FLORA, VEGETATION AND FAUNA ASSESSMENT

OF THE FLAT ROCKS WIND FARM

SURVEY AREA

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Moonies Hill Energy

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In particular, it should be noted that this report is based on the scope of services defined Moonies Hill Energy, budgetary and time constraints imposed Moonies Hill Energy, the information supplied by Moonies Hill Energy (and its agents), and the method consistent with the preceding.

Moonies Hill Energy Pty Ltd

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1. SUMMARY

Mattiske Consulting Pty Ltd was commissioned by the Moonies Hill Energy to undertake a review of the flora, vegetation and fauna values on the proposed Flat Rocks Wind Farm location. The proposed development occurs primarily within cleared agricultural areas. Therefore, the effort concentrated on desktop reviews and an assessment of the main remnants and roadside vegetation that may be disturbed by vehicle movement and installation of the wind farm facilities. Two experienced biologists completed the site assessments on the 29th of September to 1st October, 2010. In addition, a review of the fauna values were discussed with experienced zoologists.

Flora

A total of 77 vascular plant taxa from 59 plant genera and 22 plant families were recorded within the Flat Rocks Wind Farm survey area. The most prominent families represented within the survey area were Poaceae (15 taxa), Myrtaceae (13 taxa), Fabaceae (9 taxa), and Asteraceae (9 taxa).

Rare, Priority and Threatened Flora

There were no Declared Rare and Priority Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA] and as listed by the Department of Environment and Conservation (2010e) that were recorded within the Flat Rocks Wind Farm survey area (Appendix A1). Twenty one sites were chosen within the Moonies Hill survey area (Table 2).

No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (Department of the Sustainability, Environment, Water, Population and Communities 2010b) were recorded during the survey within the Flat Rocks Wind Farm survey area.

Threatened Ecological Communities

No threatened ecological communities as defined by the EPBC Act (1999) or the Department of Environment and Conservation (2010c) were located in this survey area.

Fauna

Although a range of potential fauna values were sourced from a desktop assessment of potential rare and threatened species; in view of the degree of degradation unless remnant areas are likely to be disturbed there should not be any significant issues in relation to the native fauna species. The degree of degradation is evident from the series of photographs in Appendix D.

Recommendations

Should the development of the Flat Rocks Wind Farm go ahead the following recommendations are made as a means of minimizing the impacts of infrastructure activities on the flora, vegetation and fauna values in the area:

- Limit ground disturbance and clearing of vegetation to designated areas and access routes, avoiding habitat trees (larger trees and trees with hollows) wherever possible;
- Maintain existing drainage systems, ensuring tracks and other infrastructure areas do not disrupt or divert historic water flow patterns;
- Remove and stockpile topsoil, log debris and leaf litter where possible for use in future rehabilitation programs. If possible, stockpiled topsoil should be directly replaced on disturbed areas;

- Minimise soil disturbance during clearing and practice standard vehicle hygiene to ensure introduced (exotic) species do not become established within the Flat Rocks Wind Farm survey area;
- An introduced species management plan will prevent the spread of declared introduced species; and
- All threatening processes to native vegetation are minimized.

In summary, there should be no impediments to the development of the wind farm facilities providing the remnant vegetation areas (including less disturbed road verges) are not disturbed.

2. INTRODUCTION

Mattiske Consulting Pty Ltd was commissioned in September 2010 by Moonies Hill Energy to undertake a review of the potential flora, vegetation and fauna values on the proposed Flat Rocks Wind Farm.

The proposed Flat Rocks Wind Farm survey area is located approximately 20km southeast of the town of Kojonup, 27km northwest of Tambellup, 16km west of Broomehill and 27km southwest of Katanning. The survey area is bounded by Broomehill-Kojonup Road in the north, Tambellup West Road in the south, and situated between Potts Road to the east and Palomar Road to the west.

2.1 Climate

The Flat Rocks Wind Farm survey area lies within the Southern Jarrah Forest Subregion on the border of the Avon Wheatbelt subregion (Department of Environment and Conservation 2010a). Beard (1990) described the climate of the Southern Jarrah Forest as warm mediterranean with winter precipitation between 600 and 1200mm and 5 - 6 dry months per year. The climate of the Avon Wheatbelt is described as dry, warm mediterranean, with winter precipitation of 300 – 650mm and 7 – 8 dry months per year (Beard 1990).

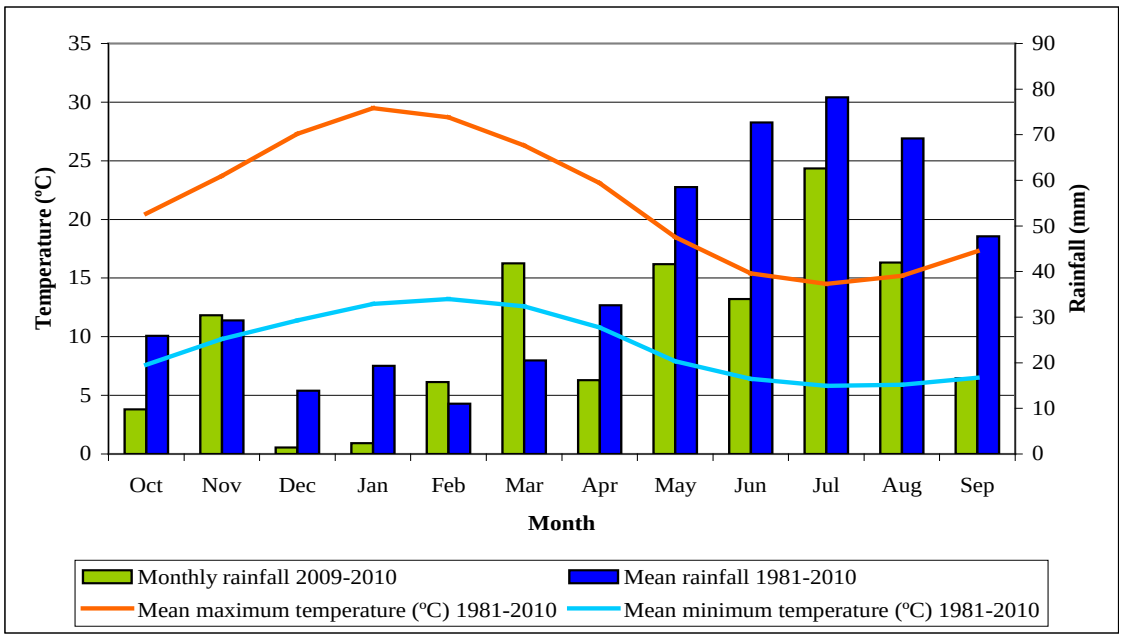


Figure 1: Climatic Averages for Kojonup (Bureau of Meterology 2010)

2.2 Regional Vegetation

The Flat Rocks Wind Farm survey area is located within the Southern Jarrah Forest subregion within 5km of the border of the Avon Wheatbelt region. The Southern Jarrah Forest subregion is characterised by jarrah forest on duricrusted plateaus and loam soils of valleys, with marri-wandoo woodlands on laterite-free soils (Beard 1990). Typical vegetation of the Avon Wheatbelt region includes scrub-heath on sandplains, *Acacia-Casuarina* thickets on ironstone gravels, woodlands of Eucalyptus loxophleba, Eucalyptus salmonophloia and Eucalyptus wandoo on varying soil types (Beard 1990). The proximity of Moonies Hill Wind Farm to the border of the Avon Wheatbelt region indicates that characteristics of both regions are likely to be present in the survey area. Katanning and Kojonup are in the Avon Province, which has a range of soil types, which range from sandy duplex soils, ironstone gravelly soils, loamy earth and duplex soils, sandy earth soil, deep sands and wet soils (CSIRO).

2.3 Clearing of Native Vegetation

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* dictate that any clearing of native vegetation in Western Australia requires a permit to do so from the Department of Environment and Conservation. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native vegetation, but not vegetation planted in a plantation or planted with commercial intent *Environmental Protection Act 1986*. In the *Environmental Protection Act 1986* Section 51A, clearing is defined as: the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage to some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

Ten clearing principles are specified in Schedule 5 of the *Environmental Protection Act 1986*:

1. Native vegetation should not be cleared if it comprises a high level of biodiversity.
2. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significant habitat for fauna indigenous to Western Australia.
3. Native Vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.
4. Native vegetation should not be cleared if it compromises the whole or part of, or is necessary for the maintenance of a threatened ecological community.
5. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.
6. Native vegetation should not be cleared if it is growing in, or in association with, and environment associated with a watercourse or wetland.
7. 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.
8. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.
9. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.
10. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 - Regulation 6 – Environmentally sensitive areas* are "the area covered by vegetation within 50 m of Rare Flora, to the extent to which the vegetation is continuous with the vegetation in which the Rare Flora is located". According to the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004 - Schedule 1 -- Low impact or other mineral or petroleum activities*, environmentally sensitive areas are non- permitted areas. Therefore Ministerial approval must be granted prior to any clearing of Declared Rare Flora, including a minimum of 50 m surrounding all populations of Rare Flora.

