

Report

Acclaim Exploration NL

**Wingellina Baseline Biological
Survey**

EP016583



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1 Executive Summary

Acclaim Exploration NL commissioned Halpern Glick Maunsell Pty Ltd to undertake a biological assessment of lease area E69/535 of the Wingellina Nickel Project.

This report presents the findings of a field survey of vegetation, flora and fauna conducted in early April 2002. The survey area of approximately 100km² includes the settlement and surrounds of the Wingellina Aboriginal Community. The report includes an inventory of all flora and fauna species recorded during the survey of the project area and an assessment of habitat utilisation patterns. It identifies species, vegetation communities and fauna habitats of conservation significance as well as reporting on disturbance resulting from previous exploration. This objective also meets the requirements to conduct baseline biological surveys as set out in the deed.

Additional information detailed in this report has been derived from literature relating to the biological aspects of the survey area, including published and unpublished reports, scientific papers and available datasets. Background information has been provided to place the biological information within the context of the physical environment, including geological, landform, soil and climatic features of the study area.

The flora and vegetation survey identified seven vegetation communities occurring within the project area. None of the vegetation communities are restricted to the project areas or are nationally listed as threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Three communities are considered to be of regional significance. One of these communities is also of regional conservation significance.

A search of the Department of Conservation and Land Management's (CALM) threatened flora database identified 11 priority flora species that have previously been recorded within the vicinity of the study area. Of the plants recorded on site and identified prior to production of this draft report no Declared Rare flora species or species listed under the EPBC Act have been recorded from the study area.

Six introduced (weed) flora taxa were observed in the survey. However, none of these are classified as Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* as at 25 October 2001.

In light of the suggestion from CALM Kalgoorlie's Regional Ecologist that the optimum timing for the faunal component of the survey would be late spring, it was proposed that a habitat assessment and non-systematic fauna survey be conducted as part of the initial biological survey. Results from this brief survey are reported here. It is proposed that a more detailed survey, including the use of fauna trapping grids, be conducted in spring 2002.

Database searches were undertaken to identify threatened fauna species. Potential species listed under the EPBC Act include the Night Parrot *Pezoporus occidentalis* and Golden Bandicoot *Isodon auratus* (Endangered nationally), the Princess Parrot *Polytelis alexandrae*, Malleefowl *Leipoa ocellata* and Bilby *Macrotis lagotis* (Vulnerable). Potential species listed under state legislation include ten Scheduled species and seven Priority Fauna. No rare or priority

fauna species were detected in the study area during the field survey. 54 species of bird, 10 reptiles and five mammals were recorded during the field visit.

Fire and historical exploration issues were identified as producing the greatest impact on the biological environment within the study area.

Acclaim Exploration NL conducts activities in the area in a fashion that is sensitive to the traditional owners. During the field survey, traditional elders of the Wingellina community accompanied the authors at all times.

2 Introduction

2.1 Project Background

Acclaim Exploration NL is currently undertaking the Wingellina Project, an exploration (drilling) project for nickel in the Wingellina Hills, Western Australia. Acclaim Exploration NL commissioned Halpern Glick Maunsell (HGM) in March 2002 to undertake a baseline biological survey of the Wingellina Project lease area (E69/535). The primary objectives of this survey were to:

- undertake a comprehensive literature review to gather relevant information on the biological and physical characteristics of the study area.
- conduct a search of CALM's databases for known populations of rare and endangered flora and threatened fauna from the vicinity of the study area (Appendices C and F);
- conduct a search of the WA Herbarium's database for voucher specimens submitted from the vicinity of the study area (Appendix B);
- liaise with the Department of Agriculture to identify any noxious or Declared Plants or animals occurring within the vicinity of the study area;
- initiate an inventory of flora species identified within the project area;
- identify and map vegetation associations within the project area;
- identify fauna habitats present;
- initiate an inventory of vertebrate fauna species within the project area;
- investigate opportunities for a fauna survey and trapping scheduled for late spring;
- conduct an audit of the lease in regard to disturbance, particularly from previous exploration; and
- liaison with CALM regional offices to identify any particular concerns relating to the project.

The project area lies close to the Wingellina Aboriginal Community, therefore activities in the area were coordinated with consideration to the traditional owners.

2.2 Project Area

The Wingellina Project Area is located on Aboriginal reserve land in the Central Ranges, Central Australia, approximately eight kilometres south-west of Surveyors General Corner (intersection of the NT, SA and WA borders) (Figure 1).

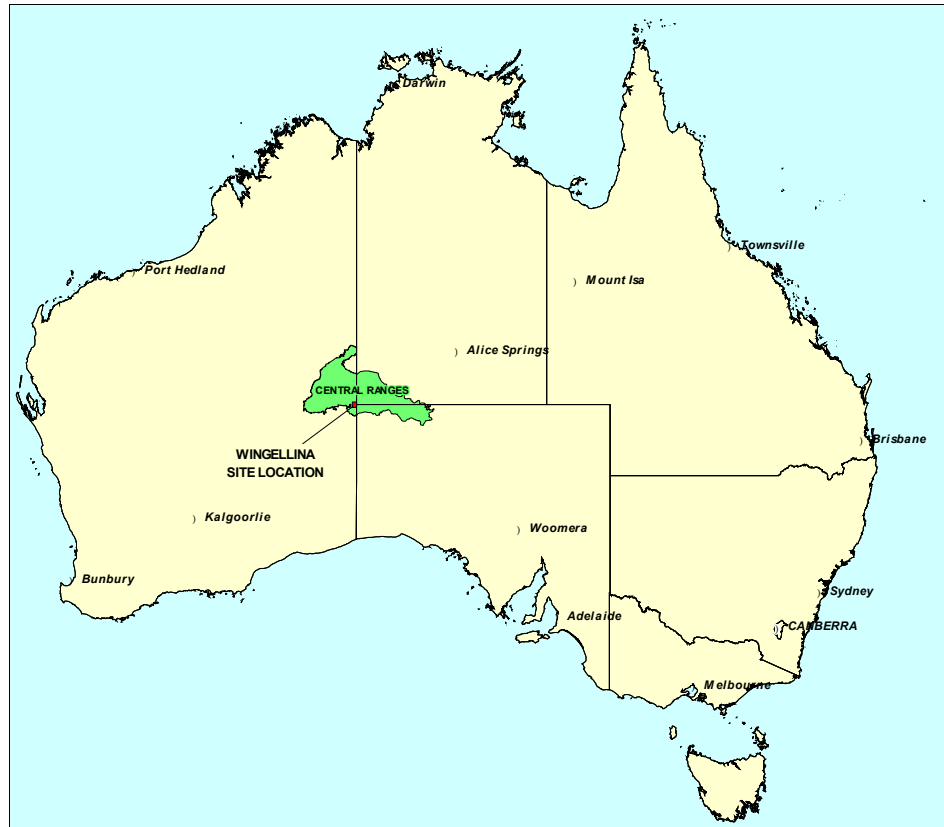


Figure 1: Location of Project Area within Central Ranges IBRA Region

The study area is approximately 100km² and centred around the Acclaim Exploration Camp located at 26°03'24"S, 128°57'35"E. As the study area occurs within the Central Aboriginal Reserve and is proximal to the Wingellina Aboriginal Community (Irrunytiju) there are several exclusion areas designated by the traditional owners. These areas were not surveyed.

2.3 Physical Environment

2.3.1 Climate

The Wingellina project area lies in central Australia, and therefore has an arid climate with variable rainfall (Bureau of Meteorology 1983).

The Central Ranges occur in a bioclimatic region that has a true desert climate, with all months considered 'dry' on the basis of average figures (Beard 1974). This area is influenced by a northern tropical/summer climatic pattern where rainfall is greatest in the summer months, and a southern climatic pattern where rainfall is non-seasonal.

In general rainfall is extremely variable, but predominantly occurs between December to March, derived from summer storms. Climate data from Giles meteorological station to the north-west of the study area (25°05'S 128°29'E) indicates an annual average rainfall of 250mm. The area is warm to hot throughout the year, with an average maximum of 29.3°C.

2.3.2 Geology and Landforms

Regional Geology

The Wingellina area occurs within the Musgrave Block, one of the two major Proterozoic structural units of the Central Ranges (Daniels 1975). The ranges within the Musgrave Block are composed of Middle Proterozoic igneous and metamorphic rocks (including intrusive elements), primarily gneiss, granite, gabbro and associated weathered material. The plains country that surrounds the ranges is elevated (generally greater than 500 metres) (Geological Society of SA 1958). These elevated landscapes are a principal source of sediment that has supplied surrounding basins and low lying areas since Pre-Cambrian times.

A series of ranges stretches from the vicinity of Warburton in Western Australia to Anangu Pitjantjatjara Lands in South Australia. This includes, from east to west, the Everard, Musgrave, Mann, Tomkinson, Blackstone and Warburton Ranges (Shephard 1995). The Wingellina Hills are essentially a portion of the Tomkinson Ranges. The Bell Rock Range lies to the southwest of the study area.

Local Geology

The Wingellina Hills consist of a series of predominately low, NW-SE trending ridges with occasional high steep hills and rocky outcrops. These hills are formed by the Wingellina Intrusion, a layered gabbro and ultramafic igneous body. In places the gabbro forms rocky outcrops with bouldery scree slopes on the steeper slopes.

Landforms and Topography

The Wingellina hills are separated from nearby ranges to the east and south by 5-10 kilometre wide flats. The hills rise 100 to 150 metres above the surrounding plains, which are at approximately 600 metres elevation. The highest point in the Wingellina Hills is 778m.

2.4 Bioregions

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions (biogeographic regions) across Australia primarily delineated on the basis of climate, geomorphology, landform lithology, flora and fauna.

The study area occurs within the Central Ranges (CR) bioregion, described by Thackway and Cresswell (1995) as follows:

‘High proportion of Proterozoic ranges and derived soil plains, interspersed with red Quaternary sandplains. The sandplains support low open woodlands of either Desert Oak or Mulga over *Triodia basedowii* hummock grasslands. Low open woodlands of Ironwood (*Acacia estrophiolata*) and Corkwoods (*Hakea* spp.) over tussock and hummock grasses often fringe ranges. The ranges support mixed wattle scrub or *Callitris glaucophylla* woodlands over hummock and tussock grasslands. Arid, with summer and winter rain.’

The Central Ranges bioregion is bounded to the south by the Great Victoria Desert and to the north by the Great Sandy Desert. The Gibson Desert lies to the west, beyond Warburton. The recently developed IBRA classification

(version 5.1) includes an additional 354 sub-regions. The study area lies within the CR1 sub-region (Mann-Musgrave Block).

The Central Ranges bioregion occupies upland areas of central Australia occupying areas within Western Australia, South Australia and the Northern Territory. This bioregion is of moderate to large size with an area of 97,061 km² (Thackway & Cresswell, 1995), typical of bioregions situated in remote arid and semi-arid areas.

Dominant limiting factors and constraints for the Central Ranges include extinction of critical weight range mammals, inappropriate fire regimes, feral animals (in particular camels, cats and foxes), and in some areas grazing and other pastoral activities. The reservation status of the bioregion is 0% (all three states), which is very low (some bioregions have a greater than 10% reservation status). Much of the region is located within Aboriginal reserves and this may serve to preserve some of the conservation values of the area.

The Central Ranges bioregion is almost entirely Aboriginal freehold land. Few people inhabit the Central Ranges, an area remote from main towns and other infrastructure with no major industries and low cattle production (Connors *et al.*, 1996). There is currently no reservation (or other formally protected areas) within this bioregion. Ayers Rock, Mt Olga National Park is in closest proximity (Northern Territory). The nearest conservation reserves in Western Australia are in the Gibson Desert and Great Victoria Desert.

2.5 Biological Environment

2.5.1 Flora

While all native flora are protected under the *Wildlife Conservation Act 1950*, a number of plant taxa are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these locations. CALM categorises species of threatened flora as declared rare (Conservation Code R or X), poorly known (Conservation Codes 1, 2 or 3) or requiring monitoring (Conservation Code 4). State and Commonwealth legislation (*Wildlife Conservation Act 1950* and EPBC Act respectively) protect taxa that are classified as declared rare. It is an offence to "take" declared rare flora without Ministerial Approval. In addition, it is recommended that disturbance of priority taxa be avoided where possible given that such flora are of high conservation value and have the potential to be reclassified as declared rare. The definitions of the categories of conservation codes are summarised in Table 1.

Table 1: Conservation codes for Threatened Flora (CALM, 2002)

Code	Definition
R	Declared Rare Flora – Extant Taxa. Taxa that have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction or otherwise in need of special protection.
X	Declared Rare Flora – Presumed Extinct. Taxa that have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all wild populations have been destroyed more recently.
P1	Priority 1 – Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.

Code	Definition
P2	Priority 2 – Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under threat.
P3	Priority 3 – Poorly Known Taxa. Taxa which are known from several populations, and the taxa are not believed to be under immediate threat.
P4	Priority 4 – Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare (in Australia), are not currently threatened by any identifiable factors.

2.5.2 Vegetation

Previous Botanical Surveys

Within the Warburton Region, systematic flora and vegetation surveys have been relatively limited compared to elsewhere in Western Australia such as the Southwest and the Goldfields. Those undertaken to date have been limited to broadscale vegetation mapping or unsystematic opportunistic collections, and many of these have been centred on the dominant ranges such as the Warburton Range to the west and the Petermann Ranges in the north.

However, there are several studies that have been conducted in the Central Ranges bioregion that provide descriptions of vegetation communities and identify species of potential conservation significance. The nearest to Wingellina and/or most relevant to the current study include:

- Vegetation survey of the Great Victoria Desert area (Beard 1974);
- Vegetation Survey of the Northern Territory (Wilson *et al.* 1990);
- Natural History of the Central Ranges (Morse 1999); and
- Opportunistic Collections in the Central Ranges (Edinger and Backhouse 2001).

The study area occurs within the Eremaean Botanical Province defined by Beard (1974 1990). The vegetation of this Province, which forms part of the 'Arid Zone' is generally described as mulga (*Acacia aneura*) low woodland and scrub.

