in the general area. Ten amphibians, 42 reptiles, 132 birds and 27 mammals have been recorded in previous surveys in the region.

Terrestrial fauna that are of conservation significance and might be found in the project area are listed and discussed below.

### 3.3 Targeted Black-Cockatoo Survey

Hollows greater than 20cm in diameter are considered sufficiently large for Black-Cockatoo species to potentially breed in (*pers. comm.*, DEWSHA, 2009). Twenty-one trees containing large hollows were observed within the project area (Table 3; Figure). However, no evidence of breeding (e.g. scratching, feathers around tree hollows) was recorded.

Coffey Environments also noted that numerous large, mature trees occurred in all fauna habitat types (Pasture, Woodland, Open Woodland, Linear Remnant Vegetation and Riparian Vegetation). These large, mature trees have trunks greater than 1m in diameter at breast height (dbh) or cavities in branches less than 10cm in diameter and thus have the potential to develop tree hollows in the next 50 years but are unlikely to currently support hollow-dependant vertebrate fauna.

**TABLE 3  
TREES WITH HOLLOWES LOCATED IN THE PROJECT AREA**

Tree Species	Number of Hollows	Tree Height (m)	Northing	Easting
Marri	1	12	389229	6306085
Dead Standing	Multiple	8	389213	6306093
Marri	1	11	389152	6306113
Dead Standing	Multiple	6	389018	6306221
Dead Standing	Multiple	3	389039	6306231
Dead Standing	Multiple	7	389045	6306315
Marri	1	15	388991	6306321
Marri	1	13	389008	6306361
Marri	1	15	389009	6306381
Marri	1	14	387901	6306052
Marri	1	8	387855	6306046
Dead Standing	Multiple	8	388001	6307661
Marri	1	13	388000	6307662
Marri	1	14	389037	6307671
Dead Standing	Multiple	8	389185	6307670
Dead Standing	Multiple	5	389249	6307368
Marri	1	9	389250	6307305
Dead Standing	Multiple	6	389248	6307172
Marri	1	8	389254	6306671
Marri	1	10	388488	6305781
Dead Standing	Multiple	4	388092	6307650

### 3.4 Targeted Western Ringtail Possum Survey

The Targeted WRP Survey identified a single drey within the project area, located within the Riparian Vegetation habitat (Plate 7; Figure 2) and a total of 14 WRPs were recorded within the Linear Remnant Vegetation and Riparian Vegetation habitat types in the southern area of the project.

### Plate 7. WRP Drey



### 3.5 Significant Fauna Species Predicted to Occur in the Project area

Conservation Significant terrestrial fauna species potentially present in the project area are listed in Table 4.

Ten species listed under the *EPBC Act (1999)* and 24 species listed under the *WA Wildlife Conservation Act (1950)* potentially occur within the vicinity of the project area. A further eight species were recorded in the database search that are considered migratory species. The DEC maintains a list of threatened and priority species that it monitors. The DEC classifies fauna under five different Priority codes and rare and endangered fauna are classified under the *Wildlife Conservation (Specially Protected Fauna) Notice 2008* into four schedules of taxa. These are:

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

In addition to the above classification, the DEC also classifies fauna under five different priority codes:

- Priority 1 – Taxa with few, poorly known populations on threatened lands. Taxa which are known from few specimens or sight records from one of a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened species.
- Priority 2 – Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not 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. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 3 – Taxa with several, poorly known populations, some on conservation lands. Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 4 and 5 – Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

Threatened and Priority species listed under the *Wildlife Conservation Act*, DEC's database and the *EPBC Act* that are likely or possibly occur in the project area are listed in Table 4. The likelihood of species listed under government legislation or conservation programs being found in the project area are discussed below.

**TABLE 4**  
**CONSERVATION SIGNIFICANT TERRESTRIAL FAUNA PREDICTED**  
**TO OCCUR IN THE PROJECT AREA**

Species	Status under Wildlife Conservation Act	Status under Commonwealth EPBC Act	Potential to be found in the project area
Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> )	Schedule 1	Endangered	Possible
Graceful Sun Moth ( <i>Synemon gratiosa</i> )	Schedule 1	Endangered	Unlikely
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Schedule 1	Endangered	Unlikely
Woylie ( <i>Bettongia penicillata</i> )	Schedule 1	Endangered	Unlikely
Numbat ( <i>Myrmecobius fasciatus</i> )	Schedule 1	Vulnerable	Unlikely
Baudin's Black Cockatoo ( <i>Calyptorhynchus baudinii</i> )	Schedule 1	Vulnerable	Possible
Chuditch ( <i>Dasyurus geoffroii</i> )	Schedule 1	Vulnerable	Possible
Forest Red-tailed Black-Cockatoo ( <i>Calyptorhynchus banksii naso</i> )	Schedule 1	Vulnerable	Possible
Quokka ( <i>Setonix brachyurus</i> )	Schedule 1	Vulnerable	Unlikely
Western Ringtail Possum ( <i>Pseudocheirus occidentalis</i> )	Schedule 1	Vulnerable	<b>Present</b>
Southern Brush-tailed Phascogale ( <i>Phascogale tapoatafa</i> )	Schedule 1		<b>Present</b>
Australasian Bittern ( <i>Botaurus poiciloptilus</i> )	Schedule 1		Unlikely
Peregrine Falcon ( <i>Falco peregrines</i> )	Schedule 4		Possible
Masked Owl ( <i>Tyto novahollandiae novahollandiae</i> )	Priority 3		Possible
Black Bittern ( <i>Ixobrychus flavicollis</i> )	Priority 3		Unlikely
Eastern Curlew ( <i>Numenius madagascariensis</i> )	Priority 4		Unlikely
Hooded Plover ( <i>Charadrius rubicollis rubicollis</i> )	Priority 4		Unlikely
Southern Carpet Python ( <i>Morelia spilota imbricata</i> )	Schedule 4/Priority 4		Possible
Western False Pipistrelle ( <i>Falsistrellus mackenzei</i> )	Priority 4		Unlikely

**TABLE 4  
CONSERVATION SIGNIFICANT TERRESTRIAL FAUNA PREDICTED  
TO OCCUR IN THE PROJECT AREA (CONT'D)**

Species	Status under Wildlife Conservation Act	Status under Commonwealth EPBC Act	Potential to be found in the project area
Water Rat ( <i>Hydromys chrysogaster</i> )	Priority 4		Unlikely
Little Bittern ( <i>Ixobrychus duvius</i> )	Priority 4		Unlikely
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	Priority 4		Unlikely
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4		Unlikely
Quenda ( <i>Isoodon obesulus fusciventer</i> )	Priority 5		Unlikely
Rainbow Bee-eater ( <i>Merops ornatus</i> )		Migratory	Possible
White-bellied Sea Eagle ( <i>Haliaeetus leucogaster</i> )		Migratory	Possible
Great Egret ( <i>Ardea alba</i> )		Migratory	Unlikely
Cattle Egret ( <i>Ardea ibis</i> )		Migratory	Unlikely
Fork-tailed Swift ( <i>Apus pacificus</i> )		Migratory	Possible
Common Greenshank ( <i>Tringa nebularia</i> )		Migratory	Unlikely
Marsh Sandpiper ( <i>Tringa stagnatilis</i> )		Migratory	Unlikely
Red-necked Stint ( <i>Calidris ruficollis</i> )		Migratory	Unlikely

The following section provides a brief discussion of the preferred habitat of species listed in Table 4 and Coffey Environments assessment of the likelihood of these species being found in the project area.

#### **Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)**

Carnaby's Black-Cockatoo inhabits the south-west of Western Australia. Its preferred habitat is the woodland where it preferentially feeds on plants of the Proteaceae family. Preferred nesting trees include the smooth-barked Salmon Gum (*Eucalyptus salmonophloia*) and Wandoo (*E. wandoo*), which contain deep hollows. Nesting also occurs in Marri (*Corymbia calophylla*) and Tuart (*E. gomphocephala*). Carnaby's Black-Cockatoo forages in woodland and kwongan heath that is dominated by Proteaceous species. Its main foods are the seeds of Hakeas, Grevilleas, Banksias, Eucalypts and introduced Pines.

Although no evidence of feeding (e.g. chewed Marri or Jarrah nuts) or breeding (e.g. scratchings, feathers in tree hollows) was recorded, Coffey Environments' view is that Carnaby's Black-Cockatoos could **possibly** utilise the project area for foraging. Several hollows were identified within the project area which may be large enough for cockatoos to use for breeding (Table 3).

#### **Graceful Sun Moth (*Synemon gratiosa*)**

This species has brightly coloured orange hind-wings, and is similar in appearance to a butterfly. The breeding season is during March, during which time adults are active during the day and thought to breed exclusively on *Lomandra* species, in particular *L. hermaphrodita*. It occurs along the Swan Coastal Plain between Wanneroo and Mandurah and is under threat due to damage to habitat for four-wheel driving and the vulnerability of larvae and juveniles to fire.



Coffey Environments believes that this species is **unlikely** to occur in the project area, as there were only sparse and isolated records of *L. hermaphrodita* within the project area.

#### **Red-tailed Phascogale (*Phascogale calura*)**

This species was formerly widespread in woodland habitat through much of inland southern and central Australia. It is now restricted to remnants of mature Wandoo or Rock Oak woodland in the southern wheatbelt.

Coffey Environments' assessment is that given the recent lack of records of this species in the vicinity of Bunbury and the habitat preferences of this species, it is **unlikely** to occur within the project area.

#### **Brush-tailed Bettong – Woylie (*Bettongia penicillata*)**

Also known as the Woylie, this medium sized bettong was once widespread through most of SW Australia. It is restricted to remnant habitat patches in south west WA and is highly susceptible to predation by foxes and cats.

Coffey Environments' assessment is that this species is highly unlikely to be found in the project area due to predation and habitat availability.

#### **Numbat (*Myrmecobius fasciatus*)**

The numbat is a medium-sized diurnal marsupial that feeds exclusively on termites. Its range has been restricted due to introduced predators and it now only occurs in the SW of WA and in reintroduced populations.

It is Coffey Environments' view that it is highly unlikely that numbats are present in the project area.

#### **Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*)**

This species is most common in the far south-west of Western Australia where it breeds. It is known to breed from the southern forests north to Collie and east to near Kojonup. Baudin's Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah and Marri woodlands, where it feeds mainly on Marri seeds and various Proteaceous species. Whilst they are seasonally present on the Swan Coastal Plain, Baudin's Black-Cockatoos are more likely to occur in the eastern region of the coastal plain.

Although no evidence of feeding (e.g. chewed Marri or Jarrah nuts) or breeding (e.g. scratchings, feathers in tree hollows) was recorded, Coffey Environments' view is that Baudin's Black-Cockatoos could **possibly** utilise the project area for foraging. Several hollows were identified within the project area which may be large enough for cockatoos to use for breeding (Table 3).

