



Vegetation survey of Avoca
Resources Limited Tenements
M15/351, M15/289, M15/225,
M15/325 & P15/4786.

Prepared For Avoca Resources Limited

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Final

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1 Introduction

Avoca Resources Limited acquired the Higginsville project in June 2004. The Higginsville tenements are located adjacently east of the Coolgardie-Esperance Highway approximately 2.5km north of Higginsville, which lies approximately 60km south of Kambalda and 53 km north of Norseman.

1.1 Topography, Soils & Climate

The Higginsville project is located in the Coolgardie Botanical District of the South Western Interzone (Beard, 1990). This botanical district is predominantly eucalypt woodland, becoming open towards the more calcareous soils, where a cover of saltbush-bluebush understorey is evident. A gently undulating topography is broken up with occasional ranges of low hills. Sand plains are more prominent in the western part with some large playa lakes. Principally the soils are brown calcareous earths. The climate of this region is semi arid, which is characterized by cool winters and hot, dry summers. Rainfall occurs in winter with an annual precipitation of 289.6mm (Bureau of Meteorology, 2006).

1.2 Vegetation

The dominant plant families within the Coolgardie Botanical District include Myrtaceae, Asteraceae, Chenopodiaceae and Poaceae. Eucalypt woodlands, which cover 6.8% of the area of the State of Western Australia, characterize the Coolgardie Botanical District (ANRA, 2006).

2 Methods

Jim's Seeds, Weeds & Trees Pty Ltd was commissioned on the 2nd August 2006 by Avoca Resources Limited, to conduct a flora survey of tenements M15/351, M15/289, M15/225, M15/325 & P15/4786, which are part of the Higginsville project (as per map shown in Appendix 1).

The survey area is approximately 364ha. The area was traversed by two people with GPS units via four-wheel drive, a Kawasaki Mule and on foot where appropriate. The vegetation groups were easily accessible throughout the survey area and were extensively covered. The survey was carried out in accordance with Jim's Seeds, Weeds & Trees Pty Ltd Safety and Environmental Management Plans.

This flora survey of the study area was planned and implemented as far as practicable according to the Environmental Protection Authority (EPA) Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*, (EPA 2005).

Prior to the field survey, the results of the combined search of DEC's Declared Rare and Priority Flora (DEC, 2006) and the Western Australian Herbarium (WAHERB, 2006) databases, were examined for species recorded within the known coordinates (GDA94 51 J 368790 6501222 and 51 J 386445 6477411). The results of this search are listed in Appendix 2 (requested 23/3/06). These significant flora species were examined on the Western Australian Herbarium's web page (WAHERB 2006) prior to the survey. Specimens collected during the survey were identified with the aid of samples housed at the Western Australian Herbarium, and where necessary, specialists were consulted.

Table 1 represents the definitions of Declared Rare and Priority ratings under the Wildlife Conservation Act (1950) as extracted from Department of Environment and Conservation (2006).

Table 1: Definitions of Rare and Priority Flora Species (DEC 2006).

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.
X: Declared Rare flora – Presumed Extinct Taxa 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.
1: 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 populations size, or being on lands under immediate threat, eg road verges, urban areas, farmland, active mineral leases, etc, or the plants are under threat, eg. From disease, grazing by feral animals, etc. May include taxa with threatened populations in protected lands. Such taxa are under consideration for declaration as “rare flora”, but are in urgent need of further survey.
2: Priority Two – Poorly Known Taxa Taxa which are known from one of 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.
3: 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.
4: Priority Four – Rare Taxa Taxa, which are considered to have been adequately surveyed, and which whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years

Locations revealed in the databases search were overlaid on aerial photography of the area showing Avoca Resources Limited tenements using MapInfo Professional 7.0. Vegetation descriptions of locations and available pictures of the priority flora were obtained from Florabase. Priority Flora were previously inspected at the WA Herbarium prior to the survey.