Environmental Protection (Clearing of Native Vegetation) Regulations 2004 - Regulation 6 – Environmentally sensitive areas, "The area covered by a threatened ecological community" is similarly considered an environmentally sensitive area and therefore non-permitted, unless Ministerial approval is granted.

2.4 Rare and Priority Flora

Species of flora and fauna are defined as Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation recognises these threats of extinction and consequently applies regulations towards population and species protection.

Rare Flora species are gazetted under subsection 2 of section 23F of the *Wildlife Conservation Act 1950* [WA] and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the *Wildlife Conservation Act 1950* [WA] 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."

Priority Flora are under consideration for declaration as 'Rare Flora', but are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Appendix A1 presents the definitions of Declared Rare and the four Priority ratings under the *Wildlife Conservation Act 1950* [WA] as extracted from Department of Environment and Conservation (2010b).

Rare Flora species can be listed as Threatened Flora species which are a matter of national environmental significance and are listed under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] (Department of Sustainability, Environment, Water, Population and Communities 2010a). A person must not take an action that has, will have, or is likely to have a significant impact on a listed threatened species or an ecological community, without approval from the Commonwealth Minister for the Environment, Water, Heritage and the Arts. Appendix A2 presents the definitions of the categories of Threatened Flora Species as extracted from the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth].

2.5 Declared Plant Species

Plant species are defined as Declared Plant species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* by Department of Agriculture and Food (2010) according to their threat to agriculture and the environment (Appendix A5). Mattiske Consulting Pty Ltd has electronic access to the "Declared Plants" database through licensing and an annual fee payment.

2.6 Threatened Ecological Communities (TECs)

Communities in Western Australia can be listed as 'Threatened Ecological Communities' (TECs) (Department of Environment and Conservation 2010c) once they have been defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee. TECs are listed under four categories; Presumed Totally Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) (Department of Environment and Conservation 2009d). Appendix A3 presents a summary of the definitions of Threatened Ecological Communities as extracted from the Department of Environment and Conservation (2010d). Some Western Australian TECs are also listed under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] (Department of Sustainability, Environment, Water, Population and Communities 2010a).

Possible Threatened Ecological Communities can be listed as Priority Ecological Communities (PECs) by the Department of Environment and Conservation (2010e). PECs are listed under five categories based on survey criteria and current knowledge, Priority 1, 2, 3, 4 and 5 Department of Environment and Conservation (2010e). Appendix A4 presents a summary of the definitions of Priority Ecological Communities as extracted from the Department of Environment and Conservation (2010e).

2.7 Local and Regional Significance

Flora or Vegetation may be locally or regionally significant in addition to statutory listings by the State or Federal Government.

In regards to Flora; species, subspecies, varieties, hybrids and ecotypes may be significant other than as Declared Rare Flora or Priority Flora, for a variety of reasons, including:

". a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;

. relic status;

. anomalous features that indicate a potential new discovery;

. being representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);

. the presence of restricted subspecies, varieties, or naturally occurring hybrids;

. local endemism/a restricted distribution;

. being poorly reserved" (Environmental Protection Authority 2004).

Vegetation may be significant because the extent is below a threshold level and a range of other reasons, including:

". scarcity;

. unusual species;

. novel combinations of species;

. a role as a refuge;

. a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;

. being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);

. a restricted distribution" (Environmental Protection Authority 2004).

Vegetation communities are locally significant if they contain Priority Flora species or contain a range extension of a particular taxon outside of the normal distribution. They may also be locally significant if they are very restricted to one or two locations or occur as small isolated communities. In addition, vegetation communities that exhibit unusually high structural and species diversity are also locally significant.

Vegetation communities are regionally significant where they are limited to specific landform types, are uncommon or restricted plant community types within the regional context, or support populations of Declared Rare Flora.

Determining the significance of flora and vegetation may be applied at various scales, for example, a vegetation community may be nationally significant and governed by statutory protection as well as being locally and regionally significant.

2.8 Fauna Species

A NatureMap search of the Moonies Hill Energy Wind Farm area (within a 20km radius of the survey area) was undertaken through a database search (Department of Environment and Conservation 2010f). In addition, a database search was undertaken on the Department of Sustainability, Environment, Water, Population and Communities 2010a) for nationally significant species.

Native fauna species are protected pursuant to the *Wildlife Conservation Act (1950)* [WA] and the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) and the International Union for Conservation of Nature and Natural Resources' Red List.

3. OBJECTIVES

The general aim of this report was to map and undertake a flora and vegetation assessment of the Flat Rocks Wind Farm. Specifically, the objectives include:

- Search the literature and databases to assess the potential flora and fauna values that may occur within the survey area;
- Search the remnant vegetation and streamzone areas within the Flat Rocks Wind Farm survey area for Rare and Priority Flora and record any opportunistic fauna sightings during the field study;
- Collect and identify the vascular plant species present in the Flat Rocks Wind Farm survey area;
- Review the conservation status of the vascular plant species and fauna species by reference to current literature and current listings by the Department of Environment and Conservation (2010a, 2010f), plant collections held at the Western Australian State Herbarium (Department of Environment and Conservation 2010a), and listed on the Department of Sustainability, Environment, Water, Population and Communities (2010a) under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth);
- Define and map the native vegetation communities and their condition;
- Define any management issues related to flora, vegetation and vertebrate fauna values;
- Provide recommendations on the local and regional significance of the vegetation communities; and
- Prepare a report summarising the findings.

4. METHODS

4.1 Desktop Assessment

An initial desktop search was conducted to establish the presence of any Declared Rare or Priority Flora and Fauna that may potentially occur within the survey area, using both NatureMap (Department of Environment and Conservation 2010f), and the Western Australian Herbarium database (Department of Environment and Conservation 2010a). The desktop search was confined to a 20km radius of the survey area as the footprint of the proposed clearing area is not expected to exceed this amount.

Further desktop reviews were then undertaken utilizing the national datasets as available on the Department of Sustainability, Environment, Water, Population and Communities (2010a).

4.2 Field Survey

The assessment of the flora, vegetation and fauna habitats of the Moonies Hill Energy Wind Farm was undertaken by two Experienced Biologists from Mattiske Consulting Pty Ltd on Wednesday the 29th September. Aerial photographs of the survey area were supplied by Dr Sarah Rankin from Moonies Hill Energy. A total of twenty one sampling sites were selected to sample the vegetation types within the remnants within survey area.

The flora and vegetation was described and sampled systematically at each survey site, and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted: GPS location, topography, percentage litter cover, soil type and colour, percentage of bare ground, outcropping rocks and their type, gravel type and size, time since fire and the percentage cover and average height of each vegetation stratum. For each vascular plant species, the average height and percent cover (both live and dead material) were recorded.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium. Where appropriate, plant taxonomists with specialist skills were consulted. Nomenclature of the species recorded is in accordance with the Department of Environment and Conservation (20010a).

Observations were undertaken on the condition of the fauna habitats and remnants.

Table 1: Potential Survey Limitations for Survey Area

Potential Survey Limitation	Impact on Survey	Reason
Sources of information and availability of contextual information (i.e. pre-existing background versus new material).	not a constraint	The study was undertaken in the Avon Botanical District which has been well studied and documented with ample literature available (e.g. Beard 1980, Beard 1990 and Beecham 2001). In addition the databases held at the State and National level were used to assess the potential fauna values.
Scope (i.e what life forms, etc., were sampled).	not a constraint	Rainfall in the months preceding the time of survey was lower than the average rainfall expected for the area (Bureau of Meteorology 2010). However the month of the survey recorded a higher average of rainfall therefore, it is plausible that life forms were sampled adequately during the time of the survey, including annuals
Proportion of flora collected and identified (based on sampling, timing and intensity).	not a constraint	We had 21 sites spread throughout all areas of remnant vegetation. This reflects the difficulty in obtaining adequate replications of sites containing similar species composition, due to the fragmented nature of the vegetation within the survey area.
Completeness and further work which might be needed (i.e was the relevant survey area fully surveyed).	not a constraint	The information collected during the survey was sufficient to assess the vegetation and potential fauna issues that may be present during the time of the survey.
Mapping reliability.	not a constraint	Aerial photography of a suitable scale was used to map the project area. Sites were chosen from these aerials on the basis of a 50-metre grid design starting at the designated boundary area proposed by the proponent. Sites were chosen in areas of remnant vegetation. Vegetation communities were assigned to each site based on topography, presence/absence and percent foliage cover of vegetation.
Timing, weather, season, cycle.	not a constraint	It is generally accepted that flora and vegetation surveys are conducted in spring following autumn rains in the Avon Wheatbelt (Environmental Protection Authority, 2004). Kojonup experienced below average rainfall in the few months preceding the time of survey but the month of the survey was above average (Figure 1) (Bureau of Meteorology, 2010).
Disturbances (fire flood, accidental human intervention, etc.).	not a constraint	Human-induced disturbances associated with pastoralism occur near the study area. However, apart from the encroachment of several weed species onto remnant bushland areas and very old rubbish, this should not be a constraint on the survey.
Intensity (in retrospect, was the intensity adequate).	not a constraint	Sites were chosen in remnant vegetation from a grid placed over the aerial maps for the entirety of the Lots. This resulted in a total of 21 sampling sites across the projected area.
Resources (i.e. were there adequate resources to complete the survey to the required standard).	not a constraint	The available resources were adequate to complete the survey.