#### **Chuditch, Western Quoll (*Dasyurus geoffroii*)**

The Chuditch was originally found in over 70% of Australian woodlands; however, since European settlement its range has diminished to a patchy distribution throughout the Jarrah forest and mixed Karri-Marri-Jarrah forest of south-west WA. They have been known to occupy a wide range of habitats including woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. The Chuditch creates dens in hollow logs or burrows and have also been recorded in tree hollows and cavities. They are opportunistic feeders, and forage on the ground at night, feeding on invertebrates, small mammals, birds and reptiles.

Coffey Environments' believes that the Chuditch is **possibly** to occur within the project area due to lack of suitable habitat.

### **Forest Red-tailed Black-Cockatoo (*Calptorhynchus banksii naso*)**

Forest Red-tailed Black-Cockatoos frequent the humid to subhumid south-west feeding on a variety of Eucalyptus species, from Gingin in the north, Albany in the south and west to Cape Leeuwin and Bunbury. Nesting occurs in hollows with a depth of 1-5m predominately in Marri (*C. calophylla*), Jarrah (*E. marginata*) and Karri (*E. diversicolor*). Forest Red-tailed Black-Cockatoos were formerly common but are now uncommon and patchily distributed.

Although no evidence of feeding (e.g. chewed Marri or Jarrah nuts) or breeding (e.g. scratchings, feathers in tree hollows) was recorded, Coffey Environments' view is that the Forest Red-tailed Black-Cockatoo could **possibly** utilise the project area for foraging. Several hollows were identified within the project area which may be large enough for cockatoos to use for breeding (Table 3).

### **Quokka (*Setonix brachyurus*)**

Quokkas were originally very common on the Swan Coastal Plain, however, their distribution is now limited to Rottnest Island and a few isolated areas in the south-west of WA. On the mainland, they prefer densely vegetated areas around wetlands and streams, whereas on Rottnest Island they inhabit low scrubby coastal vegetation where water is not readily available year-round. Quokkas breed once a year and produce a single joey. They are herbivorous, and feed on leaves, bark, succulent plants and grasses.

Coffey Environments believes that Quokkas are unlikely to occur within the project area due to lack of suitable habitat and the presence of introduced predators

### **Western Ringtail Possum (*Pseudocheirus occidentalis*)**

The WRP is closely associated with stands of Native Peppermint trees (*Agonis flexuosa*), the leaves of which are the primary food source of the species. However, individuals in residential areas may feed on garden plants, fruit and vegetables in compost heaps.

Western Ringtail Possums are nocturnal and usually shelter by day in dreys (bird-like nests). These dreys are typically located in the crown of Peppermint trees, but may be constructed in other tree species, such as *Melaleuca*, *Banksia*, or Marri and Jarrah trees. Dreys may also be present in hollows in trees.

The targeted WRP survey confirmed that the WRP is **present** within the Linear Remnant Vegetation and Riparian Vegetation habitat types in the southern area of the project (Figure 2).

Limited connectivity between suitable patches of habitat (e.g. Linear Remnant Vegetation and Riparian Vegetation) suggests this population of WRPs is isolated. Presence of feral predators (a cat and fox) within the project area is also likely to affect the dispersal ability of WRPs.

### **Southern Brush-tailed Phascogale (*Phascogale tapoatafa*)**

Southern Brush-tailed Phascogales are arboreal marsupials, which require tree hollows in suitable woodland or forest and rely on abundant invertebrate prey to sustain populations. A recent record by the DEC at Point Peron (2001) indicates this species occurs in the Rockingham region. Interviews with local residents state they occur within the project area. They are rarely detected in vertebrate fauna surveys as they are arboreal and trap shy.

The Southern Brush-tailed Phascogale was recorded in Linear Remnant Vegetation habitat near the northern boundary. Discussions with several resident farmers also indicate that Brush-tailed Phascogales have recently returned, following several years of absence, in several areas within the

project area. It is Coffey Environments' opinion that this species **present** in the Woodland and Linear Remnant Vegetation habitat types in low densities.

#### **Australasian Bittern (*Botaurus poiciloptilus*)**

The Australasian Bittern is a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. It is associated with water in tall reedbeds and occasionally saltmarsh and brackish wetlands. It is generally coastal and sub-coastal in south west WA.

Coffey Environments believes that given the condition, status, habitat type, water etc available within the project area, this species is unlikely to occur within the project area.

#### **Peregrine Falcon (*Falco peregrinus*)**

The Peregrine Falcon is listed as a Schedule 4 species under the WA *Wildlife Conservation Act 1950*. The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It shows habitat preference for areas near cliffs along coastlines, rivers and ranges and in woodlands along watercourses and around lakes. It favours hilly or mountainous country and open woodlands and may be an occasional visitor to the project area.

Coffey Environments' assessment is that the Peregrine Falcon may **possibly** be an infrequent visitor to the project area, but the potential loss of habitat due to development is unlikely to have an impact on this species.

#### **Masked Owl (*Tyto novaehollandiae novaehollandiae*)**

Little information is available on the Masked Owl; however, it is known from Yanchep east to Yealering, south to Gnowangerup and Albany and occasionally seen north to Geraldton. The Masked Owl inhabits forests and woodlands and nests in tree hollows. It is locally common around Karridale and Manjimup, but is generally uncommon elsewhere.

Coffey Environments' assessment is that the Masked Owl **possibly** occurs in the project area, as several trees were identified which may contain suitable nesting hollows (Table 3). However, the Masked Owl has a large home range and is unlikely to occur in large numbers if present.

#### **Black Bittern (*Ixobrychus flavicollis*)**

The Black Bittern roosts and nests in trees, and are found in tree-lined wetlands and in mangroves. They forage in both daylight and darkness, mainly from shady trees over water, but may be seen during the day in open areas of short marshy vegetation and along creeks in shrubby vegetation.

Coffey Environments' assessment is that this species **unlikely** to occur in the project area as no suitable habitat is present.

#### **Eastern Curlew (*Numenius madagascariensis*)**

This species breeds on open mossy or transitional bogs, moss-lichen bogs and wet meadows, and on the swampy shores of small lakes. In the non-breeding season it is essentially coastal, occurring at estuaries, mangrove swamps, saltmarshes and intertidal flats, particularly those with extensive seagrass meadows.

Coffey Environments' assessment is that the Eastern Curlew is **highly unlikely** to occur in the project area as no suitable habitat is present.

### **Hooded Plover (*Charadrius rubricollis*)**

This species frequents the margins and shallows of salt lakes, also along coastal beaches, where it forages for invertebrates along the water's edge.

Coffey Environments' assessment is that the Hooded Plover is **highly unlikely** to occur in the project area as no suitable habitat is present.

### **Carpet Python (*Morelia spilota imbricata*)**

The South-west Carpet Python occurs in the south-west of Western Australia, from Northampton, south to Albany and eastwards to Kalgoorlie. It has been recorded from semi-arid coastal and inland habitats, Banksia Woodland, Eucalypt Woodlands and grasslands. The diet of this species includes geckos, house mice, doves and small to medium-sized mammals.

Coffey Environments assessment is that the South-west Carpet Python may **possibly** occur in the project area as it often occurs in association with farming infrastructure.

### **Western False Pipistrelle (*Falsistrellus mackenziei*)**

The Western False Pipistrelle is listed as a Priority 4 species by the DEC. This bat species lives in hollows in old trees, branches and stumps. It is normally found in colonies of 5 to 30 bats. Western False Pipistrelles are vulnerable to loss of roosting sites in tree hollows and loss of feeding grounds by forestry activities, clearing for agriculture and housing. They live mainly in wet sclerophyll forests of Karri, Jarrah and Tuart eucalypts.

Coffey Environments' assessment is that the Western False Pipistrelle is **unlikely** to occur in the study as it typically occurs in well vegetated continuous forest.

### **Water Rat (*Hydromys chrysogaster*)**

The water rat is found mainly near permanent bodies of freshwater, occasionally at temporary waterholes.

Due to the lack of sufficient permanent water, Coffey Environments believes that the Water Rat is **unlikely** to inhabit the project area.

### **Little Bittern (*Ixobrychus duvius*)**

Little Bitterns frequent terrestrial freshwater wetlands that have dense emergent vegetation. They also use artificial wetlands, even in built-up areas. Little Bitterns eat small, aquatic invertebrates and tadpoles, and nest in dense vegetation over water.

Coffey Environments assessment is that given the quality of the wetlands available on site, this species is **unlikely** to be present in the project area.

### **Bush Stone-curlew (*Burhinus grallarius*)**

This species require sparsely grassed, lightly timbered, open forest of woodland habitat, however this species abundance and distribution has seen a significant decline in southern parts of Western Australia, believed to be attributed to predation by foxes and habitat degradation and fragmentation.

Coffey Environments believes that this species is **unlikely** to occur in the project area due to the small area of available habitat, degraded habitat condition and lack of recent records in the region.

### **Western Brush Wallaby (*Macropus irma*)**

The Western Brush Wallaby is listed as a Priority 4 species by the DEC. This species was very common in the early days of settlement, however, its range has been seriously reduced and fragmented and there is a significant decline in abundance in most remaining habitat. It is now distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. The optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.

Coffey Environments believes that this species is **unlikely** to occur in the project area due to the small area of available habitat, lack of habitat connectivity and lack of recent records in the region.

### **Quenda or Southern Brown Bandicoot (*Isodon obesulus fusciventer*)**

Quenda prefer dense scrub (up to one metre high), with swampy vegetation. They will often feed in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and crop land lying close to dense cover associated with the wetlands.

Coffey Environments' assessment is that the Southern Brown Bandicoot is **unlikely** to occur in the project area due to the lack of habitat.

### **Rainbow Bee-eater (*Merops ornatus*)**

The Rainbow Bee-eater is found throughout mainland Australia, as well as eastern Indonesia, New Guinea and, rarely, the Solomon Islands. In Australia it is widespread, except in desert areas, and breeds throughout most of its range, although southern birds move north to breed. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will use disturbed sites such as pastureland, quarries, cuttings and mines to build its nesting tunnels. Rainbow Bee-eaters eat insects, mainly catching bees and wasps, as well as dragonflies, beetles, butterflies and moths.

Coffey Environments' assessment is that the Rainbow Bee-eater **possibly** occurs in the project area due to the presence of suitable habitat.

### **White-bellied Sea Eagle (*Haliaeetus leucogaster*) – Migratory**

The White-bellied Sea Eagle is listed as Terrestrial Migratory species under the *EPBC Act 1999*. White-bellied Sea Eagles are most commonly found around the coastline; however, they have been reported many kilometres inland.

This species was not recorded during the survey but Coffey Environments' assessment is that the White-bellied Sea Eagle **possibly** occurs in the project area; however, it is considered unlikely to rely on the project area for survival.

### **Great Egret (*Ardea alba*) – Migratory**

This species is one of the largest Australian Egrets and is typically found near water, salt or fresh, and feeds in wetlands, streams, ponds and tidal flats. It nests in trees near water.

It is Coffey Environments' opinion that although this species may be occasionally seen in the project area, it is **unlikely** to rely on the project area for survival.

