Flora and Vegetation Assessment
Proposed Solar Facility
Merredin

Prepared for: Land Insights

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October 2017

EXECUTIVE SUMMARY

This report has been prepared by Del Botanics on behalf of Land Insights to review remnant vegetation on Lot 194 Robartson Road and Lot 19444 Bruce Rock – Merredin Road, Merredin. This report is the result of a spring botanical survey of the flora and vegetation in the survey area. The location of the site is shown on **Figure 1 & 2.**

The recent Flora and Vegetation Assessment undertaken in the area described above identified a number of flora species. The vegetation ranged from "Completely Degraded" to "Very Good" condition.

Four vegetation types were recorded at a local level during the survey. No species of Threatened (T), Priority Flora or Threatened Ecological Communities (TEC's) pursuant to The *Wildlife Conservation Act* 1950 were located during the time of the survey.

STATEMENT OF LIMITATIONS

This environmental report has been prepared in accordance with the scope of services set out in the original quotation. In preparing the report, Del Botanics has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report. Del Botanics has not verified the accuracy or completeness of the data to the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Del Botanics will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed.

In accordance with the scope of services, Del Botanics has have relied on the data and have conducted environmental field monitoring in the preparation of the report. The nature and extent of monitoring conducted is described in the report. Within the limitations imposed by the scope of services, the monitoring and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care. No other warranty, express or implied, is made.

The report has been prepared for the benefit of the Client and for no other party. Del Botanics assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report. Other parties should not rely upon the report or the accuracy or completeness of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

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1. INTRODUCTION

1.1 BACKGROUND

This report has been prepared by Del Botanics on behalf of Land Insights to review remnant vegetation on Lot 194 Robartson Road and Lot 19444 Bruce Rock – Merredin Road, Merredin. A botanical survey of the flora species and vegetation of the site was undertaken in September 2017. The site is approximately 260 kilometres east of the Perth central area. The site location is shown on **Figure 1 & 2**.

1.2 PURPOSE OF THIS REPORT

This report was prepared to document the flora and vegetation that occurs within the area described above. The flora species and vegetation were used to determine the significance of the site in regards to Threatened and Priority Flora and Threatened Ecological Communities.

In summary this report provides:

- Threatened Flora (T) and Threatened Ecological Communities (TEC's) Department of Biodiversity, Conservation and Attractions (DBCA) and Department of the Environment and Energy (DoEE) Database search to determine results for the site;
- A spring botanical survey; and
- An assessment of vegetation types and conditions.

2. EXISTING ENVIRONMENT

2.1 SOILS AND LANDFORMS

The Avon Wheatbelt (AW1) is an area of active drainage dissecting a Tertiary plateau in Yilgarn Craton. The Yilgarn block is bounded by the Darling Fault in the West and by the greenstone belts of the Southern Cross and Murchison districts in the east. It has a gently undulating landscape of low relief, with Proteaceous scrub heaths, rich in endemics, on residual lateritic uplands and derived sandplains with mixed Eucalypt, *Allocasuarina huegeliana* and Jam-York Gum woodlands.

Within this bioregion, AW1 is an ancient peneplain with low relief and gently undulating landscape. There is no connected drainage and salt lake chains occur as remnants of ancient drainage systems which only function in very wet years. Lateritic uplands are dominated by yellow sandplain. The Wheatbelt landscape creates a mosaic of plant habitats that include open woodlands, gravely or sandy heaths, extensive salt lakes and the specialised habitats associated with granite outcrops.

2.2 CLIMATE

The Wheatbelt climate consists of hot dry summers and mild winters. The summer average daily maximum temperature is 34 degrees celsius, with a daily minimum of 17 degrees celsius. In winter this becomes the daily maximum with an average minimum of 5 degrees celsius.

The average annual rainfall is 328mm usually falling between March and November. There is an average of 170 clear days per year. 70% of Merredin's rain falls from May to October. The total annual rainfall is approximately 1/3 of that received in Perth.

3. FLORA AND VEGETATION

Vegetation in Western Australia has been described on a broadscale in a series of publications by Beard (eg Beard 1972,1981,1990). He divided the State into botanical provinces, districts, subdistricts and systems. The survey area lies in the Avon Botanical District, in the eastern central Wheatbelt Region of the Southwest Botanical Province as described by Beard (1981, 1990), in the Muntadgin Vegetation System (Beard 1972). Beard mapping is provided on **Figure 3**.

The Avon Botanical System comprises of Scrub Heath on sandplain, *Acacia-Casuarina* thickets on ironstone, Woodlands of York Gum (*Eucalyptus loxophlebea*), Salmon Gum (*Eucalyptus salomonphloia*) and Wandoo (*Eucalyptus wandoo*) on loams and halophytes on saline soils (Beard 1981).

The updated mapping system IBRA (Interim Biogeographic Regionalisation for Australia) was developed in 1993-94 and is endorsed by all levels of government as a key tool for identifying land for conservation under Australia's Strategy for the National Reserve System 2009-2030. The nationally agreed regionalisation was published in Thackway and Cresswell 1995, An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves.

The latest version, IBRA7, classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. The IBRA description of vegetation for this area is best categorised as the Avon Wheatbelt Region.

The Muntadgin Vegetation System (Beard 1972) occurs on relatively high lying country with large areas of residual sandplain forming part of an old plateau surface, dissected by shallow valleys draining to the West and North West. The vegetation of the sandplains consists of dense thickets of shrubs rarely exceeding 2.5 metres in height. There are many granite outcrops. The valleys contain red brown sandy

loams overlaying clay which carry Mallee vegetation. If the clay is close to the surface the Mallee changes to Woodland.

3.1 VEGETATION METHODS

A botanical survey was undertaken on the 22nd September 2017. The site was surveyed for flora species, vegetation communities and condition, Threatened Flora (T), Priority Flora (PF) and potential areas of Threatened Ecological Communities (TEC's). Each variation or difference in vegetation was recorded with a 10 metre by 10 metre quadrat. Data was recorded to statistically determine vegetation types and condition. In total, seven quadrats were assembled to record each change or variation in vegetation type. Each quadrat recorded flora species, heights, percentage cover and percentage dead and alive. Quadrats were not assembled permanently; quadrat data is available in **Appendix B.** One transect was assessed along the road verge. Data is presented in Field sheet 8 of **Appendix B**.

The survey methodology was undertaken in accordance with EPA Position Statement No.3: *Terrestrial Biological Surveys as an Element of Biodiversity Protection* and EPA Guidance Statement No. 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.*

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with the requirements of the Western Australian State Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys.

The use of standard data collection forms ensured the data was collected in a systematic and consistent manner. At each change in vegetation the following records were made:

- Condition/disturbance;
- Topography;
- Soils.

The vegetation communities occurring on this site were described in detail. Aerial photography was used to extrapolate and map plant communities in combination with running notes made during the course of the survey.

