

**Avoca Resources  
Limited**

Report for Higginsville Project  
Area

Desktop Biological Assessment and  
Broad Scale Vegetation Mapping

February 2010

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# 1. Introduction

## 1.1 Background

The Higginsville Gold project comprises a substantial tenement package within the southern Goldfields of Western Australia and was acquired by Avoca Resources Limited (Avoca) in June 2004. The Higginsville mine site (processing plant and mine administration area) is located adjacent to the Coolgardie-Esperance Highway, approximately 53 km north of Norseman.

A number of biological surveys have been undertaken previously within the Higginsville project area, including a vertebrate fauna survey in 2006 and vegetation and flora surveys of selected sites in 2006, 2007 and 2008.

Avoca has commissioned GHD Pty Ltd (GHD) to review the survey reports, update relevant desktop information and summarise and compile relevant components into a single succinct report. Broad scale vegetation mapping of the Higginsville project area was also completed as part of this study.

## 1.2 Study Area

The study area is rectangular in shape (approximately 15 km x 11 km) and covers some 16,500 ha. The eastern perimeter of the study area intersects the margins of Lake Cowan and the western sector straddles the Coolgardie-Esperance Highway. The Higginsville mine site is situated centrally within the northern half of the study area. Impacts from previous exploration and mining activities are evident across much of the site. A map of the study area and regional location is provided in Figure 1, Appendix A.

## 1.3 Objectives

The objectives of this study were to:

- » Review existing biological survey information (nomenclature and conservation status) and relevant information on the existing physical environment;
- » Search the Department of Environment and Conservation (DEC)/Western Australian Museum (WAM) *Naturemap* database for significant flora and fauna;
- » Search the DEC's Environmentally Sensitive Areas (ESA) database;
- » Review the DEC's Threatened Ecological Community (TEC) database;
- » Search the Department of Environment, Water, Heritage and the Arts' (DEWHA) database for areas listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*;
- » Review the local and regional significance of plant communities within the study area (as mapped by Beard, 1975);
- » Compile relevant components from previous biological survey reports together with updated information into a single succinct report; and

- » Prepare a broad scale vegetation map for the study area.

A one-day site visit was also undertaken to review broad scale vegetation types present (as notated and mapped by Beard, 1979) and assist in the delineation of mapped vegetation boundaries.

## 2. Existing Environment

### 2.1 Climate

The Goldfields region experiences an arid to semi-arid climate with hot summers and mild winters with cool nights (Australian Natural Resource Atlas, 2008). Rainfall is unreliable, but mean delivery per month tends to be slightly higher during the winter period. Rainfall patterns are typically associated with cold fronts in winter and thunderstorms and rain bearing depressions in summer (Hall and McKenzie, 1992).

The closest official Bureau of Meteorology (BoM) weather recording station is at Norseman where climate data is available for the period from 1897 to 2009. Norseman's mean annual rainfall is 289.2 mm, with monthly averages ranging from 19.8 mm in January to 30.5 mm in June (BoM, 2009). Winds average 0 to 20 km/hr throughout the year, shifting direction seasonally (BoM, 2009).

Seasonal variations in temperature are reasonably large. Summer temperatures may exceed 40°C and winter frosts within the region are not uncommon. Snow has been reported (albeit briefly) in the vicinity of Norseman (ABC News, July 2005); however, this is considered to be a rare event. Mean maximum temperatures recorded range from 32.5°C in January to 16.7°C in July. Mean minimum temperatures range from 15.9°C in February to 5.2°C in July.

The study area is considered to exhibit a similar climate to that recorded at Norseman.

Table 1 outlines the mean minimum and mean maximum temperatures as well as the mean rainfall for Norseman.

**Table 1 Climate Data for Norseman (source: BoM, 2009).**

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean maximum temperature (°C)	32.5	31.3	28.8	24.5	20.4	17.4	16.7	18.4	21.6	24.9	28.0	30.7	24.6
Mean minimum temperature (°C)	15.8	15.9	14.4	11.6	8.5	6.3	5.2	5.4	7.4	9.7	12.2	14.1	10.5
Mean Monthly rainfall (mm)	19.8	25.2	24.1	23.6	30.4	30.5	27.0	25.0	21.5	20.2	20.6	21.3	289.2

Source: (BoM, 2009)

### 2.2 Geology

Higginsville is situated in the Kalgoorlie Province, which is on the central eastern portion of the Yilgarn Craton. The province consists of Archaean greenstone basement rocks with a north-south strike and a steep westerly dip. This is overlain with granitic rocks and greenstone of the Yilgarn Craton that have been extensively weathered and laterised. Undulating plains containing hills, sand plains and salt lakes overlie the bedrock (Department of Agriculture and Food, 2006). Superficial deposits are typically made up of colluvial and alluvial sediments.

A concentration of greenstone belts exists between Norseman and Kalgoorlie. The greenstones contain a mixed assemblage of metamorphosed mafic to ultramafic volcanic rocks (including basalt, amphibolite, dolerite and gabbro), felsic volcanic rocks, and metasedimentary rocks (including cherts and banded iron formations) (Department of Agriculture and Food, 2006).

The Higginsville area is dominated by a 5 km wide belt of metamorphosed high-Mg basalt and minor metakomatiite flows with doleritic and gabbroic intrusions. (Griffin, 1990).

### **2.3 Topography and Soils**

The study area falls largely within the Gumland Land System as described by Payne, Mitchell and Hennig (1998). The unit consists of broad shallow valley plains with restricted areas of slightly more elevated stony surfaces and central drainage tracts. Low rounded hills and rises occur occasionally within the central and western portions of the study area whilst the eastern periphery intersects the bare lake bed and associated saline plains, sandy plains and dunes of Lake Cowan. The highest point within the study area is 386 m (AHD), located approximately 4 km to the east of the Higginsville mine site.

Soils in the region are characterised by red loamy earths and calcareous loamy earths on the plains, calcareous shallow loams and stony soils on low hills and rises and saline soils on and near playa lakes. The study site lies largely within a relatively broad plain consisting of calcareous loamy earths and red loamy earths.

### **2.4 Surface water and Drainage**

The study area falls within the broader Balladonia Water Catchment. Drainage lines within the majority of the study area are poorly defined and are only likely to flow following major rainfall events. Sheetflow may also occur on the alluvial plains adjacent to the salt lake system following periods of heavy rainfall.

Lake Cowan, a wetland of subregional significance (CALM, 2001), intersects the eastern perimeter of the study area. The lake represents part of a former palaeodrainage channel and covers an area of approximately 4,460 km<sup>2</sup>. The lake is predominately dry but may contain water following heavy rain. Water ponded in the lake is probably lost to evaporation and seepage.

The settling ponds at the Higginsville mine site are currently listed as an artificial water body on the Western Australian Wetlands Database (*WetlandBase*).

### **2.5 Phytogeography**

The study area is located within Eastern Goldfields subregion as delineated under the Interim Biogeographic Regionalisation for Australia (IBRA) system. IBRA is a national planning framework in which 85 biogeographic regions and 403 sub-regions have been established to assist in setting reservation targets across the entire Australian landscape. Each bioregion is a geographically distinct area of land with common



characteristics such as geology, landform patterns, climate, vegetation and fauna. Sub-regions were defined on the basis of major geomorphological features within each bioregion.

The Coolgardie bioregion correlates largely to the Coolgardie Botanical District defined by Beard (1990) and is described broadly as lying within the interzone between mulga/spinifex country and eucalypt environments (ANRA, 2008). The Eastern Goldfields sub-region is summarised as supporting diverse Eucalypt woodlands on low greenstone hills, valley floors, broad plains and salt lake surrounds; samphire shrublands on saline valley floors; and Mallees, *Acacia* thickets and shrub-heaths on sandplains, playas, laterite areas and granite outcrops (Thackway and Cresswell, 1995).

Dominant environmental constraints for the Coolgardie bioregion include extinction of critical weight range mammals, wildfire, feral animals (in particular cat and fox), weeds, and pastoral and mining activities (ANRA, 2008).

## **2.6 Reserves and Conservation Areas**

The Binaronca Rock Nature Reserve is located within the northern extent of the study area, immediately east of the Coolgardie-Esperance Highway (Figure 1). The Reserve was established for the purpose of 'flora and fauna' conservation and covers an area of 185.5 ha. The Reserve is currently vested with the Conservation Commission Western Australia. No other reserves or conservation areas are located within or immediately adjacent to the study area.

## **2.7 Environmentally Sensitive Areas (ESA)**

The DEC's online Native Vegetation Viewer provides information on the location of ESAs, as declared by a Notice under section 51B of the *Environmental Protection Act 1986 (EP Act)*. These databases also indicate areas where low impact mineral and petroleum activities cannot occur without a Native Vegetation Clearing Permit, as defined under Schedule One of the Environmental Protection (Clearing of native Vegetation) Regulations 2004.

A search of the Department of Environment and Conservation's Native Vegetation Viewer indicated that no ESAs occur within the immediate vicinity of the project area. The closest recorded ESAs are located approximately 5 km beyond the north-east corner of the study area.

Schedule One areas occurring within the study area are shown in Figure 1 and include the Binaronca Rock Nature Reserve (No: 1824), and the rail reserve (Nos: 1817 and 1826).

## 2.8 Vegetation

### 2.8.1 Vegetation Description, Extent and Status

The vegetation of the Eastern Goldfields region was mapped by Beard as part of the Western Australian mapping project conducted from 1964-1981. The vegetation associations recorded for the study area are listed in Table 2. The regional extent of each vegetation type represented and the proportion of each type remaining as a percentage of the pre-European extent [as drawn from Shepherd, *et al.* (2002) and Shepherd *pers. comm.* (2005)] is also provided.

A vegetation type is considered underrepresented if there is less than 30 percent of its original distribution remaining. From a purely biodiversity perspective, and not taking into account any other land degradation issues, there are several key criteria now being applied to vegetation in States where clearing is still occurring (EPA, 2000).

- » The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at 30% of the pre-European / pre-1750 extent for the vegetation type;
- » A level of 10% of the original extent is regarded as being a level representing *Endangered*; and
- » Clearing which would put the threat level into the class below should be avoided.

Such status can be delineated into five classes, where:

- » *Presumed Extinct*: Probably no longer present in the bioregion
- » *Endangered\**: <10% of pre-European extent remains
- » *Vulnerable\**: 10-30% of pre-European extent exists
- » *Depleted\**: >30% and up to 50% of pre-European extent exists
- » *Least Concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

\* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status

**Table 2 Vegetation Extent and Status in the Coolgardie IBRA Region**

Vegetation Association Number	Association Description	Pre-European Extent (ha) in Coolgardie IBRA region	Current Extent (ha) in Coolgardie IBRA region	% Remaining	% Pre-European Extent in IUCN Class I-IV Reserves
8	Medium woodland; salmon gum & gimlet	226087.041	226087.041	100.0	23642.999
9	Medium woodland; coral gum ( <i>Eucalyptus torquata</i> ) & goldfields blackbutt ( <i>E. lesouefii</i> ), (also some e10,11)	235047.525	234440.269	99.7	3021.678
125	Bare areas; salt lakes	303090.85	303090.85	100.0	24222.358

501	Medium woodland; goldfields blackbutt	43871.132	43871.132	100.0	0
522	Medium woodland; redwood ( <i>Eucalyptus transcontinentalis</i> ) & merrit ( <i>E. urna</i> )	208175.504	208175.504	100.0	29660.911

Vegetation within the study area (as mapped by Beard) is considered to be of *Least Concern* in terms of its regional extent. As indicated in Table 2, each vegetation association is intact with only a slight reduction in area recorded for the medium woodland; coral gum and goldfields blackbutt unit (Association No: 9).

## 2.8.2 Threatened Ecological Communities (TECs)

Ecological communities are defined as 'naturally occurring biological assemblages that occur in a particular type of habitat' (English and Blythe, 1997). TECs are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered, and Vulnerable.

Some TECs are protected under the *EPBC Act*. Although TECs are not formally protected under the *State Wildlife Conservation Act 1950 (WC Act)*, the loss of, or disturbance to, some TECs triggers the *EPBC Act*. The Environmental Protection Authority's (EPA's) position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.

Possible TECs that do not meet survey criteria are added to the DEC's Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

The DEC's TEC database was queried for known occurrences of TECs or PECs near the study area. There are no known occurrences of TECs or PECs recorded within the vicinity of the study area (Department of Environment and Conservation, 2008).

## 2.9 Flora

### 2.9.1 Significant Flora

#### ***Commonwealth***

Species of significant flora are protected under both Commonwealth and State Acts. Any activities that are deemed to have a significant impact on species that are recognised by the *EPBC Act* and the *WC Act* can trigger referral to the DEWHA and/or the EPA.

A description of Conservation Categories delineated under the *EPBC Act* is detailed in Table 3. These are applicable to threatened flora and fauna species.

**Table 3 Conservation Categories and Definitions for *EPBC Act* Listed Flora and Fauna Species**

<b>Conservation Category</b>	<b>Definition</b>
<i>Extinct</i>	Taxa not definitely located in the wild during the past 50 years.
<i>Extinct in the Wild</i>	Taxa known to survive only in captivity.
<i>Critically Endangered</i>	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
<i>Endangered</i>	Taxa facing a very high risk of extinction in the wild in the near future.
<i>Vulnerable</i>	Taxa facing a high risk of extinction in the wild in the medium-term.
<i>Near Threatened</i>	Taxa that risk becoming Vulnerable in the wild.
<i>Conservation Dependent</i>	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
<i>Data Deficient (Insufficiently Known)</i>	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
<i>Least Concern</i>	Taxa that are not considered Threatened.

A search of the *EPBC Act* Protected Matters Search Tool was undertaken to identify Commonwealth protected flora species which may be present within the vicinity of the study area. *Gastrolobium graniticum* (Granite Poison) and *Pityrodia scabra* (Wyalkatchem Foxglove) were the only species of significance recorded. Both species are currently listed as 'Endangered'.

### **State**

In addition to the *EPBC Act*, significant flora in Western Australia is protected by the *WC Act*. This *Act*, which is administered by the DEC, protects DRF species. The DEC also maintains a list of Priority Listed Flora (PLF) species. Conservation codes for flora species are assigned by the DEC to define the level of conservation significance. PLF are not currently protected under the *WC Act*. PLF may be rare or threatened, but cannot be considered for declaration as rare flora until adequate surveys have been undertaken of known sites and the degree of threat to these populations clarified. Special consideration is often given to sites that contain PLF, despite them not having formal legislative protection. A description of the DEC's Conservation Codes that relate to flora species is provided in Table 4.