Table 1: Potential Survey Limitations for Survey Area

Potential Survey Limitation	Impact on Survey	Reason
Access problems (i.e. ability to access survey area).	not a constraint	Existing roads and tracks enabled adequate access to survey representative vegetation and remnant areas within the survey area. Where access was not available by car, it was easily traversed by foot.
Experience levels.	not a constraint	All survey personnel had the appropriate training in sampling and identifying the flora of the region. Experienced botanists were consulted where plants could not be identified in the field and discussions were held with experienced zoologists.

5. RESULTS

5.1 Desktop Review

5.1.1 Flora

A desktop survey for flora which has the potential to occur in the vicinity of the survey area was undertaken using NatureMap (Department of Environment and Conservation 2010f), Florabase (Department of Environment and Conservation 2010a), Protected Matters search tool, the Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002 (Department of Environment and Conservation 2010k).

5.1.2 Rare and Priority Flora

A total of 10 Rare and Priority Flora have been listed as occurring, or potentially occurring, in the Flat Rocks Wind Farm (Department of Environment and Conservation 2010f). A summary of these species can be found in Table 2.

***Amperea protensa* (P3) EUPHORBIACEAE**

Amperea protensa is a decumbent perennial herb reaching 0.4m height and producing brown to cream to green flowers between November and January. The species is found on sandy soils in seasonally wet flats, depressions, and swampy areas (Department of Environment and Conservation 2010a). Forty-four specimens are housed at the Western Australian State Herbarium, mainly collected from sedgelands and heathlands (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Amperea protensa*.

***Banksia acuminata* (P4) PROTEACEAE**

Banksia acuminata is a prostrate, lignotuberous shrub reaching 20cm in height, producing yellow to orange flowers in October and occurring on gravelly soils (Department of Environment and Conservation 2010a). Thirty-three specimens are housed at the Western Australian State Herbarium, including two collected from Kojonup (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Banksia acuminate*.

Table 2: Rare and Priority Flora potentially occurring in the Flat Rocks Wind Farm survey area (Department of Environment and Conservation 2010f)

	Priority Level	
Species	**DEC**	**EPBC**
Amperea protensa	P3	-
Banksia acuminate	P4	-
Banksia mucronulata subsp. *Retrorsa*	R	T
Banksia subpinnatifida var. *Imberbis*	P2	-
Caladenia integra	P4	-
Caladenia x triangularis	P4	-
Calectasia obtuse	P3	-
Gastrolobium lehmannii	R	T
Melaleuca micromera	P3	-
Schoenus natans	P4	-

***Banksia mucronulata* subsp. *retrorsa* (R) PROTEACEAE**

Banksia mucronulata subsp. *retrorsa* is an erect, bushy, non-lignotuberous shrub reaching 2.5m in height. The species produces cream to yellow flowers between July and August and has been recorded as occurring on clay or clay loam soils on flats and rocky hills (Department of Environment and Conservation 2010a). Forty-two specimens are housed at the Western Australian State Herbarium, collected mainly from Tambellup, Broomehill, Cranbrook and Tunney (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Banksia mucronulata* subsp. *Retrorsa.*

***Banksia subpinnatifida var. imberbis* (R) PROTEACEAE**

Banksia subpinnatifida var. *imberbis* is an erect or straggling, non-lignotuberous shrub reaching 1.5m in height, producing yellow flowers between September and October. The species is found on laterites (Department of Environment and Conservation 2010a). Fifteen specimens are housed at the Western Australian State Herbarium, including one collected from Kojonup and one from Broomehill (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Banksia subpinnatifida* var. *imberbis.*

***Caladenia integra* (P4) ORCHIDACEAE**

Tuberous, perennial, herb, 0.2–0.5 m high. Fl. green, red, Sep–Oct. Clayey loam. Granite outcrops, rocky slopes (Department of Environment and Conservation 2010a). Forty-two specimens are housed at the Western Australian State Herbarium, associated mainly with *Allocasuarina* and *Eucalyptus* woodlands (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Caladenia integra*.

***Caladenia x triangularis* (P4) ORCHIDACEAE**

Caladenia x triangularis is a tuberous, perennial, yellow-flowered orchid. Seven specimens are housed at the Western Australian State Herbarium (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Caladenia x triangularis.*

***Calectasia obtusa* (P3) DASYPOGONACEAE**

Calectasia obtusa is an erect, low herb reaching 0.4m in height. The species has aerial roots and produces blue flowers between August and September. It occurs on sand, clay loam, gravel and laterite soils and has mainly been recorded on flat topography (Department of Environment and Conservation 2010a). Eighteen specimens are housed at the Western Australian State Herbarium, many recorded near Albany (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Calectasia obtusa.*

***Gastrolobium lehmannii* (R) FABACEAE**

Gastrolobium lehmannii is an erect, domed shrub that reaches 1.5m in height, and flowers orange, yellow, red and purple between September and October. This species is found on red clay and laterite, on low hilltops and breakaways (Department of Environment and Conservation 2010a). Twenty specimens are housed at the Western Australian State Herbarium, mainly associated with jarrah and wandoo forests. Four of these specimens were recorded near Tambellup and one near Kojonup (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Gastrolobium lehmannii.*

***Melaleuca micromera* (P3) MYRTACEAE**

Melaleuca micromera is a shrub reaching 4m in height and producing yellow flowers in September and October. It occurs on gravelly sandy loam or clay (Department of Environment and Conservation 2010a). Sixteen specimens are housed at the Western Australian State Herbarium, many associated with jarrah-marri forest clay (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Melaleuca micromera.*

***Schoenus natans* (P4) CYPERACEAE**

Schoenus natans is an aquatic annual herb (sedge), 0.3m in height, with brown flowers in October. This species occurs in winter-wet depressions (Department of Environment and Conservation 2010a). Fifty-two specimens are housed at the Western Australian State Herbarium, often associated with clayey soils (Department of Environment and Conservation 2010a). Given the vegetation, soils and location of the Flat Rocks Wind Farm survey area, it is possible that it contains habitat that supports *Schoenus natans*.

5.1.3 Fauna

A NatureMap search of the Moonies Hill Energy Wind Farm area (within a 20km radius of the survey area) revealed a total of 54 fauna taxa, including both vertebrates and invertebrates, that have been recorded within the survey area (Department of Environment and Conservation 2010f).

5.1.4 Threatened, Specially Protected and Priority Fauna

A total of 170 species have been listed as potentially occurring within a 20km radius of Flat Rocks Wind Farm (Department of Environment and Conservation 2010f). A total of 15 protected fauna species were revealed from a Naturemap database search (Department of Environment and Conservation 2010f), including five birds and 10 mammals. Of these fauna species, one is extinct or likely to be extinct, nine are Threatened, three are Priority 4 and two are Priority 5 pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA] (Table 2, Appendix A). A summary of protected fauna listings pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA], the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) and the International Union for Conservation of Nature and Natural Resources' Red List, is presented in Table 2.

