

Appendix E Biodiversity Assessment



Biodiversity Assessment

CAPITAL SOLAR FARM



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1	INTRODUCTION	1
1.1	PURPOSE OF THE REPORT	1
1.2	THE PROPOSAL	1
1.2.1	Location	1
1.2.2	Proposal description	3
1.2.3	Potential impacts of the Proposal	7
2	ENVIRONMENTAL AND PLANNING CONTEXT	8
2.1	ENVIRONMENTAL CONTEXT	8
2.1.1	Interim Biogeographic Regionalisation of Australia (IBRA)	8
2.1.2	Catchment Management Area and sub-region	8
2.1.3	District scale assessment	8
2.1.4	Locality assessment	9
2.2	SITE DESCRIPTION	10
2.3	POLICY AND LEGISLATION	11
3	ASSESSMENT APPROACH AND METHODOLOGY	12
3.1	APPROACH 12	
3.2	PRELIMINARY ASSESSMENTS	12
3.3	FIELD SURVEY AND MAPPING	12
3.3.1	Flora	12
3.3.2	Fauna	13
3.3.3	Mapping	19
3.3.4	Survey limitations	19
4	FLORA RESULTS	20
4.1	PRELIMINARY ASSESSMENTS	20
4.2	SURVEY RESULTS	20
4.3	VEGETATION COMMUNITIES	22
4.3.1	Solar farm site	22
4.3.2	Transmission route	23
4.4	SPECIES AND COMMUNITIES OF CONSERVATION SIGNIFICANCE	27
4.4.1	Endangered Ecological Communities	27
4.4.2	BioMetric status	29
4.4.3	Threatened flora species	30
4.4.4	Regionally significant species	31
4.5	DISTURBANCE AND WEEDS	32

5	FAUNA RESULTS	33
5.1	PRELIMINARY ASSESSMENTS	33
5.2	SURVEY RESULTS	33
5.3	HABITAT ASSESSMENT RESULTS.....	34
5.4	SPECIES OF CONSERVATION SIGNIFICANCE	39
5.4.1	Recorded Threatened fauna species	39
5.4.2	Migratory species	40
5.4.3	SEPP 44 Koala Habitat	40
6	BIODIVERSITY CONSTRAINTS ANALYSIS.....	41
6.1	METHODS 41	
6.2	DEFINITION AND MAPPING OF CONSTRAINT CLASSES	42
6.3	IMPLICATIONS FOR THE PROJECT	44
7	IMPACT ASSESSMENT.....	45
7.1	IMPACT TYPES	45
7.1.1	Scope of potential impacts	45
7.1.2	Direct and indirect impacts	45
7.2	IMPACT ASSESSMENT.....	46
7.2.1	Direct impacts.....	46
7.2.2	Indirect and off-site impacts.....	53
7.2.3	Cumulative impacts	55
7.2.4	Assessments of Significance	55
8	RECOMMENDATIONS AND CONCLUSION	57
8.1	INFRASTRUCTURE SITING AND DESIGN.....	57
8.1.1	Supplementary surveys	58
8.1.2	Offsetting.....	58
8.2	CONSTRUCTION PHASE	59
8.3	OPERATIONAL MANAGEMENT.....	60
8.4	CONCLUSION	61
9	REFERENCES	63
APPENDIX A	ASSESSMENTS OF SIGNIFICANCE	A-1
Conclusion		A-21
APPENDIX B	HABITAT EVALUATION	B-1
APPENDIX C	HABITAT FEATURES DATA.....	C-1
APPENDIX D	THREATENED SPECIES EVALUATION	D-1
APPENDIX E	FLORA SPECIES LIST.....	E-1

APPENDIX F	FAUNA SPECIES LIST	F-1
APPENDIX G	LAYOUT AND STRUCTURAL PLANS.....	G-1
APPENDIX H	ADDITIONAL MAPS.....	H-1
APPENDIX I	DATABASE SEARCHES.....	I-1
APPENDIX J	QUALIFICATIONS	J-1
APPENDIX K	VEGETATION CLEARING GUIDELINES.....	K-1
APPENDIX L	RAW DATA	L-1

Tables

Table 3-1: Survey conditions.....	13
Table 3-2 Fauna survey design and effort.....	17
Table 4-1 Field survey results summary	21
Table 4-2 Conservation status of vegetation types at the subject site (after Gellie 2005)	25
Table 4-3 Threatened flora potentially present at the subject site	31
Table 4-4 Noxious weeds at the subject site	32
Table 5-1 Fauna habitat summary	35
Table 6-1 Biodiversity features and constraint levels at the proposed Capital Solar Farm site	42
Table 7-1 Potential impacts of the Proposal.....	45
Table 7-2 Estimated impact areas of each Proposal component	46
Table 7-3 Area of impact summary.....	47

Figures

Figure 1-1 Location of the proposed Capital Solar Farm	2
Figure 1-2 Capital Solar Farm site including development envelope and indicative PV array and roading layout	5
Figure 1-3 Capital Solar Farm site including development envelope and indicative infrastructure layout (excluding PV arrays).....	6
Figure 2-1 Palerang Council map of environmentally sensitive land in the study area – biodiversity (green) and corridors (yellow).....	10
Figure 3-1 Location of flora survey sites	15
Figure 3-2 Fauna survey points.....	16
Figure 4-1 Approximate distribution of vegetation communities at the subject site	24
Figure 4-2 View across proposed solar farm site from the south-west corner of the site off Tarago Road 26	

Figure 4-3 Fenceline between western and eastern paddocks at the solar farm site.....	26
Figure 4-4 Regrowth Bracken Fern on sand at southern end of proposed transmission corridor	26
Figure 4-5 Brittle Gum and Wire Grass in proposed transmission corridor	26
Figure 4-6 Remnant Frost Hollow Woodland (flora survey site 19)	26
Figure 5-1 Eroded Bridge Creek at the subject site	34
Figure 5-2 Granite outcrop site (Habitat Assessment 19 – refer Appendix B).....	34
Figure 5-3 Tea-tree in pasture, White-fronted Chat habitat at solar farm site (Habitat Ass. site 15)	34
Figure 5-4 Hollow-bearing Brittle Gum in proposed transmission corridor (Habitat Ass. site 6)	34
Figure 5-5 Fauna habitat features and development envelope at the subject site.....	38
Figure 5-6 Threatened Fauna recorded during the survey	40
Figure 6-1 Constraint classes at the subject site.....	43
Figure 7-1 Indicative design of fish-friendly box culvert crossing.....	49
Figure 9-1 DECCW Wildlife Atlas map of Hoary Sunray records around the study area (red circle)	A-2
Figure 9-2 Fauna habitat assessment points	B-1
Figure 9-3 Biodiversity constraints overlayed with the development envelope	H-2
Figure 9-4 Flora survey points and vegetation type	H-3
Figure 9-5 Fauna survey effort with vegetation type	H-4
Figure 9-6 Habitat features.....	H-5

Acronyms and terminology used in this report

Acronyms

DECCW	Department of Climate Change and Water (NSW)
DEWHA	Department of Environment, Water, Heritage and the Arts (Commonwealth)
TSC Act	<i>Threatened Species Conservation Act 1995</i> (NSW)
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
NPWS	National Parks and Wildlife Service (NSW)
EEC	Endangered Ecological Community
CEEC	Critically Endangered Ecological Community
ROTAP	Rare or Threatened Australian Plants register (CSIRO)
JANIS	Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee

Terminology

PV array	Refers to a photovoltaic array, a string of photovoltaic modules which are made up of interconnected solar cells.
Threatened entity	Refers to all units listed as threatened under the EPBC Act and/ or TSC Act including species, populations and ecological communities
Key species or key taxa	'Key species' or 'key taxa' refers to taxa listed under any category of conservation status by relevant legislation (i.e. migratory through to endangered under EPBC Act or TSC Act) and taxa naturally occurring at low densities (such as raptors).
Subject site	The area directly affected by the Proposal.
Development Envelope	The development envelope refers to an assessment approach. All parts of the site which have the potential to carry infrastructure are referred to as the development envelope. In practice infrastructure would rarely occupy the entire development envelope and hence the final layout of the development, or subject site, is a subset of the development envelope. The development envelope differs from the subject site in that it provides a site-specific study area within which the most appropriate areas for direct impact on biodiversity values are identified.

1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

Infigen-Suntech Australia Pty Ltd ('Infigen') proposes to construct a 50 megawatt photovoltaic solar farm on a rural property near Bungendore on the Southern Tablelands of NSW. This Biodiversity Assessment examines biodiversity values and likely impacts associated with the proposed solar farm. The Biodiversity Assessment:

- Provides a summary description of the proposed works
- Outlines the environmental and legislative context of the Proposal
- Identifies, describes and maps the biodiversity values of the site of the Proposal (the 'subject site'), including threatened species and communities
- Classifies and maps the biodiversity constraints in relation to the proposed development
- Identifies and assesses the significance of the Proposals potential impacts to biodiversity values
- Provides a series of recommended measures designed to avoid and mitigate impacts to biodiversity values.

The Biodiversity Assessment is intended to meet the assessment requirements under Part 3A of the *Environmental Planning and Assessment Act 1979*, the *Threatened Species Conservation Act 1995*, the Commonwealth *Environmental Protection Biodiversity Conservation Act 1999*, the Director-General's Requirements for the project issued by the Department of Planning, the Draft Guidelines for Threatened Species Assessment (DEC, 2005) and other relevant assessment guidelines produced by the NSW Department of the Environment, Climate Change and Water and the Commonwealth Department of the Environment, Water, Heritage and the Arts.

1.2 THE PROPOSAL

1.2.1 Location

The proposed Capital Solar Farm would be located within occupy a 250 hectare site adjacent to the existing 67 turbine Capital Wind Farm and Capital Substation at 1279 Tarago Road, Bungendore NSW (Lot 1 of DP658449, Lot 1 of DP 456698, Lots 1 and 2 of DP 1140319).

The location of the proposed works is shown on Figure 1-1.

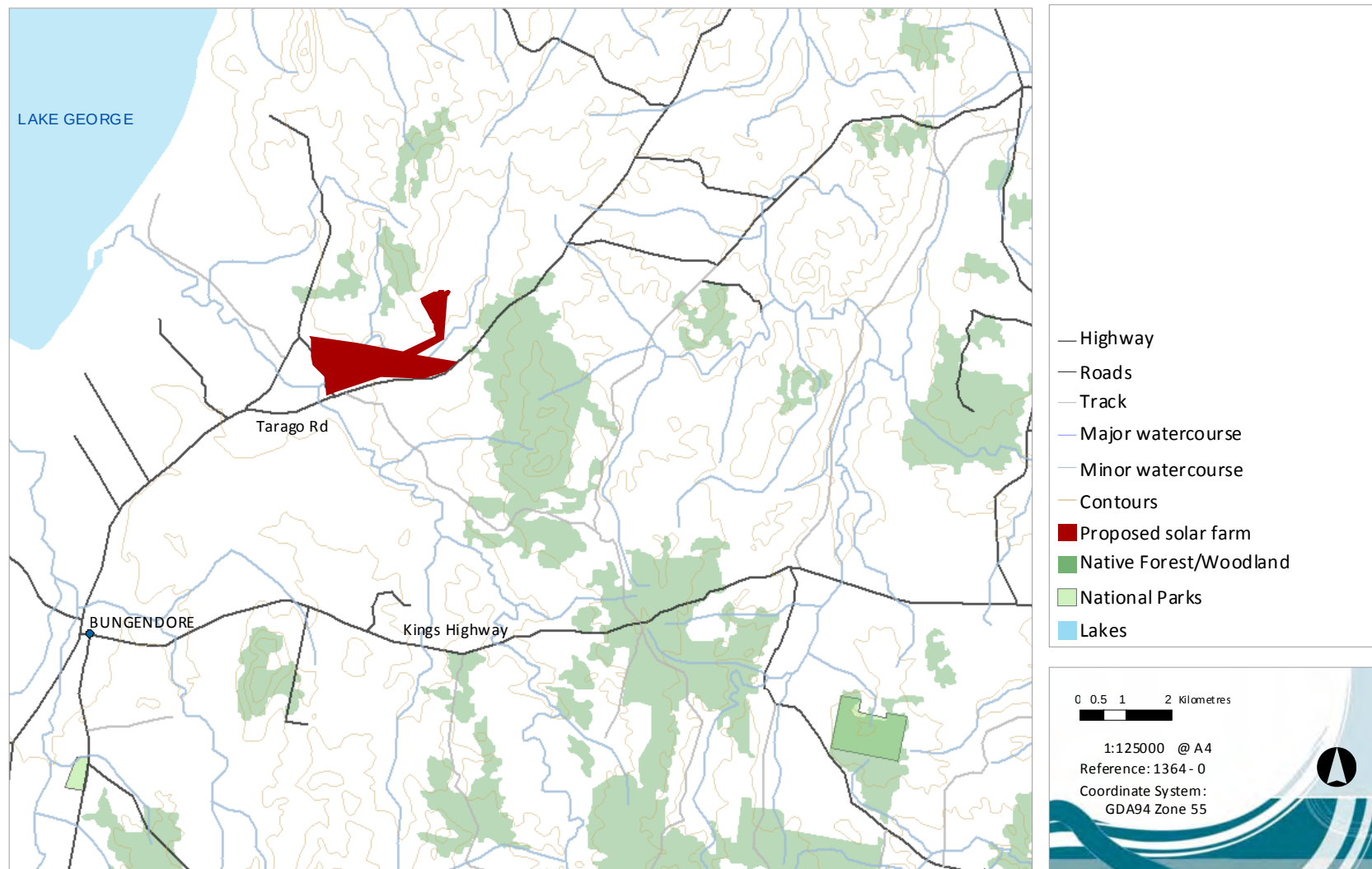


Figure 1-1 Location of the proposed Capital Solar Farm

1.2.2 Proposal description

The 50 megawatt solar farm would comprise a series of photovoltaic panels mounted on fixed frames, occupying approximately 100 ha. The development envelope and proposed layout for the solar farm and transmission line are shown on Figure 1-2 and Figure 1-3. Preliminary structural plans for the Proposal are provided in Appendix G.

The solar farm would use the existing substation constructed for the adjacent Capital Wind Farm. It is proposed that the Capital Solar Farm would include research infrastructure, such as monitoring and workshop buildings. The solar farm would have an expected operating life of up to 50 years. The decommissioning phase would remove all above ground infrastructure from the site.

Project infrastructure for the proposed solar farm would include

- A fixed photovoltaic solar panel (PV) array, arranged in a series of rows between 1 and 4 metres above the ground, angled for maximum efficiency and supported by steel framing on steel posts driven into the ground to a depth of 2 metres or concrete footings resting on the ground surface.
- A series of central inverters and kiosk transformers distributed throughout the PV array
- Electrical connections between the PV array, central inverters and transformers via underground or frame secured cabling
- Electrical connection into the existing 330kV Capital substation via an underground transmission line
- Internal access tracks and upgrades to existing roads, where required
- Fencing and landscaping around the Solar Farm
- Fencing around offset areas
- Site office and Operations and Maintenance building
- A Research Office and monitoring infrastructure
- Additional temporary construction infrastructure such as a site compound and equipment laydown area.

The construction company Tenix would be engaged to construct the solar farm. Construction works would be confined to standard construction hours (Monday-Friday 7am-6pm, Saturday 8am-1pm). It is not expected that night work would be required.

Cabling would be attached to the panel rows, and then installed in a trench to the inverter. The solar farm would connect to the substation via a 2-3 kilometre long underground line (preferred option) or an overhead cable supported by timber poles. The internal voltage between the solar farm and the substation would be 22kV or 33kV. Approximately 62 inverters and 31 kiosk transformers would be required at the solar farm (refer Appendix G).

Inverters weigh round 10 tonnes and would be transported to the site using standard articulated trucks. Approximately 200,000 solar panels would be required, transported in 167 shipping containers. Around 500 truck movements are expected during the construction phase. Rail would be used to transport the solar farm materials as close as possible to the site. Access tracks would be constructed to each inverter and around the perimeter of the farm.

Site security during the operational phase will involve a 6-8 ft cyclone mesh fence, possibly with security lighting. Security personnel will attend the site at least during the night, possibly on a 24 hour basis. Restricted access, safety signage and possibly security cameras would also be used.

An average of 50 staff would be required to construct the solar farm and 5 staff would be required during the operational phase.

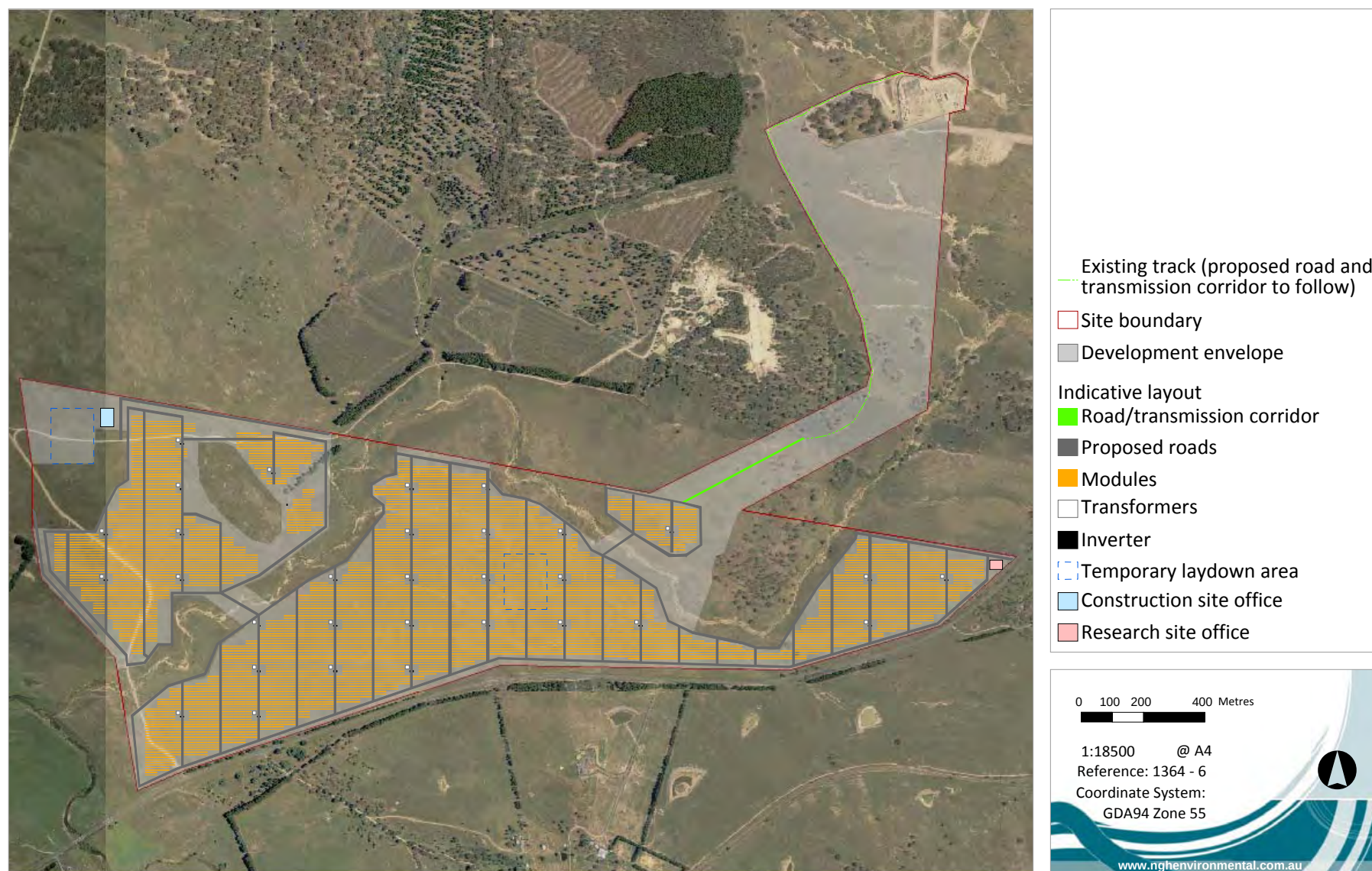


Figure 1-2 Capital Solar Farm site including development envelope and indicative PV array and roading layout

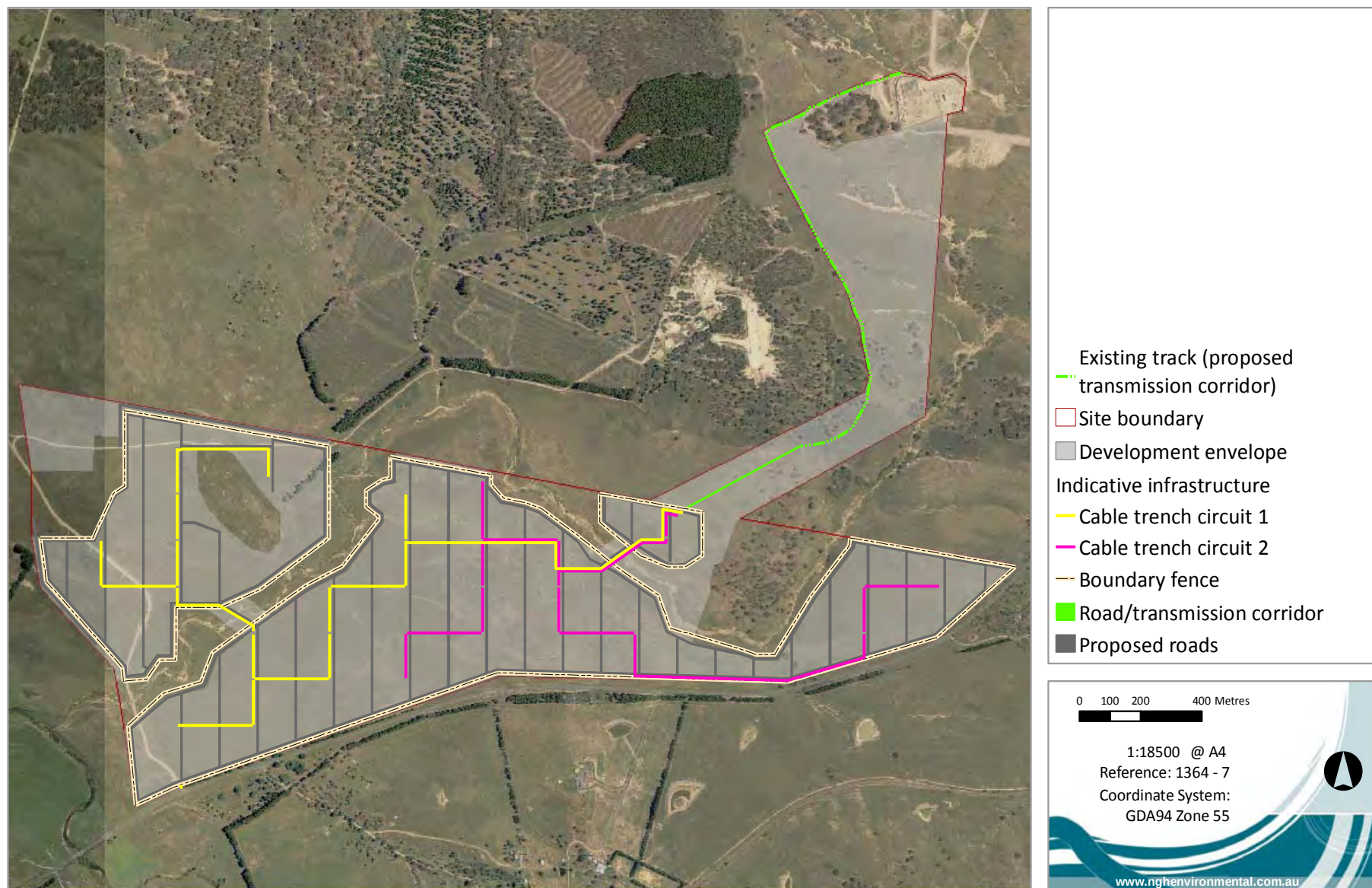


Figure 1-3 Capital Solar Farm site including development envelope and indicative infrastructure layout (excluding PV arrays)

1.2.3 Potential impacts of the Proposal

Potential impacts to biodiversity during the construction phase of the Proposal relate to site preparation, operation of vehicles and machinery and the installation of infrastructure. This may involve earthworks and excavations, vegetation clearing and pollution risks from chemicals used onsite and concreting works.

The operation of photovoltaic (PV) arrays is generally considered to generate low environmental impact, especially with regard to biodiversity values (Kaygusuz 2009). The components are non-moving, the surface non-reflective and the PV arrays release no emissions. The potential environmental impacts of PV solar farms depend on the size and nature of the project and are frequently site specific (Gekas *et al.* 2002). Biodiversity impacts in particular are likely to be closely tied to the specific biodiversity values of the site and their sensitivity to the installation of infrastructure such as solar panel arrays, perimeter fencing and overhead transmission lines.

In their summary of potential environmental impacts of PV solar farms, Gekas *et al.* (2002) include the following issues relevant to biodiversity:

- **Environmental benefits** - significant noise or chemical pollutants emission reductions and an increase in soil humidity and plant growing conditions in dry areas
- **Land use and ecosystem impacts** – these depend on specific factors such as topography, the area and the type of the land covered by the system, the distance from areas of natural beauty or sensitive ecosystems and the biodiversity. Impacts are related to construction and transport movements. Projects can ‘reserve’ soils for future uses.
- **Pollution** - emissions into soil and groundwater of poorly stored materials, abnormal plant operations, damaged panels or fire (Tsoutsos *et al.* 2005).
- **Air pollution** - minor emissions associated with transport of the panels.

Mitigation of environmental impacts can be achieved by avoiding ecologically sensitive areas (Gekas *et al.* 2002).

2 ENVIRONMENTAL AND PLANNING CONTEXT

2.1 ENVIRONMENTAL CONTEXT

2.1.1 *Interim Biogeographic Regionalisation of Australia (IBRA)*

IBRA bioregions are a landscape-scale approach to land classification using a range of environmental data (Thackway and Cresswell 2000). The Proposal is located in the South Eastern Highlands Bioregion, which occupies 8.7 million ha (6.11 per cent of the state) and includes Orange and Bathurst in the north and Bombala in the south. The bioregion supports a broad range of vegetation communities and habitats, including forests, woodlands, grasslands and riparian/aquatic communities. Across the four subregions, there are six ecological communities, 24 flora and 60 fauna species listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Conservation reserves occupy about 726,530 ha or 14.86 per cent of the bioregion (DECCW 2010).

2.1.2 *Catchment Management Area and sub-region*

The study area lies within the Murrumbidgee Catchment Management Area, which covers 84,000 square kilometres and extends from the Great Dividing Range in the east to the western Riverina. The catchment contains a large variety of landforms and vegetation types. There are eight threatened ecological communities, five threatened populations, 130 threatened species, three internationally listed wetlands and 17 nationally listed wetlands in the Murrumbidgee CMA area. Major management issues for biodiversity in the catchment include a decline in the extent and condition of native vegetation, threats to native fauna sustainability and control of pest plants and animals (Murrumbidgee CMA 2008).

The study area is located in the Monaro CMA sub-region, a plateau rising from 600 in the north to 1300 metres in the south (Morgan 2001). Much of the area is in rainshadow with annual rainfall 450-700mm. Grassy woodlands occur on undulating terrain and on flats with deeper soil development. White Gum and Brittle Gum dry forest occurs on hills. Extensive grasslands occur on the driest plains (Morgan 2001), particularly on basalt in the south.

The subject site is located in the Lake George catchment. Lake George is six kilometres to the north-west of the site and has geological significance as an internal drainage basin formed by a fault line. The lake is listed in the NSW Directory of Important Wetlands (Environment Australia 2001).

2.1.3 *District scale assessment*

The subject site is located in the Palerang Local Government Area, and is zoned 1(a) General Rural under the Yarrowlumla Local Environmental Plan 2002. The site is currently used for grazing cattle. Land uses on surrounding land include sand mining (Tegra Quarries) and electricity generation (Capital Wind Farm). The land around Lake George supplies water from aquifer to Bungendore (Turallo Creek catchment) and local landholders. Other local land uses include rural subdivision, turf farming, a transport corridor and urban settlements (Fallding 2002). The site is located five kilometres from Bungendore, a small town of 2,182 people (2006 Census), and 30 kilometres east of Canberra and Queanbeyan. Sixty-two vegetation communities have been recorded within Palerang Council Area,

including 24 of conservation significance and four Endangered Ecological Communities. The LGA contains 21 conservation reserves, totalling 75,950 ha or 15% of the LGA (ACTCE 2004).

The site occurs within the Bungendore Landscape Unit, which comprises undulating plains and low hills occupied by grasslands and woodlands, with some low hills occupied by dry forests (Fallding 2002). Grasslands and woodlands in the unit are largely cleared or modified and the dry forests are partly cleared. The unit contains significant stands of Box-Gum Woodland, Frost Hollow Grassy Woodland and natural temperate grassland Endangered Ecological Communities. Woodland and grassland in the unit have potential to support a range of threatened plant species, including *Diuris aequalis*, *Dodonea procumbens*, *Leucochrysum albicans* var *tricolor*, *Calotis glandulosa*, *Rutidosia leptorhynchoidea*, *Swainsona sericea*, *S. recta* and *Thesium australe*, and a range of threatened fauna species including the Little Whip Snake, Striped Legless Lizard, Pink-tailed Legless Lizard, microbats and woodland birds (Fallding 2002).

2.1.4 Locality assessment

A locality-scale review of habitats was conducted with reference to aerial photography, topographic maps and vehicle-based survey results. For these purposes, the locality occupies an area surrounding the subject site over a radius of 15 kilometres. The following habitat features are located within this area:

- Lake George, a large and significant ephemeral wetland located 6 kilometres north-west of the subject site
- Fourth order watercourses running through and near the site (Bridge Creek, Dry Creek and Butmaroo Creek), which drain to Lake George.
- Remnant woodland and dry forest on the Great Dividing Range located north and east of the site, forming a discontinuous corridor with Tallaganda National Park 20 kilometres to the south
- Patches of Box-Gum Woodland and Frost Hollow Woodland Endangered Ecological Community beside Tarago Road to the immediate east of the site. The 40ha Sweeney's Travelling Stock Reserve adjoins the property to the east, and contains significant stands of Frost Hollow Woodland and Box-Gum Woodland.

On their recent environmentally sensitive land mapping, Palerang Council has assessed the subject site as sensitive for biodiversity, and some parts of the site sensitive as environmental corridors (Palerang Council 2010) (refer Figure 2-1).

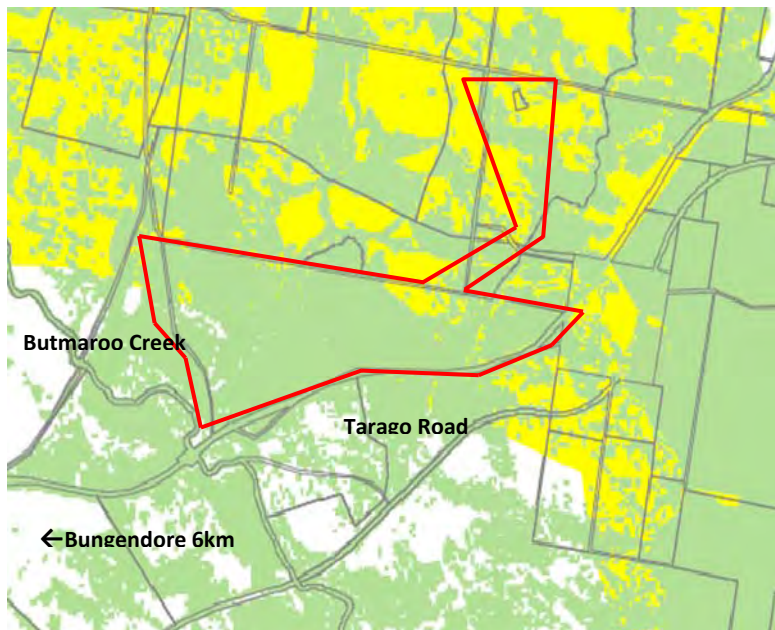


Figure 2-1 Palarang Council map of environmentally sensitive land in the study area – biodiversity (green) and corridors (yellow)

2.2 SITE DESCRIPTION

The subject site is located beside Bridge Creek and Dry Creek, fourth order tributaries of Butmaroo Creek in the Lake George catchment. The geology of the subject site belongs to the Lachlan Fold Belt, comprising Silurian and Devonian folded sediment, metasediments, volcanics and intrusive igneous rocks. The western part of the subject site comprises plains and low rises over granitic geology (adamellite), with some outcropping on crests. The central and eastern parts of the solar farm site are on flat to undulating terrain on metasediments. The proposed underground transmission line passes over rolling hills on granitic and metasedimentary geology. Elevation at the site ranges between 690 metres and 760 metres AHD. The slope is flat and gently undulating over the proposed solar farm site and moderately steep on hills along the proposed transmission corridor to the substation.

The site is grazing land carrying largely native pasture derived from grasslands, woodlands and dry forest. The proposed solar farm site is almost entirely cleared of trees. The pasture on sandy granitic soils in the west of the site appears to have been more intensively managed and carries both native and exotic grasses and few native forbs. Low-lying areas carry discrete patches of Swamp Tea-tree (*Leptospermum myrtifolium*) shrubland. The native Curly Sedge (*Carex bichenoviana*) forms dense groundcover in valley floor areas and is widely scattered across the pasture areas, particularly in the western paddock. Grazing sensitive species appear to be absent from the site.

The pasture on granite and metasediments in the east of the proposed solar farm site is dominated by native grasses (*Austrostipa* spp, *Austrodanthonia* spp, *Bothriochloa macra*, *Microlaena stipoides*, limited *Themeda australis*) and has a variable diversity of native forbs, ranging up to 8 non-grass species (observed during winter 2010). The proposed transmission corridor carries a native pasture derived from woodland and dry forest types. Small patches of remnant Brittle Gum (*Eucalyptus mannifera*), Broad-leaved Peppermint (*E. dives*) and Ribbon Gum (*E. viminalis*) occur within the

transmission line envelope. Serious infestations of several noxious weeds are present at the site (particularly Serrated Tussock and Scotch Thistle).