**Table 4 Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species**

Conservation Code	Description
X: Declared Rare Flora – Presumed Extinct	Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.
R: Declared Rare Flora – Extant Taxa	Taxa which 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, and have been gazetted as such.
P1: Priority One – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2: Priority Two – 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 immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3: Priority Three – Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
P4: Priority Four – Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.

The DEC/WAM *NatureMap* database was queried for records of significant flora occurring within 15 km of the study area. No DRF species were recorded. PLF species recorded are listed in Table 5.

**Table 5 Significant Flora Present within 15 km of the Study Area from Records of the DEC/WAM *NatureMap* Database**

Species	Conservation Code	Description <sup>1</sup>
<i>Diocirea acutifolia</i>	P3	A low dense rounded shrub, ranging from 0.3-0.8m in height. Flowers white from November –

Species	Conservation Code	Description <sup>1</sup>
		December. Occurs in clay loam, gravelly loam soils, undulating flats.
<i>Eucalyptus kruseana</i>	P4	Straggly mallee ranging in height from 2-3.5m. Flowers yellow from June – September. Occurs in sandy loams, granite outcrops and hills.
<i>Frankenia georgei</i>	P3	Small shrub which flowers pink in December. Occurs on rocky slopes.
<i>Melaleuca coccinea</i>	P3	Much branched shrub, 1.5-2.6m high. Flowers red, occurring from September - January. Occurs in sandy loam over granite, granite outcrops, sandplains and river valleys.
<i>Pityrodia</i> sp. Yilgarn (AP Brown 2679)	P3	Viscid shrub, 0.7–1.4 m high. The flowers are white and occur in October to November. Known to occur on sandy soils, and particularly prevalent in disturbed areas

<sup>1</sup> Data Source: Department of Environment and Conservation (2009) Florabase accessed on line at <http://florabase.calm.wa.gov.au/> in December 2009.

## 2.10 Fauna

### 2.10.1 Potential Fauna Species

A DEC/WAM NatureMap online search was conducted for the study area and surrounds (i.e. study area plus 40 km buffer). The search identifies terrestrial vertebrate species recorded in various databases including collections from the WAM. The search identified the potential presence of two amphibian species, 11 mammal, 17 bird and 58 reptile species. A list of species recorded from the DEC *NatureMap* search is presented in Table 14, Appendix C.

It should be noted that some of the records of the WAM are historical and some of the recorded species may now be locally extinct. Additionally these records may include species (particularly bird species) that are vagrants or present in the general area but not present within the study area due to lack of suitable habitat.

### 2.10.2 Relevant Legislation

The conservation status of fauna species is assessed under both Commonwealth and State Acts, namely the *EPBC Act* and the *WC Act*.

The significance levels for fauna used in the *EPBC Act* are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). A description of Conservation Categories delineated under the *EPBC Act* is provided in Table 3 and the circumstances under which a project will trigger referral to the DEWHA are described in Appendix C. These categories are applicable to both threatened flora and fauna species.

The *EPBC Act* also protects migratory species that are listed under the following International Agreements:

- » Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a Range State under the Convention;
- » The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);
- » The Agreement between the Government of Australia and the Republic of Korea for the protection of migratory shorebirds and their habitat (ROKAMBA); and
- » The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA).

Listed migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The *WC Act* uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and schedules are described in Table 6. These may be trigger species in the *EPBC Act*.

**Table 6 Western Australian Threatened Fauna Categories**

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct.
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	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.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

In Western Australia, the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the *WC Act*, but for which the Department feels there is a cause for concern. These species have no special legislative protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Table 7.

**Table 7 Department of Environment and Conservation Priority Codes**

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.

Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring which are considered not currently threatened or in need of special protection, but could be if present circumstances change. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

### 2.10.3 Threatened Fauna Searches

The DEWHA maintains a database of matters of national environmental significance that are protected under the *EPBC Act*. An *EPBC Act* Protected Matters Report was generated (from the website of the DEWHA), in December 2009 for the matters of significance that may occur in, or may relate to, the study area. Marine species listed in this search were included in the list. A search of the DEC/WAM *NatureMap* database for any rare and priority species that may occur in the study area was also undertaken at that time.

Protected fauna species identified from DEC/WAM and DEWHA databases as potentially occurring within the study area are listed in Table 8.

It should be noted that some species that appear in the *EPBC Act* Protected Matters Search Tool are often not likely to occur within the specified area, as the search provides an approximate guidance to matters of national significance that require further investigation. The records from the DEC search provide more accurate information for the general area; however, some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.

**Table 8 Listing of Potentially Occurring Significant, Rare and Priority Fauna Species within the Study Area, with Information Source**

Genus	Species	Common Name	Listing under Wildlife Conservation Act 1950 or DEC Priority List	Listing under <i>EPBC Act</i>	DEC NatureMap Database	EPBC Protected Matters Search Tool
<b>Birds</b>						
<i>Acanthiza</i>	<i>iredalei</i> <i>iredalei</i>	Slender-billed Thornbill (western)		Vulnerable		+
<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift		Migratory, Marine		+
<i>Ardea</i>	<i>alba</i>	Great Egret, White Egret		Migratory, Marine		+
<i>Ardea</i>	<i>ibis</i>	Cattle Egret		Migratory, Marine		+



Genus	Species	Common Name	Listing under Wildlife Conservation Act 1950 or DEC Priority List	Listing under EPBC Act	DEC NatureMap Database	EPBC Protected Matters Search Tool
<i>Ardeotis</i>	<i>australis</i>	Australian Bustard	Priority 4		+	
<i>Aquila</i>	<i>morphnoides</i> subsp <i>morphnoides</i>	Little Eagle		Migratory		
<i>Falco</i>	<i>Peregrinus</i> subsp <i>macropus</i>	Peregrine Falcon	Schedule 4		+	
<i>Hylacola</i>	<i>cauta</i> subsp. <i>whitlocki</i>	Shy Heathwren (western ssp)	Priority 4		+	
<i>Leipoa</i>	<i>ocellata</i>	Malleefowl	Schedule 1	Vulnerable	+	+
<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater		Migratory, Marine		+
<i>Oreica</i>	<i>gutturalis</i> <i>gutturalis</i>	Crested Bellbird (southern)	Priority 4		+	
<b>Mammals</b>						
<i>Phascogale</i>	<i>tapoatafa</i> subsp. (WAM M434)	Brush-tailed Phacogale, Wambenger	Schedule 1		+	
<b>Reptiles</b>						
<i>Morelia</i>	<i>spilota</i> <i>imbricata</i>	Carpet Python	Schedule 4, Priority 4		+	

## 2.11 Pathogens

*Phytophthora cinnamomi* threatens over 2,300 (40%) of different plant species in Western Australia. Introduced following European settlement, *Phytophthora cinnamomi* is a soil-borne pathogen that kills a wide range of native plant species in the south west of Western Australia by attacking their root system. *Phytophthora cinnamomi* can also survive and reproduce on a wide range of native plant species without killing them. It has a widespread but discontinuous range in areas of the south west with an annual rainfall above 400 mm (Dieback Working Group, 2005).

The study area is not in an area considered susceptible to the development of the pathogen.

### 3. Previous Biological Surveys

A number of biological surveys have been undertaken previously in the Eastern Goldfields region. The most notable being the broad scale mapping of vegetation assemblages conducted by John Beard as part of the Western Australian mapping project (Beard, 1979) and the comprehensive biological survey of the region undertaken by the Biological Surveys Committee during the 1980's (Biological Survey Committee, 1984). The latter study not only described vegetation assemblages present but also recorded vertebrate fauna sampled from all major habitats within the region. Detailed studies of avifauna (Storr, 1984) and herpetofauna (Storr *et al.*, 1981) have also been undertaken within the Eastern Goldfields and a review of the region's biodiversity significance was recently completed by the Wilderness Society (Watson, 2008).

The following biological studies have also been completed within nominated sections of the broader study area and provide valuable local information:

- » Biological Survey of Proposed Aerodrome Site at Higginsville Mine Site (GHD, 2008)
- » Flora and Vegetation Survey of an area within Tenement M15/348 (Botanica Consulting, 2007)
- » Avoca Resources Limited Flora Survey June 2006 (JSWT, 2006a)
- » Vegetation Survey of Avoca Resources Limited Tenements M15/351, M15/289, M15/225, M15/325 & P15/487 (JSWT, 2006b)
- » Vertebrate Fauna Assessment Avoca Resources (JSWT, 2006c)

A summary of each study and key findings are presented below. The nomenclature and conservation status of species listed within each report has been reviewed using the DEC *Florabase* and DEC/WAM *NatureMap* databases. Changes have been made where necessary to reflect current species information.

#### **3.1 Biological Survey of Proposed Aerodrome Site at Higginsville Mine Site (GHD, 2008)**

##### **3.1.1 Background**

GHD was commissioned by Avoca in May 2008 to undertake a baseline flora and fauna assessment of the proposed Higginsville aerodrome site. The survey was limited to the area bounded by Miscellaneous Licence L15/297 (approximately 257 ha). The location and extent of the survey area is shown in Figure 2, Appendix A. The study included both a desktop review and field survey. The key objectives of the assessment were to:

- » Review existing biological survey information for the area and relevant information on the existing physical environment;

- » Review the local and regional significance of plant communities;
- » Search government databases for relevant desktop information;
- » Compile an inventory of vascular plant species present in the survey area;
- » Search for significant flora species, including Declared Rare Flora (DRF) and Priority Listed Flora (PLF);
- » Compile an inventory of dominant exotic plants present, including declared noxious plants and environmental weed species;
- » Describe, record and map the locations of plant communities present;
- » Compile an inventory of vertebrate fauna species present in the survey area through opportunistic recording of species;
- » Identify any habitats of significance; and
- » Assess the proposed clearing against the “10 Clearing Principles” as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003* to determine whether it is at variance to the Principles.

### **3.1.2 Field Survey Methods**

The vegetation and flora survey was completed by GHD in May 2008. The survey area was traversed on foot and 20 x 20m quadrats were established within selected vegetation types. An inventory of flora species present was generated and vegetation was mapped at a scale of 1:15,000 using a combination of aerial photography and information collected in the field. A follow-up targeted species search was conducted to determine the distribution and abundance of the Priority One Flora species, *Eremophila parvifolia* subsp. *auricampa*, which was recorded during the initial field survey (refer Section 3.1.3).

The fauna survey was an opportunistic survey and was undertaken by GHD ecologists in conjunction with the flora survey. The fieldwork involved visual and aural surveys for any fauna species utilising the study area. An assessment of fauna habitat values and potential habitat linkages was also undertaken as part of the survey.

### **3.1.3 Key Findings**

#### **Vegetation**

The vegetation association within the survey area was broadly described by GHD (2008) as a transitional eucalypt woodland comprising a mosaic of vegetation types. A description of each vegetation type identified within the broader association is provided in Table 9.

**Table 9 Vegetation Type Descriptions (source: GHD, 2008)**

Vegetation Type	Description
1	<i>Eucalyptus salmonophloia</i> woodland with scattered <i>Eremophila Scoparia</i> over <i>Maireana sedifolia</i> and <i>Cratystylis conocephala</i>
2	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i> , <i>Eucalyptus lesouefii</i> and <i>Eucalyptus flocktoniae</i> over scattered tall shrubs of <i>Melaleuca sheathiana</i> with an understorey of <i>Maireana sedifolia</i>
3	<i>Eucalyptus oleosa</i> subsp. <i>oleosa</i> and <i>Eucalyptus salubris</i> over <i>Cratystylis conocephala</i> and <i>Atriplex vesicaria</i>
4	<i>Acacia acuminata</i> and <i>Eremophila dempsteri</i> shrubland with an understorey of <i>Dodonea microzyga</i> , <i>Stenanthemum</i> sp. and <i>Prostanthera</i> sp.
5	Rehabilitation zone adjacent to the old Challenger-Swordsman haul road. Areas ripped and seeded. Vegetation dominated by chenopod species.
6	Completely Degraded. Areas of vegetation cleared for access roads and tracks.

GHD did not map the distribution of the three eucalypt vegetation types recorded within the study area as distinct boundaries were not apparent. The *Acacia* shrubland, on the other hand, was clearly discernable both during the survey and from aerial photography and its distribution has been mapped within the broader transitional eucalypt woodland association (refer Figure 2, Appendix A).

### Vegetation Condition

Vegetation across the survey area was generally considered to be in *Excellent* condition, with minor areas of disturbance resulting from exploration activities, track and road construction and historical logging operations. The rehabilitated margins of the old Challenger-Swordsman haul road were considered to be in *Degraded* to *Good* condition with very few weeds present.

Vegetation condition was not mapped by GHD due to the low variability across much of the survey area.

### Threatened Ecological Communities

No Threatened Ecological Communities or Priority Ecological Communities were recorded during the field survey.

### Flora

Vegetation within the survey area was considered by GHD to be moderately diverse.

A total of 66 taxa (including one introduced species) from 19 families were recorded from the survey area.

Dominant families recorded included:

- » Chenopodiaceae (Chenopods) 13 taxa
- » Myrtaceae (gums, myrtles): 11 taxa

- » Myoporaceae (poverty / emu bushes): 10 taxa
- » Mimosaceae (wattles): 4 taxa

Dominant genera recorded from the survey area included:

- » *Eucalyptus* 10 taxa
- » *Eremophila* 10 taxa
- » *Atriplex* 5 taxa
- » *Acacia* 4 taxa
- » *Maireana* 4 taxa

A full list of species recorded during the survey is provided in Table 13, Appendix B.

### **Significant Flora Species**

No Declared Rare Flora species were recorded from the survey area. The Priority One Flora species: *Eremophila parvifolia* subsp. *auricampa* was recorded from the survey area during the field assessment. This taxa has since been reassessed by the DEC and is no longer listed as a conservation significant species.

### **Weeds**

One weed species, *Carrichtera annua*, was recorded from the rehabilitation area adjacent to the old Challenger-Swordsman haul road. No other weed species were recorded during the field survey.

### **Fauna**

A total of six bird species, two mammal species, and two reptile species were recorded during the reconnaissance survey (refer Table 14, Appendix C) It is considered that the relatively small survey area and the overcast and cool conditions at the time of the survey resulted in the relatively small number of species recorded.

