

JIM'S SEEDS, WEEDS AND TREES PTY LTD

**VERTEBRATE FAUNA ASSESSMENT
AVOCA RESOURCES**



VERSION 1

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REPORT NO: 2006/209

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1. INTRODUCTION

1.1 Background and Purpose and Scope

Avoca Resources is proposing to undertake more intensive exploration activity around an existing mining operation approximately 55km south of Kambalda, WA (Figure 1).

ATA Environmental was commissioned by Jim's Seeds, Weeds and Trees Pty Ltd to undertake a Level 1 vertebrate fauna assessment and to make recommendations on fauna related issues that should be addressed prior to any more detailed exploration being undertaken by Avoca Resources.

The fauna assessment was undertaken in accordance with the Environmental Protection Authority (EPA) *Terrestrial Biological Surveys as an Element of Biodiversity Protection Position Statement No. 3* (EPA 2002) and ATA Environmental's interpretation of *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (EPA 2004). These statements require a Level 1 fauna assessment for developments with impacts that are assessed as either 'low' or 'moderate' in the bioregion of the proposed project area.

A Level 1 fauna assessment includes a review of the relevant literature and databases, a reconnaissance survey to verify the desktop survey and delineate flora and fauna values for the area, and a broad-scale vegetation and vegetation condition mapping based on selected sites.

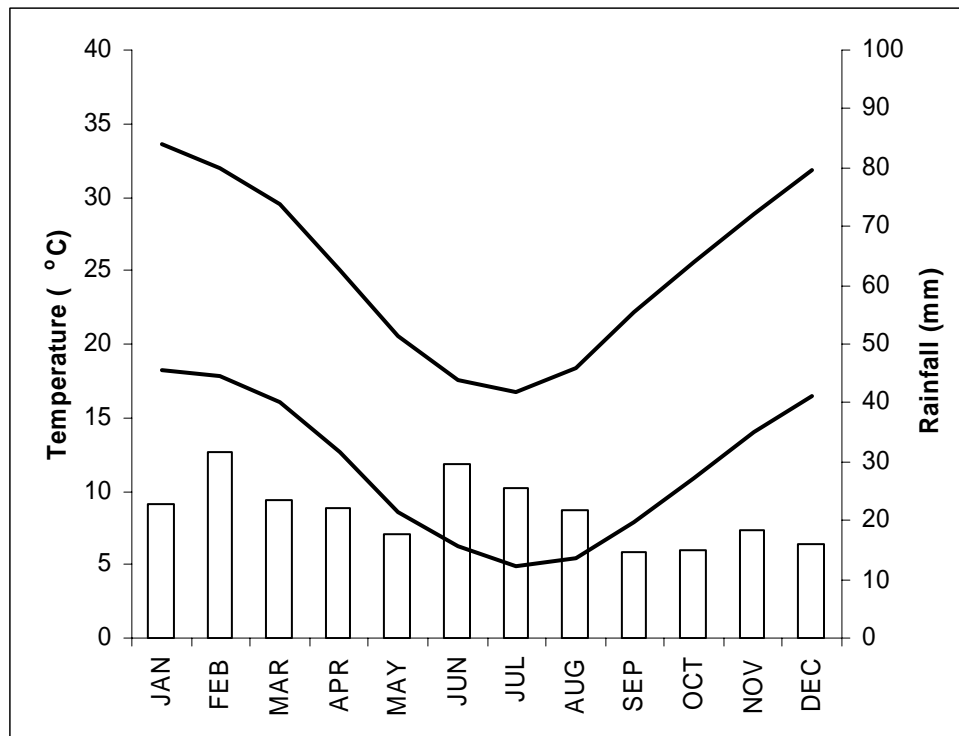
This report includes:

- a review of the Western Australian Museum on-line database (*FaunaBase*) to identify potential vertebrate fauna in the area;
- results from a search of the Department of Conservation and Environment's (DEC) Threatened and Priority Species database to identify potential scheduled and threatened species in the region;
- results from a search of the Commonwealth's on-line database to identify fauna species of national environmental significance that are protected under the *Environment Protection and Biodiversity Conservation Act 1999* potentially occurring in the area;
- a review of the published and unpublished literature that ATA Environmental could access to provide a list of fauna that have potential to occur in the region;
- discussion on the potential impacts of the development on the fauna and fauna habitat; and
- management recommendations to minimise the potential impacts on the fauna.

1.2 Climate

The climate of the region is arid, and typically characterised by cool winters and hot, dry summers. Recording of the local climatic conditions commenced at Kalgoorlie-Boulder Airport in 1939 (Bureau of Meteorology 2006). These data have been used to generate an understanding of the climate of the region in preference to the data now being gathered in Kambalda due to its long history. Highest monthly maxima occur in January, averaging 33.6°C, and lowest monthly minima occur in July, averaging 4.9°C. Rainfall mainly occurs in winter, with a dry period between October and December (Bureau of Meteorology 2006; Chart 1); the annual average rainfall is 268.4mm.

GRAPH 1
CLIMATE AVERAGES FOR KALGOORLIE-BOULDER AIRPORT (TO 2004)



Note: Upper line represents average daily maxima, lower line represents average daily minima and bars represent average monthly rainfall.

(Source: http://www.bom.gov.au/climate/averages/tables/cw_012038.shtml)

2. METHODOLOGY

2.1 Database Searches

A desktop search of the Western Australian Museum (WAM) online database (*FaunaBase*) was used to develop a list of potential bird, reptile, mammal and amphibians in the general project area. The search area was bounded by latitude 30.88°–31.88°S, and longitude 121.31°–122.31°E. Predominantly marine and freshwater species (e.g. petrels, albatrosses, pelicans, cormorants, darters, sea turtles) presented in the search of *FaunaBase* along with obvious exotics, have not been considered as the proposed development does not include a marine or freshwater habitat. This large search area was used as there were limited data in *FaunaBase* for the specific study site and the habitats represented within the project area are quite widespread.

Other more 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 (2003) for birds; and Strahan (2000) for mammals.

Collectively these sources of information were used to create lists of 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 (e.g. water birds). In addition, because *FaunaBase* is also a historical record and it can include species that are now locally extinct. *FaunaBase* records numerous species as being caught in a location, when they are actually specimens that have been held in captivity in the area (e.g. private collection) or have been transported to the area. Most of these species have been deleted from the list of species likely to be found south of Kambalda.

Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the specific project area. Also, 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 will be included in the lists produced from these database searches but will not be present in the actual project area.

A search of the DEC Threatened and Priority Fauna database by Jims Seeds, Weeds and Trees Pty Ltd to identify potential Threatened or Priority species in the region (Appendix 1). A search of the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* online database was also undertaken for the area 30.88°–31.88°S, and 121.31°–122.31°E to identify species of conservation interest to the Commonwealth Government. The results of this search were supplemented by desktop assessments aimed at identifying where geographical distributions of all listed species coincided with the Coolgardie IBRA region.

2.2 Regional Data

The study area is within the Coolgardie IBRA biogeographic region (Cowan 2001) and is part of the COO3 Eastern Goldfields subregion (Cowan 2001). The Coolgardie IBRA extends across the majority of the goldfields from approximately Paynes Find, south east to the Nullarbor Plain at Point Culver. Several systematic fauna surveys have been conducted across the bioregion, including Newby *et al.* (1984), Handley (1991), Chapman *et al.* (1991) and

McKenzie and Hall (1992). The area has been identified as one of high species diversity, especially associated with the goldfields Eucalypt woodlands (Cowan 2001).

Several fauna assessments have also been undertaken on St Ives Gold Mine tenements, including one by Halpern Glick Maunsell (1998) [describing the findings of Ninox (1995)], Ninox Wildlife Consulting (2004) and Jim's Seeds, Weeds and Trees (2005; 2006). The trapping effort employed during some of these surveys is now considered inadequate to assess species richness or assemblage structure; however, they provide useful contextual information concerning the project area.

Extensive fauna surveys have been undertaken in eleven of the major habitat types in the vicinity of Ora Banda (50km to the north of the project area), that are typical of habitats in the Goldfields. These surveys commenced in 2000 and are part of an ongoing fauna investigation for the bioregion and have been undertaken multiple times in each season and on five occasions in January when the small vertebrate fauna are most active. This is one of the largest, long-term, systematic terrestrial fauna surveys undertaken in Australia. These data have been reported in numerous publications (Thompson and Thompson, 2002, 2005a,b; Thompson, Thompson and Fraser, 2003; Thompson *et al.* 2003a,b; Thompson, Thompson and Withers, 2005a,b).

Data from these investigations underpin this Level 1 fauna assessment.