2.3 POLICY AND LEGISLATION

The Proposal is a Major Project which would be assessed as Critical Infrastructure under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Part 3A integrates the assessment and approval regime for all Major Projects that need the approval of the Minister for Planning, previously dealt with by Parts 4 and 5 of the Act. Projects approved under Part 3A of the EP&A Act do not require authorisations under the *Fisheries Management Act 1994* (sections 201, 205 or 219, stop work orders); *National Parks and Wildlife Act 1974* (section 87, consent under section 90, interim protection and stop work orders), *Native Vegetation Act 2003* (section 12) and *Threatened Species Conservation Act 1995* (interim protection and stop work orders).

Clause 111 of the EP&A Act applies a duty to determining authorities to consider ‘to the fullest extent possible all matters affecting or likely to affect the environment by reason of that activity’. The Part 3A process requires proponents to prepare a detailed and publicly available Environmental Assessment report, which includes the consideration of biodiversity values and impacts.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* provides for an assessment and approvals system for, among other things, actions that have a significant impact on ‘matters of national environmental significance’. These matters include World Heritage properties, wetlands of international importance, and Commonwealth listed threatened species and ecological communities. Proposals which would significantly affect a matter of national environmental significance must be referred to the Commonwealth Environment Minister for approval.

Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) specifies seven factors to be taken into account in deciding whether a development is likely to significantly affect threatened species, populations or ecological communities, or their habitats. Although not a legal requirement of a Part 3A development, Assessments of Significance provide a transparent and systematic characterisation of impact for listed entities.

3 ASSESSMENT APPROACH AND METHODOLOGY

3.1 APPROACH

The Biodiversity Assessment involves:

- A desktop review of research literature, online databases and other sources to determine regional and local biodiversity values and assist field survey planning and design
- Field flora and fauna surveys and habitat assessments
- Analysis and assessment of data to establish conservation values and significance of impacts in relation to environmental legislation
- Development of measures to reduce the risks and identified impacts, focussing on avoidance and mitigation and offsets where impacts are unavoidable

The Assessment focuses on a 'development envelope', a wider area which covers all parts of the subject site which have potential to carry solar farm infrastructure. This approach allows the design of the project to be adapted in response to the findings of the Assessment. Refer to Appendix H for the biodiversity constraints map overlayed with the final development envelope.

3.2 PRELIMINARY ASSESSMENTS

Online database searches of threatened and migratory species were undertaken for the Murrumbidgee CMA region, Monaro sub-region using the DECCW threatened species database and over a 25 kilometre radius using the Commonwealth EPBC Act Protected Matters search tool. Topographic maps and air photographs were used to initially stratify the site for the survey based on topography and interpreted vegetation cover.

The Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands (Fallding 2002), previous survey records (including those in the DECCW Wildlife Atlas) and predictive vegetation mapping (Thomas *et al.* 2000) were also consulted to identify threatened species and associated habitats for targeting during the survey. The likelihood of identified threatened species to occur within the study area and their potential to be impacted by the Proposal was assessed using the evaluation in Appendix B.

3.3 FIELD SURVEY AND MAPPING

3.3.1 Flora

The field survey was undertaken on 22nd June and 4th August 2010. A total of 12 hours was spent on the flora survey. The flora survey sites are indicated on Figure 3-1.

The survey is based on both sampling sites and general site inspection on foot and from a slow-moving vehicle. The site records involved a series of formal random meanders located within relatively homogeneous stratification zones. The random meanders (after Cropper 1993) were up to 30 minutes in duration and covered up to 1 hectare. Floristics, structural data, vegetation condition and site physical values were recorded. This approach allows vegetation type and condition to be

characterised, while providing the areal coverage required for a project of this scale. Targeted searches of likely habitats were used to detect significant or sparsely distributed plant species.

Vegetation condition was rated according to the following four-point scale, focusing on floristic integrity in the groundcover layer:

Exotic	Groundlayer dominated by exotics
Poor	Groundlayer dominated by one or two native grass species, <5 native non-grass species
Moderate	Groundlayer dominated by native grasses, 5-11 native non-grass species present
Good	Groundlayer dominated by native grasses with a diversity of native non grass (at least 12 native non-grass species).

These classes are most relevant for vegetation types with a naturally diverse grassy groundcover, such as grassy woodland and natural grassland.

The vegetation of the subject site has been classified using the Southern Region Comprehensive Regional Assessment (SCRA) system (Thomas *et al.* 2000), revised by Gellie (2005). The recent SCVI classification supersedes the SCRA work for the coast and eastern tablelands, but does not extend westward to include all of the study area. The SCRA classification is considered to provide better context for vegetation types at the subject site, particularly in terms of estimates of remaining extent and reservation in the region, which are critical for determining conservation status and impact significance. A map of the flora survey points in relation to the vegetation type is displayed in Appendix H.

3.3.2 Fauna

The fauna survey was undertaken over two days from the 15th to the 16th of July 2010 (winter). Details of the climatic conditions experienced during the survey are contained in Table 3-1.

Table 3-1: Survey conditions¹

Date	Max(°C)	Min (°C)	Rain (mm)	Wind (3pm)	MSLP (hPa) (3pm)	Moon	Cloud
15/7/10	11.4	1.4	8.8	NW @20km/h	1020	<1/4	2/8
16/7/10	12.2	-3.4	0.2	W@9km/h	1026	<1/4	1/8

The focus of the fauna survey was to identify and assess habitat, including suitability for threatened species, rather than to detect individual species. This approach is aimed at addressing the problems inherent in surveying for rare and cryptic species, particularly when utilising short duration surveys. Following the precautionary approach, if suitable habitat was found it has been inferred that the threatened species may also occur unless reliable data provides evidence otherwise. For these species a 'worst case' scenario approach has been adopted and the assessment has been undertaken on the

^{1 1} Weather observation data sourced from the BOM Canberra Airport weather station BOM (2010) located 30km south west of the subject site. Subject site climatic conditions are likely to have varied slightly from these figures due to spatial differences. The subject site received no rain on the 15th or the 16th July 2010.

assumption that the species occupies the site. In the case of the threatened reptile species; Striped Legless Lizard, Pink-tailed Worm-lizard, Little Whip snake and Grassland Earless Dragon, further survey effort will be undertaken to confirm the assumptions in the assessments of significance (see Appendix A). Areas supporting threatened species habitat were identified as high constraints to development early in the project planning phase and the infrastructure layout was then designed to avoid these areas.

This survey primarily focused on habitat assessment but also included 20 minute bird surveys, call playback, spotlighting, targeted habitat searches for reptiles and opportunistic records of sign and observations to identify habitat and detect resident species. The fauna survey effort is mapped on Figure 3-2. (a version of this map with the vegetation types found on the subject site is included in Appendix H), and information including survey methods, target species and effort is given in Table 3-2.

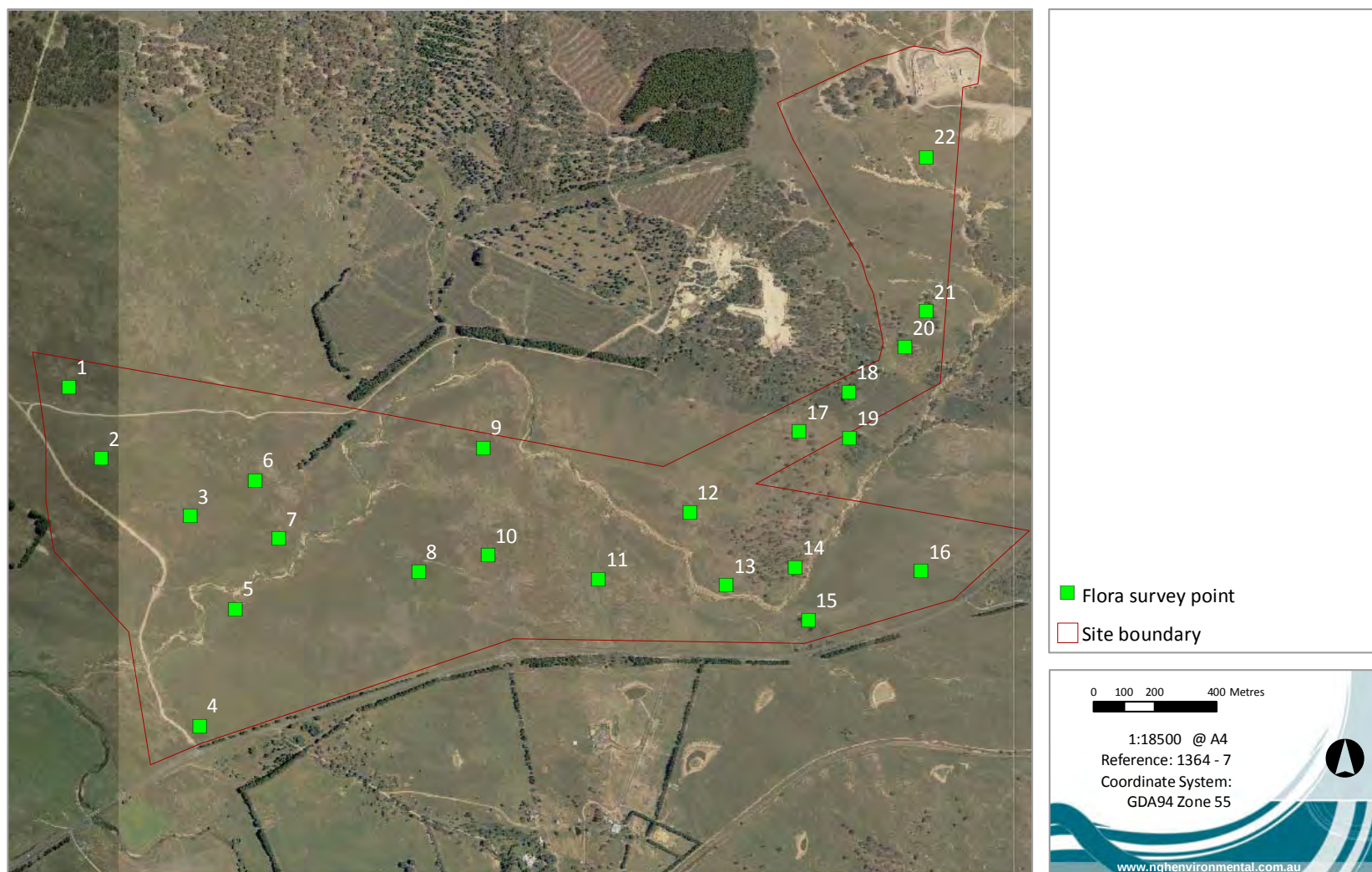


Figure 3-1 Location of flora survey sites

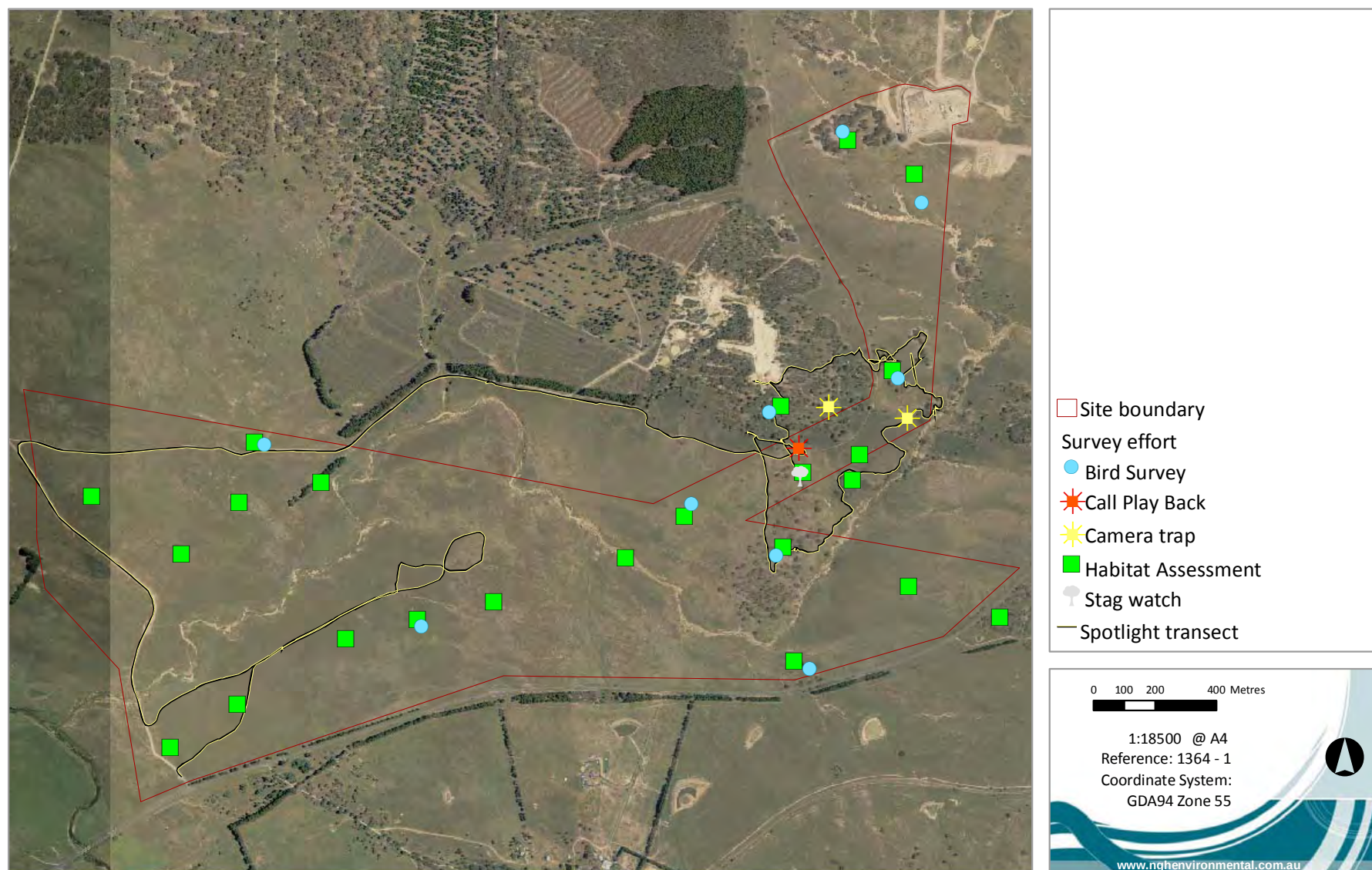


Figure 3-2 Fauna survey points

Table 3-2 Fauna survey design and effort

Survey type	Example target species	Design	Survey effort
Habitat assessment	Threatened species	Habitat assessments recording presence and quality of threatened fauna habitat (for example hollow bearing trees, rock outcrops, proximity to water, stands of native grass, fallen timber, watercourses, mistletoe, past and present disturbance) were undertaken across the site. The survey points were originally stratified using aerial photography then adjusted if required following ground truthing to ensure thorough coverage of all habitat types.	23 assessments undertaken
Diurnal bird survey	Threatened bird species including: Brown Treecreeper Gang Gang Cockatoo	Twenty minute bird surveys were undertaken by one person covering an area of approximately one hectare on foot. One 30 minute survey was undertaken in the woodland adjacent to the transmission corridor as bird diversity was high. Birds were identified by call or observation (aided by binoculars). Additional opportunistic records were noted while completing other assessments on the site.	9 surveys; total of 190 minutes
Camera traps	Spot-tailed Quolls Feral predators	Two infra-red motion detection cameras (scoutguard SG550v) were installed for one night. Cameras were set at ground bait stations located on existing animal pads through gaps in fence lines. All were baited with honey and sardines.	2 camera nights
Spotlight	nocturnal mammals, nocturnal birds and amphibians including: Squirrel Glider Large Forest Owls Spot-tailed Quoll	A foot spotlight session using a hand-held 12v 50w spotlight was conducted through the woodland and dry forest adjacent to, and within, the central transmission corridor area. Spotlighting from a vehicle travelling <5km/hr was carried out through the subject site and along the lower transmission corridor.	1 foot transect, 1 vehicle transect

Survey type	Example target species	Design	Survey effort
Call playback (CPB)	Barking Owl Powerful Owl	Two surveys broadcasting vocalisations of the Powerful Owl and Barking Owl were undertaken in the wooded section of the transmission corridor, one just after sunset and one an hour and a half later in the same location. Call playback was carried out after a 5 minute acclimation period. Calls for each species were played for 5 minutes. Listening for responses was carried out for an additional 5 minutes. Ten minutes of spotlighting around the call playback location followed the call play-back session.	2 surveys; 40mins
Opportunistic	All	All opportunistic records of fauna or fauna sign were recorded.	n/a

3.3.3 Mapping

Spatial data obtained during the survey using hand-held GPS Magellan and Garmin GPS units were plotted over aerial imagery (sourced from NSW Department of Lands) using ArcGIS software for mapping, planning and presentation. Vegetation and condition boundaries were extrapolated from point and traverse data and notes taken during the general site inspection. All map references are based on the GDA 94 (new) datum.

3.3.4 Survey limitations

The winter timing of the survey was poor and some geophytic species, spring or summer flowering annuals and species which are inconspicuous or difficult to identify in their vegetative state will not have been recorded. The species diversity of the native pasture at the site in particular may have been underestimated. The possibility that significant species may have been omitted due to seasonal factors is addressed in Section 4.4.2. Where some potential for unrecorded threatened species exists, this possibility is acknowledged and precautions incorporated into the layout design, impact assessment and mitigation measures.

At the time of survey most of the subject site was being grazed by cattle, and this may have affected the recording of some taller and more palatable species. Ephemeral species which flower in response to irregular disturbance events such as fire will also have gone unrecorded. The development envelope occupies 220 ha, requiring extrapolation and generalisation from the 23 flora survey points, using air photo interpretation with some ground-truthing. Some finescale errors are possible, but are considered unlikely to alter the broad findings of the study.

Following the flora survey, the transmission line envelope was expanded to the west to include an existing farm track passing through low diversity native pasture and a Box-Gum Woodland patch west of the substation. Similar pasture vegetation has been included in the survey. The woodland patch was not surveyed but would not be affected by the proposed works.

The timing of the survey was unsuitable for the detection of many threatened fauna species particularly reptiles and microbats. Habitat assessments (Appendix B) were used as a surrogate for direct detection of threatened species and informed the assessment of whether a species was likely to occur on the subject site. The habitat for threatened species with potential to occur on the subject site is identifiable independent of seasonal factors.

The active and passive surveys undertaken in conjunction with the habitat assessments provide a snapshot of the biodiversity occurring on the site and should not be taken as a comprehensive inventory of species.

4 FLORA RESULTS

4.1 PRELIMINARY ASSESSMENTS

The Commonwealth Matters of National Environmental Significance search tool indicated two threatened ecological communities and 6 threatened species listed under the EPBC Act which are likely to occur within a 25 kilometre radius of the subject site (refer Appendix H). The DECCW threatened species database indicates the potential presence of an additional three threatened communities and 21 threatened species listed under the TSC Act in the Monaro sub-region of the Murrumbidgee CMA region.

The evaluation presented in Appendix D concludes that three threatened communities and seven threatened species have at least moderate potential to be present in habitat at the subject site, and at least moderate potential to be impacted by the Proposal:

Threatened communities

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ('Box-Gum Woodland') - TSC and EPBC - Critically Endangered
- Tablelands Frost Hollow Grassy Woodlands ('Frost Hollow Woodland') - TSC
- Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT - EPBC.

Threatened flora species

- | | |
|--|-------------------------|
| • Buttercup Doubletail (<i>Diuris aequalis</i>) | Vulnerable (TSC, EPBC) |
| • Austral Toadflax (<i>Thesium australe</i>) | Vulnerable (TSC, EPBC) |
| • Hoary Sunray (<i>Leucochrysum albicans</i> var. <i>tricolor</i>) | Endangered (EPBC) |
| • Button Wrinklewort (<i>Rutidosis leptorhynchoides</i>) | Endangered (TSC, EPBC) |
| • Small Purple-pea (<i>Swainsona recta</i>) | Endangered (TSC, EPBC) |
| • Silky Swainson-pea (<i>Swainsona sericea</i>) | Vulnerable (TSC) |
| • Creeping Hop-bush (<i>Dodonaea procumbens</i>) | Vulnerable (TSC, EPBC). |

4.2 SURVEY RESULTS

The flora survey sites are indicated on Figure 3-1 and the survey results are summarised in Table 4-1. The full flora survey results are presented in a.i.1.a.i.Appendix E.

Table 4-1 Field survey results summary

Site	Community and location	Dominant species	Condition ¹	Significance ¹
1	Native pasture - granitic, wet and dry areas MGA 726930 6102232	<i>Carex bichenoviana</i> , <i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austroanthonia</i> spp., <i>Erodium brachycarpum</i> , <i>Panicum effusum</i> , <i>Chloris truncata</i> , unidentified grasses and sedges	Poor	Low
2	Native pasture - low ridge with granitic outcrops MGA 727035 6102001	<i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austroanthonia</i> spp., <i>Aristida ramosa</i> , <i>Erodium brachycarpum</i> , unidentified grasses	Poor	Low
3	Native pasture/tea tree shrubland - low relief valley floor MGA 727325 6101813	<i>Leptospermum myrtifolium</i> , <i>Imperata cylindrica</i> , <i>Carex bichenoviana</i>	Poor	Low
4	Native/exotic pasture - granitic, dry area MGA 727355 6101132	<i>Carex bichenoviana</i> , <i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austroanthonia</i> spp, <i>Panicum effusum</i> , <i>Erodium brachycarpum</i> , <i>Acetosella vulgaris</i> , unidentified grasses	Poor	Low
5	Native/exotic pasture - granitic, dry area MGA 727472 6101511	<i>Carex bichenoviana</i> , <i>Austrostipa scabra</i> ssp <i>falcata</i> , unidentified grasses, <i>Trifolium</i> sp., <i>Onopordum acanthium</i>	Poor	Low
6	Native pasture - low ridge with granitic outcrops MGA 727535 6101930	<i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austroanthonia</i> spp., <i>Microlaena stipoides</i> , unidentified grasses	Poor	Low
7	Native pasture - midslope, dry area MGA 727612 6101739	<i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austroanthonia</i> spp., <i>Microlaena stipoides</i> , <i>Panicum effusum</i> , <i>Themeda australis</i> , unidentified grasses, <i>Acetosella vulgaris</i>	Poor	Low
8	Native pasture/tea tree shrubland - granitic, wet area MGA 728067 6101631	<i>Leptospermum myrtifolium</i> , <i>Carex bichenoviana</i> , <i>Cynodon dactylon</i> , <i>Austroanthonia</i> spp., <i>Acetosella vulgaris</i>	Poor	Low
9	Native pasture - metasediments, dry area MGA 728277 6102035	<i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austrostipa bigeniculata</i> , <i>Bothriochloa macra</i> , <i>Austroanthonia</i> spp., <i>Erodium brachycarpum</i>	Moderate	Low-moderate
10	Native pasture - metasediments, low ridge MGA 728292 6101685	<i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austrostipa bigeniculata</i> , <i>Austroanthonia</i> spp., <i>Cynodon dactylon</i> , <i>Microlaena stipoides</i> , <i>Bothriochloa macra</i>	Moderate	Low-moderate
11	Native pasture - metasediments, drainage line MGA 728652 6101608	<i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austrostipa bigeniculata</i> , <i>Austroanthonia</i> spp., <i>Microlaena stipoides</i> , <i>Erodium brachycarpum</i>	Poor	Low ¹
12	Native pasture - metasediments, dry area MGA 728948 6101826	<i>Eucalyptus pauciflora</i> (1 tree), <i>Nassella trichotoma</i> , <i>Austroanthonia</i> spp., <i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Erodium brachycarpum</i> , <i>Leucochrysum albicans</i> (c. 4 plants)	Poor	Moderate
13	Native pasture - lower slope MGA 729068 6101587	<i>Themeda australis</i> , <i>Austroanthonia</i> spp, <i>Chryscephalum apiculatum</i>	Moderate	Moderate-high
14	Dry forest and derived native pasture - metasediments, lower slope MGA 729290 6101647	<i>Eucalyptus mannifera</i> , <i>Joycea pallida</i> , <i>Aristida ramosa</i> , <i>Austroanthonia</i> spp, <i>Poa sieberiana</i> , <i>Themeda australis</i>	Moderate	Moderate

Site	Community and location	Dominant species	Condition ¹	Significance ¹
15	Native pasture with remnant trees (EEC) - metasediments, remnant trees MGA 729333 6101475	<i>Eucalyptus viminalis</i> , <i>Eucalyptus pauciflora</i> , <i>Pteridium esculentum</i> , <i>Carex bichenoviana</i> , * <i>Cynodon dactylon</i>	Poor	Moderate
16	Native pasture - metasediments MGA 729700 6101634	<i>Austrodanthonia</i> spp., <i>Themeda australis</i> , <i>Bothriochloa macra</i> , * <i>Cynodon dactylon</i>	Poor	Low
17	Dry forest and derived native pasture - metasediments? MGA 729304 6102087	<i>Eucalyptus mannifera</i> , <i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austrodanthonia</i> spp., * <i>Nassella trichotoma</i>	Poor	Moderate
18	Dry forest -regrowth (possible EEC) - sand, midslope MGA 729465 6102217	<i>Eucalyptus dives</i> , <i>Acacia mearnsii</i> , <i>Pteridium esculentum</i> , <i>Imperata cylindrica</i> , <i>Microlaena stipoides</i> , * <i>Nassella trichotoma</i>	Poor	Moderate
19	Woodland patches (EEC) - metasediments MGA 729467 6102066	<i>Eucalyptus viminalis</i> , <i>E. pauciflora</i> , <i>Acacia</i> <i>melanoxylon</i> , <i>Pteridium esculentum</i> <i>Microlaena stipoides</i> , * <i>Nassella</i> <i>trichotoma</i> , <i>Austrostipa scabra</i> ssp <i>falcata</i> , <i>Austrodanthonia</i> spp	Poor	Moderate - high
20	Dry forest and derived native pasture - metasediments? MGA 729648 6102361	<i>Eucalyptus mannifera</i> , <i>E. dives</i> , <i>Aristida</i> <i>ramosa</i> , <i>Joycea pallida</i>	Good	Moderate
21	Forest/woodland patches (likely EEC) - metasediments MGA 729717 6102478	<i>Eucalyptus viminalis</i> , <i>E. dives</i> , <i>Microlaena</i> <i>stipoides</i> , * <i>Nassella trichotoma</i> , <i>Juncus</i> sp.	Poor	Moderate - high
22	Native pasture - upper slope, granitic MGA 729718 6102981	* <i>Nassella trichotoma</i> , <i>Microlaena</i> <i>stipoides</i> , * <i>Acetosella vulgaris</i>	Poor	Low

¹ condition and significance assessment requires confirmation with a spring survey

4.3 VEGETATION COMMUNITIES

4.3.1 Solar farm site

The envelope for the proposed solar farm comprises native pasture on soils derived from both granitic and metasedimentary geology. While generally dominated by native grasses and sedges (particularly Corkscrew Grass *Austrostipa scabra* ssp *falcata* and Curly Sedge *Carex bichenoviana*), the pasture supports very few native forb or woody species.

Based on species recordable at the time of survey, and less disturbed vegetation on adjacent roadsides, the pasture is most likely to be derived from Frost Hollow Woodland, possibly in a mosaic with natural grassland and ephemeral wetland assemblages. Some valley floor and low-lying areas are dominated by Swamp Tea-tree (*Leptospermum myrtifolium*) with a dense Curly Sedge groundcover. These areas appear to be transitional between Frost Hollow Woodland understorey and the ephemeral lacustrine grassland characteristic of the bed of Lake George (refer Rehwinkel 2010).

Frost Hollow Woodland with Snow Gums (*E. pauciflora*) and Ribbon Gums (*E. viminalis*) in the overstorey is present on roadsides and paddocks south and east of the subject site. Snow Gums and occasionally Black Sallee (*E. stellulata*) trees are sparsely scattered along Bridge and Dry Creeks at the site. A narrow strip of relatively diverse woodland groundcover dominated by Kangaroo Grass (*Themeda australis*) is present on the north side of Dry Creek (site 13). A range of native forbs occur

here, including *Leptorhynchus squamatus*, *Solenogyne dominii*, *S. gunnii*, *Chrysocephalum apiculatum*, *Goodenia hederacea*, *Plantago varia* and *Asperula conferta*.

A patch of dry forest dominated by Brittle Gum (*E. mannifera*) on metasediments occurs at the eastern end of the site, north of Dry Creek. This vegetation includes many old growth hollow-bearing trees with a variable grassy groundcover often dominated by Robust Wallaby Grass (*Joycea pallida*).

The approximate distribution of vegetation communities at the subject site is indicated on Figure 4-1. The SCRA vegetation types and conservation status related to these communities are indicated in Table 4-2.

4.3.2 Transmission route

The proposed transmission route carries a native pasture derived from woodland and dry forest types. The lower slopes in the south of the corridor would have once carried Frost Hollow Woodland. Small and fragmented patches of woodland dominated by Snow Gums and Ribbon Gums are located along the eastern edge of the corridor.

Small patches and scattered trees of remnant Brittle Gum (*Eucalyptus mannifera*) are present on ridgelines in the corridor, including old hollow-bearing trees. Stands of regrowth Broad-leaved Peppermint (*E. dives*) with a dense Bracken Fern (*Pteridium esculentum*) groundlayer are present on sandy soils along the western side of the corridor. The Brittle Gum - Broad-leaved Peppermint dry forest community corresponds to Group 109 Widespread Tablelands Dry Shrub/Tussock Grass Forest. Diagnostic species include the shrubs *Hibbertia obtusifolia*, *Lissanthe strigosa* and *Melichrus urceolatus* and the herbs *Poa sieberiana*, *Gonocarpus tetragynus* and *Lomandra filiformis* ssp. *coriacea*.

The northern half of the transmission corridor has pasture which is likely to be derived from Box-Gum Woodland, indicated by the presence of a few isolated Yellow Box trees (*E. melliodora*), and the patch of Yellow Box woodland to the immediate west of the existing substation. While this woodland patch was not formally surveyed, the understorey appeared to be depauperate and heavily affected by grazing and stock camping. The pastures in the north of the corridor are frequently dominated by the noxious weed Serrated Tussock (**Nassella trichotoma*).

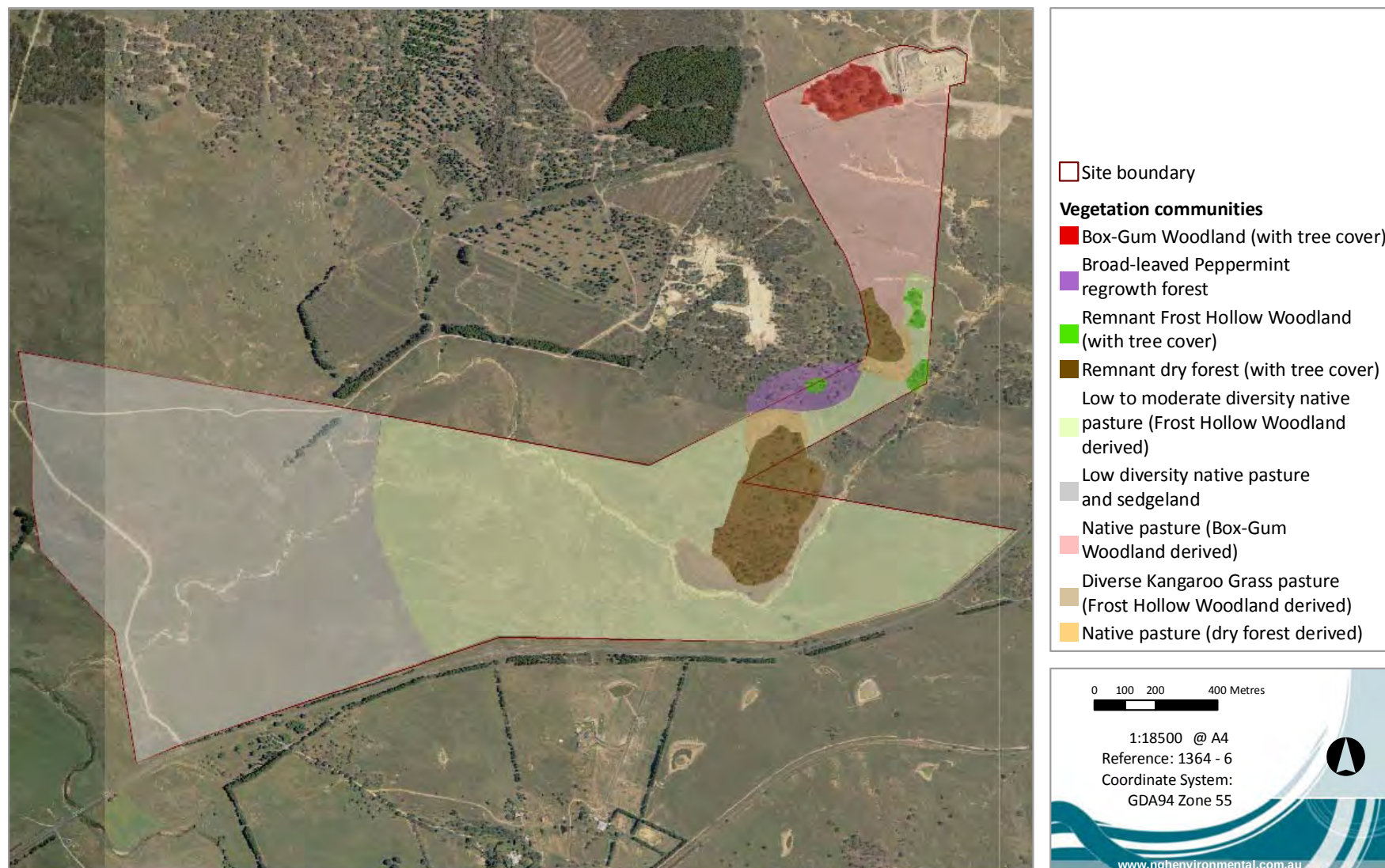


Figure 4-1 Approximate distribution of vegetation communities at the subject site

Table 4-2 shows the high level of depletion and low level of reservation of the woodland and grassland vegetation types from which the native pastures at the subject site are likely to be derived. Since woodland and natural grassland frequently coincide with prime farmland, these communities have been heavily impacted by clearing, grazing, cultivation and the introduction of weed and pasture species. The impact of this depletion is compounded by the severe fragmentation and continuing degradation of remaining stands.