### **Significant Fauna Species**

No threatened fauna species were recorded from the survey area.

### **Fauna Habitat**

The vegetation structure within the survey area is largely intact and the site retains good habitat value. Habitats present within the survey area are consistent with those recorded for similar eucalypt woodlands within the region.

### **Habitat Linkages**

The majority of the project area is surrounded by relatively unaltered vegetation and is not considered to contain any significant breaks to habitat linkages.

### **Assessment against Clearing Principles**

At the time of reporting, the project was considered by GHD to be at variance against Principle (c3) due to the presence of the Priority One Flora species *Eremophila parvifolia* subsp. *auricampa*. As indicated in Section 3.1.3, this taxa is no longer listed as a conservation significant species.

## 3.2 Flora and Vegetation Survey of an area within Tenement M15/348 (Botanica Consulting, 2007)

### 3.2.1 Background

Botanica Consulting was commissioned by Avoca in February 2007 to undertake a flora survey within tenement M15/348 prior to the construction of proposed infrastructure. The location of the survey area (approximately 69 ha) is shown in Figure 3, Appendix A. The primary objectives of the study were to:

- » Identify and collect the vascular plant taxa in the survey area;
- » Provide a description of the vegetation occurring within the survey area;
- » Assess vegetation condition; and
- » Assess the proposed clearing against the “10 Clearing Principles” as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003*.

DEC and Western Australian Herbarium (WAHERB) database searches were undertaken to identify any significant flora species potentially occurring within the study area prior to commencing the fieldwork assessment.

### 3.2.2 Field Survey Methods

Fieldwork was completed by Botanica consulting in February 2007 and involved traversing the area on foot and by vehicle. Sample points were established within different vegetation associations as well as vegetation types associated with known Priority Flora. Each sample point location was recorded using a GPS unit and traversed within a minimum radius of 50 m.

### 3.2.3 Key Findings

#### Vegetation

Vegetation within the survey area was classified by Botanica Consulting (2007) into two vegetation groups. A description of each is provided in Table 10. A vegetation map prepared by Botanica Consulting (2007) is shown in Figure 3, Appendix A. No vegetation communities recorded in the survey area were considered to have regional significance as defined by the *EPBC Act*.

**Table 10 Vegetation Group Descriptions (source: JSWT, 2007)**

Vegetation Group	Description
Transitional <i>Eucalyptus</i> Woodland	Dominant species represented by <i>Eucalyptus</i> species such as <i>E. salmonophloia</i> , <i>E. griffithsii</i> and <i>E. urna</i> . The mid-storey comprised of <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Atriplex nummularia</i> , <i>Acacia colletioides</i> , <i>Acacia nyssophylla</i> , <i>Eremophila alternifolia</i> , <i>E. decipiens</i> subsp. <i>descipiens</i> , <i>E. glabra</i> subsp. <i>glabra</i> , <i>E. interstans</i> subsp. <i>virgata</i> , <i>E. scoparia</i> , <i>E. ionantha</i> , <i>Melaleuca sheathiana</i> and <i>Exocarpos aphyllus</i> over an understorey of <i>Ptilotus obovatus</i> , <i>Olearia muelleri</i> , <i>Atriplex vesicaria</i> , <i>Maireana georgei</i> and <i>Sclerolaena ericantha</i> .

Vegetation Group	Description
<i>Acacia acuminata</i> Shrubland	<i>Acacia acuminata</i> and <i>Eucalyptus griffithsii</i> over <i>Cratystylis conocephala</i> , <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Atriplex nummularia</i> , <i>Acacia colletioides</i> , <i>Acacia nyssophylla</i> , <i>Eremophila interstans</i> subsp. <i>virgata</i> , <i>E. oldfieldii</i> subsp. <i>angustifolia</i> over <i>Olearia muelleri</i> , <i>Atriplex vesicaria</i> , <i>Stenanthemum petrauem</i> and <i>Dodonaea microzyga</i> .

### Vegetation Condition

The condition of vegetation within the survey area was considered by Botanica Consulting to be 'very good' under the vegetation condition rating scale employed (Keighery, 1994). Disturbance was in the form of historic drill tracks and grazing.

### Flora

A total of 59 taxa from 25 genera and 15 families were recorded from the survey area.

### Significant Flora Species

No DRF or Priority Listed Flora species were recorded from the survey area.

### Weeds

No introduced species were recorded within the survey area.

### Assessment against Clearing Principles

The proposed clearing was not considered by Botanica Consulting (2007) to be at variance against the Clearing Principles assessed under Schedule 5 of the *Environmental Protection Amendment Act 2003*. It should be noted that Principle (b) was not assessed as part of this study.

## 3.3 Vegetation Survey of Avoca Resources Limited Tenements M15/351, M15/289, M15/225, M15/325 & P15/487 (JSWT, 2006a)

### 3.3.1 Background

Jims Seeds Weeds and Trees (JSWT) was commissioned by Avoca in August 2006 to undertake a flora survey of tenements M15/351, M15/289, M15/225, M15/325 & P15/487. The location of the survey area (approximately 364 ha) is shown in Figure 4, Appendix A. The primary objectives of the study were to:

- » Identify and collect the vascular plant taxa in the survey area;
- » Provide a description of the vegetation occurring within the survey area;
- » Assess vegetation condition according to Keighery (1994); and
- » Assess the proposed clearing against the "10 Clearing Principles" as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003*.

DEC and WAHERB government database searches were undertaken to identify any significant flora species potentially occurring within the study area prior to commencing the fieldwork assessment.

### 3.3.2 Field Survey Methods

Fieldwork was completed by JSWT in August 2006 and involved traversing the area on foot and by Kawasaki Mule and 4WD vehicle. Sample points were established within different vegetation associations as well as vegetation types associated with known Priority Flora. Each sample point location was recorded using a GPS unit and traversed within a minimum radius of 50 m.

### 3.3.3 Key Findings

#### Vegetation

Vegetation within the survey area was classified by JSWT (2006a) into two vegetation groups. A description of each is provided in Table 11. A map of vegetation groups prepared by JSWT (2006a) is at Figure 4, Appendix A. No vegetation communities recorded in the survey area were considered to have regional environmental significance as defined by the *EPBC Act*.

**Table 11 Vegetation Group Descriptions (source: JSWT, 2006a)**

Vegetation Group	Description
Transitional <i>Eucalyptus</i> Woodland	Dominant species represented by <i>Eucalyptus</i> species such as <i>E. salmonophloia</i> , <i>E. salubris</i> and <i>E. lesouefii</i> . The mid-storey comprised of <i>Senna artemisioides</i> subsp. <i>filifolia</i> , <i>Atriplex nummularia</i> , <i>Acacia colletioides</i> , <i>Eremophila alternifolia</i> , <i>E. ionantha</i> , <i>Melaleuca sheathiana</i> and <i>Exocarpos aphyllus</i> over an understorey of <i>Ptilotus obovatus</i> , <i>Olearia muelleri</i> and <i>Atriplex vesicaria</i> .
<i>Eucalyptus</i> over Rocky Breakaway	<i>Eucalyptus stricklandii</i> over <i>Cratystylis conocephala</i> , <i>Scaevola spinescens</i> , <i>Eremophila interstans</i> subsp. <i>interstans</i> and <i>Melaleuca sheathiana</i> over <i>Ptilotus helichysoides</i> , <i>Olearia muelleri</i> , <i>Tecticornia indica</i> and <i>Westringia rigida</i> .

#### Vegetation Condition

The condition of vegetation within the survey area was considered by JSWT to be 'very good' under the vegetation condition rating scale employed (Keighery, 1994). Disturbance was in the form of historic drill tracks and grazing.

#### Flora

A total of 65 taxa from 33 genera and 22 families were recorded from the survey area.

#### Significant Flora Species

No DRF or Priority Listed Flora species were recorded from the survey area.

#### Weeds

One introduced species: *Solanum hystrix* (Afghan Thistle) was recorded within the survey area. This species is not listed as a declared weed by the Department of Agriculture and Food (2006).



### **Assessment against Clearing Principles**

The proposed clearing was not considered by JSWT (2006a) to be at variance against the Clearing Principles assessed under Schedule 5 of the *Environmental Protection Amendment Act 2003*. It should be noted that Principle (b) was not assessed as part of this study.

### **3.4 Avoca Resources Limited Flora Survey June 2006 (JSWT, 2006b)**

JSWT was commissioned by Avoca in March 2006 to undertake a flora survey of a proposed pipeline route within tenements M15/31 and M15/375 prior to construction.

The primary objectives of the study were to:

- » Provide a description of vegetation communities present;
- » Generate an inventory of vascular plant taxa occurring within the survey area; and
- » Identify any significant flora species present.

DEC and WAHERB searches were undertaken to identify any significant flora species potentially occurring within the study area prior to commencing the fieldwork assessment.

#### **3.4.1 Field Survey Methods**

The flora survey was completed by JSWT in June 2006 and involved traversing the area on foot and by vehicle. Vegetation groups identified within the survey area were recorded with a GPS unit and described. Vegetation associations were examined for the presence of DRF and Priority Flora species.

#### **3.4.2 Key Findings**

##### **Vegetation**

Vegetation within the survey area was classified by JSWT (2006b) as a *Eucalyptus* Salmon Gum Woodland. No additional vegetation description or information is provided.

##### **Flora**

A total of 40 taxa from 26 genera and 14 families were recorded from the survey area.

##### **Significant Flora Species**

No DRF or Priority Listed Flora species were recorded from the survey area.

##### **Weeds**

Two introduced species: *Centaurea melitensis* (Maltese Cockspur) and *Carrichtera annua* (Ward's Weed) were recorded within the survey area. Neither species is listed as a declared weed by the Department of Agriculture and Food (2006).

### **3.5 Vertebrate Fauna Assessment Avoca Resources (JSWT, 2006c)**

#### **3.5.1 Background**

ATA Environmental was commissioned by JSWT on behalf of Avoca Resources in October 2006 to undertake a Level 1 vertebrate fauna assessment within the Higginsville project area prior to the commencement of proposed exploration activities. The location and extent of the study area (approximately 364 ha) corresponds to that surveyed by JSWT in August 2006 (refer Section 3.3 and Figure 4, Appendix A).

The objectives of the assessment were to:

- » Review the WAM on-line database (FaunaBase) to identify potential fauna in the area;
- » Search the the DEC's Threatened and Priority Species database to identify potential and scheduled threatened species in the region;
- » Search the DEWHA database to identify fauna species of national environmental significance potentially occurring in the area;
- » Review available literature to provide a list of fauna that have potential to occur within the region;
- » Discuss the potential impacts of the development on the fauna and fauna habitat; and
- » Present management recommendations to minimise potential impacts on fauna.

#### **3.5.2 Methodology**

The level 1 fauna survey included both a desktop assessment and site assessment.

##### **Desktop Assessment**

Information obtained from database searches and available literature was used to create lists of species expected to utilise the project area. Given the habitat present within the study area, predominately marine and freshwater species generated from database searches along with obvious exotics were excluded. Conversely, it was also noted by ATA Environmental that some species expected to occur within the study area were not listed in database searches. Surveys completed by ATA Environmental, Thompson *et al.*, Halpern Glick Maunsell (1998), Ninox Wildlife Consulting (2004), Newby *et al.* (1984), Handley (1991), Chapman *et al.* (1991) and McKenzie and Hall (1992) were used by ATA Environmental to supplement database search lists.

##### **Site Assessment**

The field assessment was conducted by ATA Environmental in August 2006 and involved examining habitat types available for amphibians, reptiles, mammals and birds. The site was traversed by vehicle and on foot. No trapping was conducted as part of the assessment and short-range endemics were not considered.

### **3.5.3 Key Findings**

#### **Fauna Habitat**

A single fauna habitat covers the entire study area. The habitat unit is described by ATA Environmental as an open Eucalypt woodland with a chenopod and *Acacia* shrubland understorey. A good ground cover of leaf litter and organic matter exists across the site. A small granite, greenstone and quartz rock breakaway is situated centrally within the study area. An existing open pit and waste dump occurs within the southern portion of the study area.

#### **Fauna Species**

ATA Environmental (in JSWT, 2006c) suggest, based on database searches, literature reviews and habitat preferences, that the survey may support 154 bird species, 39 mammal species and 49 species of reptiles. A complete list of species which could potentially be found in the general locality is provided in Table 14, Appendix C.

#### **Significant Fauna Species and Potential Impacts**

No conservation significant fauna species were recorded during the site assessment. The conservation status of species potentially found in the general locality is provided in Table 14, Appendix C.

It is possible that Malleefowl could be using some of the shrublands and woodlands in the area. As this species is listed as Vulnerable under the *EPBC Act* and as a Schedule 1 species under the *WC Act*, ATA Environmental recommended further investigation if suitable habitat is to be cleared. Clearing of suitable habitat is likely to locally impact on the Carpet Python and Greater Long-eared Bat; however, given similar habitat in adjacent areas, ATA Environmental consider that clearing is unlikely to significantly impact on these species at a regional level. Other conservation significant species potentially present within the study area are unlikely to be impacted by proposed clearing works.

A detailed description of significant fauna which may potentially utilise the study area together with an assessment of potential impacts from proposed exploration activities on respective species is provided in the JSWT Vertebrate Fauna Assessment report (JSWT, 2006c).

A list of conservation significant species generated from database searches which are considered by ATA Environmental to be unlikely to utilise the study area (together with justification) is also provided in the JSWT Vertebrate Fauna Assessment report (JSWT, 2006c).

#### **Introduced and Feral Animals**

A number of introduced and feral animals have been recorded in the region, with both cats and foxes regularly observed crossing nearby roads.

#### **Biodiversity Value**

There is no information to suggest that the faunal assemblage in the study area is likely to be unique, have particular conservation significance or contains fauna habitat

that is limited in the area and is therefore significant. Presuming Malleefowl are not detected at the site, ATA Environmental do not consider that the proposed clearing is likely to have any significant affect on species or ecosystems of conservation significance.

### **Recommendations**

Recommendations presented by JSWT (2006c) to reduce potential faunal impacts associated with the proposed clearing included the following:

- » Dense shrubland is identified through flora surveys and is grid searched for Malleefowl and their breeding mounds prior to any clearing activity;
- » Large hollow bearing trees are left wherever possible;
- » Habitat clearing is minimised wherever possible; and
- » Personnel involved in clearing be made aware of the potential presence of Carpet Pythons, so that individuals that are seen can be relocated to suitable habitat.