Many of the earlier fauna survey reports provide lists of predicted species for the area or presence and absence lists for a study site. Only the reports by Ninox (2004), Halpern Glick Maunsell (1998; including data from Ninox 1995) and numerous publications by Thompson *et al.*, provide quantitative trapping data.

Taxonomy and nomenclature for fauna species used in this report are mostly those used in *FaunaBase* which presumably follows Aplin and Smith (2001) for amphibians and reptiles, How *et al.* (2001) for mammals, and Johnstone and Storr (1998, 2004) for birds. Where data have been referred to in the appendices, ATA Environmental has presumed that the identification and nomenclature were correct at the time of printing these reports. ATA Environmental has not verified any of these listed species with the Western Australian Museum.

2.3 Site Assessment

The field assessment was conducted by Dr Scott Thompson on 2 August 2006 to examine the habitat types available for amphibians, reptiles, mammals and birds. Dr Scott Thompson has previously conducted fauna surveys of similar habitat in the Goldfields region of Western Australia. The site was traversed by vehicle and on foot. No trapping was conducted as part of this assessment. The weather was fine and warm for the duration of the site visit.

2.4 Limitations

This assessment is primarily based on Western Australian Museum records made available through *FaunaBase*, unpublished information from surveys surrounding the project area, a search of the DEC Threatened Fauna database and habitat preferences for each species. These databases do not provide a comprehensive coverage of the state and are not adequate to provide species lists for small-scale sites. Large search areas are generally used in order to generate species lists for small sites, and in this case, a rectangular search area was used to cover the project area. *FaunaBase* and Birds Australia species lists are therefore likely to

include numerous species not likely to be found at any specific location within the search area. Species that will obviously not generally be found in the area have been removed.

The list of species generated from a search of the on-line databases did not contain a number of species caught or observed in similar habitat in the region. A number of species that were expected to occur in the project area were also not included in the generated lists. This information would suggest the area has not been surveyed by people likely to voucher specimens with the Western Australian Museum or Birds Australia databases. The species list is therefore likely to be incomplete. Surveys completed by ATA Environmental, Thompson *et al.*, Halpern Glick Maunsell (1998) [describing the findings of Ninox (1995)], Ninox Wildlife Consulting (2004), Newby *et al.* (1984), Handley (1991), Chapman *et al.* (1991) and McKenzie and Hall (1992) have been used to supplement these database searches.

Conclusions and management recommendations about the vertebrate faunal diversity in the region have been made based on the results from surveys in the bioregions including and surrounding the project area and comparisons of the results from searches of available databases and regional reports. It is acknowledged that multiple surveys in each habitat type, conducted in different seasons, repeated over several years are necessary to cater for seasonal and temporal variations in the faunal assemblage.

Short-range endemic invertebrates were not considered as part of this assessment.

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 1.

**TABLE 1
FAUNA SURVEY LIMITATIONS AND CONSTRAINTS**

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out the survey	No	The scientist who conducted the assessment has 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	Not applicable	
Sources of information	No	Vertebrate fauna information was available using the Western Australian Museum <i>FaunaBase</i> and unpublished reports conducted in the region.
Proportion of the task achieved	No	The conservation value of the area has been demonstrated by this assessment and results from other published and unpublished surveys in the region.
Timing/weather/season/cycle	Not applicable	
Disturbances which affected results of the survey	No	Access was sufficient to characterise the project area.
Intensity of survey effort	No	The intensity of the assessment is sufficient for a Level 1 assessment.
Completeness	No	The project area was traversed on foot and by vehicle and habitats examined. No trapping was undertaken.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	There were no access or remoteness issues.
Availability of contextual information on the region	No	WAM fauna database, DEC Threatened and Priority species lists, and a comprehensive terrestrial fauna survey database for the general area.

Negligible – less than 20%; Moderate – 20-60%; significant – greater than 60%

3. RESULTS AND DISCUSSION

3.1 Fauna Habitats

Based on the results of the site reconnaissance survey there is a single fauna habitat that covers the entire study area. The fauna habitat can be broadly described as open Eucalypt Woodland with a chenopod and acacia shrubland understorey (Plate 1a and b). This habitat contains the normal range of variations in soil and vegetation that would be expected across a landscape of this size. The study area has good ground cover of leaf litter and organic matter throughout the area. There are no creek lines, however there is a small granite, greenstone and quartz rocky breakaway in the central area of the site (Plate 2).

There is an existing open pit and waste dump (Plate 3) in the southern portion of the study area and extensive evidence of exploration activity across the southern half of the study area (Plate 4a and b).

3.2 Avifauna

Bird species recorded within the vicinity of the project area are listed in Appendices 1a and 1b. The project area is in an area of high species diversity, probably due to the diversity of habitat types. It is also a region where arid-zone species and south-west species are at the fringes of their distributions and overlap in the woodlands and heathlands of the Goldfields. A total of 154 species could potentially be found in the general locality (Appendices 1a and 1b), however, not all of these species are expected to be observed, forage or nest in the general area. There are always going to be vagrants present in an area because of unusual weather (e.g. flooding, storms).

No avifauna species listed as conservation significant under the *EPBC Act 1999* or *Wildlife Conservation Act 1950* were recorded on site during this reconnaissance survey, but the Malleefowl, Slender Thornbill, Rainbow Bee-eater, Peregrine Falcon, Fork-tailed Swift, Australian Bustard, and Bush Stone-curlew have the potential to use the project area.

3.3 Herpetofauna

Herpetofauna species likely to be present in the region are listed in Appendix 1 along with reptile species reported as being caught in the region in similar habitats during other fauna surveys.

The Carpet Python is the only herpetofauna species of conservation significance that is potentially present in the project area.

3.4 Mammals

Mammal species likely to be present in the region are listed in Appendix 1 along with species reported as being caught in the region in similar habitats during other fauna surveys.

The Greater Long-eared Bat (*Nyctophilus timoriensis*) has been recorded in the region.

3.5 Species Potentially Occurring Within the Project Area Identified as Being of National Environmental Significance

No World Heritage properties, National Heritage places, Wetlands of International Significance (i.e. Ramsar Wetlands), Commonwealth marine areas or Threatened Ecological Communities were identified by on-line searches. The only species listed as Endangered or Vulnerable under the *EPBC Act 1999* and likely to be found or recorded in the area are the Slender-billed Thornbill (*Acanthiza iredalei iredalei*) and the Malleefowl (*Leipoa ocellata*). Migratory species such as the Fork-tailed Swift (*Apus pacificus*), Great Egret (*Ardea alba*), Cattle Egret (*Ardea ibis*) and Rainbow Bee-eater (*Merops ornatus*) were also identified as likely to occur or utilize habitat within the area.

In Western Australia, all native fauna species are protected under the *Wildlife Conservation Act 1950*. Fauna species that are considered rare, threatened with extinction or have a high conservation value are specially protected under the Act. In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australian Migratory Bird Agreement (JAMBA) and the China and Australian Migratory Bird Agreement (CAMBA). In addition to the above classification, and rare and endangered fauna are registered under the *Wildlife Conservation (Specially Protected Fauna) Notice 2005* into four schedules. 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.

DEC also catalogue 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 & 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.

Table 2 includes species that were listed after conducting searches of the DEC Threatened and Priority species database, the WAM on-line fauna database *FaunaBase*, the *EPBC Act 1999* online database and DEC's list of fauna of conservation significance for the Goldfields region. Therefore there are species included in Table 2 that have not been located in the Kambalda region and are unlikely to occur in the area.

No species listed as conservation significant under the *EPBC Act 1999* or *Wildlife Conservation Act 1950* were recorded on site during this reconnaissance survey, but the Malleefowl, Slender Thornbill, Rainbow Bee-eater, Peregrine Falcon, Fork-tailed Swift, Australian Bustard and Bush Stone-curlew have the potential to utilise habitats within the project area. Threatened and Priority species listed under the *Wildlife Conservation Act* or DEC's database that may potentially occur within the study area are listed in Table 2. Included are two Schedule 1 species, and one Schedule 4 species. Seven species with a priority listing with DEC have also been predicted or recorded in the general area. The likelihood of species listed under government legislation or conservation programs being found in the project area are discussed below.