Table 3: Rankings of protected fauna species that potentially occur within the Flat Rocks Wind Farm survey area (Department of Environment and Conservation 2010f, Department of Sustainability, Environment, Water, Population and Communities 2010a, International Union for Conservation of Nature and Natural Resources 2010)

Species	Common name	DEC	EPBC Act	IUCN Red List
Ardeotis australis	Australian Bustard	Priority 4	-	Near Threatened
Bettongia penicillata subsp. *Ogilbyi*	Brush-tailed Bettong/Woylie	Endangered	-	-
Burhinus grallarius	Bush Stone-Curlew	Priority 4	-	Critically Endangered
Calyptorhynchus banksii subsp. *naso*	Forest Red-tailed Black Cockatoo	Vulnerable	-	Least Concern
Calyptorhynchus baudinii	Baudin's Cockatoo	Endangered	-	-
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	Endangered	Endangered	Endangered
Dasyurus geoffroii	Western Quoll/Chuditch	Vulnerable	-	Near Threatened
Isoodon obesulus subsp. *fusciventer*	Southern Brown Bandicoot/Quenda	Priority 5	-	Least Concern
Macropus eugenii subsp. *derbianus*	Tammar	Priority 5	-	Least Concern
Macropus irma	Western Brush Wallaby	Priority 4	-	Least Concern
Macrotis lagotis	Greater Bilby	Vulnerable	Vulnerable	Vulnerable
Myrmecobius fasciatus	Numbat	Vulnerable	Vulnerable	Endangered
Onychogalea lunata	Crescent Nailtail Wallaby	Extinct	Extinct	Extinct
Phascogale tapoatafa subsp. (WAM M434)	Brush-tailed Phascogale	Vulnerable	-	Near Threatened
Pseudocheirus occidentalis	Western Ringtail Possum	Vulnerable	Vulnerable	Vulnerable

***Ardeotis australis* (Australian Bustard)**

Ardeotis australis is a large, ground dwelling bird that occurs in grasslands, light scrubland and woodlands of inland Australia (Pizzey, 1991). The species has a distinctive shape, with its erect posture and long legs. The Australia Bustard was once common in suitable habitat throughout Australia, and prefers tussock to hummock grasslands (Downes, 1975). It is highly nomadic, and moves in response to rainfall (Ayres *et al.* 1996). In Western Australia, the Australian Bustard is classed as Priority 4 (P4) by the Department of Environment and Conservation, which is taxon in need of monitoring. P4 taxa are not currently threatened or in need of protection, but could be if circumstances change (Department of Environment and Conservation 2010l). In NSW, the Australian Bustard is classified as Endangered (E) under the TSE Act 1995.

***Pseudemydura umbrina* (Western Swamp Tortoise)**

Pseudemydura umbrina is a small, long-lived, semi-aquatic tortoise with a very restricted geographic range. It is the most endangered tortoise or turtle species in the world and is gazetted as Specially Protected fauna Schedule 1 (fauna that is rare or likely to become extinct) under the *Wildlife Conservation Act 1950* [WA], and Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* [Commonwealth] and the United Nations Convention on Trade of Endangered Species (EPA). Its distribution is now limited to a 3-5km strip the Ellenbrook Nature Reserve on the Swan Coastal Plain (Department of Environment and Conservation 2010m). This reserve supports the only viable population in the wild with two other relocated populations located at the Twin Swamps Nature Reserve and the Mogumber Nature Reserve (Department of Environment and Conservation 2010m).

***Bettongia penicillata* subsp. *ogilbyi* (Brush-tailed Bettong/Woylie)**

Bettongia penicillata subsp. ogilbyi, the Brush-tailed Bettong, or Woylie is a small marsupial, a potoroid with a body length between 280mm and 360mm, and a weight ranging between 0.75 to 1.8 kg. The Brush-tailed Bettong has a pale underside, with grey brown fur on top. The tail is dark coloured, with a black brush at the end (Van Dyck & Strahan 2008). Bettongia penicillata subsp. ogilbyi is listed nationally as endangered under the Environment Protection and Biodiversity Conservation Act 1999. In WA it is listed as Rare, or likely to become extinct under the Wildlife Conservation Act 1950. At an International status, the genus level is listed under Appendix I of the CITES, Convention on International Trade in Endangered Species of Wild Fauna and Flora (Department of Environment and Conservation 2010i). At International species level, the species is classified as Critically Endangered under the International Union for Conservation of Nature and Natural Resources (IUCN) Red List (Department of Sustainability, Environment, Water, Population and Communities 2010a). The Woylie was once endemic throughout most of Australia, but is now restricted to three areas in Western Australia, the Tutanning Nature Reserve, Perup forest and Dryandra Woodland (Van Dyck & Strahan 2008), largely due to European settlement

***Burhinus grallarius* (Bush Stone-Curlew)**

Burhinus grallarius is a long legged ground dwelling bird, standing 50-60cm tall. It likes to roost in grassy woodlands with a sparse understorey (Department of Sustainability and Environment, 1997). Preferred habitat is in casuarina, eucalyptus, acacia or epolycarpa woodlands (Leach & Hembrow 1988 in Marchant & Higgins 1993). The Bush Stone-Curlew is listed as endangered in Victoria under the *Flora and Fauna Guarantee Act 1995* and endangered in NSW on Shedule 1 of the *Threatened Species Conservation Act 1995*. It is listed as vulnerable in South Australia under the *National Parks and Wildlife Act 1972* (Department of Sustainability and Environment, 1997). Nationally the Bush Stone-Curlew is listed as near-threatened under the 2004 IUCN Red List of Threatened Animals (Department for Environment and Heritage, 2007b). IUCN classification of near threatened refers to a species that are close to being classed as vulnerable. Vulnerable status refers to a species that is facing a high risk of extinction in the wild in the medium term (Baltais, 2006).

***Calyptorhynchus banksii* subsp. *naso* (Forest Red-tailed Black Cockatoo)**

The Forest Red-tailed Black Cockatoo is 55 – 60cm in length and 570 – 870 g in weight (Higgins 1999). They are glossy black with a pair of central tail feathers, with a crest and bright red, orange or yellow cental tail feathers (Higgins 1999). The Forest Red-tailed Black Cockatoo, was originally named *Psittacus banksii* (Latham 1790), but changed to the south-west subspecies *Calyptorynchus banksii naso*, after the morphological and ecological divergence / convergence of populations, was examined by Ford in 1980. Forest Red-tailed Black Cockatoo, *Calyptorhynchus banksii naso*, is listed nationally as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999.*

In Western Australia, it is listed as Fauna that is Rare or is likely to become extinct under the *Wildlife Conservation Act 1950*. On an International level, *Calyptorhynchus banksii naso*, is listed under Appendix II on CITES, Convention on International Trade in Endangered Species of Wild Fauna and Flora (Department of Sustainability, Environment, Water, Population and Communities 2010d). The Forest Red-tailed Black Cockatoo previously occurred between Albany, Augusta and Perth, and north to Dandaragan. However, it has been rare on the Swan Coastal Plain since the early 1900s (Alexander 1921).

***Calyptorhynchus baudinii* (Baudin's Cockatoo)**

Calyptorhynchus baudinii, Baudin's Cockatoo, is a large cockatoo, with a wingspan up to 110cm, weighing 560-770g. They measure 50-57 cm in length and are a dull black colour with rectangular white panels on the tail. They also have white margins on the feathers, and whitish round patches on the ears. The males have a red-pink eye ring, and a black beak, and the females have a grey eye-ring, with a whitish grey beak with a black tip (Higgins 1999; Johnstone & Storr 1998).

Baudin's Black Cockatoo are gregarious, and usually travels in small groups, usually in pairs or in groups of three, but can gather in large flocks of 300 birds where food is abundant (Higgins 1999; Storr 1991). *Calyptorhynchus baudinii* is only found in the south west of Western Australia, extending from Albany to Mundaring and inland to the Stirling ranges and near Boyup Brook (Davies 1966; Saunders *et al*. 1985; Storr 1991). Nationally, *Calyptorhynchus baudinii* is listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999.* In WA it is listed as 'rare or likely to become extinct' under the *Wildlife Conservation Act 1950* (Edwards 2005). At an international level, *Calyptorhynchus baudinii* is listed under Appendix II of the Convention on International Trade in Endangered Fauna and Flora (CITES) (Department of Sustainability, Environment, Water, Population and Communities 2010e).

***Calyptorhynchus latirostris* (Carnaby's Black Cockatoo)**

Calyptorhynchus latirostris is a large cockatoo endemic to south-western Australia, occurring mostly in the Wheatbelt (Department of Environment, Water, Heritage and the Arts 2010n). It is a large black cockatoo with white tail panels, white cheek patches and a short bill (Department of Sustainability, Environment, Water, Population and Communities 2010n). *Calyptorhynchus latirostris* is classed in WA as 'specially protected fauna' under the *Wildlife Conservation Act 1950*, and as Endangered as Commonwealth status under *Environment Protection and Biodiversity Conservation Act 1999* List (Department of Sustainability, Environment, Water, Population and Communities 2010n). It is also considered Endangered by the International Union for Conservation of Nature and Natural Resources due to its rapid and continuing decline over three generations (International Union for Conservation of Nature and Natural Resources 2010). The range of the species is considered to have contracted by 30% since the late 1940s due to clearing for agriculture and urban development (Department of Environment, Water, Heritage and the Arts 2010c). Additionally, habitat tree regeneration has been drastically reduced by the grazing of stock and feral animals on seedlings (International Union for Conservation of Nature and Natural Resources 2010). *Calyptorhynchus latirostris* nests in tall living or dead eucalypts, particularly *Eucalyptus wandoo* and *Eucalyptus salmonophloia* (Department of Sustainability, Environment, Water, Population and Communities 2010n).