## 4. Broad Scale Vegetation Mapping

Vegetation of the Eastern Goldfields region was mapped by Beard at a scale of 1:1,000,000 as part of the Western Australian mapping project conducted from 1964-1981. Beard used a combination of both structure and floristics to delineate and describe vegetation associations within botanical districts. Vegetation associations recorded within the study area by Beard (1975) are listed in Table 2.

### 4.1 Site Assessment

A site assessment was carried out by a qualified GHD Ecologist on 15 December 2009 to verify broad scale vegetation associations present within the study area and assist in the delineation of vegetation boundaries. Aerial photography and available vegetation mapping (Beard, 1975; JSWT, 2006, 2007; Botanica Consulting 2007) was reviewed prior to conducting the site visit. Land system mapping of the area completed by the Department of Agriculture and Food in 1998 as part of a broader mapping project of the Kambalda area and surrounds was also reviewed at that time.

Given the considerable extent of the study area and limited access, fine scale mapping was not attempted. Rather, key areas representative of broader vegetation associations present were targeted and traversed by 4WD vehicle and on foot.

### 4.2 Vegetation




The broad scale vegetation map produced for the study area is shown in Figure 5, Appendix A and associated vegetation descriptions are provided in Table 12.



Despite the relatively large scale at which Beard mapped vegetation associations within the Eastern Goldfields (Beard, 1975), descriptions and boundaries provided for the study area were reasonably accurate. A number of refinements to vegetation boundaries were made following the site visit and vegetation associations have been described in greater detail. The following additional vegetation associations (to those mapped by Beard) have been included in the broad scale vegetation map (Figure 5):

- » Very open low shrubland of *Tecticornia* spp. and *Frankenia* spp. on saline plains; and
- » Cleared /degraded areas – few native species present (primarily disturbance response species).

The vegetation association description for the area mapped by Beard (1975) as a 'Medium woodland; redwood (*Eucalyptus transcontinentalis*) & merritt (*E. urna*)' has been changed to a 'Mixed woodland of *Eucalyptus urna*, *E. lesouefii*, *E. ravidia*, *E. salibrus*, *E. celastroides*, *E. oleosa* subsp. *oleosa* and *E. salmonophloia* over mixed *Eremophila* and *Atriplex* spp. interspersed with *Eucalyptus torquata* and *E. stricklandii* over *Alyxia buxifolia*, *Eremophila oldfieldii* subsp. *angustifolia* and *Dodonea lobulata* on hill slopes and crests' to more closely reflect on-site observations.

**Table 12 Vegetation Association Descriptions**

Code	Vegetation Association Description	Vegetation Association Photograph
LEW1	Low woodland of <i>Eucalyptus lesouefii</i> and <i>E. torquata</i> over <i>Eremophila psilocalyx</i> , <i>Eremophila glabra</i> , <i>Alyxia buxifolia</i> , <i>Trymalium mrytilus</i> and <i>Dodonea microzygia</i> over <i>Westringia rigidia</i> on ridges	
EW2	Woodland of <i>Eucalyptus salmonophloia</i> and <i>E. salubris</i> with scattered midstorey of <i>Melaleuca sheathiana</i> over <i>Eremophila scoparia</i> , <i>Cratystylis conocephala</i> and <i>Maireana sedifolia</i> on loamy plains	
EW3	Woodland of <i>Eucalyptus lesouefii</i> with scattered <i>E. griffithsij</i> , <i>E. celastroides</i> and <i>E. salmonophloia</i> over <i>Alyxia buxifolia</i> , <i>Eremophila scoparia</i> , <i>Eremophila glabra</i> , <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> and <i>Dodonea lobulata</i> over <i>Westringia rigidia</i>	

Code	Vegetation Association Description	Vegetation Association Photograph
EW4	Mixed woodland of <i>Eucalyptus urna</i> , <i>E. lesouefii</i> , <i>E. ravidia</i> , <i>E. salubris</i> , <i>E. celastroides</i> , <i>E. oleosa</i> subsp. <i>oleosa</i> and <i>E. salmonophloia</i> over mixed <i>Eremophila</i> and <i>Atriplex</i> spp. interspersed with <i>Eucalyptus torquata</i> and <i>E. stricklandii</i> over <i>Alyxia buxifolia</i> , <i>Eremophila oldfieldii</i> subsp. <i>angustifolia</i> and <i>Dodonea lobulata</i> on hill slopes and crests	
OLS	Very open low shrubland of <i>Tecticornia</i> spp. and <i>Frankenia</i> spp. on saline plains	
CD	Cleared /degraded areas – few native species present (primarily disturbance response species)	

## 5. Report Limitations

This report presents the results of an assessment prepared for the purpose of this commission. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent scientist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

Where reports, searches, any third party information and similar work has been performed and recorded by others, GHD has used this data in the form that it was provided. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

An understanding of site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experience based. Hence, this report should not be altered, amended or abbreviated, issued in part or incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances that arise from the issue of the report that has been modified in any way as outlined above.



## 6. References

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## Appendix A

# Figures

- Figure 1      Study Area and Environmental Constraints**
- Figure 2      Vegetation Map (GHD, 2008)**
- Figure 3      Vegetation Map (Botanica Consulting, 2007)**
- Figure 4      Vegetation Map (JSWT, 2006)**
- Figure 5      Broad Scale Vegetation Map**

Appendix B

## Flora

Combined Flora List from Previous Surveys (with information source)

**Table 13 Combined Flora Species List (with information source)**

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Aizoaceae	<i>Disphyma</i>	<i>crassifolium</i>	N	Family status assigned in JSWT (2006 b) report not current	Not threatened					+
Amaranthaceae	<i>Ptilotus</i>	<i>obovatus</i>	Y		Not threatened			+	+	+
Amaranthaceae	<i>Ptilotus</i>	<i>helichrysoides</i>	Y		Not threatened					+
Apocynaceae	<i>Alyxia</i>	<i>buxifolia</i>	Y		Not threatened		+	+		+
Asteraceae	<i>Angianthus</i>	<i>tomentosus</i>	Y		Not threatened				+	+
Asteraceae	<i>Centaurea</i>	<i>melitensis</i>	Y		Alien	*			+	
Asteraceae	<i>Cratystylis</i>	<i>conocephala</i>	Y		Not threatened		+	+	+	+
Asteraceae	<i>Olearia</i>	<i>muelleri</i>	Y		Not threatened		+	+	+	+
Asteraceae	<i>Senecio</i>	<i>pinnatifolius</i>	Y		Not threatened				+	
Boraginaceae	<i>Halgania</i>	<i>andromedifolia</i>	Y		Not threatened		+			+
Brassicaceae	<i>Carrichtera</i>	<i>annua</i>	Y		Alien	*	+		+	
Caesalpiniaceae	<i>Senna</i>	<i>artemisioides subsp filifolia</i>	Y		Not threatened		+	+	+	
Chenopodiaceae	<i>Atriplex</i>	<i>codonocarpa</i>	Y		Not threatened		+			
Chenopodiaceae	<i>Atriplex</i>	<i>holocarpa</i>	Y		Not threatened		+			
Chenopodiaceae	<i>Atriplex</i>	<i>lindleyi</i>	Y		Not threatened			+		

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Chenopodiaceae	<i>Atriplex</i>	<i>nummularia</i>	Y		Not threatened		+	+	+	+
Chenopodiaceae	<i>Atriplex</i>	<i>stipitata</i>	Y		Not threatened		+	+		+
Chenopodiaceae	<i>Atriplex</i>	<i>vesicaria</i>	Y		Not threatened		+	+	+	+
Chenopodiaceae	<i>Chenopodium</i>	<i>curvispicatum</i>	Y		Not threatened		+			
Chenopodiaceae	<i>Chenopodium</i>	<i>sp</i>	Y				+			
Chenopodiaceae	<i>Disphania</i>	<i>kalpari</i>	Y		Not threatened					+
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i>	Y		Not threatened			+	+	
Chenopodiaceae	<i>Eremophila</i>	<i>sedifolia</i>	N	Incorrect name - possibly misapplied to <i>Maireana sedifolia</i>	Not threatened					+
Chenopodiaceae	<i>Habsarcia</i>	<i>sp (synonym of Tecticornia)</i>	N	<i>Tecticornia sp.</i>			+			
Chenopodiaceae	<i>Habsarcia</i>	<i>indica (synonym of Tecticornia indica)</i>	N	<i>Tecticornia indica</i>	Not threatened					+
Chenopodiaceae	<i>Maireana</i>	<i>brevifolia</i>	Y		Not threatened		+		+	+
Chenopodiaceae	<i>Maireana</i>	<i>carnosa</i>	Y		Not threatened					+
Chenopodiaceae	<i>Maireana</i>	<i>georgei</i>	Y		Not threatened			+	+	+
Chenopodiaceae	<i>Maireana</i>	<i>pyramidata</i>	Y		Not threatened		+			+
Chenopodiaceae	<i>Maireana</i>	<i>sedifolia</i>	Y		Not threatened		+	+	+	
Chenopodiaceae	<i>Maireana</i>	<i>sp (not flowering)</i>	Y				+			
Chenopodiaceae	<i>Maireana</i>	<i>tomentosa</i>	Y		Not threatened			+	+	+

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Chenopodiaceae	<i>Maireana</i>	<i>triptera</i>	Y		Not threatened			+		+
Chenopodiaceae	<i>Rhagodia</i>	<i>drummondii</i>	Y		Not threatened			+		
Chenopodiaceae	<i>Rhagodia</i>	<i>eremaea</i>	Y		Not threatened				+	
Chenopodiaceae	<i>Sclerolaena</i>	<i>bicornis</i>	Y		Not threatened			+		
Chenopodiaceae	<i>Sclerolaena</i>	<i>diacantha</i>	Y		Not threatened		+		+	+
Chenopodiaceae	<i>Sclerolaena</i>	<i>eriacantha</i>	Y		Not threatened					+
Chenopodiaceae	<i>Sclerolaena</i>	<i>eurotioides</i>	Y		Not threatened			+		+
Chenopodiaceae	<i>Sclerostegia</i>	<i>disarticulata</i> (synonym of <i>Tecticornia disarticulata</i> )	N	<i>Tecticornia disarticulata</i>	Not threatened				+	
Franeniaceae	<i>Frankenia</i>	<i>interioris</i>	Y		Not threatened		+			+
Franeniaceae	<i>Frankenia</i>	<i>setosa</i>	Y		Not threatened				+	
Goodeniaceae	<i>Scaevola</i>	<i>spinescens</i>	Y		Not threatened		+	+	+	+
Laminaceae	<i>Prostanthera</i>	<i>grylloana</i>	Y		Not threatened		+			
Laminaceae	<i>Prostanthera</i>	<i>sp. (not flowering)</i>	Y				+			
Laminaceae	<i>Westringia</i>	<i>rigida</i>	Y		Not threatened		+			+
Malvaceae	<i>Lawrenzia</i>	<i>densiflora</i>	Y		Not threatened				+	
Malvaceae	<i>Sida</i>	<i>calyxhymenia</i>	Y		Not threatened					+
Mimosaceae	<i>Acacia</i>	<i>acuminata</i>	Y		Not threatened		+	+		
Mimosaceae	<i>Acacia</i>	<i>camptoclada</i>	Y		Not threatened			+		
Mimosaceae	<i>Acacia</i>	<i>collettioides</i>	Y		Not threatened			+		+

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Mimosaceae	<i>Acacia</i>	<i>erinacea</i>	Y		Not threatened		+	+		
Mimosaceae	<i>Acacia</i>	<i>jennerae</i>	Y		Not threatened		+	+		
Mimosaceae	<i>Acacia</i>	<i>nyssophylla</i>	Y		Not threatened			+		
Mimosaceae	<i>Acacia</i>	<i>poliochroa</i>	Y		Not threatened			+		
Mimosaceae	<i>Acacia</i>	<i>tetragonophylla</i>	Y		Not threatened		+			
Mimosaceae	<i>Acacia</i>	<i>victoriae</i>	Y		Not threatened					+
Myoporaceae	<i>Diocirea</i>	<i>acutifolia</i>	Y		P3			+	+	
Myoporaceae	<i>Eremophila</i>	<i>sp.</i>	Y						+	
Myoporaceae	<i>Eremophila</i>	<i>sp. (sterile)</i>	Y							+
Myoporaceae	<i>Eremophila</i>	<i>alternifolia</i>	Y		Not threatened		+	+		+
Myoporaceae	<i>Eremophila</i>	<i>caerulea subsp caerulea</i>	Y		Not threatened		+	+	+	+
Myoporaceae	<i>Eremophila</i>	<i>decipiens</i>	Y		Not threatened				+	
Myoporaceae	<i>Eremophila</i>	<i>decipiens subsp decipiens</i>	Y		Not threatened		+	+		+
Myoporaceae	<i>Eremophila</i>	<i>dempsteri</i>	Y		Not threatened		+			
Myoporaceae	<i>Eremophila</i>	<i>drummondii</i>	Y		Not threatened			+		
Myoporaceae	<i>Eremophila</i>	<i>glabra</i>	Y		Not threatened		+		+	
Myoporaceae	<i>Eremophila</i>	<i>glabra subsp glabra</i>	Y		Not threatened			+		+
Myoporaceae	<i>Eremophila</i>	<i>interstans subsp. virgata</i>	Y		Not threatened		+	+	+	+
Myoporaceae	<i>Eremophila</i>	<i>ionantha</i>	Y		Not threatened		+	+		+



Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Myoporaceae	<i>Eremophila</i>	<i>latrobei</i>	Y		Not threatened					+
Myoporaceae	<i>Eremophila</i>	<i>longifolia</i>	Y		Not threatened		+			
Myoporaceae	<i>Eremophila</i>	<i>maculata</i>	Y		Not threatened			+		
Myoporaceae	<i>Eremophila</i>	<i>oldfieldii</i> ssp <i>angustifolia</i>	Y		Not threatened			+		
Myoporaceae	<i>Eremophila</i>	<i>oppositifolia</i> subsp <i>angustifolia</i>	Y		Not threatened			+		
Myoporaceae	<i>Eremophila</i>	<i>parvifolia</i> subsp. <i>auricampa</i>	Y		Currently not threatened (Previously listed as P1 )		+			
Myoporaceae	<i>Eremophila</i>	<i>psilocalyx</i>	Y		Not threatened					+
Myoporaceae	<i>Eremophila</i>	<i>saligna</i>	Y		Not threatened			+		
Myoporaceae	<i>Eremophila</i>	<i>scoparia</i>	Y		Not threatened		+	+	+	+
Myrtaceae	<i>Eucalyptus</i>	<i>sp. (juvenile)</i>	Y				+			
Myrtaceae	<i>Eucalyptus</i>	<i>calycogona</i>	Y		Not threatened					+
Myrtaceae	<i>Eucalyptus</i>	<i>celastroides</i>	Y		Not threatened		+			+
Myrtaceae	<i>Eucalyptus</i>	<i>celastroides</i> subsp <i>celastroides</i>	Y		Not threatened			+		
Myrtaceae	<i>Eucalyptus</i>	<i>flocktoniae</i>	Y		Not threatened		+			
Myrtaceae	<i>Eucalyptus</i>	<i>griffithsii</i>	Y		Not threatened			+		
Myrtaceae	<i>Eucalyptus</i>	<i>lesouefii</i>	Y		Not threatened		+	+	+	+
Myrtaceae	<i>Eucalyptus</i>	<i>oleosa</i> subsp. <i>Oleosa</i>	Y		Not threatened		+			

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Myrtaceae	<i>Eucalyptus</i>	<i>platycorys</i>	Y		Not threatened		+			
Myrtaceae	<i>Eucalyptus</i>	<i>ravida</i>	Y		Not threatened		+	+	+	+
Myrtaceae	<i>Eucalyptus</i>	<i>salmonophloia</i>	Y		Not threatened		+	+	+	+
Myrtaceae	<i>Eucalyptus</i>	<i>salubris</i>	Y		Not threatened		+		+	+
Myrtaceae	<i>Melaleuca</i>	<i>sp. (juvenile)</i>	Y		Not threatened		+			
Myrtaceae	<i>Eucalyptus</i>	<i>stricklandii</i>	Y		Not threatened					+
Myrtaceae	<i>Eucalyptus</i>	<i>torquata</i>	Y		Not threatened			+		+
Myrtaceae	<i>Eucalyptus</i>	<i>transcontinentalis</i>	Y		Not threatened		+			+
Myrtaceae	<i>Eucalyptus</i>	<i>urna</i>	Y		Not threatened			+	+	
Myrtaceae	<i>Melaleuca</i>	<i>sheathiana</i>	Y		Not threatened		+	+	+	+
Papilionaceae	<i>Swainsona</i>	<i>canescens</i>	Y		Not threatened					+
Pittosporaceae	<i>Marianthus</i>	<i>sp.</i>	Y				+			
Pittosporaceae	<i>Pittosporum</i>	<i>angustifolia</i>	N	<i>Pittosporum angustifolium</i>	Not threatened					+
Poaceae	<i>Aristida</i>	<i>contorta</i>	Y		Not threatened					+
Poaceae	<i>Austrostipa</i>	<i>sp. (not flowering)</i>	Y		Not threatened		+			
Poaceae	<i>Austrostipa</i>	<i>elegantissima</i>	Y		Not threatened			+	+	
Poaceae	<i>Austrostipa</i>	<i>nitida</i>	Y		Not threatened		+			
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>	Y		Not threatened					+
Proteaceae	<i>Grevillea</i>	<i>acuarua</i>	Y		Not threatened			+		
Rhamnaceae	<i>Stenanthemum</i>	<i>sp. (not flowering)</i>	Y		Not threatened		+			

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Rhamnaceae	<i>Stenanthemum</i>	<i>petraeum</i>	Y		Not threatened			+		
Rhamnaceae	<i>Stenanthemum</i>	<i>stipulosum</i>	Y		Not threatened					+
Santalaceae	<i>Exocarpus</i>	<i>aphyllus</i>	Y		Not threatened		+	+	+	+
Santalaceae	<i>Santalum</i>	<i>acuminatum</i>	Y		Not threatened		+	+	+	+
Santalaceae	<i>Santalum</i>	<i>lanceolatum</i>	Y		Not threatened		+			+
Santalaceae	<i>Santalum</i>	<i>spicatum</i>	Y		Not threatened		+	+		+
Sapindaceae	<i>Dodonaea</i>	<i>attenuata</i> (synonym of <i>Dodonaea viscosa</i> )	N	<i>Dodonaea viscosa</i>	Not threatened			+		
Sapindaceae	<i>Dodonaea</i>	<i>lobulata</i>	Y		Not threatened		+			+
Sapindaceae	<i>Dodonaea</i>	<i>microzyga</i>	Y		Not threatened		+	+		
Solanaceae	<i>Lycium</i>	<i>australe</i>	N	Family status assigned in Botanica (2007) report not current	Not threatened			+		
Solanaceae	<i>Solanum</i>	<i>hoplopetalum</i>	Y		Not threatened		+		+	
Solanaceae	<i>Solanum</i>	<i>hystrix</i>	Y		Alien	*				
Solanaceae	<i>Solanum</i>	<i>nummularium</i>	Y		Not threatened		+			
Solanaceae	<i>Solanum</i>	<i>orbiculatum</i>	Y		Not threatened			+	+	+
Solanaceae	<i>Solanum</i>	<i>plicatile</i>	Y		Not threatened			+		
Thymelaeaceae	<i>Pimelea</i>	<i>microcephala</i>	N	Family status assigned in Botanica (2007) report not current	Not threatened			+		

Family	Genus	Species Names as Notated in Previous Surveys	Nomenclature - Current Status	Current Name	Conservation Status	Weed Status	GHD (2008)	Botanica (2007)	JSWT (2006a) (June 2006)	JSWT (2006b) (August 2006)
Zygophyllaceae	<i>Zygophyllum</i>	<i>apiculatum</i>	Y		Not threatened				+	
Zygophyllaceae	<i>Zygophyllum</i>	<i>aurantiacum</i>	Y		Not threatened		+			
Zygophyllaceae	<i>Zygophyllum</i>	<i>eremaeum</i>	Y		Not threatened					+

Appendix C

## Fauna

EPBC Act Fauna Conservation Categories

Combined fauna List (with information sources)

## **EPBC Act Fauna Conservation Categories**

### ***Listed threatened species and ecological communities***

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct in the wild,
- critically endangered,
- endangered, or
- vulnerable.

An action will also require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on an ecological community listed in any of the following categories:

- critically endangered, or
- endangered.

### ***Critically endangered and endangered species***

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat+, or
- introduce disease that may cause the species to decline, or
- interfere with the recovery of the species.

*\*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

### ***Vulnerable species***

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- Lead to a long-term decrease in the size of an important population of a species, or
- reduce the area of occupancy of an important population, or
- fragment an existing important population into two or more populations, or

- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of an important population, or
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat\*, or
- introduce disease that may cause the species to decline, or
- interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

\*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.

### ***Listed migratory species***

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened.

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or
- result in invasive species that is harmful to the migratory species becoming established\* in an area of important habitat of the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
- habitat utilised by a migratory species which is at the limit of the species range, or
- habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

\*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.

### ***The Commonwealth marine environment***

An action will require approval from the Environment Minister if:

- the action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment, or
- the action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment in a Commonwealth marine area.

An action has, will have or is likely to have a significant impact on the environment in a Commonwealth marine area if it does, will, or is likely to:

- result in a known or potential pest species becoming established in the Commonwealth marine area\*, or
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results, or
- have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (eg breeding, feeding, migration behaviour, and life expectancy) and spatial distribution, or
- result in a substantial change in air quality\*\* or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.

*\*Translocating or introducing a pest species may result in that species becoming established.*

*\*\*The Commonwealth marine area includes any airspace over Commonwealth waters.*

(Department of Environment and Heritage, 2006)



**Table 14 Combined Fauna Species List (with information source)**

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	Conservation Status	
							EPBC	DEC / WC Act
<b>Birds</b>							+	
Acanthizidae	<i>Acanthiza</i>	<i>apicalis</i>	Inland Thornbill	+	+			
Acanthizidae	<i>Acanthiza</i>	<i>chrysorrhoa</i>	Yellow-rumped Thornbill		+			
Acanthizidae	<i>Acanthiza</i>	<i>iredalei</i> subsp. <i>iredalei</i>	Slender-billed Thornbill (western)		+		V	
Acanthizidae	<i>Acanthiza</i>	<i>robustirostris</i>	Slaty-backed Thornbill		+			
Acanthizidae	<i>Acanthiza</i>	<i>sp.</i>	Thornbill species			+		
Acanthizidae	<i>Acanthiza</i>	<i>uropygialis</i>	Chestnut-rumped Thornbill		+			
Acanthizidae	<i>Aphelocephala</i>	<i>leucopsis</i>	Southern Whiteface		+			
Acanthizidae	<i>Calamanthus</i>	<i>fuliginosus</i>	Striated Fieldwren		+			
Acanthizidae	<i>Gerygone</i>	<i>fusca</i>	Westery Gerygone		+			
Acanthizidae	<i>Hylacola</i>	<i>cauta</i> subsp. <i>whitlocki</i>	Shy Heathwren (western ssp)	+	+			P4

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Acanthizidae	<i>Pyrrholaemus</i>	<i>brunneus</i>	Redthroat		+			
Acanthizidae	<i>Smicronis</i>	<i>brevirostris</i>	Weebill	+		+		
Accipitridae	<i>Accipiter</i>	<i>cirrhocephalus</i>	Collared Sparrowhawk		+		Mi	
Accipitridae	<i>Accipiter</i>	<i>fasciatus</i>	Brown Goshawk		+		Mi, Ma	
Accipitridae	<i>Aquila</i>	<i>audax</i>	Wedge-tailed Eagle		+		Mi,	
Accipitridae	<i>Aquila</i>	<i>morphnoides</i> subsp. <i>morphnoides</i>	Little Eagle	+	+		Mi	
Accipitridae	<i>Circus</i>	<i>approximans</i>	Swamp Harrier		+		Mi, Ma	
Accipitridae	<i>Circus</i>	<i>assimilis</i>	Spotted Harrier		+		Mi	
Accipitridae	<i>Elanus</i>	<i>caeruleus</i>	Black-shouldered Kite		+		Mi	
Accipitridae	<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-Eagle		+		MI, Ma	
Accipitridae	<i>Haliastur</i>	<i>sphenurus</i>	Whistling Kite		+		Mi, Ma	
Accipitridae	<i>Hamirostra</i>	<i>isura</i>	Square-tailed Kite		+		Mi	
Aegothelidae	<i>Aegotheles</i>	<i>cristatus</i>	Australian Owlet-nightjar		+			
Anatidae	<i>Anas</i>	<i>gracilis</i>	Grey Teal		+		Mi	
Anatidae	<i>Anas</i>	<i>rhynchosotis</i>	Australasian Shoveler		+		Mi	
Anatidae	<i>Anas</i>	<i>supercilliosa</i>	Pacific Blue Duck		+		Mi	

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Anatidae	<i>Chenonetta</i>	<i>jubata</i>	Maned Duck		+			
Anatidae	<i>Cygnus</i>	<i>atratus</i>	Black Swan		+		Mi	
Anatidae	<i>Malacorhynchus</i>	<i>menbranaceus</i>	Pink-eared Duck		+		Mi	
Anatidae	<i>Tadorna</i>	<i>tadornoides</i>	Australian Shelduck		+		Mi	
Anhingidae	<i>Anhinga</i>	<i>melanogaster</i> subsp. <i>novaeollandiae</i>			+			
Apodidae	<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift		+		Mi, Ma	
Ardeidae	<i>Ardea</i>	<i>alba</i>	Great Egret, White Egret		+		Mi, Ma	
Ardeidae	<i>Ardea</i>	<i>ibis</i>	Cattle Egret		+		Mi, Ma	
Ardeidae	<i>Ardea</i>	<i>novaeollandiae</i>	White-faced Heron		+			
Ardeidae	<i>Ardea</i>	<i>pacifica</i>	White-necked Heron		+			
Ardeidae	<i>Ixobrychus</i>	<i>sinensis</i>	Yellow bittern		+		Mi, Ma	
Ardeidae	<i>Nycticorax</i>	<i>nycticorax</i>	Black-crowned Night Heron		+		Ma	
Artamidae	<i>Artamus</i>	<i>cinereus</i>	Black-faced Woodswallow		+			
Artamidae	<i>Artamus</i>	<i>cyanopterus</i>	Dusky Woodswallow		+			
Artamidae	<i>Artamus</i>	<i>personatus</i>	Masked Woodswallow		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Burhinidae	<i>Burhinus</i>	<i>grallarius</i>	Bush Stone-curlew		+			
Campephagidae	<i>Coracina</i>	<i>maxima</i>	Ground Cuckoo-shrike		+			
Campephagidae	<i>Coracina</i>	<i>novaehollandiae</i>	Black-faced Cuckoo-shrike		+		Ma	
Campephagidae	<i>Lalage</i>	<i>tricolor</i>	White-winged Triller		+			
Caprimulgidae	<i>Eurostopodus</i>	<i>argus</i>	Spotted Nightjar		+		Ma	
Casuariidae	<i>Dromaius</i>	<i>novaehollandiae</i>	Emu			+		
Charadriidae	<i>Charadrius</i>	<i>rubricollis</i>	Hooded Plover		+		Mi	
Charadriidae	<i>Charadrius</i>	<i>ruficapillus</i>	Red-capped Plover		+		Mi, Ma	
Charadriidae	<i>Vanellus</i>	<i>tricolor</i>	Banded Lapwing		+		Mi	
Cinclosomatidae	<i>Cinclosoma</i>	<i>castanotus</i>	Chestnut Quail-thrush	+	+			
Climacteridae	<i>Climacteris</i>	<i>affinis superciliosa</i>	White-browed Treecreeper		+			
Climacteridae	<i>climacteris</i>	<i>rufa</i>	Rufous treecreeper		+			
Columbidae	<i>Ocyphaps</i>	<i>lophotes</i>	Crested Pigeon		+			
Columbidae	<i>Phaps</i>	<i>chalcoptera</i>	Common Bronzewing		+			
Corvidae	<i>Corvus</i>	<i>bennetti</i>	Little Crow		+			
Corvidae	<i>Corvus</i>	<i>coronoides</i>	Australian Raven		+	+		
Corvidae	<i>Corvus</i>	<i>orru</i>	Torresian Crow		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Cracticidae	<i>Cracticus</i>	<i>nigrogularis</i>	Pied Butcherbird		+			
Cracticidae	<i>Cracticus</i>	<i>tibicen</i>	Australian Magpie		+			
Cracticidae	<i>Cracticus</i>	<i>torquatus</i>	Grey Butcherbird		+			
Cracticidae	<i>Strepera</i>	<i>versicolor</i>	Grey Currawong		+	+		
Cuculidae	<i>Chrysococcyx</i>	<i>basalis</i>	Horsfield's Bronze Cuckoo		+		Ma	
Cuculidae	<i>Chrysococcyx</i>	<i>osculans</i>	Black-eared Cuckoo		+		Ma	
Cuculidae	<i>Cuculus</i>	<i>pallidus</i>	Pallid Cuckoo		+		Ma	
Dicaeidae	<i>Dicaeum</i>	<i>hirundinaceum</i>	Mistletoe Bird	+	+			
Dicruridae	<i>Grallina</i>	<i>cyanoleuca</i>	Magpie-lark		+		Ma	
Dicruridae	<i>Myiagra</i>	<i>inquieta</i>	Restless Flycatcher		+			
Dicruridae	<i>Rhipidura</i>	<i>fuliginosa</i>	Grey Fantail		+			
Dicruridae	<i>Rhipidura</i>	<i>leucophrys</i>	Willie Wagtail		+			
Falconidae	<i>Falco</i>	<i>berigora</i>	Brown Falcon		+			
Falconidae	<i>Falco</i>	<i>cenchroides</i>	Australian Kestrel		+			
Falconidae	<i>Falco</i>	<i>hypoleucos</i>	Grey Falcon		+			
Falconidae	<i>Falco</i>	<i>longipennis</i>	Australian Hobby		+			
Falconidae	<i>Falco</i>	<i>peregrinus</i> subsp. <i>macropus</i>	Peregrine Falcon	+	+			S4