3.2 DECLARED RARE AND PRIORITY FLORA

Species of Flora acquire "Threatened" "Presumed Extinct" or "Priority" conservation status where populations are restricted geographically or threatened by local processes. The Department of Biodiversity, Conservation and Attractions (DBCA) recognise these threats and subsequently applies regulations towards population protection and species conservation. The DBCA enforces regulations under the *Biodiversity Conservation Act 2016* to conserve Threatened species and protect significant

populations. Priority Flora species are potentially rare or threatened and are classified in order of threat. Threatened and Priority Flora category definitions are listed in **Table 1**.

Threatened Flora species are gazetted under subsection 2 of section 23F of the *Wildlife Conservation Act* 1950 and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the Act defines "to take" as "... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means".

Table 1: Definition of Rare and Priority Flora Species (DEC 2012)

Conservation Code	Category
T	**Threatened Flora (Declared Rare Flora – Extant).** Schedule 1 under the Wildlife Conservation Act 1950 Rare Flora Notice 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 **Threatened Flora (Schedule 1)are further ranked by the Department according to their level of threat using IUCN Red List criteria:** **CR**: Critically Endangered - considered to be facing an extremely high risk of extinction in the wild. **EN**: Endangered –considered to be facing a very high risk of extinction in the wild. **VU**: Vulnerable - considered to be facing a high risk of extinction in the wild
X	**Presumed Extinct Flora (Declared Rare Flora – Extinct)** Schedule 2 under the Wildlife Conservation Act 1950 Rare Flora Notice Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
P1	**Priority One: Poorly-known species** pecies that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes
P2	**Priority Two: Poorly-known species** Species that are known from one or a few collections or sight records, some of which are on landsnot under imminent threat of habitat destruction or degradation, e.g. national parks, conservationparks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3	**Priority Three: Poorly-known species** Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them..
P4	**Priority Four: Rare, Near Threatened and other species in need of monitoring** (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5	**Priority Five: Conservation Dependent species** Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years

A search of the Department of Biodiversity, Conservation and Attractions (DBCA) NatureMap database identified two Priority 1 (P1), one Priority 2 (P2), two Priority 3 (P3) and one Priority 4 (P4) species likely to occur within the area. These species are listed in **Table 2** below.

Table 2: NatureMap listed species

Species Name	Common Name	Conservation Code
Acacia sclerophylla var. *teretiuscula*		P1
Lepidosperma lyonsii		P4
Verticordia mitodes		P3
Verticordia multiflora subsp *solox*		P2
Vittadinia cervicularis var.*oldfieldii*		P1
Xanthoparmelia subimitatrix		P3

3.3 ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT (1999) – SPECIES LEVEL SIGNIFICANCE

The *Environment Protection and Biodiversity Conservation* (EPBC) Act promotes the conservation of biodiversity by providing strong protection for plants at a species level. Section 178 and 179 provides the lists and categories of threatened species under the Act and is presented in **Table 3** below.

Table 3: Categories of Threatened Species (EPBC Act, Section 179, 1999)

1	**Extinct** A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
2	**Extinct in the Wild** A native species is eligible to be included in the **extinct in the wild** category at a particular time if, at that time:(a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
3	**Critically Endangered** A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
4	**Endangered** A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
5	**Vulnerable** A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria..
6	**Conservation Dependant** A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

A search of the EPBC Protected Matters website was undertaken within a 10km radius of the site. The search result noted eight flora species of significance likely to occur in the area. Six flora species have been listed as Endangered and two species are listed as Critically Endangered. These species are listed in **Table 4** below. One Threatened Ecological Community (TEC) is listed as occurring in the area. Further information is provided in **Section 3.4** and **Table 6**.

Table 4: EPBC listed flora species

Species Name	Common Name	Conservation Code
Dasymalla axillaris	Native Foxglove	Critically Endangered
Eremophila resinosa	Resinous Eremophila	Endangered
Eremophila virens	Campion Eremophila, Green-flowered Emu bush	Endangered
Eremophila viscida	Varnish Bush	Endangered
Gastrolobium diabolophyllum	Bodallin Poison	Critically Endangered
Grevillea dryandroides subsp. hirsuta	Hairy Phalanx Grevillea	Endangered
Roycea pycnophylloides	Saltmat	Endangered
Symonanthus bancroftii	Bancrofts Symonanthus	Endangered

3.4 THREATENED ECOLOGICAL COMMUNITIES

In Western Australia Threatened Ecological Communities (TEC's) are assessed through a procedure coordinated by the DBCA and are assigned to one of the categories outlined below in **Table 5**. While they are not afforded direct statutory protection at a State level (unlike Threatened Flora under the *Wildlife Conservation Act* 1950) their significance is acknowledged through other State environmental approval processes (i.e. Environmental Impact Assessment pursuant to Part IV of the *Environmental Protection Act* 1986). Scheduled TEC's are afforded statutory protection at a Federal level pursuant to the EPBC Act.

The Minister for Environment may currently list an ecological community as being threatened through a non-statutory process if the community is presumed to be totally destroyed or at risk of becoming totally destroyed. The *Biodiversity Conservation Act 2016* will provide for the statutory listing of threatened ecological communities (TECs) by the Minister when the relevant Parts of the Act are proclaimed following the preparation of enabling Regulations. The new legislation also describes statutory processes for preparing recovery plans for TECs, the registration of their critical habitat, and penalties for unauthorised modification of TECs.

The department has been identifying and listing threatened ecological communities since 1994 through the non-statutory process.

The WA Minister for Environment has endorsed 69 ecological communities as threatened in the following categories:

- 21 critically endangered
- 17 endangered
- 28 vulnerable
- 3 presumed totally destroyed.

31 of these TECs, or components of them, are also listed under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999. As at June 2017, an additional 391 ecological communities (community types and sub-types) with insufficient information available to be considered a TEC, or which are rare but not currently threatened, have been placed on the Priority list and referred to as priority ecological communities (PECs).

Table 5: Categories of DPaW Threatened Ecological Communities

PD	**Presumably Totally Destroyed** An ecological community that has been adequately searched for but for which no representative occurrences have been located.
CE	**Critically Endangered** An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future.
E	**Endangered** An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future.
V	**Vulnerable** An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

The EPBC Act provides for the strong protection of TEC's, which are listed under section 181 of the Act and are described as 'Critically Endangered', 'Endangered' or 'Vulnerable' under section 182. Schedules of protected TECs maintained pursuant to the EPBC Act are based on the same FCT's as adopted by DBCA, however not all TEC's listed by the DBCA are scheduled under the EPBC Act.

An EPBC Act Protected Matters Report indicated there is one known Threatened Ecological Community (TEC) likely to occur within a 10km radius of the area, this is listed in **Table 6**.

