

**A VERTEBRATE FAUNA ASSESSMENT
OF THE
CLOVERDALE MINERAL SANDS SURVEY AREA**



Prepared for Iluka Resources Ltd

By Ninox Wildlife Consulting

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Executive Summary

The Cloverdale Mineral Sands Project Area is situated approximately 8 km south of Capel, Western Australia. For this fauna assessment, a wider area was surveyed in order to encompass all of the fauna habitats that could be impacted directly or indirectly by the Project. The area assessed for fauna has been called the Survey Area throughout this report. Much of the Survey Area is located on private property on the Southern Swan Coastal Plain (SSCP), although there is a small area of Vacant Crown Land on the Ludlow River. Much of the area is cleared for agriculture with vegetated road reserves, isolated trees in paddocks and small areas of remnant vegetation, some of which has been fenced from stock grazing.

A field assessment of the Project Area and surrounds (Survey Area) was carried out over two days in March 2005 by GHD with additional field work conducted by Ninox Wildlife Consulting in mid October 2005. This assessment incorporated a detailed literature review which included a search of State and Commonwealth vertebrate fauna databases, a review of published literature on the vertebrate fauna of the general area and a review of unpublished records from the general area held by Ninox Wildlife Consulting.

A total of 46 species of bird has been recorded within the Survey Area. The results of the literature review showed that a further 78 species could be expected to occur as resident, nomadic, migratory or occasional visitors to the general area. Not all of these are likely to occur with any regularity as their preferred habitats are either not present or are extremely degraded. The 46 species that have been recorded within the Survey Area to date are generally typical of farmland supporting fragmented remnants of degraded native vegetation.

Fifty species of bird that could potentially occur within the Survey Area are of conservation significance and 15 of these have been recorded to date. These include Carnaby's Cockatoo and the Forest Red-tailed Black-cockatoo. However, no trees with the potential to contain suitable cockatoo nesting hollows for these birds were noted within the areas containing mineral resources during this assessment. Two additional bird species that are protected under Commonwealth or State Conservation Acts could potentially occur within the Survey Area and five bird species listed on international agreements could occasionally be present in the Survey Area.

Forty-one of the 126 bird species that could occur within the Survey Area are either habitat specialists with a reduced distribution on the SSCP or are wide-ranging species with reduced populations on the SSCP. Nine of the former and five of the latter have been observed in the Survey Area during the assessment. These birds were mainly small insectivores such as three species of Thornbill, White-breasted Robin and Golden Whistler; while only one of the significant nectarivores, the New Holland Honeyeater, has been recorded.

Grey Kangaroos were observed in both remnant vegetation and pasture, and scats of the Common Brushtail Possum were also noted in several locations. An additional 20 species of native mammal could potentially occur in the Survey Area, although this is unlikely given the fragmented and degraded condition of much of the remnant vegetation in the site.

Six species of native mammal that are of conservation significance could occur within the Survey Area and one has been recorded, namely the Western Ringtail Possum which was recorded from a drey (nest) and scats in a cultivated garden. The Chuditch has been frequently captured in the Darling Range but there are very few records from the SSCP. However, they have been captured at Gwindinup, south of Boyanup in recent years. The Quokka has recently been recorded from the near-coastal area approximately 15 km north of Capel. However, the dense thickets of vegetation that this species requires are not present within the Survey Area, therefore it is unlikely to be present. The Wambenger, Southern Brown Bandicoot, Western False Pipistrelle and Water Rat have all been

recorded in the general area and the latter three could potentially be present within suitable habitat within the Survey Area.

Five species of frog have been recorded in the Survey Area and an additional five species could occur in the general Capel area. None are of particular conservation significance. Six species of reptile have also been recorded during the site assessments. A total of 41 species of reptile could be present in the general Capel area although, as for native mammals, this is unlikely given the fragmented and degraded condition of the remnant vegetation. Only one reptile that could potentially occur in the Survey Area, the Carpet Python, is of conservation significance although, given the level of existing clearing, its actual presence is unlikely.

Although approximately 3 ha of native vegetation in the vicinity of the Ludlow River and 2 ha of plantation will be cleared, none of the fauna habitats that are in good condition will be directly impacted by development of a mine. There is no connection between these remnant vegetation areas therefore, their value as part of an ecological linkage is minimal. However, they are likely to support a range of resident species, mainly birds and reptiles, and, in an area that has been substantially cleared for various land uses, their value as a fauna refuge is likely to be high. The remaining remnant vegetation patches are likely to be of significance to a range of animal species, in particular, breeding birds and small reptiles. As a result of the level of clearing within the Greater Bunbury Region, these small, and in some cases degraded, areas of native vegetation, may be of greater importance to a range of animals than their size and condition suggest. However, very little of this remnant vegetation will be cleared for development of a mine, therefore, there is likely to be minimal impact on the vertebrate fauna species that are known or predicted to occur. However, it is recommended that the remnant vegetation that has been fenced from stock and is in good condition is protected from any impact from mining and associated activities. Where clearing of vegetation is unavoidable, mitigation measures could include, but not be limited to, additional fencing of remnant vegetation, particularly along creeklines and rivers, to prevent grazing by stock and to allow regeneration of understorey plants. Some weed control may be required to ensure that native shrubs and ground covers provide appropriate habitat for vertebrate fauna.

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1 INTRODUCTION

The Cloverdale Mineral Sands Project Area is situated approximately 8 km south of Capel, Western Australia. For the fauna assessment, a wider area was surveyed in order to encompass all of the fauna habitats that could be impacted directly or indirectly by the development of a mine. The area assessed for fauna has been called the Survey Area throughout this report. The flora and vegetation of the Survey Area have been described in detail in Mattiske Consulting Pty Ltd (2006). These details have not been reproduced in this current document unless specific elements warrant it. However, the vegetation map prepared for this Survey Area by Mattiske Consulting Pty Ltd has also been used in this Ninox report (Figure 1). Figure 1 also shows the locations within the Project Area which have been excluded from mining.

As stated in GHD (2005), much of the Survey Area is located mainly on private property on the Southern Swan Coastal Plain (SSCP). As expected on private property on the SSCP, much of the area is cleared for agriculture with vegetated road reserves, isolated trees in paddocks and small areas of remnant vegetation, some of which has been fenced from stock grazing.

As part of an Environmental Impact Assessment, Ninox Wildlife Consulting (Ninox) was commissioned by Iluka to provide additional information on the vertebrate fauna of the area.

Specifically, the requirements for Ninox were:

- for the fauna survey to be in accordance with the Environmental Protection Authority's (EPA) Guidance Statement No. 56 at a Level 2 Detailed Survey;
- to provide an inventory of vertebrate fauna species present or potentially occurring in the Survey Area based on actual survey and literature review;
- an assessment of the regional and local conservation value of rare, threatened and vulnerable species that could occur in the Survey Area as listed under:
 1. the *Environment Protection and Biodiversity Act 1999 (EPBC 1999)*;
 2. the *Wildlife Conservation Act 1950 (WCA 1950)*;
 3. the Japan/Australia and China/Australia Migratory Bird Agreements;
 4. the Department of Conservation and Land Management (CALM) Priority Fauna list;
 5. Table 15 of Bush Forever Volume 2 (Government of Western Australia 2000) which show those birds that have special conservation significance on the Swan Coastal Plain.
- an assessment of the condition and conservation significance of the various fauna habitats present with the Survey Area; and

A Level 2 Detailed Survey as defined in Guidance Statement No 56 (EPA 2004) incorporates background research, a reconnaissance survey and the results of one or more site visits to enhance the level of knowledge at the locality scale.

Additional field work in the remnant vegetation of the Survey Area was conducted in mid October 2005 to increase the level of knowledge on the existing vertebrate fauna population. This field assessment by Ninox concentrated on remnant vegetation patches within the Survey Area, including fenced remnants, road reserves and riverine vegetation. This current document integrates the results from the GHD (2005) survey, this second field assessment and a detailed literature review.

2 DEFINITION OF SIGNIFICANT FAUNA AND THEIR HABITATS

Prior to any discussion of the significance of vertebrate fauna or their habitats, a definition of terms is required. This Section of the document describes the various Commonwealth and State Acts that cover rare, threatened and vulnerable vertebrate fauna species and was correct at the time of the preparation of this document. However, as changes are made to both State and Commonwealth legislation and new treaties are entered into, all current documentation regarding rare, threatened and vulnerable fauna should be periodically reviewed for any changes to the status of these animals in a given area.

Additionally, in any discussion of rare, threatened or vulnerable species, several aspects require clarification before the significance of these species can be considered in context of the development and operation of a mining project.

- ♦ Resident, habitat-specific rare fauna are much more susceptible to the influences of disturbance than nomadic or migratory species.
- ♦ Not all rare species are equally susceptible to disturbance. Some rare species such as the Peregrine Falcon can accommodate the high levels of disturbance present in urban and rural environments.
- ♦ The concept of species rarity is a dynamic process considerably influenced by the level of survey work carried out in a particular location.

2.1 Protected Species - Commonwealth

In 1974, Australia signed the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). As a result, an official list of endangered, vulnerable or presumed extinct species was constructed (Schedule 1) and is regularly updated (*Endangered Species Protection Act 1992*).