### **Cattle Egret (*Ardea ibis*)**

This species is a relatively small egret found in grasslands, woodlands and wetlands. Cattle Egret pairs are monogamous for the breeding season, and they breed in colonies, usually with other waterbirds.

It is Coffey Environments' opinion that although this species may be occasionally seen in the project area, it is **unlikely** to rely on the project area for survival.

#### **Fork-tailed Swift (*Apus pacificus*)**

The Fork-tailed Swift is a visitor to Western Australia, arriving in the south-west in December and leaving in April. It is attracted to thunderstorms, and breeds in Asia and the northern hemisphere.

As this is a migratory species that mostly feeds while flying, it is **unlikely** that the proposed development will have a significant impact on this species when it is in the area.

#### **Common Greenshank (*Tringa nebularia*)**

This species is a large wader, inhabiting fresh or saline mudflats, swamps and sandbars. It breeds in the Palaearctic regions, is widespread in Africa, Coastal Asia, the Indian subcontinent, the Philippines and Southern New Guinea. They are common throughout Australia in the summer.

The Common Greenshank is unlikely to rely on the project area for survival.

#### **Marsh Sandpiper (*Tringa stagnatilis*)**

The Marsh Sandpiper is a distinctive wader with very long legs, a fine long bill and small body. This species prefers coastal swamps and waterways and is commonly seen in small to large flocks in fresh or brackish wetlands. It is most common in northern Australia and scattered down south in coastal areas.

Coffey Environments believes that given the condition, status, habitat type, water etc available within the project area, this species is unlikely to occur within the project area.

### **3.6 Biodiversity Value**

#### **3.6.1 Biodiversity of the Terrestrial Ecosystems**

The EPA Position Statement No. 3 indicates an ecological assessment of a site must consider its biodiversity value at the genetic, species and ecosystem levels, and its ecological functional value at the ecosystem level (EPA 2002). There is insufficient information available to assess biodiversity at the genetic level.

Clearing of vegetation and cattle grazing for many years has destroyed most of the habitat for native terrestrial fauna ecosystems. What remains are the small degraded remnant patches and groves of trees, isolated trees, many of which are dead but still provide hollows for nesting birds and perhaps possums, and fragmented road side vegetation. In addition, the presence of foxes and feral cats is likely to have further depleted native fauna in the area.

Terrestrial vertebrate fauna assemblages present would bear no resemblance to those that existed prior to vegetation clearing and farming. Fauna remaining in the project area are likely to be tolerant of disturbance, but present in reduced numbers, or are quite plastic in habitat requirements and may increase in abundance. The project area therefore has the potential to provide habitat for a limited range of the original native fauna that can accommodate a high level of disturbance or persist in remnant patches of disturbed vegetation.

It is therefore highly likely that the existing fauna assemblages represent only a small portion of what once existed and would be dominated by those species that are very plastic in their requirements and can tolerate heavy predation pressure from foxes and cats and disturbance.

It is Coffey Environments' view that the species of mammals, reptiles, birds and invertebrates present or likely to visit the project area would most likely be present or visit other similarly vegetated areas in the region (e.g. Wellington National Park). Therefore, vegetation clearing associated with this development is unlikely to have a significant impact on the biodiversity value at the genetic, species, and ecosystem levels in this region. However the presence of conservation significant species (e.g., WRP and Red-tailed phascogale) indicates that the terrestrial ecosystems within the project area still have biodiversity values.

### **3.7 Ecological Functional Value at the Ecosystem Level**

From a fauna perspective, some of the wetland ecosystems and remnant patches of vegetation provide highly modified functional ecosystems in the project area. The remaining area is highly degraded, mostly pasture and would contain ecosystems characteristic of this level of disturbance.

Terrestrial vertebrate fauna species present or likely to be present in the project area are generally present elsewhere on the Swan Coastal Plain. Nothing in this Level 1 Terrestrial Fauna Assessment indicates that the terrestrial fauna assemblages present in the project area are unique, however no fauna trapping was conducted as part of this assessment.

Although not unique, the value of areas within the project area is higher than expected due to the presence of isolated populations of Brush-tailed Phascogales and Western Ringtail Possums. Therefore, the Woodland, Linear Remnant Vegetation and Riparian Vegetation in the project area are considered to have high ecological functional value.

### **3.8 Risk Assessment**

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity on a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 5, 6, and 7 provide a summary of the risk assessment associated with this project.

The assessment contained in Table 7 is supported by more detailed discussion in the sections above and the management recommendations below.

**TABLE 5**  
**FAUNA IMPACT RISK ASSESSMENT DESCRIPTORS**

Any risk assessment is a product of the likelihood of an event or impact occurring and the consequences of that event or impact. Likelihood and consequences are categorised and described below. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the events or impacts. Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 7.

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may rarely occur or conservation significant species may rarely be present in most circumstances.
B	Unlikely	The environmental event is unlikely to occur or conservation significant species are unlikely to be present in most circumstances.
C	Moderate	The environmental event could occur or conservation significant species could be present at sometime in most circumstances.
D	Likely	The environmental event should occur or conservation significant species should be present in most circumstances.
E	Almost certain	The environmental event will occur or conservation significant species will be present in most circumstances.
Consequences		
Level	Description	Criteria
1	Insignificant	No loss of conservation significant fauna or regional biodiversity and an insignificant impact on non-conservation significant fauna.
2	Minor	No loss of conservation significant fauna or the localised loss of individuals and species in a regional context.
3	Moderate	Loss of one conservation species individual or a moderate loss of non-conservation significant fauna in a regional context.
4	Major	Significant loss of conservation significant fauna as defined in the DEH (2006) publication or a loss of non-conservation significant fauna at landscape scale.
5	Catastrophic	Loss of a population of conservation significant at a local scale or loss of non-conservation significant fauna at regional scale.
Acceptability of Risk		
Level of risk	Management Action Required	
Acceptable	No action required.	
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.	
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. Will require a referral to the Commonwealth under the <i>EPBC Act 1999</i> .	
Extreme	Unacceptable, project should be redesigned or not proceed.	



**TABLE 6**  
**LEVEL OF ACCEPTABLE RISK**

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
<b>Consequences</b>	Insignificant (1)	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable
	Minor (2)	Acceptable	Acceptable	Acceptable	Moderate	Moderate
	Moderate (3)	Acceptable	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

**TABLE 7  
FAUNA IMPACT RISK ASSESSMENT**

Factor	Potential Impact	Before Management			Risk Controls	With Management		
		Inherent Risk				Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Fauna survey data inadequate	Unknown loss of fauna, fauna of conservation significance, fauna assemblages, or an incomplete fauna assessment	B	2	Acceptable				
Fauna assessment inadequate	Unknown impact on fauna assemblage and conservation significant species	B	2	Acceptable				
Inadequate regional data for contextual purposes	Incomplete analysis of data and appreciation of the impact on biodiversity values in a regional context	C	2	Acceptable				
Removal of habitat – site scale	Almost complete loss of terrestrial fauna in cleared areas, severe impact on local communities	E	3	High	Provide habitat corridors, habitat retention and minimise clearing	E	1	Acceptable
Significant reduction of habitats – local scale	Loss of fauna habitat and some impact on local fauna and fauna assemblage	C	3	Moderate	Provide and maintain habitat corridors and existing areas of remnant vegetation, minimise clearing	C	2	Acceptable
Significant reduction of habitats – landscape scale	Loss of fauna habitat linkage and impact on fauna and fauna assemblage	C	2	Acceptable				

**TABLE 7**  
**FAUNA IMPACT RISK ASSESSMENT (CONT'D)**

Factor	Potential Impact	Before Management			Risk Controls	With Management		
		Inherent Risk				Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Significant reduction of habitats – regional scale	Minimal impact on fauna and fauna assemblage	B	2	Acceptable				
Increase in introduced predators	Loss of fauna and a change in the fauna assemblages	B	3	Moderate	Fauna Management Plan and feral animal control	B	2	Acceptable
Road fauna deaths	Death of fauna	D	2	Moderate	Speed limits and public awareness programs	D	1	Acceptable
Death, loss or impact on conservation significant fauna possibly present on site	Death or loss of Carpet Python	B	2	Acceptable				
	Death or loss of Brush-tailed Phascogale	D	2	Moderate	Minimise clearing of habitat containing large Marri, Tuart and Jarrah trees, minimise habitat fragmentation, clear degraded habitats before high quality habitats, staged clearing	B	1	Acceptable

**TABLE 7  
FAUNA IMPACT RISK ASSESSMENT (CONT'D)**

Factor	Potential Impact	Before Management			Risk Controls	With Management		
		Inherent Risk				Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Death, loss or impact on conservation significant fauna possibly present on site (Cont'd)	Death or loss of Western Ringtail Possum	C	3	Moderate	Minimise habitat clearing and habitat fragmentation, clear degraded habitats before high quality. Develop habitat corridors, containing Peppermints, and <i>in situ</i> Western Ringtail Possum management under a Fauna Management Plan with specific management actions/strategies addressing management of Western Ringtail Possum	B	1	Acceptable
Resident avian species	Loss of foraging and potential breeding habitat for Black-Cockatoos	C	3	Moderate	Minimise clearing of habitat containing Proteaceous species and large Jarrah and Marri trees likely to provide potential breeding habitat, minimise habitat fragmentation, clear degraded habitats before high quality habitats, staged clearing, use of suitable foraging species when planting in development – Management Plan	C	2	Acceptable
	Death or loss of Masked Owl	C	2	Acceptable				
	Peregrine Falcon	C	2	Acceptable				

**TABLE 7  
 FAUNA IMPACT RISK ASSESSMENT (CONT'D)**

Factor	Potential Impact	Before Management			Risk Controls	With Management		
		Inherent Risk				Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Terrestrial Migratory avian species	Loss of significant habitat	C	3	Moderate	Minimise clearing and habitat fragmentation; clear degraded habitats before high quality habitat;	C	2	Acceptable
Human Impacts – Noise, dust, vibration	Reduce biodiversity by forcing individuals to move out of the area	B	2	Acceptable				
Human Impacts – Spread of weeds	Changed vegetation and a resulting loss of fauna habitat.	B	2	Acceptable				

### 3.9 Potential Impacts on *EPBC Act 1999* Listed Fauna Species

Of the eight species listed as potentially occurring within the project area under the *EPBC Act 1999*, one species, the WRP, was confirmed to be present and another four species (e.g. Carnaby's Black-Cockatoo, Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo) have the potential to occur within the project area (Table 4). The potential impacts on these species are discussed in the following sections.

#### 3.9.1 Western Ringtail Possums

Western Ringtail Possums have been recorded on multiple occasions feeding on similar vegetation in the immediate region of Dardanup and across the southern areas of the Swan Coastal Plain. They have also been recorded in a number of projects within the region (Coffey Environments, 2008; 2009; 2010b and 2010c).

The mature *E. marginata*, *C. Calophylla* and *A. flexuosa* within the project area are likely to provide feeding and breeding habitat for Western Ringtail Possums.