Vegetation types associated with known priority flora were searched for in the survey area, and when/if these vegetation types were observed during the survey, they were traversed on foot specifically looking for the threatened flora associated with that vegetation description. The sample locations recorded during the survey area are outlined in Appendix 1.

Prior to field work aerial photography was visually inspected and obvious differences in the vegetation assemblages were initially identified. These different vegetation associations were then visited and used as sample sites also.

JSWT used a method of partially combining both a random meander technique (Cropper, 1993) and a quantitative technique. The random meander technique was used

on a whole across the survey area. This technique can allow for greater coverage than a plot based survey and is less time consuming (NPWS, 2001). As the name suggests, the random meander technique involves traversing areas of suitable habitat in no set pattern, but roughly back and forth, whilst recording the different species present. However partial use of the quantitative vegetation analysis was used (i.e. representative sample points used, although quadrats were not setup) via utilizing sample points that were marked with a GPS unit and traversed within a minimum radius of 50m.

At each sample point, information recorded comprised of the following:

- GPS location
- Photograph of vegetation
- Visual identification of plants within a 50m radius
- Dominant species
- Collection and documentation of unknown plant specimens
- GPS location, photo and collection of Threatened Flora if encountered

Data from sample sites of similar vegetation was then compiled forming the two best representative vegetation groups. Similar vegetation groups were recognised visually in the field.

Additionally not all species collected were in flower, and were therefore, difficult to identify to a species level. These species are represented by a question mark (?) preceding the most likely taxonomical identification (Appendix 3).

2.1 Objectives

The objectives of this report were to

- Traverse the 364ha survey area represented by tenements M15/351, M15/289, M15/225, M15/325 & P15/4786
- Identify and collect the vascular plant taxa in the survey area.
- Provide a description of the vegetation occurring within the survey area.
- Assess the vegetation condition according to Keighery (1994).
- Assess the clearing principles specifically relating to native vegetation as outlined in Schedule 6 attached to the Environmental Protection Act 1986.

2.2 Limitations to the Survey

The main limitations to this survey are as follows:

- The vegetation units for this study were based on visual descriptions of locations in the field. The distribution of these vegetation units outside the study area is not known, however vegetation groups identified were categorized via comparison to vegetation distributions throughout WA given on ANRA 2006.
- Although field work was not completed at the EPA's recommended time period (i.e. Spring) for detecting most ephemeral flora, some species may not have been present or identifiable at the time of survey. Although, the early summer rains in January following through March April and May, would suggest timing of this survey occurred after significant rainfall events (Figure 1).
- In the opinion of JSWT the survey area was covered sufficiently but not exhaustively. Therefore it is JSWT's estimation that approximately 95% of the flora species in the survey area were recorded. This estimation was based on accessibility of vegetation groups and the timing of the survey after the summer rainfall events.