The Eremaean Botanical Province is divided into smaller units, including the Giles Botanical District (also referred to as the Warburton Region) where the study area is located (Beard 1974). This area is roughly equivalent to the Central Ranges IBRA bioregion. Connors *et al.* (1996) describes the principal broad vegetation types of the Central Ranges bioregion within the Northern Territory as *Acacia* Woodland and Hummock Grassland.

Beard (1974) describes the vegetation of the Warburton Region in terms of the ranges, the sandhills, the salt lakes, the kunkar zone, the valley plains and minor communities. Beard's (1974) 1:1 000 000 mapping describes broad vegetation communities for the Warburton Region. Two of these vegetation communities occur in the study area:

- e₂₄Lb.t₂Hi – Steppe with sparse trees on rocky ranges comprising a hummock grassland of *Triodia basedowii* with irregularly scattered *Corymbia* species; and

- a₁Li – Mulga (*Acacia aneura*) low woodland on lowland areas between the ranges.

In the eastern part of the Warburton Region the ranges become gneissic in structure with intrusive dykes that form outcrops of bare boulders. Lower slopes often have Mulga and *Triodia* spp. (Spinifex) whereas the upper parts are relatively bare, with a general cover of spinifex and occasional small Mulga and *Corymbia* species. Beard (1974) found that *Ficus platypoda* may occur in gullies and on bare rock; *Ficus brachypoda* occurs in a similar habitat in the study area. Many of the plains around the ranges support stands of Mulga, influenced by fire history, and a variety of forbs such as *Ptilotus* spp. (Mulla Mulla) and Asteraceae spp. (Everlastings) and grasses whose growth varies greatly according to the season (Beard 1974).

The vegetation communities in the Northern Territory section of the Central Ranges described and mapped at 1:1 000 000 by Wilson *et al.* (1990) include:

- *Acacia aneura* (Mulga) tall open-shrubland with *Eragrostis eriopoda* (Woollybutt) open-grassland understorey;
- *Acacia tetragonophylla* (Dead Finish), *A. kempeana* (Witchetty Bush) sparse-shrubland with herb/grassland understorey;
- *Triodia spicata* (Spike Flowered Spinifex) hummock grassland with *Grevillea wickhamii* (Holly Grevillea) and *Acacia* spp. sparse-shrubland overstorey;
- *Triodia basedowii* (Hard Spinifex) hummock grassland with *E. gamophylla* (Blue Mallee) tall sparse-shrubland overstorey;
- *Triodia irritans* (Porcupine Grass) open-hummock grassland;
- *Triodia melvillei* (Spinifex) hummock grassland with *A. aneura*, *A. kempeana* tall open-shrubland overstorey;
- *Triodia basedowii* hummock grassland with *A. aneura* tall sparse-shrubland overstorey between dunes;
- *Triodia clelandii* (Weeping Spinifex) hummock grassland with mixed low open-woodland overstorey;
- *Triodia basedowii* hummock grassland with *Allocasuarina decaisneana* (Desert Oak) low open-woodland overstorey between dunes; and
- *Triodia basedowii* hummock grassland with *Allocasuarina decaisneana* low open-woodland or *Acacia* spp. tall sparse-shrubland overstorey.

Morse (1999) reviewed natural resource information for the Central Ranges, summarising the broad-scale vegetation mapping mentioned above. Morse concluded that vegetation is closely related to physiography, which is in turn controlled by geology. Morse did not conduct systematic surveys of the region, but described the dominant vegetation in the region as:

- grasslands dominated by spinifex or soft grasses;
- shrublands dominated by *Acacia aneura* and/or a number of other species;
- open woodlands of *Eucalyptus* spp; and
- open woodlands of *Allocasuarina decaisneana*.

Edinger and Backhouse (2001) conducted flora collections of the Western Australian portion of the Central Ranges in 2000 and 2001. No vegetation descriptions or mapping was undertaken but a flora inventory was compiled. Wingellina and its surrounds were not included in the survey area but the flora

inventory is the most recent and substantial of the Central Ranges and provides a useful comparison for the present study.

These studies generally identified gorges, gullies and drainage lines as of local or regional significance due to the large variety of native species they support. Other communities restricted to exposed ridges, drainage lines and uncommon geological substrates were identified as being of local significance in terms of habitats for endangered flora or fauna.

Conservation of Vegetation Communities

Commonwealth legislation protects vegetation communities classified as threatened. Under the EPBC Act a person must not take an action that is likely to have a significant impact on a listed threatened ecological community without approval from the Minister for the Environment and Heritage. The definitions of the three categories of threatened communities (TECs) are summarised in Table 2.

Table 2: Conservation categories for Threatened Ecological Communities (EPBC Act, 1999)

Code	Definition
Critically Endangered	A community can be included in the Critically Endangered category if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	A community can be included in the Endangered category if, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	A community can be included in the Vulnerable category if, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future

2.5.3 Fauna

Zoographic Regions

Biogeographic patterns in fauna distribution arise through interactions between fauna species and communities and the terrestrial systems that comprise their environment over geological time frames. The topographic uniformity of the Australian continent means that boundaries between biogeographical regions are primarily climatically determined and relatively transitional.

The terrestrial vertebrate fauna of Western Australia are generally considered as having affinities to one of three biogeographic zones that occur across the continent (Serventy and Whittell 1976 Beard 1990). These are the Torresian (Northern), Eyrean (Central) and Bassian (Southern) divisions. Within Western Australia these zones correspond to the Kimberley division, the arid zone and the south-west area of reliable winter rainfall. Some fauna species have widespread distributions, with no obvious affinity to a particular zoogeographic region.

The study area is located in the Eyrean zoogeographic region. Vertebrate fauna within this region are well adapted to the predominantly harsh, climatically erratic conditions, and arid zone elements. Characteristic arid zone species include *Diplodactylus* geckos and *Ctenotus* skinks (reptiles), grasswrens

Amytornis, the Budgerigar *Melopsittacus undulatus* and the Grey-fronted Honeyeater *Lichenostomus plumulus*, the Red Kangaroo *Macropus rufus*, Euro *Macropus robustus*, Inland Cave Bat *Vespadelus finlaysoni* and the Spinifex Hopping Mouse *Notomys alexis*. Of these, the reptiles show the highest species richness. Few species of frogs are encountered in the arid zone, but they do occur where sufficient water accumulates to facilitate breeding, and become active following significant rainfall events.

The central ranges region has developed several taxa that are endemic; these include the Central Rock Rat *Zyzomys pedunculatus*, Centralian Tree Frog *Litoria gilleni*, and the MacDonnell Ranges race of the Black-footed Rock-wallaby *Petrogale lateralis*.

The fauna of the western Central Ranges area is poorly documented. Fauna surveys undertaken in the region are of an opportunistic nature, with no detailed site-specific surveys in the Wingellina area or bioregion as a whole.

Biological surveys the surrounding area provide a general idea of fauna composition in similar desert habitats, however this is only partially relevant to the Central Ranges. These surveys include locations in the Gibson Desert Nature Reserve, Neale Junction Nature Reserve (McKenzie & Burbidge 1979) and the Petermann Ranges (Lindner 1966).

With the exception of a recent opportunistic survey of birds undertaken by Martin Gole (2002), there is no published information dealing specifically with the fauna of the study area. A spring fauna survey of the area has been proposed. This would provide an opportunity to investigate the fauna of a poorly documented area, and is a valuable contribution to knowledge of the fauna of the Central Ranges in Western Australia.

Mammals

Finlayson (1961) provided a description of the existing knowledge of the mammals of central Australia, including the Central Ranges. Finlayson noted declines in many mammal species in the central deserts during the 20th century and drew attention to the paucity of information about the mammals of the arid interior. As with all other central Australian bioregions, the Central Ranges has suffered substantial loss of mammal species over the last century (Connors *et al.* 1996).

On the basis of discussions with Aboriginal people, WA Museum records and collecting in the area, 28 species of native mammals have been recorded in modern times from the Warburton region (from Warburton east to the border) (Burbidge and Fuller 1979). This includes several species of macropods, bandicoots, dasyurids, rodents and bats. Of the 25 known terrestrial mammals (i.e. excluding bats) eight species were found to be locally extinct, most of which were medium weight range (MWR) mammals, and the abundance of several other species had declined. Mammals listed as common were the Euro *Macropus robustus*, Red Kangaroo *Macropus rufus*, Fat-tailed Pseudantechinus *Pseudantechinus macdonnellensis*, Fat-tailed Dunnart *Sminthopsis crassicaudata*, Spinifex Hopping Mouse *Notomys alexis*, Sandy Inland Mouse *Pseudomys hermannsburgensis*, Echidna *Tachyglossus aculeatus* and three species of bats (*Nyctophilus geoffroyi*, *Vespadelus finlaysoni*, *Chalinolobus gouldii*).

Burbidge *et al.* (1988) investigated traditional knowledge of the mammals of central Australia, including the Great Sandy, Little Sandy, Tanami, Gibson Desert and Great Victoria Deserts, and the Central Ranges. Burbidge *et al.* (1988) provided details of habitat utilisation, shelter requirements, distribution and status, and listed the Aboriginal names for mammals in the region. This study suggested that the area has suffered a major loss of mammal species.

Copley *et al.* (1989) undertook a survey of mammals in the north-west of South Australia, including two sites in the Tomkinson Ranges to the east of the study area. This study recorded 16 native mammals including a variety of macropods, marsupials, rodents and bats, and six introduced species. It was estimated that approximately half of the species recorded from the area since European settlement were extant.

The distribution of rock wallabies in Western Australia has been studied in detail by Pearson and Kinnear (1997). Rock-wallabies (known as Warru) have declined or disappeared over much of their range (Pearson 1992). The MacDonnell Ranges Black-footed Rock-wallaby *Petrogale lateralis* is found in the Central Ranges. In the Wingellina area Warru have been recorded in recent times only from gabbro rockpiles in the Bell Rock Range at Purnuwara and near Inkutju Soak. Records also exist for Warru occurring within Pitjantjatjara land in South Australia (Copley and Alexander 1997), and west of Alice Springs in the Northern Territory (Lundie-Jenkins and Findlay 1997). The rocky ranges may be expected to harbour relict plant species and some declining mammals (including the Brush-tailed Possum *Trichosurus vulpecula*, known to be declining in central Australia).

Feral animal species recorded from the Northern Territory portion of the Central Ranges include the House Mouse *Mus musculus*, Feral Cat *Felis catus*, European Rabbit *Oryctolagus cuniculus* and the One-humped (or Arabian) Camel *Camelus dromedarius* (Connors *et al.* 1996). These species are all present or likely to be present in the study area (refer to Section 4.2). Foxes and dogs are also expected to occur in the study area.

Birds

Pianka and Pianka (1970) recorded a total of 70 species of birds (41 passerines and 29 non-passerines) from sites to the south and west of the project area, principally in the Great Victoria Desert. This study area is some distance from the current project area however the majority of these species are typical of the arid zone and would be expected to occur in the Wingellina area. An annotated list of the birds of north-west South Australia, including information on the status and distribution of birds in the Mann and Tomkinson Ranges (Close & Jaensch, 1984) suggests that as many as 136 species of birds (73 passerine and 63 non-passerine species) have been recorded in the area. These authors included a number of records from sites in the Great Victoria Desert to the south of the Central Ranges, hence slightly fewer species would be expected to occur in the Wingellina area. Gole (2002) visited the Wingellina area in December 2001 and recorded a total of 51 bird species.

Reid and Fleming (1992) documented the ongoing decline for several bird species from the Central Ranges bioregion. These declines are largely due to land degradation and habitat alteration (caused by exotic herbivores). Change in fire regime and introduced predators may also have contributed to these declines.

Species of interest noted in the Mann and Tomkinson Ranges (north-west South Australia) include the Grey Falcon *Falco hypoleucos*, Malleefowl *Leipoa ocellata*, Pink Cockatoo *Cacatua leadbeateri*, Princess Parrot *Polytelis alexandrae*, Dusky Grasswren *Amytornis purnelli*, and several species of waterbirds (Close and Jaensch 1984).

Reptiles and Frogs

Arid regions generally have a greater diversity and abundance of lizards than in wetter, cooler areas (Pianka 1973), notably skinks of the genus *Ctenotus* (Pianka 1969b) and geckos (Pianka and Pianka 1976). The diversity of lizards is largely due to utilisation of specific (micro) habitats, coupled with speciation due to habitats fluctuating in space and time (Pianka 1972). The majority of the field study sites used by Pianka in his investigations of desert reptile communities are to the south-west of the Central Ranges, therefore his species lists are only partly applicable to the study area. Forty-nine species of skink have been recorded from the MacDonnell region in the Northern Territory (Horner 1991).

Frogs are less common in the arid zone, several species are able to exist by spending much of their time underground and thereby avoiding desiccation. Approximately 16 frog species occur in the arid zone of Western Australia, although only four species are confined to it (Tyler *et al.* 1994). The study area is largely unsuitable for frogs and few (if any) species are expected to occur.

2.5.4 Fauna Conservation

Fauna that are considered Rare and Endangered at a national level are listed under Schedule 1 of the Commonwealth EPBC Act. Classification of species under the Act is as follows (Table 3).

Table 3: Categories of threatened species under the EPBC Act.

Code	Category	Criteria
Ex	Extinct	There is no reasonable doubt that the last member of the species has died.
E	Endangered	The species is facing a very high risk of extinction in the wild in the near future.
V	Vulnerable	The species is not considered endangered but is facing a high risk of extinction in the wild in the medium-term future.

Estimates of risk of extinction are based on prescribed criteria which includes an assessment of population size and threatening processes. Additional categories exist under the EPBC Act for listed threatened species and ecological communities (critically endangered, conservation dependant and extinct in the wild) but these are not relevant in this case to the fauna of the study area.

Fauna species that are rare, threatened with extinction or have high conservation value are also protected by WA law under the *Wildlife Conservation Act 1950*. Classification of Rare and Endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 2001*, recognises four distinct schedules of taxa (Table 4).

Table 4: WA Threatened Fauna Categories

Code	Category	
S1	Schedule 1	Fauna which is rare or likely to become extinct.
S2	Schedule 2	Fauna which are presumed to be extinct.
S3	Schedule 3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
S4	Schedule 4	Fauna that is otherwise in need of special protection.