Table 6: EPBC listed Threatened Ecological Communities

Species Name	Conservation Code	Comments
Eucalypt Woodlands of the Western Australian Wheatbelt	Critically Endangered	Community likely to occur within area

Although there are areas that contain Eucalypt woodland in good condition within the subject area, there is no area that is greater than 2ha, with an intact understorey. Most areas were dominated by Woodlands dominated by mallee trees, non-eucalypt woodlands, e.g. with jam, Sheoak, Banksia, isolated paddock trees and very small remnants and patches that are degraded. These areas are not recognised as being a representation of the Eucalypt Woodlands of the Western Australian Wheatbelt TEC. Therefore the information provided suggests that the TEC Eucalypt Woodlands of the Western Australian Wheatbelt is not present within the vegetation surveyed during this assessment.

4. SIGNIFICANT LANDSCAPES

There are patches of Granite Outcrops within the subject site. One area in particular as shown on **Figure 6** also support small caves: Granite outcrops are important as seasonal resources and temporary refuge for fauna. There are a number of reptile species that occur in the Wheatbelt that are restricted to granite outcrops. Western Australian granite outcrops support diverse flora habitats in the southwest. Granite Outcrops also support aquatic invertebrates from granite pools. It is recommended that further surveys are undertaken within the Granite Outcrops to identify the potential habitats for native flora and fauna. The location of the Granite Outcrop is shown on **Figure 6 and Photographic Plates 1, 2 & 3.**

5. VEGETATION ASSESSMENT RESULTS

A total of 59 taxa, comprising of 20 families and 50 genera were recorded on site. A list of these species has been provided in **Appendix A**. Species representation was greatest among the Poaceae, Myrtaceae and Asteraceae families.

5.1 INTRODUCED SPECIES

Eleven introduced flora species were recorded on the site. Species representation was greatest among the, Poaceae and Asteraceae, families. This represents 19% of the total number of flora species recorded on site.

5.2 THREATENED AND PRIORITY FLORA

No species of Threatened (T) or Priority Flora were recorded during the survey; No other flora, pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act* 1950 and listed by the Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey. The botanical survey was undertaken in spring to coincide with the flowering times of the threatened species.

5.3 EPBC LISTED AND THREATENED ECOLOGICAL COMMUNITIES

No EPBC listed species or TEC's were recorded during the survey. Eucalypt woodland has been recorded during this survey, however does not meet the requirements as outlined in the guide '*Eucalypt Woodlands of the Western Australian Wheatbelt*: a nationally protected ecological community, Commonwealth of Australia 2016'.

5.4 LOCAL VEGETATION COMMUNITIES

Vegetation structure is used to determine the coverage in each vegetation community recorded. Definitions are shown in **Table 7** below. These vegetation structure classes are the ones defined and used in Bush Forever (2000, Volume 2, Table 11 and p. 493) to describe vegetation in Bush Forever sites.

Table 7: Vegetation Structure Classes

Life Form/ Height Class	Canopy Cover (percentage)			
	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees < 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs <1m	Closed Low Heath	Open Low Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Four vegetation communities were represented on the site at a local level; this has been described below in **Table 8.** Photographic representations of these vegetation communities are shown in the Quadrat data sheets in **Appendix B.** Vegetation communities, condition and quadrat locations are shown on **Figure 4, 5 & 6.**

Table 8: Local Vegetation Communities Recorded at the Proposed Solar Facility, Merredin, September 2017

Mapping Code	Community Descriptions
Vegetation Community 1 – *Eucalyptus burracoppinensis* Forrest with grass understorey	
1	Low Closed Forrest of *Eucalyptus burracoppinensis* over very open grassland of introduced species.
Mapping Code	**Community Descriptions**
Vegetation Community 2 – Grevillea Shrubland	
2	Tall shrubland of *Hakea francisiana* over open shrubland of *Acacia neurophylla subsp. erugata* over open grassland of *Amphipogon caricinus var. caricinus*
Mapping Code	**Community Descriptions**
Vegetation Community 3 – Acacia Shrubland	
3	Shrubland of *Acacia coolgardiensis* and *Acacia neurophylla subsp. erugata,* over low open shruland of *Hakea francisiana* over a mix of herbs and grasses.
Mapping Code	**Community Descriptions**
Vegetation Community 4 – Acacia Shrubland **Granite Outcrop**	
4	Shrubalnd of *Acacia lasiocalyx* , over grassland of *Austrostipa flavescens* and *Aristida contorta*

5.5 VEGETATION CONDITION

Many bushland remnants have been historically subject to ongoing degradation and are especially susceptible to disturbances arising as a result of indirect impacts from surrounding developments and human activity. Degradation is caused by a wide range of factors, including isolation and edge effects, weed invasion, plant diseases, changes in fire frequency and behaviour, landscape fragmentation, increased predation on native fauna by feral animals, decrease in species richness and general modification of ecological function. These issues can affect the biodiversity rating and ecological viability of areas of remnant vegetation and should be assessed in line with conservation values.

The Vegetation Condition was rated according to the Vegetation Condition Scale commonly used in the Perth Metropolitan Region (Government of WA 2000). The definitions are described in **Table 9** below.

Table 9: Vegetation Condition Scale (Taken from Bush Forever (Government of WA 2000))

Vegetation Condition	Definition
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing
Good (4)	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

In general, the vegetation condition ranged from "Completely Degraded" to "Very Good" in the study area. Vegetation condition mapping is provided on **Figure 5.**

6. SIGNIFICANT TREE ASSESSMENT

A preliminary survey for habitat trees, in particular Black Cockatoo habitat trees was undertaken within the project area. During this assessment only isolated trees were assessed. In areas where there were multiple trees, the GPS location, the approximate number of trees and species was recorded. Significant trees with a diameter greater than 300mm (for *Eucalyptus wandoo* and *Eucalyptus salmonophloia*) were recorded as potential fauna habitat trees. Each tree was surveyed for health, species, diameter and the presence of hollows or multiple stems. Each tree was recorded with a GPS location.

A tree habitat assessment is the primary technique used to inform decisions on significant impact for black cockatoos. In potential breeding habitats the measurements of the diameter of the tree at breast height of is used to determine whether the tree meets the definition of breeding habitat. Any area within the range of the black cockatoos that contains known food or nesting plant species is considered to be potential habitat for the species.

Black cockatoos are long-lived, slow-breeding birds that display strong pair bonds and probably mate for life. These characteristics exacerbate the effects of population decline and habitat loss, and make population recovery very slow. All three black cockatoos (Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris* Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii* and Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*) breed in hollows in very long-lived trees. Hollows large enough for nesting black cockatoos are usually only found in trees that are more than 200 years old. Trees in this search area, (*Eucalyptus wandoo* and *Eucalyptus salmonophloia* with a DBH greater than 300mm are estimated as being 200yrs old and older. Currently, the overall population trend for all three black cockatoo species is declining. Largescale clearing has seen a significant proportion of original black cockatoo habitat removed. Habitat loss and alteration continue to contribute to the major decline in population density and occupancy of habitat across the range.