TABLE 2
SPECIES OF CONSERVATION-SIGNIFICANT FAUNA (COMMONWEALTH AND STATE LISTINGS) THAT HAVE POTENTIAL TO UTILISE THE PROJECT AREA

Species	Status under Wildlife Conservation Act	Status under Commonwealth EPBC Act	Potential to be found in the project area
<i>Leipoa ocellata</i> Malleefowl	Schedule 1	Vulnerable Migratory	<i>Potentially</i> found within woodland within the project area.
<i>Acanthiza iredalei iredalei</i> Slender-billed Thornbill		Vulnerable	<i>Likely</i> to utilise the salt-pans and samphire flats within the region but not likely to be in the project area.
<i>Merops ornatus</i> Rainbow Bee-eater		Migratory	<i>Recorded</i> in the region.
<i>Apus pacificus</i> Fork-tailed Swift		Migratory	<i>Likely</i> to utilise the project area, but is an aerial species not known to land, and as such unlikely to be affected by any development.
<i>Falco peregrinus</i> Peregrine Falcon	Schedule 4		<i>Likely</i> to utilise the woodlands of the project area.
<i>Cacatua leadbeateri</i> Major Mitchell's Cockatoo	Schedule 4		<i>Potentially</i> utilises the woodlands of the project area.
<i>Morelia spilota imbricata</i> Carpet Python	Schedule 4		<i>Recorded</i> in the region.
<i>Hylacola cauta whitlocki</i> Shy Heathwren	Priority 4		<i>Recorded</i> in the region.
<i>Oreoica gutturalis gutturalis</i> Crested Bellbird	Priority 4		<i>Recorded</i> in the region.
<i>Pomatostomus superciliosus ashbyi</i> White-browed Babbler	Priority 4		<i>Recorded</i> in the region, however the sub-species are unclear.
<i>Ardeotis australis</i> Australian Bustard	Priority 4		<i>Likely</i> to utilise the woodlands in the project area.
<i>Burhinus grallarius</i> Bush Stone-curlew	Priority 4		<i>Likely</i> to utilise the woodlands in the project area.
<i>Nyctophilus timoriensis</i> Greater Long-eared Bat	Priority 4		<i>Recorded</i> in the region.

3.6 Significant Fauna with a Potential to Utilise the Project Area

Below is a brief description of the preferred habitat of species listed in Table 2 and ATA Environmental's assessment of the likelihood of these species being found within the project area.

Malleefowl (*Leipoa ocellata*) – The Malleefowl is a large, mound building bird that spends the majority of its time on the ground. Breeding involves the construction and maintenance of a large mound of decaying vegetation and small stones, which are used to incubate the eggs. Although the reproduction period is limited to a couple of months, the maintenance of the mound requires attention from the male for the majority of the year. Disturbance to the mounds can cause pairs to abandon them, although abandoned mounds are often re-colonised and reused.

Clearing and predation by feral species have caused marked population declines, particularly in the Wheatbelt region. Ninox Wildlife Consulting (2004) recorded a very old disused mound on Delta Island. Although not recorded in any of the recent surveys, Malleefowl could possibly utilise the shrublands and woodlands within the project area.

It is ATA Environmental's recommendation that any proposed clearing of large tracks of vegetation that contain suitable habitat for Malleefowl (e.g. dense with open areas at ground level) should be grid searched before clearing commences.

Slender-billed Thornbill (*Acanthiza iredalei iredalei*) – This bird is very similar in appearance to other thornbills. The Slender-billed Thornbill is olive-grey on the back, with creamy underparts and a pale buff rump. Slender-billed Thornbills preferred habitat is samphire flats and sandplain heath, and are therefore likely to be limited to these sections of the project area. It would be expected along the shores of Lake Lefroy and other such saline clay-pans.

It is ATA Environmental's assessment that any proposed clearing of vegetation along the shores of Lake Lefroy or other saline clay patches within the project area should be undertaken in a manner that minimises the impact on this species.

Rainbow Bee-eater (*Merops ornatus*) – The Rainbow Bee-eater is a migratory bird that arrives in the south-west of WA in late September – early October and nests in a burrow dug in the ground. It is found in a wide variety of sandy habitats throughout Australia. This species is listed as a Migratory species under the *EPBC Act*.

This species was recorded during the survey and breeding burrows were recorded in sand banks near site 10.

It is ATA Environmental's assessment that any clearing of the project area is unlikely to significantly impact on this species, as it will most probably move its foraging (and breeding) to adjacent areas of undisturbed habitat.

Fork-tailed Swift (*Apus pacificus*) - This species breeds in the northeast and mid-east Asia and winters in Australia and southern New Guinea. It is a visitor to most parts of Western Australia, beginning to arrive in the Kimberley in late September, in the Pilbara and Eucla in November and in the southwest land division in mid-December, and leaving by late April. The Fork-tailed Swift is an almost exclusively aerial species, foraging and sleeping on the wing. It rarely comes to earth, usually only for breeding. It is common in the Kimberley, uncommon to moderately common near northwest, west and southeast coasts and rare to scarce elsewhere. Usually flocks (up to 2000)

occur when changed weather conditions (e.g. storms and cyclones) occur. ATA Environmental considers that any proposed land clearing will have a non-significant impact on this species as there are many other suitable foraging and breeding sites for this species in the general vicinity, and, given their aerial nature, are unlikely to be primarily or peripherally impacted by exploration activities.

Peregrine Falcon (*Falco peregrinus*) – This species is uncommon, although widespread throughout much of Australia, excluding the extremely dry areas and has a wide and patchy distribution. It shows a habitat preference for areas near cliffs along coastlines, rivers and ranges and within woodlands along watercourses and around lakes.

Given the abundance of suitable habitats in the region, ATA Environmental has determined that any clearing is unlikely to significantly impact this species.

Major Mitchell's Cockatoo (*Cacatua leadbeateri*) – This large, pink cockatoo is found across the arid zone of Australia, however, its distribution is patchy and the species has been suggested to be nomadic. They are often found foraging in mallee and mulga vegetation, but require hollows in large trees to breed. They are expected to occasionally forage in habitats within the project area, but are probably not reliant upon them. The project area contains a few large trees that have suitable breeding hollows for Major Mitchell's Cockatoo.

It is ATA Environmental's assessment that clearing may impact on Major Mitchell's Cockatoo if it includes large hollow-bearing Eucalypts. If these large trees can be avoided during clearing, this will preserve potential breeding hollows for this and other species. However, clearing of vegetation is unlikely to significantly impact on this species.

Carpet Python (*Morelia spilota imbricata*) – The South-west Carpet Python is a large snake found across the south-west of Western Australia, north to Geraldton and Yalgoo, and east to Kalgoorlie, Fraser Range and Eyre. They inhabit forest, heath, or wetland areas and shelter in hollow logs or in branches of large trees. Carpet Pythons are often found in colonies, particularly when breeding in spring. This species is widespread within the southwest, but is not in high density across its distribution.

The Carpet Python has been observed on numerous occasions in the region indicating that there is a resident population. However, small populations of Carpet Pythons are known from a number of locations in the bioregions, and are likely to be widespread but in low densities. It is therefore ATA Environmental's assessment that any proposed clearing of vegetation within the project area is unlikely to significantly impact on this species. It is recommended that Carpet Pythons that are caught on site be relocated to undisturbed areas, as this will improve their chances of survival.

Shy Heathwren (*Hylacola cauta whitlocki*) – This species is reliant upon dense shrub and heath undergrowth of mallee communities. The Shy Heathwren was recorded during this survey, and would be expected across the majority of the project area, but is likely to be confined to very specific habitats. Disturbance of these dense scrub and heath habitats will impact on this species most probably causing them to move to adjacent areas.

ATA Environmental's assessment is that any proposed clearing of vegetation within the project area is unlikely to significantly impact on this species, however, if it is possible areas of dense shrub and heath undergrowth of mallee woodlands should remain undisturbed.

Crested Bellbird (*Oreoica gutturalis gutturalis*) – This species has probably been listed as a result of habitat loss due to clearing in the wheatbelt region as its preferred habitat is woodlands and shrublands. Outside of the wheatbelt, threats to this species are generally not significant as the habitat utilised by this species is widespread across the project area. The species was recorded during other surveys in the region but not within the project area.

It is ATA Environmental's assessment that any vegetation clearing will not significantly impact on the Crested Bellbird, as it is likely to move to adjacent areas once clearing commences.

White-browed Babbler (*Pomatostomus superciliosus*) – Austral-Papuan Babblers, as a group tend to be omnivorous and live in highly sociable, territorial groups. Due to their territoriality, these groups are quite sedentary. This is a ground-dwelling species with a preference for dense shrubs and heathlands. It is, however, widespread and relatively common and was recorded in the region during previous surveys in most habitat types. This species has probably been listed as a result of habitat loss due to clearing in the wheatbelt region. Outside of the wheatbelt, threats to this species are generally not significant.

It is ATA Environmental's assessment that any vegetation clearing will not significantly impact on the White-browed Babbler, as it is likely to move to adjacent areas once clearing commences.