In addition to lists of Scheduled Fauna CALM also maintains a list of Priority Fauna. This includes species that have been removed from the Scheduled list and other species that are poorly known or infrequently recorded. Four classifications are recognised (Table 5).

Table 5: CALM Priority Fauna Categories

Code	Category	
P1	Priority 1	Taxa with few, poorly known populations on threatened lands.
P2	Priority 2	Taxa with few, poorly known populations on conservation lands.
P3	Priority 3	Taxa with several, poorly known populations, some on conservation lands.
P4	Priority 4	Taxa in need of monitoring.

2.6 Historical Land Use

Aboriginal Occupation

Recent archaeological evidence suggests that in much of the arid zone people were restricted to suitable refuge areas during times of extreme aridity, such as were experienced during the last glacial (Veth 1989). Some areas in the Central Ranges continued to be occupied during this period (Smith, 1989). The warming trend and increased availability of water sources associated with the transition into the Holocene epoch (~10 000 years ago) led to the reoccupation other areas within the Central Ranges and surrounding area.

Communities such as Wingellina act as small population centres within the greater Aboriginal Reserve. Land use within the reserve is essentially traditionally based, although there are limited areas where mineral prospecting continues. The area is not used for pastoral or other agricultural activities. Several minor roads and a variety of graded tracks emanate from the Wingellina township.

Fire History

Traditional use of 'fire stick farming' and other uses of fire appear to have been used by Aborigines in the arid zone for many thousands of years. Fires would be lit to aid in capturing animals, for warmth and to clear areas for ease of access. Fires were lit as people passed through country in order to keep fire sticks alight. It is likely that the fire regime in the area has altered in the past 50-100 years. There is thought to be an increase in fire frequency in the Wingellina area (Morse 1999).

3 Methodology

3.1 Flora and Vegetation Assessment

3.1.1 Desktop Review

The flora and vegetation survey of the project area complies with the Environmental Protection Agency (EPA) requirements for terrestrial biological surveys as outlined in Position Statement No. 3 (EPA 2002). The survey incorporated a detailed desktop study including a review of available literature and searches of relevant flora databases prior to commencement of the field survey.

Prior to the field survey, a search for Declared Rare and Priority flora species previously recorded or likely to occur within the vicinity of the project area was undertaken using the following databases:

- CALM's *Threatened (Declared Rare) Flora* database;
- the *Western Australian Herbarium Specimen* database; and
- CALM's *Declared Rare and Priority Flora List*.

In addition, the EPBC Act list of TECs was examined to determine if any communities were previously recorded or likely to occur within the vicinity of the project area.

3.1.2 Field Survey

A reconnaissance survey of the proposed alignment was undertaken in combination with aerial photographic and topographic analysis to identify likely community boundaries. The project area was then surveyed utilising a combination of plotless sampling sites, opportunistic field observations and specimen collections. This level of survey is considered by the EPA to be appropriate for arid zone environments (relatively low 'sensitivity') in which the scale of impact is moderate to high.

Sampling sites were located such that they were representative of the vegetation communities occurring within the general project area. At each site the following parameters were recorded within an approximate 50m radius using a plotless sampling technique:

- vegetation association description;
- vascular plant taxa present;
- estimated percentage foliage cover of plant taxa present;
- estimated height of plant taxa present;
- general soil type and description of stony mantle and outcropping;
- presence, type and abundance of litter;
- evidence of fire; and
- comments on general condition of site, including disturbances such as grazing, mining exploration activities and frequent fires.

A colour photograph representative of each vegetation type was taken. Additional foot traverses were conducted to ground truth the boundaries of vegetation types.

However, ground traverses were not possible in several exclusion areas designated by the Wingellina traditional elders. Figure 2 indicates the mapping confidence for the vegetation distribution map.

Opportunistic collections were made on an ongoing basis and the species added to the list of the plant taxa for the community type where they occurred.

Where field identification of plant taxa was not possible collections were made in a systematic manner for later identification at the Western Australian Herbarium. Where necessary, specialist taxonomists were consulted.

3.2 Fauna and Habitat Assessment

3.2.1 Desktop Review

A desktop review was undertaken to collate all available information pertaining to the fauna of the Wingellina area, central ranges, and the central deserts in general. A review of available literature pertaining to the birds, mammals and herpetofauna of central Australia, including material from nearby parts of South Australia and the Northern Territory was undertaken. Previously reported studies of relevance to the area have been discussed in Section 2.5.

Additional information relating fauna species previously recorded or potentially occurring in the study area has been obtained from CALM and the WA Museum fauna database. Data obtained include:

- a search of CALM's database of known populations of rare and endangered fauna from the study area and vicinity; and
- a search of the WA Museum fauna database for the Wingellina area for records of frogs, reptiles, mammals and birds (within the boundaries of 25°00'S to 27°00'S and 127°00'E). A large area was used for the search as it was considered likely that there would be very few records specifically from the study area. The database search therefore serves to gain an appreciation of species likely to be present in the project area and surrounding areas.

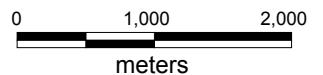
In combination with database information specialist fauna reference texts were used to prepare lists of species that potentially occur in the project area. These lists will be reinterpreted and modified following the spring field survey. Texts used for the relevant taxonomic groups are as follows:



Mammals	Strahan (1995)
Bats	Churchill (1998)
Skinks	Storr <i>et al.</i> (1999), Horner (1991)
Monitors	Storr <i>et al.</i> (1983)
Agamids	Storr <i>et al.</i> (1983), Houston (1998)
Geckos	Storr <i>et al.</i> (1990)
Pygopods	Storr <i>et al.</i> (1990)
Snakes	Storr <i>et al.</i> (1986)
Reptiles	Cogger (2000)
Amphibians	Tyler <i>et al.</i> (2000)
Birds	Simpson and Day (1996), Slater <i>et al.</i> (1991)
Birds	Blakers <i>et al.</i> (1984)



LEGEND

- 1 Ground truthed with foot or vehicle traverses
- 2 Extrapolated from aerial photography
- 3 Extrapolated from aerial photography, restricted are;
- 4 Least confident, restricted area



 Halpern Glick Maunsell Pty Ltd  <small>AN AECOM COMPANY</small>	Date	Project Name	Scale	Dwg Size
	AUGUST 2002	WINGELLINA BASELINE BIOLOGICAL	1:5500	A4
	Design By RMR	Drawing Title	Datum MGA 94 zone 52	Rev.
	Drawn By JXD	VEGETATION MAPPING CONFIDENCE	Figure No. 2	A
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Taxonomy and nomenclature for mammals, reptiles and frogs is based on the WA Museum 'Checklists of the vertebrates of Western Australia (How *et al.* 2001 and Aplin and Smith 2001). The taxonomy and nomenclature for birds is based on 'The taxonomy and species of birds of Australia and its territories' (Christidis and Boles 1994).

3.2.2 Field Survey

A preliminary fauna survey of the Wingellina study area was undertaken from the 5th-8th April 2002, concurrent with the vegetation and flora survey. Following examination of aerial photos and topographic information fauna habitats were identified and a search was undertaken for vertebrate fauna throughout the lease area. The survey consisted of opportunistic field observations, microhabitat searching and limited trapping.

Opportunistic observations were made whilst travelling through the study area and by walking transects, particularly in the area of the camp. Avifauna transects were undertaken in selected habitats and data collected on species present, relative abundance and habitat use. Due to the opportunistic nature of the avifauna surveys, the presence of a bird species on each of the four days has been used as approximate measure of abundance for the project area in general.

Microhabitat searching for reptiles and small mammals was undertaken near the camp area, primarily under spinifex spoil heaps, in the vicinity of the old diggings (under rocks and debris), and opportunistically at other locations in the study area. Searching techniques included identification of active animals, raking of leaf litter and spoil heaps, overturning logs and stones, searching under the bark of trees, breaking open old logs and stumps, and investigating burrows, tracks and scats. Several species of reptiles were found in this way and in combination with trapping should serve to record many of the species that occur in the area. Several spinifex (hummock grasses) clumps were also burnt at one location as a means of finding reptiles with permission of local traditional owners. This method met with some success but is destructive to plants at a local scale.

Limited fauna trapping was undertaken using medium sized Elliott box traps (9 x 9 x 32cm) baited with universal bait (rolled oats and peanut butter). Traps were set near the camp, including five traps in Eucalypt woodland habitat and five in areas of scattered Mulga with a grass and forb ground layer. Traps were set for two nights resulting in a total of 20 trap nights (10 traps open for two nights).

Nocturnal searching was undertaken in the study area on foot for nocturnal species such as geckos and nocturnal birds. A vehicular transect was undertaken at night over several of the roads and tracks in the area, including searching on the road for geckos, nocturnal birds and small mammals, and spotlighting of adjacent habitats for kangaroos.

Representatives from the local community accompanied personnel during all stages of the fauna survey, thereby providing local knowledge of the area including access and local fauna. They provided assistance in searching for fauna, particularly in locating burrows and identification of animal scats and tracks.

4 Flora and Vegetation

4.1 Flora

4.1.1 Vascular Flora

A total of 188 vascular plant taxa (including incomplete identifications) from 87 genera and 37 families have been recorded in the vegetation communities from the survey areas. The vascular plant taxa recorded in each of the vegetation community types are listed in Appendix A. Six sterile specimens were identified to a specific level but with a degree of uncertainty (indicated by "?") and one was identified to genus level. The taxonomic identification of a further 30 specimens are yet to be confirmed, and have been included in Appendix A as those with a collection number in parentheses. A complete species list will be included in the final document.

To maximise the collection of ephemeral species in flower the opportune time to conduct a field survey is post-wet season. The Central Ranges experienced above-average non-seasonal precipitation in January and February 2002 (Donald Thomson, *pers. comm.*), that was expected to result in stimulated growth and flowering of many flora taxa. However, there were still several specimens that were not identified with certainty due to a lack of reproductive material. It is likely that additional seasonal surveys would result in a greater number of vascular flora.

The number and range of flora collected during the survey was compared with data from the opportunistic collections of Edinger and Backhouse (2001), the records of the WA, SA and NT Herbariums within a grid area defined by the corners: (25°30S, 128°E) and (26°30S, 129°E). The WA Herbarium holds vouchers of 281 flora taxa from the vicinity of Wingellina. Edinger and Backhouse (2001) list 539 taxa from the Central Ranges. Neither of these collection lists represents the entire flora of the Wingellina area, but provide some comparison. It appears that 75 taxa recorded during the present survey have not been recorded previously in the area (Appendix B). This large number of new recordings of flora contributes substantially to knowledge of the Central Ranges in Western Australia.

4.1.2 Declared Rare and Priority Flora

The results of the database search for Declared Rare and Priority flora species (Table 6, Appendix C) indicate 11 priority flora species that have previously been recorded or are likely to occur within the vicinity of the study area. No Declared Rare flora species were recorded during this database search.

Table 6: Priority Flora Species Potentially Occurring within the Study Area

Species	Conservation Code
<i>Abutilon</i> sp. Warburton (AS George 8164)	P1
<i>Calotis latiuscula</i>	P3
<i>Danisia arthropoda</i>	P1
<i>Eucalyptus pimpiniana</i>	P3
<i>Goodenia schwerinensis</i>	P3
<i>Neurachne lanigera</i>	P1
<i>Teucrium grandiusculum</i> subsp. <i>grandiusculum</i>	P2

Species	Conservation Code
<i>Thysanotus solitaster ms</i>	P2
<i>Verticordia jamiesonii</i>	P3
<i>Verticordia mirabilis</i>	P1
<i>Verticordia</i> sp. Warburton (EA George 1/99)	P1

Specimens of the priority flora were examined at the Western Australian Herbarium prior to conducting the survey. The habitats where these species have previously been recorded were determined from relevant literature, to enable a targeted approach to the survey.

Of the plants recorded on site and identified prior to production of this draft report no threatened flora have been recorded from the study area. Of the specimens yet to be completely identified it appears unlikely that any of the threatened flora identified as a result of the Department of CALM's database search as possibly occurring within the study area have been collected from the project site. This will be confirmed in the final document following complete identification of remaining specimens. It has been assumed in following sections that no threatened flora are present within the project area. However, if a taxa listed as Declared Rare Flora under the *Wildlife Conservation Act 1950* or under the EPBC Act is identified, a voucher specimen will be submitted to the WA Herbarium.

Generally, given the relative paucity of botanical collection in the Central Ranges region, it is likely that the Priority Flora are more widely distributed than the voucher specimens of the WA Herbarium would indicate. Any loss of individuals is unlikely to affect the overall conservation status of the Priority Flora.

4.1.3 Weeds

Six introduced taxa were recorded during the survey of the study area (Table 7). None of these are Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* as at 25 October 2001.

Table 7: Introduced Weeds observed within the Study Area

Species	Vegetation Communities					
	1	2	3	4	5	6
* <i>Acetosa vesicaria</i>	+					
* <i>Cenchrus ciliaris</i>			+	+		
* <i>Chloris virgata</i>	+					
* <i>Eragrostis tenuifolia</i>	+				+	
* <i>Malvastrum americanum</i>				+		
* <i>Solanum hystrix</i>						+

Of the weeds recorded in the present survey, only *Malvastrum americanum* (Spiked Malvastrum) had been previously recorded in the Central Ranges according to the WA Herbarium records (WA Herbarium 2002).

In general, the surroundings of Wingellina were considerably disturbed by human activities. Human activities have exacerbated the spread of weeds, in particular along roads close to the Wingellina township. For example, many roads through Community A1 have sections dominated by a grassy layer of introduced *Chloris virgata* (Feathertop Rhodes Grass).

No Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* have been recorded elsewhere in the Central Ranges according to WA Herbarium records (WA Herbarium 2002).