Applying the general JANIS reservation target of 15% of the original extent for each forest type (JANIS 1997), all of the vegetation types within the study area are under-represented in the conservation reserve system (refer Table 4-2). Under JANIS criteria, 60% of the remaining stands of vulnerable types and 100% of endangered types should be reserved or otherwise protected.

Table 4-2 Conservation status of vegetation types at the subject site (after Gellie 2005)

Vegetation type	Pre-1750 extent in CRA region (ha)	Extant area in CRA region (ha)	Reserved in CRA region (ha)
Brittle Gum - Broad-leaved Peppermint dry forest			
Vegetation Group 109	158,000	70,600	16,200
Widespread Tablelands Dry Shrub/Tussock Grass Forest		(45% of 1750 extent)	(10% of 1750 extent)
Box-Gum Woodland			
Vegetation Group 161	87,100	3,800	nil
Tablelands and Slopes Dry Herb/Grass Woodland		(4% of 1750 extent)	
Frost Hollow Woodland			
Vegetation Group 146	3,900	2,600	1,900
Tableland Dry Herb/Grass Woodland		(66.6% of 1750 extent)	(46% of 1750 extent)
Vegetation Group 153	206,000	3,900	25
Tablelands and Slopes Herb/Grassland/Woodland		(1.9% of 1750 extent)	(<1% of 1750 extent)
Natural Temperate Grassland			
Vegetation Group 152	38,400	5,200	3,600
Tableland Herb/Grassland		(13.5% of 1750 extent)	(10% of 1750 extent)
Vegetation Group 153	206,000	3,900	25
Tablelands and Slopes Herb/Grassland/Woodland		(1.9% of 1750 extent)	(<1% of 1750 extent)



Figure 4-2 View across proposed solar farm site from the south-west corner of the site off Tarago Road



Figure 4-3 Fenceline between western and eastern paddocks at the solar farm site



Figure 4-4 Regrowth Bracken Fern on sand at southern end of proposed transmission corridor



Figure 4-5 Brittle Gum and Wire Grass in proposed transmission corridor



Figure 4-6 Remnant Frost Hollow Woodland (flora survey site 19)

4.4 SPECIES AND COMMUNITIES OF CONSERVATION SIGNIFICANCE

4.4.1 Endangered Ecological Communities

The evaluation in Appendix C indicated the recorded or potential presence of three listed threatened communities at the subject site:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ('Box-Gum Woodland') (EPBC and TSC)
- Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (EPBC)
- Tablelands Frost Hollow Grassy Woodlands (TSC).

Box-Gum Woodland

NSW Endangered Ecological Community (EEC)

The White Box, Yellow Box, Blakely's Red Gum Woodland EEC listed under the NSW *Threatened Species Conservation Act 1995* includes intact and disturbed areas such as:

- woodlands which include Yellow Box or Blakely's Red Gum (with or without native understorey); and
- grasslands and pastures dominated by native grasses that are derived from this community.

A few isolated Yellow Box trees are present midway along the transmission corridor (729473 6102705). Yellow Box woodland is present immediately west of the existing substation. It is likely that the native pasture in the northern half of the transmission corridor is derived from Box-Gum Woodland, although the general absence of tree cover and low diversity in the groundlayer makes defining vegetation boundaries difficult.

Pasture in this area with greater than 50% native grass cover would belong to the Box-Gum Woodland EEC. The pasture is typically dominated by native grass species including Wallaby Grasses and Spear Grasses. Kangaroo Grass is very uncommon. Serrated Tussock is increasingly abundant and dominant toward the northern end of the corridor.

Commonwealth Critically Endangered Ecological Community (CEEC)

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) sets more stringent criteria for the recognition of the Box-Gum Woodland Critically Endangered Ecological Community (CEEC) listed under that Act. Under the EPBC Act, Box-Gum Woodland remnants belong to the CEEC if:

- one of the most common overstorey species is/was Yellow Box, Blakely's Red Gum or White Box; and
- the understorey is predominantly native; and
- the patch is greater than 0.1 ha; and either:
 - there are 12 or more non-grass species in the understorey including at least one important species (based on a list issued by the Commonwealth Government); or

- o the patch is greater than 2 ha with an average of 20 or more mature trees per hectare, or natural regeneration of the dominant overstorey eucalypts is present.

Based on the survey results, the vegetation at the subject site would not meet these criteria and the Commonwealth Box-Gum Woodland CEEC is therefore not present at the site.

Natural Temperate Grassland

Commonwealth Endangered Ecological Community (EEC)

Natural Temperate Grassland occurs in a range of landscape positions and on a range of substrates, but is usually associated with heavy textured soils with low nutrient levels (Costin 1954, Groves & Lodder 1991 in DEWHA 2010). It is generally located between altitudes 560 metres and 1200 metres on open plains and in valleys influenced by cold air (Costin 1954, Environment ACT 2005, Rehwinkel 1997; Sharp 1997 in DEWHA 2010). Minimum ground temperatures are often below 10°C (Sharp 1997). Grasslands in the Eastern and North-western sub-regions are generally dominated by grass species such as *Austrodanthonia* spp, *Austrostipa bigeniculata*, *Bothriochloa macra*, *Themeda australis* and *Aristida ramosa*. The graminoids *Lomandra bracteata* or *L. filiformis* and the forb *Chrysocephalum apiculatum* are usually also co-dominant (Rehwinkel 2007b in DEWHA 2010).

Remnants of natural temperate grassland are considered part of the listed community (Environment ACT 2005) if:

- they are dominated by native grasses and/or native forbs (more than 50% total vegetative cover, excluding exotic annuals), and
- a diversity of native forbs is present, or
- if disturbed, they have components of the indigenous native species (including both existing plants and reproductive propagules in the soil such as soil seed banks) sufficient to re-establish the characteristic native groundcover.

Secondary or derived grasslands are excluded from the listed Natural Temperate Grassland ecological community.

The paddocks at the solar farm site have generally low native forb diversity (although seasonal factors may have depressed the recorded diversity at the site). The dominance of *Austrodanthonia* spp, *Austrostipa* spp and *Microlaena stipoides*, the scarcity of *Themeda australis* and the absence of most native forb species is evidence of a long and sustained grazing history. Propagules and seed reserves of grazing sensitive species are unlikely to have persisted in the soil at the site.

Most of the pasture at the solar farm site is considered more likely to be derived from Frost Hollow Woodland than natural grassland (refer section 4.4.1 below). If some areas of pasture are derived from natural grassland, the pasture would not form part of the natural temperate grassland EEC on the basis of condition and diversity.

Tablelands Frost Hollow Grassy Woodlands

NSW Endangered Ecological Community (EEC) – Preliminary Determination

Tablelands Frost Hollow Grassy Woodlands ('Frost Hollow Woodland') typically forms an open-forest, woodland or open woodland that transitions into grassland at low tree cover. The canopy is dominated by *Eucalyptus pauciflora* (Snow Gum), *E. rubida* (Candlebark), *E. stellulata* (Back Sallee) and

E. viminalis (Ribbon Gum), either as single species or in combinations. The community may also have the small trees *Acacia dealbata* and *A. melanoxylon*, and a naturally species-rich groundlayer including *Themeda australis*, *Poa* spp, *Austrostipa* spp and *Austrodanthonia* spp., the graminoids *Carex inversa* and *Juncus subsecundus* and the herbs *Chrysocephalum apiculatum*, *Acaena echinata* and *Hydrocotyle laxiflora*. Frost Hollow Woodland mainly occurs on valley floors, margins of frost hollows, footslopes and undulating terrain approximately between 600 and 1400 m in altitude, on a variety of substrates including granite, basalt, metasediments and Quaternary alluvium (Crooks *et al* 2008, NSW Scientific Committee 2010).

Based on the valley floor position of the solar farm site, the composition of the native pasture, the presence of isolated Ribbon Gum, Black Sallee and Snow Gum trees at the site and the presence of Snow Gum woodland on the adjacent roadside, most of the pasture at the solar farm site is likely to be derived from this community.

Condition threshold criteria related to the listing are not known. If an approach similar to the Box-Gum Woodland is adopted, treeless secondary grassland dominated by native grasses would form part of the EEC. This would include the native pasture at the solar farm site.

Some discrete low-lying and valley-floor areas in the western parts of the site appear to be transitional with an ephemeral lacustrine grassland dominated by Curly Sedge (refer Rehwinkel 2010) and may not belong to the EEC.

4.4.2 BioMetric status

BioMetric is a tool used to assess the impacts on terrestrial biodiversity of clearing applications and incentives in native vegetation under the NSW *Native Vegetation Act 2003*. The tool identifies 'red flag' areas that are important for biodiversity conservation and cannot easily be replaced. They include:

- Over-cleared vegetation (>70%) in moderate to good condition
- EEC in moderate to good condition
- Threatened species records (where species cannot withstand further loss in the CMA).

Approval to impact red flag areas may be granted provided:

- all reasonable measures have been considered – to avoid adverse impacts on the red flag area or to retain the viability of the red flag area
- the contribution that the development site's impacted biodiversity values make to regional biodiversity values is low
- the development site's biodiversity values are low, or not viable
- if the development impacts on a vegetation type that has 10% or less remaining in the catchment management area, the area of land containing this highly cleared vegetation type is less than 4 ha in size (DECC 2008a).

The BioMetric 2.0 Operational Manual (DECC 2008) defines 'low condition' native woody vegetation as:

- The over-storey per cent foliage cover is <25% of the lower value of the over-storey per cent foliage cover benchmark for that vegetation type

AND

- <50% of vegetation in the ground layer is indigenous species or >90% is ploughed or fallow.

Native grassland or herbfield is in 'low condition' if:

- <50% of vegetation in the ground layer is indigenous species or >90% is ploughed or fallow.

Vegetation which is not in 'low condition' is considered to be in 'moderate to good condition'. Note that a 0.25 hectare minimum area threshold applies for vegetation condition mapping under the BioMetric guidelines.

Under the BioMetric guidelines, vegetation derived from a grassy woodland EEC that:

- is treeless but dominated by native grasses, or
- has woodland tree cover (>4% cover for Box-Gum Woodland) over exotic or native pasture,

are included in the 'moderate to good' BioMetric condition category and are 'red flag' areas.

Much of the native pasture at the proposed solar farm site is likely to be derived from EECs (Frost Hollow Woodland and Box-Gum Woodland) and would be considered to be in moderate to good BioMetric condition and are therefore red flag areas.

The remnant dry forest and pasture derived from dry forest in the transmission corridor is not over-cleared or EEC and would not be considered a red flag area under the BioMetric guidelines.

4.4.3 Threatened flora species

One potential threatened species was recorded during the field surveys undertaken on the 22nd June and 4th of August 2010. Hoary Sunray (*Leucochrysum albicans*) was recorded in low diversity native pasture north of Dry Creek (flora survey site 12, refer Figure 3-1). The four plants recorded were not flowering at the time of survey and it is therefore not possible to determine whether they belong to var. *tricolor*, which is listed as threatened under the EPBC Act, or var. *albicans*, which is not listed. In view of the timing of the survey, the extent and abundance of this species at the site may be underestimated. East of this survey site is a relatively diverse stand of Kangaroo Grass which has some further potential for threatened flora (site 13). The slope, southerly aspect and position on the northern side of Dry Creek may have resulted in lower grazing pressure in this area.

An assessment of the biodiversity impacts of the then proposed Capital Wind Farm site located immediately north of the subject site by Kevin Mills and Associates found no threatened flora species (Mills 2005). The northern end of the transmission corridor falls inside the area surveyed as part of this assessment.

The evaluation presented in Appendix D concludes that seven threatened species have at least moderate potential to be present in habitat at the subject site, and at least moderate potential to be impacted by the Proposal. These species are listed in Table 4-3.

Table 4-3 Threatened flora potentially present at the subject site

Species	Status
Buttercup Doubletail (<i>Diuris aequalis</i>)	Vulnerable (TSC, EPBC)
Austral Toadflax (<i>Thesium australe</i>)	Vulnerable (TSC, EPBC)
Hoary Sunray (<i>Leucochrysum albicans</i> var. <i>tricolor</i>)	Endangered (EPBC)
Button Wrinklewort (<i>Rutidosis leptorhynchoides</i>)	Endangered (TSC, EPBC)
Small Purple-pea (<i>Swainsona recta</i>)	Endangered (TSC, EPBC)
Silky Swainson-pea (<i>Swainsona sericea</i>)	Vulnerable (TSC)
Creeping Hop-bush (<i>Dodonaea procumbens</i>)	Vulnerable (TSC, EPBC)

All of these species are grassy woodland or natural grassland species declining in the region due to clearing and agriculture. Low diversity native pasture derived from Frost Hollow Woodland and Box-Gum Woodland is present and dominant at the proposed solar farm site.

The threatened species are all perennial although the Buttercup Doubletail (*Diuris aequalis*) is a terrestrial orchid which would not be identifiable outside its October-November flowering period. It is closely associated with the pea shrub *Gompholobium* spp; this shrub was not recorded at the site and is unlikely to persist under sustained grazing pressure. Species such as Small Purple-pea (*Swainsona recta*) and Silky Swainson-pea (*Swainsona sericea*) may not have been conspicuous during the winter period.

Despite the seasonal limitation of the survey, the vast majority of the native pasture at the subject site is considered unlikely to support these grazing-sensitive species. A precautionary survey during spring (early November) would be required to confirm this assessment, and the distribution and significance of Hoary Sunray at the site.

4.4.4 Regionally significant species

None of the nationally significant (ROTAP - Rare or Threatened Australian Plants) species listed by Briggs and Leigh (1995) or regionally significant species listed for the Bungendore landscape unit (Fallding 2002), Yarrowlumla Shire (Barrer 1997) or the wider Goulburn region (RACAC 1999) were recorded during the survey.

A relatively diverse stand of Kangaroo Grass is present in a strip along the northern side of Dry Creek (site 13, refer Figure 3-1). This vegetation has some potential for regionally significant flora. Scaly Buttons (*Leptorhynchos squamatus*) was recorded in this area, a grassy woodland species which is likely to be declining in the region with the loss of its woodland habitat. Several other grassy woodland species which are uncommon on the property were also recorded in this area, including *Asperula conferta*, *Solenogyne dominii* and *S. gunnii*.

One large, mature Black She-oak (*Allocasuarina littoralis*) is present at the western edge of the transmission corridor (at 729421 6102775). This species is considered uncommon in the former Yarrowlumla Shire LGA (Barrer 1997). A small population also occurs to the west, in the ACT. Both the ACT and local populations are disjunct from the species' main range, and the ACT population appears to be at the western limit of the species' range on the Southern Tablelands (Barrer 1997). Black She-

Oak is the primary food source for the threatened Glossy Black Cockatoo. No feeding sign of this species was recorded at the subject site.

4.5 DISTURBANCE AND WEEDS

Forests and woodlands have been cleared and thinned at the site to provide pasture. Clearing and agriculture has produced a range of direct and indirect impacts to flora habitats, including altered microclimate, loss of pollinator and dispersal fauna, sheet erosion of soils, watercourse bed incision and damming, localised sedimentation and elevated soil nutrients. Gully erosion in drainage lines is widespread and active in some parts of the subject site.

Agricultural activities have also resulted in the colonisation of a range of introduced plant species, with greatest displacement of natives occurring in moister, more fertile valley floor areas. In many areas, grazing is likely to have reduced or eliminated selectively grazed or grazing sensitive species, such as Kangaroo Grass (*Themeda australis*), terrestrial orchids, wattles and pea shrubs.

Minor pasture weed species were common across the majority of the study area. Several noxious weeds declared for the Palerang Shire Council Area under the *Noxious Weeds Act 1993* were recorded at the subject site. The status and distribution of these weeds at the site are summarised in Table 4-4.

All of the recorded noxious weeds are listed as Class 4 weeds, meaning that the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

Table 4-4 Noxious weeds at the subject site

Weed species	Status	Abundance and distribution
Serrated Tussock <i>*Nassella trichotoma</i>	Class 4	Widespread at site, some sprayed. Particularly dense in parts of transmission corridor. Survey sites: all sites
African Lovegrass <i>*Eragrostis curvula</i>	Class 4	Sparsely scattered at site, some sprayed. Survey sites: 1, 3, 7, 20, 23
Scotch Thistle <i>*Onopordum acanthium</i>	Class 4	Widespread in pasture at proposed solar farm site Survey sites: 1, 2, 4, 5, 6, 7, 8, 9, 11, 12
Paterson's Curse <i>*Echium plantagineum</i>	Class 4	Uncommon at site Survey site: 1, 4, 19
Sweet Briar <i>*Rosa rubiginosa</i>	Class 4	Widespread in pasture at site, particularly eastern paddock of proposed solar farm site Survey sites: 8, 9, 10, 12, 15, 16, 17,
African Boxthorn <i>*Lycium ferocissimum</i>	Class 4	Central solar farm site, transmission line route, Box-Gum woodland patch west of substation Survey site: 15, 22

5 FAUNA RESULTS

5.1 PRELIMINARY ASSESSMENTS

The Commonwealth Matters of National Environmental Significance search tool indicated 13 threatened terrestrial fauna species and 21 migratory species listed under the EPBC Act which may occur within a 25 kilometre radius of the subject site (refer Appendix I).

The DECCW threatened species database indicates the potential presence of an additional 28 threatened species listed under the TSC Act in the Monaro sub-region of the Murrumbidgee CMA region. A further two species were added to this list following a search of the DECCW Wildlife Atlas database for district records.

As discussed in section 4.5, the subject site was generally degraded and disturbed following a history of agricultural production. In spite of this the evaluation presented in Appendix D concludes that 23 threatened fauna species have at least moderate potential to occupy habitat on the subject site. An additional four migratory species listed under the EPBC Act have potential to be present at the site. Of these, 12 threatened species have potential to occupy the subject site and be impacted by the Proposal. These species include woodland birds which forage in grassland and grassy woodland understorey, hollow-dependent birds and arboreal mammals, microbats and ground-dwelling reptiles.

5.2 SURVEY RESULTS

A total of 52 species including two amphibians, 42 birds eight mammals and one reptile species were recorded during the survey (see the fauna species list in Appendix F Three species listed as vulnerable under the TSC Act were detected on, or adjacent to, the subject site (refer to section 5.4.1).

Pest species

Four species listed as pest animals for the Palerang Local Government Area in the Regional State of the Environment Report (Office of the Commissioner for Sustainability and the Environment, 2008) were recorded on the site. These vertebrate pests included Fallow Deer, Red Fox, feral Cats and rabbits. Brown hares were also recorded but are not listed in the report. Fallow deer were recorded in high numbers with herds of up to 70 animals seen. The impacts of deer on biodiversity are widely reported (Stewart, 2001, Stockwell, 2003, Moriarty, 2004) and environmental degradation caused by deer browse is listed as a key threatening process in NSW (DECCW 2008e). It is likely that such high densities of feral deer are impacting the native vegetation on and around the subject site and their presence has the potential to hamper restoration efforts such as mitigation plantings. There is no management plan or reported control measures for Fallow Deer in the Palerang LGA (Office of the Commissioner for Sustainability and the Environment, 2008).

5.3 HABITAT ASSESSMENT RESULTS

During the biodiversity survey a total of 23 fauna habitat evaluations were undertaken, covering the variety of fauna habitats on and adjacent to the subject site (see Appendix B for details). From these assessments eight major habitat types were identified:

- Native pasture
- Old growth Brittle Gum Dry forest
- Rock outcrops
- Aquatic/riparian
- Dry forest
- Frost Hollow Woodland
- Box Gum Woodland
- Exotic Pine plantation/shelter belt

These habitat types are summarised in Table 5-1 below. Significant habitat features recorded within the development envelope are included in Appendix H. A list of hollow bearing trees and their location within the development envelope can be found in Appendix C.



Figure 5-1 Eroded Bridge Creek at the subject site



Figure 5-2 Granite outcrop site (Habitat Assessment 19 – refer Appendix B)



Figure 5-3 Tea-tree in pasture, White-fronted Chat habitat at solar farm site (Habitat Ass. site 15)



Figure 5-4 Hollow-bearing Brittle Gum in proposed transmission corridor (Habitat Ass. site 6)

Table 5-1 Fauna habitat summary

Vegetation type			Habitat quality	Habitat Assessment Numbers ²	Location and area	Habitat features	Potential threatened species
Native Pasture			Low-high	1, 7, 12, 13, 14, 17, 20	Native pasture dominates the subject site including the southern end of the transmission corridor, covering an area of approximately 210ha. Of this the eastern portion is considered of moderate quality (100ha approx) with some small localised areas of higher quality grass land, while the western portion is considered low quality (110ha approx).	Seed resources and invertebrate foraging area Some cover for grassland species (compromised by a long history of grazing). Rock outcrops occur in this habitat type Several localised Swamp Tea-tree (<i>Leptospermum myrtifolium</i>) stands provide potential breeding habitat for White-fronted Chats Small ephemeral pools provide limited breeding opportunities for amphibians	Diamond Firetail White fronted Chat Flame Robin Scarlet Robin Little Whip Snake (low probability) Striped Legless Lizard (low probability)
Brittle Gum (<i>E. mannifera</i>) Dry Forest	(E. dominated)		Moderate	6, 10	A single 12ha stand of Brittle Gum is located on a rocky knoll in the north east of the site, north of Dry Creek. This patch is isolated from all directions other than a loose connection to dry forest to the north. It extends from the main section of the development envelope into the transmission corridor.	Many hollows ranging from small to very large. No midstorey species present other than the occasional Box thorn. Some fallen timber and limited surface rocks (metasedimentary). Mistletoe common on the northern edge within the transmission corridor	Gang-gang Cockatoo Regent Honeyeater (low probability)

² See Appendix B for habitat assessments

Vegetation type	Habitat quality	Habitat Assessment Numbers	Location and area	Habitat features	Potential threatened species
Rocky outcrops Granitic and metamorphic	Low - Moderate	11, 15, 19, 22	Rocky outcrops occur across the subject site. Two larger granitic outcrops occur in the north west of the site providing some rock on rock and surface rock habitats. Surface rocks are largely embedded. Outcrops in the rest of the subject site are small isolated and largely embedded.	Surface rocks, rock on rock habitats	Pink-tailed Worm Lizard (low probability) Little Whip Snake (low probability)
Creek	Low	8	Dry Creek runs through the eastern section of the subject site for a distance of approximately 1.5km before joining Bridge Creek just to the north of the site. Bridge creek then flows in a south easterly direction through the western section of the subject site, joining Butmaroo Creek 200m down stream of the subject site	Loose rock beside creek provides potential shelter for frogs. No emergent vegetation. Shallow with runs and small pools, water torpid after rains.	Nil
Dry Forest	Moderate	3, 9	Broad-leafed Peppermint dominated Dry Forest occurs within the central transmission corridor and extends to the east and west from this point.	Mistletoe common, some fallen timber, occasional small rock outcrop, some hollows, some mid storey structure (regenerating trees and native shrubs), some large Banksia trees provide a nectar resource adjacent to the transmission corridor. Some <i>Allocasuarina littoralis</i> present adjacent to transmission corridor provide a potential foraging resource for Glossy Black-Cockatoo	Brown Treecreeper Glossy Black-Cockatoo Regent Honeyeater (low probability) Gang-gang Cockatoo Varied Sittella

Vegetation type	Habitat quality	Habitat Assessment Numbers	Location and area	Habitat features	Potential threatened species
Frost Hollow Woodland	Moderate	5, 16	Several small remnant examples of this community are located in the central section of the transmission corridor.	Ribbon gum (Koala feed tree), some hollows,	Koala (low probability) Gang-gang Cockatoo
Box-Gum Woodland	Low – moderate , modified by clearing, grazing and weed infestation	2, 18	A 4ha stand of Box-Gum Woodland exists at the extreme northern end of the proposed transmission corridor (although only a handful of trees lie within the subject site). The stand is isolated by at least 200m of cleared land in every direction and is adjacent to the Capital substation. A large 40ha area of high diversity Box-Gum woodland, Sweeney's Reserve, is located across Tarago Rd from the subject site.	Few hollows, foraging and shelter habitat, little fallen timber, dense mid storey structure provided by large Boxthorn plants. Understorey sparse and dominated by serrated tussock (much of this sprayed and dead)	Diamond Firetail Flame Robin Scarlet Robin
Exotic Pine plantation/shelter belt	Low	21	A small, 0.5ha, <i>Pinus radiata</i> shelter belt is located in the north of the development envelope.	The stand provides structure and shelter for birds but few other habitat values.	Nil

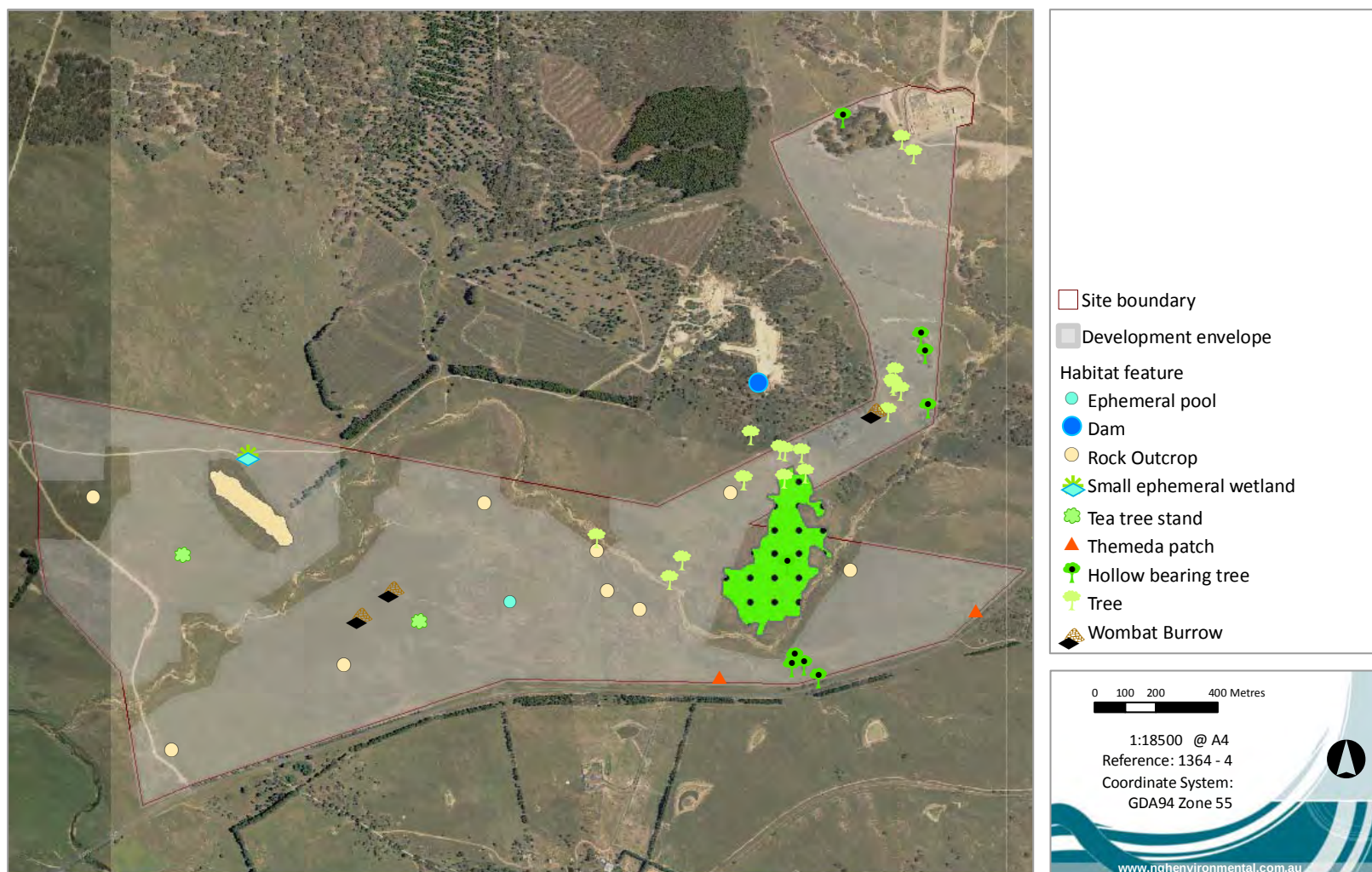


Figure 5-5 Fauna habitat features and development envelope at the subject site

5.4 SPECIES OF CONSERVATION SIGNIFICANCE

5.4.1 Recorded Threatened fauna species

Three threatened fauna species listed under the *Threatened Species Conservation Act 1995* (TSC Act) were recorded during the survey (see Figure 5-6).

- **Flame Robins** were recorded (6 in total) within the proposed transmission corridor and both the eastern and western paddocks of the subject site. Open areas within the development envelope are used for foraging by this species however Flame Robins are unlikely to breed on site. As a precautionary measure an assessment of significance had been undertaken for this species (see Appendix A).
- **Speckled Warblers** were recorded (3 in total) within the woodland adjacent to the central section of the proposed transmission corridor. This species is likely to occasionally cross the transmission corridor to access woodland to the south. It is unlikely to utilise the land within the development envelope for foraging or breeding. If mitigation measures included fencing and or planting to assist the regeneration of the woodland/dry forest in the central transmission corridor were adopted as proposed there would be a net gain for this species in terms of habitat values.
- Two flocks of **White-fronted Chats** (each flock numbering >10 individuals) were recorded in the central and far eastern paddocks of the site. Males were displaying signs of mate guarding, which is a precursor to breeding in this species (Major, 1992). Locally, White – fronted Chats appear to respond to specific environmental conditions (most likely driven by numbers of invertebrate prey) and will occupy areas for a period of time before moving on, not to be recorded at that site again for months or years (R. Rehwinkel, Senior Threatened Species Officer, DECCW pers comm.). The birds observed within the development envelope were foraging within and around sparse stands of low Tea-Tree. This vegetation is suitable nesting habitat (R. Major, Senior Research Scientist, Australian Museum, pers. com.), however it is unclear if the birds were gathering to take advantage of favourable foraging conditions following recent rains or to breed in the area. An assessment of significance had been undertaken for this species (see Appendix A) and further survey effort will be undertaken to determine if breeding is occurring onsite.

Threatened fauna survey results

The Threatened Species Evaluation (Appendix D) (informed by desktop assessment and survey results) identifies 12 threatened fauna species with some potential to be impacted by the proposed development. Assessments of significance have been undertaken for these species and are detailed in Appendix A.

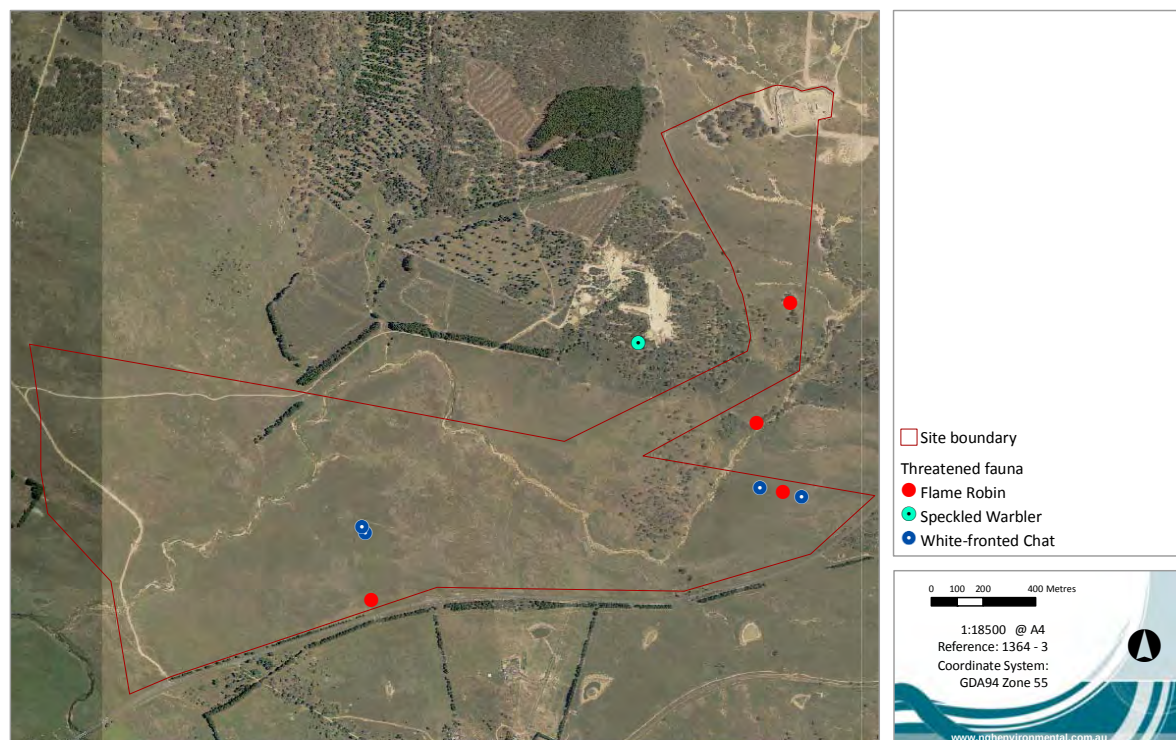


Figure 5-6 Threatened Fauna recorded during the survey

5.4.2 Migratory species

No migratory species listed under the EPBC Act were recorded during this survey however species such as the White-throated Needle-tail and Rainbow Bee-eater are likely to be occasional visitors to the site. The Proposal would not impact any populations of migratory species.

5.4.3 SEPP 44 Koala Habitat

NSW State Environmental Planning Policy 44 – Koala Habitat Protection aims to identify areas of potential and core Koala Habitat. These are described as follows:

- Potential Koala Habitat: areas of native vegetation where the trees listed in Schedule 2 of SEPP 44 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component; and
- Core Koala Habitat: an area of land with a resident population of Koalas, evidenced by attributes such as breeding females, and recent and historical records of a population.

Using these definitions areas of the subject site (particularly the central transmission corridor) would be considered Potential Koala Habitat as no resident population is present and Ribbon Gum (listed in Schedule 2 of SEPP 44) constitutes >15% of the total number of trees in these areas. Secondary feed species including Yellow Box and Brittle Gum (DECCW 2008c) are present on and adjacent to the site so, as a precaution, an assessment of significance has been carried out for the Koala (see Appendix A).