Carnaby's cockatoo breeds in the semi-arid and sub-humid interior ("wheatbelt") and some locations along the south and west coasts. This species is known to have its breeding range to include Merredin. It is recommended that further survey work is required to determine if the trees are suitable breeding habitat trees, as outlined in the *EPBC Act referral guidelines for three threatened black cockatoo species*. Tree information is provided in **Appendix C** and the locations are shown on **Figure 6.**

7. CONCLUSIONS AND RECOMMENDATIONS

The recent Flora and Vegetation Assessment at the Proposed Solar Facility in Merredin identified a number of flora species. The vegetation ranged from "Completely Degraded" to "Very Good" Condition".

Four Vegetation Types at a local level was recorded during the survey. No species of Threatened (T), Priority Flora or Threatened Ecological Communities (TEC's) pursuant to the *Biodiversity Conservation Act* 2016 and listed by Department of Biodiversity, Conservation and Attractions (DBCA) were located during the time of the survey.

Based on the results of this survey, if clearing works are undertaken, Del Botanics proposes the following recommendations:

- Where possible, vegetation in "Good" or better condition is retained;
- Where possible, large mature trees that provide fauna habitats are retained; and
- Undertake a Significant Tree Assessment on each tree over 300mm in diameter.

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https://www.environment.gov.au/system/files/resources/895d4094-af63-4dd3-8dff-ad2b9b943312/files/referral-guidelines-wa-black-cockatoo.pdf