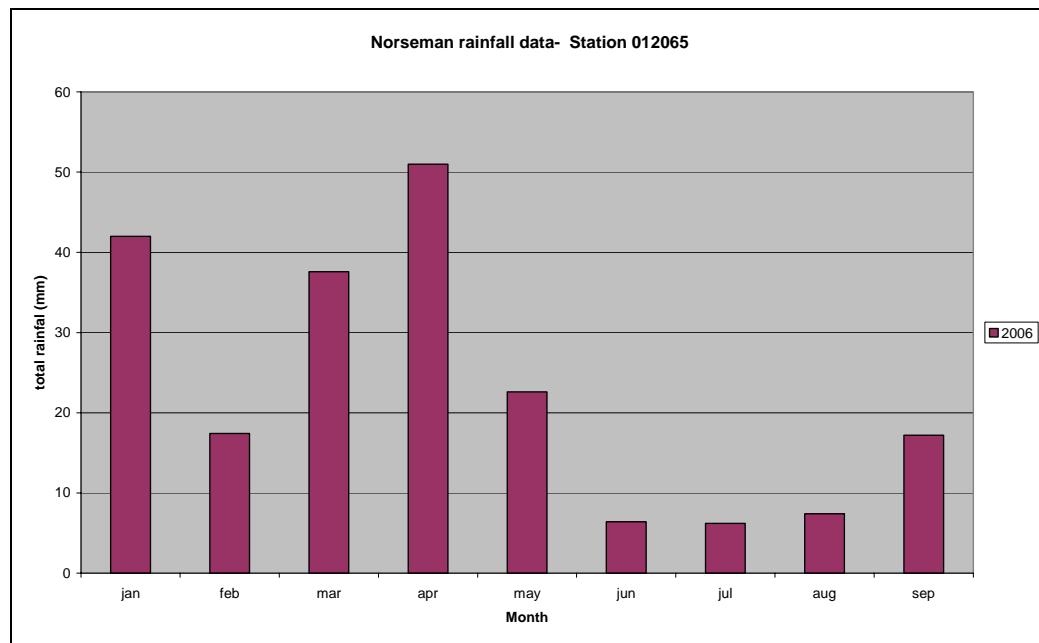


Figure 1: Total monthly rainfall for Norseman 2006 (BOM, 2006).

3 Results

Two vegetation groups were encountered within the survey area. These vegetation groups were Transitional *Eucalyptus* woodland and *Eucalyptus* over Rocky breakaway community.

3.1 Transitional *Eucalyptus* woodland

3.1.1 Flora

Flora recorded in the Transitional *Eucalyptus* woodland vegetation group was represented by 22 Families, 31 Genera and 60 Species (Appendix 2).

No Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the Department of Environment and Conservation (2006) were found in the area surveyed.

No Priority Species as defined by the Department of Environment and Conservation (2006) were located during the survey.

The area has no national environmental significance as defined by the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (Department of Environment and Heritage 2006).

3.1.2 Vegetation

The vegetation recorded in this community was representative of Transitional *Eucalyptus* woodland. The understorey was very similar throughout this vegetation group with only the dominant upper storey species of *Eucalyptus* showing variance. The dominant species were represented by *Eucalyptus* species such as *E. salmonophloia*, *E. salubris* and *E. lesouefii*. The mid-storey was very uniform throughout this community comprising of *Senna artemisioides ssp filifolia*, *Atriplex nummularia*, *Acacia colletioides*, *Eremophila alternifolia*, *E. inonantha*, *Melaleuca sheathiana* and *Exocarpos aphyllus*, while the understorey comprised of *Ptilotus obovatus*, *Olearia muelleri*, *Atriplex vesicaria*,

No Broad scale clearing has occurred for agricultural purposes in this community within the survey area.

This community occurs within the *Eucalyptus* woodland vegetation group, which covers 3.5% of the State of Western Australia (ANRA, 2006).



Figure 2: Transitional *Eucalyptus* woodland within the survey area.

3.2 *Eucalyptus* over Rocky breakaway

3.2.1 Flora

Flora recorded in the *Eucalyptus* over Rocky breakaway vegetation group was represented by 12 Families, 18 Genera and 23 Species (Appendix 2).

No Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the Department of Environment and Conservation (2006) were recorded in the area surveyed.

No Priority Species as defined by the Department of Environment and Conservation (2006) were located during the survey.

The area has no national environmental significance as defined by the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (Department of Environment and Heritage 2006).

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3.2.2 Vegetation

The vegetation recorded in this community was representative of a *Eucalyptus* over breakaway community. The dominant species was *Eucalyptus stricklandii*. The mid-storey comprised of *Cratystylis conocephala*, *Scaevola spinescens*, *Eremophila interstans ssp interstans* and *Melaleuca sheathiana*, while the understorey comprised of *Ptilotus helichysoides*, *Olearia muelleri*, *Halosarcia indica* and *Westringia rigida*.

No Broad scale clearing has occurred for agricultural purposes in this community within the survey area.

This community occurs within the *Eucalyptus* woodland vegetation group, which covers 3.5% of the State of Western Australia (ANRA, 2006).