***Dasyurus geoffroii* (Western Quoll/Chuditch)**

Dasyurus geoffroii, commonly known as the Chuditch is a large carnivore red-brown to grey in colour with white spots. It has a long tail with no spots and a black brush at the end (Van Dyck & Strahan 2008). Males weigh up to 1300 g, whiles females weigh up to 600 g (Orell & Morris 1994). *Dasyurus geoffroii* is now restricted to the south-west of Western Australia, and is listed as Vulnerable under the *Wildlife Conservation Act 1950*. In the Northern Teritory and Queensland it is listed as Extinct. In South Australia, *Dasyurus geoffroii* is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*, and at an International level, it is listed as Near Threatened on the 2008 *IUCN Red List of Threatened Species.* The Chuditch once occupied nearly 70% of the Australian mainland and occurred in every State and Territory but is now restricted to the south-west of WA (Department of Sustainability, Environment, Water, Population and Communities 2010f).

***Isoodon obesulus* subsp. *fusciventer* (Southern Brown Bandicoot/Quenda)**

Isoodon obesulus, the Southern Brown Bandicoot or Quenda, is a solid built marsupial with soft underfur and coarse guard hairs and small rounded ears. The soft underfur is creamy white, and the back is brown-grey flecked with yellow-brown (Cronin 1991). The body length of *Isoodon obesulus* is up to 33cm, with a tail length 11 – 12cm. Males weigh between 500 to 1500 g and females 400 to 1000g (Department of Sustainability, Environment, Water, Population and Communities 2010g).

***Macropus eugenii* subsp. *derbianus* (Tammar)**

Macropus eugenii subsp. *derbianus*, the Tammar Wallaby is a small macropod with dark, grey-brown fur above and pale grey below. Males grow up to 68 cm with a tail length up to 45 cm, while females grow to 63 cm, with a tail length up to 44 cm. Males weigh up to 4.6kg, and females up to 3.7kg (Department of Environment and Conservation, 2010h) *Macropus eugenii* subsp. *derbianus* is classed as Near Threatened on the 2000 IUCN Red List of Threatened Species Lower Risk, and Priority 4 under the *Western Australia Wildlife Conservation Act* (Department of Environment and Conservation, 2010f).

***Macropus irma* (Western Brush Wallaby)**

Macropus irma, the Western Brush Wallaby is a medium sized macropod up to 120cm in length, with a tail lengh of 97 cm, weighing up to 9kg. It is grey with a distinct white facial stripe, black and white ears, black hands, black feet and a black crest at the end of its long tail (Department of Environment and Conservation, 2010h). *Macropus irma* has a prefered habitat of opens forest and woodland of mallee, heathland, open low grasses and scrubby thickets (Morris and Christensen 2008). The Western Brush Wallaby is now distributed throughjout the south-west of Western Australia, from Cape Arid to Kalbarri. *Macropus irma* is classed as Near Threatened on the 2000 IUCN Red List of Threatened Species Lower Risk, and Priority 4 under the *Western Australia Wildlife Conservation Act* (Department of Environment and Conservation, 2010h).

***Macrotis lagotis* (Greater Bilby)**

Macrotis lagotis, the Greater Bilby, is a marsupial the size of a rabbit, which was formerly found over 70% of the Australian mainland, but is now found in less than 20% of its former range. In Western Australia, wild populations now only occur in the Great Sandy and Gibson Deserts (Department of Environment, Water, Heritage and the Arts 2010c). The Bilby has blue-grey soft fur, with a white/cream underside, with big ears, a pointed snout and a ling tail with a black tip. The Greater Bilby grows up to 55cm in length, with a tail up to 29cm. Males weigh up to 2500 g, and females 1200 g (Cronin 1991; Strahan 1998). In New South Wales *Macrotis lagotis* is listed as Presumed extinct, in the Northern Territory it is listed as Threatened under the *Territory Parks and Wildlife Conservation Act 2000*, and in Queensland, *Macrotis lagotis* is listed as Endangered under the *Nature Conservation Act 1994*. In South Australia, the Greated Bilby is listed as Vulnerable under the *National Parks and Wildlife Act 1972*, and in Western Australia, listed as Rare under the *Wildlife Conservation (Specially Protected Fauna) Notice 2008(2)*.

Nationally, *Macrotis lagotis* is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*. On an international level it is listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), as well as Vulnerable, (C2a), under the International Union for Conservation of Nature Red List (Department of Sustainability, Environment, Water, Population and Communities 2010i).

***Myrmecobius fasciatus* (Numbat)**

Myrmecobius fasciatus, or Numbat, is a reddish-brown marsupial with white strips across its back. It has a dark stripe from the ear to the mouth, running across the eye, and can grow to a length of 27.4 cm, with a bushy tail reaching 21cm in length. The Numbat can weigh up to 715 g (Cronin 1991; Strahan 1998). *Myrmecobius fasciatus* was originally widespread throughout Australia, ranging from western NSW, through SA and southern Northern Territory to the south-west of Western Australia (Department of Sustainability, Environment, Water, Population and Communities 2010m). *Myrmecobius fasciatus* is now only found in several locations in Western Australia, some of where populations have been reintroduced and it is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999*.

***Onychogalea lunata* (Crescent Nailtail Wallaby)**

Onychogalea lunata, the Crescent Nailtail Wallaby was a medium sized macropod, with a body mass up to 3.5kg. It had ash-grey and reddish fur with a white cresent from the shoulder blades down to the chest, with another white marking along the thigh (Pavey, 2006). *Onychogalea lunata*, the Crescent Nailtail Wallaby is listed as Extinct under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of Sustainability, Environment, Water, Population and Communities 2010j).

***Phascogale tapoatafa* subsp. (WAM M434) (Brush-tailed Phascogale)**

Phascogale tapoatafa subsp. (WAM M434), Brush-tailed Phascogale is a small, arboreal dasyurid with grey fur above and cream-white fur below, and has large furless ears. Males grow up to 26.1cm, with a tail length up to 23.4cm which has a distinctive black bottle-brush at the end. They weigh up to 0.31 kg, while females weigh up to 0.21 kg. Females grow up to 22.3cm with a tail length up to 22.6cm. *Phascogale tapoatafa* were once widespread in eastern and south-western Australia, but its present range has been reduced to 50% of its former range, extending from Perth to south of Albany (Department of Environment and Conservation, 2010g). *Phascogale tapoatafa* is classed as Near Threatened on *the 2000 IUCN Red List of Threatened Species Lower Risk* and classed as Priority 3 under the *Western Australian Wildlife Conservation Act* (Department of Sustainability, Environment, Water, Population and Communities 2010k).

***Pseudocheirus occidentalis* (Western Ringtail Possum)**

Pseudocheirus occidentalis, the Western Ringtail Possum is a nocturnal marsupial, weighing up to 1.3 kg and 40cm in body length, with a long tail up to 41cm. It has cream grey fur on the underside and dark brown fur above, with a white tip on the tail (Van Dyck & Strahan 2008). It is only distributed throughout the south-west of WA. In Western Australia *Pseudocheirus occidentalis* is listed as Rare or likely to become Extinct under the *Wildlife Conservation Act 1950*. Nationally, the Western Ringtail Possum is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Department of Sustainability, Environment, Water, Population and Communities 2010l).

5.2. Field Survey

5.2.1 Flora

A total of 77 vascular plant taxa from 59 plant genera and 22 plant families were recorded within the Flat Rocks Wind Farm survey area. The majority of taxa was recorded within the Poaceae (15 taxa), Myrtaceae (13 taxa), Fabaceae (9 taxa), and Asteraceae (9 taxa) families (Appendix B).

5.2.2 Rare and Priority Flora

There were no Declared Rare and Priority Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA] and as listed by the Department of Environment and Conservation (2010a) that were recorded within the Flat Rocks Wind Farm survey area (Appendix A1). Twenty-one sites were chosen within the Flat Rocks Wind Farm survey area (Table 4). No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (Department of the Sustainability, Environment, Water, Population and Communities 2010a) were recorded during the survey within the proposed Flat Rocks Wind Farm survey area.

Table 4: GPS locations of 21 sites within the Moonies Hill survey area

Site Number	EASTING	NORTHING
	DATUM GDA94 ZONE 50H	
1	533137	6240034
2	529092	6251356
3	529518	6250544
4	532866	6252093
5	531686	6247741
6	531431	6248093
7	531307	6247294
8	531128	6246980
9	534589	6246243
10	536127	6245442
11	535790	6245790
12	536315	6247272
13	533222	6238117
14	531000	6236500
15	529297	6239799
16	529773	6240336
17	529952	6239475
18	530161	6239864
19	529820	6235244
20	528231	6237067
21	528612	6238877

5.2.3 Introduced (Exotic) Plant Species

A total of 23 introduced (exotic) taxa were recorded within the Moonies Hill survey area (Appendix B). Of these only one species is a Declared Plants species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* according to the Western Australian Department of Agriculture and Food (2010).