In July 2000, this Act was replaced by *The Environment Protection and Biodiversity Conservation Act 1999 (EPBC 1999)*, which retained the schedule of threatened species of the Act it replaced.

The vertebrate fauna listed on the current schedule differs from the two State lists, although there are several species that appear on both, for example, the Chuditch (*Dasyurus geoffroii*), and Baudin's and Carnaby's Black-Cockatoos (*Calyptorhynchus baudinii* and *Calyptorhynchus latirostris*). There are six parts to the EPBC Act covering species that are:

1. extinct;
2. extinct in the wild;

3. critically endangered;
4. endangered;
5. vulnerable;
6. conservation dependent.

Table 1 lists the criteria for referral of a project under the *EPBC Act (1999)* for endangered and vulnerable fauna species.

Table 1 Criteria for referral of a project under the EPBC Act (1999) for endangered and vulnerable fauna species. (Extracted from www.deh.gov.au.)

| ENDANGERED |
|--|
| An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to: |
| * lead to a long-term decrease in the size of a population; |
| * reduce the area of occupancy of the species; |
| * fragment an existing population into two or more populations; |
| * adversely affect habitat critical to the survival of a species; |
| * disrupt the breeding cycle of a population; |
| * modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; |
| * result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat; |
| * interfere with the recovery of the species. |
| VULNERABLE |
| An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to: |
| * lead to a long-term decrease in the size of an important population of a species; |
| * reduce the area of occupancy of an important population; |
| * fragment an existing important population into two or more populations; |
| * adversely affect habitat critical to the survival of a species; |
| * disrupt the breeding cycle of an important population; |
| * modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; |
| * result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat; |
| * interferes substantially with the recovery of the species. |

2.2 International Agreements

A range of birds are listed under the Japan-Australia (JAMBA) and China-Australia (CAMBA) Migratory Bird Agreements. Most of the species listed on the JAMBA and/or CAMBA agreements are shorebirds associated with coastal shores or inland saline wetlands and most are not relevant to the current Cloverdale Mineral Sands Project. However, there is a small range of birds listed on these international treaties that could occur within the Survey Area and these species are discussed in this report.

2.3 Protected Species - Western Australia

Currently in Western Australia, rare or endangered species are protected by the *Wildlife Conservation Act 1950 (WC Act 1950)*. The various schedules defined under this act are:

- ♦ Declared Threatened Fauna - fauna that is ranked as presumed extinct, critically endangered, endangered or vulnerable;
- ♦ Conservation Dependent Fauna; and
- ♦ Other Specially Protected Fauna.

This Act is periodically reviewed and the current list of protected fauna can be viewed on CALM's Faunabase website. Burbidge (2004) acknowledges however, that the *Wildlife Conservation Act 1950* is now outdated and a Biodiversity Conservation Bill is currently being prepared for introduction to Western Australia's Parliament.

2.4 Priority Species - Western Australia

The Department of Conservation and Land Management (CALM) Priority Fauna List classifies species as:

- ♦ Priority 1 - taxa with few, poorly known populations on threatened lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
- ♦ Priority 2 - taxa with few, poorly known populations on conservation lands.
Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. 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 - taxa in need of monitoring.
Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

- Priority 5 - taxa in need of monitoring.

Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

The Priority Fauna List does not confer any additional legal protection to the species listed apart from the normal protection afforded to most native animals. It does, however, indicate the need for vigilance during the construction and commissioning of development projects to manage native vegetation and rehabilitation so that Priority species, should they occur, do not meet the criteria for listing on the Threatened Species List as a result of that development.

2.5 Significant Birds Listed in Bush Forever

Bush Forever (Government of Western Australia 2000) states that approximately 40% of the Non-passerine bird species that occur on the SCP have decreased in abundance since European Settlement. Those that have suffered serious declines are those that occupy swamp and lake edges as these have been altered or cleared and birds of prey. Nearly half of the Passerine species have also decreased in abundance since European settlement with many experiencing this decline in numbers as a direct result of clearing of native vegetation. Although many of these species still occur on the Darling Scarp and Plateau, several no longer occur on the SCP. These birds have all been listed in Bush Forever as having particular conservation significance on the SCP portion of the Perth metropolitan region. However, because of the amount of clearing in the southern region of the SCP, these birds are relevant in this current assessment of the vertebrate fauna of the Cloverdale Mineral Sands Project Area.

2.6 Significant Fauna Habitats

Australia-wide, a small number of Threatened Ecological Communities (TEC) has been defined under Commonwealth legislation. However, while not defined under any legislation, some fauna habitats within a Survey Area may be defined as locally significant because they:

- ◆ support rare or vulnerable species;
- ◆ support specialised or habitat specific fauna;
- ◆ are regionally or locally uncommon; or
- ◆ are restricted in area.

Although not protected under any State or Commonwealth legislation, in the interests of good project management, where possible, conservation of such locations within a Survey Area will provide the basis for the fauna component of an environmental management plan to be put in place for the duration of a project.

3 METHODS

A detailed literature review consisted of three parts:

1. a search of State and Commonwealth vertebrate fauna databases;
2. a review of published literature on the vertebrate fauna of the general area;
3. a review of unpublished records from the general area held by Ninox Wildlife Consulting.

A table showing the results of a search of the Western Australian Museum's database was presented in GHD (2005). This has been adapted for use in this current document. In addition, the field records as shown in the earlier report have also been used (Appendix 1). The nomenclature in this Appendix follows the Western Australian Museum checklist except where errors in this list have occurred.

The follow-up field survey was conducted by Ninox Principal Jan Henry between the 17 and 18 October 2005. This survey was done in order to gain as much information as possible on the vertebrate fauna of the Survey Area. The actual results from this recent assessment have been integrated into Appendix 1.

Weather conditions were warm during the 1.5 day sampling period. All birds both seen and heard were recorded and signs of animal presence such as scats, tracks and diggings were identified and noted. Specific searches were made for evidence of the presence of the Western Ring-tailed Possum (*Pseudocheirus occidentalis*) and nesting trees of any of the three Black-cockatoo (*Calyptorhynchus*) species that could occur in the general area.

4 SITE DESCRIPTION

Following the GHD 2005 assessment, Matiske Consulting Pty Ltd was commissioned by Iluka to review the flora and vegetation of the remnant vegetation within the Survey Area and to report on the plant communities present, assess their regional conservation values and to recommend ways of mitigating the impacts of mining-related activities (Matiske Consulting Pty Ltd 2005) and this more recent flora and vegetation document has been referred to in this fauna assessment. Matiske Consulting Pty Ltd (2005) described 10 major vegetation communities, some of which have been amalgamated to form eight fauna habitats. Open water has also been defined as an additional fauna habitat. For ease of reference, a brief summary of the major fauna habitats has been provided below.

Table 2 Vegetation mapping codes, descriptions and corresponding fauna habitat within the Cloverdale Mineral Sands Survey Area. (Vegetation community descriptions extracted from Mattiske Consulting Pty Ltd 2005 and modified for use in this table.)

| Vegetation Mapping Code | Vegetation Description | Fauna Habitat |
|-------------------------|---|---------------|
| B1 | Open Woodland of <i>Banksia attenuata</i> - <i>Banksia ilicifolia</i> over <i>Kunzea ericifolia</i> , <i>Podocarpus drouynianus</i> and <i>Dasypogon bromeliifolius</i> with emergent <i>Eucalyptus marginata</i> subsp. <i>marginata</i> on sandy soils. This community has been subjected to grazing pressures and very little of the understorey persists. The community varies from very good to largely degraded. | 1 |
| E1 | Open Woodland of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Banksia attenuata</i> - <i>Banksia grandis</i> - <i>Xylomelum occidentale</i> over <i>Stirlingia latifolia</i> and <i>Dasypogon bromeliifolius</i> on sandy soils. This community has been protected from grazing pressures and consequently the understorey persists. The condition of the community varies from excellent to good. The decline in the condition is largely related to the infestation of dieback (<i>Phytophthora cinnamomi</i>) in the community | 2 |
| C2 | Open Forest to Woodland of <i>Corymbia calophylla</i> over <i>Banksia grandis</i> , <i>Kingia australis</i> and <i>Xanthorrhoea preissii</i> on loam soils. This community is listed at the State level (CALM 2005) as critically endangered and at the Federal level under the EPBC Act (1999) as a Threatened Ecological Community. The areas within the survey area are largely degraded with only the <i>Corymbia calophylla</i> (Marri) and <i>Kingia australis</i> present in many instances within the paddocks. | 3 |
| E2 | Open Forest of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> - <i>Corymbia calophylla</i> over low shrubs and herbs on sandy-loam soils. This community has been protected from regular grazing pressures and consequently some of the understorey persists. The condition of the community is good. | 3 |
| C1 | Forest to Woodland of <i>Corymbia calophylla</i> - <i>Eucalyptus rudis</i> over <i>Melaleuca preissiana</i> , <i>Melaleuca raphiophylla</i> and <i>Agonis flexuosa</i> over <i>Astartea scoparia</i> , <i>Taxandria linearifolia</i> and <i>Cyathochaeta avenacea</i> on major watercourses. This community has been subjected to grazing pressures and very little of the understorey persists. The community varies from good to largely degraded. | 4 |
| M1 | Woodland of <i>Melaleuca preissiana</i> over <i>Hypocalymma angustifolium</i> and mixed sedges. This community has been protected from grazing pressures and consequently the understorey persists. The condition of the community is very good. The decline in the condition is largely related to the infestation of dieback (<i>Phytophthora cinnamomi</i>) in the community. | 5 |
| A1 | Woodland of <i>Agonis flexuosa</i> over pasture on sandy soils. This community has been subjected to grazing pressures and very little of the understorey persists. The community is largely degraded. | 6 |
| C3 | Woodland of <i>Corymbia calophylla</i> over pasture on loam soils. The areas within the survey area are largely degraded. | 7 |
| CL | Mostly cleared cultivated paddocks with occasional <i>Corymbia calophylla</i> , <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Melaleuca preissiana</i> . | |
| PL | Plantations | 8 |
| - | Open Water – seasonally inundated areas. | 9 |