Figure 3: Rocky breakaway vegetation group within the survey area.

4 Vegetation condition

The vegetation condition of the vegetation groups within the area surveyed by Jim's Seeds, Weeds & Trees Pty Ltd is classed as being in a "very good" health condition (Keighery, 1994). A very good health condition depicts that the vegetation structure is altered due to obvious signs of disturbance. Disturbance was in the form of historic drill tracks and grazing by pastoral animals.

5 Introduced species

One introduced species was recorded within the survey area. This species *Solanum hystrix* (Afghan Thistle) is defined by the DEC as a weed species, although the Department of Agriculture and Food (2006) does not list this species as a declared weed.

6 Discussion

The 364ha of surveyed area revealed two vegetation communities comprising a combined total of 22 Families, 33 Genera and 65 Species.

No Priority Species as defined by the Department of Environment and Conservation (2006) were located during the survey.

No Declared Rare Flora species, pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* and as listed by the Department of Environment and Conservation (2006) were found in the area surveyed.

No vegetation communities recorded within the survey area are considered to have regional environmental significance as defined by the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (Department of Environment and Heritage 2006).

6.1 Recommendations

- For the purpose of this vegetation survey, the clearing principals specifically related are as follows.

It is of JSWT opinion that for clearing principal:

- (a) **Native vegetation should not be cleared if it comprises a high level of biological diversity.**

As stated in the Biodiversity Audit of Western Australia's 53 Biogeographical Subregions (CALM, 2002), the Coolgardie 3 subregion has an exceptionally high diversity of *Eucalyptus* species, but most species are wide ranging and usually occur in at least one, and often several, adjoining subregions. This flora survey reveals diverse flora that are not restricted to the project area and occur across the region. The vegetation is also degraded by historic tracks and drilling activities.

- (c) **Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.**

No DRF were recorded in the survey area.

- (d) **Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community (TEC).**

No Threatened Ecological Communities (TEC's) listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* are in the survey area.

- (e) **Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared**

No vegetation considered as a significant remnant of extensively cleared vegetation was identified in the survey area.

- (f) **Native vegetation should not be cleared if it is growing, in, or in association with, an environment associated with a watercourse or wetland**

No vegetation growing in, or in association with a watercourse or wetland occurs in the survey area.

- (h) **Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.**

The survey area lies 2.2km southwest of the Binoronca Rocks Nature Reserve and 17.5km southwest of the Dordie Rocks Nature Reserve. These small Nature Reserves (185.5ha and 35.66ha respectively) have high conservation values based on either the presence of wetlands, unmodified eucalypt woodland, rich vertebrate fauna or geomorphology (CALM 1994). Clearing within the survey area will not have any adverse effects on the environmental values of these conservation areas.

7 **Personnel involved**

- Jim Williams- Botanist (Diploma of Horticulture).
- Eren Reid- Assistant Botanist (BSc- Biological Science).
- Nicole Garbin- Environmental Scientist (BESc).
- Frank Obbens- Consultant Botanist (BA-Environmental Studies, BSc- first class honours).

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[bin/erin/ert/ert_dispatch.pl?loc_type=coordinate&search=Search&report=epbc](http://www.deh.gov.au/cgi-bin/erin/ert/ert_dispatch.pl?loc_type=coordinate&search=Search&report=epbc)