Australian Bustard (*Ardeotis australis*) – Preferring open woodlands and grasslands, the Australian Bustard is a large, ground bird with a distinctive body shape. Although not flightless, Bustards spend the greater proportion of the time on the ground and tend to run from danger rather than fly. Predation by introduced species, including anthropogenic hunting, and habitat loss has caused population declines. This species is expected to utilise habitats across much of the project area.

It is ATA Environmental's assessment that any vegetation clearing will not significantly impact on the Australian Bustard, as they are likely to move to adjacent undisturbed areas once clearing commences.

Bush Stone-curlew (*Burhinus grallarius*) – Bush Stone-curlews are nocturnal and inhabit open woodlands, and live in small groups. This species would be expected in any of the woodland habitats within the project area. The tendency of this species to freeze when in danger makes them vulnerable to feral predators. The Bush Stone-curlew is becoming rare in the southern sections of its range, a possible result of habitat loss or feral predation.

It is ATA Environmental's assessment that any vegetation clearing will not significantly impact on the Bush Stone-curlew, as they are likely to move to adjacent undisturbed areas once clearing commences.

Greater Long-eared Bat (*Nyctophilus timoriensis*) – This bat has a wide distribution, and inhabits a wide range of woodland and forest habitats, often roosting in tree hollows. The Greater Long-eared Bat's forage mainly by gleaning in the understorey, and may be threatened in Western Australia by habitat loss, since they utilise woodlands that have been heavily cleared for agriculture. This bat was recorded in previous surveys in the region.

It is ATA Environmental's assessment that any vegetation clearing will not significantly impact on the Greater Long-eared Bat, as they are likely to move to adjacent undisturbed areas once clearing commences.

3.7 Other Species

There are a number of species which resulted from searches of the DEC Threatened and Priority species database, the WAM on-line fauna database *FaunaBase*, the *EPBC Act 1999* online database and DEC's list of fauna of conservation significance for the Goldfields region which are considered unlikely to utilise the project area. Although the species listed in Table 3 are unlikely to utilise the area, they are included as potential species for consideration as fauna assessments need to be based on the precautionary principle (EPA 2002). Comments on why each species is considered unlikely to inhabit the project area are provided in Table 3.

TABLE 3
SPECIES OF CONSERVATION-SIGNIFICANT FAUNA (COMMONWEALTH AND STATE LISTINGS) THAT ARE UNLIKELY TO UTILISE THE PROJECT AREA

Species	Status under Wildlife Conservation Act	Status under Commonwealth EPBC Act	Reason that the species is considered Unlikely to utilise the project area
<i>Calyptorhynchus latirostris</i> Short-billed Black Cockatoo, Carnaby's Cockatoo	Schedule 1	Endangered	Whitlock (1937) reported them in the vicinity of Norseman over 60 years ago, but they have not been recorded in the area in recent years.
<i>Phascogale calura</i> Red-tailed Phascogale	Schedule 1	Endangered	Project area lies on the northern fringe of the species geographical distribution.
<i>Dasyurus geoffroyi</i> Chuditch	Schedule 1	Vulnerable	Unlikely due to lack of recent records.
<i>Polytelis alexandrae</i> Princess Parrot	Priority 4	Vulnerable	Project area lies on the south-western fringe of the species geographical distribution.
<i>Myrmecobius fasciatus</i> Numbat	Schedule 1	Vulnerable	Presumed extinct in the region.
<i>Branchinella denticulata</i>	Priority 1		Known only from Gidgi Lake north of the project area.
<i>Jalmenus aridus</i>	Priority 1		Known from only a single colony, on a single <i>Acacia</i> tree in the vicinity of Lake Douglas, north-west of the project area.
<i>Ogyris subterrestris petrina</i>	Priority 1		Known only from Lake Douglas, north-west of the project area.
<i>Aspidites ramsayi</i> Woma	Priority 1		The Woma Python has been recorded to the northeast and northwest of this site, however, there are no records nearby. It is unlikely to be in the project area.
<i>Lerista puncticauda</i>	Priority 2		Project area lies on the western fringe of the species geographical distribution.

Species	Status under Wildlife Conservation Act	Status under Commonwealth EPBC Act	Reason that the species is considered Unlikely to utilise the project area
<i>Acanthophis antarcticus</i> , Southern Death Adder	Priority 3		Project area lies on the northern fringe of the species geographical distribution.
<i>Platycercus icterotis xanthogenys</i> Western Rosella	Priority 3		Project area lies on the northern fringe of the species geographical distribution.
<i>Falco hypoleucos</i> Grey Falcon	Priority 4		Project area does not lie within the species established geographical distribution. Species is highly nomadic, and vagrant individuals regularly leave the distribution, but viable populations are not known outside the distribution.
<i>Macropus irma</i> Western Brush Wallaby	Priority 4		Project area lies on the extreme north-eastern fringe of the species geographical distribution.
<i>Ardea alba</i> Great Egret		Migratory	Unlikely due to lack of suitable habitat
<i>Ardea ibis</i> Cattle Egret		Migratory	Unlikely due to lack of suitable habitat
<i>Charadrius rubricollis</i> Hooded Plover	Priority 4		Unlikely due to lack of suitable habitat

3.8 Introduced and Feral Animals

A number of introduced and feral animals have been recorded in the region. Cats (*Felis catus*) and foxes (*Vulpes vulpes*) are both regularly observed crossing roads nearby. If cats or foxes are present on site, clearing of vegetation may force the fox and cat populations into the adjacent habitats. This could have a short-term impact on the native fauna in these areas.

3.9 Biodiversity Value

The EPA's Position Statement No. 3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* indicated that 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).

It is ATA Environmental's view that species of mammals, reptiles, birds and amphibians present or likely to visit the project area would also be present or visit other similarly vegetated areas in the region, and habitats of similar vegetation structure are extensive outside of the project area. Species of conservation interest have been addressed above. The habitat throughout the area is uniform except for a small portion containing a greenstone/granite breakaway. The habitat type found within the project area is similar to that found at St Ives, and the study site 'Salmon Gums' and 'Palace' (Thompson et al., 2003) that have been comprehensively surveyed nearby (Appendix 1). There is nothing in the available data to

suggest that the faunal assemblage in the project area is likely to be unique, have particular conservation significance or contains fauna habitat that is limited in the area and is therefore significant.

It is therefore ATA Environmental's assessment that the proposed clearing of this land is unlikely to have any significant affect on species or ecosystems of conservation significance.

It is not possible to assess the biodiversity value at a genetic level based on the information available.

3.10 Ecological Functional Value at the Ecosystem Level

Although this site has been disturbed and is fragmented by tracks, it is a large area with much of the habitat in good to very good condition from a faunal perspective. It therefore provides habitat for the normal range of vertebrate species found in similar habitats in the region. This site represents only a small fraction of the available similar habitat in this bioregion. Although all undisturbed habitat has ecological value, there is nothing that is obviously special or significant about this site, provided it does not contain Malleefowl, which would warrant special protection if the proposed clearing were to occur.

3.11 Additional Fauna Surveys

Based on information contained in the EPA's *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, Guidance Statement No 56* (Table 3; EPA, 2004) it could be argued that a Level 2 fauna survey is necessary for this site. Recent correspondence from the Minister for the Environment (pers. comm. 24 November 2005) indicated that where the WAM, CALM (now part of the DEC) and the Terrestrial Section of the Department of the Environment (DoE) are familiar with the historical fauna surveys for the bioregion further vertebrate fauna surveys to assess likely impacts of a proposal were unnecessary given the substantial information that was already available. Much of this site is similar to those that the author has extensively surveyed in recent years and the general area has been surveyed as part of the WAM and DEC surveys of the Goldfield region.

There is no doubt that a comprehensive survey of the site would provide a detailed list of the species for this particular area but it is unlikely to differ much from that provided in the 'St Ives', 'Salmon Gums' and 'Palace' columns in Appendix 1. Based on the Minister's communication, the EPA and DoE routinely accepting this level of documentation for the terrestrial fauna and that there is no evidence to suggest that species of conservation significance, other than possibly Malleefowl, will be significantly impacted by this development, ATA Environmental can see no justification for additional fauna survey work to be undertaken.

If certain habitat types are likely to be significantly impacted by clearing, targeted searches for conservation significant species may be necessary.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

Of the possible species listed for the area under the *EPBC Act 1999* the Rainbow Bee-eater, Slender-billed Thornbill, Fork-tailed Swift and Malleefowl possibly frequent the area proposed to be cleared. The site represents a very small fraction of similar habitat in the general area. Migratory birds, such as the Rainbow Bee-eater, have many alternative sites to forage and are not likely to be impacted on by the clearing of this site.