5 RESULTS AND DISCUSSION

A field survey of the whole Survey Area was carried out over two days in March 2005 by GHD to examine the habitats present and their condition, and to carry out an opportunistic survey of the vertebrate fauna (GHD 2005). The results of this GHD survey have been incorporated into Appendix 1, which lists the vertebrate fauna species recorded and species predicted to occur in the habitats of the Survey Area. This latter group was compiled from the results of the Ninox review of published and unpublished data and searches of Government Department databases.

Appendix 1 shows that the results of the GHD field survey included 33 bird species, one native mammal species, three frog and four species of reptile. Two feral or introduced species consisting of one bird and one mammal were also recorded. This current Ninox survey resulted in the recording of 37 species of bird, three species of native mammals, three frog and three reptile species (Appendix 1). Introduced species included one bird and two mammal species.

Literature sources for the construction of the predicted species list shown in Appendix 1 included but were not limited to:

- mammals, frogs and reptiles: Bush *et al.* (1995); Churchill (1998); Cogger (1992); Storr *et al.* (1983); Storr *et al.* (1990); Storr *et al.* (1999); Storr *et al.* (2002); Strahan (1998); Tyler *et al.* (2000); Wilson and Swann (2003);
- birds: Storr and Johnstone (1988); Storr (1991); Barrett *et al.* (2003); Johnstone and Storr (1998 and 2004).

5.1 Birds

Appendix 1 shows that 33 bird species were recorded during the GHD field survey and 37 species were recorded during the Ninox survey. However, 23 species were common to both and 23 species were unique to either the GHD or Ninox survey. This has resulted in a total number of 46 species being known to occur periodically within the Survey Area. While some of these birds, mainly ducks, ibis and herons, were observed in waterlogged paddocks the majority of the remaining species were recorded in the remnant vegetation of the Survey Area.

The results of the literature review showed that in addition to the species recorded within the Survey Area, a further 78 species could be expected to occur as resident, nomadic, migratory or occasional visitor to the general area. Not all of these are likely to occur regularly within the Survey Area as their preferred habitats are either not present or are extremely degraded. Additional species could occur as vagrants but these have not been listed in Appendix 1. This latter group of birds could occur following specific climatic events, either in the South-west or inland, which encourage birds into or away from their normal patterns of distribution. As discussed above, the majority of these birds that are predicted to occur will be found in the remnant vegetation in the Survey Area.

During March 2001, a comprehensive, two season, systematic survey by MJ & MR Bamford Consulting Ecologists (2001) in the Ludlow Mining Lease to the south of Boyanup resulted in 44 species of bird being recorded. While many of the bird species recorded during this survey

of Tuart and Peppermint forest have also been recorded or could potentially be present within the Cloverdale Survey Area, the fauna habitats of the Ludlow Mining Lease and this current Survey Area are quite different and cannot be compared on a regional basis. Appendix 1 lists all of the species recorded by MJ & MR Bamford Consulting Ecologists.

Many of the species listed in Appendix 1 have become extremely scarce on the SCP and Darling Range foothills although they may be common elsewhere. These birds are either habitat specialists with a reduced distribution on the SCP or are wide-ranging species with reduced populations on the SCP; some may be locally extinct (Government of Western Australia 2000). The birds that fit into these categories include many birds of prey such as the Square-tailed and Whistling Kites (*Hamirostra isura* and *Haliastur sphenurus*), Brown Goshawk (*Accipiter fasciatus*), Collared Sparrowhawk (*Accipiter cirrhocephalus*), Little Eagle (*Aquila morphnoides*) and Wedgetail Eagle (*Aquila audax*). Birds such as these are wide-ranging and being predators, will never have been particularly common. Other, small birds such as Fairy-wrens (*Malurus* spp.) and Thornbills (*Acanthiza* spp.) are less mobile than the larger birds and may only be surviving in remnants of native vegetation on the SCP (Government of Western Australia 2000), although they are still common in parts of the adjacent Darling Range (Dunlop *et al.* 1995 and Ninox Wildlife Consulting 2003, 2004). These species are discussed in more detail in Section 5.6.1.3.

The 46 species that have been recorded within the Survey Area to date are generally typical of farmland with fragmented remnants of degraded native vegetation. While the number of species of bird will increase with additional field work, it is unlikely that this increase will be substantial.

5.2 Native Mammals

One native mammal, the Western Grey Kangaroo (*Macropus fuliginosus*) was recorded by GHD during the field survey in March 2005 (Appendix 1). The Ninox survey confirmed the presence of Grey Kangaroos which were observed in both remnant vegetation and pasture, and scats of the Common Brushtail Possum (*Trichosurus vulpecula*) were also noted. Specific searches were conducted for evidence of the presence of Western Ringtail Possum (*Pseudocheirus occidentalis*) but dreys and scats were only located in cultivated gardens.

Appendix 1 shows that an additional 20 species could potentially occur in the Survey Area, although this is unlikely given the fragmented and degraded condition of much of the remnant vegetation in the site. This number of species includes nine species of bat, a group that has not been systematically surveyed on the SCP and about which little information is available on current status (Government of Western Australia 2000).

Relatively little survey work on ground-dwelling fauna, including native mammals, has been carried out on the SSCP. However, some unpublished data and a small number of published papers have been reviewed for this current assessment. The March 2001 survey by MJ & MR Bamford Consulting Ecologists (2001) in the Ludlow Mining Lease to the south of Boyanup consisted of five nights of trapping, spotlight runs, mist-netting and the use of an ultrasonic detector for bats, and clearing of tracks to detect footprints left by mammals. This detailed level of work resulted in the detection of eight species of native mammal, including three bat species. Appendix 1 lists all of the species recorded by MJ & MR Bamford Consulting Ecologists.

5.3 Amphibians

Three species of frog were recorded by GHD in March 2005 and two additional species were recorded by Ninox in this more recent survey. An additional five species could occur in the general area (Appendix 1), with many of these likely to occur in the Cloverdale Survey Area, as several species are able to persist in degraded creeks and wetlands (personal observations). MJ & MR Bamford Consulting Ecologists (2001) recorded three species of frog during their survey (Appendix 1). However, it is possible that the low autumn rainfall before the survey had not activated many of the winter-breeding burrowing species that could be present.

Most of the frogs known to occur in the general area rely on surface water to breed and all of the species recorded during this current survey were heard calling in the various wetland habitats of the Survey Area. However, many will be found in a range of habitats some distance away from water outside of their breeding season.

5.4 Reptiles

Three species of reptile were identified during the GHD March 2005 survey and three additional species were observed during the Ninox October 2005 assessment (Appendix 1). MJ & MR Bamford Consulting Ecologists (2001) recorded only 10 species of reptile during their systematic trapping survey in Ludlow Mining Lease to the south of Boyanup. As discussed previously, while the reptiles that have been recorded within Ludlow Mining Lease are also likely to be present within the Cloverdale Survey Area, the respective habitats cannot be compared on a regional basis. Appendix 1 lists all of the species recorded by MJ & MR Bamford Consulting Ecologists.

A total of 41 species of reptile could be present in the general area although, as for native mammals, this is unlikely given the fragmented and degraded condition of the remnant vegetation.

An almost complete assemblage of reptiles can be found on recently isolated, small areas of undisturbed native vegetation in the Darling Range (Ninox Wildlife Consulting 1996), therefore it is possible that many are able to persist in the less disturbed and fenced remnant vegetation within the Survey Area (approximately 1.3 km south-east of the junction of Goodwood and Cloverdale Roads, see Mattiske Consulting Pty Ltd 2005).

5.5 Introduced Species

Two introduced mammal species were recorded in March 2005 by GHD (Appendix 1). This included one predator, the Red Fox (*Vulpes vulpes*), and one herbivore, the European Rabbit (*Oryctolagus cuniculus*). Both of these species were also recorded during the Ninox October 2005 assessment. One introduced bird species was also observed during both seasonal visits: the Laughing Kookaburra (*Dacelo novaeguineae*).