FIGURES

FIGURE 1: LOCATION OF SUBJECT SITE

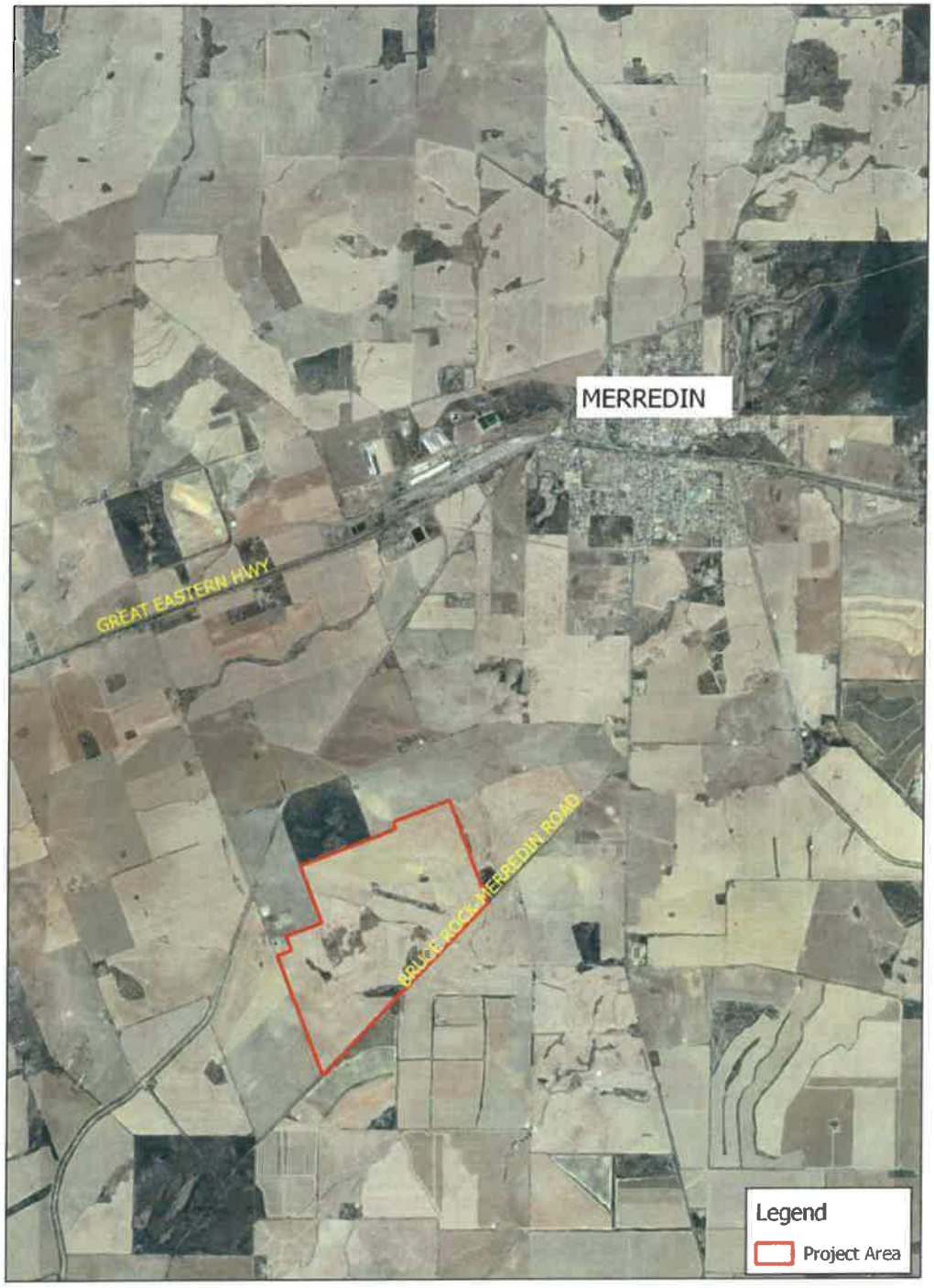

FIGURE 1 - SITE LOCATION

1:70,000

0 1000 2000 3000 4000 m

FIGURE 2: PROJECT SITE

FIGURE 2 - PROJECT AREA

1:20,000

0 250 500 750 1000 m

FIGURE 3: BEARD MAPPING

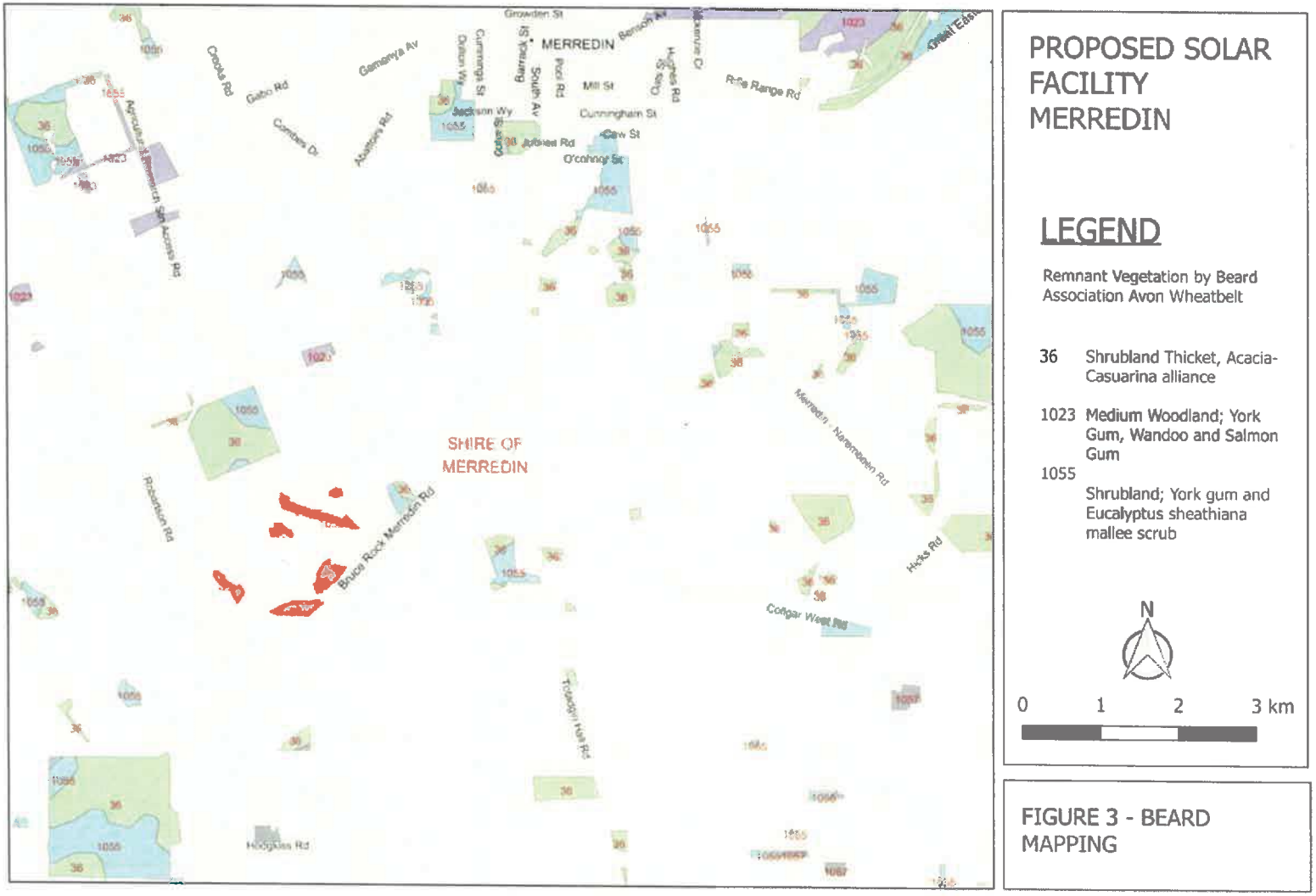

FIGURE 4: VEGETATION COMMUNITIES

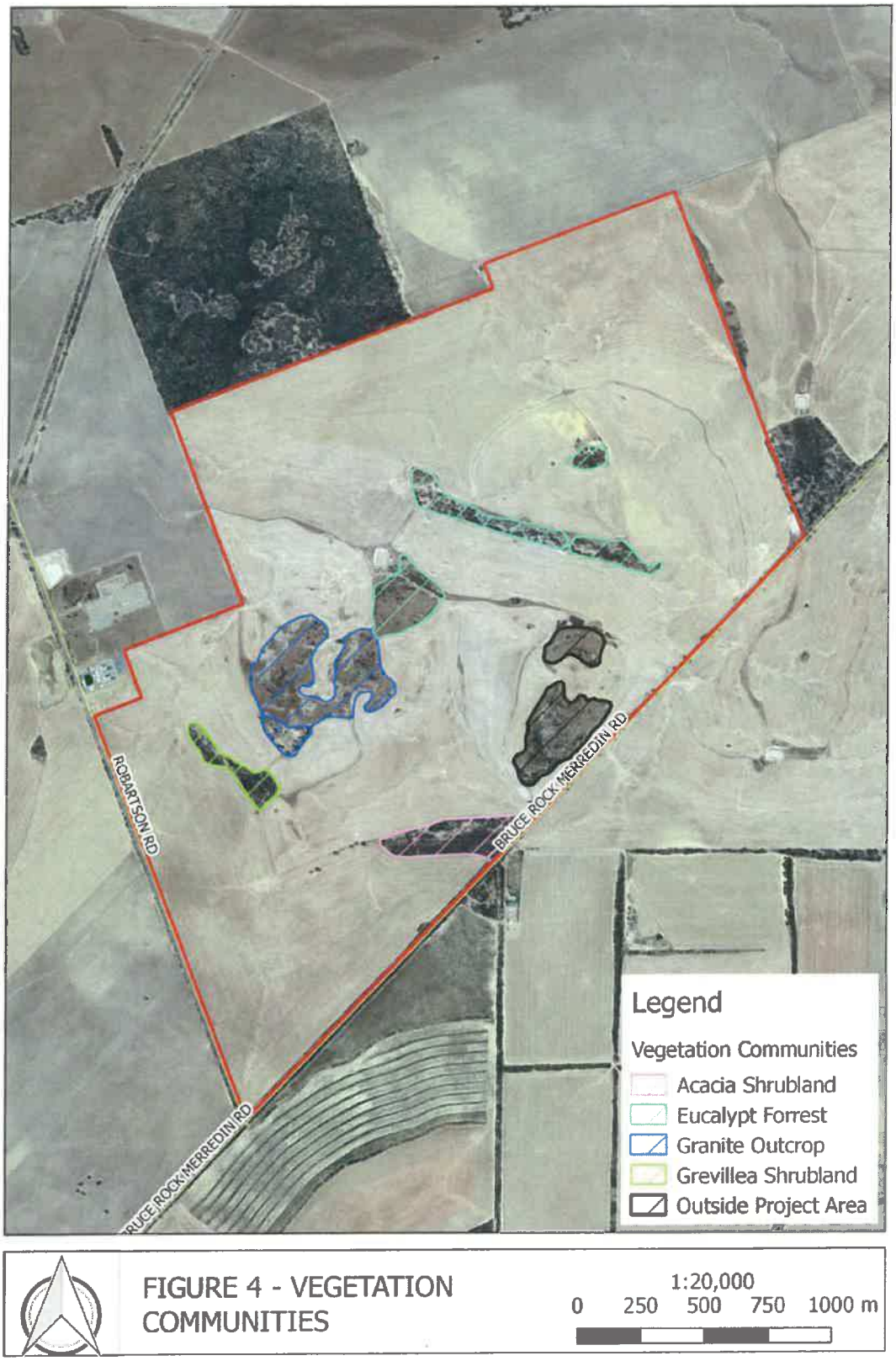

FIGURE 4 - VEGETATION COMMUNITIES

1:20,000

0 250 500 750 1000 m

FIGURE 5: VEGETATION CONDITION

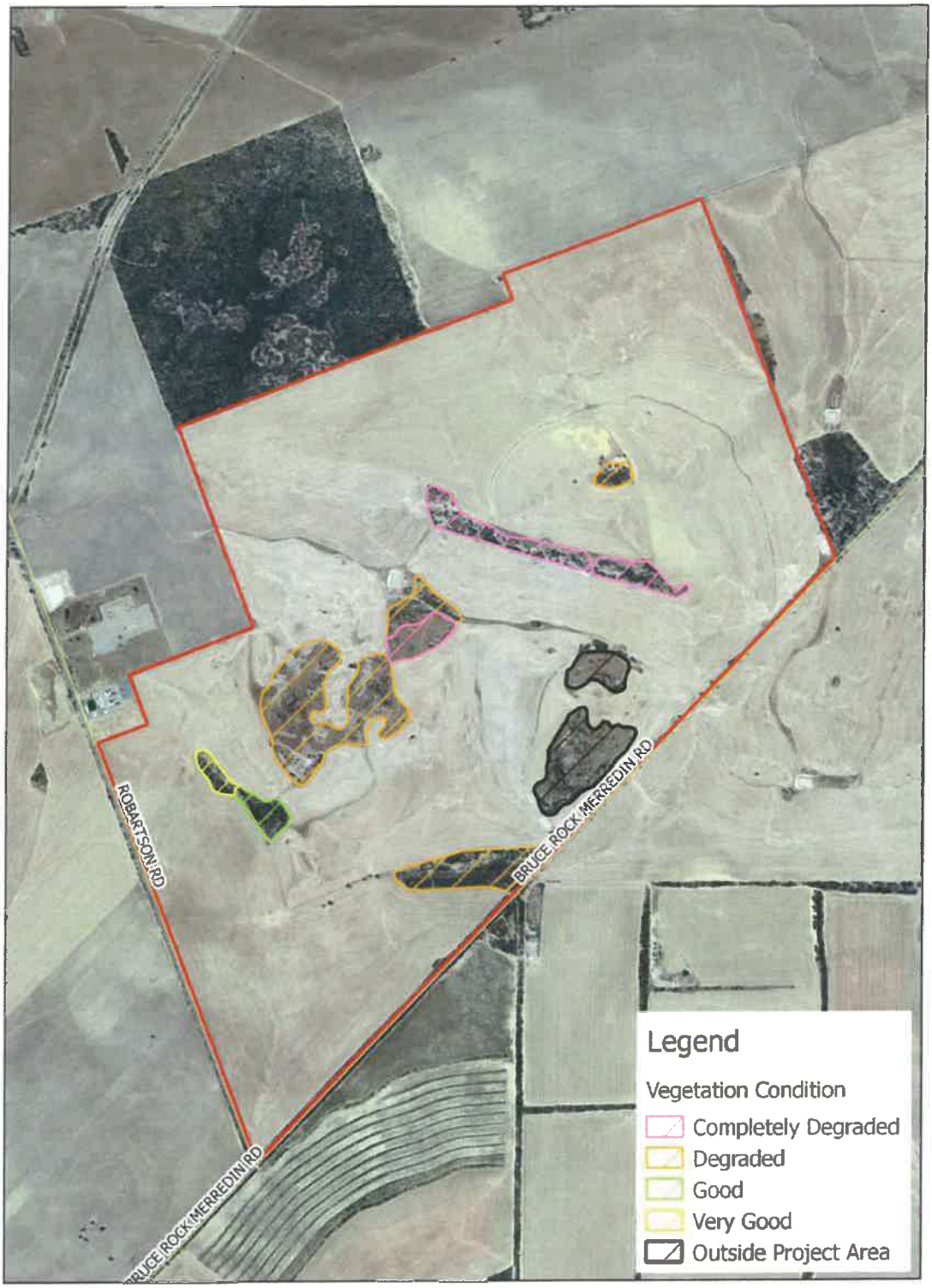

FIGURE 5 - VEGETATION CONDITION

1:20,000

0 250 500 750 1000 m

FIGURE 6: QUADRAT LOCATIONS, SIGNIFICANT TREES AND SIGNIFICANT AREAS

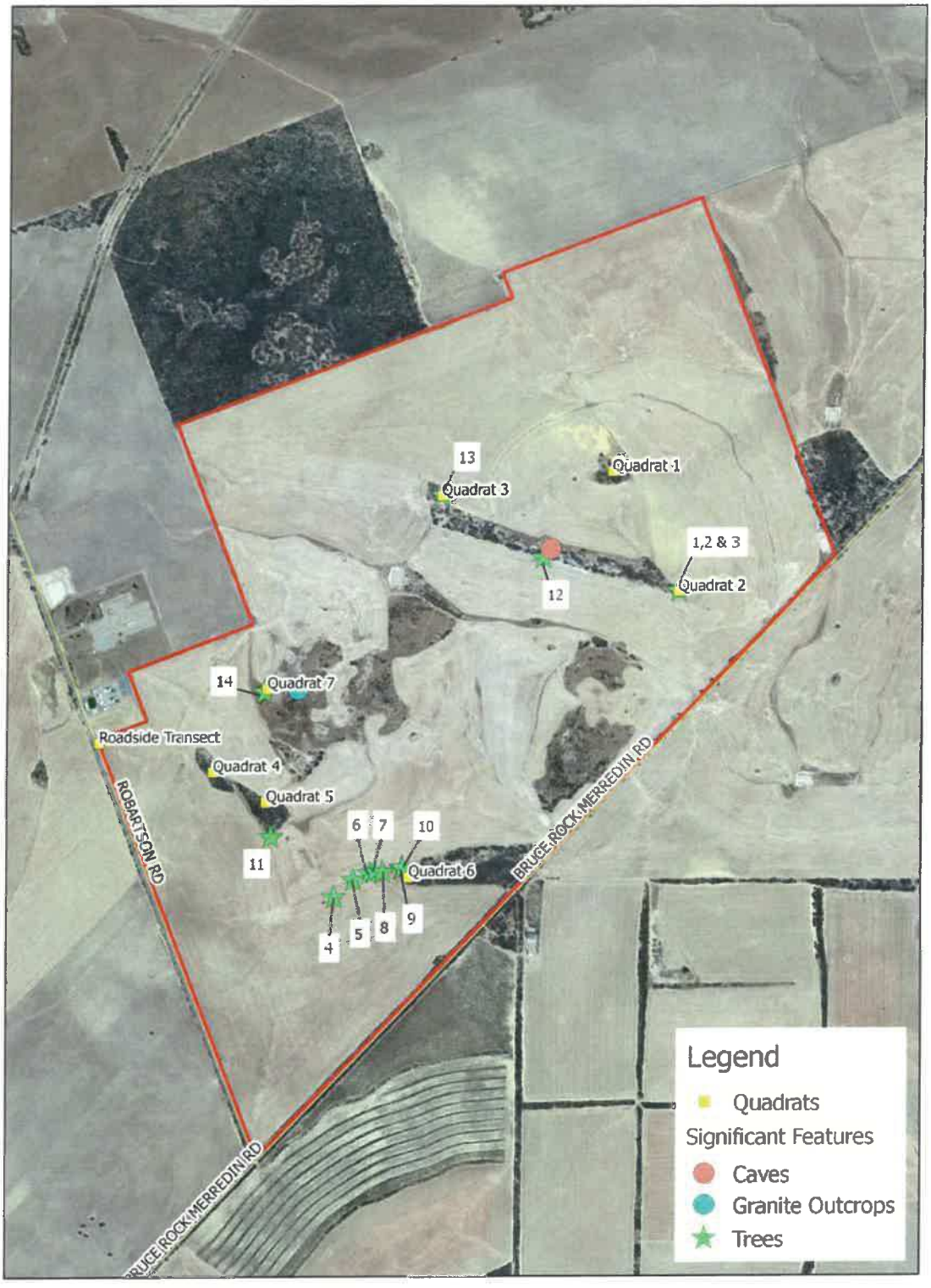

FIGURE 6 - QUADRATS, SIGNIFICANT TREES AND FEATURES

1:20,000

0 250 500 750 1000 m

PHOTOGRAPHIC PLATES

Plate 1: Caves

Plate 2: Caves system

Plate 3: Granite Outcrop

APPENDIX A
VASCULAR PLANT SPECIES RECORDED

APPENDIX A: VASCULAR PLANT SPECIES RECORDED AT THE PROPOSED SOLAR FACILITY, MERREDIN SEPTEMBER 2017

(*DENOTES A WEED SPECIES)

Family	* Genus/Species
Aizoaceae	**Cleretum papulosum*
	Mesembryanthemum nodiflorum
Amaranthaceae	*Ptilotus polystachyus*
Araliaceae	*Trachymene ornata*
Asparagaceae	*Thysanotus patersonii*
Asteraceae	**Arctotheca calendula*
	**Hypochaeris glabra*
	**Ursinia anthemoides*
	Actinobole uliginosum
	Angianthus tomentosus
	Brachyscome perpusilla
	Calocephalus multiflorus
	Chthonocephalus pseudevax
	Hyalosperma glutinosum subsp. glutinosum
	Podolepis capillaris
	Waitzia acuminata var. acuminata
Casuarinaceae	*Allocasuarina acutivalvis subsp. acutivalvis*
Crassulaceae	*Crassula exserta*
Cupressaceae	*Callitris canescens*
Cyperaceae	*Lepidosperma costale*
Dilleniaceae	*Hibbertia glomerosa var. glomerosa*