Development of the project area may require the removal of Western Ringtail Possums foraging and breeding resources.

As the presence of WRPs within the project area was confirmed during the targeted WRP survey, the project will need to be referred under the *EPBC Act 1999*.

#### 3.9.2 Black Cockatoos

Black-Cockatoos have been recorded on multiple occasions feeding on similar vegetation in the immediate region of Dardanup and across the Swan Coastal Plain. Reports also suggest that Carnaby's and Forest Red-tailed Black-Cockatoos may have bred in the region in the past (Biota 2006). They have also been recorded in numerous projects within the area (Coffey Environments, 2009; 2010a; 360 Environmental, 2008; Gole, 2003; Turpin, 1990).

The mature Eucalypts within the project area are likely to provide feeding habitat for Black-Cockatoo species and a significant number of trees contain hollows that may potentially be used for breeding.

Development of the project area will require the removal of Forest Red-tailed and Carnaby's Black-Cockatoo foraging and potential breeding resources.

The Commonwealth *EPBC Policy Act Statement 1.1 Matters of National Environmental Significance* (DEWHA, 2006) provides criteria for determining when a development is likely to have a significant impact on Critically Endangered or Endangered species. These criteria will be applied by the Commonwealth to assess the likely impacts of the project on the Carnaby's Black-Cockatoo. An example of the application of these criteria on the Carnaby's Black-Cockatoo is provided below.

**Criteria 1. Lead to a long-term decrease in the size of a population;**

The clearing of habitat in the project area will result in the removal of Carnaby's Black-Cockatoo foraging habitat and potential breeding habitat. On the south Swan Coastal Plain more than two-thirds of the original vegetation has been cleared for urban use, agriculture and mining, and in many areas only scattered remnants of native vegetation remain. These remnants vary from small isolated patches in roadside verges to large areas of native vegetation such as Wellington National Park. In the greater Bunbury region, cockatoo foraging habitats are replicated in nearby Wellington State Park and areas of

Regional Open Space. It is Coffey Environments opinion that although the clearing will decrease areas of available foraging habitat for these species; it is unlikely to lead to a long term decrease in population size.

**Criteria 2. *Reduce the area of occupancy of the species;***

Black-Cockatoos are likely to visit for feeding purposes and may even nest in the project area. Twenty-one trees containing large hollows were observed within the project area. Clearing of large trees is likely to impact the potential foraging and breeding habitat within the project area and may therefore reduce the level of occupancy within the project area.

**Criteria 3. *Fragment an existing population into two or more populations;***

Black-Cockatoos are likely to visit the project area for feeding purposes and are unlikely to be fragmented into multiple populations as a result of the development.

**Criteria 4. *Adversely affect habitat critical to the survival of a species;***

The clearing of habitat in the survey area will have a minimal impact on available foraging habitat. Coffey Environments believe that the clearing of this habitat within the project area is not likely to lead to the decline of the species' population due to the small amount of available foraging habitat within the project area and habitat located in secure tenure in the immediate region. Breeding habitat in the Western Australian Wheatbelt is understood to be habitat critical to the survival of the species, as opposed to foraging habitat (Saunders, 1982). Although hollows were identified onsite that were large enough for cockatoos, Coffey Environments does not consider this area to be critical habitat for their breeding, given the published literature that is currently available.

**Criteria 5. *Disrupt the breeding cycle or a population;***

Clearing of large trees is likely to impact potential breeding habitat within the project area, through the removal of existing tree hollows and mature trees with the potential to form hollows in the future.

**Criteria 6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;***

Habitat in the project area currently provides small areas of potential breeding habitat and feeding areas. Retention of mature eucalypt trees (Marri and Jarrah greater than 10 m) where possible will provide a relatively continuous fragments of feeding habitat throughout the project area and will prevent the potential decline of the species in the area.

**Criteria 7. *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;***

No species harmful to Carnaby's Black-Cockatoo is likely to be introduced as a result of the development.

**Criteria 8. *Introduce disease that may cause the species to decline;***

No disease likely to be harmful to Carnaby's Black-Cockatoo is likely to be introduced as a result of the development.

**Criteria 9. Interfere with the recovery of the species.**

The Recovery Plan for Carnaby's Black-Cockatoo outlines five broad strategies for the period 2002-2012 (Cale, 2003):

- Habitat management of priority areas: This includes identifying feeding and breeding habitat in priority areas;
- Habitat management of non-breeding areas: The recovery team will encourage and promote practices to retain and increase areas of native vegetation that provide food for Carnaby's Black-Cockatoo;
- Monitoring of the Carnaby's Black-Cockatoo: Includes regularly monitoring the number of breeding pairs and use of hollows in priority areas;
- Community Involvement: A coordinated public information and participation program is considered an essential strategy for this Recovery Plan;
- Captive-Breeding Program: Continuation of the captive breeding program.

The project area contains feeding habitat and has the potential to provide breeding hollows for Carnaby's Black-Cockatoo. The proposal is likely to require referral under the *EPBC Act 1999* but given the large areas of similar habitat reserved within the region, the clearing of the habitat in the project area represents a minor proportion of the available foraging habitat within the region. There is also little evidence that this species relies on habitat in the region for breeding purposes.



## 4 DISCUSSION AND CONCLUSION

The methodology used for this Level 1 Terrestrial Fauna Assessment for the Southern Extension of the Dardanup Mineral Sands Project adequately addresses the EPA Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002) and Coffey Environments' interpretation of the EPA Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA, 2004) and the EPA (2010) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment*.

The majority of the project area is either disturbed or completely degraded. There are small areas of degraded remnant vegetation and isolated trees, many of which are dead, and discontinuous roadside and riparian vegetation. Most of the area has been grazed by cattle for many years. The site assessment indicated that patches of remnant vegetation along the road side and drainage lines may contain vegetation suitable for supporting a limited range of fauna species.

The Pasture (P) habitat with mature trees in the project area is generally in a degraded condition due to significant impact by previous anthropogenic activities and would generally be assessed as highly degraded fauna habitat that is unlikely to contain a unique fauna assemblage at a local scale or in a regional context.

The fauna habitat of the Woodland (W) in the project area is considered to be in disturbed condition due to the fragmentation, lack of understorey and significant grazing occurring in the area. Although species of conservation significant fauna utilise the Woodland habitat e.g. Southern Brush-tailed Phascogale), it is unlikely to contain a unique fauna assemblage at a local scale and in a regional context.

The Open Woodland (OW) in the project area is considered to be in disturbed condition due to the abundance of weeds, cleared understorey and significant occurring in the area. Although species of conservation significant fauna utilise the OW habitat (e.g. Black-Cockatoo species, Schedule 1), it is unlikely to contain a unique fauna assemblage at a local scale and in a regional context.

The Linear Remnant Vegetation (LRV) in the project area is considered to be in disturbed condition due to the abundance of weeds and fragmentation with other LRV patches. Despite the presence of WRP and Southern Brush-tailed Phascogales, it is unlikely to contain a unique fauna assemblage at a local scale and in a regional context.

The Riparian Vegetation (RP) was recorded along Paradise Creek in the project area and is considered to be in disturbed condition due to the abundance of weeds, limited connectivity and significant erosion from cattle. Despite the presence of WRP, it is unlikely to contain a unique fauna assemblage at a local scale and in a regional context.

Based on the available data from DEC online databases, the EPBC online database, published and unpublished reports and a visual inspection of the site, Coffey Environments' concluded that the project area does not contain fauna habitat that has high ecological significance or is in low abundance in the bioregion. Therefore the proposed development is unlikely to cause any significant loss of a fauna ecosystem of conservation significance or to significantly impact on an ecosystem of high conservation value.

The proposed Southern Extension of the Dardanup Mineral Sands Project will however result in a loss of pasture, isolated live and dead trees in paddocks, woodland and linear habitats.

A search of the DEC threatened fauna species database and the Commonwealth's online database for Protected Matters identified 24 conservation significant species that may be recorded in the region as well as a number of Migratory Bird species that would utilise local wetlands. Twelve of these species either occur on site or have the possibility of occurring on site or in the nearby vicinity. In particular, WRPs were observed within the LRV and RV habitat within the project area. The population of WRPs is likely to be isolated due to high fragmentation of suitable habitat and presence of several predators in the project area. Southern Brush-tailed Phascogales were also recorded within the LRV habitat in the project area and are likely to also occur in the W habitat.

Although no fauna habitats within the project area are likely to contain a unique fauna assemblage at both a local scale or in a regional context and is generally in a degraded condition, the development size and presence of conservation significant species will require further assessment at both the State and Federal levels.

## 5 RECOMMENDATIONS

The EPA objective for terrestrial fauna is to maintain the abundance, species diversity and geographic distribution of terrestrial fauna and protect specially protected (Threatened) fauna consistent with the provisions of the *Wildlife Conservation Act (1950)*. If the recommendations proposed below are adopted, the potential impact to terrestrial fauna and the effect on the conservation status of specially protected and significant species is likely to meet the EPA's objectives for terrestrial fauna. Therefore, Coffey Environments recommends that:

- All large trees should be retained where possible, particularly those containing hollows, to help reduce the impact of land clearing within the project area on species of conservation significance that may occur on site. These tall trees provide valuable feeding, roosting and nesting sites for locally common bird species (including conservation significant birds like Black-Cockatoo species) and aesthetic values for the public;
- Biannual monitoring of WRP population in the project area in conjunction with a control site adjacent to the project area for the project duration. This will assist in determining the secondary impacts of mining (e.g. noise, dust and vibration) on the WRP population;
- A robust feral predator control program should be undertaken in conjunction with surrounding farmers/land owners to reduce predation pressures on WRPs;
- Peppermint trees (*A. flexuosa*) should be planted in strategic areas to increase the linkage between areas of WRP habitat;
- The proposal is referred to the DEWHA for consideration under the *EPBC Act 1999* due to the presence of WRPs and loss of WRP habitat, and the anticipated loss of Carnaby's Black-Cockatoo preferred foraging habitat and potential breeding habitat;
- 'Fauna friendly' clearing protocols should be employed when clearing the vegetation;
- Any changes to the creek bed profiles during earth works and mining should be returned to pre-construction conditions; and
- Road kills' should be removed as soon as possible.