In addition to these species, a further two introduced rodent species could be expected to occur: the Black Rat (*Rattus rattus*) and House Mouse (*Mus musculus*). Domestic and feral Cats (*Felis catus*) almost certainly occur throughout the general Capel area. Two additional introduced bird species could also occur: the feral Pigeon or Rock Dove (*Columba livia*) and the Spotted Turtle-dove (*Streptopelia chinensis*). MJ & MR Bamford Consulting Ecologists

(2001) recorded the Laughing Kookaburra and all five of the introduced mammals that could occur in the Cloverdale Survey Area.

It is unlikely that additional feral species to those described above will occur in the Survey Area. However, Cattle (*Bos taurus*) have grazed some of the remnant patches of vegetation resulting in a highly modified environment throughout the Survey Area. Unless fenced from Cattle, these remnants will continue to degrade over time. Remnants that have been fenced from stock are in good condition and have the potential to support a number of vertebrate species, particularly birds and possibly reptiles. An example of this is the remnant that has been fenced from stock near the north-eastern section of the Survey Area (Vegetation Codes E1 and M1 on Figure 1 at approximately 371 250mE and 6 280 500mN).

5.6 Significant Vertebrate Fauna Species

5.6.1 Birds

Fifty species of bird that could potentially occur within the Cloverdale Survey Area are of conservation significance (see following Sections and Appendix 1). Of these, 15 species have been recorded within the Survey Area to date. Some of the remaining species may only occur seasonally or when specific conditions are met. For example, some of the honeyeaters that now have reduced populations on the SCP may visit the area when particular plants are flowering. However, the limited diversity of plants within the remnant vegetation patches could restrict the range of honeyeaters that could potentially visit the area. In addition, the preferred habitat of some of the small insectivores such as the Western Yellow Robin (*Eopsaltria australis*) and White-breasted Robin (*Eopsaltria georgiana*) is either highly degraded or absent from the Survey Area. Therefore, it is unlikely that these birds will occur with any regularity.

Two species of Black-Cockatoo have been recorded in the Cloverdale survey area: Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*). Baudin's Cockatoo (*Calyptorhynchus baudinii*) could also occur. All three are discussed in more detail in the following sections.

Forestry, mining and clearing for orchards, tree plantations, roads and powerlines have all resulted in the loss of habitat and nesting hollows for these three species. In addition, competition for tree hollows through invasion by feral Honey Bees and other birds such as Galahs (*Cacatua roseicapilla*) and Australian Wood Duck (*Chenonetta jubata*) has also had an impact on Black-Cockatoos (R. Johnstone pers. comm.). Both the Galah and Australian Wood Duck have increased in number in the South-west in recent years. The Galah was a rare visitor to the SCP in 1940 but is now well established; there was an explosive increase in numbers of Australian Wood Duck in the 1940's to the mid-1950's due to the proliferation of farm dams and establishment of pastures (Johnstone and Storr 1998).

5.6.1.1 Commonwealth and State

One bird species listed as Endangered under the *EPBC Act (1999)* and Vulnerable under the *WC Act (1950)* was recorded during the Ninox October 2005 field survey: Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Appendix 1). A small flock of these birds were observed feeding within a group of approximately 20 pine trees (*Pinus radiata*) in riparian

vegetation adjacent to the Capel River at the north-eastern section of the Survey Area. While Cloverdale is not generally considered to be within the known breeding range of this species, as a result of changes to its preferred environmental conditions, the centre of gravity of this Black-Cockatoo's distribution has moved considerably south and west (Johnstone and Storr 1998) in recent years and, as a result, it is possible that nesting by this species could occur in the general Capel area. The main cause of decline of this species is thought to be widespread clearing of semi-arid sandplains and loss of nesting trees in the Wheatbelt. Clearing and subsequent land degradation has eliminated much of the coastal kwongan vegetation where this species prefers to spend much of its time in summer (Burbidge 2004). The proximity of nesting sites to feeding areas is of prime importance to this species. Burbidge (2004) states that because of clearing in the northern parts of the breeding range of Carnaby's Cockatoo, the distance between remaining nest sites and feeding areas in kwongan have become so great in some areas that chicks have starved.

Baudin's Cockatoo (*Calyptorhynchus baudinii*), which is listed as Endangered under the *EPBC (1999) Act* and Vulnerable under the *WC Act (1950)*, could also occur in the Cloverdale Survey Area. This species is known to breed in the deep South-west as far north as Lowden to the east of the Survey Area. Baudin's Black-Cockatoos are endemic to the south-west of Western Australia although generally believed to avoid the Swan Coastal Plain west of the Darling Range foothills. This species is thought to have declined greatly in the last 50 years, their slow rate of reproduction precluding them from replacing the large numbers being shot by orchardists (Johnstone and Storr 1998). Approximately one quarter of the original habitat of this species has been cleared for Agriculture (Burbidge 2004).

The Forest Red-tailed Black-cockatoo (*Calyptorhynchus banksii naso*) was observed during this current assessment flying over a degraded section of the Ludlow River (C1 Vegetation Code on Figure 1). This Black-cockatoo is listed as Vulnerable under the *WC Act (1950)*. This cockatoo is more commonly seen in the Jarrah forest of the Darling Range although it will be observed in remnant Jarrah or Marri vegetation on the Darling Scarp and foothills. Johnstone and Storr (1998) state that the main impact on this species has been the destruction of forests with the subsequent loss of nesting and feeding resources.

While it is possible that some of the larger, mature eucalypts along the Capel and Ludlow Rivers could contain hollows of suitable size for Black-cockatoo nesting, very little of this vegetation will be disturbed for mining. No trees with the potential to contain suitable cockatoo nesting hollows were noted within the areas containing mineral resources during this assessment.

Three birds listed on the China/Australia Migratory Bird Agreement (CAMBA): Great Egret (*Ardea alba*), Cattle Egret (*Ardea ibis*) and Glossy Ibis (*Plegadis falcinellus*); one bird listed on the Japan/Australia Migratory Bird Agreement (JAMBA): Rainbow Bee-eater (*Merops ornatus*); and one bird listed on both: Fork-tailed Swift (*Apus pacificus*); could occasionally be present in the Survey Area (Appendix 1). The two Egrets and Glossy Ibis use a variety of wetland habitats including flooded pastures, farm dams and drains and are unlikely to be affected by the loss of a relatively small area of pasture on the SSCP. The Fork-tailed Swift rarely lands in Australia but may be seen overhead, often ahead of storm fronts. The Rainbow Bee-eater, however, is known to breed in the South-west, excavating a nesting burrow into flat sandy ground or sand banks, wherever the sand is able to support a burrow. It is unlikely that these birds will nest in cleared paddocks and much of the area that will be disturbed by

mining is situated within these areas. Therefore it is unlikely that there will be any impact on these migratory birds.

The Peregrine Falcon (*Falco peregrinus*) which is listed as Other Specially Protected Fauna on the Western Australian *WC Act (1950)* could occur in the Survey Area. This bird of prey may be seen hunting for ducks or other prey over farmland and it has taken advantage of disused quarries along the Darling Scarp and in the Eastern Goldfields where it uses the ledges for roosting and nesting (personal observations).

5.6.1.2 CALM Priority List

None of the birds listed in Appendix 1 are listed on CALM's Priority Fauna list.

5.6.1.3 Other Significant Bird Species

Forty-one of the 126 bird species listed in Appendix 1 are either habitat specialists with a reduced distribution (RD) on the SCP or are wide-ranging species with reduced populations (RP) on the SCP (Government of Western Australia 2000). This includes many of the birds of prey (RP), a number of small insectivores such as the Splendid Fairy-wren (*Malurus splendens*) and various Thornbills (*Acanthiza* spp.) (RD) and a relatively large number of Honeyeaters (Family Meliphagidae) (RP). Most of these birds are common in the remainder of their geographic distribution but are reliant on the often fragmented and sometimes small remnant areas of native vegetation on the SCP.

Of the 41 species listed as RD or RP in Table 15 of Volume 2 of Bush Forever (Government of Western Australia 2000) nine of the former and five of the latter have been observed in the Survey Area during the two assessments (Appendix 1). These birds were mainly small insectivores such as three species of Thornbill (*Acanthiza* spp.), White-breasted Robin (*Eopsaltria georgiana*) and Golden Whistler (*Pachycephala pectoralis*); while only one of the significant Honeyeaters, the New Holland Honeyeater (*Phylidonyris novaehollandiae*), has been observed during the site assessments.

5.6.2 Native Mammals

Six species of native mammal that are of conservation significance could occur within the Cloverdale Survey Area and one, the Western Ringtail Possum (*Pseudocheirus occidentalis*), has been recorded (see following Sections and Appendix 1). While it is possible that species such as the Chuditch (*Dasyurus geoffroii*) may be present within the general area, it is unlikely that many of the small native mammals remain due to the long-term fragmentation and isolation of the remnant vegetation in the general area.