ATA Environmental's assessment is that the proposed clearing of this site is unlikely to have any significant affect on this species. It is possible that the Malleefowl could be using some of the shrublands and woodlands in the area. As this species is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the *Wildlife Conservation Act 1950* further investigation is recommended if suitable habitat is to be cleared.

The Carpet Python, Peregrine Falcon, Shy Heathwren, Crested Bellbird, White-browed Babbler, Bush-stone Curlew, Greater Long-eared Bat and Australian Bustard are almost certainly in the general area. If Carpet Pythons are in the general area then it is possible that they are on this site. Carpet Pythons are generally found in low numbers and are dispersed across a relatively large area. Clearing of habitat is likely to locally impact upon the Carpet Python and Greater Long-eared Bat, however, given the many square kilometres of similar habitat in the adjacent area clearing is unlikely to be a significant impact on either of these species regionally. The other conservation species listed are birds and are therefore likely to move if clearing occurs. ATA Environmental's assessment is that the proposed clearing of this site is unlikely to have any significant impact on these species.

Presuming that Malleefowl are not detected on the site, then ATA Environmental could find no evidence to suggest that this site contains an ecosystem or ecosystem value that is of conservation significance from a faunal perspective or is significantly different to that in the adjacent areas, and therefore warrant some level of special protection.

4.2 Recommendations

ATA Environmental recommends that:

- a) dense shrubland is identified through flora surveys and is grid searched for Malleefowl and their breeding mounds prior to any clearing activity;
- b) large hollow bearing trees are left wherever possible;
- c) habitat clearing is minimised wherever possible; and
- d) the clearing contractor and other people involved in clearing the site be made aware of the possible presence of Carpet Pythons in the area, so that individuals that are seen might be relocated to suitable habitat.

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PLATES



Plate 1a Eucalypt Woodland with a Chenopod Shrubland



Plate 1b Eucalypt Woodland with an Acacia Shrubland



Plate 2 Rocky Breakaway



Plate 3 Rehabilitated Mine Waste Dump



Plate 4a Evidence of Exploration Activity



Plate 4b Evidence of Exploration Activity

FIGURES

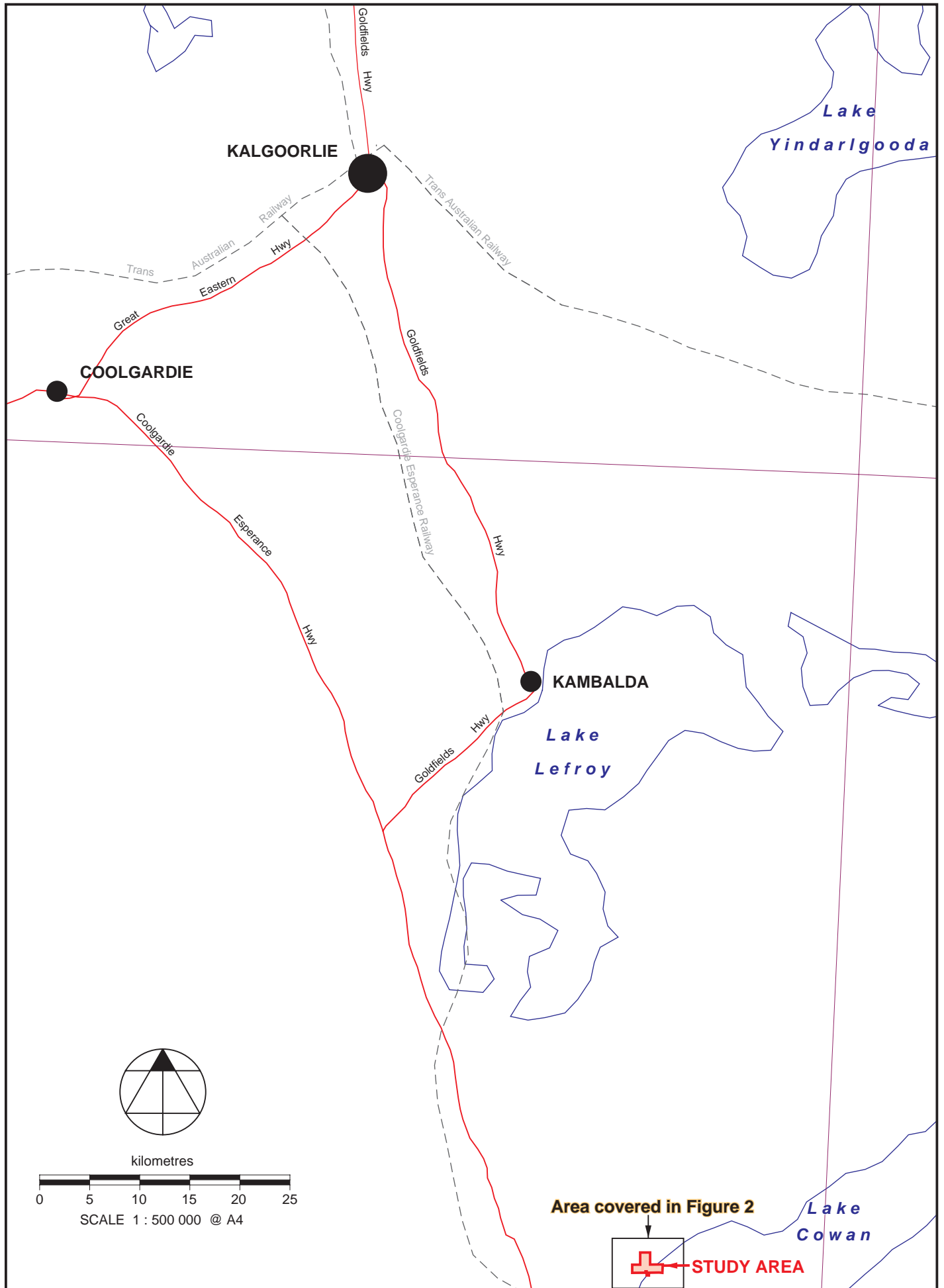
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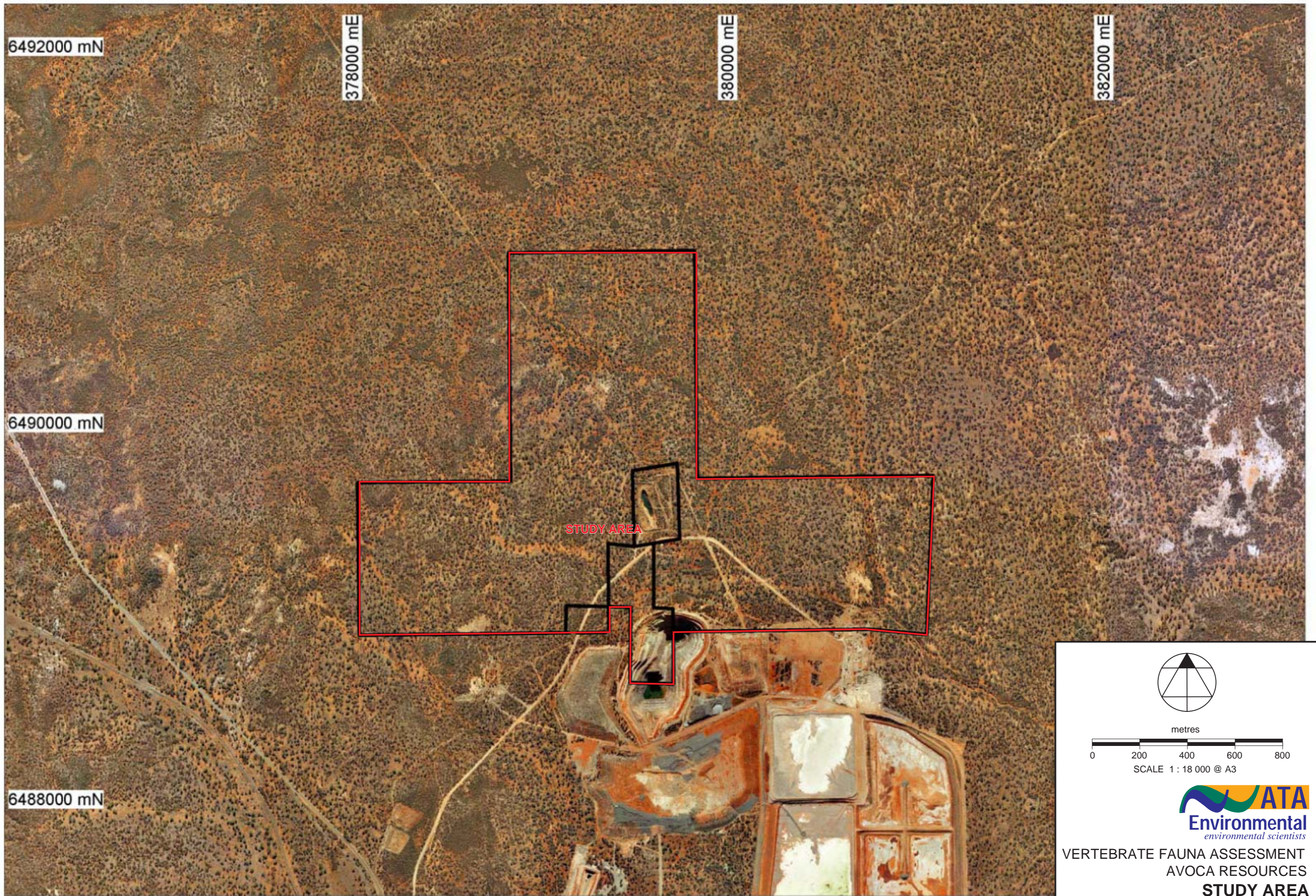
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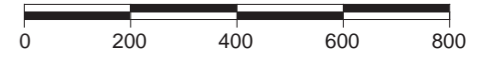
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metres