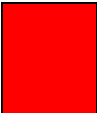
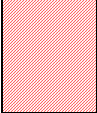
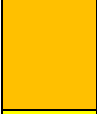
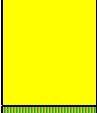
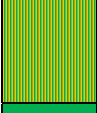
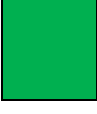
6 BIODIVERSITY CONSTRAINTS ANALYSIS

6.1 METHODS

An environmental constraint, for the purposes of the analysis, is an environmental condition that reduces the capability of a site to accommodate the specific development proposed. The identification and mapping of biodiversity constraints provides a visual guide to the significance of potential impacts to biodiversity values in different parts of the site. It is a tool to aid the transparent planning and design of the solar farm project, and provides a wider local context for the impact assessment. Refer to a.i.1.a.i.Appendix H for a map of the biodiversity constraints identified on site overlayed with the final development envelope.

Biodiversity values at the site have been identified in Table 6-1, against the assessed degree of constraint imposed on the development.

A 'traffic light' model has been adapted for grading and mapping constraint levels:

	High constraint – direct and indirect impacts need to be avoided in these areas
	High constraint with the potential for microsining infrastructure with input from an ecologist – there is potential to carefully manage a small amount of direct and indirect impact
	Further survey is needed to accurately determine the level of constraint
	Moderate constraint – direct and indirect impacts can be managed in these areas with relatively standard mitigation strategies
	Further survey is needed to accurately determine the level of constraint, however the constraint is predicted to be low
	Low constraint – the most appropriate areas to develop, direct and indirect impacts can be managed in these areas with relatively standard mitigation strategies

Biodiversity values associated with higher constraint levels are generally more significant and difficult to replace or offset. The avoidance or mitigation of impacts to these features has been considered in the planning stage of this project.

6.2 DEFINITION AND MAPPING OF CONSTRAINT CLASSES

Key biodiversity features which constrain development at the proposed Capital solar farm site are indicated in Table 6-1, with corresponding constraint levels. The identified constraint levels are specific to the types of impacts expected to be involved in the construction of the solar farm. The constraint classes are mapped on Figure 6-1 below.

Table 6-1 Biodiversity features and constraint levels at the proposed Capital Solar Farm site

Biodiversity feature	Main location	Constraint level
Hollow-bearing trees (Brittle Gum): Potential nest sites for threatened microbats and birds	Transmission corridor	High
Tablelands Frost Hollow Grassy Woodland EEC (with tree cover)	Transmission corridor	High
Tablelands Frost Hollow Grassy Woodland EEC (higher diversity groundcover, no tree cover)	North side of Dry Creek Survey site 13 (729068 6101587)	High
Hoary Sunray colony	North of Dry Creek Survey site 12 (728948 6101826)	High
Surface rock, native grassland and remnant dry forest trees	Transmission corridor	High but potential to microsite
Waterway (creek)	Transmission corridor	High but potential to microsite
Dry Forest patch (large Black Wattle)	Transmission corridor	Moderate
Yellow Box remnant tree, mature, no hollows	Transmission line corridor (729473 6102705).	Moderate
Native pasture (moderate diversity): - Frost Hollow Grassy Woodland EEC - Potential White-fronted Chat nesting area and buffer - Potential threatened flora habitat	Solar farm site - eastern paddock and eastern section of western paddock	Further survey required (Potential moderate to high constraint)
Native pasture (low diversity) Potential threatened flora habitat (limited)	Solar farm site - western paddock	Further survey required (Potential low constraint)
Native pasture primarily derived from dry forest with some areas derived from Frost Hollow Grassy Woodland EEC	Transmission corridor	Low

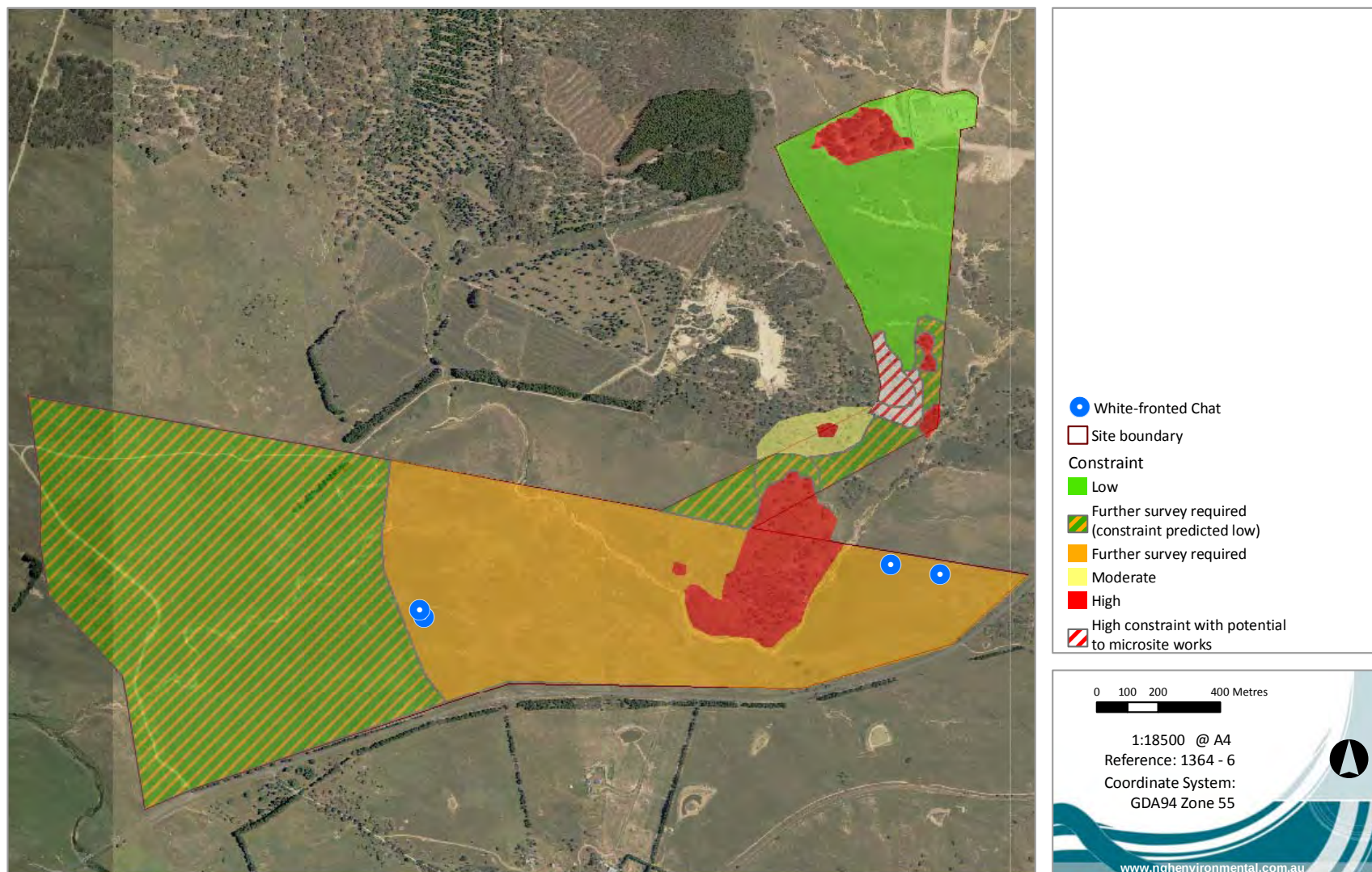


Figure 6-1 Constraint classes at the subject site

6.3 IMPLICATIONS FOR THE PROJECT

Frost Hollow Woodland patches are located at the edges of the transmission line corridor and are avoidable. The higher diversity Frost Hollow Woodland understorey located along the north side of Dry Creek is on sloping terrain between a dry forest patch and the incised creekline and has been avoided when siting the PV arrays.

The Hoary Sunray colony recorded at the site would be directly affected by the construction of the PV array. A supplementary survey in spring is required to determine the distribution and significance of this species at the site. Hoary Sunray has been included in the Assessment of Significance in Appendix A.

There are likely to be no other significant constraints to the development of the proposed solar farm due to flora values. However as most of the pasture is derived from either the Frost Hollow Woodland EEC or Box-Gum Woodland and has moderate-good condition BioMetric status, the need to offset any vegetation to be removed will be assessed.

An Assessment of Significance for impacts to the EECs has been included in Appendix A. The Assessment concludes that the Proposal would not be likely to significantly impact either EEC, subject to the results of supplementary surveys in spring, the subsequent review of the Assessment of Significance and the implementation of the safeguards included in this report.

If White-fronted Chats utilise the Tea-Tree stand in the centre of the development envelope for breeding a management plan would be developed in consultation with Dr Richard Major (a White-fronted Chat specialist from the Australian Museum).. During the field surveys a flock of Chats was recorded in this area on three occasions. A survey in late September/October will be undertaken to determine if this gathering was in response to opportunistic foraging opportunities or was a precursor to breeding.

Careful micro-siting should enable the avoidance of impacts to localised habitat features such as surface rock, hollow-bearing trees and Ribbon Gums. This approach will ensure connectivity between wooded areas to the north and south of the site is maintained.

Specific recommendations regarding the finescale location and design of the Proposal reflecting the identified constraints have been included in Chapter 7 of this report.

7 IMPACT ASSESSMENT

7.1 IMPACT TYPES

7.1.1 Scope of potential impacts

Potential biodiversity impacts relevant for the construction/decommissioning and operational phases of the Capital solar farm project are summarised in Table 7-1.

Table 7-1 Potential impacts of the Proposal

	Construction and decommissioning	Operation phase
Vegetation	- Clearing and disturbance during construction and installation of the array - Tree clearing required for the transmission cable corridor and possibly along access routes - Risk of noxious and environmental weed introduction and spread	- Microclimate impacts under the pv array (shading, temperature, humidity) - Potential soil erosion under the array from concentrated rainsplash and possible vegetation loss - Weed growth and spread
Fauna	- Clearing of habitat for the transmission cable and access roads (such as tree food sources, tree hollows, rock habitats) – likely to be low as existing farm tracks are proposed to be used. - Disturbance to local fauna from noise, light and vibration - Vehicle collision risks to fauna	- Loss of or alteration to grassland habitat for macropods, birds, reptiles and insects due to shading, changed microclimate and reduced productivity - Movement barrier and collision hazard created by perimeter fencing - Habitat avoidance due to presence of infrastructure - Vehicle collision risks to fauna
Riparian and aquatic habitats	- Potential soil erosion and sedimentation - Alteration to local hydrology due to earthworks, site drainage or concentrated runoff - Pollution risks	- Potential soil erosion and sedimentation during the construction and operation phases - Alteration to local hydrology (eg due to panel washing, site drainage or concentrated runoff) - Use of water resources for panel washing - Pollution risks

7.1.2 Direct and indirect impacts

The Proposal has potential to directly impact biodiversity values at the subject site through:

- Impacts to soils, vegetation and habitats during construction
- Disturbance to local fauna during construction
- Altered productivity and microclimatic conditions under the pv array
- Soil erosion potential under the pv array
- Habitat avoidance behaviour, movement barriers and collision hazards for fauna
- Potential for introduction and spread of weeds
- Riparian and aquatic habitat impacts from the new creek crossing.

Indirect and off-site impacts relevant to the Proposal include:

- Fauna habitat avoidance and corridor impacts
- Downstream sedimentation and pollution
- Effects on fire frequency and impact.

7.2 IMPACT ASSESSMENT

7.2.1 Direct impacts

Loss of vegetation and habitats during construction

Estimates of the areas affected by each component of the Proposal are indicated in Table 7-2 and Table 7-3.

Table 7-2 Estimated impact areas of each Proposal component

Component	quantity	Length (m)	Width (m)	Area (m ²)
Site office/Operations and Maintenance building	1	20	20	400
Research Office	1	20	20	400
Transmission line option 1				
Underground, including access track	1	1,800	8	14,400
Transmission line option 2 overhead	1	1800	20	36,000
Overhead electricity transmission clearing corridor	1	1800	20	36,000
Solar panels	180,000	2	1	360,000 (panel surface) 306,000 (ground coverage)
Posts option 1: Pile driven	75,000	0.1	0.1	750
Posts option 2: Concrete bases	25,500	3.05	0.19	14,777
Underground cabling (2 circuits)	1	8,837	0.5	4,418
Inverters	62	3	3	558
Pad-mount transformers	31	4.3	2.2	293
Internal access tracks	1	10,332	8	82,656
Perimeter tracks	1	10,814	8	86,512
Diverted existing road	1	1,512	8	12,096
Transmission line track (only if overhead transmission option)	1	1,800	8	14,400
Perimeter fencing	1	12,740	1	12,740
Temporary laydown area	1	200	150	30,000
Total solar array - 100 ha				

Table 7-3 Area of impact summary

Total area permanently cleared ¹	Components	% of subject site area
184,414m ² (18.4 ha) - using pile driven posts	Site Office and carpark	4.5% (pile driven posts)
198,441 (19.80 ha) – using precast concrete bases	Research Office	5.1% (concrete base posts)
	PV array posts	
	Inverter and transformer pads	
	Perimeter and internal tracks	
	Diverted existing road	
	Transmission line track	
Total area cleared and rehabilitated	Components	% of site area
26,293m ² (2.6 ha)	Underground cabling	1.4%
	Temporary laydown area	

¹ for the operating life of the solar farm

Groundlayer vegetation

The higher diversity woodland groundcover located along the northern side of Dry Creek would be avoided and protected during the works.

Groundlayer vegetation over an estimated area of around 20-22 ha would be removed for the operating life of the solar farm. Most of this clearing will result from the establishment of the perimeter and internal access tracks. The access tracks required during the construction phase may need to be up to 8 metres wide (worst case scenario), but could be scaled back to 3-5 metres width for the operational phase of the project.

Up to one hectare of native pasture derived from Frost Hollow Woodland, Box-Gum Woodland and Brittle Gum dry forest may also be cleared during the construction of the transmission line access track. An existing track which passes through low diversity pasture on the western side of the corridor would be used for this purpose and this is expected to reduce the area of vegetation impact considerably, as well as avoiding the need for gully crossings (refer Figure 1-2).

500 m² (0.05 ha) of pasture groundcover within the PV array area would be removed if the pile driven steel post option is used. If precast concrete bases are used to support the array posts, an estimated 1.7 ha of pasture would be displaced. The size and number of concrete bases used to calculate this figure are indicative only.

Around 2.7 ha of pasture would be temporarily affected by the proposal and rehabilitated at the end of the construction period. Most of this area would be used for the laydown site. These works would affect low diversity native pasture, which, while being derived from Frost Hollow Woodland, has generally low conservation value. Similar vegetation is locally abundant and the loss of this vegetation would not be significant.

Threatened vegetation

The Hoary Sunray colony recorded in the north of the site would be directly affected by the construction of the PV array. A supplementary survey in spring is required to determine the distribution and significance of this species at the site.

In view of the depauperate condition of the native pasture and the disturbance history, the likelihood of other threatened flora species being present at the proposed PV array site is considered low. The proposed spring survey (early November) would also target these species as a precautionary measure to confirm this assessment. DECCW would be consulted regarding optimal timing for this survey.

An Assessment of Significance for impacts to the Frost Hollow Woodland and Box-Gum Woodland EECs and threatened flora and fauna has been included in Appendix A. The Assessment concludes that the Proposal would not be likely to negatively impact threatened species and communities, subject to a supplementary survey in spring and the implementation of the safeguards included in this report.

Canopy vegetation and hollow bearing trees

It is proposed to connect the solar farm to the substation via a cable in an underground trench. This option is preferred as the cable can be sited along an existing farm track thereby minimising any impact to native vegetation. If this option is unfeasible due to geological constraints, overhead powerlines would be used. In this case a 20 metre wide transmission line corridor would need to be kept cleared of tall woody vegetation. For the most part the proposed corridor is treeless, with the exception of 20 hollow bearing trees (see Appendix C). No eucalypt regeneration was observed on the site. With careful micro-siting of the transmission line, it would be possible to avoid all but one or two trees. This would minimise the loss of tree habitat and maintain fauna habitat connectivity through the subject site should an overhead transmission option be adopted.

A narrower strip would need to be cleared of trees and shrubs along the perimeter fenceline. The proposed fenceline route is also already cleared of trees. A small stand of Frost Hollow Woodland comprising two mature Ribbon Gums, one small Snow Gum and one dead stag (all with fissures and/hollows or potential hollows) at 729333 6101475 (refer flora survey site 15 and habitat site 16) would be removed to site the PV arrays. Vegetation clearing guidelines, including hollow-bearing tree removal, would be adopted. Example guidelines are provided in Appendix J.

Aquatic habitats

The new crossing over Bridge Creek or Dry Creek would affect riparian and aquatic habitats during construction from stream bank and bed disturbance. Best practice erosion and sediment controls would be implemented during this work, including silt fencing and avoidance of works during rain or high flows, consistent with the guidelines in Landcom (2004), DECC (2008d), DWE (2008a,b,c) and DLWC (1994). The selection of the type of crossing and construction methods would comply with relevant DPI (Fisheries) guidelines, including Fairfull and Witheridge (2003), NSW Fisheries (2003) and NSW Fisheries (1999). See Figure 7-1 for an indicative fish friendly crossing design.

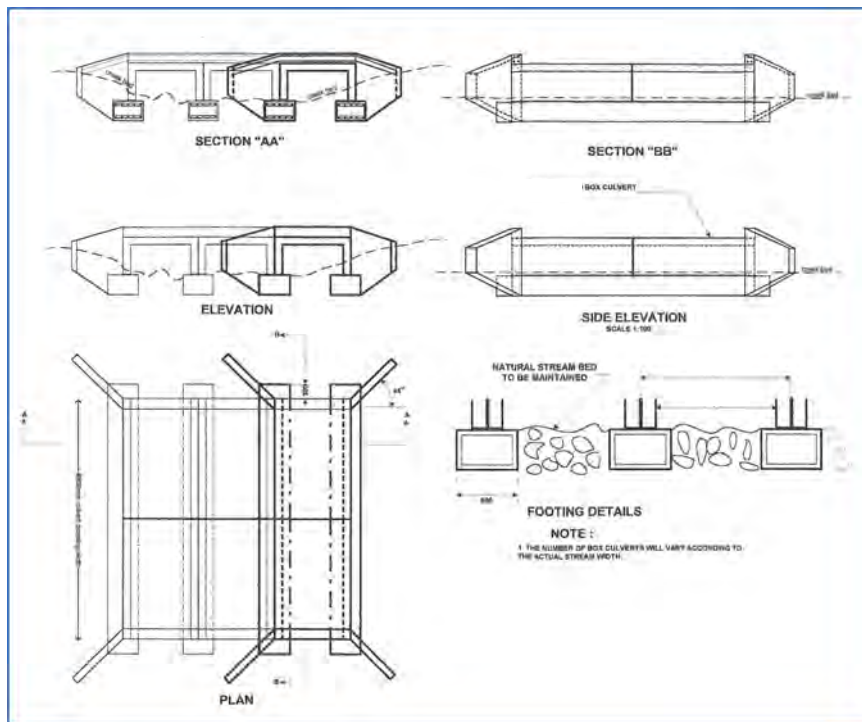


Figure 7-1 Indicative design of fish-friendly box culvert crossing

The Perimeter fence would not be required to cross any of the creeks. The streambed of both Dry Creek and Bridge Creek over much of the site has been scoured to bedrock. There is virtually no native riparian or aquatic vegetation at the site and flora and fauna impacts arising from these works would not be significant.

Rock outcrops

An estimated 5.7ha of rock outcrops exist within the development envelope (see Figure 5-5 Fauna habitat features and development envelope at the subject site. Of these up to 0.1ha would lie within the proposed temporary laydown area. It is unlikely that these outcrops would be removed, however if they were, this action would be unlikely to impact any significant fauna species due to the low probability of such species inhabiting the isolated and modified habitat. As a precaution it is recommended that any clearing of surface rocks be preceded by a clearance check, and that unearthed rocks be placed nearby to provide habitat.

Disturbance to fauna during construction

Habitat alienation is a potential impact during the construction of infrastructure. Excessive noise and vibration, increased human and vehicle activity may not directly impact individual animals but it could affect feeding and breeding behaviours resulting in negative impacts on long term population viability.

Trenching works have the potential to trap and injure native fauna. Trenches should be backfilled as soon as possible to minimise the chance of fauna becoming trapped. If trenches are left open for any length of time ramps or ladders should be installed to allow trapped fauna to escape. Trapped fauna should be removed unharmed and released into nearby cover.

Two wombat burrow complexes were recorded within the central subject site. It is advised that efforts are made to encourage these wombats to relocate to areas outside the proposed perimeter fence prior to installation of the PV arrays. This can be achieved by erecting a strong temporary fence around

the burrow with a one way door installed. Careful monitoring of the burrows for signs of activity (tracks, scats) should be undertaken to ensure the occupant has left the burrow system prior to works starting. While the forced relocation of at least one wombat may cause localised territory disputes wombats commonly use several burrows within their home ranges (Van Dyck & Strahan, 2008), and the action is unlikely to significantly impact the local population.

Alteration to microclimate and erosion potential under the solar array

Vegetation and ground habitats under the PV array would be affected by altered microclimate beneath the array, through changes in the local distribution of rainfall, reduced insolation and temperature and increased humidity. Wind speeds may also be reduced. The array would slow the rate of radiated heat loss overnight and the transformers and inverters would produce heat, which may reduce the frost hollow effect which currently operates at the site.

Changes in rainfall distribution

The vertically projected area under the solar panels is estimated to be 30.6 ha, or 30% of the total array site. There would be a concentration of rainfall runoff in a strip below the lower edge of the solar panel rows. This would increase rainsplash intensity and soil erosion potential in this area during heavy rainfall events. The erosion risks should be manageable using adequate site preparation, and responsive pasture and stock management. A rainshadow below the solar panel rows would also be created. Soil in this area may be drier than surrounding soil, but this would be offset by reduced evapotranspiration losses due to shading and reduced air movement, variation in the angle of rainfall and lateral movement of soil water from adjacent rain-exposed areas. Thick and continuous pasture cover should be established prior to the installation of the array, and maintained at all times, including during winter and drought periods if possible.

Shading

The total area of permanent shading is estimated to be 30% of the area under the array (30 ha). 70% (70 ha) would be partially shaded depending on the season and time of day.

Pasture grasses at the proposed solar array site comprise two physiological groups; cool season C3 grasses and warm season C4 grasses. C4 grasses require more sunlight to drive photosynthesis than C3 grasses (Langford *et al.* 2004) and are likely to decline or disappear from under the array. C4 grasses present at the site include the natives Kangaroo Grass (*Themeda australis*), Red Grass (*Bothriochloa macra*) and Windmill Grass (*Chloris truncata*), and the introduced Couch (*Cynodon dactylon*) and African Lovegrass (*Eragrostis curvula*). Kangaroo Grass is a keystone species for native grassy communities because it provides long term protection from invasive annual weeds by locking up soil nitrate (Prober and Lunt 2008). However this species has been greatly reduced at the subject site and is generally limited to small patches.

The C4 species may over time be out-competed and replaced by C3 species present at the subject site. C3 grasses recorded at the site include the natives Wallaby Grasses (*Austrodanthonia* spp.), Spear and Corkscrew Grass (*Austrostipa* spp.), Wheat Grass (*Elymus scaber*), Weeping Grass (*Microlaena stipoides*) and Hairy Panic (*Panicum effusum*), and the noxious weed Serrated Tussock (*Nassella trichotoma*).

Weeping Grass is also a forest species and is known to be shade-tolerant; where it is present, this species may come to dominate the sward under the solar array. It occurs in parts of the site but

usually in low abundance and appears to be absent from many areas. Weeping Grass can form a dense low mat if well managed, which will assist weed resistance, protect soils and reduce dust.

Reduced insolation and daytime temperatures are likely to mean lower rates of plant growth and biological productivity, although this will also be affected by any shift in species composition at the site. It may also be offset by increased soil moisture. Shading experiments conducted on the pasture species Perennial Ryegrass (*Lolium perenne*) showed that 50 per cent shading decreased tiller densities and stubble yields, but did not affect mean tiller weights (Thomas and Davies 1978). Shaded swards were also slower to recover when full light was restored. Reduced productivity and slower recovery rates have implications for grazing management under the array.

Native pasture management under the array

For long term stability of native pastures, grazing pressure needs to be maintained in early to mid-spring to keep annual grasses and legumes in check and maintain the health of the perennial grasses (Langford *et al.* 2004). Pasture should be kept short (<5cm). Weeping Grass can become rank and of low quality if under-grazed and Wallaby Grasses can be severely thinned by excessive annual exotic grass growth during spring (Langford *et al.* 2004). Soil disturbance should be minimised to reduce opportunities for weed invasion and germination. Construction and maintenance vehicles should not access the site when soils are very wet to minimise soil compaction.

Where shade-tolerant pasture species are absent, alternative grasses may need to be sown and established, ideally prior to the installation of the PV array. Advice from an agronomist will be sought in relation to species/varieties and establishment methods. Weeping grass may be an option if seed is available and sowing this species is practical at the site. A proportion of the area under the array could be given over to pasture trials involving commercial Weeping Grass cultivars and other shade tolerant species. This would help to guide any pasture renovation that may be required after the installation of the array, and land preparation requirements for any future expansion of the solar farm.

The space between the solar panel rows would be adequate to allow an ATV to access the site for ongoing weed control and pasture renovation if required. The proponent should routinely monitor soil condition and vegetation cover below the array and liaise with the landowner regarding stock and vegetation management issues as required. Any localised erosion that develops under the array (for example, due to concentrated rainsplash) should be promptly treated with techniques such as hardening with gravel or organic mulch, reseeding and covering with an open weave jute matting, gypsum application to improve structure and infiltration, protection with geotextile fabric or localised flow dispersal and diversion structures.

A groundcover management plan would be developed to ensure groundcover is maintained across the site.

Fauna impacts

It is unclear what the impact to soil moisture, soil nitrogen and subsequent vegetation composition from factors such as reduced light and near ground wind levels will be following the installation of the PV arrays. The response of local fauna to these changes is equally hard to predict and will be largely influenced by the vegetation changes that occur. An altered microclimate under the PV arrays due to shading and associated vegetation changes has the potential to affect sensitive fauna eg. ants and ectothermic species such as reptiles. Basking opportunities may be reduced however the structure of

the PV arrays may provide fauna with a degree of protection from predation, particularly from raptors. Increased soil moisture may create favourable shelter and foraging habitat for amphibians. As the PV arrays will be located in modified and grazed paddocks, there is little probability of threatened species being impacted by any microclimate and associated vegetation changes that occur.

Of the estimated 5.7 ha of rock outcrops within the development envelope 0.5ha would be modified due to shading by the PV arrays. The outcrops impacted by the PV arrays are of a metamorphic origin, largely embedded (very few surface rocks) and are compromised in terms of habitat values by a history of grazing and trampling by stock. These outcrops provide little in the way of habitat for fauna.

The two granite outcrops to the north of Bridge Creek in the north west of the site are larger than those on the metamorphic outcrops to the south. Granite outcrops are predominant geological features in agricultural landscapes in south-eastern Australia, and some fauna species, particularly reptiles, are restricted to these habitats (Michael *et al.* 2010). Outcrop habitats can be negatively impacted by physical damage or shading. It is recommended that these small granite outcrops at the site be excluded from the array, together with a minimum 3 metre buffer to avoid shading (based on array dimensions in Appendix G).

Fauna habitat loss and collision hazards

Infrastructure collision impacts on local fauna are a possibility post construction. The impacts of powerlines on bird mortality are well documented both in Australia and overseas (Bevanger & Brøseth 2000, Winning & Murray 1997). The relatively short length of powerline required and absence of wetland habitat on and adjacent to the subject site suggest collision impacts of the powerline on local wetland bird species would be negligible.

Increased vehicle movements during construction may lead to collisions with native fauna. Vehicle movements should be restricted during dawn and dusk and speed limits should be enforced. It is unlikely that any threatened species would be put at risk by this potential impact.

The construction of a perimeter fence has the potential to impact native fauna by creating a barrier to movement and by providing a collision risk. Barbed wire should not be used in the fence construction as it is capable of entangling and killing a range of native fauna (van der Ree 1999). High chainlink fences are a hazard to fast flying bird species such as the Swift Parrot, however installing coloured streamers, using shade cloth or using coloured wire are recommended as mitigation measures to increase the visibility of this type of fence (Pfennigwerth 2008). Fencing along Tarago road should be maintained so as macropods and other large native fauna are not funnelled along the perimeter fence and onto the road creating a traffic hazard and collision risk to the animal.

A perimeter fence would provide a barrier to the movement of many large terrestrial fauna species. Species likely to use the subject site for foraging and dispersal would be capable of covering significant distances of open ground and are unlikely to be greatly affected by the reduction in habitat resulting from a perimeter fence as similar grazing habitat is abundant and wide spread in the locality. Localised impacts from increased grazing pressure by Fallow Deer in areas adjacent to the subject site should be monitored and a deer control plan developed if significant economic or environmental damage is being sustained.

For species that will still have access to the habitat within the perimeter fence habitat modification due to microclimate changes and associated invertebrate and vegetation changes may reduce the quality of the foraging habitat. Species such as the Diamond Firetail forage on a range of native and

exotic seeds (Read, 1994) so changes to vegetation composition under the PV arrays may not prove to be detrimental.

The modification of a White-fronted Chat breeding area would be a potentially significant impact for a local population and a targeted survey will be conducted during the breeding season to ascertain if the birds detected during the winter survey are breeding on or adjacent to the site.

The presence of the crossing would permanently alter in-stream conditions which may affect the ability of fish and other aquatic fauna to move past the crossing. The selection of the type of crossing and construction methods would comply with relevant DPI (Fisheries) guidelines, including Fairfull and Witheridge (2003), NSW Fisheries (2003) and NSW Fisheries (1999). No fencing would be required to cross the creeks at the site.

Potential introduction and spread of weeds

The site carries several noxious weeds which will require control before and after the proposed works. Best practice hygiene will be required to prevent the movement of weeds around and off the property, and prevent the introduction of any new weeds. Safeguards have been included in the Statement of Commitments to ensure weeds are adequately controlled at the site. With the application of best practice during and following construction, weed impacts at and off the subject site are not expected to be significant.

Serrated Tussock

Invasion of native plant communities by exotic perennial grasses is a Key Threatening Process listed under the TSC Act. The noxious weed Serrated Tussock (*Nassella trichotoma*) is included in the listing and is widespread at the subject site. It requires relatively cool conditions for growth and survival (DPI 2006). It is readily dispersed by wind, and its seed can pass through stock and remain viable. Seed life in the soil may be more than a decade, but the vast majority will have germinated, been eaten by ants, or otherwise lost within a few years (NSW Agriculture 2003).

Serrated Tussock is a C3 grass but shows less vigour and fertility in shaded environments (author pers. obs.). Serrated Tussock seedlings can be selectively removed from improved pastures by shading with vigorous pasture growth (NSW Agriculture 2003). The two most widely used herbicides registered for use on Serrated Tussock are the broad-spectrum glyphosate and the residual and more selective flupropanate. Both herbicides should be used in a strategy to prevent herbicide resistance. Weeping Grass has high tolerance of glyphosate (up to 3 litres/ha) but is readily killed by flupropanate (Langford *et al.* 2004). Wallaby Grasses, Spear Grasses and legumes are also susceptible to flupropanate (DPI 2006). Kangaroo Grass and Red Grass are more tolerant of flupropanate (NSW Agriculture 2003).

7.2.2 Indirect and off-site impacts

Fauna habitat avoidance and corridor impacts

The structure provided by the PV arrays and perimeter fence may deter species from foraging between the PV arrays however, they may also increase the habitat value for perching species such as the Flame and Scarlet Robins. Flame Robins were recorded foraging from the central stock fence and would be likely to use the PV arrays (particularly those on the edge) as a surrogate for the fallen timber that they use in a more natural setting. Post construction site usage studies would be valuable to determine the level of site usage by native fauna.

As the subject site is largely cleared, connectivity is unlikely to be compromised by the construction of the PV arrays and perimeter fence. The significant corridor feature across the site is the broken strip of remnant woodland and dry forest that is located in the mid section of the power line easement. This vegetation provides a link to the large expanse of woodland to the east with the woodland and dry forest surrounding the sand quarry to the north of the site. This link is identified by the Palarang Council as a significant wildlife corridor and is unlikely to be impacted by the Proposal as the underground transmission line is planned to follow an existing track and therefore avoid existing trees. Offset plantings could be used to improve the biodiversity values of this corridor.

Downstream sedimentation and pollution

The proposed works have potential to release sediment and pollutants into riparian and aquatic habitats of Dry Creek and Bridge Creek, located immediately adjacent to the site, and Butmaroo Creek and Lake George, located downstream of the site. These risks would apply mainly during the construction phase but could also arise due to concentrated rainsplash below the lower edge of the solar panel rows. Any erosion which develops can be readily treated using established erosion control and vegetation management techniques. The setback of the PV array from the top banks of Dry Creek and Bridge Creek would be 50-75 metres to avoid off-site impacts due to erosion under the PV array. Additional safeguards have been included in the Statement of Commitments to ensure erosion and sedimentation risks are reduced to an acceptable level.

The panels would be periodically washed as required, using a pressure hose and water truck. Washing is expected to be infrequent, and in response to particular events such as a dust storm. Water for washing would be obtained from existing Council supplies. Given the porous nature of the soils and the reduced evaporative potential beneath the array, virtually all of the wash water would be returned to the groundwater system through infiltration. No detergent would be used for washing the panels. The panel washwater is not expected to result in pollution of local waterways or the groundwater resource.

A continuous grassy groundcover would need to be maintained under the array to maximise infiltration of panel runoff, reduce sediment pollution risks and reduce dust during the operational phase of the project (refer Section 6.4.1 Native pasture management under the array).

Leaching of broken panels into garden water or into soil of a residential house is not considered to represent an acute risk to human beings or the environment (Steinberger 1998 in Tetra Tech 2003). The PV array would be monitored electronically and any faults would be addressed by onsite maintenance staff. The risk of chemical pollution during the operational phase is considered to be low.