5.6.2.1 Commonwealth and Western Australia

The Western Ringtail Possum (*Pseudocheirus occidentalis*) is listed as Vulnerable under both the *EPBC Act (1999)* and the *WC Act (1950)*. The Western Ringtail Possum is endemic to the forests and woodlands of south-western Western Australia (Jones 1995). Once widely distributed throughout the south-western forests of Western Australia, since 1909 the pattern

of decline of this species has been patchy with local extinctions being most extensive in inland areas. Most populations are now restricted to near coastal areas of Peppermint (*Agonis flexuosa*) woodland and Tuart (*Eucalyptus gomphocephala*) forest with a Peppermint mid-storey. However, small, sometimes isolated, populations may be found on the SSCP between Harvey and Busselton, particularly within riparian vegetation where Peppermint is a component of the understorey (Ninox unpublished data). The scats and dreys (nests) of this species are readily identifiable and a specific search to detect their presence within the Cloverdale Survey Area was undertaken. No fresh scats or dreys were located in the remnant vegetation although both were found in the cultivated garden surrounding a house within the Survey Area. This location will not be affected by development of the proposed Cloverdale Mineral Sands Mine.

While large amounts of Common Brushtail Possum scats were located in riverine vegetation (Vegetation Code C1 in Figure 1) along the Capel River, only two, relatively old, scats of the Western Ringtail Possum were found in this location. In the long-term, where these two species occur together and the former outnumber the latter, the larger Common Brushtail Possum is known to actively exclude the Western Ringtail Possum from such areas (B. Jones pers. comm.).

The Chuditch (*Dasyurus geoffroii*) is listed as Vulnerable on both the *EPBC (1999)* and *WC Act (1950)*. While this marsupial has been frequently captured in the Darling Range (Ninox Wildlife Consulting 2002, 2003), there are very few records from the SSCP. However, Chuditch have been captured at Gwindinup, south of Boyanup in recent years (M.J. Bamford pers. comm.). While not recorded in the Cloverdale Survey Area, Chuditch are known to persist in relatively disturbed areas (Ninox personal observations). However, the existing degree of clearing in the Cloverdale Survey Area might preclude this marsupial from being resident in the area.

The Quokka (*Setonix brachyurus*) is listed as Vulnerable on both the *EPBC (1999)* and *WC Act (1950)*. There has been a recent record (2002) of this species from the near coastal area approximately 15 km north of Capel (Western Australian Museum's Faunabase). Burbidge (2004) states that this species now lives only in the densest vegetation, often on the edge of swamps in forested areas. The major threats to this species on the Western Australian mainland are predation by the Red Fox and habitat degradation through inappropriate fire regimes (Burbidge 2004). However, the dense thickets of vegetation that this species requires are not present within the Cloverdale Survey Area, therefore it is unlikely that the Quokka is present.

5.6.2.2 CALM Priority List

No native mammal species shown on CALM's Priority Fauna list have been recorded in the Cloverdale Survey Area. Four species on that list could occur (Appendix 1). These species are listed below with details on their Priority listing.

- Priority 3: Wambenger (*Phascogale tapoatafa*) - in 1995 a specimen was located on the Ludlow-Hithergreen Rd approximately 12 km south of the Cloverdale Survey Area (Western Australian Museum Faunabase). Scats that could possibly be attributed to this species were located during an assessment of the Yoganup West Survey Area (Ninox Wildlife Consulting 2002). The Wambenger has been captured at Gwindinup, south of Boyanup in recent years (MJ & MR Bamford

Consulting Ecologists 2001). It is possible that this animal occurs in the remnant vegetation of the Survey Area wherever trees with suitable shelter hollows are present. The most likely areas are the riverine vegetation along the Capel and Ludlow Rivers (Vegetation Code C1 in Figure 1) where large eucalypts are present.

- Priority 5: Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventer*) – while there are no recent records on the Western Australian Faunabase, CALM records indicate that this species has been recorded along a section of the Ludlow River within 5 km of the Survey Area. The Quenda has also been captured at Gwindinup, south of Boyanup in recent years (MJ & MR Bamford Consulting Ecologists 2001). As the Quenda can occur in highly disturbed areas where weeds such as *Watsonia* predominate, it is likely that it will occur within the Survey Area in any of the remnant vegetation within the survey area, most likely within the riverine vegetation along the Capel and Ludlow Rivers (Vegetation Code C1 in Figure 1). These animals create distinctive, conical diggings in the soil when foraging for food, but none were found during any of the site assessments conducted to date.
- Priority 4: Western False Pipistrelle (*Falsistrellus mackenziei*) - while this small bat has a widespread distribution in the South-west, it appears to be locally common in Karri (*Eucalyptus diversicolor*) forests (Start and McKenzie 1998). These authors also suggest that this bat may be more common than it appears from recent captures. As this species of bat may roost in tree hollows and hollow logs it is possible that they occur within the Survey Area.
- Priority 4: Water Rat (*Hydromys chrysogaster*) - there are no recent records of this large native rat from the southern SCP in the Western Australian Museum's Faunabase. The most recent record from the general area is an animal that was recorded from the Blackwood River near Balingup in 2002. Given the presence of riparian zones within the Cloverdale Survey Area it is possible that the Water Rat could occur. However, the degraded nature of these riparian areas limits that possibility.

5.6.2.3 Other Significant Native Mammal Species

The Government of Western Australia (2000) states that at least 33 native mammals once occurred on the SCP. Only 18 were recorded during 1978 and subsequent work on the SCP. It is also stated that there has been further decline in the last 20 years and the work discussed in Section 5.2 confirms the depauperate state of small native mammal species on the SCP. Therefore, it can be said that all native mammals remaining in these areas are of significance.

5.6.3 Amphibians

None of the frogs recorded or predicted to occur in the general area or within the Cloverdale Survey Area are listed on any of the Government rare, threatened or vulnerable species lists.

5.6.4 Reptiles

Only one reptile that could potentially occur in the Survey Area, the Carpet Python (*Morelia spilota imbricata*) is listed on any rare, threatened or vulnerable species list. This python is shown as Other Specially Protected Fauna on the *WC Act (1950)*. There are no recent records of this species in the general area of Cloverdale. Given the level of existing clearing and relative isolation of much of the remnant vegetation in the general area, the likelihood of this python actually occurring in the Survey Area is minimal.

5.7 Fauna Habitats

Although approximately 3 ha of native vegetation in the vicinity of the Ludlow River and 2 ha of plantation will be cleared, none of the fauna habitats that are in good condition will be directly impacted by development of a mine. There is no connection between these remnant vegetation areas therefore, their value as part of an ecological linkage is minimal. However, they are likely to support a range of resident species, mainly birds and reptiles, and, in an area that has been substantially cleared for various land uses, their value as a fauna refuge is likely to be high. This is particularly the case with the remnant patch at approximately 371 250mE and 6 280 500mN which is in very good overall condition (Vegetation Codes E1 and M1 on Figure 1). While small and isolated, this area has been fenced for a long period of time and has a wide range of flowering shrubs in the understorey with relatively few weed species. The number of bird species within this area was high by comparison with all of the other areas visited during this assessment with 25 observed in a relatively short period of time. This compares with 12 species recorded in the vegetation along the Capel River and 17 along the Ludlow River. The vegetation along both of these rivers has been significantly modified by past grazing activities (Mattiske Consulting Pty Ltd 2005) although the large eucalypts may provide a range of hollows suitable for shelter for a range of small animals including bats. However, only 3 ha of vegetation along the Ludlow River will be disturbed by mining and this vegetation has little in the way of understorey with the result that its significance to vertebrate fauna is diminished.

5.8 Ecological Linkages

While south and west of the Capel River, the remnant vegetation of the Cloverdale Survey Area does not form part of the Capel River Ecological Linkage as shown in EPA (2003). Some vegetated sections of the Ludlow River also pass through the Survey Area and, while 3 ha of this will be cleared, there is no link with any significant remnant vegetation in the eastern sections of the river. As discussed in Mattiske Consulting Pty Ltd (2005) however, there is a need to maintain these riverine communities in these areas as they provide significant values for fauna (mainly birds) as corridors for movement.

6 CONCLUSIONS

Much of the Cloverdale Survey Area and surrounds is cleared grazing land. Therefore the remaining remnant vegetation patches are likely to be of significance to a range of animal species, in particular, breeding birds and small reptiles. As a result of the level of clearing within the Greater Bunbury Region, these small, and in some cases degraded, areas of native vegetation, may be of greater importance to a range of animals than their size and condition

suggest. However, very little of this remnant vegetation will be cleared for development of a mine, therefore, there is likely to be minimal impact on the vertebrate fauna species that are known or predicted to occur in the Cloverdale Survey Area.

7 RECOMMENDATIONS

While much of the Cloverdale Survey Area is cleared it is recommended that the remnant vegetation that has been fenced from stock and is in good condition is protected from any impact from mining and associated activities. In the current planning, this area will not experience any direct disturbance.

Where clearing of vegetation is unavoidable, mitigation measures could include, but not be limited to, additional fencing of remnant vegetation, particularly along creeklines and rivers, to prevent grazing by stock and allow some regeneration of understorey plants. Some weed control may be required to ensure that native shrubs and ground covers provide appropriate habitat for vertebrate fauna.

8 PARTICIPANTS

This assessment of the vertebrate fauna and their habitats was conducted by Ninox Wildlife Consulting principal Jan Henry.

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APPENDIX 1 List of vertebrate fauna species recorded or predicted to occur in the various habitats of the Cloverdale Mineral Sands Survey Area.