4.2 Vegetation Communities

The vegetation communities of the survey area were divided into three main groups on the basis of geomorphology:

- A Plains
- B Mid slopes and small hills
- C Hills, ridges and breakaways

Seven vegetation communities were identified within the survey area. Vascular plant species recorded in each community are presented in Appendix A and photographs of each community type are presented in Appendix D (with the exclusion of community B3 as ground access to the area was prohibited because of its Aboriginal Heritage status). The distribution of vegetation communities within the study area was mapped using orthorectified aerial photography (Figure 3).

As the study area occurs within the Central Aboriginal Reserve and is proximal to the Wingellina Aboriginal Community (Irrunytiju) there are several exclusion areas designated by the traditional owners. These areas were not surveyed.

In the following discussion, ms after a Latin name is an abbreviation for 'manuscript name' and denotes that the name is unpublished. Flora identifications with a degree of uncertainty are prefaced by a question mark (?).

A Plains

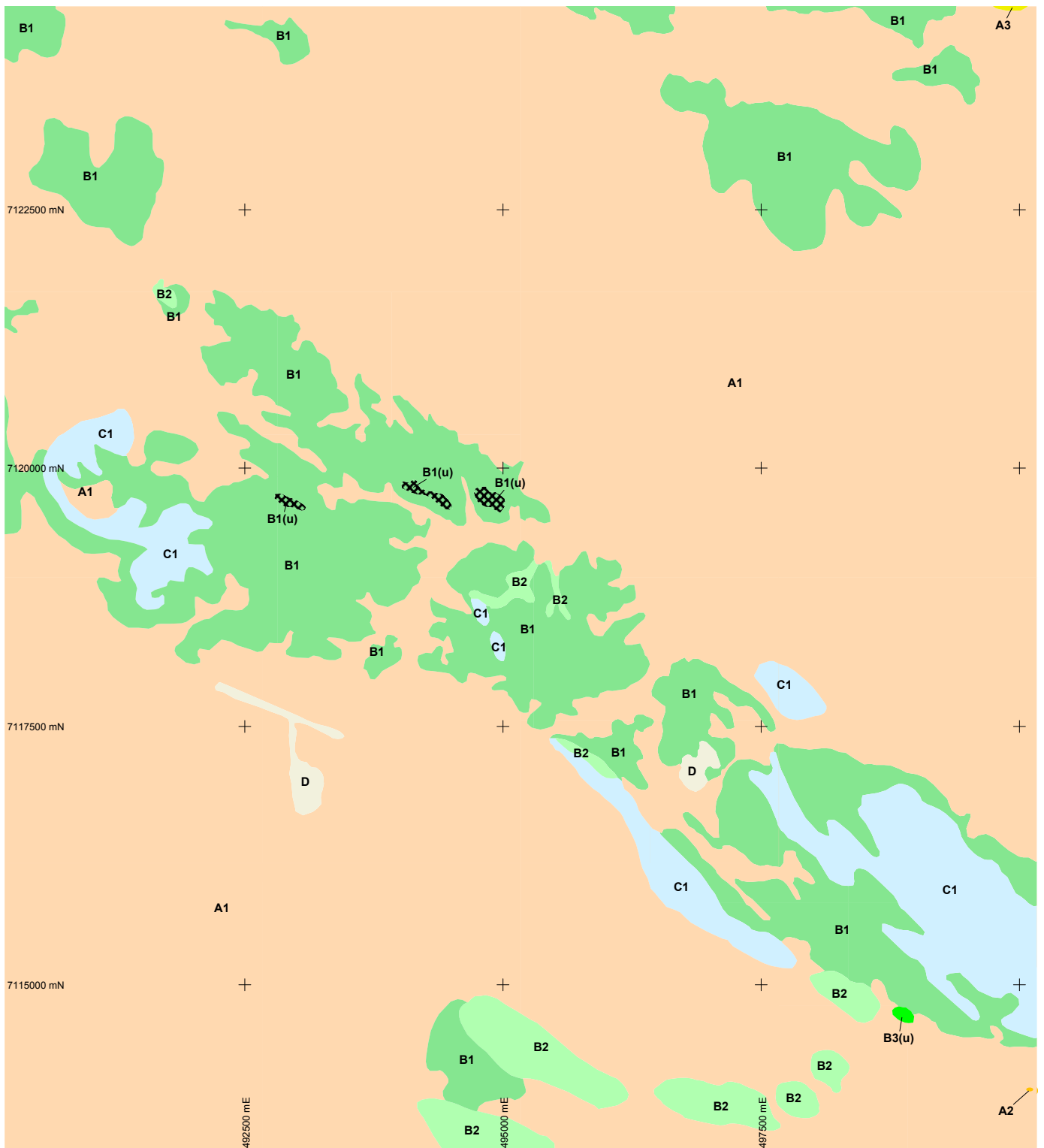
- A1:** Open Shrubland of *Hakea lorea* and *Senna artmeisioides* subsp. x *artemisioides* over mixed grasses and herbs in clay on low plains.

This vegetation community was the predominant vegetation type and occurred on the open plains. It was dominated by a sparse cover of *Hakea lorea* and *Acacia victoriae* over an open tall shrubland of *Senna artmeisioides* subsp. x *artemisioides*. Other tall shrubs included *Acacia kempeana*, *Acacia pruinocarpa* and *Acacia aneura* var. *aneura*. Grasses such as *Cymbopogon obtectus*, *Aristida holathera* var. *holathera* and *Paspalum constrictum* as well as several Malvaceae and Asteraceae spp. provided a sparse to moderately dense cover.

Community A1 was typically in poor to medium condition, with minor disturbance from mineral exploration, high fire frequency and weed invasion along tracks.

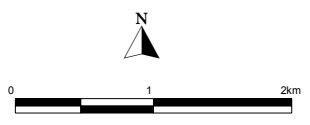
- A2:** Grassland of Poaceae spp. with occasional *Senna glutinosa* subsp. *glutinosa* and *Sida fibulifera* in patches of cracking clay.

This vegetation community was restricted to a low lying clay depression thought to be part of a poorly defined drainage channel and was only observed in one location within the survey area. It was dominated by a sparse cover of



LEGEND

- A1 Open Shrubland of *Hakea lorea* and *Senna artmeisioides* subsp. *x artmeisioides* over mixed grasses and herbs in clay on low plains
- A2 Grassland of *Poaceae* spp. with occasional *Senna glutinosa* subsp. *glutinosa* and *Sida fibulifera* in patches of cracking clay
- A3 Dense Low Woodland of *Eucalyptus mannensis* subsp. *mannensis* over *Acacia pachyaca*, *Acacia prainii* and *Dodonaea viscosa* subsp. *angustissima* over *Triodia rigidissima* and *Triodia ?helmsii* in sand over clay on low plains
- B1 Dense Low Woodland of *Eucalyptus socialis* subsp. *eucentrica* and *Acacia aneura* var. *major* over mixed shrubs over *Triodia scariosa* in clay on low ferricrete ridges
- B1(u) Unconfirmed B1
- B2 Very Open Shrubland of *Acacia pruinocarpa* and *Acacia aneura* var. *major* over *Senna pleurocarpa* var. *pleurocarpa* over *Triodia scariosa* in clay on midslopes or low rocky hills
- B3(u) Unconfirmed low Scrub over *Triodia* spp. in sand on sand dune
- C1 Open Low Woodland of *Eucalyptus gamophylla* and *Eucalyptus socialis* subsp. *eucentrica* over *Acacia validinervia* over mixed shrubs over *Triodia scariosa* in clay loam on upper slopes of mafic ridges
- D Disturbed



<p style="font-size: small; margin-top: 5px;">Halpern Click Maunsell Pty Ltd</p> <p style="font-size: x-small; margin-top: 5px;">AN AECOM COMPANY</p>	Date AUGUST 2002	Project Name WINGELLINA BASELINE BIOLOGICAL	Scale 1:5 500	Dwg Size A4
	Design By R RYAN	Drawing Title VEGETATION MAP WINGELLINA	Datum MGA 94 zone 52	Rev. A
Drawn By J DELFOS	Client ACCLAIM EXPLORATION NL		Figure No. 3	File location e:\ep016583...workspaces\Figure2.WOR

Senna glutinosa subsp. *glutinosa* and *Sida fibulifera* over a dense cover of grasses such *Eriachne ?mucronata*, *Eragrostis eriopoda* and *Themeda triandra*.

Community A2 was in good condition. It was difficult to distinguish from Community A1 on the aerial photography and therefore it is possible that it occurs elsewhere in the survey area.

A3: Dense Low Woodland of *Eucalyptus mannensis* subsp. *mannensis* over *Acacia pachyacra*, *Acacia prainii* and *Dodonaea viscosa* subsp. *angustissima* over *Triodia rigidissima* and *Triodia ?helmsii* in sand over clay on low plains.

This vegetation community occurred on open sandy plains. It was dominated by a dense cover of *Eucalyptus mannensis* subsp. *mannensis* and *Eucalyptus socialis* subsp. *eucentrica* over an open tall shrubland of *Acacia pachyacra*, *Acacia prainii* and *Dodonaea viscosa* subsp. *angustissima*. Other tall shrubs included *Brachychiton gregorii*, *Acacia coolgardiensis* subsp. *effusa*, *Acacia victoriae* and *Eremophila gilesii* subsp. *gilesii* ms. Grasses such as *Triodia rigidissima*, *Triodia ?helmsii*, *Paractaenum refractum* and *Triodia epactia* provided a moderately dense cover.

This vegetation community was typically in good condition, with little disturbance from vehicle use, minor weed invasion, and only small areas of burnt or regenerating vegetation. This community was only observed in one location in the extreme northeast corner of the survey area, but was observed to occur extensively beyond the survey area boundary.

B Mid slopes and small hills

B1: Dense Low Woodland of *Eucalyptus socialis* subsp. *eucentrica* and *Acacia aneura* var. *major* over mixed shrubs over *Triodia scariosa* in clay on low ferricrete ridges.

This ridge vegetation community occurred on the low ferricrete ridges. It was dominated by a dense cover of *Eucalyptus socialis* subsp. *eucentrica* with some *Eucalyptus gamophylla* and *Corymbia eremaea* subsp. *eremaea* over an open tall shrubland of *Acacia aneura* var. *major*. Other tall shrubs included *Acacia nyssophylla*, *Acacia oswalidii*, *Acacia prainii* and *Dodonaea lobulata*. Grasses such as *Triodia scariosa*, *Cymbopogon obtectus*, *Panicum decompositum* and *Triraphis mollis* as well as *Ptilotus obovatus* var. *obovatus* provided a sparse to moderately dense cover.

This vegetation community was typically in good condition, with some disturbance from mineral exploration and weed invasion.

B2: Very Open Shrubland of *Acacia pruinocarpa* and *Acacia aneura* var. *major* over *Senna pleurocarpa* var. *pleurocarpa* over *Triodia scariosa* in clay on midslopes or low rocky hills.

This vegetation community occurred on rocky midslopes or on isolated low hills. It was dominated by a sparse cover of *Acacia pruinocarpa* and *Acacia aneura* var. *major* over an open shrubland of *Senna pleurocarpa* var. *pleurocarpa* and *Eremophila alternifolia*. An isolated patch of *Ficus brachypoda* was located on north-facing rocky scree. Other small shrubs included *Euphorbia boophthona*, *Senna stricta* and *Ptilotus clementii*. Grasses

such as *Triodia scariosa*, *Aristida holathera* var. *holathera* and *Enneapogon avenaceus* as well as *Hibiscus leptocladus* and *Hibiscus sturtii* var. *truncatus* provided a sparse to moderately dense cover.

This vegetation community was typically in moderate condition, with some disturbance from fire, limited mineral exploration and some weed invasion.

B3: Low Scrub over *Triodia* spp. in sand on sand dune.

A detailed description and collection of flora specimens was not possible in this vegetation community. Ground access to the area was prohibited because of its Aboriginal Heritage status. However, interpretation of the aerial photography has enabled the limited extent of this community to be defined.

C Hills, ridges and breakaways

C1: Low Open Low Woodland of *Eucalyptus gamophylla* and *Eucalyptus socialis* subsp. *eucentrica* over *Acacia validinervia* over mixed shrubs over *Triodia scariosa* in clay loam on upper slopes of mafic ridges.

This ridge vegetation community occurred only on the upper slopes and ridge tops. It was dominated by a sparse cover of *Eucalyptus gamophylla* and *Eucalyptus socialis* subsp. *eucentrica* over an open tall shrubland of *Acacia validinervia*. Other tall shrubs included *Acacia strongylophylla*, *Hakea lorea* subsp. *lorea* and *Hibiscus leptocladus*. Grasses such as *Triodia scariosa*, *Cymbopogon obtectus* and *Dichanthium sericeum* subsp. *sericeum* as well as several Malvaceae spp. provided a sparse to moderately dense cover.

This vegetation community was typically in good condition, with evidence of fire recovery.

4.3 Vegetation of Conservation Significance

None of the vegetation communities recorded in the survey area are nationally listed as threatened ecological communities under the EPBC Act. It is unlikely that any of the vegetation communities are restricted only to the project area.

Vegetation assemblages similar to those described during the current study have previously been recorded in the studies of Beard (1974). However, the lack of systematic biological surveys within the Central Ranges makes it difficult to comment regarding the conservation status of the vegetation communities and the significance of potential impacts. Only those communities observed to be in very low density and thought to have potential conservation significance have been included in this category.

Three communities are likely to be of regional significance (Table 8), and one also has local conservation significance.

A vegetation community is considered to have local conservation significance when it supports Priority flora, provides a refuge to flora and fauna in times of drought, or represents an uncommon species assemblage or structural diversity. Regional conservation significance is determined by whether a community supports populations of Declared Rare flora, is restricted to specific geomorphological features or is isolated in the landscape.

Table 8: Factors contributing to Local or Regional Conservation Significance of Vegetation Communities in the Study Area

Community	Drought Refuge	Structural Diversity	Potential for Threatened Flora	Geomorphology	Isolated
A2					+
B3				+	+
C1		+	+	+	+

Community A2 was restricted to a low lying clay depression thought to be part of a poorly defined drainage channel and was only observed in one location within the survey area. Cracking clay soil types have been identified as being important habitat for some poorly known plant species (Trudgen 1992). While this community has only been mapped in one location, it is possible that it occurs elsewhere in the survey area. Given its restricted distribution and that it is a likely habitat for threatened flora, this community has regional conservation significance. It is recommended that Community A2 be avoided where practicable.