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Falconidae	<i>Falco</i>	<i>subniger</i>	Black Falcon		+			
Halcyonidae	<i>Dacelo</i>	<i>novaeguineae</i>	Laughing Kookaburra		+			
Halcyonidae	<i>Todiramphus</i>	<i>pyrrhopygia</i>	Red-backed Kingfisher	+	+			
Halcyonidae	<i>Todiramphus</i>	<i>sanctus</i>	Sacred Kingfisher		+			
Hirundinidae	<i>Cheramoeca</i>	<i>leucosterna</i>	White-backed Swallow		+			
Hirundinidae	<i>Hirundo</i>	<i>ariel</i>	Fairy Martin	+	+			
Hirundinidae	<i>Hirundo</i>	<i>neoxena</i>	Welcome Swallow		+			
Hirundinidae	<i>Hirundo</i>	<i>nigricans</i>	Tree Martin		+			
Laridae	<i>Sterna</i>	<i>hybrida</i>	Whiskered Tern		+			
Laridae	<i>Sterna</i>	<i>nilotica</i>	Gull-billed Tern		+			
Maluridae	<i>Amytornis</i>	<i>textilis</i>	Thick-billed Grasswren		+			
Maluridae	<i>Malurus</i>	<i>lamberti</i>	Variiegated Fairy-wren		+			
Maluridae	<i>Malurus</i>	<i>leucopterus</i>	White-winged Fairy-wren		+			
Maluridae	<i>Malurus</i>	<i>pulcherrimus</i>	Blue-breasted Fairy-wren	+	+			
Maluridae	<i>Malurus</i>	<i>splendens</i>	Splendid Fairy-wren		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Megapodiidae	<i>Leipoa</i>	<i>ocellata</i>	Mallefowl	+	+		V	S1
Meliphagidae	<i>Acanthagenys</i>	<i>rufogularis</i>	Spiny-cheeked Honeyeater		+			
Meliphagidae	<i>Anthochaera</i>	<i>carunculata</i>	Red Wattlebird		+			
Meliphagidae	<i>Certhionyx</i>	<i>niger</i>	Black Honeyeater		+			
Meliphagidae	<i>Certhionyx</i>	<i>variegates</i>	Pied Honeyeater		+			
Meliphagidae	<i>Epthianura</i>	<i>albifrons</i>	White-fronted Chat		+			
Meliphagidae	<i>Epthianura</i>	<i>aurifrons</i>	Orange Chat		+			
Meliphagidae	<i>Epthianura</i>	<i>tricolor</i>	Crimson Chat		+			
Meliphagidae	<i>Lichenostomus</i>	<i>cratitius</i>	Purple-gaped Honeyeater		+			
Meliphagidae	<i>Lichenstomus</i>	<i>leucotis</i>	White-eared Honeyeater		+			
Meliphagidae	<i>Lichenstomus</i>	<i>ornatus</i>	Yellow-plumed Honeyeater		+			
Meliphagidae	<i>Lichenstomus</i>	<i>plummulus</i>	Grey-fronted Honeyeater		+			
Meliphagidae	<i>Lichenstomus</i>	<i>virescens</i>	Singing Honeyeater		+			
Meliphagidae	<i>Lichmera</i>	<i>indistincta</i>	Brown Honeyeater		+			
Meliphagidae	<i>Manorina</i>	<i>flavigula</i>	Yellow-throated Miner		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Meliphagidae	<i>Melithreptus</i>	<i>brevirostris</i>	Brown-headed Honeyeater		+			
Meliphagidae	<i>Phylidonyris</i>	<i>albifrons</i>	White-fronted Honeyeater		+			
Meliphagidae	<i>Phylidonyris</i>	<i>nigra</i>	White-cheeked Honeyeater		+			
Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater		+		Mi, Ma	
Motacillidae	<i>Anthus</i>	<i>australis</i>	Australian Pipit		+			
Neosittidae	<i>Daphoenositta</i>	<i>chrysoptera</i>	Varied Sittella		+			
Otididae	<i>Ardeotis</i>	<i>australis</i>	Australian Bustard		+			
Pachycephalidae	<i>Colluricincla</i>	<i>harmonica</i>	Grey Shrike-thrush		+			
Pachycephalidae	<i>Falcunulus</i>	<i>frontatus</i>	Crested Shrike-tit		+			
Pachycephalidae	<i>Oreica</i>	<i>gutturalis</i> subsp. <i>gutturalis</i>	Crested Bellbird (southern)	+	+			P4
Pachycephalidae	<i>Pachycephala</i>	<i>inornata</i>	Gilbert's Whistler	+	+			
Pachycephalidae	<i>Pachycephala</i>	<i>pectoralis</i> subsp. <i>fuliginosa</i>		+				
Pachycephalidae	<i>Pachycephala</i>	<i>rufiventris</i>	Rufous Whistler		+			
Pardalotidae	<i>Pardalotus</i>	<i>punctatus</i> subsp. <i>punctatus</i>		+				
Pardalotidae	<i>Pardalotus</i>	<i>striatus</i>	Striated Pardalote		+			



Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Passeridae	<i>Taeniopygia</i>	<i>guttata</i>	Zebra Finch		+			
Petroicidae	<i>Drymodes</i>	<i>brunneopygius</i>	Southern Scrub-robin		+			
Petroicidae	<i>Eopsaltria</i>	<i>Australia</i> subsp. <i>grisegularis</i>	Western Yellow Robin	+	+			
Petroicidae	<i>Microeca</i>	<i>fascinans</i>	Jacky Winter		+			
Petroicidae	<i>Microeca</i>	<i>flavigaster</i>	Lemon-breasted Flycatcher		+			
Petroicidae	<i>Petroica</i>	<i>cucullata</i>	Hooded Robin		+			
Petroicidae	<i>Petroica</i>	<i>goodenovii</i>	Red-capped Robin		+			
Petroicidae	<i>Poecilodryas</i>	<i>superciliosa</i>	White-browed Robin		+			
Phalacrocoracidae	<i>Phalacrocorax</i>	<i>melanleucos</i>	Little Pied Cormorant		+			
Phalacrocoracidae	<i>Phalacrocorax</i>	<i>sulcirostris</i>	Little Black Cormorant		+			
Podargidae	<i>Podargus</i>	<i>strigoides</i>	Tawny Frogmouth		+			
Podicipedidae	<i>Poliocephalus</i>	<i>poliocephalus</i>	Hoary-headed Grebe		+			
Pomatostomidae	<i>Pomatostomus</i>	<i>superciliosus</i>	White-browed Babbler		+			
Psittacidae	<i>Barnardius</i>	<i>zonarius semitorquatus</i>	Australian Ringneck		+			
Psittacidae	<i>Cacatua</i>	<i>leadbeateri</i>	Major Mitchell's Cockatoo		+			S4

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Psittacidae	<i>Cacatua</i>	<i>roseicapilla</i>	Galah		+			
Psittacidae	<i>Glossopsitta</i>	<i>porphyrocephala</i>	Purple-crowned Lorikeet		+			
Psittacidae	<i>Melopsittacus</i>	<i>undulatus</i>	Budgerigar		+			
Psittacidae	<i>Neophema</i>	<i>splendida</i>	Scarlet-chested Parrot	+	+			
Psittacidae	<i>Nymphicus</i>	<i>hollandicus</i>	Cockatiel		+			
Psittacidae	<i>Platycercus</i>	<i>icterotis xanthogenys</i>	Western Rosella		+			
Psittacidae	<i>Platycercus</i>	<i>varius</i>	Mulga Parrot		+			
Psittacidae	<i>Polytelis</i>	<i>alexandrae</i>	Princess Parrot		+		V	P4
Psittacidae	<i>Polytelis</i>	<i>anthopeplus</i>	Regent Parrot		+			
Psittacidae	<i>Psephotus</i>	<i>varius</i>	Mulga Parrot			+		
Rallidae	<i>Fulica</i>	<i>atra</i>	Eurasian Coot		+			
Rallidae	<i>Gallinula</i>	<i>ventralis</i>	Black-tailed Native Hen		+			
Rallidae	<i>Rallina</i>	<i>fasciata</i>	Red-legged Crake		+			
Recurvirostridae	<i>Cladorhynchus</i>	<i>leucocephalus</i>	Banded Stilt		+		Mi	
Recurvirostridae	<i>Himantopus</i>	<i>himantopus</i>	Black-winged Stilt		+		Mi, Ma	
Recurvirostridae	<i>Recurvirostra</i>	<i>novaehollandiae</i>	Red-necked Avocet		+		Mi, Ma	