SCALE 1 : 18 000 @ A3



VERTEBRATE FAUNA ASSESSMENT
 AVOCA RESOURCES
STUDY AREA
 FIGURE 2

APPENDICES

APPENDIX 1A

**SPECIES PREDICTED FROM DATABASE
SEARCHES, CAUGHT DURING THE SURVEYS
OR IN OTHER SYSTEMATIC FAUNA SURVEYS
TO THE NORTH OF THE PROJECT AREA**

Family Genus species	Common name	EPBC	ST IVES	Kurnalpi-Kalgoorlie									Ora Banda							Chapman <i>et al.</i> (1991)										
				Qpv	Qqs	Qas	As	Agb	Qqz	Qps	Ts	Tg	Crossroads	Davyhurst	Floodplains	Gimlet	Golden Arrow	Palace	Rose	Salmon Gums	Security	Spinifex	Wendy Gully	KNR #1	KNR #2	KNR #3	KNR #4	KNR #5	KNR #6	KNR #7
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill		11		2	33	25	67	42	2	3	12													X	X				
<i>Aphelocephala leucopsis</i>	Southern Whiteface							18				2																		
<i>Calamanthus fuliginosus</i>	Striated Fieldwren																													
<i>Gerygone fusca</i>	Western Gerygone																													
<i>Hylacola cauta whitlocki</i>	Shy Heathwren		7																											
<i>Pyrrholaemus brunneus</i>	Redthroat		3			2	1	14	6	2		7																		
<i>Smicromis brevirostris</i>	Weebill		99		155	12	77	15	137	42	55	40											X	X	X	X	X			
MELIPHAGIDAE																														
<i>Lichmera indistincta</i>	Brown Honeyeater		4				30	2				2																X		
<i>Certhionyx niger</i>	Black Honeyeater																													
<i>Certhionyx variegatus</i>	Pied Honeyeater																													
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater																													
<i>Lichenostomus virescens</i>	Singing Honeyeater		6			9	15	10				1																		
<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater											2																		
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater		172		30		8					1											X	X		X	X		X	
<i>Lichenostomus leucotis</i>	White-eared Honeyeater		13		3				7	2	1	1															X			
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater						5		17	9																				
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater								7																					
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater				11	17	19	4	15	6	15																			
<i>Manorina flavigula</i>	Yellow-throated Miner		31		86	52	36		2	10	1	1													X			X	X	
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater		7		10	20	14	21	13	13	12	22														X	X			
<i>Anthochaera carunculata</i>	Red Wattlebird		168		31																		X	X	X		X		X	
<i>Epthianura albifrons</i>	White-fronted Chat																													
<i>Epthianura tricolor</i>	Crimson Chat																													
<i>Epthianura aurifrons</i>	Orange Chat																													
POMATOSTOMIDAE																														
<i>Pomatostomus superciliosus</i>	White-browed Babbler		14		5	1	28	23			3	18																		
PETROICIDAE																														
<i>Drymodes brunneopygius</i>	Southern Scrub-robin		9																											
<i>Eopsaltria griseogularis</i>	Western Yellow Robin																													
<i>Microeca fascinans</i>	Jacky Winter				11	1	6		8													X					X			
<i>Microeca flavigaster</i>	Lemon-breasted Flycatcher																													
<i>Petroica cucullata</i>	Hooded Robin				1																									
<i>Petroica goodenovii</i>	Red-capped Robin				5	5	6	187	14		5	7																		X
<i>Poecilodryas superciliosa</i>	White-browed Robin																													
CINCLOSOMATIDAE																														
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush		1																								X	X		
PACHYCEPHALIDAE																														
<i>Falcunculus frontatus</i>	Crested Shrike-tit																													
<i>Oreoica gutturalis</i>	Crested Bellbird		13		5	5		6	5	1	2	2													X	X	X		X	
<i>Pachycephala rufiventris</i>	Rufous Whistler							7	10	1	5	8																		
<i>Pachycephala inornata</i>	Gilbert's Whistler																													
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		15		1		1	9	7			2															X		X	
DICRURIDAE																														

Vegetation for each of the habitat types surveyed and listed in Appendix 1a
Qpv - Eucalypt low woodland
Qqs - Eucalypt woodland
Qas - Acacia woodland
As - Low woodland
Agb - Tall shrubland
Qqz - Acacia low woodland
Qps - Eucalypt woodland
Ts - Breakaway and tall shrubs
Tg - Breakaway and tall shrubs
Crossroads - Chenopod/Broom Bush (<i>Eremophila scoparia</i>) shrubland with scattered Eucalypt trees (<i>Eucalyptus clellandii</i> and <i>E. salmonophloia</i>)
Davyhurst - <i>Eucalyptus clellandii</i> and <i>Allocasuarina eriochlamys</i> ssp. <i>eriochlamys</i> woodland over mixed woody shrubs
Floodplains - Sparse chenopod shrubland and is a common vegetation community in the area
Gimlet South - Acacia/ <i>Allocasuarina</i> woodland over a mixed shrubland of perennial woody species
Golden Arrow - Open mixed shrubland with spinifex (<i>Triodia</i>) grass
Palace - Open <i>Eucalyptus</i> woodland over chenopod shrubs
Rose - Open <i>Eucalyptus</i> woodland over chenopod shrubland
Salmon Gums - Open <i>Eucalyptus salmonophloia</i> woodland over a shrub layer of chenopod species and broom-bush (<i>E. scoparia</i>)
Security - <i>Acacia aneura</i> woodland over poverty bush (<i>Eremophila</i> spp) and mixed shrubs
Spinifex - <i>Acacia</i> woodland over mixed shrubs and spinifex (<i>Triodia</i>) grass
Wendy Gully - Open <i>Eucalyptus</i> woodland over <i>Acacia</i> shrubs and spinifex (<i>Triodia</i>) grass
KNR #1 - Salmon Gum woodland on sandy clay loam
KNR #2 - Mixed eucalypt woodland on clayey sand
KNR #3 - Redwood/Gimlet woodland on clayey sand
KNR #4 - Griffiths Grey Gum mallee on clayey sand
KNR #5 - Griffiths Grey Gum woodland on sandy loam
KNR #6 - Mixed eucalypt woodland on sandy loam
KNR #7 - opportunistic on Kurrawang Nature Reserve

APPENDIX 1B

SPECIES PREDICTED FROM DATABASE SEARCHES OR CAUGHT IN OTHER SYSTEMATIC FAUNA SURVEYS IN THE REGION AND TO THE SOUTH OF THE PROJECT AREA