Asparagus asparagoides has a Declared Plant status of P1 for the whole state (Department of Agriculture and Food 2009). A Declared Plant status of P1 prohibits the movement within the State, specifically governing the movement of contaminated machinery and produce including livestock and fodder (Appendix A5; Department of Agriculture and Food 2010). *Asparagus asparagoides* was recorded at one site within the Flat Rocks Wind Farm survey area.

5.3 Vegetation

Five vegetation communities were defined and mapped within the Flat Rocks Wind Farm survey area (Figure 2). The plant communities are summarised below:

E1: Mosaic of Open Woodland of *Eucalyptus rudis* subsp. *rudis –Acacia acuminata - ,Melaleuca rhaphiophylla* with patches of *Melaleuca cuticularis* over introduced grasses and Chenopod Shrubland of *Tecticornia lepidosperma* over introduced grasses on saline clays and sandy-clays in creeklines.

E2: Open Woodland of *Eucalyptus rudis* subsp. *rudis – Melaleuca rhaphiophylla* over *Acacia saligna, Acacia acuminata, Jacksonia sternbergiana* over *Ficinia nodosa* and introduced grasses on sandy-loams and clay-loams on fringes of creeklines.

E3: Woodland of *Eucalyptus wandoo* with patches and mixtures of *Eucalyptus marginata* subsp. *marginata – Corymbia calophylla* abuting *Eucalyptus loxophleba* subsp. *loxophleba* on sandy gravels and *Allocasuarina huegeliana* on granites over low shrubs of *Acacia lasiocarpa* var. *sedifolia, Bossiaea eriocarpa, Gastrolobium praemorsum, Astrioloma compactum, Acacia pulchella, Hibbertia commutata* over low sedges and annuals on sandy-loam gravels on mid and upper slopes.

E4: Woodland of *Eucalyptus wandoo* with patches of *Allocasuarina huegeliana* over low subshrubs and introduced grasses on sandy soils and near shallow granites on mid and upper slopes.

E5: Woodland of *Eucalyptus astringen*s subsp. *astringens – Eucalyptus wandoo* on sandy-loam and some *Eucalyptus marginata* subsp. *marginata* over subshrubs and introduced grasses on sandy-loams on slopes.