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Scolopacidae	<i>Limosa</i>	<i>limosa</i>	Bar-tailed Godwit		+		Mi, Ma	
Scolopacidae	<i>Tringa</i>	<i>nebularia</i>	Common Greenshank		+		Mi, Ma	
Strigidae	<i>Ninox</i>	<i>novaeseelandiae</i>	Boobook Owl		+		Ma	P4
Sylviidae	<i>Cincloramphus</i>	<i>mathewsi</i>	Rufous Songlark		+			
Syviidae	<i>Cincloramphus</i>	<i>cruralis</i>	Brown Songlark		+			
Threskiornithidae	<i>Platalea</i>	<i>flavipes</i>	Yellow-billed Spoonbill		+			
Tytonidae	<i>Tyto</i>	<i>alba</i>	Barn Owl		+			P4
Zosteropidae	<i>Zosterops</i>	<i>lateralis</i>	Silvereye		+		Ma	
<b>Mammals</b>								
Macropodidae	<i>Macropus</i>	<i>sp.</i>	Kangaroo			+		
Canidae	<i>*Vulpes</i>	<i>Vulpes</i>	Red Fox			+		
Dasyuridae	<i>Phascogale</i>	<i>tapoatafa</i> subsp. (WAM M434)	Brush-tailed Phacogale, Wambenger	+	+			S 1
Vespertilionidae	<i>Nyctophilus</i>	<i>timoriensis</i>	Greater Long-eared Bat		+			P4
Tachyglossidae	<i>Tachyglossus</i>	<i>aculeatus</i>	Echidna	+	+			
Dasyuridae	<i>Antechinomys</i>	<i>laniger</i>	Kultarr		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Dasyuridae	<i>dasyurus</i>	<i>geoffroii</i>	Chuditch		+		V	S1
Dasyuridae	<i>Dasyuridae</i>	<i>ridei</i>	Wongai Ningai		+			
Dasyuridae	<i>Dasyuridae</i>	<i>sp.</i>			+			
Dasyuridae	<i>Ningai</i>	<i>yvonneae</i>	Southern Ningai	+	+			
Dasyuridae	<i>Pseudantechinus</i>	<i>woolleyae</i>	Woolley's Pseudantechinus		+			
Dasyuridae	<i>Sminthopsis</i>	<i>crassicaudata</i>	Fat-tailed Dunnart		+			
Dasyuridae	<i>Sminthopsis</i>	<i>dolichura</i>	Little Long-tailed Dunnart	+	+			
Dasyuridae	<i>Sminthopsis</i>	<i>gilberti</i>	Gilbert's Dunnart		+			
Dasyuridae	<i>Sminthopsis</i>	<i>hirtipes</i>	Hairy-footed Dunnart	+				
Dasyuridae	<i>Sminthopsis</i>	<i>ooldea</i>	Ooldea Dunnart		+			
Myrmecobiidae	<i>Myrmecobius</i>	<i>faciatus</i>	Numbat, Walpurti		+		V	S1
Macropodidae	<i>Macropus</i>	<i>fuliginosus</i>	Western Grey Kangaroo	+	+			
Macropodidae	<i>Macropus</i>	<i>robustus</i>	Common Wallaroo, Euro		+			
Macropodidae	<i>Macropus</i>	<i>rufus</i>	Red Kangaroo		+			
Burramyidae	<i>Cercatetus</i>	<i>concinmus</i>	Western Pygmy-possum	+	+			
Vespertilionidae	<i>Chalinolobus</i>	<i>gouldii</i>	Gould's Wattled Bat		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Vespertilionidae	<i>Chalinolobus</i>	<i>morio</i>	Chocolate Wattled Bat		+			
Vespertilionidae	<i>Nyctophilus</i>	<i>geoffroyi</i>	Lesser Long-eared Bat		+			
Vespertilionidae	<i>Nyctophilus</i>	<i>gouldi</i>	Gould's Long-eared Bat		+			
Vespertilionidae	<i>Scotorepens</i>	<i>balstoni</i>	Inland Broad-nosed Bat		+			
Vespertilionidae	<i>Vespadelus</i>	<i>berstocki</i>	Inland Forest Bat		+			
Vespertilionidae	<i>Vespadelus</i>	<i>regulus</i>	Southern Forest Bat		+			
Molossidae	<i>Mormopterus</i>	<i>planiceps</i>	Southern Freetail-bat		+			
Molossidae	<i>Tadarida</i>	<i>australis</i>	White-striped Freetail-bat		+			
Muridae	* <i>Mus</i>	<i>musculus</i>	House Mouse	+	+			
Muridae	<i>Notmys</i>	<i>mitchellii</i>	Mitchell's Hopping-mouse	+	+			
Muridae	<i>Pseudomys</i>	<i>albocinereus</i>	Ash-grey Mouse		+			
Muridae	<i>Pseudomys</i>	<i>bolami</i>	Bolam's Mouse	+	+			
Muridae	<i>Pseudomys</i>	<i>hermannsburgensis</i>	Sandy Inland Mouse	+	+			
Muridae	<i>Pseudomys</i>	<i>sp.</i>			+			
Leporidae	* <i>Oryctolagus</i>	<i>cuniculus</i>	Rabbit		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Bovidae	* <i>Capra</i>	<i>hircus</i>	Goat		+			
Canidae	* <i>Canis</i>	<i>lupus</i>	Dog		+			
Canidae	<i>Canis</i>	<i>lupus dingo</i>	Dingo		+			
Felidae	* <i>Felis</i>	<i>catus</i>	Cat		+			
					+			
<b>Amphibians</b>					+			
Hylidae	<i>Littoria</i>	<i>moorei</i>	Motorbike Frog		+			
Myobatrachidae	<i>Neobatrachus</i>	<i>kunapalari</i>	Kunapalari Frog	+	+			
Myobatrachidae	<i>Neobatrachus</i>	<i>pelobatoides</i>	Humming Frog		+			
Myobatrachidae	<i>Neobatrachus</i>	<i>sutor</i>	Shoemaker Frog		+			
Myobatrachidae	<i>Neobatrachus</i>	<i>wilsmorei</i>	Wilsmore's Frog		+			
Myobatrachidae	<i>Pseudophryne</i>	<i>occidentalis</i>	Western Toadlet	+	+			
<b>Reptiles</b>						+		
Gekkonidae	<i>Heteronotia</i>	<i>binoei</i>	Bynoe's Gecko	+	+	+		
Varanidae	<i>Varanus</i>	<i>sp.</i>	Goanna			+		
Gekkonidae	<i>Christinus</i>	<i>marmoratus</i>	Marbled Gecko	+				
Gekkonidae	<i>Crenadactylus</i>	<i>ocellatus</i> subsp. <i>ocellatus</i>		+	+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Gekkonidae	<i>Diplodactylus</i>	<i>assimilis</i>			+			
Gekkonidae	<i>Diplodactylus</i>	<i>conspicillatus</i>			+			
Gekkonidae	<i>Diplodactylus</i>	<i>elderi</i>			+			
Gekkonidae	<i>Diplodactylus</i>	<i>granariensis</i> subsp. <i>granariensis</i>		+	+			
Gekkonidae	<i>Diplodactylus</i>	<i>maini</i>			+			
Gekkonidae	<i>Diplodactylus</i>	<i>pulcher</i>		+	+			
Gekkonidae	<i>Lucasium</i>	<i>maini</i>		+				
Gekkonidae	<i>Nephurus</i>	<i>laevissimus</i>		+	+			
Gekkonidae	<i>Nephurus</i>	<i>levis</i>			+			
Gekkonidae	<i>Nephurus</i>	<i>mili</i>		+	+			
Gekkonidae	<i>Oedura</i>	<i>reticulata</i>		+	+			
Gekkonidae	<i>Rhynchoedura</i>	<i>ornata</i>			+			
Gekkonidae	<i>Strophurus</i>	<i>assimilis</i>		+	+			
Gekkonidae	<i>Strophurus</i>	<i>elderi</i>			+			
Gekkonidae	<i>Strophurus</i>	<i>Strophurus</i>		+				
Gekkonidae	<i>Gehyra</i>	<i>purpurascense</i>			+			
Gekkonidae	<i>Gehyra</i>	<i>variegata</i>		+	+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Gekkonidae	<i>Underwoodisaurus</i>	<i>millis</i>			+			
Pygopodidae	<i>Delma</i>	<i>australis</i>		+	+			
Pygopodidae	<i>Delma</i>	<i>butleri</i>		+	+			
Pygopodidae	<i>Delma</i>	<i>fraseri</i>		+	+			
Pygopodidae	<i>Delma</i>	<i>nasuta</i>			+			
Pygopodidae	<i>Lialis</i>	<i>burtonis</i>		+	+			
Pygopodidae	<i>Pygopus</i>	<i>lepidopodus</i>	Common Scaly Foot	+	+			
Pygopodidae	<i>Pygopus</i>	<i>nigriceps</i>			+			
Scincidae	<i>Cryptoblepharus</i>	<i>buchananii</i>		+				
Scincidae	<i>Cryptoblepharus</i>	<i>carnabyi</i>			+			
Scincidae	<i>Cryptoblepharus</i>	<i>plagiocephalus</i>			+			
Scincidae	<i>Ctenotus</i>	<i>atlas</i>		+	+			
Scincidae	<i>Ctenotus</i>	<i>impar</i>			+			
Scincidae	<i>Ctenotus</i>	<i>leonhardii</i>			+			
Scincidae	<i>Ctenotus</i>	<i>pantherinus ocellifer</i>			+			
Scincidae	<i>Ctenotus</i>	<i>severus</i>		+				
Scincidae	<i>Ctenotus</i>	<i>schomburkii</i>			+			
Scincidae	<i>Ctenotus</i>	<i>uber</i>		+	+			



Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Scincidae	<i>Cyclodomorphus</i>	<i>branchialis</i>			+			
Scincidae	<i>Cyclodomorphus</i>	<i>melanops</i> subsp. <i>elongatus</i>		+	+			
Scincidae	<i>Egernia</i>	<i>depressa</i>			+			
Scincidae	<i>Egernia</i>	<i>formosa</i>		+	+			
Scincidae	<i>Egernia</i>	<i>inornata</i>			+			
Scincidae	<i>Egernia</i>	<i>multiscutata</i>		+	+			
Scincidae	<i>Egernia</i>	<i>striata</i>			+			
Scincidae	<i>Egernia</i>	<i>richardi</i>		+				
Scincidae	<i>Eremiascincus</i>	<i>richardsonii</i>		+	+			
Scincidae	<i>Hemiergis</i>	<i>initialis</i> subsp. <i>initialis</i>		+	+			
Scincidae	<i>Hemiergis</i>	<i>peronii</i> subsp. <i>peronii</i>			+			
Scincidae	<i>Lerista</i>	<i>desertorum</i>			+			
Scincidae	<i>Lerista</i>	<i>distinguenda</i>			+			
Scincidae	<i>Lerista</i>	<i>muelleri</i>			+			
Scincidae	<i>Lerista</i>	<i>picturata</i>		+	+			
Scincidae	<i>Lerista</i>	<i>taeniata</i>		+				
Scincidae	<i>Lerista</i>	<i>tridactyla</i>		+				

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Scincidae	<i>Menetia</i>	<i>greyii</i>		+	+			
Scincidae	<i>Morethia</i>	<i>adelaidensis</i>		+	+			
Scincidae	<i>Morethia</i>	<i>butleri</i>			+			
Scincidae	<i>Morethia</i>	<i>obscura</i>		+	+			
Scincidae	<i>Tiliqua</i>	<i>occipitalis</i>			+			
Scincidae	<i>Tiliqua</i>	<i>rugosa subsp. rugosa</i>		+	+			
Agamidae	<i>Caimanops</i>	<i>amphiboluroides</i>			+			
Agamidae	<i>Ctenophorus</i>	<i>clayi</i>			+			
Agamidae	<i>Ctenophorus</i>	<i>caudicinctus</i>		+				
Agamidae	<i>Ctenophorus</i>	<i>cristatus</i>		+	+			
Agamidae	<i>Ctenophorus</i>	<i>femoralis</i>			+			
Agamidae	<i>Ctenophorus</i>	<i>fordi</i>		+	+			
Agamidae	<i>Ctenophorus</i>	<i>isolepis citrinus</i>			+			
Agamidae	<i>Ctenophorus</i>	<i>maculatus</i>			+			
Agamidae	<i>Ctenophorus</i>	<i>nuchalis</i>			+			
Agamidae	<i>Ctenophorus</i>	<i>ornatus</i>		+	+			
Agamidae	<i>Ctenophorus</i>	<i>reticulatus</i>		+	+			
Agamidae	<i>Ctenophorus</i>	<i>salinarum</i>			+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Agamidae	<i>Ctenophorus</i>	<i>scutulatus</i>		+	+			
Agamidae	<i>Moloch</i>	<i>horridus</i>		+	+			
Agamidae	<i>Pogona</i>	<i>minor subsp. minor</i>		+	+			
Agamidae	<i>Tympanocryptis</i>	<i>cephala</i>		+	+			
Varanidae	<i>Varanus</i>	<i>caudolineatus</i>			+			
Varanidae	<i>Varanus</i>	<i>eremius</i>			+			
Varanidae	<i>Varanus</i>	<i>gouldii</i>		+	+			
Varanidae	<i>Varanus</i>	<i>panoptes</i>			+			
Varanidae	<i>Varanus</i>	<i>tristis subsp. tristis</i>		+	+			
Typhlopidae	<i>Ramphotyphlops</i>	<i>australis</i>		+	+			
Typhlopidae	<i>Ramphotyphlops</i>	<i>bicolor</i>			+			
Typhlopidae	<i>Ramphotyphlops</i>	<i>bituberculatus</i>		+	+			
Typhlopidae	<i>Ramphotyphlops</i>	<i>hamatus</i>			+			
Typhlopidae	<i>Ramphotyphlops</i>	<i>waitii</i>			+			
Boidae	<i>Aspidites</i>	<i>ramsayi</i>	Woma		+			S4, P1
Boidae	<i>Morelia</i>	<i>spilota subsp. imbricata</i>	Carpet Python	+	+			S4, P4
Elapidae	<i>Acanthophis</i>	<i>pyrrhus</i>	Desert death-adder		+			

Conservation Status

Family	Genus	Species	Common Name	DEC/WAM NatureMap database	Fauna potentially present <sup>2</sup>	Observed fauna (GHD, 2008)	EPBC	DEC / WC Act
Elapidae	<i>Brachyurophis</i>	<i>fasciolata</i> subsp. <i>fasciolata</i>		+	+			
Elapidae	<i>Brachyurophis</i>	<i>semifasciata</i>	Southern shovel-nosed snake	+	+			
Elapidae	<i>Demansia</i>	<i>psammophis</i> subsp. <i>psammophis</i>	Yellow-faced Whipsnake	+	+			
Elapidae	<i>Echiopsis</i>	<i>curtis</i>			+			
Elapidae	<i>Furina</i>	<i>ornata</i>	Moon snake		+			
Elapidae	<i>Nellaps</i>	<i>bimaculatus</i>	Black-naped snake		+			
Elapidae	<i>Parasuta</i>	<i>gouldii</i>	Gould's snake	+	+			
Elapidae	<i>Parasuta</i>	<i>nigriceps</i>		+				
Elapidae	<i>Parasuta</i>	<i>monachus</i>	Monk snake		+			
Elapidae	<i>Pseudechis</i>	<i>affinis</i> subsp. <i>affinis</i>	Dugite	+				
Elapidae	<i>Pseudechis</i>	<i>australis</i>	Mulga snake	+	+			
Elapidae	<i>Pseudonaja</i>	<i>modesta</i>	Ringed brown snake	+	+			
Elapidae	<i>Pseudonaja</i>	<i>nuchalis</i>	Gwardar	+	+			
Elapidae	<i>Sinyselaps</i>	<i>bertholdi</i>	Jan's banded snake	+	+			
Elapidae	<i>Suta</i>	<i>fasciata</i>	Rosen's snake	+	+			
Elapidae	<i>Suta</i>	<i>gouldii</i>			+			
Elapidae	<i>Vermicella</i>	<i>bertholdi</i>			+			

**Conservation Status**

<b>Family</b>	<b>Genus</b>	<b>Species</b>	<b>Common Name</b>	<b>DEC/WAM NatureMap database</b>	<b>Fauna potentially present <sup>2</sup></b>	<b>Observed fauna (GHD, 2008)</b>	<b>EPBC</b>	<b>DEC / WC Act</b>
Elapidae	<i>Vermicella</i>	<i>fasciolata</i>			+			
Elapidae	<i>Vermicella</i>	<i>semifasciatus</i>			+			

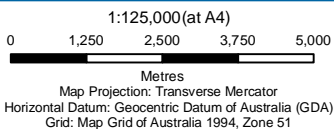
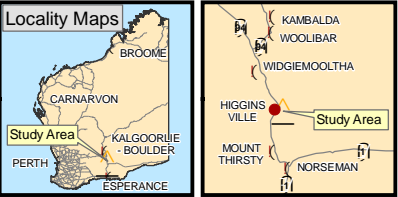
Note:

1. \* indicates introduced species
2. Potential fauna present data obtained from JSWT (2006c) and GHD (2008)
3. Conservation Status Codes: P- Priority, S – Schedule, V – Vulnerable, Mi – Migratory, Ma - Marine



**Legend**

- Study Area
- Aboriginal Heritage Site
- DEC Estate
- Schedule 1 Area
- Rare and Priority Flora**
- # Priority 3 Flora Species