Family Genus species	Common name	Chapman <i>et al.</i> (1991)															Halpern Glick Maunsell (1998)						Ninox Wildlife Consulting (2004)			
		BRNR #1	BRNR #2	BRNR #3	BRNR #4	BRNR #5	BRNR #6	CHNR #1	CHNR #2	CHNR #3	CHNR #4	CHNR #5	CHNR #6	CHNR #7	DRNR #1	DRNR #2	DRNR #3	DRNR #4	DRNR #5	SL	H	LF		LS	OMT	M/S
<i>Aquila audax</i>	Wedge-tailed Eagle					X						X										+	+	+		X
<i>Aquila morphnoides</i>	Little Eagle		X			X							X									+	+	+		X
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle																									
<i>Circus assimilis</i>	Spotted Harrier																									
<i>Circus approximans</i>	Swamp Harrier																									
FALCONIDAE																										
<i>Falco berigora</i>	Brown Falcon						X					X										+	+	+	+	X
<i>Falco cenchroides</i>	Australian Kestrel																					+	+	+		X
<i>Falco longipennis</i>	Australian Hobby																					+	+	+	+	
<i>Falco hypoleucos</i>	Grey Falcon																							+		
<i>Falco peregrinus</i>	Peregrine Falcon																					+	+	X	+	X
<i>Falco subniger</i>	Black Falcon																					+	+	+	+	
RALLIDAE																										
<i>Gallinula ventralis</i>	Black-tailed Naitve Hen																					+				
<i>Rallina fasciata</i>	Red-legged Crake																									
<i>Fulica atra</i>	Eurasian Coot																					+				
SCOLOPACIDAE																										
<i>Limosa limosa</i>	Bar-tailed Godwit																					+				
<i>Tringa nebularia</i>	Common Greenshank																					+				
OTIDIDAE																										
<i>Ardeotis australis</i>	Australian Bustard																						+	+	+	
BURHINIDAE																										
<i>Burhinus grallarius</i>	Bush Stone-curlew																								+	
RECURVIROSTRIDAE																										
<i>Himantopus himantopus</i>	Black-winged Stilt																					+	+			
<i>Cladorhynchus leucocephalus</i>	Banded Stilt																					+	+			X
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet																					+	+			X
CHARADRIIDAE																										
<i>Charadrius ruficapillus</i>	Red-capped Plover																					+	+			X
<i>Charadrius rubricollis</i>	Hooded Plover																					+	+			
<i>Vanellus tricolor</i>	Banded Lapwing					X																				
LARIDAE																										
<i>Sterna nilotica</i>	Gull-billed Tern																					+	+			
<i>Sterna hybrida</i>	Whiskered Tern																					+	+			
COLUMBIDAE																										
<i>Phaps chalcoptera</i>	Common Bronzewing		X			X						X											+	+	+	X
<i>Ocyphaps lophotes</i>	Crested Pigeon																						+	+		X
PSITTACIDAE																										
<i>Cacatua roseicapilla</i>	Galah																						+	+		
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo																							+		
<i>Nymphicus hollandicus</i>	Cockatiel																							+		
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet		X		X		X	X							X							+		X	+	X
<i>Polytelis alexandrae</i>	Princess Parrot																							+	+	
<i>Polytelis anthopeplus</i>	Regent Parrot		X	X	X		X					X												+	+	X
<i>Barnardius zonarius semitorquatus</i>	Australian Ringneck			X	X	X	X	X	X			X			X	X	X					+	X	X	+	X

Family Genus species	Common name	Chapman <i>et al.</i> (1991)															Halpern Glick Maunsell (1998)						Ninox Wildlife Consulting (2004)						
		BRNR #1	BRNR #2	BRNR #3	BRNR #4	BRNR #5	BRNR #6	CHNR #1	CHNR #2	CHNR #3	CHNR #4	CHNR #5	CHNR #6	CHNR #7	DRNR #1	DRNR #2	DRNR #3	DRNR #4	DRNR #5	SL	H	LF		LS	OMT	M/S			
<i>Platycercus icterotis xanthogenys</i>	Western Rosella											X																	
<i>Platycercus varius</i>	Mulga Parrot							X																	+				
<i>Neophema splendida</i>	Scarlet-chested Parrot																								+	+			
<i>Melopsittacus undulatus</i>	Budgerigar																								+				
CUCULIDAE																													
<i>Cuculus pallidus</i>	Pallid Cuckoo																					X			+	+	X		
<i>Chrysococcyx osculans</i>	Black-eared Cuckoo																									+	X		
<i>Chrysococcyx basalus</i>	Horsfield's Bronze Cuckoo																								+	+	X		
STRIGIDAE																													
<i>Ninox novaeseelandiae</i>	Boobook Owl												X												+	+	+		
TYTONIDAE																													
<i>Tyto alba</i>	Barn Owl																								+	+	+		
PODARGIDAE																													
<i>Podargus strigoides</i>	Tawny Frogmouth							X																	+	+	+	X	
CAPRIMULGIDAE																													
<i>Eurostopodus argus</i>	Spotted Nightjar												X												+	+			
AEGOTHELIDAE																													
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar												X		X										+	+	X		
APODIDAE																													
<i>Apus pacificus</i>	Fork-tailed Swift																												
HALCYONIDAE																													
<i>Dacelo novaeguineae</i>	Laughing Kookaburra																												
<i>Todiramphus pyrrhopygia</i>	Red-backed Kingfisher																									+	X		
<i>Todiramphus sanctus</i>	Sacred Kingfisher												X														X		
MEROPIDAE																													
<i>Merops ornatus</i>	Rainbow Bee-eater					X	X		X		X	X		X			X								+	+	X		
NEOSITTIDAE																													
<i>Daphoenositta chrysoptera</i>	Varied Sittella																									+	+	X	
CLIMACTERIDAE																													
<i>Climacteris rufa</i>	Rufous Treecreeper																	X					X		X	+	X		
<i>Climacteris affinis superciliosa</i>	White-browed Treecreeper																												
MALURIDAE																													
<i>Malurus lamberti</i>	Variegated Fairy-wren	X		X			X				X														+	+	+	+	
<i>Malurus leucopterus</i>	White-winged Fairy-wren																								+		X		
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren																										X		
<i>Malurus splendens</i>	Splendid Fairy-wren																								+	+	+		
<i>Amytornis textilis</i>	Thick-billed Grasswren																												
PARDALOTIDAE																													
<i>Pardalotus striatus</i>	Striated Pardalote		X	X			X	X	X	X					X										X	X	X	+	X
ACANTHIZIDAE																													
<i>Acanthiza apicalis</i>	Inland Thornbill	X	X		X		X						X			X									X	X	+	+	X
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill					X	X				X		X													+		X	
<i>Acanthiza iredalei iredalei</i>	Slender-billed Thornbill																												
<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill																												
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill														X	X									X	X	+	X	

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<i>Aphelocephala leucopsis</i>	Southern Whiteface																									
<i>Calamanthus fuliginosus</i>	Striated Fieldwren																				+		+			
<i>Gerygone fusca</i>	Western Gerygone																							+	+	X
<i>Hylacola cauta whitlocki</i>	Shy Heathwren																									X
<i>Pyrrholaemus brunneus</i>	Redthroat	X		X	X											X						+			+	X
<i>Smicromis brevirostris</i>	Weebill		X	X	X		X				X	X	X			X	X					X	X	+	+	X
MELIPHAGIDAE																										
<i>Lichmera indistincta</i>	Brown Honeyeater					X	X	X			X											+		+	+	X
<i>Certhionyx niger</i>	Black Honeyeater																								+	
<i>Certhionyx variegates</i>	Pied Honeyeater																								+	
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater			X			X				X															
<i>Lichenostomus virescens</i>	Singing Honeyeater												X									X	X	+	+	X
<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater																									
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater						X								X	X	X					+		X	+	X
<i>Lichenostomus leucotis</i>	White-eared Honeyeater		X		X	X					X		X		X									X		X
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				X										X							+		X	+	X
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater																									
<i>Phylidonyris albifrons</i>	White-fronted Honeyeater											X			X							X	X	X	+	X
<i>Manorina flavigula</i>	Yellow-throated Miner																					X	X	+	+	X
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater						X		X						X		X					X	X	+		X
<i>Anthochaera carunculata</i>	Red Wattlebird						X	X							X	X	X					X		X		X
<i>Epthianura albifrons</i>	White-fronted Chat											X										+		+		X
<i>Epthianura tricolor</i>	Crimson Chat																					+		+	X	
<i>Epthianura aurifrons</i>	Orange Chat																									
POMATOSTOMIDAE																										
<i>Pomatostomus superciliosus</i>	White-browed Babbler				X								X											+		X
PETROICIDAE																										
<i>Drymodes brunneopygius</i>	Southern Scrub-robin			X	X								X												+	
<i>Eopsaltria griseogularis</i>	Western Yellow Robin						X																			X
<i>Microeca fascinans</i>	Jacky Winter											X			X									X		X
<i>Microeca flavigaster</i>	Lemon-breasted Flycatcher																									
<i>Petroica cucullata</i>	Hooded Robin																							+		
<i>Petroica goodenovii</i>	Red-capped Robin					X	X			X						X						X		+	+	X
<i>Poecilodryas superciliosa</i>	White-browed Robin																									
CINCLOSOMATIDAE																										
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush											X					X						+	+	X	
PACHYCEPHALIDAE																										
<i>Falcunculus frontatus</i>	Crested Shrike-tit																									
<i>Oreoica gutturalis</i>	Crested Bellbird	X					X	X		X		X		X	X	X						X		X		X
<i>Pachycephala rufiventris</i>	Rufous Whistler																					+		+	+	X
<i>Pachycephala inornata</i>	Gilbert's Whistler																								+	
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	X		X		X	X					X		X		X						X		X	+	X
DICRURIDAE																										
<i>Myiagra inquieta</i>	Restless Flycatcher												X													
<i>Rhipidura fuliginosa</i>	Grey Fantail																					+		+	+	