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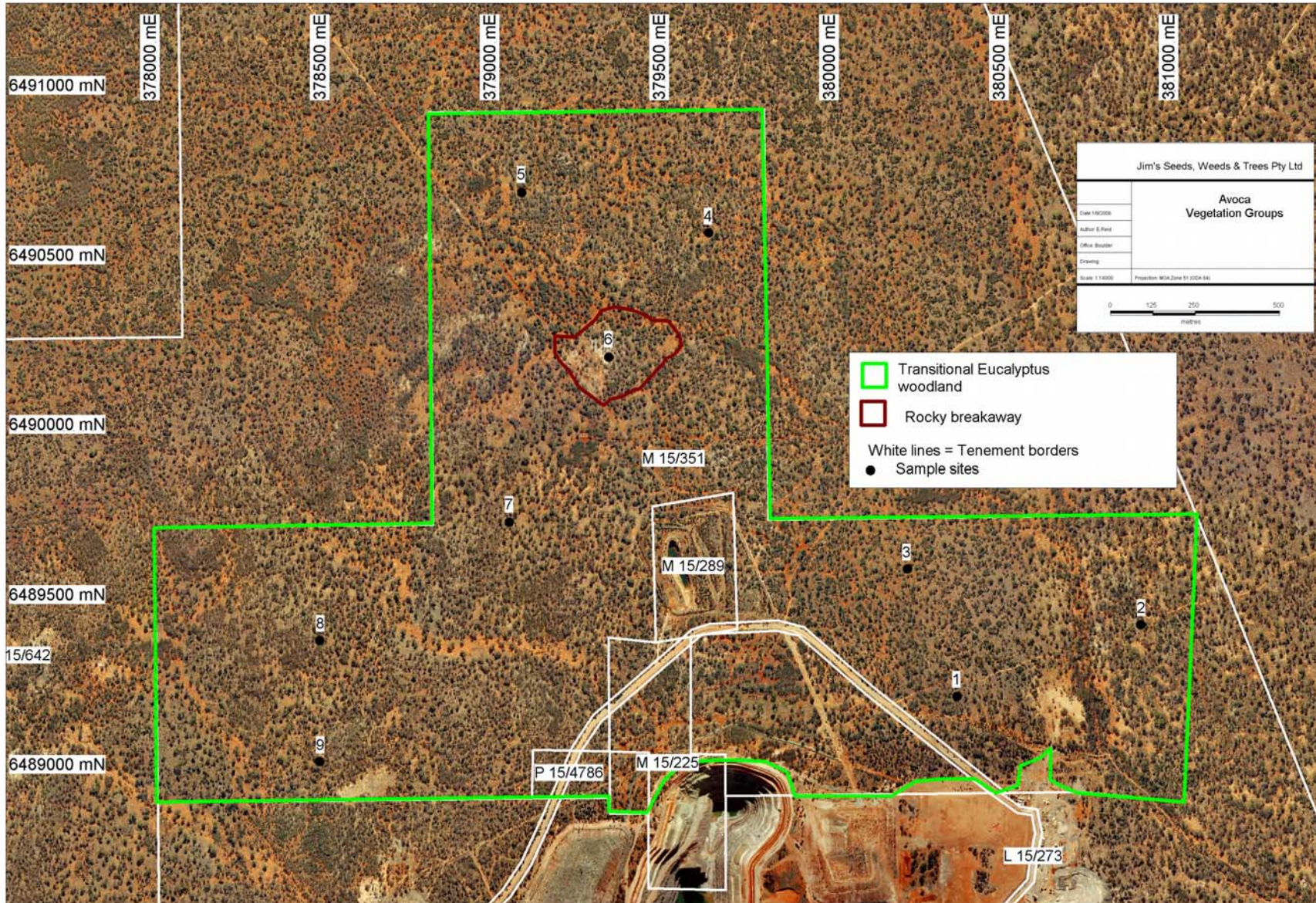
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Appendix 1: Map of the surveyed area and sample site coordinates.



	GDA94 51J	
Sample site	Easting	Northing
1	380360	6489218
2	380901	6489429
3	380214	6489594
4	379628	6490583
5	379078	6490702
6	379335	6490217
7	379042	6489731
8	378483	6489383
9	378483	6489026

Appendix 2: DEC and WAHERB Databases search results for Rare and Priority species within the area.

Grevillea phillipsiana P1

Halosarcia flabelliformis P1

Prostanthera splendens P1

Austrostipa blackii P3

Eucalyptus brachyphylla x P4

Melaleuca coccinea P3

Pityrodia sp. Yilgarn (AP Brown 2679) P3

Appendix 3: Species list of the surveyed area.