Community B3 was unable to be completely defined. Ground access to the area was prohibited because of its Aboriginal Heritage status. However, interpretation of the aerial photography has demonstrated the limited extent of this community. Given its isolated distribution and that it is restricted to sand dunes, this community has regional conservation significance. It is recommended that Community B3 be avoided where practicable.

Community C1 occurred only on the upper slopes and ridge tops. While this community has considerable extent within the survey area, it is uncommon in the regional context and is limited to mafic and ultramafic ridges. It also demonstrated a high degree of structural diversity, and supported the greatest number of flora taxa. Given its restricted nature, structural and biological diversity, this community is likely to be of local and regional conservation significance. It is recommended that Community B3 be avoided where practicable.

5 Fauna

5.1 Vertebrate Fauna and Habitat Assessment

The preliminary fauna survey in April of 2002 yielded 69 terrestrial vertebrate species; namely 54 birds, 10 reptiles and five mammals (three native and one introduced species). Western Australian Museum database records indicate that 13 bird species, 40 reptiles, one amphibian and nine mammal species have been recorded in the general Warburton region (Appendix E).

5.1.1 Fauna habitats

Fauna habitats were principally defined on the basis of prevailing landforms and vegetation within the study area. Fauna habitats generally correspond with vegetation communities or a composite of vegetation communities (as defined in Section 4.2). However, substrate conditions also influence faunal habitat utilisation patterns, and these have been taken into account in defining habitats.

Three principle fauna habitats have been defined in the preliminary survey. Fauna habitats will be further defined and assessed during the spring survey. Brief descriptions of habitats are as follows:

Upland rocky ridges, hill slopes and boulders

This habitat type includes the upper stony portions of hills and outcrops of rocks and primarily corresponds with vegetation association 6. These areas are sparsely vegetated with spinifex clumps, scattered shrubs, and occasional *Ficus platypoda* and show minimal soil development. Rock piles potentially support saxicoline (rock inhabiting) reptiles and small mammals. In the past these inaccessible areas were important for Rock-wallabies.

Lower and mid slope scree and low stony rises

These stony areas dominate the study area and are the principal focus of the exploration program. This habitat mostly corresponds to vegetation association 4, open Eucalypt woodlands, with an understorey of spinifex and scattered shrubs. Variants of this habitat type include minor drainage lines and low rises. These areas are important for Honeyeaters and other passerine birds, with small mammals utilising spinifex clumps, and reptiles inhabiting spinifex and leaf litter. This habitat also supports the Euro *Macropus robustus*.

Lowland grasses and forbs in valleys and on flats

These areas occur around the base of the hills and lowland areas. This habitat type corresponds with vegetation association 1 and has characteristically loamy soils. Vegetation is dominated by a dense ground layer of grasses and forbs with occasional patches of Mulga regrowth. These areas, particularly where Mulga occurs, are important for passerine birds, but also support small mammals such as the Spinifex Hopping Mouse.

The vegetation and hence fauna habitats of the study area are influenced by fire history, which acts as an overlay forming a mosaic of post fire succession stages. Habitats that are similar but with different fire histories may support different communities of animals, and differ in the relative abundance of fauna species. Much of the area has been influenced by fire and has caused a general decline in Mulga communities.

5.1.2 Mammals

Four mammal species (three native and one introduced species) were observed in the study area during the preliminary survey, including representatives of major family groups such as the macropods and native rodents and bats.

One species of macropod (kangaroos and wallabies) was recorded from the study area, the Euro *Macropus robustus*. This species, known locally as *kanyala*, is generally restricted to rocky slopes, breakaways and scree slopes, and was observed in mid-slope habitat.

Native placental mammals recorded include a single species of rodent and the Spinifex Hopping Mouse *Notomys alexis*. This Spinifex Hopping Mouse was observed at night bounding between spinifex hummocks.

The White-striped Mastiff-bat *Tadarida australia*, was heard in the study area near the exploration camp.

One introduced mammal was recorded from the project area, the *House Mouse *Mus musculus*. This species was trapped near Mulga habitat close to the camp and found under debris near the old mine area.

Information provided by local people indicate that several other species may occur in the area. These include; the Red Kangaroo *Macropus rufus* (or *malu*), the Echidna *Tachyglossus aculeatus*, the Sandy Inland Mouse *Pseudomys hermannsburgensis*, the One-humped (or Arabian) Camel **Camelus dromedarius*, the Feral Cat **Felis catus*, the Fox **Vulpes vulpes* and Rabbit **Oryctolagus cuniculus*. Additional marsupial species and common bat species are also likely to occur in the project area.

5.1.3 Birds

Fifty-four bird species were recorded from the project area during the survey. (Appendix F). A greater number of passerines (38) were recorded than non-passerines (16), this fairly typical of arid areas with no wetlands to support waterbirds. Of the passerine birds the most speciose families were the Meliphagidae (honeyeaters; seven species), Pardalotidae (thornbills, pardalotes and allies; five species) and Artamidae (woodswallows and allies; five species). Of the non-passerines the raptors (Accipitridae and Falconidae), parrots (Cacatuidae and Psittacidae) and pigeons and doves (Columbidae) were well represented.

In combination with Martin Gole's records (2002), a total of 65 bird species have been recorded from the Wingellina area (Appendix F). The Birds Australia Atlas records for the surrounding area indicates that potentially 85 bird species occur in the project area.

The most widespread and common species recorded in the preliminary survey (recorded on all four days) were the Brown Falcon *Falco berigora*, Australian Kestrel *Falco cenchroides*, Budgerigar *Melopsittacus undulatus*, Yellow-throated Miner *Manorina flavigula*, Grey-fronted Honeyeater *Lichenostomus plumulus*, Singing Honeyeater *Lichenostomus virescens*, Willie Wagtail *Rhipidura leucophrys*, Black-faced Cuckoo-shrike *Coracina novaehollandiae*, Black-faced Woodswallow *Artamus cinereus* and Australian Magpie *Gymnorhina tibicen*.

Species recorded on only one occasion included Black Kite *Milvus migrans* and White-plumed Honeyeater *Lichenostomus penicillatus* (near Wingellina settlement), Brown Goshawk *Accipiter fasciatus*, Dusky Grasswren *Amytornis purnelli*, Yellow-rumped Thornbill *Acanthiza chrysorrhoa*, Chestnut-rumped Thornbill *Acanthiza uropygialis*, Ground Cuckoo-shrike *Coracina maxima* and Western Bowerbird *Chlamydera guttata*.

A detailed appraisal of habitat use, species diversity and abundance of avifauna will be undertaken following the spring assessment survey. Set time avifauna transects within fauna habitats facilitates comparison of quantitative data between sites including species composition and relative abundance.

5.1.4 Reptiles

Nine species of reptiles were recorded from the project area; two geckos, two pygopods (legless lizards), three skinks and two varanids.

The Tree Dtella *Gehyra variegata* and Binoe's Gecko *Heteronotia binoei* were found under debris in the study area. Both these species have a widespread distribution.

The legless lizard *Delma nasuta* was observed amongst spinifex clumps within the project area, this habitat is typical for this arid zone species. Burton's Legless Lizard *Lialis burtonis* was found in spoil heaps. Distribution maps from the WA museum indicate that this is a range extension for this species. As *Lialis burtonis* is generally widespread across Australia this collection is indicative of poor collecting in the region rather than actual distribution limits.

An individual Perentie *Varanus giganteus* was observed by members of the field team amongst a rock pile and the Sand Goanna *Varanus gouldii* was observed under a sheet of metal in lowland plain habitat.

The skinks *Ctenotus leonhardii* and *Cyclodomorphus melanops* were observed in the project area, the latter of which was found underneath a spoil heap. The small Red-tailed Skink *Morethia ruficauda* was observed in a rocky area near the old mine diggings. The Red-tailed Skink is not known to occur in this area and thus suggests a range extension (according to distribution maps from the WA Museum) of this species.

WA Museum fauna database records indicate that 40 reptile species have been recorded from the Warburton region (Appendix E). Reptiles that are expected to occur in the area, and are likely to be observed in the proposed spring survey include; species from the genera *Diplodactylus* and *Nephrurus*; agamids (known to be active in warm and hot weather), elapids or 'front-fanged' snakes, blind snakes and pythons.

Burbidge (1983) described habitat use of reptiles recorded from the Great Sandy Desert, and Pianka (1969a,b) has shown that habitat specificity of lizards in arid areas varies according to species. Habitat use of reptiles will be further examined following trapping in different habitats to allow comparisons.

5.1.5 Amphibians

The majority of frog species expected to occur in the general area are burrowing species that spend the greater part of their life underground. Species of the genera *Cyclorana* and *Notaden* are obligatory burrowing species, only

coming to the surface after heavy rain. The species *Pseudophryne occidentalis* is listed on the WA Museum database for the general area (Appendix E), but would require more reliable (semi-permanent) sources of water as found in other parts of the Tomkinson Range. Aboriginal informants indicated that whilst frogs occurred further afield, no frogs had been observed in the Wingellina area.

5.2 Fauna of Conservation Significance

5.2.1 EPBC Act

Potential species listed under the EPBC Act include the Night Parrot *Pezoporus occidentalis* and Golden Bandicoot *Isodon auratus* (Endangered nationally), the Princess Parrot *Polytelis alexandrae*, Malleefowl *Leipoa ocellata* and Bilby *Macrotis lagotis* (Vulnerable). The Night Parrot is rarely sighted and possibly extinct; it is unlikely to occur in the project area. Other species of conservation significance are discussed in Sections 5.2.2 below.

5.2.2 Western Australian Wildlife Conservation Act

During the preliminary fauna survey no species of rare fauna listed under the *Wildlife Conservation Act 1950* were recorded from within the survey area.

A search was carried out of CALM's threatened fauna database for species likely to occur in the project area. On the basis of this information ten Scheduled species and seven Priority Fauna potentially occur in the project area. A summary of their habitats and status is provided below. The following information is provided by CALM, with some alteration and additions by the author.

Schedule 1 (Fauna which is rare or likely to become extinct)

Mulgara (*Dasyercus cristicauda*) This medium sized dasyurid occurs in arid sandy regions with hummock grasses (spinifex) from the eastern Pilbara to central Australia. It is rarely recorded but may occur in the area in question in lowland plain habitats. This species was recently recorded approximately 45km south-west of Warburton. Pearson (1991) recorded the Mulgara in the Gibson Desert, and from the Queen Victoria Spring Nature Reserve.

Black-footed Rock-wallaby, MacDonnell Ranges subspecies (*Petrogale lateralis* ssp.). Despite enhanced understanding of the taxonomy, distribution and conservation status of the five *Petrogale* spp. of Rock-wallaby in Western Australia (Pearson & Kinnear, 1997), this group is poorly known in many remote areas. The MacDonnell Ranges subspecies of *P. lateralis* has a distribution that extends from central Australia into the western desert region. Typical habitat includes rocky cliffs and gorges with caves and crevasses used as shelter sites. In the past this species occupied granite outcrops in the area (Pearson, 1992). This species, known locally as *warru*, has been recorded in the Cavenagh Range, Bell Rock Range and at Lightning Rocks (Pearson, 1992).

Golden Bandicoot (*Isodon auratus auratus*) This species was last recorded near Warburton in the 1930's though is now presumed extinct in the Central Ranges region. Secure populations persist in the northwest Kimberley.

Marsupial Mole (*Notoryctes spp.*) Marsupial moles are inhabitants of sandy deserts and are rarely observed or recorded. These unusual marsupials resemble the burrowing moles of the northern hemisphere, a result of convergent evolution and adaptation to a burrowing existence. Two species are currently recognised, the Southern (*N. typhlops*) and Northern (*N. caurinus*) Marsupial Mole. The distribution of these species appears extends to the desert areas east of Warburton. There are three recent records from the general area but it is not known which species were observed.

It is considered unlikely that either species of Marsupial Mole would occur within the project area as the substrate in the Wingellina Hills is not suited to these burrowing animals.

Lesser Stick-nest Rat (*Leporillus apicalis*) This species is presumed to be locally extinct but the remains of old stick nests may be found in small caves and under ledges in breakaways and gorges.

Malleefowl (*Leipoa ocellata*) The Malleefowl is a turkey-sized, ground dwelling bird that constructs a large mound of sand and debris that is used to incubate the eggs. This species was once widely distributed across southern Australia but now is patchily distributed and has disappeared from much of its former range due to habitat loss and introduced predators. It prefers woodland or shrublands with an abundant litter layer that provides material for the construction of its distinctive mounds.

The Malleefowl ('*nganamara*' to the local people) is known to have previously occurred in the Wingellina area and old mounds have apparently been observed in the area. There are, however, no recent records of this species from the project area or surrounds. Much of the distribution of this species in Western Australia is from the semi-arid southern interior east to Laverton. An isolated population has been observed at Barrow Range east of Warburton (Johnstone & Storr, 1998), i.e. 150 kilometres west of the study area.

Giant Desert Skink (*Egernia kintorei*) A relatively large, burrowing skink found in a variety of desert habitats on sandy, clay and loam soils. This species was recorded in the Great Victoria Desert in the 1960's.

This species, known as '*tjakura*' to the local people, has been the subject of surveys in the Central Ranges area, and indications are that although it has been recorded in the region it does not occur in the Wingellina area.

The **Bilby *Macrotis lagotis*** is an additional Schedule 1 species that potentially occurs in the area, although it is generally associated with alluvial surfaces, sandplains and dunes. The Bilby once inhabited arid and semi-arid regions throughout mainland Australia but is now confined to the deserts of central Australia, from the Tanami Desert west to Broome and south to Warburton. There are no recent records from the area.

Schedule 4 (Fauna which is Otherwise Specially Protected)

Peregrine Falcon (*Falco peregrinus*) This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses or open woodland. It may occur in the area particularly amongst the ranges.

Pink (Major Mitchell's) Cockatoo (*Cacatua leadbeateri*) This species is sporadically distributed in arid and semi-arid Australia where it occurs in

sparsely wooded grasslands and shrublands, generally near water. Johnstone and Storr (1998) indicate that there is a population in the Warburton and Cavenagh Ranges to the west, hence it may occur in the study area.