Effects on fire frequency and impact

Although there have been isolated cases of sparks from the back of panels, the risk of this causing a grass fire is considered to be low. Vegetation under the array would be kept low by slashing or sheep grazing. Access tracks would be constructed to each inverter and around the perimeter of the farm. This network would serve to contain any fire starting at the array, to protect the array during a wildfire and to provide access for fire suppression during an event. The Proposal is unlikely to significantly affect wildfire frequency in the study area.

Natural wildfires produce noxious gases and temporary habitat changes which would affect local fauna populations over the short-medium term. Any additional releases from a fire-affected PV array are not

expected to add significantly to these impacts to fauna. The Suntech modules to be used do not have passed the Underwriters Laboratories standard UL1703 (which includes flammability tests) and are inflammable and do not pose a pollution risk in the event of fire.

7.2.3 Cumulative impacts

Impacts to vegetation at the PV array site would result from the direct effects on microclimate in combination with altered land use patterns, such as grazing. The site would be managed to maintain a dense low groundcover to protect soils and water values, and to minimise dust and fire hazard. The cumulative effects of microclimate and land use changes are not expected to be significant.

The proposed solar farm is located adjacent to the Capital Wind Farm. Construction of the wind farm has involved the loss of limited areas of native pasture under access tracks, turbine footings and a substation. Together with these impacts, the limited loss or modification of native pasture at the site would not be significant in the context of the poor condition and local abundance of similar vegetation.

7.2.4 Assessments of Significance

Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) specifies seven factors to be taken into account in deciding whether a development is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

An Assessment of Significance for impacts to the Frost Hollow Woodland and Box-Gum Woodland EECs and threatened flora and fauna has been included in Appendix A. The following threatened species and communities have been included in the Assessment:

Endangered Ecological Communities

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ('Box-Gum Woodland')
- Tablelands Frost Hollow Grassy Woodlands

Threatened species

Flora	Fauna
Austral Toadflax	White-fronted Chat
Buttercup Doubletail	Scarlet Robin
Button Wrinklewort	Flame Robin
Hoary Sunray	Gang-gang Cockatoo
Silky Swainson-pea	Brown Treecreeper
Small Purple-pea	Diamond Firetail
Creeping Hop-bush	Koala
	Eastern False Pipistrelle
	Little Whip Snake
	Pink-tailed Worm-lizard
	Striped Legless Lizard
	Grassland Earless Dragon

The assessments conclude that, with the adoption of the mitigation measures listed in Section 8 and pending follow up spring-summer surveys to confirm the assumptions of the assessment, the Proposal is unlikely to have a significant impact on any of the threatened entities listed above.

The focus of follow up surveys would be to confirm the site does not provide habitat for the following threatened species:

Species	Survey timing	Survey method
Hoary Sunray, Austral Toadflax, Buttercup Doubletail, Button Wrinklewort, Silky Swainson-pea, Small Purple-pea, Creeping Hop-bush	November	Targeted search
Striped Legless Lizard	October (Mid November to December if habitat is found to be suitable)	Detailed habitat assessment of the site in spring conditions (then pitfall traps and artificial shelter sites (tiles) if habitat is considered suitable for the species)
Pink-tailed Worm-lizard	October	Rock rolling and hand searching under logs and debris
Grassland Earless Dragon	October (February to April if habitat is found to be suitable)	Detailed habitat assessment of the site in spring conditions including search of invertebrate burrows using fibroscope (then spider tube survey if habitat is considered suitable for the species)
Little Whip Snake	October	Rock rolling and hand searching under logs and debris
White Fronted Chat (breeding habitat)	October	Targeted search

Should habitat be deemed suitable, additional surveys to confirm presence or absence of these species would be undertaken. Should presence be confirmed, management actions would be incorporated into the proposal to ensure significant impacts are avoided..

8 RECOMMENDATIONS AND CONCLUSION

The following measures are required to ensure that biodiversity impacts are adequately managed and to avoid the likelihood of significant impact for any listed entity. They are ordered chronologically, by project phase.

8.1 INFRASTRUCTURE SITING AND DESIGN

- The transmission cable trench, PV array, site access tracks and other infrastructure should be sited to avoid:
 - The two Frost Hollow Woodland patches located at the eastern edge of the transmission corridor
 - The higher diversity Frost Hollow Woodland understorey located along the north side of Dry Creek (Survey site 13, 729068 6101587)
 - As far as is possible, the hollow-bearing Brittle Gum trees within the transmission corridor to minimise the loss of tree habitat and maintain fauna habitat connectivity (see Appendix C)
 - The mature Yellow Box tree located on the western side midway along the transmission corridor (729473 6102705)
 - Rock outcrops (including a minimum 3 metre buffer from the PV array to avoid shading impacts).
- Biologically sensitive areas (listed above and on the constraints map, Figure 6-1) would be clearly identified during construction and protected from the direct and indirect impacts of the Proposal. Contractors and staff will be made aware of the significance and sensitivity of these areas.
- An underground cable, in preference to an overhead transmission line, following the existing farm track, is the recommended option to minimise biodiversity impacts of the transmission line. An upgrade of this track would be undertaken to allow access to the site from the substation.
- The selection of the type of crossing to be constructed across Bridge Creek or Dry Creek and construction methods would comply with relevant DECCW and DPI (Fisheries) guidelines, including DWE (2008a,b,c), Fairfull and Witheridge (2003), NSW Fisheries (2003) and NSW Fisheries (1999).
- The setback of the PV array from the top banks of Dry Creek and Bridge Creek would be 50-75 metres to avoid potential off-site impacts from erosion and runoff from under the array.
- Existing farm tracks should be used wherever possible. Where use levels are low, and where tracks pass over level terrain and stable substrate, a grassed surface should be maintained if possible.
- Where security considerations permit, fencing should not contain barbed wire, particularly the top strands.

- Where practicable, the vegetation clearing guidelines provided in Appendix J should be applied.
- Pre clearance checks would be conducted if hollow bearing trees or rock outcrops require removal.
- Where practicable, power poles and overhead powerlines will be bird-safe using flags or marker balls, large wire size and wire and conductor spacing.

8.1.1 *Supplementary surveys*

- Supplementary surveys, prior to finalisation of infrastructure layout, are required to confirm the assumptions of this assessment as follows:
 - A survey for White-fronted Chat breeding areas would be required before the finalisation of the project layout. This survey could be carried out over 1 – 2 days in late September/October. Timing of this survey would be triggered by the onset of breeding in a Sydney population monitored by Dr Richard Major (White-fronted Chat specialist from the Australian Museum). If breeding was recorded a management plan would be developed for this species in consultation with Dr Major to ensure biodiversity values relating to this species are maintained or improved.
 - A supplementary flora survey in spring (early November) would be required to confirm the assumptions of the EEC derived grassland assessment and the distribution and significance of the Hoary Sunray at the subject site.
 - Targeted habitat surveys for threatened reptiles would be undertaken prior to any works to confirm the habitat assessments and assessments of significance. Surveys would involve rock rolling in all areas of surface rocks found within the development envelope for Little Whip Snakes and Pink-tailed Worm-lizard, invertebrate hole surveys for Grassland Earless Dragons (including the use of a fibro scope) and surveys to document cover and potential for Striped Legless Lizard presence during spring conditions.
 - Additional habitat assessment for Grassland Earless Dragon would be undertaken to confirm that habitat is marginal for this species on site.
- If these surveys indicated the likelihood of any of these species being present, further targeted surveys would be undertaken to determine presence / absence and management to avoid the likelihood of significant impact would be incorporated into the proposal. This work should be completed prior to the determination of the project.

8.1.2 *Offsetting*

The permanent removal of quality flora and fauna habitat is expected to be minimal, as the infrastructure footprint is comparatively small and areas of conservation significance have been mapped to allow infrastructure placement to avoid them. This assessment considers that there is ample ability to offset the minor amount of wooded vegetation removal onsite. Enhancing local connectivity, particularly through the central transmission corridor area, will ensure that this aspect of the proposal provides an net environmental benefit. Native pasture is in varying condition. Offsetting

impacts to native pasture would only be undertaken where it is in moderate-good condition and considered to provide quality habitat. Offsite offset areas may be required to achieve this. Surveys and assessments conducted in spring would be used to determine the area and locations of native pasture providing quality habitat.

The biodiversity offset principles developed by DECCW would guide the development of an Offset Plan, namely:

1. Impacts must be avoided first by using prevention and mitigation measures
2. All regulatory requirements must be met
3. Offsets must never reward ongoing poor performance
4. Offsets will complement other government programs
5. Offsets must be underpinned by sound ecological principles
6. Offsets should aim to result in a net improvement in biodiversity over time
7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs
8. Offsets should be agreed prior to the impact occurring
9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated
10. Offsets must be targeted
11. Offsets must be located appropriately
12. Offsets must be supplementary
13. Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract

The final infrastructure layout design will determine the precise amount of clearing required. At that time, and prior to construction commencing, formal agreements would be sought with the affected involved land owners to secure offsetting for areas of habitat permanently removed by the proposal. It appears that, by locating infrastructure in areas of lesser habitat value, managing offset areas to improve their biodiversity value for the life of the project and, viewed in terms of the wider environmental benefits of establishing renewable energy generation in rural areas, that the proposal can achieve an overall 'maintain or improve biodiversity outcome'.

8.2 CONSTRUCTION PHASE

- The planning, construction and maintenance of tracks at the site would be consistent with DLWC (1994) guidelines.
- Where practicable, whole sods will be removed with an excavator where these areas are well-vegetated with dense root systems. Sods will be stored in moist, shaded conditions and replaced following the works. Sod storage time will be minimised and sods will be replaced in a manner that maximises the chances of re-establishment.

- Excavated topsoil, subsoil and weathered rock will be stored separately and replaced in a manner that replicates the original profile as closely as possible.
- Construction materials should not be stockpiled on site for extended periods of time as local fauna may take up residence and be injured when the materials are moved.
- Works will avoid impacts to mature eucalypts wherever possible. Tree protection standards should comply with Australian standard AS4970-2009 Protection of trees on development sites (Standards Australia, 2009). Wherever practicable, excavations and vehicle/machinery movements will occur outside the canopy dripline of large eucalypts.
- As a general rule, disturbed areas will be used for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and the deposition and retrieval of spoil whenever practicable.
- Works will be avoided during, and immediately following heavy rainfall events to protect soils and vegetation at the site.
- Machinery and vehicles used in construction works will be washed before and after site access to reduce the introduction and spread of weeds and pathogens.
- Laydown sites for excavated spoil, equipment and construction materials will be weed-free or treated for weeds wherever practicable.
- A weed management plan would be developed for the site including but not limited to the following outcomes;
 - The control of noxious weeds recorded on the site
 - Preventative measures for the spread or introduction of weeds, including machinery washdown and sourcing weed free sediment control materials.
 - Monitoring of control and preventative measures and ongoing adaptive management
- Sediment control materials should be weed free such as certified weed free hay bales or geotextiles.
- Imported materials such as sand and gravel will be sourced from sites which do not show evidence of noxious weeds or Phytophthora infection.
- Rock and log habitat removed during the construction phase will be reinstated following the works.
- Trenches should be backfilled as soon as possible to minimise the chance of fauna becoming trapped. Any trench sections left open for greater than a day would be inspected daily, early in the morning and any trapped fauna removed. The use of ramps or ladders to facilitate trapped fauna escape is recommended (dependent on the size of trench needed).

8.3 OPERATIONAL MANAGEMENT

- A groundcover management plan would be developed in consultation with an agronomist that would include regular monitoring of vegetation cover and composition and allow for adaptive management. This plan would aim to maintain thick and continuous pasture cover across the site including during winter and drought periods if possible and viable. Where information on

establishment of groundcover under shade is lacking, trials may be required onsite to test suitable shade tolerant groundcover varieties for planting if required.

- The proponent would routinely monitor soil condition and vegetation cover below the array and liaise with the landowner regarding stock and vegetation management issues as required. If localised erosion develops, effective treatments would be applied without delay, such as hardening with mulch, reseeding and covering with an open weave jute matting, gypsum application to improve structure and infiltration, protection with geotextile fabric or localised flow dispersal and diversion structures.
- The noxious weed Serrated Tussock will require control before, during and following the works. Soil disturbance should be minimised to reduce germination. An herbicide strategy should be used which minimises the potential for resistance, and minimises impacts to non-target grasses.
- The PV array should be monitored for panel faults to minimise the potential for wildfire or the release of chemicals such as the heavy metals cadmium and selenium.

8.4 CONCLUSION

The subject site has native pasture derived from communities that have been listed as Endangered Ecological Communities under the TSC Act; Tablelands Frost Hollow Grassy Woodland and Box-Gum Woodland. Box-Gum Woodland has also been listed under the Commonwealth EPBC Act. Small patches of remnant Frost Hollow Woodland with tree cover are present at the edge of the proposed transmission corridor. Remnant dry forest and derived pasture is also present in the transmission corridor. Potential habitat for several threatened fauna species is present at the site. While the Proposal may reduce foraging habitat for these species, there appears to be an abundance of these open pasture habitats in the surrounding locality.

Groundlayer vegetation over an estimated area of around 20-22 ha would be removed for the operating life of the solar farm. Most of this clearing will result from the establishment of the perimeter and internal access tracks. Around 3.4 ha would be temporarily affected by the Proposal and rehabilitated at the end of the construction period. Approximately 30 ha of low diversity native pasture derived from Frost Hollow Woodland would be modified by microclimate changes under the PV array.

These impacts would not be significant in light of the low condition of the native vegetation, the low habitat values and the local abundance of similar vegetation in the locality.

The operational phase of the project will require careful management of pasture under the PV array to control weeds (particularly Serrated Tussock) and maintain good groundcover. This is considered to be readily achievable and biodiversity impacts at the site and off the site are not expected to be significant.

By identifying areas of high biodiversity values early in the planning process and then using this information to develop a sensitive layout design, the Proposal achieves the aim of minimising any impacts to biodiversity. In conjunction with a targeted offset plan that aims to improve connectivity and habitat values both on site and for the wider locality, the Proposal would maintain or improve biodiversity values. In terms of the significance thresholds identified in the Draft Guidelines for

Threatened Species Assessment for Part 3A Applications (DEC/DPI 2005), and with the exception of potential impacts to the White-fronted Chat and Hoary Sunray – see below, the project would:

- Be likely to maintain or improve biodiversity values
- Be unlikely to reduce the long-term viability of a local threatened species population or ecological community
- Be unlikely to accelerate the extinction of a species, population or ecological community or place it at risk of extinction
- Not adversely affect critical habitat.

In relation to the Hoary Sunray colony that would be directly affected by the Proposal, a more detailed survey of population size, distribution and significance at the subject site and in surrounding areas is required during the spring flowering period. If the colony is confirmed as the EPBC Act-listed var. *tricolor*, a referral to the Commonwealth Environment Minister for approval would be required.

A spring survey is also required to determine if the White-fronted Chat is breeding at the subject site or adjacent to the site. If this is the case, the Proposal would represent a potentially significant impact for a local population. If breeding was recorded a management plan would be developed for this species in consultation with Dr Richard Major (White-fronted Chat specialist from the Australian Museum) to ensure biodiversity values relating to this species are maintained or improved.

9 REFERENCES

- ACT Commissioner for the Environment (ACTCE) (2004) *Regional State of the Environment Report 2004*
<http://www.environmentcommissioner.act.gov.au/soe/soe2004/Palerang/ecologicalcommunities.htm> accessed 1 July 2010
- ACT Commissioner for Sustainability and the Environment (ACTCSE) (2008) *Regional State of the Environment Report 2008*, <http://www.envcomm.act.gov.au/soe/rsoe2008/index.shtml> accessed 2 Dec 2009
- ACT Government (1997). Striped Legless Lizard (*Delma impar*): A vulnerable species. Action Plan No. 2. [Online]. Canberra: Environment ACT. Available from:
http://www.tams.act.gov.au/__data/assets/pdf_file/0003/154623/actionplans2.pdf.
- ACT Government (2004) *Woodlands for Wildlife, ACT Lowland Woodland Conservation Strategy Action Plan No. 27*, prepared by the Wildlife Research and Monitoring Unit, Environment ACT
- Barrer, P. (1997) *The Flora of South-east Yarrowlumla – a Preliminary Assessment* consultant's report to the Save the Bush grant scheme and Stoney Creek Landcare Group
- Birds Australia (2009) Important Bird Areas of Australia. <http://www.birdsaustralia.com.au/ibas>
- Blakers, M., Davies, S.J.J.F. & Reilly, P. N. (1984) *The Atlas of Australian Birds*, Royal Australasian Ornithologists Union, Melbourne.
- BOM (2010) Canberra, Australian Capital Territory July 2010 Daily Weather Observations Australian Government Bureau of Meteorology, accessed at
<http://www.bom.gov.au/climate/dwo/201007/html/IDCJDW2801.201007.shtml>
- Churchill S. (1998) Australian Bats. Reed New Holland, Sydney, NSW
- Churchill, S. (2008) Australian Bats 2nd edition, Allen & Unwin, NSW
- COG (2009) *Lakes George and Bathurst Waterbird Surveys*, Canberra Ornithological Group, accessed at
<http://canberrabirds.org.au/>
- Coulson, G. (1995) Management directions for the Striped Legless Lizard (*Delma impar*) in the Australian Capital Territory
- Crooks, J., Rehwinkel, R., Treweek, A and Baines, G. (2008) The Conservation Value and Reservation Status of the Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodlands of South-Eastern NSW Australasian Plant Conservation: Journal of the Australian Network for Plant Conservation Volume 17 Issue 1 (June/Aug 2008)
- Daly, G & Senior, C. (2003) Surveys for and habitat assessment of the Green and Golden Bell Frog *Litoria aurea* on the Far South Coast of New South Wales, *Herpetofauna* 33, 86-102.
- Department of Environment and Conservation (DEC) (2004) Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities
- Department of Environment and Conservation and Department of Primary Industries (DEC/DPI) (2005) Draft Guidelines for Threatened Species Assessment for Part 3A applications.
- Department of Environment, Climate Change (NSW DECC) (2005). Striped Legless Lizard - profile. [Online]. Available from:
<http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10211>.
- Department of Environment and Climate Change (DECC) (2007) Threatened species assessment guidelines: the assessment of significance, August 2007

- Department of Environment and Climate Change (DECC) (2008a) BioMetric 2.0 A Terrestrial Biodiversity Assessment Tool for the NSW Native Vegetation Assessment Tool (formerly Property Vegetation Plan Developer) Operational Manual. Gibbons, P., Ayers, D., Seddon, J., Doyle, S. and Briggs, S. July 2008
- Department of Environment and Climate Change (DECC) (2008b) BioBanking Handbook for Local Government, Nov 2008
- Department of Environment and Climate Change (DECC) (2008c) Recovery plan for the koala (*Phascolarctos cinereus*). Sydney.
- Department of Environment and Climate Change (DECC) (2008d) Managing Urban Stormwater Soils and Construction Volume 2C Unsealed roads, January 2008
- Department of Environment, Climate Change and Water (DECCW) (2008) Golden Sun Moth: ACT-NSW Area (map). Environment Resources Information Network.
- Department of Environment, Climate Change and Water (DECCW) (2010a)
http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/cma_details.aspx?name=Murrumbidgee
- Department of Environment, Climate Change and Water (DECCW) (2010b) Threatened species, populations and ecological communities of NSW, Department of Environment and Climate Change NSW accessed at <http://www.threatenedspecies.environment.nsw.gov.au/index.aspx>.
- Department of Environment, Climate Change and Water (DECCW) (2010c) South Eastern Highlands Bioregion in
<http://www.environment.nsw.gov.au/bioregions/SouthEasternHighlandsBioregion.htm> retrieved 11 January 2010.
- Department of Environment and Heritage (DEH) (undated) *White Box Yellow Box Blakely's Red Gum Grassy Woodland and Derived Grassland Ecological Community Species List*, Department of Environment and Heritage website, <http://www.deh.gov.au>
- Department of Environment, Water, Heritage and the Arts (DEWHA) (2010a) Special Profile and Threats Database, Department of Environment, Water, Heritage and the Arts, Australian Government. Accessed at <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>
- Department of Environment, Water, Heritage and the Arts (DEWHA) (2010b) Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory
<http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=14&status=Endangered>
- Department of the Environment, Water, Heritage and the Arts (2010c). *Delma impar* in Species Profile and Threats Database, Department of the Environment, Water, Heritage and the Arts, Canberra. Available from: <http://www.environment.gov.au/sprat>. Accessed Tue, 7 Sep 2010 23:48:59 +1000.
- Department of Land and Water Conservation (DLWC)(1994) Guidelines for the planning, construction and maintenance of tracks, Maitland June 1994
- Department of Planning (2008) Sydney-Canberra Corridor Regional Strategy 2006-31
- Department of Primary Industries (DPI) (undated) Policy and Guidelines for Fish Friendly Waterway Crossing
- Department of Primary Industries (DPI) (1999) Policy and Guidelines for Aquatic Habitat Management and Fish Conservation
- Department of Primary Industries (DPI) (2006) Primefact No 44 Serrated tussock – identification and control, May 2006

- Department of Primary Industries (DPI) (2008) Threatened species assessment guidelines - The assessment of significance, February 2008
- Department of Sustainability and Environment, Vic. (DSE) (2010) National Recovery Plan for the Hoary Sunray *Leucochrysum albicans* var. *tricolor* Draft for Public Comment, prepared by Steve J. Sinclair, DSE, October 2009
- Department of Water and Energy (DWE) (2008a) Water Management Act 2000 Guidelines for controlled activities - In-stream works, February 2008
- Department of Water and Energy (DWE) (2008b) Water Management Act 2000 Guidelines for controlled activities – riparian corridors, February 2008
- Department of Water and Energy (DWE) (2008c) Water Management Act 2000 Guidelines for controlled activities – watercourse crossings, February 2008
- Eddy, D., Mallinson, D., Rehwinkel, R. and Sharp, S. (1998) Grassland Flora a field guide for the Southern Tablelands (NSW and ACT) Environment ACT, NPWS, WWF, DLWC, SMA
- Emison, W.B., Beardsell, C.M., Norman, F.I., Loyn, R.H. & Bennett, S. (1987) *Atlas of Victorian Birds*, Department of Conservation, Forests and Lands and Royal Australasian Ornithologists Union, Melbourne.
- Environment Australia (2001) A Directory of Important Wetlands in Australia, Third Edition
- Fairfull, S. and Witheridge, G. (2003) Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings NSW Fisheries, Cronulla, 16 pp.
- Fallding, M. (2002) *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands*, Natural Heritage Trust, NSW National Parks and Wildlife Service and Land and Environment Planning
- Fernandez-Juricic, E., Jimenez, M.D. and Lucas, E. (2002) Factors affecting intra- and inter-specific variations in the difference between alert distances and flight distances for birds in forested habitats. *Canadian Journal of Zoology*. 80: 1212-1220
- Fleay, D. (1968) *Nightwatchmen of Bush and Plain*, Jacaranda Press, Brisbane
- Gekas, V., Frantzeskaki, N., Tsoutsos, T. (2002) Environmental Impact Assessment of Solar Energy Systems Results from a Life Cycle Analysis in Proc. International Conference on the Protection and Restoration of the Environment VI Skiathos, July 1-5, 2002, Pages 1569-1576
- Gellie, N. J. H. (2005) *Native vegetation of Southern forests: South-East Highlands, Australian Alps, South-West Slopes & South-East Corner bioregions*, *Cunninghamia* 9, 219-254.
- Hall, L.S. & Richards, G.C. (1979) *Bats of eastern Australia*, Queensland Museum Booklet 12. 66pp.
- Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee (JANIS) (1997) Nationally agreed criteria for the establishment of a comprehensive, adequate and representative reserve system for forests in Australia, prepared by the Technical Working Group on Reserve Criteria
- Kaygusuz, K. (2009) Environmental Impacts of the Solar Energy Systems Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 1556-7230, Volume 31, Issue 15, 2009
- Klippel, K. (1992) *Wildlife Data Search: Threatened Animal Species of New South Wales*, Breakout Press, NSW.
- Landcom (2004) Managing Urban Stormwater: Soils and Construction, (the 'Blue Book') 4th edition

- Langford, CM, Simpson, PC, Garden, DL, Eddy, DA, Keys, MJ, Rehwinkel, R and Johnston, WH (2004) *Managing Native Pastures for Agriculture and Conservation*, NSW Department of Primary Industries, Southern Rivers CMA, Natural Heritage Trust
- Major, RE (1991a). Breeding Biology of the White-fronted Chat *Ephthianura albifrons* in a Saltmarsh Near Melbourne. *Emu* 91, 236–249.
- Major, R. E.(1991b) Flocking and feeding in the white-fronted chat *Ephthianura albifrons*: The relationship between diet, food availability and patch selection. *Australian Journal of Ecology* **16**, Issue 3, pp. 395–406
- Major, RE (1992). Mate Guarding in a Population of White-Fronted Chats, *Ephthianura-Albifrons* Jardine and Selby (Passeriformes, Ephthianuridae) - a Response to Group Living and a Male-Skewed Sex-Ratio. *Australian Journal of Zoology* **40**, 401–409.
- Menkhorst P.W. & Knight, F. (2003) *A field guide to the Mammals of Australia*, Oxford University Press
- Michael, DR, Lindenmayer, DB and Cunningham, RB (2010) Managing rock outcrops to improve biodiversity conservation in Australian agricultural landscapes in *Ecological Management and Restoration* Vol 11 No 1 April 2010.
- Mills, K. and Associates (2005) Flora and Fauna Assessment Capital Wind Farm Southern Tablelands NSW.
- Morgan, G. 2001. Delineation and description of the Eastern Environmental Subregions (provinces) in New South Wales Study. NPWS, Hurstville
- Moriarty A (2004a) The liberation, distribution, abundance and management of wild deer in Australia. *Wildlife Research* 31, 291–299.
- Murrumbidgee Catchment Management Authority (2008) Murrumbidgee Catchment Action Plan
- NPWS (2003a) *Draft NSW Recovery Plan for the Barking Owl (Ninox connivens)*, National Parks and Wildlife Service, Hurstville, NSW
- NSW Fisheries (1999) Policy and Guidelines for Aquatic Habitat Management and Fish Conservation
- NSW Fisheries (2003) Fishnote - Policy and Guidelines for Fish Friendly Waterway Crossings, November 2003
- NSW Scientific Committee (2010) Tablelands Frost Hollow Grassy Woodlands in the South Eastern Highlands, Sydney Basin, South East Corner and NSW South western Slopes Bioregions - proposed endangered ecological community listing - preliminary determination
- NSW Agriculture (2003) Serrated Tussock Manager's Fact Pack
- NSW Scientific Committee (NSWSC) (2002) White box yellow box Blakely's red gum woodland - endangered ecological community listing. Department of Environment and Climate Change.
<http://www.environment.nsw.gov.au/determinations/BoxgumWoodlandEndComListing.htm>
- NSW State of the Environment 2009, accessed 6 July 2010 from
http://www.environment.nsw.gov.au/soe/soe2009/chapter3/chp_3.2.htm#3.2.12
- Osborne, W. S. & Jones, S. R. (1995) *Recovery plan for the Pink-tailed Worm Lizard (Aprasia parapulchella)*. in ACT Parks and Conservation Service (Ed.) Technical Report 10. Tuggeranong, Department of Environment, Land and Planning
- P & A Walsh Consulting (2008) Bungendore Land use Strategy and Structural Plan(Public exhibition draft). Prepared for the Palerang Council.
- Palerang Council (2006) Discussion Paper on the Future of the Bungendore Water Supply Covering Implications of the Lake George Groundwater Sustainability Investigation (September 2005)
- Palerang Council (2010) www.palerang.nsw.gov.au/

- Pennay, M., Law, B. And Reinhold, L. (2004) *Bat calls of New South Wales*, Department of Environment and Conservation, Hurstville
- Pfennigwerth S., (2008) Minimising the swift parrot collision threat Guidelines and recommendations for parrot-safe building design. WWF Australia. <http://www.wwf.org.au/publications/swift-parrot-report/>
- Phillips, W.R. and S.J. Inwards, (1985) 'The Tasmanian Pipistrelle: *Pipistrellus tasmaniensis* Gould 1858: Annual activity and breeding cycles', *Macroderma* 1, 2-11.
- Pizzey, G. & Knight, F. (2003) *A Field Guide to the Birds of Australia*, Collins, Sydney
- Prober, S. and Lunt, I. (2008) Kangaroo Grass: a keystone species for restoring weed-invaded temperate grassy woodlands *Australasian Plant Conservation* Vol 17:1
- Rehwinkel, R. (2010) Eight grassland associations found in Southern Tablelands grasslands in News of Friends of Grasslands (FOG) January - February 2010
- Robertson, P. and Evans, M. (2009). National Recovery Plan for the Grassland Earless Dragon *Tympanocryptis pinguicolla*. ACT Department of Territory and Municipal Services, Canberra.
- Schodde, R. and Tidemann, S. C., Eds. (2007) *Readers Digest Complete Book of Australian Birds*, Readers Digest Services, Sydney
- Smith, W. J. S., and Robertson, P. (1999) National recovery plan for the Striped Legless Lizard (*Delma impar*) 1999-2003 NSW National Parks and Wildlife Service & Wildlife Profiles Pty Ltd
- Stewart AJA (2001) The impact of deer on lowland woodland invertebrates: a review of the evidence and priorities for future research. *Forestry* 74, 259-270.
- Stockwell M (2003) Assessing the levels and potential impacts of browsing by Sambar deer (*Cervus unicolor*) in the upper Yarra catchment, Victoria. BSc(Hons) thesis. Monash University.
- Tetra Tech Inc (2003) Potential Health and Environmental Impacts Associated With the Manufacture and Use of Photovoltaic Cells Final Report November 2003 prepared for EPRI and the California Energy Commission
- Thackway, R. and Cresswell, I. D. (eds) (2000). Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1 – Summary Report. Environment Australia
- Thomas, H and Davies, A. (1978) Effect of Shading on the Regrowth of *Lolium perenne* Swards in the Field Welsh Plant Breeding Station Aberystwyth *Annals of Botany* 42: 705-715
- Thomas V, Gellie N, Harrison T (2000) Forest Ecosystem Classification and Mapping for the Southern CRA Region. Report for the NSW CRA/RFA Steering Committee, Project No. NS 08EH. NSW National Parks and Wildlife Service, Queanbeyan
- Tsoutsos, T., Gekas, V. and Frantzeskaki, N. (2005) Environmental impacts from the solar energy technologies. *Energy Policy* 33:289–296.
- van der Ree, R. (1999), 'Barbed wire fencing as a hazard for wildlife', *The Victorian Naturalist*, 116, 210-217.
- Van Dyck, V. & Strahan, R. (2008) *The Mammals of Australia*, Brisbane, Reed New Holland
- Woodford, J. (2002) *Getting to the bottom of the Lake George mystery*, Sydney Morning Herald 30 November 2002

Appendix A Assessments of Significance

ASSESSMENTS UNDER THE TSC ACT (NSW)

Section 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) specifies seven factors to be taken into account in deciding whether a development is likely to significantly affect threatened species, populations or ecological communities, or their habitats.

The following Assessment of Significance assesses the significance of the likely impacts associated with the Capital Solar Farm Proposal on Endangered Ecological Communities and threatened flora and fauna species declared under the *Threatened Species Conservation Act 1995* (TSC Act). Species and communities listed as threatened under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) have also been included in the assessment.

The following threatened species and communities have been included in the Assessment of Significance:

Endangered Ecological Communities

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland ('Box-Gum Woodland')
- Tablelands Frost Hollow Grassy Woodlands

Threatened species

Flora	Fauna
Austral Toadflax	White-fronted Chat
Buttercup Doubletail	Scarlet Robin
Button Wrinklewort	Flame Robin
Hoary Sunray (EPBC assessment only)	Gang-gang Cockatoo
Silky Swainson-pea	Brown Treecreeper
Small Purple-pea	Diamond Firetail
Creeping Hop-bush	Koala
	Eastern False Pipistrelle
	Little Whip Snake
	Pink-tailed Worm-lizard (TSC and EPBC assessments)
	Striped Legless Lizard (TSC and EPBC assessments)
	Grassland Earless Dragon (TSC and EPBC assessments)

Section 'g' of the Assessment of Significance:

"whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process"

is addressed at the end of the Assessments of Significance below rather than for each species.

FLORA AND ECOLOGICAL COMMUNITIES

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Buttercup Doubletail (<i>Diuris aequalis</i>)	Vulnerable (TSC, EPBC)
Austral Toadflax (<i>Thesium australe</i>)	Vulnerable (TSC, EPBC)
Button Wrinklewort (<i>Rutidosia leptorhynchoidea</i>)	Endangered (TSC, EPBC)
Small Purple-pea (<i>Swainsona recta</i>)	Endangered (TSC, EPBC)
Silky Swainson-pea (<i>Swainsona sericea</i>)	Vulnerable (TSC)
Creeping Hop-bush (<i>Dodonaea procumbens</i>)	Vulnerable (TSC, EPBC).

The natural habitat for these species is grassy woodland and natural grassland. They generally persist in remnants in good condition, with no or very light grazing history.

The native pasture at the proposed PV array site is derived from Frost Hollow Grassy Woodland, but has a long history of grazing. Grazing sensitive species such as lilies, orchids, tall daisies and pea shrubs were not recorded at the solar farm site, although the winter timing of the survey will have made some of these species unrecordable. Even grazing tolerant native species such as *Rumex brownii* and *Oxalis perennans* were either absent or present in very low abundance.

The dominance of Wallaby Grasses (*Austrodanthonia* spp.), Spear Grasses (*Austrostipa* spp.) and Weeping Grass (*Microlaena stipoides*), and the scarcity of Kangaroo Grass (*Themeda australis*), is consistent with a long period of sustained grazing pressure (Moore 1953a in NSWSC 2002, Eddy *et al.* 1998). With increasing grazing and fertility under agriculture, groundcover in grassy communities typically changes from a *Poa-Themeda* association through increased abundance of *Poa*, *Austrostipa* and *Austrodanthonia* species and *Bothriochloa macra* to an end state dominated by *Microlaena* and *Austrodanthonia* species (Langford *et al.* 2004).