Family	Genus	Species	Transitional Eucalyptus woodland	Rocky Breakaway
Amaranthaceae	Ptilotus	helichrysoideus		*
Amaranthaceae	Ptilotus	obovatus	*	
Apocynaceae	Alyxia	buxifolia	*	
Asteraceae	Cratystylis	conocephala	*	*
Asteraceae	Olearia	muelleri	*	*
Boraginaceae	Halgania	andromedifolia	*	
Caesalpiniaceae	Senna	artemisioides ssp filifolia	*	
Chenopodiaceae	Atriplex	nummularia	*	
Chenopodiaceae	Atriplex	stipitata		*
Chenopodiaceae	Atriplex	vesicaria	*	*
Chenopodiaceae	Disphyma	crassifolium	*	*
Chenopodiaceae	Dysphania	kalpari	*	
Chenopodiaceae	Eremophila	sedifolia	*	
Chenopodiaceae	Halosarcia	indica	*	*
Chenopodiaceae	Maireana	brevifolia	*	
Chenopodiaceae	Maireana	carnosa		*
Chenopodiaceae	Maireana	georgei	*	
Chenopodiaceae	Maireana	pyramidata	*	
Chenopodiaceae	Maireana	tomentosa	*	
Chenopodiaceae	Maireana	triptera	*	*
Chenopodiaceae	Sclerolaena	diacantha	*	
Chenopodiaceae	Sclerolaena	ericantha	*	
Chenopodiaceae	Sclerolaena	eurotioides	*	
Frankeniaceae	Frankenia	interioris	*	
Goodeniaceae	Scaevola	spinescens	*	*
Lamiaceae	Westringia	rigida	*	*
Malvaceae	Sida	calyxhymenia	*	
Mimosaceae	Acacia	colletioides	*	
Mimosaceae	Acacia	victoriae	*	
Myoporaceae	Eremophila	alternifolia	*	
Myoporaceae	Eremophila	caerulea ssp caerulea	*	*
Myoporaceae	Eremophila	decipiens ssp decipiens	*	
Myoporaceae	Eremophila	glabra ssp glabra	*	
Myoporaceae	Eremophila	interstans ssp virgata	*	*
Myoporaceae	Eremophila	ionantha	*	
Myoporaceae	Eremophila	latrobei	*	
Myoporaceae	Eremophila	psilocalyx	*	*
Myoporaceae	Eremophila	scoparia	*	
Myoporaceae	Eremophila	sp (sterile)	*	
Myrtaceae	Eucalyptus	calycogona	*	
Myrtaceae	Eucalyptus	celastroides	*	*
Myrtaceae	Eucalyptus	lesouefii	*	
Myrtaceae	Eucalyptus	ravida	*	
Myrtaceae	Eucalyptus	salubris	*	
Myrtaceae	Eucalyptus	salmonophloia	*	
Myrtaceae	Eucalyptus	stricklandii	*	*
Myrtaceae	Eucalyptus	torquata	*	
Myrtaceae	Eucalyptus	transcontinentalis	*	
Myrtaceae	Melaleuca	sheathiana	*	*
Papilionaceae	Swainsona	canescens	*	
Pittosporaceae	Pittosporum	angustifolia	*	
Poaceae	Aristida	contorta		*
Poaceae	Eragrostis	eriopoda	*	
Rhamnaceae	Stenanthemum	stipulosum	*	

Family	Genus	Species	Transitional Eucalyptus woodland	Rocky Breakaway
Santalaceae	Exocarpos	aphyllus	*	*
Santalaceae	Santalum	acuminatum	*	*
Santalaceae	Santalum	lanceolatum	*	
Santalaceae	Santalum	spicatum	*	
Sapindaceae	Dodonaea	lobulata	*	*
Solanaceae	Solanum	orbiculatum	*	*
Solanaceae	# Solanum	hystrix	*	
Zygophyllaceae	Zygophyllum	eremaeum	*	

denotes weed species