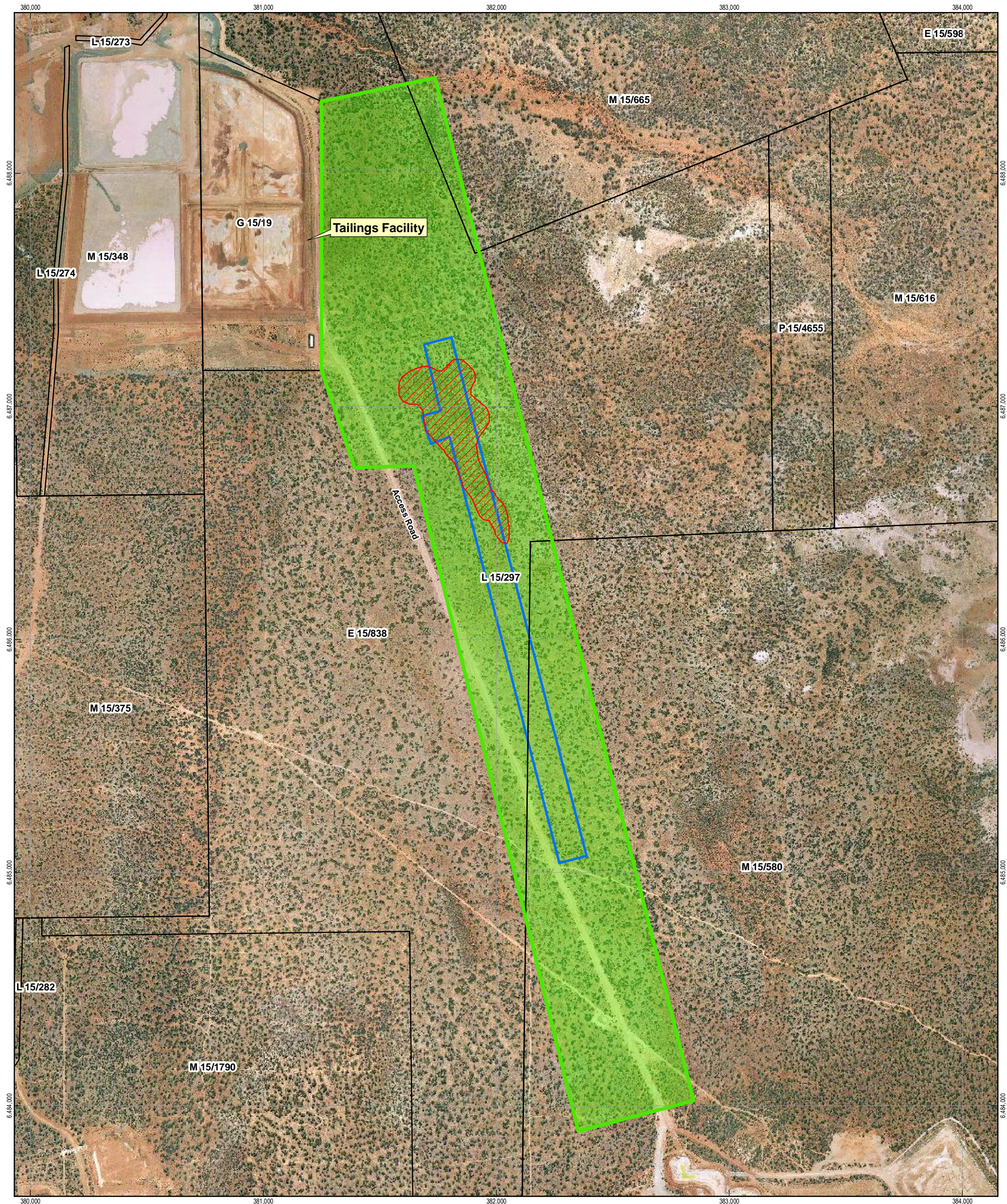
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**Study Area &  
Environmental Constraints**

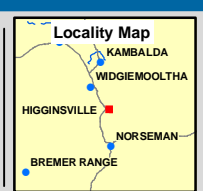
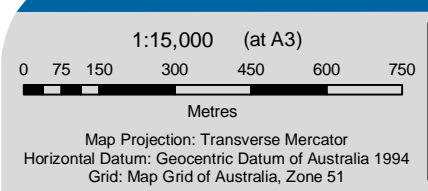
**Figure 1**

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 Data Source: GHD: Study Area - 20091220; DIA: Aboriginal Heritage Sites - 20100112; DEC: DEC Estate - 20100112, Schedule 1 Areas - 20100112, Rare and Priority Flora - 20080505; Landgate: Cowan 2006 Mosaic - 20100112; Geoscience Australia: Roads mgs50 - 2005. Created by: ageiger  
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**LEGEND**

- Extent of Survey Area - GHD - 20080627
- Airstrip boundary (including clearing margins) - SKM - 2008
- Mining Tenements - DoIR - 20080625
- Acacia acuminata* and *Eremophila dempsteri* shrubland over *Dodonea microzyga*, *Stenanthemum* sp. and *Prostanthera* sp. - GHD - 20080627
- Transitional Eucalypt Woodland Community - GHD - 20080627



<p>Avoca Resources Biological Survey of Higginsville Aerodrome site</p>	<table border="0"> <tr><td>Job Number</td><td>6122485</td></tr> <tr><td>Revision</td><td>0</td></tr> <tr><td>Date</td><td>30 June 2008</td></tr> </table>	Job Number	6122485	Revision	0	Date	30 June 2008
Job Number	6122485						
Revision	0						
Date	30 June 2008						
<p><b>Vegetation Map (from GHD, 2008)</b></p>							
<p><b>Figure 2</b></p>							

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 Dataset names include published date where available. Landgate Aerial Photography Cowan 2006 Mosaic acquired from SLIP June 2008. Created by: K Iralu, C Hoermann

Figure 3: Vegetation Map (extracted from Botanica Consulting, 2007)

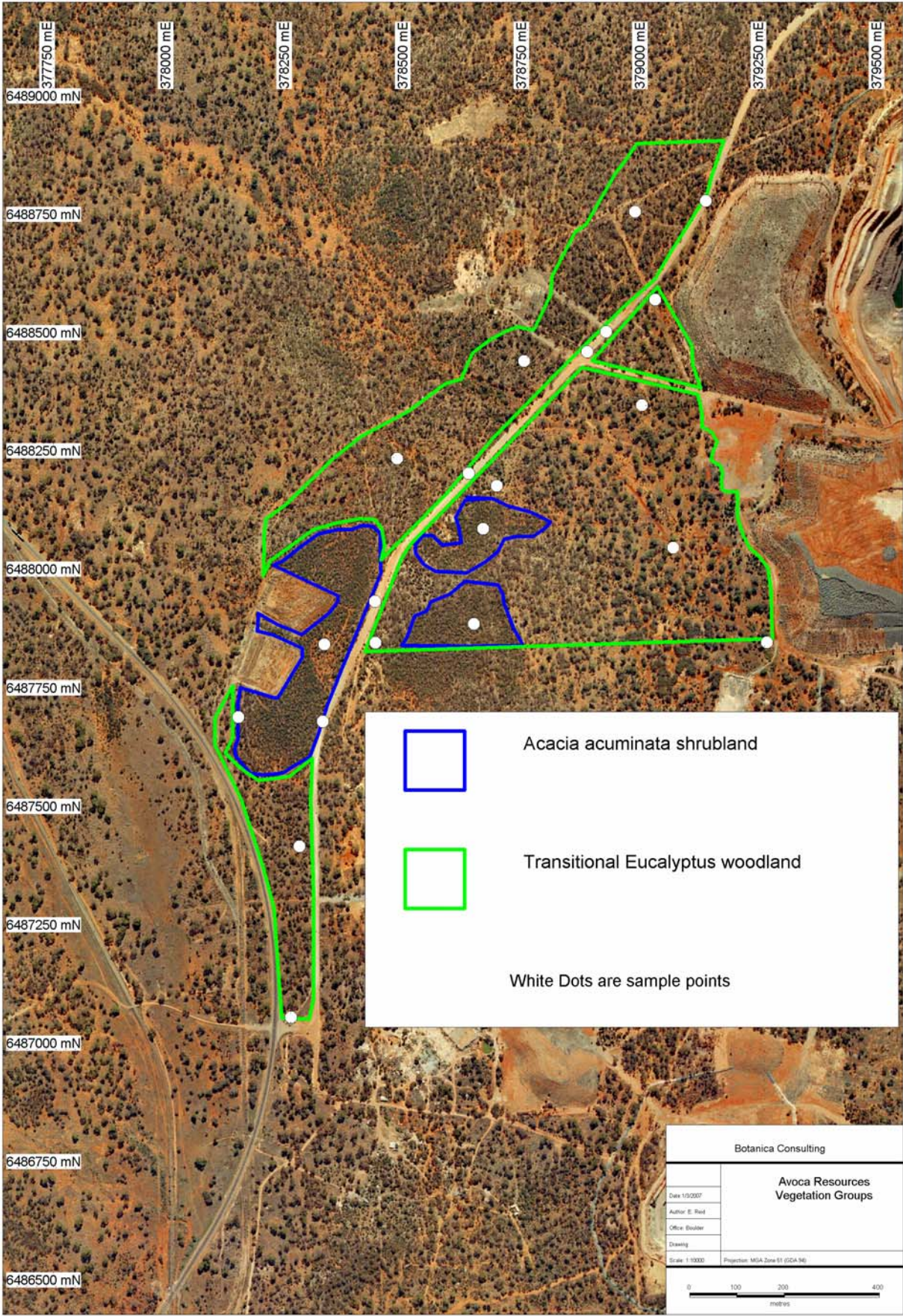
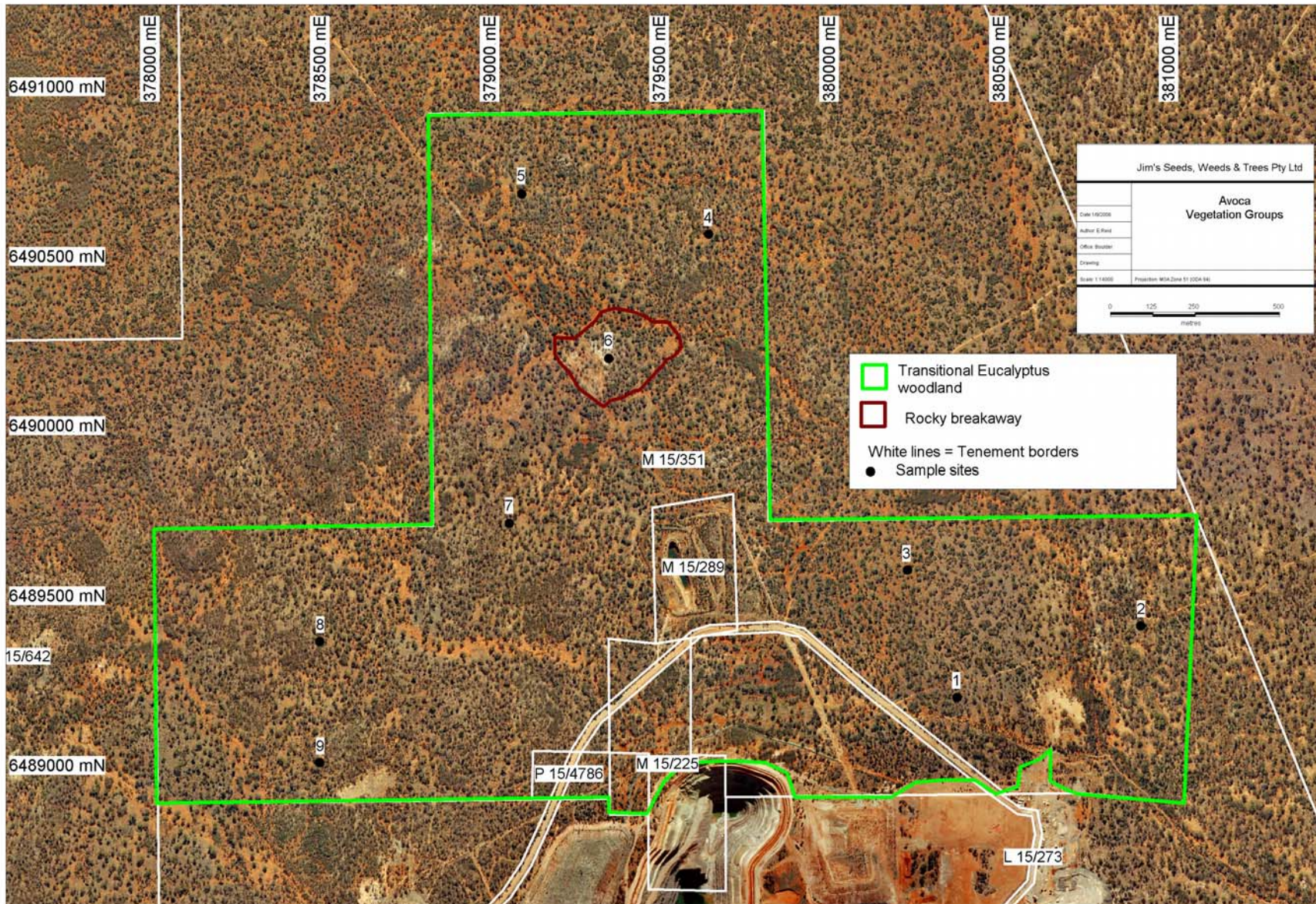




Figure 4: Vegetation Map (extracted from JSWT, 2006)





**LEGEND - Vegetation Type**

- OLS** - Very open low shrubland of *Tecticornia* spp. and *Frankenia* spp. on saline plains
- LEW1** - Low woodland of *Eucalyptus lesouefii* and *E. torquata* over *Eremophila psilocalyx*, *Eremophila glabra*, *Alyxia buxifolia*, *Trymalium myrtilus* and *Dodonea microzygia* over *Westringia rigidia* on ridges
- EW4** - Mixed woodland of *Eucalyptus urna*, *E. lesouefii*, *E. ravida*, *E. salubris*, *E. celastroides*, *E. oleosa* subsp. *oleosa* and *E. salmonophloia* over mixed *Eremophila* and *Atriplex* spp. interspersed with, *Eremophila oldfieldii* subsp. *angustifolia* and *Dodonea lobulata* on hill slopes and crests

- EW2** - Woodland of *Eucalyptus salmonophloia* and *E. salubris* with scattered midstorey of *Melaleuca sheathiana* over *Eremophila scoparia*, *Cratystylis conocephala* and *Maireana sedifolia* on loamy plains
- EW3** - Woodland of *Eucalyptus lesouefii* with scattered *E. griffithsii*, *E. celastroides* and *E. salmonophloia* over *Alyxia buxifolia*, *Eremophila scoparia*, *Eremophila glabra*, *Eremophila oldfieldii* subsp. *angustifolia*, and *Dodonea lobulata* over *Westringia rigidia*
- CD** - Cleared/degraded area
- Lake bed
- Study Area

1:75,000 (at A4)  
 0 750 1,500 2,250 3,000  
 Metres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: Geocentric Datum of Australia (GDA)  
 Grid: Map Grid of Australia 1994, Zone 51



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**Broadscale Vegetation Map** **Figure 5**

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 Data Source: Landgate: Cowan Mosaic - 2006; GHD: Vegetation Types - 20091220, Study Area - 20091220. Created by: ageiger


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**Document Status**

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0	P Moonie	A Napier	Signed copy on file	A. Venter		3/2/10