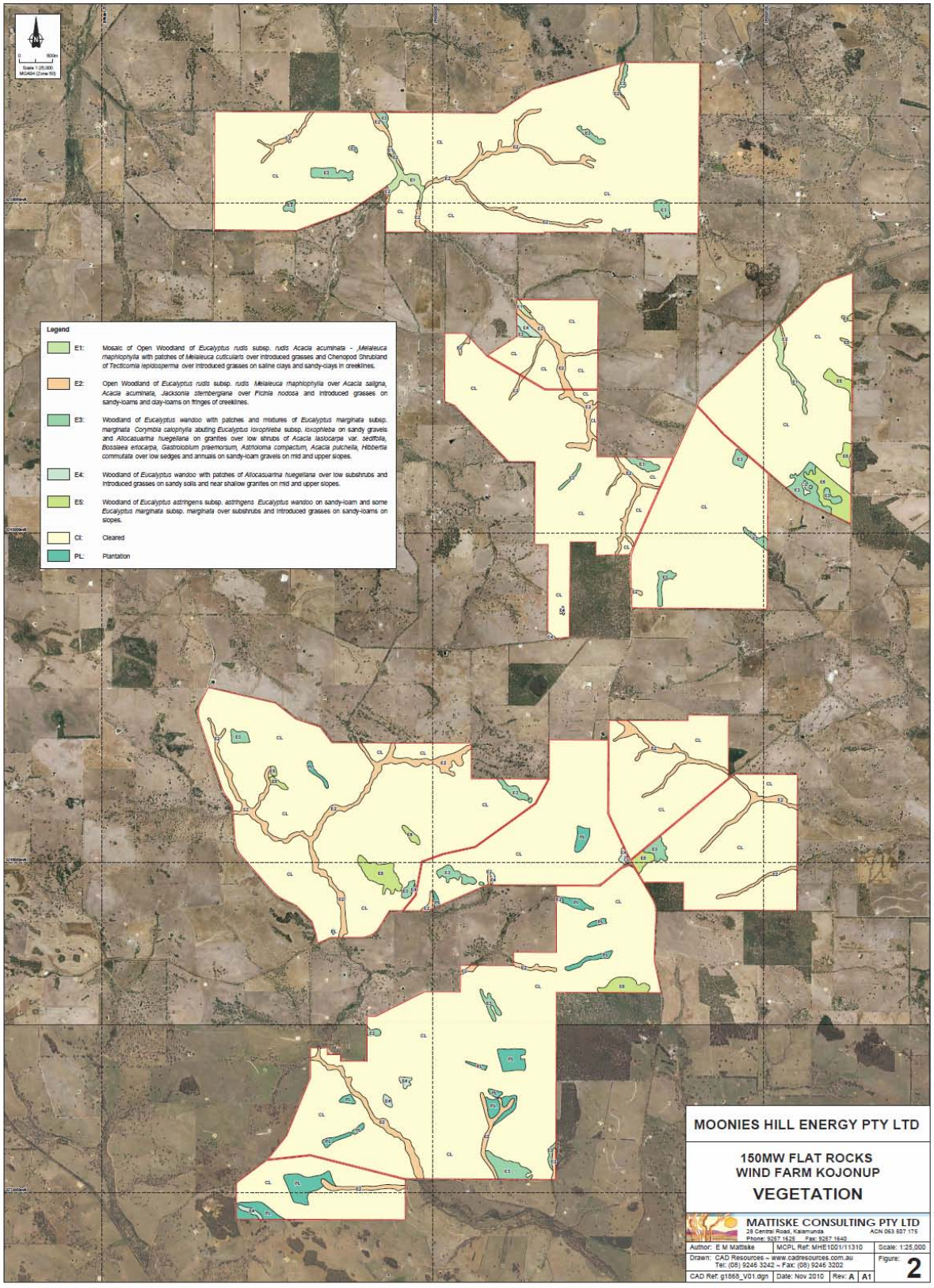
Cl: Cleared

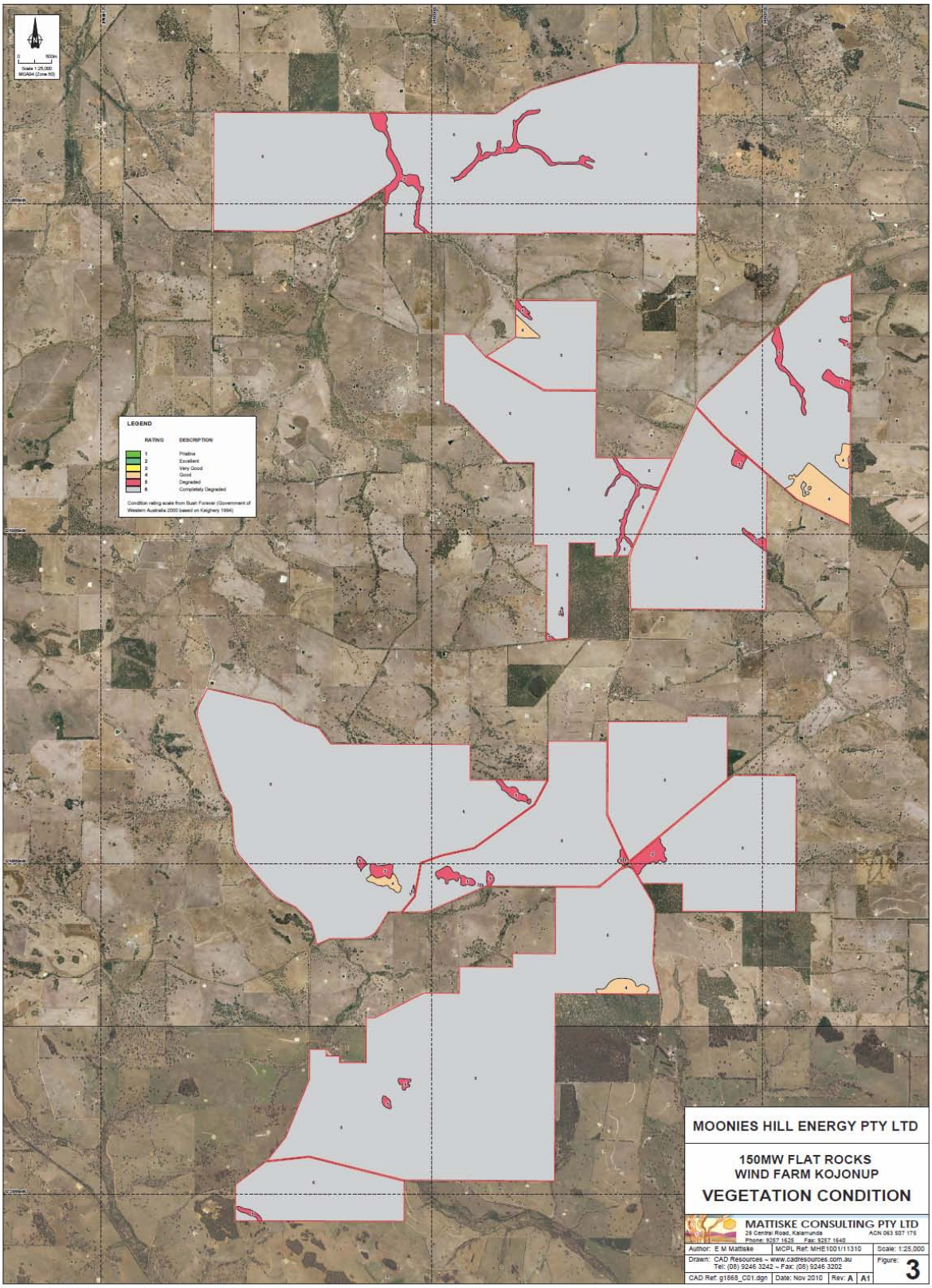
PL: Plantation

No threatened ecological communities as defined by the EPBC Act (1999) or the Department of Environment and Conservation (2010c) were located in this survey area.

5.4 Vegetation Condition

The plant communities were very disturbed and had been largely grazed or cleared (Figure 3). Consequently the majority of the survey area is completely degraded or degraded.


Legend
E1: Mosaic of Open Woodland of Eucalyptus rudis subsp. rudis Acacia acuminata - Melaleuca maphiophylla with patches of Melaleuca cuticularis over introduced grasses and Chenopod Shrubland of Tecticornia lepidosperma over introduced grasses on saline clays and sandy-clays in creeklines.
E2: Open Woodland of Eucalyptus rudis subsp. rudis Melaleuca maphiophylla over Acacia saligna, Acacia acuminata, Jacksonia sternbergiana over Fichia nodosa and introduced grasses on sandy-loams and clay-loams on fringes of creeklines.
E3: Woodland of Eucalyptus wandoo with patches and mixtures of Eucalyptus marginata subsp. marginata Corymbia calophylla abutting Eucalyptus loxophleba subsp. loxophleba on sandy gravels and Allocasuarina huegeliana on granites over low shrubs of Acacia lasiocarpa var. sedifolia, Bossiaea eriocarpa, Gastrolobium praemorsum, Astroloma compactum, Acacia pulchella, Hibbertia commutata over low sedges and annuals on sandy-loam gravels on mid and upper slopes.
E4: Woodland of Eucalyptus wandoo with patches of Allocasuarina huegeliana over low subshrubs and introduced grasses on sandy soils and near shallow granites on mid and upper slopes.
E5: Woodland of Eucalyptus astringens subsp. astringens Eucalyptus wandoo on sandy-loam and some Eucalyptus marginata subsp. marginata over subshrubs and introduced grasses on sandy-loams on slopes.
CL: Cleared
PL: Plantation
MOONIES HILL ENERGY PTY LTD
150MW FLAT ROCKS
WIND FARM KOJONUP
VEGETATION
MATTISKE CONSULTING PTY LTD
Author: E M Mattiske
MCPL Ref: MHE1001/11310
Scale: 1:25,000
Figure: 2
CAD Ref: g1868_V01.dgn
Date: Nov 2010
Rev: A
A1


LEGEND
RATING
DESCRIPTION
1
Pristine
2
Excellent
3
Very Good
4
Good
5
Degraded
6
Completely Degraded
Condition rating scale from Bush Forever (Government of Western Australia 2000 based on Keighery 1994)
MOONIES HILL ENERGY PTY LTD
150MW FLAT ROCKS
WIND FARM KOJONUP
VEGETATION CONDITION
MATTISKE CONSULTING PTY LTD
28 Central Road, Kalamunda
ACN 063 507 175
Phone: 9257 1525 Fax: 9257 1640
Author: E M Mattiske
MCPL Ref: MHE1001/1/1310
Scale: 1:25,000
Drawn: CAD Resources – www.cadresources.com.au
Tel: (08) 9246 3242 – Fax: (08) 9246 3202
Figure: 3
CAD Ref: g1868_C01.dgn
Date: Nov 2010
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5.5 Fauna

Discussions were held with Ron Johnstone from the W.A. Museum in regard to the cockatoo species that may occur in the area. As a result it appears that the most likely of the cockatoos in the project area is the Carnaby's cockatoo and as in his opinion the risk of these cockatoos flying into the wind turbine is very low (personal communication between Dr Libby Mattiske and Ron Johnstone, 15 March 2011). The windfarm occurs on the fringes of the other two Cockatoos (Red-Tailed and Baudin) and consequently the potential remains very low for these two species. On the basis of previous studies it appears that the Carnaby's Cockatoo has reasonable night vision and therefore will avoid obstacles. Current studies in areas supporting Cockatoos both north of Perth and near Albany have indicated that these species tend to avoid these facilities and therefore the risk remains very low.

Although a range of potential fauna values were sourced from a desktop assessment of potential rare and threatened species; in view of the degree of degradation unless remnant areas are likely to be disturbed there should not be any significant issues in relation to the native fauna species. The degree of degradation is evident from the series of photographs in Appendix D.

6. DISCUSSION

Mattiske Consulting Pty Ltd was commissioned by the Moonies Hill Energy to undertake a review of the flora, vegetation and fauna values on the proposed Flat Rocks Wind Farm location. The proposed development occurs primarily within cleared agricultural areas. Therefore, the effort concentrated on desktop reviews and an assessment of the main remnants and roadside vegetation that may be disturbed by vehicle movement and installation of the wind farm facilities.

The relatively low range of native species is a reflection of the degree of disturbance and clearing in the Flat Rocks Wind Farm survey area.

There were no Declared Rare and Priority Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA] and as listed by the Department of Environment and Conservation (2010e) that were recorded within the Flat Rocks Wind Farm survey area (Appendix A1). Twenty one sites of remnant vegetation were chosen within the Flat Rocks Wind Farm survey area (Table 2).

No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (Department of the Sustainability, Environment, Water, Population and Communities 2010b) were recorded during the survey within the proposed Flat Rocks Wind Farm survey area.

No threatened ecological communities as defined by the EPBC Act (1999) or the Department of Environment and Conservation (2010c) were located in this survey area.

Although a range of potential fauna values were sourced from a desktop assessment of potential rare and threatened species; in view of the degree of degradation unless remnant areas are likely to be disturbed there should not be any significant issues in relation to the native fauna species

The areas proposed for the windfarms are all within largely cleared agricultural lands and as such are unlikely to provide any substantial nesting or foraging sites. The remnant vegetation that does occur is restricted to the degraded valley floors and as such is influenced by local salinity and degraded soils. Several smaller remnants occur on the edges of the proposal area, but will not be influenced by the proposed development.

In the highly modified Wheatbelt all areas of remnant native vegetation are significant from a conservation perspective. The proposed areas for the wind turbines of the Flat Rocks Wind Farm project are located almost entirely within cleared farmland and therefore will have a very low impact on native vegetation or native fauna habitats or native species. In the case that clearing of remnant vegetation is unavoidable (e.g. for access points from public roads), it is recommended that effort be made to minimise clearing by routing access points through existing gaps in vegetation such as farm gates or within remnants that do not support significant patches of native species..

To minimize impacts on the environment at all times vehicle hygiene measures should be maintained such as vehicle inspections and under vehicle clearing to minimize the spread of weeds and introduced species in the project area. This survey identified twenty three exotic species however the total number of exotic species is expected to be higher over the entire proposed wind farm area because our survey focused only on patches of remnant vegetation, not the highly disturbed cleared agricultural land.

In summary, there should be no impediments to the development of the wind farm facilities providing the remnant vegetation areas (including less disturbed road verges) are not disturbed.

7. RECOMMENDATIONS

In response to the proposed clearing of vegetation in the Flat Rocks Wind Farm survey area, it is recommended to:

- Limit ground disturbance and clearing of vegetation to designated areas and access routes, avoiding habitat trees (larger trees and trees with hollows) wherever possible;
- Maintain existing drainage systems, ensuring tracks and other infrastructure areas do not disrupt or divert historic water flow patterns;
- Remove and stockpile topsoil, log debris and leaf litter where possible for use in future rehabilitation programs. If possible, stockpiled topsoil should be directly replaced on disturbed areas;
- Minimise soil disturbance during clearing and practice standard vehicle hygiene to ensure introduced (exotic) species do not become established within the Flat Rocks Wind Farm survey area;
- An introduced species management plan will prevent the spread of declared introduced species; and
- All threatening processes to native vegetation and potential fauna habitats (creekline vegetation, isolated larger trees with hollows) should be minimized.