Kangaroo Grass is a critical keystone species for native grassy communities because it provides long term protection from invasive annual weeds by locking up soil nitrate (Prober and Lunt 2008). The loss of Kangaroo Grass may also trigger the decline of a range of other species in the community, particularly inter-tussock forbs. *Thesium australe* is semi-parasitic on grasses, particularly Kangaroo Grass.

In view of depauperate condition of the native pasture and the disturbance history, the likelihood of these species being present at the site is considered low. A targeted survey in Spring (early November) would be undertaken as a precautionary measure to confirm this assessment. Subject to the results of the supplementary survey, the works are not expected to adversely affect the life cycle of these species such that viable local populations are likely to be placed at risk of extinction.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

No populations have been listed for the local area under Part 2 of Schedule 1 of the TSC Act or Part 2 of Schedule 4 of the FM Act.

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or**
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

Tablelands Frost Hollow Grassy Woodland and Box-Gum woodland remnants are present at the subject site, generally in the form of low diversity native pasture. Two small patches of Frost Hollow Woodland with tree cover are present on the eastern side of the transmission corridor; these would be avoided by the works. A small area of higher diversity Frost Hollow Woodland groundcover dominated by Kangaroo Grass is present on the northern side of Dry Creek; this area would also not be impacted by the proposed works.

In view of the long grazing history, the pasture at the proposed solar farm site is unlikely to be capable of recovering flora diversity. Many native grassy understorey species do not appear to form a long term seed bank in the soil. This is supported by the results of experiments with daisy and lily species (Lunt 1990) and by the loss of species diversity which results from the absence of fire for periods greater than 7-10 years (Scarlett and Parsons 1990).

As discussed in section 6.4.1, the shading effects of the 100 hectare PV array are likely to result in a reduction of C4 grasses (such as Kangaroo Grass, Red Grass and Windmill Grass, and the introduced Couch and African Lovegrass), in favour of more shade-tolerant C3 grasses (such as Wallaby Grasses, Spear and Corkscrew Grass, Wheat Grass, Weeping Grass, Hairy Panic and the noxious weed Serrated Tussock).

Up to 20 ha of native pasture derived from Frost Hollow Woodland would be permanently cleared during the construction phase of the Proposal. A further 2.7 ha would be impacted by the Proposal, but rehabilitated following the construction phase. Most of this area would be used for the laydown site, not all of which would be cleared of vegetation. Up to 0.72 ha of native pasture derived from Frost Hollow Woodland (0.3 ha), Box-Gum Woodland (0.3 ha) and Brittle Gum dry forest may also be cleared during the construction of the transmission access track and cable trench. An existing track would be used for this purpose and the impact on the EECs is expected to be considerably less than this area.

Native pasture in similar depauperate condition derived from both of these EECs is abundant within the region and locality. The impact of shading on species composition and the loss of 10.8 ha of this vegetation would not affect the EECs such that their local occurrences are likely to be placed at risk of extinction.

- d) in relation to the habitat of a threatened species, population or ecological community:**
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality**

20 ha of native pasture derived from Frost Hollow Woodland would be permanently cleared during the construction of the solar farm. A further 2.7 ha would be impacted by cable trenching and the establishment of the laydown area, but rehabilitated following the construction phase. The works would not further fragment existing remnants. The PV array, underground transmission cable and other infrastructure would be sited to avoid the need to clear examples of the Frost Hollow Woodland and Box Gum Woodland EECs with tree cover.

Native pasture in similar depauperate condition derived from both Frost Hollow Woodland and Box Gum Woodland EECs is abundant within the region and locality, and is unlikely to have substantial natural recovery potential. Thus, the vegetation is likely to be of low importance to the long-term survival of the EECs in the locality.

The native pasture at the subject site generally offers very low potential for threatened flora species. A higher diversity patch of Frost Hollow Woodland groundcover located along the northern side of Dry Creek would be avoided and protected during the works.

An occurrence of the Hoary Sunray would be directly impacted by the establishment of the PV array and the transformer/inverter units. An assessment of the impact of the Proposal on the local population will require a more detailed survey of population size and distribution at the subject site and in surrounding areas during the spring flowering period. The variety of the plants at the subject site also remains to be determined. A targeted survey would be undertaken in spring (early November). With the exception of Hoary Sunray, and subject to the findings of the supplementary survey, the Proposal is not expected to adversely affect the long-term survival of threatened flora species in the locality.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No areas of critical habitat have been declared within the locality.

f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

A draft recovery plan has been prepared for the Hoary Sunray (DSE 2010). The overall objective of recovery is to minimise the probability of extinction of Hoary Sunray in the wild and to increase the probability of populations becoming self-sustaining in the long term. The specific objectives are to:

1. Determine distribution, abundance and population structure
2. Determine habitat requirements
3. Ensure that key populations and their habitat are protected and managed appropriately
4. Manage threats to populations
5. Identify key biological functions
6. Determine growth rates and viability of populations
7. Build community support for conservation.

A small Hoary Sunray colony would be directly impacted by the establishment of the PV array and the transformer/inverter units. An assessment of the impact of the Proposal on the local population will require a more detailed survey of population size and distribution at the subject site and in surrounding areas during the spring flowering period. The variety of the plants at the subject site also remains to be determined. The Assessment of Significance for this species, and an evaluation of the consistency of the Proposal with the Recovery Plan objectives and strategies, would need to be completed following this supplementary survey.

FAUNA

White-fronted Chat (*Epthianura albifrons*)

Ecological information

White-fronted Chats are insectivorous birds that inhabit open fields, heaths, saltmarshes and low shrubland surrounding lakes and swamps. Birds often nest in loose colonies, sometimes only meters apart (Schodde and Tidemann, 2007). Nests are built low to the ground (generally less than 30cm height) with nest predation being the most common form of nest failure (Major 1991a). White-fronted Chats forage for invertebrates on the ground with Diptera and Coleoptera being the major components of the diet (Major 1991b). The White-fronted Chat is regarded as resident in many areas, but has been referred to as nomadic in some places. There is no evidence of any migratory movements although flocks of White-fronted Chats have been recorded gathering temporarily in some areas in response to temporary high abundance of food (DECCW 2009, Major 1991a). This species is prone to human disturbance and urbanisation of saltmarsh habitat in the Sydney region has been implicated in the decline of local populations (Jenner et al in press).

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Over recent years White-Fronted Chats have suffered significant population declines in NSW (Jenner et al in press). The Lake George/Bungendore area is a known local stronghold for the species (COG, 2002, Cog, 2009). White-Fronted Chats were recorded in the central and eastern sections of the subject site on all three site visits (22/6/10, 15-16/7/10, 4/8/10). The species utilises sparse low shrubs and tall grass for nesting (Major 1991a, (Schodde and Tidemann, 2007) and the areas of Tee Tree on the subject site provide potential nesting habitat (R. Major pers.com.). Due to the sensitivity of this species to human disturbance (Jenner et al in press) the Proposal has the potential to significantly impact this species if breeding is occurring on site. A survey during the breeding season will be undertaken once evidence of breeding in the Sydney population (monitored Richard Major) is recorded. Optimal timing is likely to be in September-October (R. Major pers. comm.). The Assessment of Significance for this species would need to be completed following this supplementary survey.

If breeding is detected, a management plan would be developed in consultation with experts including an assessment of the local population and potential offsets.

The Proposal site contains suitable foraging habitat for this species as evidenced by the presence of foraging flocks recorded during the field survey. It is likely that this habitat would be effectively lost to the local population following the installation of the PV arrays, due to the sensitivity of this species to disturbance.

Modified agricultural habitat, similar to that found on the subject site, along with extensive areas of lake bed/ shoreline exist in the locality, providing alternative foraging habitat for this species. The loss of 100ha of pasture is unlikely to significantly impact this species in terms of foraging habitat considering the availability of this, and higher quality lake edge habitat in the locality.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality

- i) A total of 100 ha of grazed pasture will be modified by the installation of the PV arrays. White-Fronted Chats are likely to use only a small portion (estimated at 5ha comprising the Tee tree areas and a buffer around them) for foraging due to the exposed nature of the surrounding paddocks.. Flocks have been seen onsite on four separate occasions and each time they have been within the same localised area, in and around the tee tree patches. It is assumed that, due to this species sensitivity to disturbance, the entire area under the PV arrays would be lost as a foraging resource. Monitoring of fauna usage of the site during the operational phase is recommended to provide data for future impact assessments.
- ii) No areas of habitat would become fragmented by the Proposal, as the birds are mobile and the site is not extensive.
- iii) To be confirmed following spring survey. If no breeding is taking place the abundance of foraging opportunities along the Lake George shore line suggests that the loss of up to 5ha of foraging areas would not be significant for this species. If breeding is occurring a management plan for this species would be developed to ensure the long term viability of the local population.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

No recovery plan has been produced for this species.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

All key threatening processes are discussed at the end of the Assessments of Significance below.

Flame Robin (*Petroica phoenicea*), Scarlet Robin (*Petroica boodang*)

Ecological information

Each year the Flame Robin migrates up to the highlands of south-eastern Australia to breed in alpine and subalpine woodlands and scrubby forest. In winter it moves to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains (Higgins and Peter 2002).

The Scarlet Robin breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and sometimes in open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris (NSW Scientific Committee 2010b).

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Flame Robins and Scarlet Robins are capable of foraging in modified farmland and have a high probability of frequenting the subject site as Flame Robins were recorded on site and Scarlet Robins have been recorded within 20km to the west, south and east of the subject site. Breeding habitat is absent for these species and the foraging habitat found on the subject site is common in the surrounding district. It is likely that the PV arrays and perimeter fence would provide perching opportunities for the Flame Robin and Scarlet Robins, replacing the fallen timber that these species commonly use as foraging platforms in natural settings.

As neither species is likely to breed on site and given that the foraging habitat provided by the subject site is abundant in the locality the Proposal is unlikely to negatively impact these species.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:**
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality**

- i) A total of 100 ha of grazed pasture will be modified by the installation of the PV arrays. It is assumed that the entire area under the PV arrays would be lost as a foraging resource. Monitoring of fauna usage of the site during the operational phase is recommended to provide data for future impact assessments.
- ii) No areas of habitat would become fragmented by the Proposal, as the birds are mobile and the site is not extensive.
- iii) The low diversity native pasture that will be impacted by the Proposal is unlikely to be important to either of these species based on the abundance of this habitat in the locality.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan**

No recovery plans has been produced for these species.

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

All key threatening processes are discussed at the end of the Assessments of significance below

*Gang-gang Cockatoo (*Callocephalon fimbriatum*)*

Ecological information

The Gang-gang Cockatoo also occurs in eucalypt forests and woodlands, particularly Box-Ironbark assemblages (Shields and Crome 1992). It is a long lived species with low fecundity and requires tree hollows for nesting (Gibbons and Lindenmayer 2002). The Gang-gang Cockatoo is known to favour old growth attributes for nesting and roosting and breeding and usually occurs in tall mature sclerophyll forests that have a dense understorey (NSW Scientific Committee 2005).

The Gang-gang Cockatoo moves between tall mature wet sclerophyll forest for breeding (summer) and dry open eucalypt forests (winter) feeding mostly on seeds of eucalypt trees and shrubs (e.g. banksia, hakea, casuarina), although invertebrates may also be eaten (Cameron 2007).

Threats for this species include habitat loss (including breeding, foraging and roosting areas), degradation (including overgrazing) of habitat, fragmentation of habitat and loss of hollow bearing trees. Competition from aggressive generalists over foraging and nesting areas may be exacerbated by forest fragmentation and decline of important habitat features, such as hollows (Higgins, 1996; NSW Scientific Committee 2008; Manning et al. 2006).

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

The Gang-gang Cockatoo was not recorded during the field survey, however numerous records exist in the Bungendore area (nearest records are 10km from the subject site, NSW Wildlife Atlas) and this species is expected to occur on the site from time to time.

Considering the extent of the woodland and dry forest in the locality the removal of a maximum of <1 hectare ha of trees is unlikely to significantly impact this species. Theoretically a maximum of 20 hollow bearing trees could be removed, however, the Proposal is unlikely to cause the loss of more than one or two hollow bearing trees following micro-siting of the power poles. The hollow bearing trees that may be removed are unlikely to be used as nesting sites as they occur on the edge of stands (and are likely to be subjected to higher predation risks), and displayed no signs of parrot nesting activity (chewing around the entrance). Given the extent and nature of the expected impacts, and assuming the mitigation measures listed in this report are adopted, the project is unlikely to negatively impact any local population of this species,

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or**
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:**
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality**

- i) A total of up to 20 hollow bearing trees may be removed, however it is likely that the clearing of trees would be avoided with the adoption of a underground transmission to the substation.
- ii) The Proposal would not impact the movements of this mobile species. By regenerating the forest/woodland in the central section of the transmission corridor habitat for the species would increase in the local area.
- iii) It is unlikely that the habitat to be impacted by the Proposal would be utilised by this species and, therefore, considering the worst case scenario where all trees within the development envelope were lost, it is unlikely that a local population would be negatively impacted.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan**

No recovery plan has been produced for this species

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

All key threatening processes are discussed at the end of the Assessments of significance below.

Brown Treecreeper (*Climacteris picumnus victoriae*)

Ecological information

Brown Treecreepers inhabit drier forests and woodlands. They appear to rely on relatively undisturbed stands of remnant vegetation and require areas of >200ha to maintain viable populations (Barrett et al. 1994). This species often forages on the ground or on fallen timber as well as the more typical treecreeper foraging habitat of tree trunks and branches (Norske 1979). Brown Treecreepers are reliant on hollows for nesting and roosting. They are sedentary species holding permanent territories and are usually found in pairs or in family groups.

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

No Brown Treecreepers were recorded during the surveys, however scattered records exist in the Bungendore area with the nearest located 20km away. It is likely that Brown Treecreepers would cross the proposed transmission corridor from time to time to access adjacent woodland/forest.

Given the quality and extent of the woodland and dry forest in the locality, the removal of a maximum of <1ha of trees is unlikely to impact this species. A maximum of 20 hollow bearing trees could be removed in a worst case situation (although using the proposed underground transmission option no trees would be removed), however these are unlikely to be used as roost/nesting sites as they occur on the edge of stands and are likely to be less favorable than hollows in more contiguous woodland due to higher predation risks. Considering the extent and nature of the expected impacts, and assuming the mitigation measures listed in this report are adopted, the project is unlikely to negatively impact any local population of this species.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality

- i) The Proposal has the potential to remove <1ha of mature dry forest/woodland trees including up to 20 hollow bearing trees. It is highly unlikely that these figures would be realised as only four trees would require removal to site the PV arrays and the remainder of trees in the transmission corridor would be avoided by siting the cable trench along the existing farm track. If an overhead transmission line was utilised trees in the corridor can be avoided by micro-siting poles and using the existing vehicle track. Due to the modified nature of the subject site and the expanses of native woodland/forest in the locality it is unlikely that the removal of this vegetation would have a negative impact on a local population.
- ii) No habitat would be fragmented or isolated by the Proposal as the subject site, including the transmission corridor, is largely cleared and would not be utilised by this species for dispersal. By increasing the connectivity across the central transmission corridor through offset planting and fencing a net gain in habitat values would be attained.
- iii) The importance of the habitat to be modified or removed (including hollow bearing trees) is likely to be low. Therefore, the Proposal is unlikely to affect the local long-term survival of Brown Treecreeper.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

No recovery plan has been developed for this species

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

All key threatening processes are discussed at the end of the Assessments of significance below.

Diamond Firetail (*Stagonopleura guttata*)

Ecological information

Diamond Firetails live in scattered groups of five to 40 birds in the open eucalypt woodlands of South Eastern Australia. They forage exclusively on the ground for seeds and insects. This species is sedentary, though some populations move locally. Diamond Firetail populations appear unable to persist in areas which lack remnants of native vegetation larger than 200ha (NSW Scientific Committee 2001) although they are able to utilise areas around towns and farms (DECCW 2010).

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

Diamond Firetails are capable of foraging in modified farmland and are likely to frequent the subject site considering local records exist (Diamond Firetails have been recorded 10km from the subject site).

Diamond Firetails have adapted to feed on a range of introduced weed and pasture species and foraging habitat is not considered limiting for this species (Read, 1994). Breeding habitat is absent from the subject site and would not be impacted by the Proposal. Given that foraging habitat is abundant adjacent to the subject site the Proposal is unlikely to negatively impact a local population of this species.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or**
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:**
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality**

- i) The Proposal would modify 100ha of potential foraging habitat in the form of cleared pasture.
- ii) The response of Diamond Firetails to the PV arrays is unknown but even if they avoided the subject site there is no reason to assume an area would be fragmented as pastoral land with woodland remnants is widespread in the locality.
- iii) As discussed above, foraging habitat for Diamond Firetail in surrounding agricultural landscapes is abundant. The importance of the habitat on site is therefore likely to be low, and its modification is thus unlikely to affect the local long-term survival of the Diamond Firetails.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)**

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan**

No recovery plan has been produced for this species

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process**

All key threatening processes are discussed at the end of the Assessments of Significance below.

Koala (Phascolarctos cinereus)

Ecological information

The Koala occupies woodlands and forest and appears able to occupy moderately disturbed environments (DECC 2008; Gordon et al. 1988; McAlpine et al 2006; Wintle et al. 2008). Home range size varies with quality of habitat, ranging from less than 2 ha to several hundred ha in size (DECCW 2009). Connectivity is important to Koala persistence in an area. Koalas are less able than many other mammals to travel between fragments due to their low energy diet however young koalas commonly disperse three to four kilometres from their natal area (Dique et al 2003). Koala Secondary habitat has been found to be highly important, as it is more common and can aid dispersal (McAlpine et al 2006).

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction**

No Koala sign was detected during the field surveys. Scattered records of this species exist >25km from the subject site. The presence of feed tree species indicates the potential for Koalas to forage in the area (see

section 5.4.3). If an underground transmission cable was used as planned, no trees would be removed from the transmission corridor and only two isolated ribbon gums would be cleared from the rest of the subject site. The Proposal could remove up to 5 Ribbon Gum trees (primary feed species) and up to 30 secondary feed trees (Brittle Gum and Yellow Box) from the transmission corridor (<1ha of habitat) if the preferred option of an underground transmission cable was unachievable and an overhead power line option was adopted. These habitat loss figures are likely to be an over estimate as the mature trees in the transmission corridor are scattered and micro-siting works to avoid them is realistic. If these worst case figures are used the Proposal would be unlikely to impact any local Koalas considering the abundance of woodland habitat in the locality and the exposed location of the trees that may be removed and the low probability of Koalas occurring on the site.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or**
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:**
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality**

- i) As mentioned above, if the preferred option of an underground transmission cable was unachievable and an overhead power line option was adopted the Proposal could remove up to 5 Ribbon Gum trees and up to 30 secondary feed trees from the transmission corridor (<1ha of habitat) in a worst case scenario
- ii) The transmission corridor contains sparse trees and the clearing of several of these would not significantly add to the fragmentation of the area for Koalas. The main area of the subject site would not be used for dispersal due to the lack of trees and presence of adjacent woodland that provides a more favourable medium for dispersal. Fencing would not significantly restrict Koala movement for these reasons. By improving connectivity across the central transmission corridor a net gain in habitat values would be achieved for this species.
- iii) The Proposal would be unlikely to negatively impact any local Koalas considering the abundance of woodland habitat in the locality, the exposed location of the trees (and therefore low importance to the species) that may be removed and the low probability of Koalas occurring on the site.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

The Proposal is not inconsistent with the approved recovery plan for this species (DECC, 2008).

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

All key threatening processes are discussed at the end of the Assessments of Significance below

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)

Ecological information

The Eastern False Pipistrelle is a large bat that is found in wet sclerophyll forest in south east Australia. This species prefers tall forest (trees greater than 20m) with a thick understorey. Roost sites are hollows in eucalypts, with colonies of up to 80 individuals recorded. Numerous roost sites are used across the home range of up to 136ha (Churchill, 2008). This bat feeds on large prey including beetles and moths.

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Typical habitat for this species, wet sclerophyll forest with thick understorey, is absent from the site however, due to the presence of eight records of this species within 30km of the subject site, assessment of significance has been completed for this species as a precautionary measure.

It is likely that the clearing of trees would be avoided with the adoption of an underground transmission to the substation, however in the worst case scenario, where an overhead power line option is necessary, impacts to microbats may arise from the removal of potential roost sites. If a hollow bearing tree containing a colony of this species was cut down impacts to the local population would be significant.

Considering the extent of the woodland and dry forest in the locality the removal of a maximum of <1ha of mature trees is unlikely to impact this species in terms of foraging. A maximum of 20 hollow bearing trees have the potential be removed (if all hollow bearing trees within the transmission corridor development envelope were cleared) however these are unlikely to be used as roosting sites considering the location of these trees on the edge of stands, the abundance of roost sites in the adjacent woodland/forest and the lack of wet sclerophyll forest on site. Micrositing the transmission line to avoid hollow bearing trees is the best mitigation strategy in this case. If hollow bearing trees are to be removed stag watching with hand held anabats and then the adoption of a preclearance tree removal policy (such as the one listed in Appendix J) would be required.

Preclearance checks of any hollow bearing trees to be removed would minimise the risk of impacting this species. Given the extent and nature of the expected impacts, and assuming the mitigation measures listed in this report are adopted, the project is unlikely to negatively impact any local population of this species.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality

- i) A maximum of 20 hollow bearing trees have the potential be removed (if all hollow bearing trees within the transmission corridor development envelope were cleared, see above)
- ii) No habitat fragmentation would be caused by the Proposal
- iii) The habitat on the subject site is not typical for this species and would be of low importance. The likelihood of a local population of Eastern False Pipistrelles is highly unlikely. The potential habitat to be removed (hollow bearing trees) would not negatively impact this species.

- e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No areas of critical habitat have been declared within the locality.

- f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

No recovery plan has been created for his species

- g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

See below

Little Whip Snake (*Suta flagellum*), Pink-tailed Worm-lizard (*Aprasia parapulchella*), Striped Legless Lizard (*Delma impar*), Grassland Earless Dragon *Tympanocryptis pinguicolla*

Ecological information

Little Whip Snake has been found in grasslands, grassy woodlands, and secondary grasslands. It requires well-drained slopes with loose scattered rocks or rocky outcrops to provide shelter and foraging habitat (NSW Scientific Committee 2008) and appears able to persist locally in high diversity grassland in the absence of this surface cover (R. Rehwinkel, Senior Threatened Species Officer, DECCW pers. comm.). This species is nocturnal and feeds on primarily on skinks. The Little Whip Snakes cryptic nature and low density results in a lack of ecological information for this species.

Pink-tailed Worm-lizards occur in open grassland habitats that have a substantial cover of small rocks (Osborne & Jones 1995). This species also shows a preference for sunny aspects, avoiding south facing slopes. Pink-tailed Worm-lizards are only found at sites with good numbers of invertebrates under rocks (Barrer 1992), particularly small ants upon which it feeds. Most sites occur in relatively open vegetation (Osborne & McKergow 1993). The species is occasionally recorded from grassland sites that are dominated by exotic species. Populations may extend into adjacent woodland but remain undetected (Barrer 1992).

Pink-tailed Worm-lizards are most commonly found sheltering under small rocks (150 - 600 mm basal area) shallowly embedded in the soil (2 - 5 cm). Some individuals have been found under larger rocks embedded up to 30 cm deep. Rocks are used for thermoregulation, with lizards preferring rocks that receive direct sunlight (Barrer 1992). Individuals may be faithful to the same rock for long periods of time. The lizards utilise ant burrows underneath the rocks, possibly retreating deep into burrows in hot, dry weather (Osborne & Jones 1995, in DEWHA 2010).

Striped Legless Lizard is found primarily in lowland native grasslands, dominated by tussock-forming grasses (ACT Government 1997). The species can be found in areas dominated by exotic grasses, however a tussock structure appears to be an important habitat characteristic for this species. Striped Legless Lizards are also found in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland (DECCW, 2005). This species feeds on a variety of insects and arthropods and may display some selectivity in it's diet with caterpillars implicated as a particularly important food source (ACT Government 1997).

Grassland Earless Dragons are small robust lizards found in native temperate grassland habitats. Observations in NSW and the ACT indicate that the species is found in natural temperate grasslands, dominated by wallaby grasses (*Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.), tussock grasses (*Poa* spp.) and possibly Kangaroo Grass (*Themeda triandra*). Captures in the ACT suggest that the animals prefer well-drained natural temperate grasslands that are relatively undisturbed and with minimal pasture improvement (Robertson and Evans 2009).

The importance of invertebrate burrows or lightly embedded surface rocks as shelter and refuge sites has become apparent, and the availability of such sites may be the predominant factor influencing persistence of the species at some sites, rather than the structure or floristics of the grasslands per se (Robertson and Evans 2009).

- a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction

Following habitat evaluations on site, the habitat present is considered unlikely to support a local population of any of these species due to vegetation modification following a history of disturbance (clearing and stock grazing), absence of local records, presence of foxes and feral cats and sparse and isolated surface rock habitat. However this assessment has been undertaken as a precautionary measure.

Striped Legless Lizards have been recorded in the north of the ACT, 30km to the south west of the subject site. Surveys for this species in optimal grassland habitat within the Bungendore area have failed to detect any individuals (Gunninah Environmental Consultants 1997 in ACT Government 1997) and the lack of tussock grass structure (other than serrated tussock which has been found to support this species on occasion (DEHWA, 2010), cracking clay and limited surface rocks on the subject site further reduces the probability of this species occurring.

Pink-tailed Worm-lizards have been recorded 25km to the south west of the subject site in the ACT and Queanbeyan areas. Extensive searches have not located this species in the north west of the ACT (the closest section of the ACT to the subject site) (Osborne et al, 1991). The scarcity of small, shallowly embedded surface rocks and of Kangaroo Grass *Themeda triandra*, habitat features associated with the nearest records of this species in the ACT (Osborne et al, 1991), suggests the site would not support this species.

Little Whip Snakes have been recorded within 30 km to the east, south and west of the subject site and, of the four species considered in this assessment, they are the most likely to occur on site based on existing records. As for the previous two species the absence of high diversity native grassland (an indication of sustained grazing pressure) and surface rocks indicates the site is of poor habitat quality for this species in spite of the native dominated composition of the pasture.

Grassland Earless Dragons have been recorded in the Queanbeyan area and north east ACT. Surveys to the south of Bungendore have failed to detect this species (Robertson and Evans 2009). The extent of the site that would have been native temperate grassland prior to modification for agricultural purposes is unknown. It is likely, based on the surrounding vegetation, that the less modified pasture in the east of the site would have been wooded. Considering the degree of modification by stock grazing it is unlikely that Grassland Earless Dragons would persist within the development envelope even if native temperate grassland was once found on areas of the site. Few invertebrate holes were observed during the habitat assessments and while surface rocks are present in some areas these are largely well embedded and offer little surface shelter. Considering these factors, and as this species is strongly associated with grasslands that are relatively undisturbed it is unlikely that the species occurs onsite (Robertson and Evans 2009).

If populations of these species did occur onsite, potential impacts of the Proposal include removal of rock outcrops (on a very small scale with a worst case of 0.5ha impacted) for roading and temporary laydown areas and modification of grazed native pasture due to shading impacts of the PV arrays. For this assessment it is assumed that, as a worst case scenario, the entire 100ha impacted by shading would be lost as habitat for these species, although the effects of altered microclimate on vegetation and fauna under the PV arrays are unknown and cover would remain for these species. Potential impacts during construction include the trapping of individuals in open trenches and crushing of individuals by machinery or infrastructure. As discussed above, the probability of resident populations of these species is unlikely and the probability of crushing individuals is therefore very low. Trenches should be back filled as soon as possible and, if left open, ramps to enable trapped fauna to escape should be temporarily installed. Trenches should be inspected for fauna prior to back filling.

Habitat assessments have been the only method used to determine the presence of these species on the subject site and, while they indicate that it is unlikely for these species to occur based on known habitat associations, as a precautionary measure it is recommended that targeted surveys of all areas of surface rock habitat on site, invertebrate holes (including the use of a fibroscope) be carried out in spring to confirm the findings of the habitat assessments. This survey would enable the abundance of invertebrate prey items and the condition of the pasture in favourable spring condition (a time that would offer the highest quality

vegetative structural habitat) to be assessed, further indicating the suitability/unsuitability of the subject site for these species and the corresponding potential for impact.

Pending the results of this follow up survey, the modification of the subject site following shading impacts of the PV arrays and the loss of habitat due to construction activities would not adversely impact populations of Little Whip Snake, Pink-tailed Worm-lizards or Striped Legless Lizard. If the surveys indicated the habitat within the development envelope is of a quality to support populations of any of these species further targeted species surveys would be undertaken to determine the distribution of the species onsite and in the local area. Mitigation measures would be developed based on the findings of these surveys to ensure a maintain or improve outcome was achieved for that species.

- b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction**

N/A

- c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
- i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at the risk of extinction, or**
 - ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction**

N/A

- d) in relation to the habitat of a threatened species, population or ecological community:**
- i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
 - ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
 - iii) the importance of the habitat to be removed, modified, fragmented or isolated, to the long-term survival of the species, population or ecological community in the locality**

- i) Impacts of the Proposal include removal of rock outcrops (on a very small scale with a worst case of 0.5ha impacted) for roading and temporary laydown areas and modification of grazed native pasture due to shading impacts of the PV arrays. For this assessment it is assumed that the entire 100ha impacted by shading would be lost as habitat for these species, although the effects of altered microclimate on vegetation and fauna under the PV arrays are unknown and cover would remain for these species. The exclusion of foxes by the perimeter fence may increase the habitat values within the subject site and monitoring of fauna use of the operational site is recommended to increase the understanding of the impacts of solar farms on local biodiversity
- ii) The diverse grassy woodland habitat of Sweeney's Reserve (See Appendix B Habitat Assessment 18) has a far higher potential to support these species than the subject site based on this area being subjected to less disturbance and supporting a greater diversity of native grassland species, yet even here it is unlikely that populations of these three species occur. Following a 40 minute search of the few rocky areas within the reserve only 86 rocks were able to be turned and of these only 5 supported colonies of small black ants. No evidence of threatened reptiles was found.

It is unlikely that any areas on the subject site could support populations of these species due to the absence of surface rocks for shelter (outcrops on the subject site are generally massive with few loose surface rocks), sustained stock grazing and resultant lack of grassland diversity and structure. The perimeter fence would not impede dispersal of any of these species and the vegetation under the PV arrays would not be considerably different than the existing low diversity pasture in terms of connectivity.

- iii) As discussed the habitat quality is poor and likely to be of low importance to any local populations of Little Whip Snakes, Pink-tailed Worm-lizards or Striped Legless Lizards or Grassland Earless Dragons. As such its' modification is considered unlikely to affect the continued survival of local populations of these species.

e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

No areas of critical habitat have been declared within the locality.

f) whether the action proposed is consistent with the objectives or action of a recovery plan or threat abatement plan

There is no recovery plan developed for the Little Whip Snake.

The Proposal is not inconsistent with the National recovery plan for the Striped Legless Lizard (*Delma impar*) 1999-2003 (Smith and Robertson, 1999), the ACT Striped Legless Lizard (*Delma impar*) Action Plan (ACT Government, 1997), the ACT Recovery plan for the Pink-Tailed Worm Lizard (*Aprasia parapulchella*) (Osbourne and Jones, 1995) or the National Recovery Plan for the Grassland Earless Dragon *Tympanocryptus pinguicolla*.

g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

Five listed Key Threatening Processes are relevant to this Proposal:

1. **Bush Rock Removal.** Includes removal of rocky outcrops or rock within areas of native vegetation. Impacts of bush rock removal includes loss or disturbance of native flora and fauna species habitat. The subject site is unlikely to support threatened fauna dependent on bush rock (refer to assessments above) and similar habitat is likely to be widespread in the locality. Rocky outcrops at the subject site would be largely avoided and the Proposal is not expected to significantly exacerbate bush rock removal as a threatening process in the study area.
2. **Clearing of native vegetation.** In the determination, the NSW Scientific Committee found that 'clearing of any area of native vegetation, including areas less than two ha in extent, may have significant impacts on biological diversity'. Clearing can lead to direct habitat loss, habitat fragmentation and associated genetic impacts, habitat degradation, loss of the leaf litter layer increased habitat for invasive species and off-site impacts such as downstream sedimentation. The Proposal would not contribute significantly to the operation of clearing as a threatening process at the local or regional level, since the bulk of the subject site is already cleared of tree cover and given the depauperate condition of the nature pasture that would be affected by the works. The design of the infrastructure layout has been carefully planned to minimize the requirement for clearing any significant vegetation.
3. **Loss of hollow-bearing trees.** In NSW, terrestrial vertebrate species that are reliant on tree

hollows for shelter and nests include at least 46 mammals, 85 birds, 32 reptiles and 16 frogs (Gibbons and Lindenmayer 1997, Gibbons and Lindenmayer 2002). Of these, 45 species are listed as threatened. Hollow-nearing trees are in decline for reasons including lack of recruitment and clearing. Trees bearing large hollows in particular are increasingly rare. Generally hollow-bearing trees near riparian habitat are most valuable. Very few hollows were observed at the subject site, although medium and small hollows are common within the Brittle Gum stand. Transmission and access track routes would avoid hollow-bearing trees by following existing tracks wherever possible. The limited clearing required (anticipated to be restricted to two hollow bearing trees, one hollow bearing stag and one possible hollow bearing tree over the 250ha site) is not expected to significantly exacerbate this threatening process in the study area.

4. **Removal of dead wood and dead trees.** The removal of standing or fallen dead wood removes hollows as well as forest floor litter. The limited clearing required is not expected to significantly exacerbate this threatening process in the study area as only one stag is expected to be removed
5. **Invasion of native vegetation by exotic perennial grasses.** The Box-Gum Woodland and Frost Hollow Woodland EECs are vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog and Paspalum. Serrated Tussock is a significant problem at the subject site and is readily spread by wind and stock. Safeguards have been included in the Statement of Commitments to ensure that risks to these communities on and off the site are minimised. Given best practice weed hygiene and control during and following the works, this KTP is not likely to be exacerbated by the proposed works.