Key

Data sources

- WAM = Western Australian Museum database
 10&12/02 = Ninox Survey of Yoganup West
 3/05 = GHD field survey
 10/05 = Ninox field survey
 (Those left blank indicate species distribution maps only)

Conservation Status - Western Australia

- CR = Critically Endangered under the *Wildlife Conservation Act 1950*
 VU = Vulnerable under the *Wildlife Conservation Act 1950*
 OP = Other Specially Protected Fauna under the *Wildlife Conservation Act 1950*
 P# = Listed under CALM's Priority Fauna list

Conservation Status - Commonwealth

- V = Vulnerable under the *EPBC Act 1999*
 E = Endangered under the *EPBC Act 1999*
 J = JAMBA treaty
 C = CAMBA treaty

Significant Bird Species (Table 15 Bush Forever Vol. 2)

- RD = Habitat specialists with a reduced distribution on the Swan Coastal Plain
 RP = Wide-ranging species with reduced populations on the Swan Coastal Plain locally extinct

| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|------------------------------------|------------------------|--------|-----------|-----|-----------|------|-------|
| BIRDS | | | | | | | |
| CASUARIIDAE | | | | | | | |
| <i>Dromaius novaehollandiae</i> | Emu | RP | | | | X | |
| PHASIANIDAE | | | | | | | |
| <i>Coturnix pectoralis</i> | Stubble Quail | | | | | | |
| ANATIDAE | | | | | | | |
| <i>Cygnus atratus</i> | Black Swan | | | | | X | |
| <i>Tadorna tadornoides</i> | Australian Shelduck | | X | | X | X | |
| <i>Chenonetta jubata</i> | Australian Wood Duck | | | | X | X | X |
| <i>Anas gracilis</i> | Grey Teal | | | X | X | X | |
| <i>Anas superciliosa</i> | Pacific Black Duck | | | | | | |
| PODICIPEDIDAE | | | | | | | |
| <i>Tachybaptus novaehollandiae</i> | Australasian Grebe | | | X | | | |
| PHALACROCORACIDAE | | | | | | | |
| <i>Phalacrocorax sulcirostris</i> | Little Black Cormorant | | | | | | |
| <i>Phalacrocorax melanoleucos</i> | Little Pied Cormorant | | | | | | |
| ARDEIDAE | | | | | | | |
| <i>Ardea pacifica</i> | White-necked Heron | | | | X | | X |
| <i>Ardea novaehollandiae</i> | White-faced Heron | | | | X | X | X |
| <i>Ardea alba</i> | Great Egret | C | | X | | | |
| <i>Ardea garzetta</i> | Little Egret | | | | | | |
| <i>Ardea ibis</i> | Cattle Egret | C | | | | | |
| <i>Nycticorax caledonicus</i> | Rufous Night Heron | RP | | X | | | |
| THRESKIORNITHIDAE | | | | | | | |
| <i>Plegadis falcinellus</i> | Glossy Ibis | C | | | | | |
| <i>Threskiornis molucca</i> | Australian White Ibis | | | | | | |

| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|-------------------------------------|----------------------------------|--------|-----------|-----|-----------|------|-------|
| <i>Threskiornis spinicollis</i> | Straw-necked Ibis | | | | X | X | X |
| <i>Platalea regia</i> | Royal Spoonbill | | | | | | |
| <i>Platalea flavipes</i> | Yellow-billed Spoonbill | | | | | | |
| ACCIPITRIDAE | | | | | | | |
| <i>Elanus caeruleus</i> | Black-shouldered Kite | | | | | | |
| <i>Hamirostra isura</i> | Square-tailed Kite | RP | | | | | |
| <i>Haliastur sphenurus</i> | Whistling Kite | RP | X | | X | | |
| <i>Accipiter fasciatus</i> | Brown Goshawk | RP | X | X | | | |
| <i>Accipiter cirrhocephalus</i> | Collared Sparrowhawk | RP | X | | | | |
| <i>Aquila morphnoides</i> | Little Eagle | RP | X | | | | |
| <i>Aquila audax</i> | Wedge-tailed Eagle | RP | X | X | | X | |
| <i>Circus assimilis</i> | Spotted Harrier | | | | | | |
| <i>Circus approximans</i> | Swamp Harrier | | | X | | | |
| FALCONIDAE | | | | | | | |
| <i>Falco berigora</i> | Brown Falcon | RP | X | | | | |
| <i>Falco cenchroides</i> | Australian Kestrel | | | X | X | | |
| <i>Falco longipennis</i> | Australian Hobby | | | | | | |
| <i>Falco peregrinus</i> | Peregrine Falcon | OP/RP | | | | | |
| TURNICIDAE | | | | | | | |
| <i>Turnix varia</i> | Painted Button-quail | RP | | | | | |
| RALLIDAE | | | | | | | |
| <i>Porphyrio porphyrio</i> | Purple Swamphen | | | X | | | |
| <i>Gallinula ventralis</i> | Black-tailed Native-hen | | | | | | |
| <i>Gallinula tenebrosa</i> | Dusky Moorhen | RD | | | | | |
| <i>Fulica atra</i> | Eurasian Coot | | | | | | |
| CHARADRIIDAE | | | | | | | |
| <i>Vanellus tricolor</i> | Banded Lapwing | | | X | | | |
| <i>Charadrius ruficapillus</i> | Red-capped Plover | | | X | | | |
| <i>Charadrius melanops</i> | Black-fronted Dotterel | | | | | | |
| <i>Erythrogonys cinctus</i> | Red-kneed Dotterel | | | | | | |
| COLUMBIDAE | | | | | | | |
| <i>Phaps chalcoptera</i> | Common Bronzewing | RD | X | X | | X | X |
| <i>Ocyphaps lophotes</i> | Crested Pigeon | | | | X | X | X |
| PSITTACIDAE | | | | | | | |
| <i>Calyptorhynchus banksii naso</i> | Forest Red-tailed Black-Cockatoo | VU | | X | X | | X |
| <i>Calyptorhynchus latirostris</i> | Carnaby's Cockatoo | E/VU | X | X | | | X |
| <i>Calyptorhynchus baudinii</i> | Baudin's Cockatoo | V/VU | | X | | | |
| <i>Cacatua roseicapilla</i> | Galah | | | | | | |
| <i>Glossopsitta porphyrocephala</i> | Purple-crowned Lorikeet | | | | | | |
| <i>Polytelis anthopeplus</i> | Regent Parrot | | X | X | | | X |
| <i>Platycercus zonarius</i> | Australian Ringneck | | X | X | X | X | X |
| <i>Platycercus spurius</i> | Red-capped Parrot | | X | X | | X | X |
| <i>Platycercus icterotis</i> | Western Rosella | RP | X | X | | | X |
| <i>Neophema elegans</i> | Elegant Parrot | | | X | X | | |
| CUCULIDAE | | | | | | | |
| <i>Cuculus pallidus</i> | Pallid Cuckoo | | | X | | | |
| <i>Cacomantis flabelliformis</i> | Fan-tailed Cuckoo | | X | | | | |
| <i>Chrysococcyx basalis</i> | Horsfield's Bronze-Cuckoo | | | | | | |
| <i>Chrysococcyx lucidus</i> | Shining Bronze-Cuckoo | | X | X | | | X |
| STRIGIDAE | | | | | | | |