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## 7 DISCLAIMER

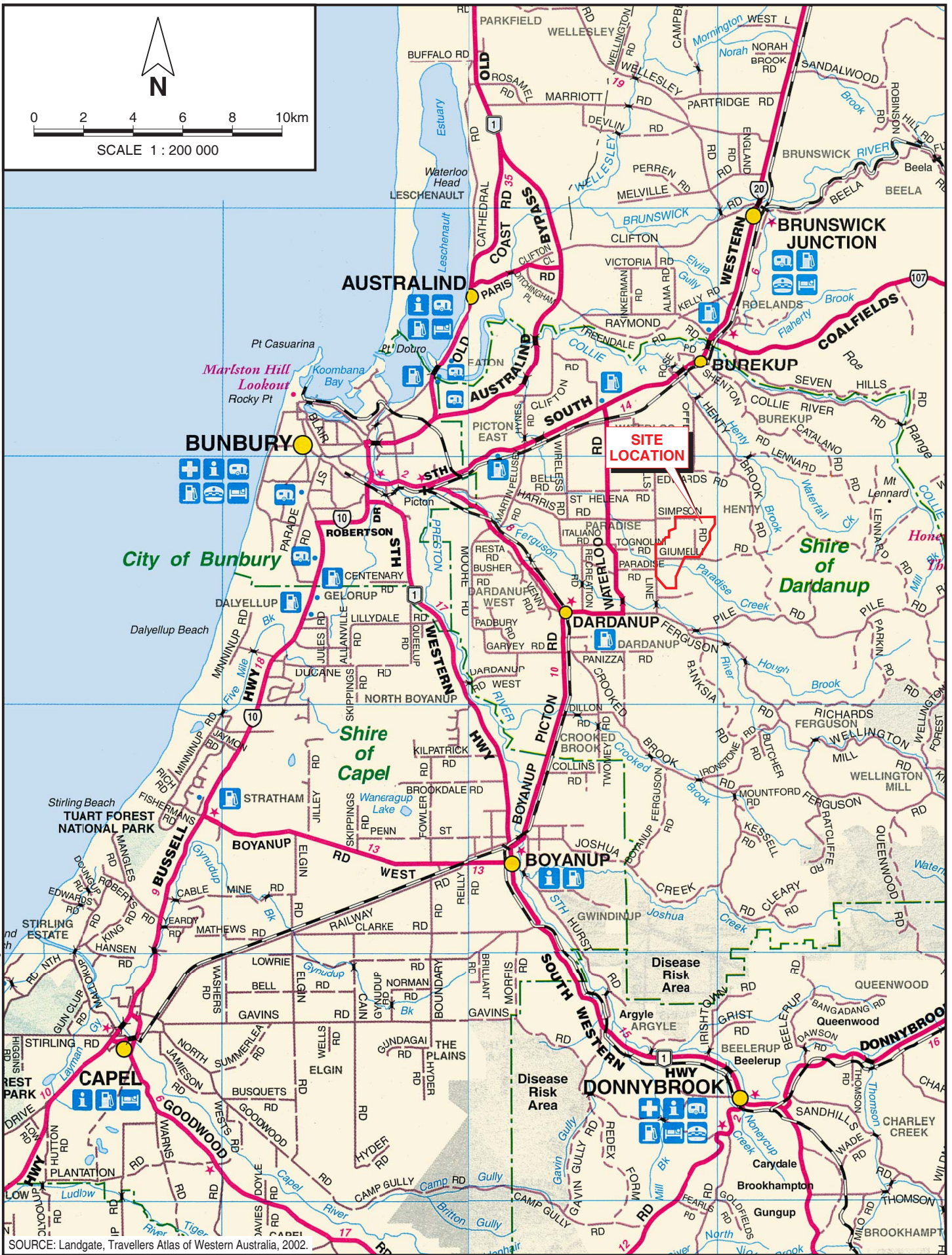
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# Figures

**Level 1 Fauna Assessment – Southern Extension of the Dardanup Mineral Sands Project**





SOURCE: Landgate, Travellers Atlas of Western Australia, 2002.

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Checked:	P. Mitrovski
Date:	7 Mar 2011
Projection:	MGA zn50
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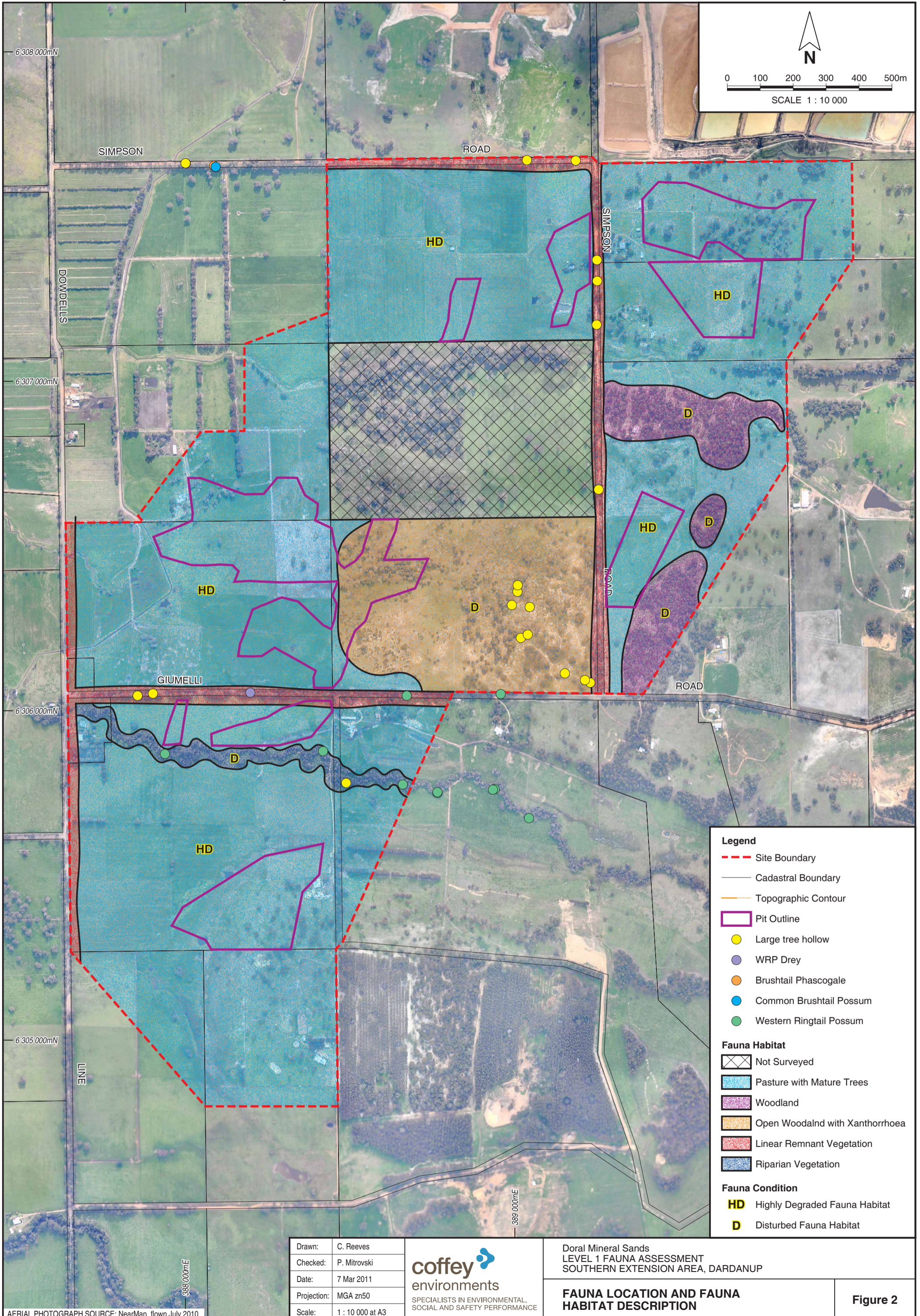
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Doral Mineral Sands  
LEVEL 1 FAUNA ASSESSMENT  
SOUTHERN EXTENSION AREA, DARDANUP

**REGIONAL LOCATION**

**Figure 1**

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**Legend**

- - - Site Boundary
- Cadastral Boundary
- Topographic Contour
- Pit Outline
- Large tree hollow
- WRP Drey
- Brushtail Phascogale
- Common Brushtail Possum
- Western Ringtail Possum

**Fauna Habitat**

- Not Surveyed
- Pasture with Mature Trees
- Woodland
- Open Woodland with Xanthorrhoea
- Linear Remnant Vegetation
- Riparian Vegetation

**Fauna Condition**

- HD Highly Degraded Fauna Habitat
- D Disturbed Fauna Habitat

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Doral Mineral Sands  
 LEVEL 1 FAUNA ASSESSMENT  
 SOUTHERN EXTENSION AREA, DARDANUP

**FAUNA LOCATION AND FAUNA HABITAT DESCRIPTION**

**Figure 2**

AERIAL PHOTOGRAPH SOURCE: NearMap, flown July 2010.