Conclusion

Flora and ecological communities

This assessment concludes that impact to generally poor condition nature pasture derived from the Frost Hollow Woodland and Box-Gum Woodland EECs will occur as a result of the Proposal. These impacts to these EECs would not be significant in the local context, given the poor condition of the vegetation, the limited scale of the project and the local abundance of similar vegetation.

With the exception of the Hoary Sunray, the Proposal is not likely to adversely affect the cycle of threatened flora species such that a viable local population is likely to be placed at risk of extinction, subject to the findings of a supplementary spring survey.

In relation to the Hoary Sunray colony that would be affected by the Proposal, a more detailed survey of population size, distribution and significance at the subject site and in surrounding areas is required during the spring flowering period. If the colony is confirmed as the EPBC Act-listed var. *tricolor*, a referral to the Commonwealth Environment Minister for approval would be required.

Fauna

As discussed in the assessments above the Proposal is unlikely to negatively impact on any threatened fauna species with the exception of the White-fronted Chat. If breeding is detected during a targeted breeding survey, a management plan would be developed in consultation with Dr Richard Major (White-Fronted Chat specialist from the Museum of Australia) including an assessment of the local

population and potential offsets. Follow up surveys are recommended to confirm the site does not provide habitat for Little Whip Snakes, Pink-tailed Worm-lizards or Striped Legless Lizards or Grassland Earless Dragons.

ASSESSMENTS UNDER THE EPBC ACT (COMMONWEALTH)

The following assessment of significance is undertaken according to the Significant Impact Guidelines for Matters of National Environmental Significance listed under the *Environment Protection and Biodiversity Conservation Act 1999*, for species with potential to occur (and thereby be impacted).

Hoary Sunray (<i>Leucochrysum albicans</i> var. <i>tricolor</i>)	E EPBC
Striped Legless Lizard <i>Delma impar</i>	V EPBC
Pink-tailed Worm-lizards <i>Aprasia parapulchella</i>	V EPBC
Grassland Earless Dragon <i>Tympanocryptis pinguicolla</i>	E EPBC

Please refer to the TSC Act assessment for ecological information used herein.

Endangered Species Assessment – Hoary Sunray (*Leucochrysum albicans* var. *tricolor*)

Will the action ...

a) Lead to a long-term decrease in the size of a population?

The Hoary Sunray is a small, perennial paper daisy occurring in NSW, ACT, Victoria and Tasmania. Although still widely distributed and numerically abundant, the species has undergone a substantial decline in range and abundance, largely due to degradation and loss of habitat for agriculture, with some losses due to infrastructure and urban development. Many remaining populations are small, highly fragmented, and threatened by weed invasion, competition and further habitat disturbance and loss (DSE 2010). Hoary Sunray (var. *tricolor*) is listed as Endangered under the Commonwealth EPBC Act, and is also listed as threatened in Victoria and Tasmania. It is not listed in NSW under the TSC Act.

Although perennial, the species dies back over summer, when the plant survives as a perennial rootstock. Individual plants probably live for only a few years (Gilfedder & Kirkpatrick 1994b in DSE 2010), and plant numbers can fluctuate widely between years (Berechree 2003 in DSE 2010). The Hoary Sunray is an obligate out-breeder, dependant pollination by many different insects, including bees and flies (Berechree 2003 in DSE 2010). Seed can probably disperse over many kilometres, will germinate fairly rapidly under a wide range of conditions, and can remain viable in the soil for at least a few months, although probably not for long periods (Gilfedder & Kirkpatrick 1994a, b, c in DSE 2010).

Small population size and the effects on genetic diversity is regarded as a key threat to the survival of this species, which is especially susceptible to local extinction where populations are small and isolated (DSE 2010). Population numbers fluctuate considerably from year to year (DSE 2010).

The Hoary Sunray readily colonises disturbed sites such as roadsides (Eddy *et al.* 1998). The species relies on the presence of bare ground for germination and establishment, and will colonise roadsides that have been scraped (R. Rehwinkel, I. Crawford, pers. comm. in DSE 2010).

In south-eastern NSW, Hoary Sunray often occurs on roadside reserves but not on adjacent grazing lands, suggesting a degree of sensitivity to grazing or associated agricultural activities such as cultivation and fertilising (DSE 2010). The species has been recorded in lightly grazed paddocks in the ACT and occurs in sites with a history of light or infrequent grazing, such as Travelling Stock Reserves (TSR). The DECCW Wildlife Atlas map of Hoary Sunray records in the vicinity of the subject site is shown in . In addition, it has been recorded in Turallo Grassland reserve (3km south of Bungendore) and Brookes Hill reserve, to the west of Bungendore. Both *Leucochrysum albicans* var. *tricolor* and the unlisted var. *albicans* have been recorded at Reedy Creek TSR 13 kilometres east of the subject site. The plants at the subject site could

belong to either taxon.

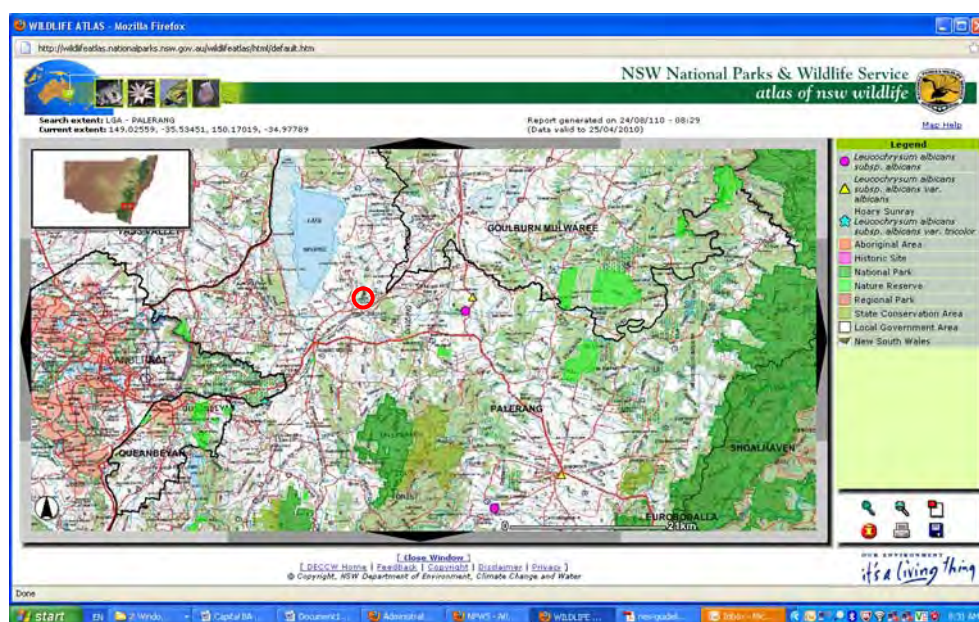


Figure 9-1 DECCW Wildlife Atlas map of Hoary Sunray records around the study area (red circle)

Four Hoary Sunray plants were recorded in low diversity native pasture dominated by Corkscrew Grass north of Dry Creek (flora survey site 12, refer Figure 4-1). The plants were not flowering at the time of survey and it is therefore not possible to determine whether they belong to the EPBC Act listed var. *tricolor*, or var. *albicans*. East of this site is a relatively diverse stand of Kangaroo Grass which has some further potential for threatened flora (site 13). In view of the timing of the survey, the extent and abundance of this species at the site may be under-estimated. It is likely that all of the lower slope and valley floor pasture at the site would originally have carried Frost Hollow Woodland habitat for the Hoary Sunray. The slope, southerly aspect and position on the northern side of Dry Creek may have resulted in lower grazing pressure in this area and account for the persistence of Hoary Sunray.

This area would be directly impacted by the establishment of the PV array and the transformer/inverter units. An assessment of the impact of the Proposal on the local population will require a more detailed survey of population size and distribution at the subject site and in surrounding areas during the Spring flowering period. The variety of the plants at the subject site also remains to be determined. The Assessment of Significance for this species would need to be completed following this supplementary survey.

b) Reduce the area of occupancy of the species?

See part a) above.

c) Fragment an existing population into two or more populations?

See part a) above.

d) Adversely affect habitat critical to the survival of a species?

No areas of critical habitat have been declared within the locality. The potential habitat for these species within the subject site has a long history of grazing. In view of the degraded state and disturbance

history of the potential habitat that will be impacted by the Proposal, its value is considered low. Native pasture in similar depauperate condition derived from both Frost Hollow Woodland and Box Gum Woodland EECs is abundant within the region and locality, and is unlikely to have substantial natural recovery potential. The habitat that will be impacted by the Proposal is not considered critical to the survival of this species.

e) Disrupt the breeding cycle of a population?

See part a) above

f) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

20 ha of native pasture derived from Frost Hollow Woodland would be permanently cleared during the construction of the solar farm. A further 2.7 ha would be impacted by cable trenching and the establishment of the laydown area, but rehabilitated following the construction phase. The works would not further fragment existing remnants.

The native pasture at the subject site generally offers very low potential for threatened flora species. A higher diversity patch of Frost Hollow Woodland groundcover located along the northern side of Dry Creek would be avoided and protected during the works.

An occurrence of the Hoary Sunray would be directly impacted by the establishment of the PV array and the transformer/inverter units. An assessment of the impact of the Proposal on the local population will require a more detailed survey of population size and distribution at the subject site and in surrounding areas during the spring flowering period. The variety of the plants at the subject site also remains to be determined. A targeted survey would be undertaken in spring (early November).

g) Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the critically endangered or endangered species' habitat?

Minor pasture weeds are common across the site along with several declared noxious weeds. The Proposal has the potential to introduce and/or further distribute weeds within the subject site through the movement of vehicles, people and equipment. Mitigation measures have been described in Section **Error! Reference source not found.** of this report to minimise the impacts from invasive species. Given the current level of disturbance and providing the recommendations contained within this report are adhered to, it is unlikely that the Proposal will result in additional harmful invasive species becoming established in the habitat of these species.

h) Introduce disease that may cause the species to decline?

The movement of vehicles, plant, equipment and people on and off the subject site has the potential to introduce disease that may impact upon this species. Mitigation measures have been described in Section **Error! Reference source not found.** of this report to minimise the introduction or spread of weeds. These measures would also reduce the likelihood of introducing or spreading disease. Providing the recommendations contained within this report are adhered to, it is considered unlikely that disease would be introduced which may cause the species to decline.

i) Interfere substantially with the recovery of the species?

A draft recovery plan has been prepared for the Hoary Sunray (DSE 2010). The overall objective of recovery is to minimise the probability of extinction of Hoary Sunray in the wild and to increase the probability of

populations becoming self-sustaining in the long term. The specific objectives are to:

1. Determine distribution, abundance and population structure
2. Determine habitat requirements
3. Ensure that key populations and their habitat are protected and managed appropriately
4. Manage threats to populations
5. Identify key biological functions
6. Determine growth rates and viability of populations
7. Build community support for conservation.

A small Hoary Sunray colony would be directly impacted by the establishment of the PV array and the transformer/inverter units. An assessment of the impact of the Proposal on the local population will require a more detailed survey of population size and distribution at the subject site and in surrounding areas during the spring flowering period. The variety of the plants at the subject site also remains to be determined. The Assessment of Significance for this species, and an evaluation of the consistency of the Proposal with the Recovery Plan objectives and strategies, would need to be completed following this supplementary survey.

Pink-tailed Worm-lizard (*Aprasia parapulchella*), Striped Legless Lizard (*Delma impar*), Grassland Earless Dragon *Tympanocryptis pinguicolla*

Will the action ...

j) Lead to a long-term decrease in the size of an (important) population?

As discussed in the TSC assessment above it is considered unlikely that populations of these species exist onsite due to vegetation modification following a history of disturbance (clearing and stock grazing), absence of local records, presence of foxes and feral cats and sparse and isolated surface rock habitat and lack of native tussock structure.

k) Reduce the area of occupancy of an important population/the species?

As the habitat on site is unlikely to support a viable population and if recommendations to protect outcrop areas are adopted there will be no reduction of an important population.

l) Fragment an existing population into two or more populations?

The only structural habitat, rocky outcrops with few scattered rocks, suitable for these species exist as naturally fragmented and widely dispersed outcrops. As this habitat is unlikely to support a population of Striped Legless Lizards, Pink-tailed Worm-lizards or Grassland Earless Dragons, the proposed development is unlikely fragment a population.

m) Adversely affect habitat critical to the survival of a species?

No areas of critical habitat have been declared for these species. It is recommended that rock outcrops are conserved within the proposed development and layout design has been developed to achieve this aim.

n) Disrupt the breeding cycle of an (important) population?

The Proposal is unlikely to disrupt the breeding cycle of an important population as the probability of a viable population of these species being present is low considering the quality of the habitat present and the nearest records.

o) Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

As described in the TSC Assessment of Significance above the Proposal would impact 100ha of native pasture. It is unlikely that these species occupy the subject site and it is therefore unlikely that the modification of this habitat would impact a population.

p) Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?

Foxes and feral cats were detected on site during the survey. The Proposal would not add to the invasive species problem already impacting the site, and the presence of the perimeter fence is likely exclude these predators from the subject site

q) Introduce disease that may cause the species to decline?

There are no diseases known to be a threat to these species.

r) Interfere (substantially) with the recovery of the species?

Given the information presented above and the recommendations given in Section 8, the proposed development is not considered likely to interfere substantially with the recovery of the subject species.

Appendix B Habitat evaluation

HABITAT EVALUATION

Twenty three habitat evaluations targeting threatened species habitat were undertaken across the subject site including four assessments undertaken in adjacent woodland. Results of these assessments are found below and were used to inform the threatened species evaluation which identifies the threatened species with potential to be impacted by the Proposal. The locations of these assessments are shown in Figure 9-2.

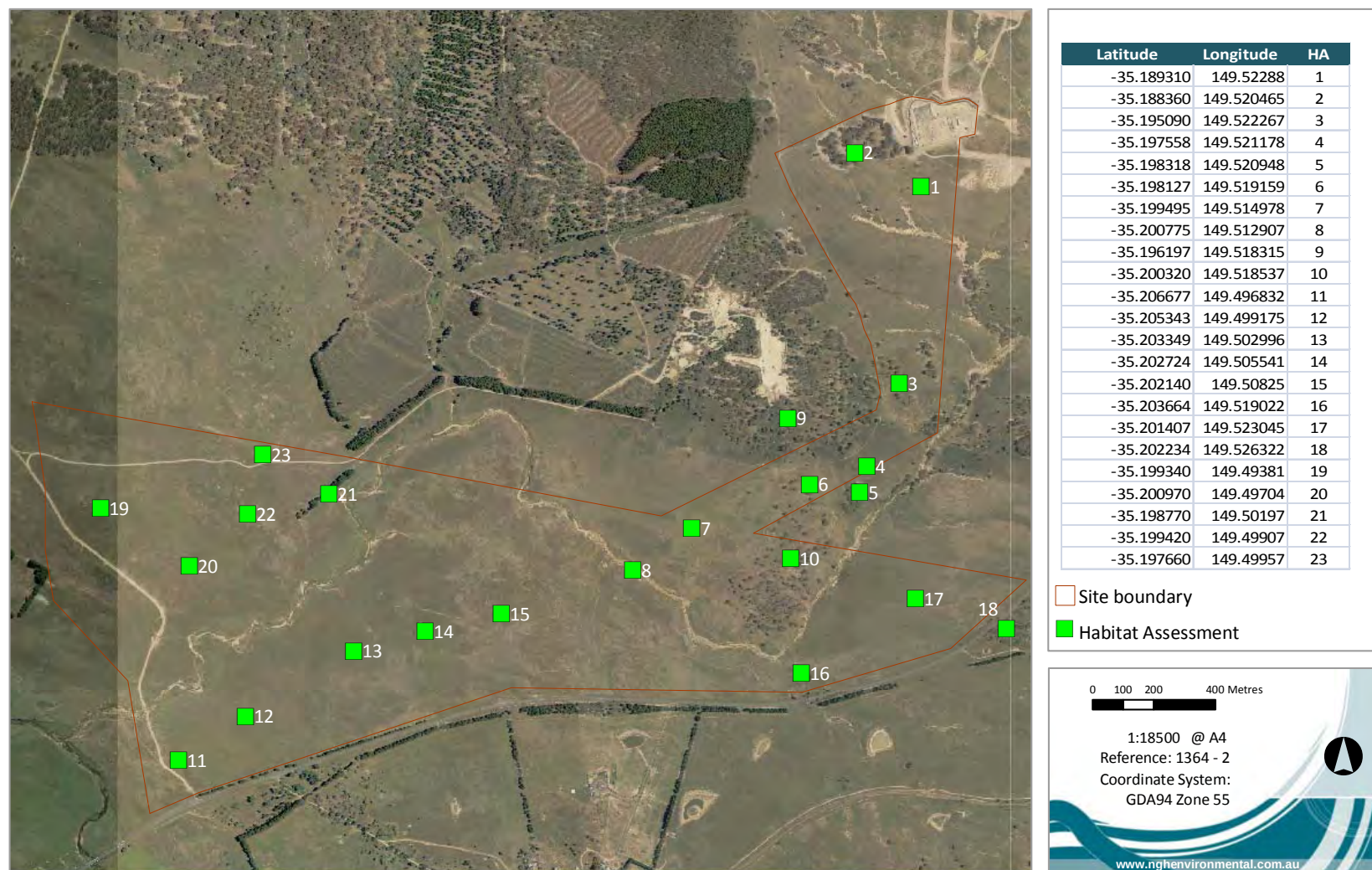


Figure 9-2 Fauna habitat assessment points

Habitat Assessment 1

Habitat Type:	Native pasture (infested with serrated tussock)
Area:	Approximately 8 ha within the transmission corridor (total native pasture is much greater than this than this and appears to form the general landscape matrix of the locality but this is the area this habitat assessment covers)
Landscape position:	Mid slope, gently sloping, easterly aspect. Northern end of transmission corridor with substation immediately north. Eroded gully crosses the transmission corridor from west to east.
Connectivity:	Forms a matrix separating woodland/forest patches
Land use/disturbance:	Cleared grazing land, heavily grazed by stock native fauna and introduced fauna (Fallow Deer, rabbits)
Dominant Overstorey:	Lone yellow box tree in far north (part of habitat assessment 2).
Regeneration:	No eucalypt regeneration
Understorey:	Serrated tussock with closely grazed native grasses.
Water sources:	Nearest water is Dry creek 600m east
Habitat features:	Little habitat for anything other than common grazing species
Comments:	Serrated tussock control evident with areas of spot spraying (probably undertaken during the previous growing season) to the north and west.



Habitat Assessment 2

Habitat Type:	Woodland (Yellow Box, Red Gum)
Area:	3 ha approx (only 4 trees or so in transmission corridor)
Landscape position:	Mid slope, gently sloping, easterly aspect. Northern end of transmission corridor with substation immediately east.
Connectivity:	Isolated by at least 200m from woodland to the west. Surrounded by moderate to heavily grazed pasture.
Land use/disturbance:	Grazed (un fenced). Ground bare due to stock trampling and camping (cattle). Trees cleared (numerous small stumps remain). Weed infestations – serrated tussock (sprayed out within patch) and numerous large boxthorn towards western edge.
Dominant Overstorey:	Yellow Box dominates with some Red Gum.
Regeneration:	Very limited, some seedlings to 60cm present at a low density
Understorey:	Exotics with bare ground.
Water sources:	Dry creek 800m south east, soak to the east of the stand following recent rain (boggy)
Habitat features:	Few hollows (50m x 50m plot data: 16 trees no hollows). Trees large but very few hollows. Some medium (50cm diameter approx) nests probably Raven or magpie). The large boxthorn provides shelter for small passerines. No mistletoe, limited fallen timber.
Comments:	Low habitat value due to degradation by stock and clearing.



Habitat Assessment 3

Habitat Type:	Dry Forest and frost hollow woodland transition zone remnant patches
Area:	<1 ha total of trees in the transmission easement
Landscape position:	Midslope of low ridge south west facing.
Connectivity:	Provides the only connectivity between modified forest/woodland to the east (>2000ha) and west (800ha approx)
Land use/disturbance:	Grazed, although good ground cover. Cleared
Dominant Overstorey:	Acacia and Allocasuarina woodland exists upslope to the west, patches of Brittle Gum, Broad Leafed Peppermint and Ribbon Gum occur within and adjacent to the easement. Large Ribbon gum also present along Dry creek to the east.
Regeneration:	Some regeneration present around large remnant trees including Broad-leaved Peppermint and Ribbon Gum (pole sized, young mature (DBH>15cm) and seedlings)
Understorey:	Native grasses (wire grass dominates with stipa in the rockier areas also a 20x20m kangaroo grass dominated patch). Less serrated tussock than areas to the north. Dense patch of Bladey Grass (40x40m) provides cover for grassland species such as quail.
Water sources:	Dry Creek 170m to the south east
Habitat features:	Many mistletoe present (>20), 2 hollow bearing trees(Large Ribbon Gums) one active hollow with parrot chew. Small sedimentary outcrop with few surface rocks (flat and <A4) generally cattle disturbed (dislodged by trampling). Several wombat burrows present within transmission corridor.
Comments:	The area provides some habitat values in its own right but is an imported (though patchy) corridor between treed areas to the east and west.



Habitat Assessment 4

Habitat Type:	Bracken patch
Area:	Approximately 1.5 ha
Landscape position:	Lower slope, gently sloping south east towards Dry creek 150m east.
Connectivity:	Patch extends up into the dry forest to the north.
Land use/disturbance:	Grazing land, past fire may have promoted the bracken growth.
Dominant Overstorey:	Nil, dry forest species (Broad Leafed Peppermint, Black Wattle, Allocasuarina exist to the north), frost hollow woodland species are found along the creek (Snow Gum, Black Sallee, Ribbon Gum)
Regeneration:	No tree regeneration
Understorey:	Bracken fern with native grass understorey, small Tee tree stands down slope to the south east
Water sources:	Dry Creek 150m east
Habitat features:	Provided limited cover for terrestrial fauns, little foraging value.
Comments:	Many animal tracks through the bracken, no rocks or logs – little habitat value.



Habitat Assessment 5

Habitat Type:	Frost Hollow Woodland
Area:	1 ha approx (lies adjacent to the transmission corridor)
Landscape position:	Flats along Dry Creek
Connectivity:	Relatively isolated, some linkage along Dry Creek to the North
Land use/disturbance:	Grazed and cleared around
Dominant Overstorey:	Snow Gum (40cm DBH with larger broken trees also present) with several large Ribbon Gums on the upslope edge and occasional large Blackwood . Black Sallee along creek line.
Regeneration:	Regeneration present including in adjacent grassland (Snow Gum and Black Sallee)
Understorey:	Some bracken patches, native grasses moderate to heavy grazing
Water sources:	Adjacent to Dry Creek
Habitat features:	Hollows present – moderate density, mistletoe present, fallen timber common.
Comments:	Snow Gums looking unhealthy with sparse canopy.



Habitat Assessment 6

Habitat Type:	Dry Forest (Brittle Gum patch) within the transmission corridor
Area:	0.3ha in transmission corridor (see habitat assessment 10 for description of the rest of stand)
Landscape position:	Low, flat ridge/saddle
Connectivity:	Isolated, closest treed area is to the north.
Land use/disturbance:	Grazed – heavy,
Dominant Overstorey:	Brittle Gum dominates, relatively uniform stand (average DBH >50cm). Broad-leaved Peppermint (3 trees) north of the Brittle Gm stand.
Regeneration:	Nil
Understorey:	Native pasture with serrated tussock
Water sources:	Dry Creek adjacent to east and south
Habitat features:	Numerous hollows (from the 20 trees in the transmission corridor 14 small, 18 medium and 1 large hollow), lots of mistletoe (29 from 20 trees), poor understorey habitat values – heavily grazed native pasture with serrated tussock
Comments:	High number and diversity of hollows, edge effects could be significant in terms of nest predation for species utilising this patch



Habitat Assessment 7

Habitat Type:	Native pasture (dominated by serrated tussock)
Area:	Matrix, within the southern section of the transmission easement
Landscape position:	Lower slope (south west aspect), and flats
Connectivity:	matrix
Land use/disturbance:	Heavily grazed, cleared, weed infestations – serrated Tussock and sweet briar
Dominant Overstorey:	Browsed Sweet Briar, (nearest trees are Yellow Box, Brittle Gum and Broad leaved Peppermint 250m to the North and very low density young snow gum near Dry Creek)
Regeneration:	Nil
Understorey:	Serrated Tussock, with heavily grazed Wallaby and occasional Kangaroo Grass, lots of scotch thistle
Water sources:	Dry creek 250m south west
Habitat features:	Limited, one small rock outcrop sedimentary– no loose surface rocks. Serrated tussock provides the only shelter/structure.
Comments:	Low habitat values



Habitat Assessment 8

Habitat Type:	Dry Creek
Area:	Runs through the subject site from east to west.
Landscape position:	Drainage line
Connectivity:	Creek largely cleared along it's length in the vicinity of the site
Land use/disturbance:	Grazed, stock trampling in riparian zone
Dominant Overstorey:	Very widely spaced regrowth snow gums (<1 per 500m of creek)
Regeneration:	See dominant over storey above
Understorey:	Grassy vegetation only – no shrubs or trees.
Habitat features:	Some sedimentary rock shelter sites for reptiles and frogs but little cover (heavily grazed/trampled by stock). Some small pool and run sections – generally shallow
Comments:	Water discoloured due to recent rains. Low habitat value du to stock impacts and clearing



Habitat Assessment 9

Habitat Type:	Dry Forest (north of transmission corridor)
Area:	Part of larger modified stand (800ha)
Landscape position:	Mid slope/ low ridge south aspect
Connectivity:	Southern extent of larger modified patch of 800 ha approx extending to the north.
Land use/disturbance:	Grazed, sand quarry is located within the patch, also areas of forestry (harvested pine plantations exist within the patch.
Dominant Overstorey:	Brittle Gum, Broad-leaved Peppermint, Some Banksia, Acacia (Blackwood) and Allocasuarina trees present, also Ribbon Gum and small stand of 9 Snow Gums
Regeneration:	Little regeneration present, presumably due to grazing
Understorey:	Bracken and native grass in grazed areas, more diverse shrubby understorey around the quarry.
Water sources:	Small dam in the sand quarry
Habitat features:	Lots of mistletoe, Banksias provide nectar foraging resource, some fallen timber, structural diversity including a midstorey layer provides cover for smaller species.
Comments:	Many of the larger eucalypts (Broad-leaved Peppermints) were dead. Mistletoe present in the acacia as well as the eucalypts.



Habitat Assessment 10

Habitat Type:	Dry Forest (Brittle Gum patch)
Area:	10 ha approx, 0.3ha in transmission corridor (see habitat assessment 6), 8 ha within the development envelope
Landscape position:	Rocky ridge running down to Dry Creek, south-west aspect
Connectivity:	Isolated, closest treed area is to the north.
Land use/disturbance:	Grazed – heavy,
Dominant Overstorey:	Brittle Gum dominates, relatively uniform stand (average DBH >50cm)
Regeneration:	Nil
Understorey:	Exotics, scotch thistle, serrated tussock, some native grasses (stipa) bare ground especially towards top of ridge where rocky, lone boxthorn. Native grasses dominate lower slope towards creek.
Water sources:	Dry Creek adjacent to east and south
Habitat features:	Numerous hollows (50x50m tree survey: 15 trees, 14 with hollows 20 Small hollows, 31 medium hollows, 16 large hollows). Hollows likely to be used by birds only due to lack of connectivity and small patch size. Moderate fallen timber .Little understory diversity (or cover towards ridge top). Sedimentary rock outcrop on ridge top – very few habitat rocks (rock is massive and embedded). Some mistletoe present on edge of stand.
Comments:	Lots of hollows, grazing and isolation have reduced the habitat value of this patch.



Habitat Assessment 11

Habitat Type:	Small rocky outcrop
Area:	<0.5 ha
Landscape position:	Flats near creek, quarry access road cuts the outcrop.
Connectivity:	matrix
Land use/disturbance:	Grazed paddock
Dominant Overstorey:	Nil
Regeneration:	Nil
Understorey:	Native pasture including Stipa species, scotch thistle, serrated tussock (sprayed)
Water sources:	Bridge Creek 100m north
Habitat features:	Embedded outcrop, few surface rocks, cattle disturbance of surface rocks.
Comments:	Little habitat value



Habitat Assessment 12

Habitat Type:	Native pasture (Curly Sedge dominated)
Area:	10 ha (within a
Landscape position:	Flats near Bridge creek, western paddock of the subject site
Connectivity:	matrix
Land use/disturbance:	Grazing land
Dominant Overstorey:	Nil
Regeneration:	Nil
Understorey:	Corkscrew Grass and Curly Sedge
Water sources:	Bridge Creek 150m north
Habitat features:	Little cover (no rocks, logs, tussocks etc) or foraging values
Comments:	Sandy substrate, few fauna species likely to occur at this site



Habitat Assessment 13

Habitat Type:	Native pasture (Stipa and thistle dominated)
Area:	matrix
Landscape position:	Flats near Bridge creek, western paddock of the subject site
Connectivity:	matrix
Land use/disturbance:	Grazing land
Dominant Overstorey:	Nil
Regeneration:	Nil
Understorey:	Speargrass and thistle dominated
Water sources:	Bridge Creek 150m north
Habitat features:	Little cover (no rocks, logs, tussocks etc) or foraging values
Comments:	Low habitat values



Habitat Assessment 14

Habitat Type:	Native pasture with Tea tree stands
Area:	<1 ha Tea Tree
Landscape position:	Flat
Connectivity:	matrix
Land use/disturbance:	Grazing land
Dominant Overstorey:	Swamp Tea-tree
Regeneration:	Some Tea tree (no tree species)
Understorey:	Speargrass and thistle dominated
Water sources:	Bridge creek 300m north west
Habitat features:	Some cover, foraging are and potential nesting sites for White-fronted Chats
Comments:	Structure provided by the Tea Tree and fence gives perching habitat for robins and other small passerines.



Habitat Assessment 15

Habitat Type:	Native pasture with embedded rock outcrops
Area:	10ha approx
Landscape position:	Low
Connectivity:	matrix
Land use/disturbance:	Grazed and cleared, weed invasion by some exotic forbs, serrated tussock and sweet briar
Dominant Overstorey:	Sweet briar (no trees in the area)
Regeneration:	No tree species regeneration
Understorey:	Native grass odminated
Water sources:	Dry creek 600m to the north
Habitat features:	Ephemeral pools (the quartzite base rock has retained the water from recent rain creating perched pools on the ridge top), little rock habitat inspite of the rock outcrops as there is little loose rock, grassland (light to moderate grazing)
Comments:	Common Froglet (<i>Crinea signifera</i>) breeding in small ephemeral pools.



Habitat Assessment 16

Habitat Type:	Woodland (small isolated frost hollow woodland stand - 4 trees)
Area:	<0.5ha
Landscape position:	Flats
Connectivity:	Isolated paddock trees but close to loose roadside corridor running to the east.
Land use/disturbance:	Grazed and cleared, weed invasion by some exotic forbs, Sweet Briar and African Boxthorn
Dominant Overstorey:	Ribbon Gums, a Snow Gum and a stag
Regeneration:	No tree regeneration
Understorey:	Native grass, serrated tussock, bracken
Water sources:	Dry Creek adjacent <100m the north
Habitat features:	Large remnant trees w hollows Some fallen timber.
Comments:	Only moderate grazing pressure. One large ribbon gum splitting and will fall soon, no regeneration – patch is isolated



Habitat Assessment 17

Habitat Type:	Native Pasture
Area:	Matrix
Landscape position:	Flats
Connectivity:	Matrix, high quality grassland habitat across the road to the south east
Land use/disturbance:	Grazed and cleared, weed invasion by some exotic forbs and sweet briar
Dominant Overstorey:	Sweet Briar and small localised patches of Swamp Tea Tree, frost hollow woodland species in the area – Snow Gum and Ribbon Gum
Regeneration:	No tree regeneration
Understorey:	Native grass, some Themeda patches
Water sources:	Dry Creek adjacent to the north
Habitat features:	Native grassland moderately grazed. Some areas of surface rock (no significant outcrops), sparse Swamp Tea Tree patches becoming thicker along the creek.
Comments:	Only moderate grazing pressure and little serrated tussock. Surface rock generally disturbed by cattle trampling. High quality native grassy woodland to the south across the road.



Habitat Assessment 18

Habitat Type:	Woodland/native grassland
Area:	Sweeneys Traveling Stock Reserve, directly linked to >1000ha of woodland and dry forest
Landscape position:	Lower slopes
Connectivity:	Forms part of a large woodland/forest stand of >1000ha
Land use/disturbance:	Past grazing and clearing. Hunting, camping and burnouts (gate broken down allowing illegal access for these activities. Few weeds – some briar around the dam.
Dominant Overstorey:	Snow Gum, Yellow Box, Ribbon Gum, and Brittle Gum dominated areas
Regeneration:	Regeneration present
Understorey:	Native grass, Themeda dominated. Patches of Tea-tree in some of the grassed areas. Some Acacia midstorey in wooded areas.
Water sources:	Small ephemeral creek (flowing during survey following good rains). Dam plus small deep rocky pools all full following rains.
Habitat features:	Native grassland lightly grazed. Some areas of surface rock to the south – very few loose surface rocks, some mistletoe (1-2 per ha) and limited fallen timber. The entire wooded area is able to support viable populations of species reliant on large remnants (eg speckled Warbler, Quolls etc)
Comments:	The habitat assessment is part of Sweeny's Reserve, recognised as an area of significant conservation value and high biodiversity (P&A Walsh ,2008). Illegal access – evidence of hunting camping burn outs. Little deer sign compared with areas on the site.



Habitat Assessment 19

Habitat Type:	Granitic outcrop in native pasture
Area:	Scattered outcrops occur over 0.5ha
Landscape position:	Low knoll beside creek flats
Connectivity:	Outcrop is isolated, nearest outcrops are 400m to the east (Habitat 22) and 800m to the south (Habitat 11)
Land use/disturbance:	Grazed and cleared, weed invasion by some exotic forbs
Dominant Overstorey:	No trees remain following clearing for grazing (nearest trees are exotic pine shelter belts 300m south west and 700m east)
Regeneration:	No tree regeneration
Understorey:	Native grass and exotic forbs (see Table 4-1 random meander 2)
Water sources:	Bridge Creek 600m to the south, small ephemeral wetland (Habitat 23) 550m to the north east.
Habitat features:	Native grassland moderately to high grazing pressure. Granite slabs (A3 size) and embedded outcrops.
Comments:	History of grazing pressure and isolation are factors that make threatened species presence highly unlikely at this site.