Woma (*Aspidites ramsayi*) The Woma is a nocturnal species of python restricted to arid areas. Numbers are thought to have decreased particularly in south Western Australia but it is still encountered in the sandy deserts of the interior including the Tanami.

Priority Taxa

Long-tailed Dunnart (*Sminthopsis longicaudata*) P4 This little known species inhabits rugged rocky areas. It has been recorded south of Warburton and may possibly occur in the area in question.

Central Long-eared Bat (*Nyctophilus timoriensis* central form) P4 This bat species roosts in tree hollows and under loose bark but little else is known about its habits. It may occur in the area in question.

Ghost Bat (*Macroderma gigas*) P4 This species is Australia's only carnivorous bat and whilst it was recorded south-west of Warburton in 1961 it is now known only from the Pilbara and Kimberley in Western Australia. It occurs also in the top end of the Northern Territory. It shelters in caves, mine shafts and deep rock fissures and is sensitive to disturbance.

Grey Falcon (*Falco hypoleucos*) P4 A nomadic species inhabiting lightly timbered riverine plains and Mulga Woodlands. It may occur in the area in question.

Princess Parrot (*Polytelis alexandrae*) P4 Little is known about this species of parrot which is recorded sporadically in the arid interior. It is highly nomadic and has been reported from arid shrublands, red desert sandplains and dunes and along tree-lined watercourses in central Australia. It is rarely recorded but occurs in areas that are infrequently visited and therefore its status is difficult to determine accurately (Blakers *et al.*, 1984). It has been recorded from the southern Great Sandy Desert and from the Great Victoria Desert.

Australian Bustard (*Ardeotis australis*) P4 This species is generally uncommon although it is more abundant in areas away from human population centres. It may occur in open or lightly wooded grasslands.

Although not observed during the preliminary survey, the local people indicated that Bustards do occur in the general vicinity.

Striated Grasswren, sandplain subspecies (*Amytornis striatus striatus*) P4 This subspecies of Striated Grasswren inhabits spinifex on sandhills and rocky hillslopes and is thought to occur in the area in question. It was not recorded during the preliminary survey.

6 Lease Audit

The study area was found to be significantly disturbed as a result of mineral exploration, mining, fire regimes, vehicle disturbance and other minor human activities.

Fire

Anecdotal evidence suggests that large areas of vegetation in the Wingellina area have been subject to repetitive and extensive burning. During the April Survey (2002) large areas of vegetation showed evidence of recent fire.

It is likely that the high frequency of fire has affected the distribution and diversity of flora in the survey area. Fauna may be affected directly during a fire or indirectly through the loss of vegetation and resulting change in the community structure. Ground dwelling species such as reptiles and small mammals are usually the most directly affected, although burrows may provide an escape from less intense fires. Birds may be affected by loss of habitat and shelter however fire-affected areas may provide foraging opportunities not encountered elsewhere. Mammals are generally thought to respond in a fairly predictable manner to post-fire vegetation stages, as these influence shelter, food and breeding requirements (Bamford, 1995).

Mineral Exploration and Mining

Mineral exploration by Inco in the 1960's has impacted the landscape and associated vegetation in a number of areas within the project area. Vehicle tracks, uncapped drill holes and litter are evidence of prior disturbance and still have significant repercussions for local flora and fauna.

Vehicle tracks encourage the spread of weeds and continued use of these tracks has allowed little natural regeneration for native species. However, despite little rehabilitation effort some tracks showed evidence of regeneration of native taxa.

Exploration drill holes were evident throughout the study area. These holes, approximately 20cm wide and up to 50m deep are virtual 'traps' for fauna and are likely to be responsible for past and present death or injury of countless native species. The continual erosion of these drill holes is likely to increase the impact on native fauna and undermine the regenerating potential of vegetation in the area.

There were a number of abandoned chrysophase pits throughout the survey area. These mines showed disturbance to landscape and surrounding vegetation, were often sites of significant weed invasion and may cause potential injury or death to fauna.

Other human disturbance

Vegetation close to the township of Wingellina was observed to be significantly disturbed by human activities such as driving and littering. Weed invasion was observed to be exacerbated in these areas of high human disturbance (around the township, near the rubbish tip sites and adjacent to tracks and roads).

There was minimal evidence of grazing in the survey area. This is due to a lack of pastoral activities within the survey area and the relatively low density of introduced grazing fauna.

7 Conclusions and Recommendations

The baseline biological survey of lease area E69/535 reported on here fulfils the requirements of the deed as well as the EPA.

The report includes an inventory of all flora and fauna species recorded during the survey of the project area and an assessment of habitat utilisation patterns. It identifies flora and fauna taxa, vegetation communities of conservation significance and fauna habitats as well as reporting on disturbance resulting from previous exploration. Additional information detailed in this report has been derived from literature relating to the biological aspects of the survey area, including published and unpublished reports, scientific papers and available datasets.

The flora survey identified a total of 188 vascular plant taxa (including incomplete identifications) from 87 genera and 37 families from the survey area. Six specimens were identified to specific level but with a degree of uncertainty (indicated by '?') and one was identified to genus level. This was the result of sterile specimens. It appears that 75 taxa recorded during the present survey have not been recorded previously in the area. This large number of new recordings of flora contributes substantially to knowledge of the Central Ranges in Western Australia.

A search of the Department of Conservation and Land Management's (CALM) threatened flora database identified 11 priority flora species that have previously been recorded within the vicinity of the study area. Of the plants recorded on site and identified prior to production of this draft report no Declared Rare flora listed under the *Wildlife Conservation Act 1950* or threatened flora listed under the EPBC Act have been recorded from the study area.

Six introduced (weed) flora taxa were observed in the survey. However, none of these are classified as Declared Plants pursuant to Section 37 of the *Agriculture and Related Resources Protection Act 1976* as at 25 October 2001.

The opportune time to conduct a field survey in order to maximise the collection of ephemeral taxa in flower is post-wet season. The timing of the flora and vegetation survey aimed to capitalise on the above-average non-seasonal precipitation recorded in the Central Ranges in early 2002. It was expected that the condition of many flora taxa following this period would aid in positive identification of flora taxa. However, there were still several specimens that were not identified with certainty due to a lack of reproductive material. It is likely that additional seasonal surveys would result in recordings of a greater number of vascular flora, and therefore it is proposed that a flora collection survey is conducted in spring 2002. This seasonal survey would focus particularly on vegetation communities of regional conservation significance.

The vegetation survey identified seven vegetation communities occurring within the project area. It is unlikely that any of the vegetation communities are restricted only to the project area. None of the vegetation communities are restricted to the project areas or are nationally listed as threatened ecological communities under the EPBC Act.

The lack of systematic biological surveys within the Central Ranges makes it is difficult to comment regarding the conservation status of the vegetation

communities and the significance of potential impacts. However, three communities (A2, B3 and C1) are considered to be of regional conservation significance based on their isolated distribution and geomorphological restriction. One of these communities (C1) is also of local conservation significance. It is recommended that these communities be avoided where practicable.

Community A2 was restricted to a low lying clay depression thought to be part of a poorly defined drainage channel. Cracking clay soil types have been identified as being important habitat for some poorly known plant species (Trudgen 1992). While this community has only been mapped in one location, it is possible that it occurs elsewhere in the survey area. Given its restricted distribution and that it is a likely habitat for threatened flora, this community has regional conservation significance. Community B3 was unable to be completely defined. Despite this, the isolated distribution and restriction to sand dunes suggests this community has regional conservation significance. Community C1 occurred only on the upper slopes and ridge tops. Given its restricted nature, structural and biological diversity, this community is likely to be of local and regional conservation significance.

The fauna habitat assessment determined three habitat types within the project area. The preliminary fauna survey recorded 54 species of bird, 10 reptiles and five mammals. No rare or priority fauna species were detected in the study area during the field survey. Database searches identified the following threatened categories as potentially occurring within the project area:

- two nationally endangered fauna under the EPBC Act;
- three vulnerable fauna under the EPBC Act;
- ten Scheduled fauna under the ; and
- seven Priority Fauna.

A fauna survey is recommended contribute to the knowledge of the fauna of the central ranges in Western Australia. CALM Kalgoorlie's Regional Ecologist recommended that the optimum timing for the survey would be late spring.

Fire and historical exploration issues were identified as producing the greatest impact on the biological environment within the study area.

The contribution of traditional elders from Wingellina was of benefit to the survey, both in terms of ground reconnaissance, flora collection and in assisting in extrapolation of vegetation community boundaries. The cooperation between Acclaim and Wingellina traditional elders is likely to enhance the understanding of the biological environment.

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Appendix A

Vascular Plants Recorded within each Vegetation Community

Family	Species	Vegetation Community					
		A1	A2	A3	B1	B2	C1
Adiantaceae	<i>Cheilanthes lasiophylla</i>					+	+
Poaceae	<i>Aristida contorta</i>	+		+	+		+
	<i>Aristida holathera</i> var. <i>holathera</i>	+				+	
	<i>Aristida latifolia</i>		+				
	<i>Austrostipa scabra</i> subsp. <i>scabra</i>				+		
	* <i>Cenchrus ciliaris</i>				+	+	
	<i>Chloris pectinata</i>				+		
	* <i>Chloris virgata</i>	+					
	<i>Cymbopogon obtectus</i>	+		+	+	+	+
	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	+	+			+	+
	<i>Digitaria ammophila</i>	+				+	
	<i>Enneapogon avenaceus</i>	+				+	
	<i>Enneapogon caerulescens</i> var. <i>caerulescens</i>					+	+
	<i>Enneapogon polyphyllus</i>				+		
	<i>Enteropogon acicularis</i>				+		
	<i>Eragrostis eriopoda</i>		+				
	<i>Eragrostis laniflora</i>			+			
	* <i>Eragrostis tenuifolia</i>	+		+			
	<i>Eriachne mucronata</i>					+	
	<i>Eriachne ?mucronata</i>		+				
	<i>Panicum decompositum</i>	+		+	+		
	<i>Paractaenum refractum</i>			+			
	<i>Paraneurachne muelleri</i>						+
	<i>Paspalidium constrictum</i>	+					
	<i>Themeda triandra</i>		+			+	
	<i>Triodia basedowii</i>			+			
	<i>Triodia epactia</i>			+			
	<i>Triodia ?helmsii</i>			+			
<i>Triodia rigidissima</i>			+				
<i>Triodia scariosa</i>				+	+	+	
<i>Triraphis mollis</i>	+			+	+		
Moraceae	<i>Ficus brachypoda</i>					+	
Proteaceae	<i>Hakea lorea</i> subsp. <i>lorea</i>	+				+	+
	Proteaceae sp. (BR153)						+
Santalaceae	<i>Santalum lanceolatum</i>						+
Loranthaceae	<i>Amyema maidenii</i> subsp. <i>maidenii</i>	+					
	<i>Amyema miquelii</i>			+			
	<i>Lysiana casuarinae</i>				+		
Polygonaceae	* <i>Acetosa vesicaria</i>	+					
Chenopodiaceae	<i>Chenopodium desertorum</i> subsp. <i>desertorum</i>	+					
	<i>Dysphania kalpari</i>			+			+
	<i>Einadia nutans</i> subsp. <i>eremaea</i>	+			+		
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	+		+	+		
	<i>Enchylaena</i> sp.				+		
	<i>Eremophea spinosa</i>				+		
	<i>Maireana scleroptera</i>				+		
	<i>Salsola tragus</i> subsp. <i>tragus</i>	+			+	+	+

Family	Species	Vegetation Community					
		A1	A2	A3	B1	B2	C1
Chenopodiaceae (cont.)	<i>Sclerolaena costata</i>	+					+
	<i>Sclerolaena johnsonii</i>			+			
	<i>Sclerolaena obliquicuspis</i>	+			+		
	<i>Sclerolaena parviflora</i>				+		
Amaranthaceae	<i>Ptilotus chippendalei</i>		+				
	<i>Ptilotus clementii</i>			+		+	+
	<i>Ptilotus decipiens</i>				+		
	<i>Ptilotus exaltatus</i> var. <i>exaltatus</i>					+	
	<i>Ptilotus obovatus</i> var. <i>obovatus</i>	+		+	+		+
	<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>	+					
	<i>Ptilotus sessilifolius</i> var. <i>sessilifolius</i>	+					
	<i>Ptilotus</i> sp. (BR57)		+				
Nyctaginaceae	<i>Boerhavia coccinea</i>		+		+	+	
	<i>Boerhavia repleta</i>	+					
Gyrostemonaceae	<i>Codonocarpus cotinifolius</i>					+	+
	<i>Gyrostemon ramulosus</i>	+					
Portulacaceae	<i>Portulaca oleracea</i>	+		+		+	
Capparaceae	<i>Cleome viscosa</i>		+				
Brassicaceae	<i>Lepidium phlebopetalum</i>	+				+	+
Pittosporaceae	<i>Pittosporum angustifolium</i>				+		
Mimosaceae	<i>Acacia aneura</i> var. <i>aneura</i>	+					
	<i>Acacia aneura</i> var. <i>major</i>				+	+	+
	<i>Acacia aneura</i> var. <i>tenuis</i>				+	+	
	<i>Acacia coolgardiensis</i> subsp. <i>effusa</i>			+			
	<i>Acacia kempeana</i>	+					
	<i>Acacia nyssophylla</i>				+		
	<i>Acacia oswaldii</i>				+		
	<i>Acacia pachyacra</i>			+			
	<i>Acacia prainii</i>			+	+		
	<i>Acacia pruinocarpa</i>	+			+	+	
	<i>Acacia strongylophylla</i>						+
	<i>Acacia tetragonophylla</i>				+		+
	<i>Acacia validinervia</i>						+
	<i>Acacia victoriae</i>	+		+			
	<i>Neptunia dimorphantha</i>		+				
<i>Neptunia dimorpophantha</i>						+	
Caesalpinaceae	<i>Senna artemisioides</i> subsp. <i>helmsii</i> x <i>oligophylla</i>	+					
	<i>Senna artemisioides</i> subsp. <i>petiolaris</i>				+		
	<i>Senna artemisioides</i> subsp. x <i>artemisioides</i>	+					
	<i>Senna glaucifolia</i>				+		+
	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>		+				
	<i>Senna pleurocarpa</i> var. <i>pleurocarpa</i>				+	+	+
	<i>Senna stricta</i>				+	+	
Papilionaceae	<i>Indigofera georgei</i>					+	
	<i>Indigofera</i> ? <i>georgei</i>	+					
Papilionaceae (cont.)	<i>Indigofera helmsii</i>						+
	<i>Indigofera linnaei</i>					+	