# Appendix A Terrestrial Vertebrate Fauna Potentially Occurring in the Project Area

**Level 1 Fauna Assessment – Southern Extension of the Dardanup Mineral  
Sands Project**

**Appendix A**  
Fauna Species Potentially Occurring within the Vicinity of the Project Area

Family/ Species Name	Common Name	Conservation Status <sup>1</sup>	EPBC Protected Matter Search Tool (Feb 2011)	DEC Threatened and Priority Fauna Database (Feb 2011)	NatureMap (Feb 2011)	Barnes Ave Australind (Ecologia, 2001)	Lot 801 and Lot 4 Preston Beach (Western Wildlife, 2007)	Preston Beach North (Coffey, 2007)	Burekup Mineral Sands Project Area (Ninox 2006)	Dawesville to Binningup Study Area (Hyder and Dell, 2009)	Clifton Beach, Yalgorup (Bamford 2003)	Clifton Beach (ENV 2008)	Clifton Beach (ENV 2009)	South Binningup (Metcalf and Bamford, 2008)	Dawesville to Binningup Study Area (How et al., 2009)	Maidens Area, Bunbury (Bow, 1999)	Dawesville to Binningup Study Area (Dell and Hyder, 2009)	Binningup Bat Survey (Bullen 2009)
<b>INVERTEBRATE</b>																		
<i>Pachysaga munggai</i>	(cricket)	P3		X														
<b>AMPHIBIANS</b>																		
<b>Hylidae</b>																		
<i>Litoria adelaidensis</i>	Slender Tree Frog					X					X		X					
<i>Litoria moorei</i>	Motorbike Frog										X		X	X	X			
<b>Myobatrachidae</b>																		
<i>Heleioporus eyrei</i>	Moaning Frog				X	X		X			X		X	X	X	X		
<i>Heleioporus psammophilus</i>	Sand Frog							X									X	
<i>Limnodynastes dorsalis</i>	Western Banjo Frog							X			X		X				X	
<i>Crinia georgiana</i>	Quacking Frog					X		X									X	
<i>Crinia glauerti</i>	Clicking Frog																X	
<i>Crinia insignifera</i>	Squelching Froglet					X				X			X				X	
<i>Geocrinia leai</i>	Ticking Frog														X			
<i>Pseudophryne guentheri</i>	Crawling Toadlet														X	X		
<b>REPTILES</b>																		
<b>Agamidae (Dragons)</b>																		
<i>Ctenophorus adelaidensis</i>	Southern Heath Dragon						X	X					X	X				
<i>Pogona minor</i>	Bearded Dragon						X	X			X		X	X	X	X		
<b>Boidae (Pythons)</b>																		
<i>Morelia spilota</i>	Carpet Python	S4, P4											X	X	X			
<b>Cheluidae (Freshwater turtles)</b>																		
<i>Chelodina oblonga</i>	Oblong Turtle				X								X	X				
<b>Elapidae (Elapids)</b>																		
<i>Demansia psammophis</i>	Yellow-faced Whipsnake							X			X		X					
<i>Echiopsis curta</i>	Bardick					X		X						X				
<i>Neelaps bimaculatus</i>	Black-naped Snake							X					X				X	
<i>Notechis scutatus</i>	Tiger Snake							X			X							
<i>Parasuta gouldii</i>					X						X		X					
<i>Pseudonaja affinis</i>	Dugite				X	X	X	X			X		X		X	X		
<i>Simoselaps bertholdi</i>	Jan's Banded Snake				X			X			X		X		X			
<i>Elapognathus coronatus</i>					X													
<b>Gekkonidae (Geckos)</b>																		
<i>Christinus marmoratus</i>	Marbled Gecko				X	X	X				X		X	X	X	X		
<i>Nephurus milii</i>	Barking Gecko				X													
<i>Strophurus spinigerus</i>								X			X		X		X			
<i>Strophurus strophurus</i>							X											
<b>Pygopodidae (Legless lizards)</b>																		
<i>Aprasia repens</i>															X	X		
<i>Delma fraseri</i>										X			X		X			
<i>Delma grayii</i>							X	X					X		X			
<i>Lialis burtonis</i>							X	X			X		X	X	X	X		
<i>Pygopous lepidopodus</i>	Common Scaly Foot										X		X					
<b>Scincidae (Skinks)</b>																		
<i>Acritoscincus trilineatum</i>						X	X	X			X		X		X			
<i>Cryptoblepharus buchananii</i>					X	X		X			X		X		X	X		
<i>Ctenotus australis</i>							X	X					X	X	X	X		
<i>Ctenotus impar</i>					X												X	
<i>Ctenotus labillardieri</i>																	X	
<i>Egernia kingii</i>	King's Skink				X	X												
<i>Egernia luctuosa</i>	Western Swamp Skink						X											
<i>Egernia napoleonis</i>							X	X			X		X					
<i>Hemiergis quadrilineata</i>					X	X	X	X			X		X	X	X	X		
<i>Lerista distinguenda</i>					X													
<i>Lerista elegans</i>					X	X	X				X		X	X	X	X		
<i>Lerista lineopunctulata</i>											X			X				
<i>Menetia greyii</i>					X	X	X	X			X		X	X	X	X		
<i>Morethia lineoocellata</i>					X	X	X				X		X	X	X			
<i>Morethia obscura</i>													X	X	X	X		

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<b>REPTILES (Cont'd)</b>																		
<b>Scincidae (Skinks)</b>																		
<i>Tiliqua rugosa</i>								X			X		X	X	X	X		
<i>Lerista lineata</i>	Lined Skink	P3									X		X					
<b>Typhlopidae (Blind snakes)</b>																		
<i>Ramphotyphlops australis</i>					X	X	X	X			X		X					
<i>Ramphotyphlops pinguis</i>					X													
<b>Varanidae (Goannas)</b>																		
<i>Varanus rosenbergi</i>													X			X		
<i>Varanus tristis</i>	Racehorse Monitor														X			
<b>BIRDS</b>																		
<b>Acanthizidae (Thornbills, scrubwrens and weebills)</b>																		
<i>Acanthiza apicalis</i>	Inland Thornbill				X		X	X	X									X
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				X	X	X	X	X									X
<i>Acanthiza inornata</i>	Western Thornbill				X			X										X
<i>Gerygone fusca</i>	Western Gerygone				X	X	X	X										X
<i>Sericornis frontalis</i>	White-browed Scrubwren				X		X	X										X
<i>Smicornis brevirostris</i>	Weebill				X		X	X										X
<b>Accipitridae (Kites, hawks and eagles)</b>																		
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk				X													X
<i>Accipiter fasciatus</i>	Brown Goshawk				X			X										X
<i>Aquila audax</i>	Wedge-tailed Eagle				X		X	X										X
<i>Circus approximans</i>	Swamp Harrier				X			X										
<i>Elanus axillaris</i>	Black-shouldered Kite				X													X
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	M	X		X													X
<i>Haliaeetus spheerulus</i>	Whistling Kite				X			X										X
<i>Hieraaetus morphnoides</i>	Little Eagle				X													X
<i>Lophoictinia isura</i>	Square-tailed Kite					X		X										X
<i>Pandion cristatus</i>	Osprey					X		X										X
<b>Acrocephalidae (Reed-Warblers)</b>																		
<i>Acrocephalus australis</i>	Australian Reed Warbler				X													
<b>Apodidae</b>																		
<i>Apus pacificus</i>	Fork-tailed Swift	M	X															
<b>Anatidae (Ducks and geese)</b>																		
<i>Anas gracilis</i>	Grey Teal																	X
<i>Anas platyrhynchos</i>	Mallard*				X													
<i>Anas rhynchotis</i>	Australasian Shoveler				X													
<i>Anas superciliosa</i>	Pacific Black Duck				X	X		X										X
<i>Biziura lobata</i>	Musk Duck				X													X
<i>Chenonetta jubata</i>	Australian Wood Duck				X			X	X									X
<i>Cygnus atratus</i>	Black Swan				X													X
<i>Stictonetta naevosa</i>	Freckled Duck					X												
<i>Tadorna tadornoides</i>	Australasian Shelduck				X													X
<b>Anhingidae</b>																		
<i>Anhinga novaehollandiae</i>	Australasian Darter				X	X												X
<b>Ardeidae (bitterns, herons and egrets)</b>																		
<i>Ardea ibis</i>	Cattle Egret	M	X		X													
<i>Ardea modesta</i>	Great Egret	M	X		X	X												X
<i>Ardea pacifica</i>	White-necked Herron		X															
<i>Botaurus poiciloptilus</i>	Australasian Bittern	S1			X													
<i>Egretta novaehollandiae</i>	White-faced Heron				X													X
<i>Ixobrychus duvius</i>	Little Bittern	P4			X													
<i>Ixobrychus flavicollis</i>	Black Bittern	P3			X													
<i>Nycticorax caledonicus</i>	Nankeen Night-Herron				X													
<b>Artamidae (Woodswallows, butcherbirds, currawongs and magpies)</b>																		
<i>Artamus cinereus</i>	Black-faced Woodswallow				X			X										X
<i>Artamus cyanopterus</i>	Dusky Woodswallow				X													
<i>Cracticus tibicen</i>	Australian Magpie				X		X	X	X									X
<i>Cracticus torquatus</i>	Grey Butcherbird				X		X	X										X
<i>Strepera versicolor</i>	Grey Currawong				X													X

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<b>BIRDS (Cont'd)</b>																		
<b>Burhinidae (Stone-curlews)</b>																		
<i>Burhinus grallarius</i>	Bush Stone-curlew	P4		X														
<b>Cacatuidae (Cockatoos, galahs and corellas)</b>																		
<i>Cacatua sanguinea</i>	Little Corella				X													
<i>Cacatua tenuirostris</i> *	Long-billed Corella				X													
<i>Calyptorhynchus banksii</i>	Forrest Red-tailed Black-Cockatoo	V, S1	X	X	X		X											X
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo	V, S1	X	X	X													X
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo	EN, S1	X	X														X
<i>Eolophus roseicapilla</i>	Galah				X		X	X										X
<b>Campephagidae (Cuckoo-shrikes)</b>																		
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-Shrike				X	X		X										X
<b>Casuariidae</b>																		
<i>Dromaius novaehollandiae</i>	Emu						X	X										X
<b>Charadriidae (Plovers, dotterels and lapwings)</b>																		
<i>Charadrius ruficapillus</i>	Red-capped Plover							X										
<i>Euseyornis melanops</i>	Black-fronted Dotterel				X													
<i>Erythrogonys cinctus</i>	Red-kneed Dotterel					X												
<i>Thinornis rubricollis</i>	Hooded Plover	P4		X				X										X
<i>Vanellus tricolor</i>	Banded Lapwing				X													
<b>Columbidae (Pigeons and doves)</b>																		
<i>Ocyphaps lophotes</i>	Crested Pigeon				X													X
<i>Phaps chalcoptera</i>	Common Bronzewing				X	X	X	X										X
<i>Streptopelia senegalensis</i> *	Laughing Turtle-Dove				X													X
<b>Corvidae (Ravens and crows)</b>																		
<i>Corvus coronoides</i>	Australian Raven				X	X	X	X	X									X
<b>Cuculidae (Cuckoos)</b>																		
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo																	X
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo				X	X		X										
<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo				X													X
<b>Falconidae (Falcons)</b>																		
<i>Falco berigora</i>	Brown Falcon				X													X
<i>Falco cenchroides</i>	Nankeen Kestrel				X													X
<i>Falco longipennis</i>	Australian Hobby																	X
<i>Falco peregrinus</i>	Peregrine Falcon	S4		X	X													X
<b>Halcyonidae (Forest kingfishers)</b>																		
<i>Dacelo novaeguineae</i>	Laughing Kookaburra				X	X	X	X										X
<i>Todiramphus sanctus</i>	Sacred Kingfisher				X													X
<b>Hirundinidae (Swallows)</b>																		
<i>Hirundo neoxena</i>	Welcome Swallow				X			X										X
<i>Petrochelidon nigricans</i>	Tree Martin				X	X		X										X
<b>Laridae (Noddys, turns and gulls)</b>																		
<i>Chroicocephalus novaehollandiae</i>	Silver Gull				X													X
<i>Hydroprogne caspia</i>	Caspian Tern				X													X
<b>Maluridae (Wrens)</b>																		
<i>Malurus splendens</i>	Splendid Fairy-wren				X		X	X										X
<b>Megaluridae (Grassbirds and songlarks)</b>																		
<i>Megalurus gramineus</i>	Little Grassbird				X													X
<b>Meliphagidae (Honeyeaters)</b>																		
<i>Acanthorhynchus superciliosus</i>	Western Spinebill				X													X
<i>Anthochaera carunculata</i>	Red Wattlebird				X	X	X	X	X									X
<i>Anthochaera chrysoptera</i>	Little Wattlebird				X													
<i>Epthianura albifrons</i>	White-fronted Chat							X										
<i>Glyciphila melanops</i>	Tawny-crowned honeyeater																	X
<i>Lichenostomus virescens</i>	Singing Honeyeater						X											X
<i>Lichmera indistincta</i>	Brown Honeyeater					X	X											X
<i>Melithreptus lunatus</i>	White-napped Honeyeater				X													X
<i>Phylidonyris niger</i>	White-cheeked Honeyeater																	X
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater				X	X		X										X