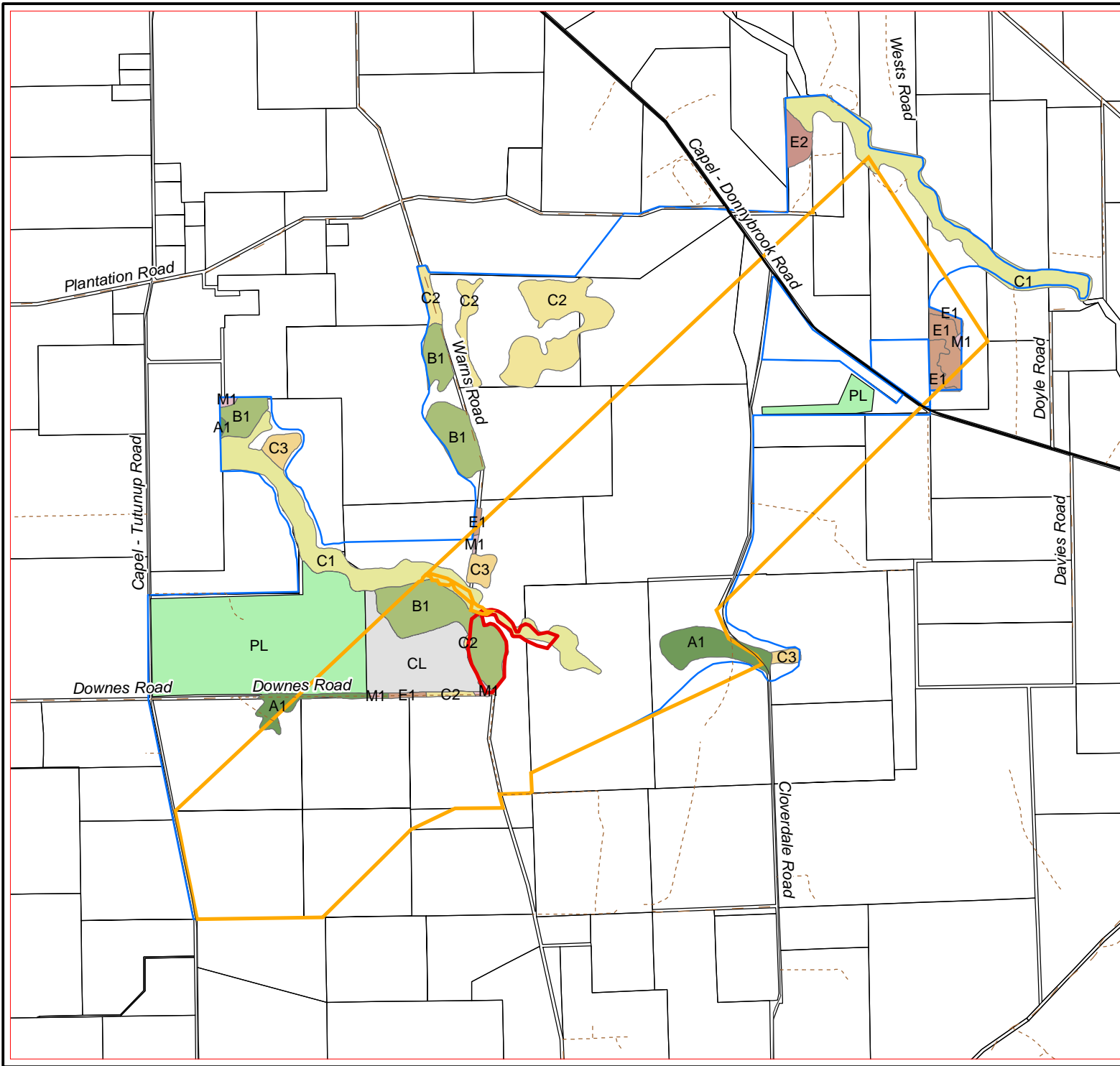
| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|--------------------------------------|--------------------------------|--------|-----------|-----|-----------|------|-------|
| <i>Ninox novaeseelandiae</i> | Southern Boobook | | X | | | | |
| TYTONIDAE | | | | | | | |
| <i>Tyto novaehollandiae</i> | Masked Owl | RP | | X | | | |
| <i>Tyto alba</i> | Barn Owl | | | X | | | |
| PODARGIDAE | | | | | | | |
| <i>Podargus strigoides</i> | Tawny Frogmouth | | X | X | X | | |
| AEGOTHELIDAE | | | | | | | |
| <i>Aegotheles cristatus</i> | Australian Owlet-nightjar | | | X | | | |
| APODIDAE | | | | | | | |
| <i>Apus pacificus</i> | Fork-tailed Swift | J/C | | | | | |
| HALCYONIDAE | | | | | | | |
| <i>Todiramphus sanctus</i> | Sacred Kingfisher | | X | | X | | |
| MEROPIDAE | | | | | | | |
| <i>Merops ornatus</i> | Rainbow Bee-eater | J | X | | X | | X |
| CLIMACTERIDAE | | | | | | | |
| <i>Climacteris rufa</i> | Rufous Treecreeper | RD | | X | | | |
| MALURIDAE | | | | | | | |
| <i>Malurus splendens</i> | Splendid Fairy-wren | RD | X | X | X | X | X |
| <i>Stipiturus malachurus</i> | Southern Emu-wren | RD | | X | | | |
| PARDALOTIDAE | | | | | | | |
| <i>Pardalotus punctatus</i> | Spotted Pardalote | | X | X | | | X |
| <i>Pardalotus striatus</i> | Striated Pardalote | | X | X | X | | X |
| ACANTHIZIDAE | | | | | | | |
| <i>Sericornis frontalis</i> | White-browed Scrubwren | RD | X | X | | X | X |
| <i>Smicronis brevirostris</i> | Weebill | RD | X | | X | X | |
| <i>Gerygone fusca</i> | Western Gerygone | | X | X | X | X | X |
| <i>Acanthiza apicalis</i> | Broad-tailed Thornbill | RD | X | | X | | X |
| <i>Acanthiza inornata</i> | Western Thornbill | RD | | | X | | |
| <i>Acanthiza chrysorrhoa</i> | Yellow-rumped Thornbill | RD | X | X | X | X | X |
| MELIPHAGIDAE | | | | | | | |
| <i>Lichmera indistincta</i> | Brown Honeyeater | | X | | X | | X |
| <i>Lichenostomus virescens</i> | Singing Honeyeater | | | X | | | |
| <i>Lichenostomus ornatus</i> | Yellow-plumed Honeyeater | RD | | | | | |
| <i>Melithreptus brevirostris</i> | Brown-headed Honeyeater | | | | | | |
| <i>Melithreptus chloropsis</i> | Western White-naped Honeyeater | RP | | | | | |
| <i>Phylidonyris novaehollandiae</i> | New Holland Honeyeater | RP | | X | X | X | X |
| <i>Phylidonyris nigra</i> | White-cheeked Honeyeater | RP | | | | | |
| <i>Phylidonyris melanops</i> | Tawny-crowned Honeyeater | RP | | | | | |
| <i>Acanthorhynchus superciliosus</i> | Western Spinebill | | X | | | | |
| <i>Manorina flavigula</i> | Yellow-throated Miner | RP | | | | | |
| <i>Anthochaera lunulata</i> | Western Little Wattlebird | RP | | | | | |
| <i>Anthochaera carunculata</i> | Red Wattlebird | | X | X | X | X | X |
| <i>Ephthianura albifrons</i> | White-fronted Chat | | | | | | |
| PETROICIDAE | | | | | | | |
| <i>Petroica multicolor</i> | Scarlet Robin | RD | X | X | | | |
| <i>Petroica goodenovii</i> | Red-capped Robin | | | | | | |
| <i>Petroica cucullata</i> | Hooded Robin | RD | | | | | |
| <i>Eopsaltria australis</i> | Yellow Robin | RD | | X | | | |
| <i>Eopsaltria georgiana</i> | White-breasted Robin | RD | | | | X | |
| NEOSITTIDAE | | | | | | | |

| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|----------------------------------|---------------------------|--------|-----------|-----|-----------|------|-------|
| <i>Daphoenositta chrysoptera</i> | Varied Sittella | RD | X | | | | |
| PACHYCEPHALIDAE | | | | | | | |
| <i>Pachycephala pectoralis</i> | Golden Whistler | RD | X | X | X | | X |
| <i>Pachycephala rufiventris</i> | Rufous Whistler | | X | | X | | X |
| <i>Colluricincla harmonica</i> | Grey Shrike-thrush | RD | X | | | | |
| DICRURIDAE | | | | | | | |
| <i>Myiagra inquieta</i> | Restless Flycatcher | RD | | | | | |
| <i>Rhipidura fuliginosa</i> | Grey Fantail | | X | | X | X | X |
| <i>Rhipidura leucophrys</i> | Willie Wagtail | | X | | X | X | X |
| <i>Grallina cyanoleuca</i> | Magpie-lark | | | | X | X | X |
| CAMPEPHAGIDAE | | | | | | | |
| <i>Coracina novaehollandiae</i> | Black-faced Cuckoo-shrike | | X | | X | X | X |
| <i>Lalage tricolor</i> | White-winged Triller | | | | X | | |
| ARTAMIDAE | | | | | | | |
| <i>Artamus personatus</i> | Masked Woodswallow | | | | | | |
| <i>Artamus cinereus</i> | Black-faced Woodswallow | RP | X | | | | |
| <i>Artamus cyanopterus</i> | Dusky Woodswallow | RP | | X | X | X | |
| CRACTICIDAE | | | | | | | |
| <i>Cracticus torquatus</i> | Grey Butcherbird | | X | | X | X | X |
| <i>Cracticus tibicen</i> | Australian Magpie | | X | X | X | X | X |
| <i>Strepera versicolor</i> | Grey Currawong | RP | | | | | |
| CORVIDAE | | | | | | | |
| <i>Corvus coronoides</i> | Australian Raven | | X | X | X | X | X |
| HIRUNDINIDAE | | | | | | | |
| <i>Hirundo neoxena</i> | Welcome Swallow | | | | X | X | X |
| <i>Hirundo nigricans</i> | Tree Martin | | | | | | X |
| ZOSTEROPIDAE | | | | | | | |
| <i>Zosterops lateralis</i> | Grey-breasted White-eye | | X | X | X | X | X |
| SYLVIIDAE | | | | | | | |
| <i>Acrocephalus australis</i> | Australian Reed-warbler | | | | | | |
| <i>Megalurus gramineus</i> | Little Grassbird | | | | | | |
| <i>Cinclorhampus mathewsi</i> | Rufous Songlark | | | | X | | |
| <i>Cinclorhampus cruralis</i> | Brown Songlark | | | X | | | |
| DICAEIDAE | | | | | | | |
| <i>Dicaeum hirundinaceum</i> | Mistletoebird | | | X | | | |
| PASSERIDAE | | | | | | | |
| <i>Stagonopleura oculata</i> | Red-eared Firetail | | | | | | |
| MOTACILLIDAE | | | | | | | |
| <i>Anthus australis</i> | Australian Pipit | | X | | X | X | |
| NATIVE MAMMALS | | | | | | | |
| TACHYGLOSSIDAE | | | | | | | |
| <i>Tachyglossus aculeatus</i> | Echidna | | | | | | |
| DASYURIDAE | | | | | | | |
| <i>Antechinus flavipes</i> | Mardo | | | | | | |
| <i>Dasyurus geoffroii</i> | Chuditch | V/VU | X | X | | | |
| <i>Phascogale tapoatafa</i> | Wambenger | P4 | X | X | ?X | | |
| <i>Sminthopsis gilberti</i> | Gilbert's Dunnart | | | | | | |
| <i>Sminthopsis griseoventer</i> | Grey-bellied Dunnart | | | | | | |
| PERAMELIDAE | | | | | | | |

| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|--|----------------------------|--------|-----------|-----|-----------|------|-------|
| <i>Isoodon obesulus fusciventer</i> | Southern Brown Bandicoot | P4 | X | X | | | |
| MACROPODIDAE | | | | | | | |
| <i>Macropus fuliginosus</i> | Western Grey Kangaroo | | X | | | | |
| <i>Setonix brachyurus</i> | Quokka | E/VU | | X | | | |
| PSEUDOCHEIRIDAE | | | | | | | |
| <i>Pseudocheirus occidentalis</i> | Western Ringtail Possum | V/VU | X | | | | X |
| PHALANGERIDAE | | | | | | | |
| <i>Trichosurus vulpecula vulpecula</i> | Common Brushtail Possum | | X | | X | | X |
| BURRAMYIDAE | | | | | | | |
| <i>Cercartetus concinnus</i> | Western Pygmy -possum | | | X | | | |
| VESPERTILIONIDAE | | | | | | | |
| <i>Chalinolobus gouldii</i> | Gould's Wattled Bat | | | | | | |
| <i>Chalinolobus morio</i> | Chocolate Wattled Bat | | | | | | |
| <i>Falsistrellus mackenziei</i> | Western False Pipistrelle | P4 | | X | | | |
| <i>Nyctophilus geoffroyi</i> | Lesser Long-eared Bat | | | | | | |
| <i>Nyctophilus gouldii</i> | Gould's Long-eared Bat | | X | | | | |
| <i>Nyctophilus timoriensis</i> | Greater Long-eared Bat | | X | X | | | |
| <i>Vespadelus regulus</i> | Southern Forest Bat | | | X | | | |
| MOLOSSIDAE | | | | | | | |
| <i>Mormopterus planiceps</i> | Southern Freetail-bat | | | | | | |
| <i>Tadarida australis</i> | White-striped Freetail-bat | | X | | | | |
| MURIDAE | | | | | | | |
| <i>Hydromys chrysogaster</i> | Water-rat | P4 | | X | | | |
| AMPHIBIANS | | | | | | | |
| HYLIDAE | | | | | | | |
| <i>Litoria adelaidensis</i> | Slender Tree Frog | | | | | | X |
| <i>Litoria moorei</i> | Motorbike Frog | | | | | | X |
| MYOBATRACHIDAE | | | | | | | |
| <i>Heleioporus eyrei</i> | Moaning Frog | | X | X | | | |
| <i>Heleioporus psammophilus</i> | Sand Frog | | | | | | |
| <i>Limnodynastes dorsalis</i> | Banjo Frog | | X | X | | X | |
| <i>Crinia georgiana</i> | Quacking Frog | | | X | | | |
| <i>Crinia glauerti</i> | Glauert's Froglet | | | | | X | X |
| <i>Crinia insignifera</i> | Squelching Frog | | X | X | | X | |
| <i>Geocrinia leai</i> | Lea's Frog | | | X | | | |
| <i>Myobatrachus gouldii</i> | Turtle Frog | | | | | | |
| <i>Pseudophryne guentheri</i> | Crawling Frog | | | X | | | |
| REPTILES | | | | | | | |
| CHELUIDAE | | | | | | | |
| Freshwater Turtles | | | | | | | |
| <i>Chelodina oblonga</i> | | | X | | | | |
| AGAMIDAE | | | | | | | |
| <i>Pogona minor</i> | | | | X | | | |
| GEKKONIDAE | | | | | | | |
| <i>Christinus marmoratus</i> | | | X | X | | | |
| <i>Diplodactylus polyophthalmus</i> | | | | | | | |
| <i>Underwoodisaurus milii</i> | | | | | | | |
| PYGOPODIDAE | | | | | | | |
| <i>Aprasia repens</i> | | | | | | | |

| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|---------------------------------------|----------------------|--------|-----------|-----|-----------|------|-------|
| <i>Delma fraseri</i> | | | | | | | |
| <i>Delma grayii</i> | | | | | | | |
| <i>Lialis burtonis</i> | | | | X | | | |
| <i>Pygopus lepidopodus</i> | | | | | | | |
| SCINCIDAE | | | | | | | |
| <i>Acritoscincus trilineatum</i> | | | | X | | | |
| <i>Cryptoblepharus plagiocephalus</i> | | | X | X | | | X |
| <i>Ctenotus impar</i> | | | | X | | | |
| <i>Ctenotus labillardieri</i> | | | | X | | X | |
| <i>Egernia kingii</i> | | | | X | | | X |
| <i>Egernia luctuosa</i> | | | | X | | X | |
| <i>Egernia napoleonis</i> | | | | X | | | |
| <i>Glaphyromorphus gracilipes</i> | | | | X | | | |
| <i>Hemiergis peronii</i> | | | X | | | | |
| <i>Hemiergis quadrilineata</i> | | | | X | | | |
| <i>Lerista distinguenda</i> | | | | X | | | |
| <i>Lerista elegans</i> | | | X | X | | | |
| <i>Lerista lineopunctulata</i> | | | | X | | | |
| <i>Lerista microtis</i> | | | | | | | |
| <i>Menetia greyii</i> | | | X | | | | |
| <i>Morethia lineocellata</i> | | | X | | | | |
| <i>Morethia obscura</i> | | | | X | | | |
| <i>Tiliqua rugosa</i> | | | X | X | | X | |
| VARANIDAE | | | | | | | |
| <i>Varanus gouldii</i> | | | X | X | | | |
| <i>Varanus rosenbergi</i> | | | | | | | |
| <i>Varanus tristis</i> | | | | | | | |
| TYPHLOPIDAE | | | | | | | |
| <i>Ramphotyphlops australis</i> | | | X | X | | | |
| <i>Ramphotyphlops pinguis</i> | | | | X | | | |
| BOIDAE | | | | | | | |
| <i>Morelia spilota imbricata</i> | | OP | | | | | |
| ELAPIDAE | | | | | | | |
| <i>Elapognathus coronatus</i> | | | | X | | | |
| <i>Echiopsis curta</i> | | | | | | | |
| <i>Neelaps bimaculatus</i> | | | | | | | |
| <i>Notechis scutatus</i> | | | | X | | | |
| <i>Parasuta gouldii</i> | | | | | | | |
| <i>Parasuta nigriceps</i> | | | | X | | | |
| <i>Pseudonaja affinis</i> | | | X | X | | | |
| <i>Simoselaps bertholdi</i> | | | | X | | | |
| | | | | | | | |
| INTRODUCED SPECIES | | | | | | | |
| BIRDS | | | | | | | |
| COLUMBIDAE | | | | | | | |
| <i>Columba livia</i> | Feral Pigeon | | | | | | |
| <i>Streptopelia senegalensis</i> | Laughing Turtle-Dove | | | | | | |
| <i>Streptopelia chinensis</i> | Spotted Turtle-Dove | | | | | | |
| HALCYONIDAE | | | | | | | |
| <i>Dacelo novaeguineae</i> | Laughing Kookaburra | | X | X | X | X | X |

| | | Status | Lit. Rev. | WAM | 10&12 /02 | 3/05 | 10/05 |
|------------------------------|-------------|--------|-----------|-----|-----------|------|-------|
| MAMMALS | | | | | | | |
| MURIDAE | | | | | | | |
| <i>Mus musculus</i> | House Mouse | | X | X | | | |
| <i>Rattus rattus</i> | Black Rat | | X | X | | | |
| LEPORIDAE | | | | | | | |
| <i>Oryctolagus cuniculus</i> | Rabbit | | X | | X | X | X |
| CANIDAE | | | | | | | |
| <i>Vulpes vulpes</i> | Red Fox | | X | | X | X | X |
| FELIDAE | | | | | | | |
| <i>Felis catus</i> | Feral Cat | | X | | | | |



REVISIONS

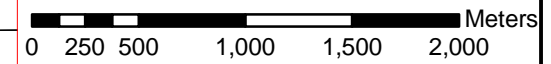
| Ver. | ORIG | DESIGN | DATE | COMMENTS |
|------|------|--------|------|----------|
| | | | | |
| | | | | |

Legend

- Project Area
- Survey Area
- No Mining Area
- Cadastre

Vegetation (Mattiske 2005)

- A1
- B1
- C1
- C2
- C3
- CL
- E1
- E2
- M1
- PL



MGA Coordinates, GDA94



CLOVERDALE

Fauna Survey

ORIG: SJones
 DRAWN: SJones
 SCALE: 1:25,000
 DATE: 24 Feb 2006

DWG No: APJCVFauna Survey Area060224 **FIGURE: 1**