Family	Species	Vegetation Community					
		A1	A2	A3	B1	B2	C1
	<i>Papilionaceae</i> sp. (BR142)						+
	<i>Swainsona acuticarinata</i>				+		
	<i>Templetonia egena</i>				+		
	<i>Tephrosia sphaerospora</i>	+					+
Zygophyllaceae	<i>Zygophyllum apiculatum</i>				+		
	<i>Zygophyllum eremaeum</i>			+	+		
Euphorbiaceae	<i>Euphorbia boophthona</i>					+	
	<i>Euphorbia drummondii</i> subsp. <i>drummondii</i>	+	+	+		+	+
	<i>Euphorbiaceae</i> sp. (BR185)					+	
Sapindaceae	<i>Dodenea lobulata</i>				+		
	<i>Dodonea microzyga</i> var. <i>?microzyga</i>						+
	<i>Dodonea viscosa</i> subsp. <i>angustissima</i>	+		+			
	<i>Dodonea</i> sp. (BR163)						+
Malvaceae	<i>Abutilon cryptopetalum</i>			+			
	<i>Abutilon leucopetalum</i>						+
	<i>Abutilon macrum</i>				+		
	<i>Gossypium sturtianum</i> var. <i>sturtianum</i>						+
	<i>Hibiscus leptocladus</i>	+				+	+
	<i>Hibiscus sturtii</i> var. <i>truncatus</i>					+	
	* <i>Malvastrum americanum</i>				+		
	<i>Sida cardiophylla</i>				+		
	<i>Sida excedentifolia</i> ms					+	
	<i>Sida fibulifera</i>	+	+				+
Sterculiaceae	<i>Brachychiton gregorii</i>			+			
Thymelaeaceae	<i>Pimelea microcephala</i> subsp. <i>microcephala</i>			+			
	<i>Pimelea trichostachya</i>					+	
Myrtaceae	<i>Corymbia eremaea</i> subsp. <i>eremaea</i>	+			+		+
	<i>Eucalyptus gamophylla</i>				+		+
	<i>Eucalyptus mannensis</i> subsp. <i>mannensis</i>			+			
	<i>Eucalyptus oxymitra</i>						+
	<i>Eucalyptus socialis</i> subsp. <i>eucentrica</i> ms			+	+		+
	<i>Eucalyptus</i> aff. <i>socialis</i> subsp. <i>eucentrica</i> ms				+		
	<i>Eucalyptus striaticalyx</i> subsp. <i>striaticalyx</i>						+
	<i>Eucalytus trivalvis</i>						+
Haloragaceae	<i>Haloragis uncatapila</i>						+
Asclepiadaceae	<i>Marsdenia australis</i>					+	
Convolvulaceae	<i>Convolvulus angustissimus</i> subsp. <i>angustissimus</i>	+	+				
	<i>Convolvulus clementii</i>				+		
	<i>Ipomoea</i> sp. (BR53)		+				
Boraginaceae	<i>Halgania cynea</i> var. <i>latisejala</i> ms			+			+
	<i>Heliotropium ammophilum</i>					+	
	<i>Heliotropium brachythrix</i>					+	
	<i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i>		+		+	+	+
Lamiaceae	<i>Newcastelia spodiotricha</i>						+

Family	Species	Vegetation Community					
		A1	A2	A3	B1	B2	C1
Solanaceae	<i>Dubosia hopwoodii</i>						+
	<i>Solanum chippendalei</i>	+					
	<i>Solanum coactiliferum</i>			+			
	* <i>Solanum hystrix</i>						+
	<i>Solanum lasiophyllum</i>					+	+
	<i>Solanum orbiculatum</i> subsp. <i>orbiculatum</i>			+			
	<i>Solanum ?sturtianum</i>				+		
Bignoniaceae	<i>Pandorea pandorana</i>						+
Myoporaceae	<i>Eremophila alternifolia</i>	+			+	+	
	<i>Eremophila gilesii</i> subsp. <i>gilesii</i> ms			+			
	<i>Eremophila glabra</i> subsp. <i>glabra</i> ms				+		
	<i>Eremophila latrobei</i> subsp. <i>latrobei</i> ms				+		
	<i>Eremophila longifolia</i>	+			+		
	<i>Eremophila platythamnos</i> subsp. <i>exotrachys</i> ms			+			
	<i>Myoporum montanum</i>						+
Rubiaceae	<i>Psydrax attenuata</i> var. <i>tenella</i> ms				+		
Cucurbitaceae	<i>Cucumis melo</i> subsp. <i>agrestis</i>	+					
	<i>Mukia maderaspatana</i>			+		+	
Campanulaceae	<i>Wahlenbergia queenslandica</i>	+		+	+		
Goodeniaceae	<i>Goodenia centralis</i>				+		
	<i>Goodenia grandiflora</i>						+
	<i>Goodenia gibbosa</i>	+				+	+
	<i>Goodenia lunata</i>	+					
	<i>Scaevola parviflora</i> subsp. <i>parviflora</i>			+			
	<i>Goodenia ramelii</i>					+	
	<i>Scaevola spinescens</i>				+		
	<i>Scaevola</i> sp. (159)						+
	<i>Goodenia</i> sp. (BR111)			+			
	<i>Goodenia grandiflora</i>						+
	<i>Scaevola</i> sp. (BR156)						+
	<i>Scaevola</i> sp. (BR77)					+	+
	<i>Scaevola</i> sp. (BR78)					+	+
		<i>Goodenia</i> sp. (183)					
Asteraceae	<i>Chrysocephalum apiculatum</i>			+	+	+	+
	Asteraceae sp. (BR92)	+		+	+		
	<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>	+					
	<i>Chrysocephalum pterochaetum</i>					+	
	<i>Minuria leptophylla</i>	+		+			+
	<i>Pterocaulon serrulatum</i>	+			+	+	
	<i>Rhodanthe citrina</i>			+			
	<i>Rhodanthe floribunda</i>	+					
	<i>Rutidosis helichrysoides</i> subsp. <i>helichrysoides</i>	+					
	<i>Senecio laceratus</i>						+
	<i>Vittadinia sulcata</i>			+			
	<i>Xerochrysum bracteatum</i> subsp. <i>interiore</i> ms	+					
Unknown	Unknown sp. (BR154)						+
	Unknown sp. (BR9)	+		+			

Appendix B

Inventory of Vascular Plants Recorded in the Vicinity of the Project Area

Species	Current Study (2002)	Edinger & Backhouse (2001)	WA Herbarium (2002)	NT Herbarium (2002)	SA Herbarium (2002)
<i>Abutilon cryptopetalum</i>	+				
<i>Abutilon leucopetalum</i>	+			+	
<i>Abutilon macrum</i>	+				
<i>Acacia aneura</i> var. <i>aneura</i>	+		+		
<i>Acacia aneura</i> var. <i>major</i>	+				
<i>Acacia aneura</i> var. <i>tenuis</i>	+				
<i>Acacia coolgardiensis</i> subsp. <i>effusa</i>	+				
<i>Acacia kempeana</i>	+		+		+
<i>Acacia nyssophylla</i>	+		+		
<i>Acacia oswaldii</i>	+		+		+
<i>Acacia pachyacra</i>	+		+		+
<i>Acacia prainii</i>	+				+
<i>Acacia pruinocarpa</i>	+	+	+		+
<i>Acacia strongylophylla</i>	+	+			+
<i>Acacia tetragonophylla</i>	+	+	+		+
<i>Acacia validinervia</i>	+	+	+	+	+
<i>Acacia victoriae</i>	+	+			+
<i>Acetosa vesicaria</i>	+				+
<i>Amyema maidenii</i> subsp. <i>maidenii</i>	+	+			+
<i>Amyema miquelii</i>	+	+			+
<i>Aristida contorta</i>	+	+	+		
<i>Aristida holathera</i> var. <i>holathera</i>	+	+	+		+
<i>Aristida latifolia</i>	+	+			
<i>Austrostipa scabra</i> subsp. <i>scabra</i>	+	+	+		+
<i>Boerhavia coccinea</i>	+	+	+		
<i>Boerhavia repleta</i>	+		+		
<i>Brachychiton gregorii</i>	+				
<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>	+	+			
<i>Cenchrus ciliaris</i>	+	+			
<i>Cheilanthes lasiophylla</i>	+	+	+		+
<i>Chenopodium desertorum</i> subsp. <i>desertorum</i>	+	+			
<i>Chloris pectinata</i>	+	+			
<i>Chloris virgata</i>	+				
<i>Chrysocephalum apiculatum</i>	+				
<i>Chrysocephalum pterochaetum</i>	+	+	+		+
<i>Cleome viscosa</i>	+	+	+		
<i>Codonocarpus cotinifolius</i>	+	+			
<i>Convolvulus angustissimus</i> subsp. <i>angustissimus</i>	+				
<i>Convolvulus clementii</i>	+	+		+	+
<i>Corymbia eremaea</i> subsp. <i>eremaea</i>	+		+	+	+
<i>Cucumis melo</i> subsp. <i>agrestis</i>	+				
<i>Cymbopogon obtectus</i>	+	+	+	+	+
<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	+	+	+		+
<i>Digitaria ammophila</i>	+	+			+
<i>Dodenea lobulata</i>	+				
<i>Dodonaea microzyga</i> var. <i>?microzyga</i>	+				+
<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>	+				+
<i>Dodonaea</i> sp. (BR163)	+				
<i>Dubosia hopwoodii</i>	+				
<i>Dysphania kalpari</i>	+				
<i>Einadia nutans</i> subsp. <i>eremaea</i>	+	+	+		
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	+	+			+
<i>Enchylaena</i> sp.	+				
<i>Enneapogon avenaceus</i>	+	+		+	+
<i>Enneapogon caeruleus</i> var. <i>caeruleus</i>	+	+			
<i>Enneapogon polyphyllus</i>	+	+		+	+

Species	Current Study (2002)	Edinger & Backhouse (2001)	WA Herbarium (2002)	NT Herbarium (2002)	SA Herbarium (2002)
<i>Enteropogon acicularis</i>	+	+	+		
<i>Eragrostis eriopoda</i>	+	+		+	+
<i>Eragrostis laniflora</i>	+			+	+
<i>Eragrostis tenuifolia</i>	+				
<i>Eremophea spinosa</i>	+		+		+
<i>Eremophila alternifolia</i>	+				+
<i>Eremophila gilesii</i> subsp. <i>gilesii</i> ms	+	+	+		
<i>Eremophila glabra</i> subsp. <i>glabra</i> ms	+	+	+		+
<i>Eremophila latrobei</i> subsp. <i>latrobei</i> ms	+	+			
<i>Eremophila longifolia</i>	+	+	+		+
<i>Eremophila platythamnus</i> subsp. <i>exotrachys</i> ms	+	+	+		+
<i>Eriachne mucronata</i>	+	+	+		+
<i>Eriachne ?mucronata</i>	+				
<i>Eucalyptus gamophylla</i>	+	+	+		+
<i>Eucalyptus mannensis</i> subsp. <i>mannensis</i>	+	+	+		+
<i>Eucalyptus oxymitra</i>	+	+	+	+	+
<i>Eucalyptus socialis</i> subsp. <i>eucentrica</i> ms	+	+	+		
<i>Eucalyptus</i> aff. <i>socialis</i> subsp. <i>eucentrica</i> ms	+				
<i>Eucalyptus striaticalyx</i> subsp. <i>striaticalyx</i>	+				
<i>Eucalyptus trivalvis</i>	+		+	+	+
Euphorbaceae sp. (BR185)	+				
<i>Euphorbia boophthona</i>	+	+			
<i>Euphorbia drummondii</i> subsp. <i>drummondii</i>	+	+			
<i>Ficus brachypoda</i>	+		+		
<i>Goodenia centralis</i>	+	+	+		
<i>Goodenia grandiflora</i>	+				
<i>Goodenia gibbosa</i>	+				
<i>Goodenia lunata</i>	+				
<i>Goodenia grandiflora</i>	+				
<i>Goodenia ramelii</i>	+				
Goodeniaceae sp. (BR72)	+				
<i>Gossypium sturtianum</i> var. <i>sturtianum</i>	+				+
<i>Gyrostemon ramulosus</i>	+	+			
<i>Hakea lorea</i> subsp. <i>lorea</i>	+	+	+		+
<i>Halgania cyanea</i> var. <i>latisejala</i> ms	+				
<i>Haloragis uncatapila</i>	+	+	+		
<i>Heliotropium ammophilum</i>	+				
<i>Heliotropium brachythrix</i>	+				
<i>Hibiscus leptocladus</i>	+	+			
<i>Hibiscus sturtii</i> var. <i>truncatus</i>	+	+	+		
<i>Indigofera georgei</i>	+	+			
<i>Indigofera ?georgei</i>	+				
<i>Indigofera helmsii</i>	+		+		
<i>Indigofera linnaei</i>	+	+	+		
<i>Ipomoea</i> sp. (BR53)	+				
<i>Lepidium phlebopetalum</i>	+	+	+		
<i>Lysiana casuarinae</i>	+				
<i>Maireana scleroptera</i>	+	+	+		+
<i>Malvastrum americanum</i>	+	+			
<i>Marsdenia australis</i>	+	+			
<i>Minuria leptophylla</i>	+				+
<i>Mukia maderaspatana</i>	+	+			+
<i>Myoporum montanum</i>	+		+		+
<i>Neptunia dimorphantha</i>	+				
<i>Neptunia dimorphantha</i>	+				
<i>Pandorea pandorana</i>	+	+	+		