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<b>BIRDS (Cont'd)</b>																		
<b>Meropidae (Bee-eaters)</b>																		
<i>Merops ornatus</i>	Rainbow Bee-eater	M	X		X	X		X										X
<b>Monarchidae (Flycatchers and monarchs)</b>																		
<i>Grallina cyanoleuca</i>	Magpie-Lark				X			X	X									X
<i>Myiagra inquieta</i>	Restless Flycatcher				X													
<b>Motacillidae (Pipits and true wagtails)</b>																		
<i>Anthus novaeseelandiae</i>	Australasian Pipit				X			X										X
<b>Nectariniidae (Flower-peckers)</b>																		
<i>Dicaeum hirundinaceum</i>	Mistletoebird																	X
<b>Neositidae (Sittellas)</b>																		
<i>Daphoenositta chrysoptera</i>	Varied Sittella				X													X
<b>Pachycephalidae (Whistlers)</b>																		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush				X		X	X										X
<i>Pachycephala pectoralis</i>	Golden Whistler				X		X											X
<i>Pachycephala rufiventris</i>	Rufous Whistler				X	X	X	X										X
<b>Pardalotidae (Pardalotes)</b>																		
<i>Pardalotus punctatus</i>	Spotted Pardalote				X	X	X		X									
<i>Pardalotus striatus</i>	Striated Pardalote				X	X	X	X										X
<b>Pelecanidae</b>																		
<i>Pelecanus conspicillatus</i>	Australian Pelican				X	X												X
<b>Petroicidae (Australian robins)</b>																		
<i>Eopsaltria australis</i>	Eastern Yellow Robin																	
<i>Eopsaltria georgiana</i>	White-breasted Robin				X													
<i>Eopsaltria griseogularis</i>	Western Yellow Robin				X		X											
<i>Petroica boodang</i>	Scarlet Robin				X			X										X
<i>Petroica goodenovii</i>	Red-capped Robin					X												
<b>Phalacrocoracidae (Cormorants and shags)</b>																		
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant				X	X												X
<i>Phalacrocorax carbo</i>	Great Cormorant				X													
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant				X													
<i>Phalacrocorax varius</i>	Pied Cormorant				X													X
<b>Phasianidae (Quails and fowl)</b>																		
<i>Coturnix pectoralis</i>	Stubble Quail				X													
<b>Podargidae (Frogmouths)</b>																		
<i>Podargus strigoides</i>	Tawny Frogmouth																	X
<b>Podicipedidae (Grebes)</b>																		
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe				X													X
<i>Tachybaptus novaehollandiae</i>	Little Grebe				X													X
<b>Psittacidae (Lorikeets and parrots)</b>																		
<i>Barnardius zonarius</i>	Australian Ringneck				X	X	X	X	X									X
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet						X											X
<i>Neophema elegans</i>	Elegant Parrot				X			X										
<i>Platycercus icterotis</i>	Western Rosella	S1			X													
<i>Polytelis anthopeplus</i>	Regent Parrot																	X
<i>Purpureicephalus spurius</i>	Red-capped Parrot				X	X		X	X									X
<b>Rallidae (Rails, crake and water-hen)</b>																		
<i>Fulica atra</i>	Eurasian Coot				X													X
<i>Gallinula tenebrosa</i>	Dusky Moorhen				X	X		X										X
<i>Gallirallus philippensis</i>	Buff-banded Rail				X													
<i>Porphyrio porphyrio</i>	Purple Swamphen				X			X										X
<i>Porzana tabuensis</i>	Spotless Crake				X													
<b>Recurvirostridae</b>																		
<i>Himantopus himantopus</i>	Black-winged Stilt				X													
<b>Rhipiduridae (Fantails)</b>																		
<i>Rhipidura albiscapa</i>	Grey Fantail				X	X	X	X										X
<i>Rhipidura leucophrys</i>	Willie Wagtail				X			X	X									X

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<b>BIRDS (Cont'd)</b>																		
<b>Scolopacidae</b> (Snipes, godwits, sanpipers, curlews, tattlers, stints, phalaropes)																		
<i>Calidris ruficollis</i>	Red-necked Stint	M																
<i>Numenius madagascariensis</i>	Eastern Curlew	P4, M		X														
<i>Tringa nebularia</i>	Common Greenshank	M			X	X		X										
<b>Strigidae</b> (Hawk-owls)																		
<i>Ninox novaeseelandiae</i>	Southern Boobook				X													
<b>Threskiornithidae</b> (Ibis and spoonbills)																		
<i>Platalea flavipes</i>	Yellow-billed Spoonbill				X													
<i>Threskiornis molucca</i>	Australian White Ibis				X	X			X									X
<i>Threskiornis spinicollis</i>	Straw-necked Ibis								X									X
<b>Timaliidae</b> (White-eyes)																		
<i>Zosterops lateralis</i>	Silvereye				X	X	X	X										X
<b>Turnicidae</b> (Button-quails)																		
<i>Turnix varius</i>	Painted Button-quail				X													X
<b>MAMMALS</b>																		
<b>Bovidae</b>																		
<i>Capra hircus</i> *	Goat		X															
<i>Vulpes vulpes</i> *	Red Fox		X			X		X		X	X			X				
<i>Dasyurus geoffroii</i> ES	Chuditch	V, S1	X	X	X													
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	S1		X	X													
<b>Felidae</b> (Cats)																		
<i>Felis catus</i> *	Cat		X								X			X				
<b>Leporidae</b> (Rabbits)																		
<i>Oryctolagus cuniculus</i> *	Rabbit		X					X		X	X	X		X				
<b>Macropodidae</b> (Kangaroos and wallabies)																		
<i>Macropus fuliginosus</i>	Western Grey Kangaroo					X		X		X	X			X				
<i>Macropus irma</i>	Western Brush Wallaby	P4		X														
<i>Setonix brachyurus</i>	Quokka	V, S1	X	X	X													
<b>Molossidae</b> (Free-tail bats)																		
<i>Mormopterus planiceps</i>	Southern Free-tail Bat																	X
<i>Tadarida australis</i>	White-striped Free-tail Bat																	X
<b>Muridae</b> (Rodents)																		
<i>Hydromys chrysogaster</i>	Water-rat	P4		X														
<i>Mus musculus</i> *	House Mouse					X	X	X			X	X		X				
<i>Rattus rattus</i> *	Black Rat					X												
<b>Myrmecobiidae</b>																		
<i>Myrmecobius fasciatus</i>	Numbat	V, S1			X													
<b>Peramelidae</b> (Bandicoots)																		
<i>Isoodon obesulus fusciventer</i> P	Southern Brown Bandicoot	P5		X						X		X						
<b>Phalangeridae</b> (Brush-tailed possums)																		
<i>Trichosurus vulpecula</i>	Common Brushtail Possum				X	X	X	X			X	X		X				
<i>Bettongia penicillata</i>	Woylie	EN, S1	X	X														
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	V, S1	X	X	X					X								
<b>Suidae</b> (Pigs)																		
<i>Sus scrofa</i> *	Feral Pig		X															
<b>Tachyglossidae</b>																		
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna											X						
<b>Vespertilionidae</b> (Evening bats)																		
<i>Chalinolobus morio</i>	Chocolate Wattled Bat					X												
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat																	X
<i>Falsistrellus mckenziei</i>	Western False Pipistrelle																	X
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat																	X
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat																	X
<i>Vespadelus regulus</i>	Southern Forest Bat																	X



Appendix A

Fauna Species Potentially Occurring within the Vicinity of the Project Area

1. Conservation Status Key

*	represents an introduced species
X	represents species that were present during surveys
EN	endangered species under the <i>EPBC Act 1999</i>
V	vulnerable species under the <i>EPBC Act 1999</i>
S	schedule species under <i>Wildlife Conservation Act 1950</i> (Schedule 1, 2 and 4)
M	migratory species under <i>Wildlife Conservation Act 1950</i> (Schedule 3)
P	priority species under <i>Wildlife Conservation Act 1950</i> (P1, P2, P3 and P4)

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## **APPENDIX 2**

Dardanup Mineral Sands Mine Proposed Southern  
Extension Black Cockatoo Tree Hollow Assessment  
November 2011

Greg Harewood  
Zoologist  
PO Box 755  
BUNBURY WA 6231  
21 December 2011

Doral Mineral Sands Pty Ltd  
Lot 7 Harris Road  
PICTON WA 6229

ATTN: Craig Bovell

Dear Craig

**DARDANUP MINERAL SANDS MINE  
PROPOSED SOUTHERN EXTENSION  
BLACK COCKATOO TREE HOLLOW ASSESSMENT  
NOVEMBER 2011**

**Introduction**

This letter report provides a summary of the results of a black cockatoo tree hollow assessment carried out over sections of Doral's proposed southern mine extension (the study area) located near their existing Dardanup mineral sand mine.

A recent tree survey carried out by Aurora Environmental located five trees within the proposed mine disturbance area which contained one or more medium to large sized hollows (i.e. ~>10cm diameter entrance). The aim of the assessment reported on here was to assess each of these trees and the hollows present and provide comment on their potential to represent existing or potential black cockatoo breeding habitat.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black cockatoo *Calyptorhynchus baudinii*, Carnaby's black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso*.

**Previous Surveys**

Trees containing large hollows potentially suitable for black cockatoos within and near the study area were previously searched for and recorded by Coffey in 2011 (Coffey 2011). Coffey's criteria for hollows suitable for black cockatoo species to potentially breed in were those with an entrance diameter of greater than 20cm. This criterion was based on information they obtained from the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (referenced as *pers. comm*, DEWSHA 2009 in Coffey 2011).

Coffey identified 21 trees containing large hollows within the project area (see Table 1 below and Figure 1). None of the identified trees were within proposed mine disturbance areas.

**Table 1: Trees identified by Coffey's as containing large (>20cm entrance diameter) hollows**

ID	Tree Species	Number of Hollows	Tree Height (m)	Easting	Northing
C1	Marri	1	12	389229	6306085
C2	Dead Standing	Multiple	8	389213	6306093
C3	Marri	1	11	389152	6306113
C4	Dead Standing	Multiple	6	389018	6306221
C5	Dead Standing	Multiple	3	389039	6306231
C6	Dead Standing	Multiple	7	389045	6306315
C7	Marri	1	15	388991	6306321
C8	Marri	1	13	389008	6306361
C9	Marri	1	15	389009	6306381
C10	Marri	1	14	387901	6306052
C11	Marri	1	8	387855	6306046
C12	Dead Standing	Multiple	8	388001	6307661
C13	Marri	1	13	388000	6307662
C14	Marri	1	14	389037	6307671
C15	Dead Standing	Multiple	8	389185	6307670
C16	Dead Standing	Multiple	5	389249	6307368
C17	Marri	1	9	389250	6307305
C18	Dead Standing	Multiple	6	389248	6307172
C19	Marri	1	8	389254	6306671
C20	Marri	1	10	388488	6305781
C21	Dead Standing	Multiple	4	388092	6307650

Aurora Environmental have recently (November 2011) carried out a detail survey of trees with proposed mine disturbance areas. During this time they recorded five trees which contained one or more medium to large sized hollows (i.e. ~>10cm diameter entrance) not previously identified by Coffey. Details of these trees are provided in Table 2 and Figure 1 (number of hollows refers to all hollows present not just those with >20cm entrance diameter).