Fabaceae	*Acacia coolgardiensis*
	Acacia longispinea
	Acacia neurophylla subsp. erugata
	Acacia lasiocalyx
	**Trifolium sp*
Geraniaceae	**Erodium ?botrys*
Goodeniaceae	*Goodenia havilandii*
Haloragaceae	*Glischrocaryon aureum*
Hemerocallidaceae	*Dianella revoluta*
Malvaceae	*Seringia velutina*
Myrtaceae	*Baeckea elderiana*
	Calothamnus gilesii
	Eucalyptus burracoppinensis
	Eucalyptus loxophleba subsp. supralaevis
	Eucalyptus wandoo
	Eucalyptus salmonophloia
	Leptospermum nitens
	Melaleuca eleuterostachya
	Melaleuca lateriflora
	Rinzia sp.
	Thryptomene cuspidata
Poaceae	**Aira cupaniana*

	**Avena barbata*
	**Ehrharta longiflora*
	**Hordeum leporinum*
	**Lolium perenne*
	Amphipogon caricinus var. caricinus
	Aristida contorta
	Austrostiopa elegantissima
	Austrostipa flavescens
	Monachather paradoxus
	Neurachne alopecuroidea
	Rytidosperma caespitosum
	Spartochloa scirpoidea
Proteaceae	*Grevillea paradoxa*
	Hakea francisiana
	Hakea lissocarpha
Santalaceae	*Santalum acuminatum*

APPENDIX B
QUADRAT DATA

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin, PSF	**Date:** 22/09/17	**Site:** Q1
GPS Datum: 50 0618367 6510491	**Topography:** Upper slope	**Litter cover:** 10 % twigs, 5 % leaves Logs 10%
Age since fire: >10 yrs	**Disturbance:** Hi Med Lo	**Soils:** Sandy loam
Vegetation Description: Eucalypt mallee over weedy understorey		
Vegetation Condition: Degraded.		
Observations: Dominated by weed species, areas has been impacted by sheep and farming practices		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Eucalyptus burracoppinensis	400	80	20	80
	**Cleretum papulosum*	10	10	90	70
	**Ehrharta longiflora*	10	100		<1
	**Arctotheca calendula*	10	100		5
	**Crassula exserta*	5	80	20	1
	**Lolium perenne*	5	100		1