Species	Current Study (2002)	Edinger & Backhouse (2001)	WA Herbarium (2002)	NT Herbarium (2002)	SA Herbarium (2002)
<i>Panicum decompositum</i>	+	+	+	+	+
Papilionaceae sp. (BR142)	+				
<i>Paractaenum refractum</i>	+	+	+		+
<i>Paraneurachne muelleri</i>	+	+	+	+	+
<i>Paspalidium constrictum</i>	+	+			
<i>Pimelea microcephala</i> subsp. <i>microcephala</i>	+				
<i>Pimelea trichostachya</i>	+	+	+		
<i>Pittosporum angustifolium</i>	+		+		
<i>Portulaca oleracea</i>	+				
<i>Psyrdrax attenuata</i> var. <i>tenella</i> ms	+	+			
<i>Pterocaulon serrulatum</i>	+	+			
<i>Ptilotus chippendalei</i>	+		+	+	
<i>Ptilotus clementii</i>	+	+	+	+	
<i>Ptilotus decipiens</i>	+	+			
<i>Ptilotus exaltatus</i> var. <i>exaltatus</i>	+		+		
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	+		+		
<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>	+		+		
<i>Ptilotus sessilifolius</i> var. <i>sessilifolius</i>	+	+	+	+	
<i>Ptilotus</i> sp. (BR57)	+				
<i>Ptilotus</i> sp. (BR162)	+				
<i>Rhodanthe citrina</i>	+				+
<i>Rhodanthe floribunda</i>	+	+	+		+
<i>Rutidosis helichrysoides</i> subsp. <i>helichrysoides</i>	+	+			
<i>Salsola tragus</i> subsp. <i>tragus</i>	+	+			
<i>Santalum lanceolatum</i>	+	+	+		+
<i>Scaevola spinescens</i>	+	+			
<i>Scaevola parviflora</i> subsp. <i>parviflora</i>	+				
<i>Scaevola</i> sp. (BR77)	+				
<i>Scaevola</i> sp. (BR78)	+				
<i>Scaevola</i> sp. (BR111)	+				
<i>Scaevola</i> sp. (BR156)	+				
<i>Sclerolaena costata</i>	+				+
<i>Sclerolaena johnsonii</i>	+	+			+
<i>Sclerolaena obliquicuspis</i>	+				+
<i>Sclerolaena parviflora</i>	+	+			+
<i>Senecio laceratus</i>	+		+		+
<i>Senna artemisioides</i> subsp. <i>helmsii</i> x <i>oligophylla</i>	+				
<i>Senna artemisioides</i> subsp. <i>petiolaris</i>	+	+	+	+	+
<i>Senna artemisioides</i> subsp. x <i>artemisioides</i>	+		+		+
<i>Senna glaucifolia</i>	+				
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	+		+		+
<i>Senna pleurocarpa</i> var. <i>pleurocarpa</i>	+	+			+
<i>Senna stricta</i>	+				
<i>Sida cardiophylla</i>	+	+			
<i>Sida excedentifolia</i> ms	+	+	+		
<i>Sida fibulifera</i>	+	+			
<i>Solanum chippendalei</i>	+	+			
<i>Solanum coactiliferum</i>	+	+	+	+	
<i>Solanum hystrix</i>	+				
<i>Solanum lasiophyllum</i>	+	+	+	+	
<i>Solanum orbiculatum</i> subsp. <i>orbiculatum</i>	+	+			
<i>Solanum ?sturtianum</i>	+				
<i>Swainsona acuticarinata</i>	+	+			+
<i>Templetonia egena</i>	+	+	+		
<i>Tephrosia sphaerospora</i>	+	+	+		
<i>Themeda triandra</i>	+	+	+		

Species	Current Study (2002)	Edinger & Backhouse (2001)	WA Herbarium (2002)	NT Herbarium (2002)	SA Herbarium (2002)
<i>Trichodesma zeylanicum</i> var. <i>grandiflorum</i>	+	+	+		
<i>Triodia ?helmsii</i>	+				+
<i>Triodia basedowii</i>	+	+	+		
<i>Triodia epactia</i>	+				
<i>Triodia rigidissima</i>	+				
<i>Triodia scariosa</i>	+		+	+	
<i>Triraphis mollis</i>	+	+	+	+	+
Unknown sp. (BR9)	+				
Unknown sp. (BR112)	+				
Unknown sp. (BR153)	+				
Unknown sp. (BR154)	+				
<i>Vittadinia sulcata</i>	+	+			
<i>Wahlenbergia queenslandica</i>	+				
<i>Xerochrysum bracteatum</i> subsp. <i>interiore</i> ms	+				
<i>Zygophyllum apiculatum</i>	+				
<i>Zygophyllum eremaeum</i>	+	+			

Appendix C

Declared Rare Flora and Priority Flora

Appendix D

Photographic Record of Vascular Plant Communities



Community A1. Open Shrubland of *Hakea lorea* and *Senna artemisioides* subsp. *x artemisioides* over mixed grasses and herbs in clay on low plains.



Community A2. Grassland of *Poaceae* spp. with occasional *Senna glutinosa* subsp. *glutinosa* and *Sida fibulifera* in patches of cracking clay.



Community A3. Dense Low Woodland of *Eucalyptus mannensis* subsp. *mannensis* over *Acacia pachyacra*, *Acacia prainii* and *Dodonaea viscosa* subsp. *angustissima* over *Triodia rigidissima* and *Triodia ?helmsii* in sand over clay on low plains.



Community B1. Dense Low Woodland of *Eucalyptus socialis* subsp. *eucentrica* and *Acacia aneura* var. *major* over mixed shrubs over *Triodia scariosa* in clay on low ferricrete ridges.



Community B2. Very Open Shrubland of *Acacia pruinocarpa* and *Acacia aneura* var. *major* over *Senna pleurocarpa* var. *pleurocarpa* over *Triodia scariosa* in clay on midslopes or low rocky hills.



Community C1. Low Open Low Woodland of *Eucalyptus gamophylla* and *Eucalyptus socialis* subsp. *eucentrica* over *Acacia validinervia* over mixed shrubs over *Triodia scariosa* in clay loam on upper slopes of mafic ridges.

Appendix E

Western Australian Museum Fauna Database Search Results

Mammals

Family	Species	Common Name
Dasyuridae	<i>Pseudantechinus macdonnellensis</i>	Fat-tailed False Antechinus
Macropodidae	<i>Petrogale lateralis lateralis</i>	Black-footed Rock-wallaby (MacDonnell Ranges race)
Muridae	<i>Leggadina forresti</i> <i>Notomys alexis</i> <i>Pseudomys hermannsburgensis</i> <i>Mus musculus</i>	Desert Short-tailed Mouse Spinifex Hopping Mouse Sandy Inland Mouse *House Mouse
Molossidae	<i>Tadarida australis</i>	White-striped Mastiff-bat
Vespertilionidae	<i>Vespadelus finlaysoni</i>	Little Cave Bat
Canidae	<i>Canis familiaris</i>	*Dog/Dingo

Birds

Family	Species	Common Name
Megapodiidae	<i>Leipoa ocellata</i>	Malleefowl
Cuculidae	<i>Chrysococcyx osculans</i>	Black-eared Cuckoo
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth
Maluridae	<i>Amytornis purnelli</i> <i>Amytornis striatus</i> <i>Malurus lamberti</i> <i>Malurus splendens</i>	Dusky Grasswren Striated Grasswren Variegated Fairy-wren Splendid Fairy-wren
Pardalotidae	<i>Aphelocephala leucopsis</i>	Southern Whiteface
Meliphagidae	<i>Lichenostomus keartlandi</i> <i>Manorina flavigula</i>	Grey-headed Honeyeater Yellow-throated Miner
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler
Cinclosomatidae	<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush

Frogs and Reptiles

Family	Species
Myobatrachidae ('ground frogs')	<i>Pseudophryne occidentalis</i>
Elapidae (elapid snakes)	<i>Brachyuropsis semifasciata</i> <i>Demansia psammophis</i> <i>Pseudonaja modesta</i>
Agamidae (dragons)	<i>Ctenophorus caudicinctus graafi</i> <i>Ctenophorus clayi</i> <i>Ctenophorus isolepis gularis</i> <i>Ctenophorus nuchalis</i> <i>Ctenophorus reticulatus</i> <i>Ctenophorus rufescens</i> <i>Moloch horridus</i> <i>Tympanocryptis (lineata) centralis</i>
Gekkonidae (geckos)	<i>Diplodactylus conspicillatus</i> <i>Diplodactylus damaeus</i> <i>Diplodactylus stenodactylus</i> <i>Gehyra montium</i> <i>Gehyra purpurascens</i> <i>Gehyra variegata</i> <i>Heteronotia binoei</i> <i>Nephruirus levis levis</i> <i>Rhynchoedura ornata</i> <i>Strophurus ciliaris aberrans</i> <i>Strophurus elderi</i> <i>Strophurus strophurus</i>
Pygopodidae (legless lizards)	<i>Delma nasuta</i> <i>Pygopus nigriceps</i>
Scincidae (skinks)	<i>Ctenotus ariadnae</i> <i>Ctenotus leonhardii</i> <i>Ctenotus quattordecimlineatus</i> <i>Ctenotus schomburgkii</i> <i>Cyclodomorphus melanops</i> <i>Egernia depressa</i> <i>Egernia inornata</i> <i>Eremiascincus richardsonii</i> <i>Lerista bipes</i> <i>Lerista desertorum</i> <i>Lerista labialis</i> <i>Menetia greyii</i> <i>Proablepharus reginae</i>
Varanidae (monitors or goannas)	<i>Varanus eremius</i> <i>Varanus gilleni</i>

Appendix F

Avifauna from the Wingellina Project Area

No. days = number of days on which the species was recorded during the preliminary survey.

MG = Martin Gole's records for December 2001.

Common Name	Species	No. days	MG 12/01
Wedge-tailed Eagle	<i>Aquila audax</i>	1	
Spotted Harrier	<i>Circus assimilis</i>		1
Black-shouldered Kite	<i>Elanus axillaris</i>	3	1
Black Kite	<i>Milvus migrans</i>	1	
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>	1	
Brown Goshawk	<i>Accipiter fasciatus</i>	1	1
Brown Falcon	<i>Falco berigora</i>	4	1
Australian Kestrel	<i>Falco cenchroides</i>	4	1
Australian Hobby	<i>Falco longipennis</i>	2	1
Little Button-quail	<i>Turnix velox</i>		1
Diamond Dove	<i>Geopelia cuneata</i>	1	1
Crested Pigeon	<i>Ocyphaps lophotes</i>	2	1
Common Bronzewing	<i>Phaps chalcoptera</i>		1
Galah	<i>Cacatua roseicapilla</i>	2	
Cockatiel	<i>Nymphicus hollandicus</i>		1
Australian Ringneck	<i>Barnardius zonarius</i>	4	1
Budgerigar	<i>Melopsittacus undulatus</i>	4	1
Mulga Parrot	<i>Psephotus varius</i>	3	1
Bourke's Parrot	<i>Neopsephotus bourkii</i>		1
Pallid Cuckoo	<i>Cuculus pallidus</i>	2	1
Spotted Nightjar	<i>Eurostopodus argus</i>	1	
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>		1
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>		1
Dusky Grasswren	<i>Amytornis purnelli</i>	1	1
Variegated Fairy-wren	<i>Malurus lamberti</i>	2	1
White-winged Fairy-wren	<i>Malurus leucopterus</i>	1	
Rufous-crowned Emu-wren	<i>Stipiturus ruficeps</i>	2	
Red-browed Pardalote	<i>Pardalotus rubricatus</i>	2	
Weebill	<i>Smicrornis brevirostris</i>	1	
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	1	
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>	1	
Southern Whiteface	<i>Aphelocephala leucopsis</i>	4	1
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	4	1
Yellow-throated Miner	<i>Manorina flavigula</i>	4	1
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	1	
Grey-fronted Honeyeater	<i>Lichenostomus plumulus</i>	4	1
Singing Honeyeater	<i>Lichenostomus virescens</i>	4	1
White-fronted Honeyeater	<i>Phylidonyris albifrons</i>	4	
Crimson Chat	<i>Epthianura tricolor</i>	1	1
Hooded Robin	<i>Melanodryas cucullata</i>	2	1
Jacky Winter	<i>Microeca fascinans</i>		1
White-browed Babbler	<i>Pomatostomus superciliosus</i>	1	1
Grey Shrike-Thrush	<i>Colluricincla harmonica</i>	1	1
Crested Bellbird	<i>Oreoica gutturalis</i>	3	1
Rufous Whistler	<i>Pachycephala rufiventris</i>	2	1

Common Name	Species	No. days	MG 12/01
Australian Magpie-lark	<i>Grallina cyanoleuca</i>	1	
Willie Wagtail	<i>Rhipidura leucophrys</i>	4	1
Ground Cuckoo-shrike	<i>Coracina maxima</i>	1	1
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	4	1
White-winged Triller	<i>Lalage sueurii</i>		1
Black-faced Woodswallow	<i>Artamus cinereus</i>	4	1
Masked Woodswallow	<i>Artamus personatus</i>	3	1
Grey Butcherbird	<i>Cracticus torquatus</i>	3	1
Pied Butcherbird	<i>Cracticus nigrogularis</i>	3	1
Australian Magpie	<i>Gymnorhina tibicen</i>	4	1
Little Crow	<i>Corvus bennetti</i>	1	1
Torresian Crow	<i>Corvus orru</i>	3	1
Western Bowerbird	<i>Chlamydera guttata</i>	1	
Richard's Pipit	<i>Anthus novaeseelandiae</i>	3	1
Zebra Finch	<i>Taeniopygia guttata</i>	3	1
Mistletoe Bird	<i>Dicaeum hirundinaceum</i>	2	
Brown Songlark	<i>Cincloramphus cruralis</i>		1
Rufous Songlark	<i>Cincloramphus mathewsi</i>	2	1
White-backed Swallow	<i>Cheramoeca leucosternum</i>	1	1
Tree Martin	<i>Hirundo nigricans</i>		1
Total species:		54	51

Total species recorded: 65