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9. LIST OF PERSONNEL:

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APPENDIX A1: DEFINITION OF RARE AND PRIORITY FLORA SPECIES (Department of Environment and Conservation 2010a)

Conservation Code	Category
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. 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 urgently need 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 need further survey."
P4	**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."

APPENDIX A2: CATEGORIES OF THREATENED FLORA SPECIES (Department of the Sustainability, Environment, Water, Population and Communities 2010a)

Category Code	Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or 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.
CE	**Critically Endangered** Taxa which 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.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, 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 within a period of 5 years.

APPENDIX A3: SUMMARY OF THREATENED ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2010b)

Category Code	Category
PTD	**Presumed Totally Destroyed** An ecological community will be listed as Presumed Totally Destroyed if there are no recent records of the community being extant and either of the following applies: (i) records within the last 50 years have not been confirmed despite thorough searches or known likely habitats or; (ii) all occurrences recorded within the last 50 years have since been destroyed.
CE	**Critically Endangered** An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future, meeting any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 90% and is either continuing to decline with total destruction imminent, or is unlikely to be substantially rehabilitated in the immediate future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the immediate future.
E	**Endangered** An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. The ecological community must meet any one of the following criteria: (i) The estimated geographic range and distribution has been reduced by at least 70% and is either continuing to decline with total destruction imminent in the short term future, or is unlikely to be substantially rehabilitated in the short term future due to modification; (ii) The current distribution is limited ie. highly restricted, having very few small or isolated occurrences, or covering a small area; (iii) The ecological community is highly modified with potential of being rehabilitated in the short term future.
V	**Vulnerable** An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing high risk of total destruction in the medium to long term future. The ecological community must meet any one of the following criteria: (i) The ecological community exists largely as modified occurrences that are likely to be able to be substantially restored or rehabilitated; (ii) The ecological community may already be modified and would be vulnerable to threatening process, and restricted in range or distribution; (iii) The ecological community may be widespread but has potential to move to a higher threat category due to existing or impending threatening processes.

APPENDIX A4: SUMMARY OF PRIORITY ECOLOGICAL COMMUNITIES (Department of Environment and Conservation 2010b)

Category Code	Category
P1	**Poorly-known ecological communities** Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist.
P2	**Poorly-known ecological communities** Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, un-allocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.
P3	**Poorly known ecological communities** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing and inappropriate fire regimes.
P4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.
P5	**Conservation Dependent ecological communities** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX A5: CATEGORIES OF STANDARD CONTROL CODES FOR DECLARED PLANT SPECIES IN WESTERN AUSTRALIA (Department of Agriculture and Food 2010)

CONTROL CODE REQUIREMENTS	CONDITIONS
P1 Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3 Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infestation • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Of the remaining infested area:- Where plant density is 1-10 per hectare treat 100% of infestation. Where plant density is 11-100 per hectare treat 50% of infestation. Where plant density is 101-1000 per hectare treat 10% of infestation. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT THE PROPOSED MOONIES HILL WINDFARM AREA, KOJONUP, SEPTEMBER/OCTOBER 2010

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2010a)

FAMILY		SPECIES
POACEAE		*Austrostipa flavescens*
		Austrostipa juncifolia
		Austrostipa trichophylla
		Austrostipa sp.
	*	*Avena barbata*
	*	*Briza maxima*
	*	*Bromus diandrus*
	*	*Ehrharta longiflora*
		Enneapogon sp.
	*	*Hordeum hystrix*
	*	*Hordeum leporinum*
	*	*Lolium perenne*
		Neurachne alopecuroidea
		Neurachne sp.
	*	*Vulpia ?bromoides*
	*	*Vulpia* sp.
		Poaceae sp.
CYPERACEAE		*Chorizandra enodis*
		Ficinia nodosa
		Lepidosperma leptostachyum
		Tetraria octandra
RESTIONACEAE		*Desmocladus asper*
JUNCACEAE	*	*Juncus acutus*
		Juncus pauciflorus
ASPARAGACEAE	*	*Asparagus asparagoides*
		Chamaescilla corymbosa
		Lomandra micrantha subsp. micrantha
		Thysanotus patersonii
ASPHODELACEAE	*	*Asphodelus fistulosus*
HEMEROCALLIDACEAE		*Dianella revoluta*
		Stypandra glauca
		Tricoryne tenella
HAEMODORACEAE		*Conostylis setigera*

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT THE PROPOSED MOONIES HILL WINDFARM AREA, KOJONUP, SEPTEMBER/OCTOBER 2010

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2010a)

FAMILY		SPECIES
IRIDACEAE	*	*Moraea setifolia*
ORCHIDACEAE		*Caladenia sp.*
	*	*Disa bracteata*
CASUARINACEAE		*Allocasuarina huegeliana*
CARYOPHYLLACEAE	*	*Spergularia marina*
CHENOPODIACEAE		*Tecticornia lepidosperma*
CRASSULACEAE		*Crassula decumbens var. decumbens*
FABACEAE		*Acacia acuminata*
		Acacia lasiocarpa var. *sedifolia*
		Acacia pulchella
		Acacia saligna subsp. *saligna*
		Bossiaea eriocarpa
		Gastrolobium praemorsum
		Jacksonia sternbergiana
		Kennedia prostrata
	*	*Trifolium arvense*
DILLENIACEAE		*Hibbertia commutata*
MYRTACEAE		*Corymbia calophylla*
		Eucalyptus astringens subsp. *astringens*
	*	*Eucalyptus globulus*
	*	*Eucalyptus leucoxylon*
		Eucalyptus loxophleba subsp. *lissophloia*
	*	*Eucalyptus ?macrandra*
		Eucalyptus marginata subsp. *marginata*
		Eucalyptus rudis subsp. *rudis*
		Eucalyptus spathulata subsp. *spathulata*
		Eucalyptus wandoo subsp. *wandoo*
		Melaleuca cuticularis
		Melaleuca rhaphiophylla
ERICACEAE		*Astroloma compactum*
		Leucopogon propinquus

APPENDIX B: SUMMARY OF VASCULAR PLANT SPECIES RECORDED AT THE PROPOSED MOONIES HILL WINDFARM AREA, KOJONUP, SEPTEMBER/OCTOBER 2010

Note: * denotes introduced species; P1, P2, P3 and P4 denote - Priority Flora Species (DEC, 2010a)

FAMILY		SPECIES
CAMPANULACEAE		*Lobelia anceps*
GOODENIACEAE		*Dampiera sacculata*
STYLIDIACEAE		*Stylidium piliferum*
ASTERACEAE	*	*Arctotheca calendula*
	*	*Cotula coronopifolia*
		Helichrysum leucopsideum
	*	*Hypochaeris glabra*
		Lagenophora huegelii
		Podolepis gracilis
		Rhodanthe manglesii
	*	*Sonchus asper*
	*	*Ursinia anthemoides*

APPENDIX C: DEFINITION OF RARE FAUNA SPECIES (Department of Sustainability, Environment, Water, Population and Communities 2010a)

Conservation Code	Category
CE	**Critically Endangered -** • The species has undergone, is suspected to have undergone or is likely to undergo in the immediate future a very severe reduction in numbers; • Its geographic distribution is precarious for the survival of the species and is very restricted; • the estimated total number of mature individuals is very low and either of (a) or (b) is true: (a) evidence suggests that the number will continue to decline at a very high rate or (b) the number is likely to continue to decline and its geographic distribution is precarious for its survival; • the estimated total number of mature individuals is extremely low; • the probability of its extinction in the wild is at least 50% in the immediate future.
E	**Endangered -** • The species has undergone, is suspected to have undergone or is likely to undergo in the immediate future a severe reduction in numbers; • its geographic distribution is precarious for the survival of the species and is restricted; • the estimated total number of mature individuals is low and either of (a) or (b) is true: (a) evidence suggests that the number will continue to decline at a high rate or (b) the number is likely to continue to decline and its geographic distribution is precarious for its survival; • the estimated total number of mature individuals is very low; • the probability of its extinction in the wild is at least 20% in the immediate future.
V	**Vulnerable -** • The species has undergone, is suspected to have undergone or is likely to undergo in the immediate future a substantial reduction in numbers; • its geographic distribution is precarious for the survival of the species and is limited; • the estimated total number of mature individuals is limited and either of (a) or (b) is true: (a) evidence suggests that the number will continue to decline at a substantial rate or (b) the number is likely to continue to decline and its geographic distribution is precarious for its survival; • the estimated total number of mature individuals is low; • the probability of its extinction in the wild is at least 10% in the immediate future.