	**Aira cupaniana*	5	100		<1
	Austrostipa flavescens	15	100		<1
	Amphipogon caricinus var. caricinus	10	100		<1
Opp	*Rinzia sp.*				
Opp	**Ursinia anthemoides*				
Opp	*Waitzia acuminata var. acuminata*				
Opp	*Austrostiopa elegantissima*				
Opp	*Goodenia havilandii*				

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merriden, PSF	**Date:** 17/10/2016	**Site:** Q2
GPS Datum: 50 0618617 6510033	**Topography:** mid slope	**Litter cover:** 20 % twigs, 10 % leaves 10% Logs
Age since fire: >10 yrs	**Disturbance:** Hi Med Lo	**Soils:** brown sandy loam
Vegetation Description: Eucalypt Mallee Woodland/Wandoo		
Vegetation Condition: Completely Degraded – Parkland Cleared		
Observations: No native understorey. Parkland cleared, sheep grazing		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Eucalyptus wandoo	1000	100		20
	Allocasuarina acutivalvis subsp. acutivalvis	10	100		10
	Eucalyptus burracoppinensis	10	100		10
	**Lolium perenne*	30	100		<1
	**Hordeum leporinum*	20	100		<1

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin, PSF	**Date:** 22/09/17	**Site:** Q3
GPS Datum: 50 617717 6510398	**Topography:** upper slope	**Litter cover:** 10 % twigs, 10 % leaves % logs
Age since fire: >10 yrs	**Disturbance:** Hi Med **Lo**	**Soils:** clay/loan
Vegetation Description: Wandoo Woodland		
Vegetation Condition: Completely Degraded		
Observations: Parkland cleared, limited native understorey		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Eucalyptus wandoo	1000	100		15
	Allocasuarina acutivalvis subsp. acutivalvis	100	100		5
	Mesembryanthemum nodiflorum	20	100		<1
	**Arctotheca calendula*	10	100		<1
	**Hordeum leporinum*	10	100		<1
	Angianthus tomentosus	5	100		<1
Opp	*Callitris canescens*				