**Table 2: Trees identified by Aurora as containing medium to large (>10cm entrance diameter) hollows**

ID	Tree Species	Number of Hollows	Tree Height (m)	Easting	Northing
H1	Jarrah	Multiple	15-20	389823	6307470
H2	Jarrah	Multiple	20+	389797	6307399
H3	Jarrah	Multiple	20+	389461	6306392
H4	Marri (dead)	Multiple	15-20	388484	6306132
H5	Marri	Multiple	20+	388562	6306237

## **Scope of Works**

The scope of works for the assessment reported on here was to:

- Assess each of the recently identified habitat trees (H1 to H5) for the potential to represent actual (in use or signs of previous use) or potential (presence of large hollows) black cockatoo breeding habitat.

## **Methods**

### **Day Time Field Survey**

Each of the identified trees (H1 to H5) were visited and assessed from ground level for the presence of hollows. Details on tree species, number, type and entrance size of hollows were recorded as were details of any evidence indicating present or past use (e.g. chew marks). The assessment has included a comment on the likelihood of any hollows present representing an actual or potential black cockatoo nest hollow.

For the purposes of this study a potential cockatoo nest hollow was defined as:

*Generally any tree which is alive or dead that contains one or more visible hollows (cavities within the trunk or branches) suitable for occupation by any of the three black cockatoo species for the purpose of nesting/breeding. Hollows that had an entrance greater than about 12cm in diameter and that would allow the entry of a cockatoo (white tailed or red-tailed) into a suitably sized branch/tree trunk will be recorded as a "potential nest hollow".*

The actual internal dimensions of hollows observed were not determined and so this assessment of potential suitability is based solely on the size of the hollow entrance and the size and orientation of the branch/trunk it provides access to.

The day time was carried out on the 1 December 2011 by Greg Harewood and Craig Bovell.

### **Dusk Survey**

A dusk survey was undertaken in the vicinity of H1 and H2. The aim of the dusk survey was to confirm daytime observations that the hollows seen within these two trees were not in current use by black cockatoos. The dusk survey was carried out between 6pm and 8pm on the 1 December 2011 by Greg Harewood and Glen Murray.

## **Survey Limitations**

The results and conclusions presented here are based upon field data and monitoring carried out over a limited period of time and must therefore be considered merely indicative of the environmental condition of the site at the time of the field assessments.

The assessment of habitat trees from ground level is likely to result in an over estimation of the number of hollows that would be suitable for use by black cockatoos as the full characteristics (e.g. depth) of each hollow cannot be made. It should also be noted that some tree species have a much lower propensity to develop hollows suitable for black cockatoos than others (e.g. Jarrah trees have very low probability of developing large hollows compared to Marri - Kirkby 2009).

The location of habitat trees and other observations were recorded using a handheld gps. The accuracy of the GPS cannot be guaranteed above a level of about 5 to 10 metres, though it should be noted that in some circumstance the accuracy can be worse or better than this.

## **Results**

### Day Time Field Survey

The results of the daytime field survey are shown in Table 3. Trees H1, H2 and H3 were observed to contain hollows that based on entrance and branch/trunk size, can be considered possibly suitable for black cockatoos to use for nesting, though none showed any evidence of past or present use in this respect. Trees H4 and H5 did not appear to have hollows that would be suitable for black cockatoos to use for nesting.

Tree H3 is, based on information provided by Craig Bovell, located just outside of the area of proposed disturbance and therefore is unlikely to be directly impacted on when mining proceeds. Trees H1 and H2 are located within the disturbance footprint and will required removal for mining to proceed.

### Dusk Survey

The dusk survey carried out near H1 and H2 did not record any black cockatoo activity in or near either tree.

## **Conclusion and Recommendations**

The assessment identified three of the five trees as containing hollows possibly suitable for cockatoos to use for nesting purposes. No evidence of any hollow actually being used by black cockatoos for nesting either in the past or present was found and it is concluded that they have not, up to the time of the survey, been used for this purpose.

Trees H1 and H2 will required removal for mining to proceed. It is recommended that these trees (and others potentially containing large hollows) be re-assessed for black cockatoo use immediately prior to clearing.

It is generally not practical to examine all hollows directly for other resident fauna and therefore the use of a suitably experienced "fauna spotter" during clearing is also suggested. The "fauna spotter" should be employed to inspect logs, trees and hollows (where possible)

before clearing to reduce likelihood of injury to fauna. Trees observed to contain hollows (or other fauna refuge sites such as dreys) should be felled, if possible, in a manner that reduces the likelihood that fauna present will be injured. Hollows in fallen trees should then be inspected for fauna prior to removal/stockpiling. If feasible any fauna encountered should be relocated to suitable retained habitat nearby. Native fauna injured during clearing operations should be taken to a designated veterinary clinic or a DEC nominated wildlife carer.



Greg Harewood  
Zoologist

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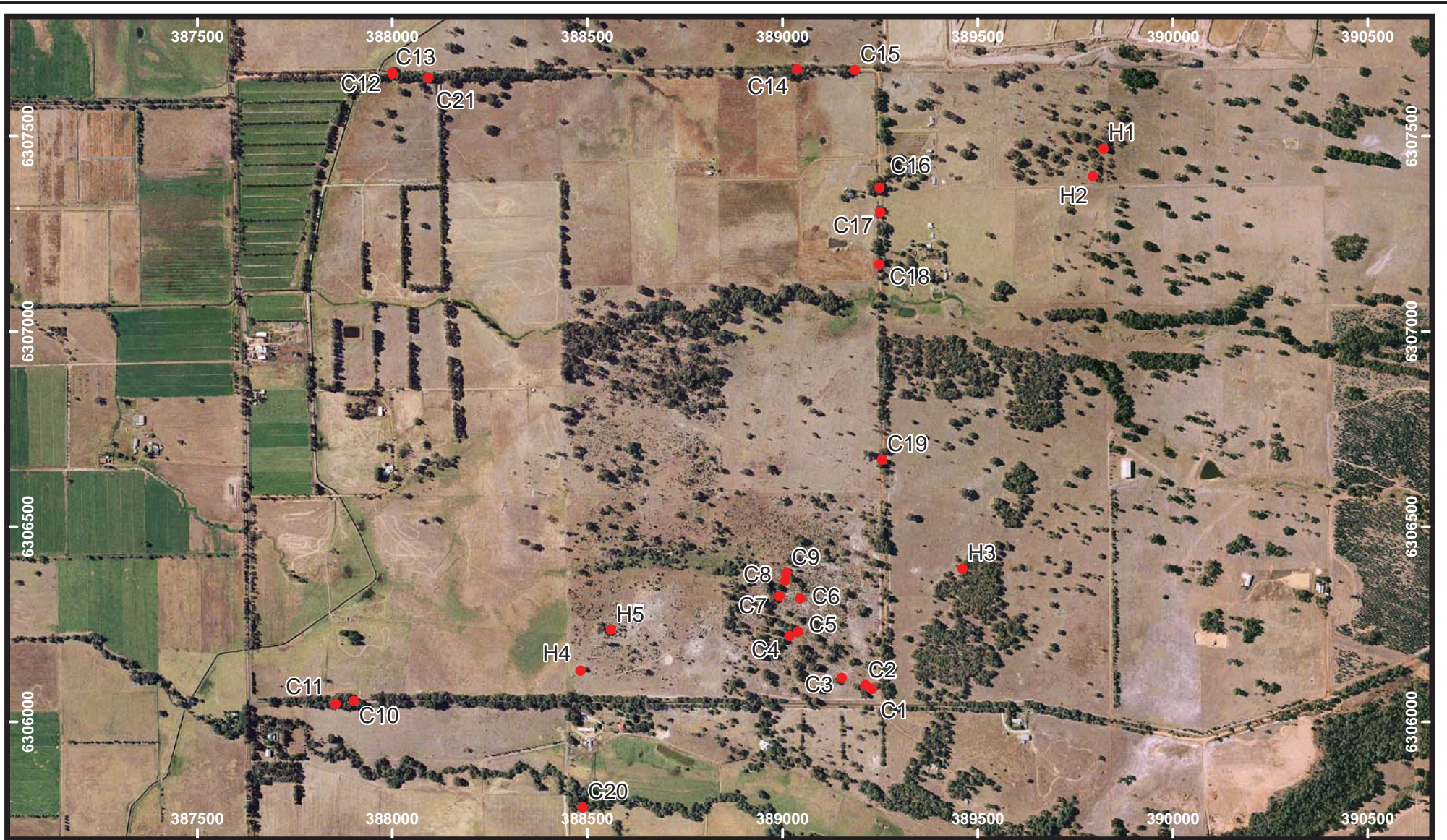
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Table 3: Habitat Trees - Doral South Extension

Datum = GDA94

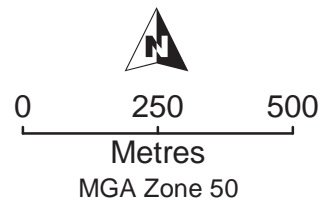
Waypoint Number	Zone	mE	mN	Tree Species	DBH	Tree Height	Number of Hollows	Hollow Type 1	Hollow Size 1	Hollow Type 2	Hollow Size 2	Hollow Type 3	Hollow Size 3	Hollow Type 4	Hollow Size 4	Hollow Type 5	Hollow Size 5	Occupancy	Chew Marks	Potential Cockatoo Nest Hollow	Comments
H1	50	389823	6307469	Jarrah	>50	15-20	5+	Knot Hole	10-20	Fissure	20+	Branch	5-10	Branch	10-20	Branch	10-20	No signs	No signs	Yes	
H2	50	389796	6307398	Jarrah	>50	20+	5+	Knot Hole	20+	Branch	20+	Branch	5-10	Branch	10-20	Branch	5-10	No signs	No signs	Yes	
H3	50	389461	6306392	Jarrah	>50	20+	5+	Knot Hole	20+	Fissure	20+	Branch	5-10	Branch	10-20	Branch	5-10	No signs	No signs	Yes	Outside of disturbance area. Tree dying
H4	50	388483	6306132	Dead	>50	15-20	5+	Fissure	20+	Spout Trunk	20+	Branch	5-10	Branch	5-10	Branch	5-10	No signs	No signs	No	Large hollow too open/shallow for nesting
H5	50	388561	6306236	Marri	>50	20+	5+	Knot Hole	5-10	Branch	5-10	Branch	10-20	Branch	5-10	Branch	5-10	Bees	No signs	No	Bees. Hollows too small





**Legend**

- Trees potentially containing medium to large hollows
- C1 to C21 = Coffey 2011, H1 to H5 = Aurora 2011



DRAWN: G Harewood  
 DATE : Dec 2011  
 SCALE: 1:14,000

Doral Mineral Sands Pty Ltd  
 Southern Mine Extension

**Habitat Trees with Possible Large Hollows**