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<i>Rhipidura leucophrys</i>	Willie Wagtail					X						X	X		X							X		X		X	
<i>Grallina cyanoleuca</i>	Magpie-lark																					+	+	+		X	
CAMPEPHAGIDAE																											
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			X				X				X				X	X					X		X	+	X	
<i>Coracina maxima</i>	Ground Cuckoo-shrike																							X		X	
<i>Lalage tricolor</i>	White-winged Triller																							+			
ARTAMIDAE																											
<i>Artamus cinereus</i>	Black-faced Woodswallow											X										+	X	+		X	
<i>Artamus cyanopterus</i>	Dusky Woodswallow						X												X							X	
<i>Artamus personatus</i>	Masked Woodswallow					X																X	X	+			
CRACTICIDAE																											
<i>Cracticus torquatus</i>	Grey Butcherbird						X								X							X		X	+	X	
<i>Cracticus nigrogularis</i>	Pied Butcherbird																					+		+	+	X	
<i>Cracticus tibicen</i>	Australian Magpie																					+		+	+	X	
<i>Strepera versicolor</i>	Grey Currawong	X	X		X	X	X	X			X				X	X						+		+	+	X	
CORVIDAE																											
<i>Corvus bennetti</i>	Little Crow			X			X						X		X							X	+	+	+	X	
<i>Corvus coronoides</i>	Australian Raven												X		X							X	+	+	+	X	
<i>Corvus orru</i>	Torresian Crow																									X	
HIRUNDINIDAE																											
<i>Cheramoeca leucosterna</i>	White-backed Swallow																					+	X	+		X	
<i>Hirundo neoxena</i>	Welcome Swallow																					+	+	+	+		
<i>Hirundo nigricans</i>	Tree Martin					X																+		+		X	
<i>Hirundo ariel</i>	Fairy Martin																					+		+			
DICAEIDAE																											
<i>Dicaeum hirundinaceum</i>	Mistletoebird																					+		+	+	X	
PASSERIDAE																											
<i>Taeniopygia guttata</i>	Zebra Finch																							+			
MOTACILLIDAE																											
<i>Anthus australis</i>	Australian Pipit					X							X	X								+				X	
ZOSTEROPIDAE																											
<i>Zosterops lateralis</i>	Silvereye																								+	X	
SYLVIIDAE																											
<i>Cincloramphus mathewsi</i>	Rufous Songlark																								+		
<i>Cincloramphus cruralis</i>	Brown Songlark																								+		
AMPHIBIANS																											
HYLIDAE																											
<i>Litoria moorei</i>	Motorbike Frog																										
MYOBATRACHIDAE																											
<i>Neobatrachus kunapalari</i>	Kunapalari Frog																						X		X	+	X
<i>Neobatrachus pelobatoides</i>	Humming Frog																						X			+	X
<i>Neobatrachus sutor</i>	Shoemaker Frog																							X	+	X	
<i>Neobatrachus wilsmorei</i>	Wilsmore's Frog																										
<i>Pseudophryne occidentalis</i>	Western Toadlet						X																X		+	X	

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<i>Eremiascincus richardsonii</i>																						+		+			
<i>Hemiergis initialis initialis</i>																										X	
<i>Hemiergis peronii peronii</i>																											
<i>Lerista desertorum</i>																						+		+			
<i>Lerista muelleri</i>														X								+	+	X	+	X	
<i>Lerista picturata</i>																						+	+	+		X	
<i>Menetia greyii</i>									X													X	+	X	+	X	
<i>Morethia adelaidensis</i>																					+			X	+		
<i>Morethia butleri</i>																								+	+	X	
<i>Morethia obscura</i>																	X							+	+		
<i>Tiliqua occipitalis</i>							X																	+		X	
<i>Tiliqua rugosa</i>																						X	+	+	+	X	
AGAMIDAE																											
<i>Caimanops amphiboluroides</i>																											
<i>Ctenophorus clayi</i>																								+			
<i>Ctenophorus cristatus</i>							X					X			X		X									X	
<i>Ctenophorus femoralis</i>																											
<i>Ctenophorus fordi</i>																						X		+		X	
<i>Ctenophorus isolepis citrinus</i>																								+			
<i>Ctenophorus maculatus</i>																						+					
<i>Ctenophorus nuchalis</i>																									+		
<i>Ctenophorus ornatus</i>							X																				
<i>Ctenophorus reticulatus</i>																										X	
<i>Ctenophorus salinarum</i>																					+	X	X			X	
<i>Ctenophorus scutulatus</i>				X							X																
<i>Moloch horridus</i>													X										+	+		X	
<i>Pogona minor</i>							X															X	+	+	+	X	
<i>Tympanocryptis cephalo</i>																										X	
VARANIDAE																											
<i>Varanus caudolineatus</i>																								+			
<i>Varanus eremius</i>																								+			
<i>Varanus gouldii</i>																						+	+	+	+	X	
<i>Varanus panoptes</i>																						+	+	+	+		
<i>Varanus tristis</i>													X											+			
TYPHLOPIDAE																											
<i>Ramphotyphlops australis</i>																								+	+	X	
<i>Ramphotyphlops bicolor</i>																											
<i>Ramphotyphlops bituberculatus</i>																								+	+	X	
<i>Ramphotyphlops hamatus</i>																											
<i>Ramphotyphlops waitii</i>																											
BOIDAE																											
<i>Aspidites ramsayi</i>	Woma																							+	+		
<i>Morelia spilota imbricata</i>	Carpet python													X										+	+		
ELAPIDAE																											
<i>Acanthophis pyrrhus</i>	Desert death-adder																						+	+	+	+	

Family Genus species	Common name	Chapman <i>et al.</i> (1991)															Halpern Glick Maunsell (1998)						Ninox Wildlife Consulting (2004)			
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<i>Vespadelus baverstocki</i>	Inland Forest Bat																									
<i>Vespadelus regulus</i>	Southern Forest Bat																					+	+	+	+	
MOLOSSIDAE																										
<i>Mormopterus planiceps</i>	Southern Freetail-bat																					+	+	+	+	+
<i>Tadarida australis</i>	White-striped Freetail-bat																					+	+	+	+	+
MURIDAE																										
<i>*Mus musculus</i>	House Mouse								1				3				1					+	X	X	X	+
<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse	1	8	2												1	1							+		
<i>Pseudomys albocinereus</i>	Ash-grey Mouse																									
<i>Pseudomys bolami</i>	Bolam's Mouse																					+			+	X
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse																						+		+	X
LEPORIDAE																										
<i>*Oryctolagus cuniculus</i>	Rabbit																					+	X	+	X	+
BOVIDAE																										
<i>Capra hircus</i>	Goat																						+	+	+	+
CANIDAE																										
<i>*Canis lupus</i>	Dog																									
<i>Canis lupus dingo</i>	Dingo																									
<i>*Vulpes vulpes</i>	Red Fox																					+	+	+	X	+
FELIDAE																										
<i>*Felis catus</i>	Cat																					+	+	+	+	+

Vegetation for each of the habitat types surveyed and listed in Appendix 1b
BRNR #1 - Mixed shrubland on clay sand
BRNR #2 - Salmon Gum woodland on sandy clay loam
BRNR #3 - Mallee on sandy loam
BRNR #4 - Mixed mallee and shrubland on sandy loam
BRNR #5 - 'Farm' site
BRNR #6 - opportunistic on Burra Rock Natur Reserve
CHNR #1 - Eucalypt woodland on loam
CHNR #2 - Salmon Gum woodland on sandy loam
CHNR #3 - Jam shrubland on fine sandy loam
CHNR #4 - Mallee on sandy clay loam
CHNR #5 - opportunistic in vegetation fringing Cave Hill
CHNR #6 - opportunistic on Cave Hill Nature Reserve
CHNR #7 - on Cave Hill
DRNR #1 - Mixed eucalypt woodland on sandy clay loam
DRNR #2 - Mallee and shrublands on sandy clay loam
DRNR #3 - Redwood woodland on sandy loam
DRNR #4 - on Dordie Rock
DRNR #5 - opportunistic on Dordie Rock Nature Reserve
SL - Salt lake Bed
H - Halophytic shrublands
LF - Lake Foredunes
LS - Lakeside Shrublands
OM/T - Open Mallee woodland over moderately dense spinifex
M/S - Moderately dense mallee woodland over open shrubs and spinifex