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin, PSF	**Date:** 22/09/17	**Site:** Q4
GPS Datum: 50 0617055 6509229	**Topography:** mid slope	**Litter cover:** 20 % twigs, 10 % leaves 5% logs Bare ground 60%
Age since fire: >10 yrs	**Disturbance:** **Hi** Med Lo	**Soils:** Loam
Vegetation Description: Grevillea/grass shrubland		
Vegetation Condition: Good- Very Good		
Observations: Limited weeds, increased diversity, less sheep grazing, edge effects		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Grevillea paradoxa	100	100		20
	Waitzia acuminata var. acuminata	5	100		<1
	Austrostiopa elegantissima	15	100		<1
	Amphipogon caricinus var. caricinus	30	20	80	30
	Acacia neurophylla subsp. erugata	100	100		10
	Trachymene ornata	5	100		<1
	Allocasuarina acutivalvis subsp. acutivalvis	100	100		<1
	Seringia velutina	100	100		5
	Rytidosperma caespitosum	30	100		<1
	Neurachne alopecuroidea	10	100		<1

	Chthonocephalus pseudevax	5	100		<1
	Thysanotus patersonii	T	100		<1
	Podolepis capillaris	10	100		<1
	Hyalosperma glutinosum subsp. glutinosum	5	100		<1
	Brachyscome perpusilla	5	100		<1
	Calocephalus multiflorus	2	100		<1
Opp	*Dianella revoluta*				

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin PSF	**Date:** 22/09/17	**Site:** Q5
GPS Datum: 50 0617055 6509229	**Topography:** upper slope	**Litter cover:** 20 % twigs, 40 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance:** **Hi** Med Lo	**Soils:** gravel orange/granite outcrop
Vegetation Description: Casuarina/Acacia Mallee		
Vegetation Condition: Good		
Observations: Limited number of understorey species, 50% granite outcrop		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Calothamnus gilesii	120	100		10
	Acacia neurophylla subsp. erugata	150	90	10	15
	Allocasuarina acutivalvis subsp. acutivalvis	400	100		20
	Waitzia acuminata var. acuminata	5	100		<1
	Hyalosperma glutinosum subsp. glutinosum	5		100	2
	Austrostipa flavescens	10	100		<1
	Grevillea paradoxa	100	100		5
	Thysanotus patersonii	T	100		<1
	**Aira cupaniana*	5	100		<1

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin PSF	**Date:** 22/09/17	**Site:** Q6
GPS Datum: 50 0617597 6508943	**Topography:** mid slope	**Litter cover:** 20 % twigs, 60 % leaves 10% logs
Age since fire: >10 yrs	**Disturbance:** Hi Med **Lo**	**Soils:** gravel/loam orange/brown
Vegetation Description: Acacia shrubland		
Vegetation Condition: Degraded		
Observations: Weedy understorey, sheep grazing		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Acacia coolgardiensis	200	100		10
	Acacia neurophylla subsp. erugata	150	100		20
	Hakea francisiana	100	100		10
	Hyalosperma glutinosum subsp. glutinosum	10		100	<1
	Rinzia sp.	40	100		5
	Austrostipa flavescens	40	100		<1

	Waitzia acuminata var. acuminata	10	100		<1
Opp	*Eucalyptus burracoppinensis*				
Opp	*Melaleuca eleuterostachya*				

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin PSF	**Date:** 22/09/17	**Site:** Q7
GPS Datum: 50 0617058 6509661	**Topography:** upper slope	**Litter cover:** 20 % twigs, 20 % leaves 10% logs
Age since fire: **>10** yrs	**Disturbance:** Hi Med **Lo**	**Soils:** granite outcrop
Vegetation Description: Acacia/Quandong		
Vegetation Condition: Good		
Observations: Granite outcrop		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Dianella revoluta	100	100		10
	Acacia lasiocalyx	200	100		20
	**Aira cupaniana*	5	100		1
	Aristida contorta	30	100		20
	**Avena barbata*	15	100		1
	Austrostipa flavescens	20	100		60
	Actinobole uliginosum	5	100		<1
	Chthonocephalus pseudevax	5	100		<1
	Podolepis lessonii	5	100		1
	Thysanotus patersonii	T	100		<1
	**Hypochaeris glabra*	5	100		1
	**Ehrharta longiflora*	15	100		1
	**Arctotheca calendula*	10	100		<1
	**Trifolium sp*	10	100		<1
	**Erodium ?botrys*	10	100		<1
	Crassula exserta	10	100		<1
	**Ursinia anthemoides*	5	100		1
	Spartochloa scirpoidea	60	100		4
Opp	*Sanatlum accuminatum*				
Opp	*Hakea lissocarpha*				
Opp	*Lepidosperma costale*				
Opp	*Baeckea elderiana*				

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FIELD SHEET – FLORA AND VEGETATION SURVEY

Job Code: Merredin PSF	**Date:** 22/09/17	**Site:** RoadsideTranscet
GPS Datum: 50 0616421 6509456	**Topography:** mid slope	**Litter cover:**
Age since fire: >10 yrs	**Disturbance:** Hi Med **Lo**	**Soils:** sand
Vegetation Description: Acacia woodland		
Vegetation Condition: Good		
Observations: Road verge approximately 200 meters from power facility driveway		

Coll No.	Taxon	Ht (cm)	% Alive	% Dead	% Cover
	Dianella revoluta				
	Rytidosperma caespitosum				
	Ptilotus polystachyus				
	Acacia longispinea				
	Hibbertia glomerosa var. glomerosa				
	Glischrocaryon aureum				
	Seringia velutina				
	Austrostiopa elegantissima				
	Grevillea paradoxa				
	Allocasuarina acutivalvis subsp. acutivalvis				
	Baeckea elderiana				
	Austrostipa flavescens				
	Rinzia sp.				

	Hakea francisiana				
	Leptospermum nitens				

APPENDIX C
SIGNIFICANT TREE LOCATIONS

Significant trees recorded at the proposed Solar Facility, Merredin

Species	Map Reference Number	GPS Location GDA94/MGA Zone 50	Height (m)	DBH (mm)	Condition	Comments
Eucalyptus wandoo	1	0618617 6510033	8	785	Good	2 Hollows (1 large/ 1 medium)
Eucalyptus wandoo	2	0618617 6510033	9	691	Good	1 large hollow
Eucalyptus wandoo	3	0618617 6510033	9	659	Good	1 medium hollow
Eucalyptus salmonophloia	4	0617312 6508865	16	879	Good	2 small hollows
Eucalyptus salmonophloia	5	0617385 6508931	14	1068	Good	2 Hollows, current birds nest
Eucalyptus wandoo	6	0617448 6508956	12	744	Good	2 Hollows (1 large/ 1 medium)
Eucalyptus salmonophloia	7	0617466 6508964	18	691	Good	
Eucalyptus wandoo	8	0617496 6508961	14	864	Good	
Eucalyptus wandoo	9	0617569 6508974	14	691	Good	
Eucalyptus wandoo	10	0617572 6508977	12	581	Good	
Eucalyptus wandoo	11	0617073 6509095	10		Good	
Eucalyptus wandoo	12	0618103 6510160	Various	Various	Good	Large number of Wandoo's greater than 300mm in diameter
Eucalyptus wandoo	13	0617717 6510398	Various	Various	Good	15 + Wandoo's, greater than 300mm in diameter
Santalum acuminatum	14	0617047 6509649	4		Good	Significant tree for its species