Habitat Assessment 20

Habitat Type:	Native pasture with Tea tree stand
Area:	Tea tree stand <0.1ha, native pasture forms the landscape matrix
Landscape position:	Creek flats
Connectivity:	Matrix, nearest shrub or tree cover are pine shelter belts 500m east and west
Land use/disturbance:	Grazed and cleared, weed invasion exotic forbs and sweet briar
Dominant Overstorey:	Swamp Tea Tree
Regeneration:	No tree regeneration
Understorey:	Native grass, (see Table 4-1 random meander 3)
Water sources:	Dry Creek adjacent to the north
Habitat features:	Low shrubby cover and nectar foraging opportunity when in flower (for insects).
Comments:	Tea tree looks unhealthy, no sign of WF Chats. Isolation means the cover provided is unlikely to be used by species reliant on shrubby veg layers.



Habitat Assessment 21	
Habitat Type:	Pine shelter belt
Area:	0.5ha, <50 trees
Landscape position:	Creek flats
Connectivity:	Isolated stand 70m south of a thin pine buffer strip lining the sand quarry access road (left following the harvest of the Pines to the north)
Land use/disturbance:	Planted exotic shelter belt in grazed paddock
Dominant Overstorey:	Radiata pine
Regeneration:	No tree regeneration
Understorey:	Native grass with exotic forbs (little vegetation under the pines)
Water sources:	Bridge Creek 50m south east
Habitat features:	Some shelter value for roosting birds.
Comments:	Little habitat value.

Habitat Assessment 22

Habitat Type:	Granitic outcrop in native pasture
Area:	Scattered outcrops occur over 4ha
Landscape position:	Low knoll beside creek flats
Connectivity:	Outcrop is isolated, nearest outcrops are 400m to the west (Habitat 19) and 800m to the south west (Habitat 11)
Land use/disturbance:	Grazed and cleared, weed invasion
Dominant Overstorey:	nil
Regeneration:	No tree regeneration
Understorey:	Native grass with exotic forbs ((see Table 4-1 random meander 6)
Water sources:	Bridge Creek 300m to the south east
Habitat features:	Scattered medium rocky outcrops largely embedded. Some loose surface rocks. Native grassland moderate grazing pressure matrix.
Comments:	Moderate grazing pressure, area likely to be degraded in times of drought. Little recolonisation potential considering the isolation and degraded matrix.



Habitat Assessment 23

Habitat Type:	Ephemeral wetland in native Pasture
Area:	0.5ha approx (boggy area)
Landscape position:	Flats, slightly elevated from creek
Connectivity:	Cleared matrix Matrix
Land use/disturbance:	Grazed and cleared, weed invasion by some exotic forbs and some Serrated Tussock
Dominant Overstorey:	Pine shelter belt 200m to south east
Regeneration:	No tree regeneration
Understorey:	Native grass, and exotic forbs
Water sources:	Natural shallow drainage line
Habitat features:	Shallow standing water, low tussocks emerging – foraging for generalist and mobile wetland species.
Comments:	Wood Duck, White-faced Heron and Australian Shelduck recorded. This area is likely to provide wetland habitat only after heavy rains as no aquatic vegetation was noted.



Appendix C Habitat features data

Datum used GDA94, Error on the coordinates is approximately 5m.

TREES RECORDED WITHIN THE DEVELOPMENT ENVELOPE

The table below contains the raw data collected for trees within the Development envelope. Smaller trees within the transmission easement (DBH <15cm) have not all been recorded.

Hollow sizes correspond to the following measurements Small hollows (S) = <5cm, Medium Hollows (M)= 5-10cm, Large hollows (L)=>10cm

HA	Tree	Lat	Long	Location	tree species	Hollows			No. of mistletoe	DBH (cm)	comments
						S	M	L			
H1	1	-35.188697	149.522717	Easement Nth	<i>E. melliodora</i>	0	0	0	0	60	
H1	2	-35.188285	149.522300	Easement Nth	<i>E. melliodora</i>	0	0	0	0	120	plus regrowth
H3	1	-35.195090	149.522267	Easement Nth	<i>E. dives</i>	0	0	0	5	120	multi stemmed, w lg regen and blackwood
H3	2	-35.194034	149.523168	Easement Nth	<i>E. viminalis</i>	2	1	1	0	160	signs of dieback, w/ regrowth and E. dives regrowth w/ mature E. viminalis E. dives regrowth DBH 10cm-20cm.
H3	3	-35.194547	149.523324	Easement Nth	<i>E. viminalis</i>	1	0	0	0	120	
H3	4	-35.195423	149.522183	Easement Nth	<i>E. mannifera</i>	0	0	0	3	80+40	
H3	5	-35.195492	149.522230	Easement Nth	<i>E. dives</i>	0	0	0	4	N/A	short growth form, multi stemmed
H3	6	-35.195642	149.522488	Easement Nth	<i>E. mannifera</i>	0	0	0	5	90, 40	2 lg trees w/ 16 mature E. mannifera regrowth DBH<30cm
H3	7	-35.196278	149.522061	Easement Nth	<i>A. melanoxylon</i>	0	0	0	0	40	lg wattle on fence line
H6	1	-35.198127	149.519159	Easement Sth	<i>E. mannifera</i>	0	0	0	7	80	
H6	2	-35.198295	149.519167	Easement Sth	<i>E. mannifera</i>	0	1	0	1	100	
H6	3	-35.198342	149.519175	Easement Sth	<i>E. mannifera</i>	0	1	0	5	90	
H6	4	-35.198315	149.519107	Easement Sth	<i>E. mannifera</i>	1	0	0	0	30	

HA	Tree	Lat	Long	Location	tree species	Hollows			No. of mistletoe	DBH (cm)	comments
						S	M	L			
H6	5	-35.198280	149.519077	Easement Sth	<i>E. mannifera</i>	2	0	0	0	80+20	
H6	6	-35.198325	149.519005	Easement Sth	<i>E. mannifera</i>	1	0	0	7	120	
H6	7	-35.198410	149.518355	Easement Sth	<i>E. mannifera</i>	3	2	0	0	90	
H6	8	-35.198228	149.518248	Easement Sth	<i>E. mannifera</i>	1	2	0	1	80	
H6	9	-35.198197	149.518255	Easement Sth	<i>E. mannifera</i>	0	1	0	0	60	broken top
H6	10	-35.198302	149.518417	Easement Sth	<i>E. mannifera</i>	0	0	0	0	70	die back
H6	11	-35.198265	149.518623	Easement Sth	<i>E. mannifera</i>	0	2	0	1	90	
H6	12	-35.198110	149.518488	Easement Sth	<i>E. mannifera</i>	3	3	0	1	50+60	
H6	13	-35.198043	149.518507	Easement Sth	<i>E. mannifera</i>	0	2	0	0	50	die back
H6	14	-35.198025	149.518569	Easement Sth	<i>E. mannifera</i>	3	3	0	0	60+30	
H6	15	-35.197993	149.518650	Easement Sth	<i>E. mannifera</i>	0	1	1	0	110	die back
H6	16	-35.197534	149.519012	Easement Sth	<i>E. dives</i>	0	0	0	3	30	
H6	17	-35.197497	149.518425	Easement Sth	<i>E. dives</i>	0	0	0	1	40+40	
H6	18	-35.197460	149.518240	Easement Sth	<i>E. dives</i>	0	0	0	1	70	
H6	19	-35.198372	149.516987	Easement Sth	<i>E. melliodora</i>	0	0	0	0	20	die back
H6	20	-35.198382	149.516965	Easement Sth	<i>E. melliodora</i>	0	0	0	1	50	
H7	1	-35.200761	149.514845	Subject site north	<i>E. pauciflora</i>	0	0	0	0	100	old broken snow gum, 2m tall
H7	2	-35.201343	149.514432	creek	<i>E. pauciflora</i>	0	0	0	0	<30	3 sapling snow gums
H15	1	-35.200194	149.511789	creek	<i>E. pauciflora</i>	0	0	0	0	15	snow gum sapling
H16	1	-35.203524	149.518953	Subject site west	<i>E. viminalis</i>	0	1	1	0	180	lg tree
H16	2	-35.203793	149.518855	Subject site west	stag	2	2	1	0		
H16	3	-35.203733	149.519285	Subject site west	<i>E. viminalis</i>	1	0	0	0	200	lg tree splitting in two.
H16	4	-35.204120	149.519811	Subject site west	<i>E. pauciflora</i>	0	1	1	0	140	old broken tree

ROCK OUTCROPS

The table below contains location data for rock outcrops detected across the development envelope. Each point is taken from roughly the centre of the outcrop.

HA	Lat	Long	Location
H11	-35.206677	149.496832	Subject site west
H13	-35.204062	149.502895	Subject site central west
H15	-35.200531	149.511799	Central subject site
H15	-35.201695	149.512218	Central subject site
H15	-35.199232	149.507768	Central subject site
H15	-35.202227	149.513378	Central subject site
H17	-35.200929	149.520856	Subject site east
H7	-35.198752	149.516522	Easement Sth
H19	-35.199340	149.493810	Subject site north west
H22	-35.199468	149.499141	Subject site north west

OTHER HABITAT FEATURES

HA	Feature	Lat	Long	Location
H15	Ephemeral pool	-35.202098	149.508749	Central subject site
H21	Pine shelter belt	-35.198770	149.501970	Subject site north west
H23	small ephemeral wetland	-35.197991	149.499286	Subject site north west
H20	Tea tree stand	-35.200970	149.497040	Subject site west
H14	Tea tree stand	-35.202724	149.505541	Central subject site
H16	Themeda patch	-35.204138	149.516284	Subject site south east
H17	Themeda patch	-35.201989	149.525376	Subject site east
H3	Wombat Burrow	-35.196210	149.521650	Easement (central)
H13	Wombat Burrow	-35.202573	149.503507	Central subject site
H14	Wombat Burrow	-35.201780	149.504626	Central subject site

Appendix D THREATENED SPECIES EVALUATION

- Murrumbidgee CMA Region – Monaro sub-region (DECCW threatened species tool)
- EPBC Act Matters of National Significance search tool - 10 kilometre radius
- Additional species based on local records from the DECCW Wildlife Atlas database

Species identified as having a moderate or higher potential to be impacted by the Proposal and have undergone a subsequent Assessment of Significance are highlighted (grey).

FLORA AND ECOLOGICAL COMMUNITIES

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Trees and shrubs						
<i>Eucalyptus aggregata</i> Black Gum Myrtaceae TSC –V	A medium tree to 18 metres with persistent fibrous-flaky grey-black bark inhabiting grassy woodland on alluvium on broad cold flats. Recorded near Bungendore.	• Montane Bogs and Fens • Eastern Riverine Forests • Southern Montane Heaths • Subalpine Woodlands • Tableland Clay Grassy Woodlands • Temperate Montane Grasslands	Yes	Moderate	No	Nil
<i>Eucalyptus parvula</i> Small-leaved Gum	A distinctive small tree with small, dark leaves and smooth bark. Has a very limited distribution in a	• Montane Bogs and Fens • Subalpine Woodlands	No	Nil	No	Nil

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Myrtaceae TSC - V EPBC - V	narrow 100km strip from Big Badja Mountain to Nunnock Swamp. Grows at and above an elevation of 1100 m in acidic soil on cold wet grassy flats.					
<i>Eucalyptus pulverulenta</i> Silver-leafed Gum Myrtaceae TSC - V EPBC - V	A mallee or small tree with smooth grey or bronze bark, shedding in long strips, and round, sessile, glaucous juvenile leaves retained on mature plants. Found in the Lithgow to Bathurst area and the Bredbo-Bombala areas. Grows in shallow soils, typically with <i>E. mannifera</i> , <i>E. macrorhyncha</i> , <i>E. dives</i> , <i>E. sieberi</i> and <i>E. bridgesiana</i> .	Southern Tableland Dry Sclerophyll Forests	Yes	Low-moderate	No	Nil
<i>Bossiaea oligosperma</i> Few-seeded Bossiaea Fabaceae TSC - V EPBC - V	An erect shrub to 2 metres high with small, circular, bright-green leaves. Bright yellow flowers appear in late spring. Known from two disjunct areas - the lower Blue Mountains and the Windellama area. Occurs in open <i>E. mannifera</i> forest on loamy soil at Windellama.	Not indicated in DECCW Monaro sub-region search	Yes	Low	No	Nil
<i>Dillwynia glauca</i> Michelago Parrot-pea Fabaceae TSC -E	An erect shrub to 2.5m recorded from three areas; near Windellama, at Michelago and at Numeralla. Occurs on exposed clay or rocky outcrops in woodland often dominated by <i>E. rossii</i> , <i>E. pauciflora</i> , <i>E. dives</i> and <i>E. macrorhyncha</i> . Grows adjacent to Natural Temperate Grassland at Michelago.	- Southern Tableland Dry Sclerophyll Forests - Temperate Montane Grasslands - Southern Montane Heaths	Yes	Low-moderate	No	Nil
<i>Dodonia procumbens</i> Creeping Hop-bush Sapindaceae TSC - V EPBC - V	A prostrate shrub recorded on shallow sedimentary soil in <i>Eucalyptus pauciflora</i> , <i>E. dives</i> or <i>E. rubida</i> woodland between Michelago and Dalgety, and in Corkscrew Grass-Curly Sedge grassland at Lake Bathurst. Tolerates some degree of disturbance and sometimes occurs on roadside cuttings but is seldom	- Southern Tableland Dry Sclerophyll Forests - Southern Tableland Grassy Woodlands - Tableland Clay Grassy Woodlands	Yes	Moderate	No	Moderate

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
	seen in grazed sites.	Temperate Montane Grasslands				
<i>Grevillea renwickiana</i> Nerriga Grevillea TSC - E	Nerriga Grevillea is a prostrate shrub restricted to a small area between Mongarlowe and Nerriga. Grows in a range of plant communities.	Not indicated in DECCW Monaro sub-region search.	Yes (marginal)	Low	No	Low
<i>Monotoca rotundifolia</i> Trailing Monotoca Ericaceae TSC - E	A low shrub, less than 30 cm tall with round leaves bluish with three obvious ridges below, and red stems. Known only from Big Badja Hill and Wadbilliga Trig and an unconfirmed record from west of Kybean SCA. In NSW, occurs in shrubland or Snow Gum woodland from 1250 to 1360m ASL.	- Subalpine Woodlands - Tableland Clay Grassy Woodlands	No	Nil	No	Nil
<i>Pomaderris delicata</i> Delicate Pomaderris Rhamnaceae TSC - CE	A 1-2 m shrub with yellow, petalled flowers growing in dry open <i>E. sieberi</i> forest dominated by with a dense she-oak understorey, on shallow sedimentary soils. Recorded from between Goulburn and Bungonia and south of Windellama.	Not indicated in DECCW Monaro sub-region search	No	Nil	No	Nil
<i>Pomaderris pallida</i> Pale Pomaderris Rhamnaceae TSC - V EPBC - V	This shrub grows in rocky sites in open forest or shrubland near rivers. Recorded from north-west of Nimmitabel, Tinderry Nature Reserve, and the Queanbeyan River. Flowers mid Sept - Dec.	- Southern Tableland Dry Sclerophyll Forests - Eastern Riverine Forests	Yes	Low	No	Nil
<i>Pultenaea pedunculata</i> Matted Bush-pea Fabaceae TSC - E	The mat-forming shrub with small leaves growing generally in woodland vegetation but also on road batters and coastal cliffs. Grows in loamy soils in dry gullies at Windellama. Flowers Aug-Dec.	Not indicated in DECCW Monaro sub-region search	Yes	Low	No	Low
<i>Rulingia prostrata</i>	A mat-forming shrub with white to pink flowers	Montane Lakes	Yes	Low	No	Low

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Dwarf Kerrawang Sterculiaceae TSC - E	produced mainly Oct-Nov. At Penrose State Forest occurs in <i>E. mannifera</i> woodland, and in <i>E. pauciflora</i> woodland at Rose Lagoon. Grows in sandy, sometimes peaty soils, with <i>Imperata cylindrica</i> , <i>Empodisma minus</i> and <i>Leptospermum continentale</i> .	- Subalpine Woodlands - Temperate Montane Grasslands	(marginal)			
<i>Westringia kydrensis</i> Kydra Westringia Lamiaceae TSC - E	An erect shrub to 40 cm with leaves in whorls of three and white flowers Occurs on shallow rocky granite or quartzite soils in <i>Allocasuarina nana</i> and <i>Banksia canei</i> heath on rocky areas at Kydra Reefs, south-east of Cooma.	Southern Montane Heaths	No	Nil	No	Nil
<i>Wilsonia rotundifolia</i> Round-leafed Wilsonia Convolvulaceae TSC - E	A hairy, prostrate, perennial subshrub with broad succulent sessile leaves. Grows in coastal salt marsh and inland saline lakes. Known from coast NSW, Deniliquin and in Lake George (locally extensive) and Lake Bathurst. Flowers in spring and summer.	Montane Lakes	Yes (marginal)	Low	No	Low
<i>Zieria citriodora</i> Lemon Zieria Rutaceae TSC - E	A low lemon-scented shrub to 15 cm tall with small hairy leaflets and one to three, pink or white flowers. Flowers late winter to summer. Known from two sites in NSW - Numeralla and Kybean Trig - east of Cooma. Grows in low shrubby <i>E. mannifera</i> - <i>E. macrorhyncha</i> - <i>E. dives</i> woodland.	Southern Tableland Dry Sclerophyll Forests	Yes (marginal)	Low	No	Nil
Herbs						
<i>Ammobium craspedioides</i> Yass Daisy Asteraceae TSC - V	Perennial daisy growing in sclerophyll woodland, forest and roadsides, in Yass district and near Wagga Wagga. Flowers spring-early summer. No close records.	Not indicated in DECCW Monaro sub-region search.	Yes	Low-moderate	No	Low

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
EPBC - V						
<i>Caladenia concolor</i> Crimson Spider Orchid Orchidaceae TSC - E EPBC - E	Terrestrial orchid known in NSW from near Cootamundra, Lake Burrinjuck and Albury and Wagga Wagga. Comprises more than one species. The Burrinjuck population grows in dry open forest (<i>E. goniocalyx</i> , <i>E. dives</i> , <i>E. macrorhyncha</i> , <i>E. mannifera</i> , <i>E. rossii</i>) with a shrubby understorey. Flowers late August-October.	Not indicated in DECCW Monaro sub-region search.	Yes (marginal)	Low	Not recordable during survey	Low
<i>Caladenia tessellata</i> Tessellated Spider Orchid Orchidaceae TSC - E EPBC - V	A terrestrial orchid with cream petals with reddish stripes recorded from coastal NSW and Braidwood. A population in Queanbeyan is presumed extinct. The Braidwood population is on stony soil, in woodland with little understorey, dominated by <i>E. dives</i> and <i>E. macrorhyncha</i> (K. McDougall, pers. comm.). Flowers Sept-Nov (late Sept or early Oct in southern populations).	Not indicated in DECCW Monaro sub-region search	Yes (marginal)	Low	Not recordable during winter survey	Low
<i>Calotis glandulosa</i> Mauve Burr-daisy Asteraceae TSC - V EPBC - V	A sprawling perennial daisy to 20 cm tall with soft bright green, hairy, toothed leaves and 2 cm wide solitary flowers, mauve with yellow centres. Flowers in spring and summer. Recorded mainly from the Monaro and Kosciuszko, in montane grasslands, subalpine grassland (dominated by <i>Poa</i> spp.), Natural Temperate Grassland (<i>Themeda australis</i>) and Snow Gum Woodlands on the Monaro. Colonises roadsides, but does not persist in heavily-grazed pastures.	• Temperate Montane Grasslands • Subalpine Woodlands • Tableland Clay Grassy Woodlands • Southern Tableland Wet Sclerophyll Forests	Yes	Low-moderate	No	Low-moderate
<i>Diuris aequalis</i> Buttercup Double-tails	At Braidwood, found in dry woodland dominated by <i>Eucalyptus dives</i> and <i>E. mannifera</i> , although further	• South East Dry Sclerophyll Forests	Yes	Moderate	Not recordable	Moderate

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Orchidaceae TSC - E EPBC - V	north it may occur in association with <i>E. pauciflora</i> (R Rehwinkel, pers. comm.). North of Goulburn (Mt Rae area) it occurs in moist forest dominated by <i>E. radiata</i> or <i>E. fastigata</i> (J. Miles, pers. obs.). Mimics and always grows with <i>Gompholobium</i> sp. Flowers mid-October and mid-November in the southern part of its range.	- Southern Escarpment Wet Sclerophyll Forests - Temperate Montane Grasslands - Southern Tableland Grassy Woodlands - Tableland Clay Grassy Woodlands - Southern Tableland Wet Sclerophyll Forests			during winter survey. <i>Gompholobium</i> absent.	
<i>Diuris ochroma</i> Pale Golden Moths Orchidaceae TSC - E EPBC - V	Terrestrial orchid pale yellow flowers with reddish-purple striations inhabiting frost hollow woodland. In NSW, restricted to a single 6 ha population in the Kybeyan area at 975-1000 metres ASL. Flowers December.	Not indicated in DECCW Monaro sub-region search.	Unlikely	Low	Not recordable during winter survey	Low
<i>Lepidium ginninderrense</i> Ginninderra Peppercress Brassicaceae EPBC - V	A perennial herb to about 20cm, flowering in late spring. Occurs on a single site on Belconnen Naval Transmission Station, in natural grassland dominated by <i>Austrodanthonia</i> spp and <i>Bothriochloa macra</i> .	Not indicated in DECCW Monaro sub-region search	Yes	Low	No	Low
<i>Lepidium hyssopifolium</i> Aromatic Peppercress Brassicaceae TSC - E EPBC - E	An erect perennial herb to 50 cm tall with variable leaves and small flowers. Recorded in grassy woodland and grassland near Bathurst, and near Bungendore and Crookwell. (A specimen collected in the Cooma area about 100 years ago may also be this species.)	- Temperate Montane Grasslands - Southern Tableland Grassy Woodlands	Yes	Low	No	Low
<i>Leucochrysum albicans</i> ssp <i>albicans</i> var <i>tricolor</i> Hoary Sunray	Perennial daisy growing in grasslands and grassy woodlands, often colonising disturbed sites such as road verges, but does not persist well in grazed	- Temperate Montane Grasslands - Southern Tableland	Yes	Moderate	Yes (variety requires	Moderate

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Asteraceae EPBC - E	situations. Flowers spring-summer. May be locally common, and is not listed as threatened in NSW. Var. <i>tricolor</i> recorded in Act, Queanbeyan and Goulburn. Var. <i>albicans</i> recorded at Lake Bathurst.	Subalpine Woodlands Southern Tableland Grassy Woodlands			confirmation with flowering specimen)	
<i>Pelargonium</i> sp. (G. W. Carr 10345) Geraniaceae TSC – E (Prelim. Determination)	A tufted perennial herb with a basal rosette, sub-velvety stems and 8-11 mm pale pink petals with darker crimson or purple striations. Flowers Oct-Mar, peaking Nov-Dec. In NSW, has a narrow habitat just above the high-water level of irregularly inundated or ephemeral lakes, between grass-dominated communities and sedge-dominated aquatic vegetation. 4 NSW populations known at 680-1030 m ASL; Lake Bathurst, two grazing properties (one probably extinct) south-west of Cooma, and Maffra Lake near Dalgety (TSR). At Lake Bathurst occurs with <i>Dodonaea procumbens</i> , <i>Schoenus nitens</i> and <i>Carex bichenoviana</i> , in sandy soils. At Maffra Lake, on basalt with <i>Carex bichenoviana</i> , <i>Austrostipa bigeniculata</i> , <i>A. scabra</i> subsp. <i>falcata</i> , <i>Chloris truncata</i> .	Not indicated in DECCW Monaro sub-region search	Yes (marginal)	Low-moderate	No	Low-moderate
<i>Prasophyllum petilum</i> Tarengo Leek Orchid Orchidaceae TSC - E EPBC - E	Small leek orchid with white-green flower spike to 12cm tall. Recorded from Box-Gum Woodland in Hall cemetery, and in Natural Temperate Grassland at Captains Flat and Boorowa. Appears highly sensitive to grazing. Higher densities at Boorowa in Wallaby Grass. Flowers Oct at Boorowa and Dec at Captains Flat. The Hall and Captains Flat populations occur in areas with high watertables. Flowers Oct-Nov.	- Temperate Montane Grasslands - Southern Tableland Subalpine Woodlands - Tableland Clay Grassy Woodlands	Yes	Low	Not recordable during winter survey.	Low

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
<i>Rutidosia leirolepis</i> Monaro Golden Daisy Asteraceae TSC - V EPBC - V	A low, tufted perennial with a woody root-stock, and narrow dark green leaves woolly underneath. Has solitary, slightly domed bright yellow flower-heads surrounded by pale brown papery bracts on numerous 25 cm tall woolly stems. Occurs in sub-alpine grasslands at Kosciuszko and Natural Temperate Grassland on the Monaro, on basalt, granite and sedimentary substrates. Apparently highly sensitive to grazing. Recorded near Braidwood and Cooma.	Temperate Montane Grasslands	Unlikely	Low	No	Low
<i>Rutidosia leptorhynchoidea</i> Button Wrinklewort Asteraceae TSC - E EPBC - E	A perennial, multi-stemmed daisy sometimes with narrow basal leaves and with leafy flower stems to 35 cm tall. Flower-heads are bright yellow, slightly domed and button-like, to 2 cm wide. Recorded at Goulburn, Canberra-Queanbeyan area and Michelago, in Box-Gum Woodland and natural grassland on shallow, stony clay loams, including disturbed areas. Flowers Dec-Mar. Does not resprout from underground structures. The stems usually die back in late summer or autumn and new basal leaves are evident by early winter. Sensitive to grazing.	- Temperate Montane Grasslands - Southern Tableland Grassy Woodlands	Yes	Moderate	No	Moderate
<i>Swainsona recta</i> Mountain Swainson-pea Fabaceae TSC - E EPBC - E	A slender, erect pinnate perennial pea growing to 30 cm tall. Recorded near Queanbeyan and Wellington-Mudgee area on undulating terrain, often stony hillsides. Natural habitat is Box-Gum Woodland. Plants die back in summer, surviving as rootstock until they shoot again in autumn. Flowers late Sept-early Nov, peaking Oct. Recorded in ACT –Queanbeyan area (Atlas). Fallding (2002) has a record near Bungendore.	- Temperate Montane Grasslands - Southern Tableland Grassy Woodlands	Yes	Moderate	No	Moderate

Species and status	Ecology and distribution	Vegetation community	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
<i>Swainsona sericea</i> Silky Swainson-pea Fabaceae TSC - V	A pinnate leaved perennial pea growing to 10 cm tall. Recorded in Natural Temperate Grassland, Snow Gum Woodland and Box-Gum Woodland. Recorded near Queanbeyan.	- Southern Tableland Grassy Woodlands - Southern Tableland Wet Sclerophyll Forests - Subalpine Woodlands - Tableland Clay Grassy Woodlands - Temperate Montane Grasslands	Yes	Moderate	No	Moderate
<i>Thesium australe</i> Austral Toadflax Santalaceae TSC - V EPBC - V	A small, straggling herb to 40 cm tall with narrow pale green to yellow-green, somewhat succulent leaves, minute white flowers appearing in spring. Grows in grassland and woodland, semi-parasitic on grasses, particularly kangaroo grass. Recorded SW of Canberra and at Bundanoon to the east. Shows a preference for moist areas.	- Southern Tableland Grassy Woodlands - Temperate Montane Grasslands - Subalpine Woodlands - Tableland Clay Grassy Woodlands	Yes	Moderate	No	Moderate

Ecological communities	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Montane Peatlands and Swamps (EPBC and TSC)	Marginal	Low	Unlikely	Low
Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT (EPBC)	Yes	Moderate	Possible	Moderate
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC and TSC)	Yes	High	Yes (derived pasture)	Moderate

Frost Hollow Grassy Woodlands (TSC)	Yes	High	Yes	High
Upland Wetlands (EPBC)	No	Nil	No	Nil
Tablelands Basalt Forest (TSC)	No	Nil	No	Nil

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Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Amphibians					
Alpine Tree Frog <i>Litoria verreauxii alpina</i> TSC - E	The Alpine Tree Frog occurs in the south-eastern NSW and Victorian high country (alpine and sub-alpine zones) generally above 1100 m asl. Most locations are within National Park and some are close to alpine resorts. Found in a wide variety of habitats including woodland, heath, grassland and herb fields where it breeds in natural and artificial wetlands including ponds, bogs, fens, streamside pools, stock dams and drainage channels that are still or slow flowing (DECCW 2010).	No	Nil	No	Nil
Yellow-spotted Bell Frog <i>Litoria castanea</i> TSC –CE EPBC - E	The Yellow-spotted Bell Frog had not been recorded in the wild since the 1970s. It has two separate highland ranges, on the New England Tableland and on the southern highlands from Lake George to Bombala. This species require large permanent ponds or slow flowing streams with plenty of emergent vegetation such as bullrushes. Shelter during autumn and winter under fallen timber, rocks, other debris or thick vegetation (DECCW 2010)	No	Nil	No	Nil
Booroolong Frog <i>Litoria booroolongensis</i> E TSC E EPBC	Lives along permanent streams with some fringing vegetation cover such as ferns, sedges or grasses. It typically inhabits rocky western-flowing creeks and their headwaters, although a small number of animals have also been recorded in eastern-flowing streams (DECCW 2010). Adults occur on or near cobble banks and other rock structures within stream margins. Shelters under rocks or amongst vegetation near the ground on the stream edge. Sometimes basks in the sun on exposed rocks near flowing water during summer. Eggs are laid in submerged rock crevices and tadpoles grow in slow-flowing connected or isolated pools.	No	Nil	No	Nil

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Littlejohn's Tree Frog, <i>Litoria littlejohni</i> V TSC V EPBC	This species occurs in scattered locations on the plateaus and eastern slopes of the Great Dividing Range between the Watagan Mountains, New South Wales and to Buchan in Victoria (White et al. 1994). It is known to inhabit forest, coastal woodland and heath from 100 to 950 m above sea level (White & Ehmann 1997), Breeding habitat has been variously reported as rocky streams and semi-permanent dams (Barker et al. 1995), still water in dams, ditches, isolated pools and flooded hollows (Hero et al. 1991), dams, creeks and lagoons (Griffiths 1997), semi-permanent or permanent dams, ponds and creeks (Anstis 2002) and temporary pools when sufficient run-off water was available (White et al. 1994).	Yes	Low	No	Low: records for this species exist >50km to the east on the other side of the great dividing range. Habitat is present but the recorded habitat for this species is very broad and occurs in most locations in NSW, the presence of this species on site is highly unlikely
Green and Golden Bell Frog <i>Litoria aurea</i> TSC -E	Formerly, distributed across most of NSW, although since 1990 recorded populations have become largely isolated and separated, restricted to small, coastal or near coastal populations. It is known to inhabit marshes, dams and stream-sides, particularly those containing bulrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.) (Daly and Senior, 2003). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as the Plague Minnow or Mosquito Fish (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available (DECCW 2010). Recorded at Queanbeyan, Collector and Sutton.	No	Nil	No	Nil
Southern Bell Frog <i>Litoria raniformis</i> EPBC - V	It is currently widespread throughout the Murray River valley but appears to have disappeared along the Murrumbidgee River and the Monaro district. This species is found mostly amongst emergent vegetation, including <i>Typha</i> sp., <i>Phragmites</i> sp. and <i>Eleocharis</i> sp., in or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds and farm dams. Also occurs in clays or well-watered sandy soils; open grassland, open forest, and ephemeral and permanent non-saline marshes and swamps; montane eucalypt forest, dry sclerophyll forest in coastal Victoria; steep-banked water edges (like	No	Nil	No	Nil

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
	ditches and drains) and gently graded edges containing fringing plants; and formerly, areas of high altitudes. Highly mobile species capable of travelling up to 1 km in 24 hours (DEWHA 2009).				
Birds					
Little Lorikeet TSC - V	Distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. In NSW, found westward as far as Dubbo and Albury. May be nomadic or resident for much of the year. Forages primarily in Eucalyptus forest and woodland, particularly riparian habitats. Also uses Isolated flowering trees in open country. Nest typically in hollows in the limb or trunk of smooth-barked Eucalypts, often riparian trees. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Recorded near Sutton.	Yes	Low	No	Low:
Swift Parrot <i>Lathamus discolor</i> TSC – E EPBC - V	A non-breeding winter migrant to southern and eastern NSW, where it inhabits eucalypt forests and woodlands (Blakers <i>et al.</i> 1984). Feeds on eucalypt blossom and psyllids.	Yes	Low	No	Low
Glossy Black-Cockatoo <i>Calyptorhynchus lathami</i> TSC - V	A species of open forests and woodland, dependent mainly on the seeds of Allocasuarina trees as a food source (Blakers <i>et al.</i> 1984). Large trees with hollows are required for breeding sites (Emison <i>et al.</i> 1987). Competition for hollows increases with openness of habitat and can be a threat to this species. May prefer to travel long distances over treed rather than open landscapes. Prefers large (>15cm) spout hollows for nesting (Cameron 2006). Recorded at Collector and local records around Bungendore (R. Reywinkle Senior Threatened Species Officer, DECCW pers comm).	Yes	Moderate	No	Low : No Allocasurina feed trees or suitable nesting hollows are present on the subject site or will be impacted by the Proposal.

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> TSC - V	Feeds in pairs or small flocks on seeds of eucalypts and wattles, primarily in forest, but occasionally towns and farming areas for artificial food resources such as berry-bearing exotic shrubs. It is a seasonal altitudinal migrant. Nesting is in large tree hollows. Recorded at Bungendore.	Yes	Moderate	No	Moderate
Turquoise Parrot <i>Neophema pulchella</i> V TSC	Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December (DECCW 2010).	Yes	Low	No	Low: Only one record within 100km of the subject site, highly unlikely to occur.
Superb Parrot <i>Polytelis swainsonii</i> TSC – V EPBC -V	Nesting habitat on SW Slopes is often open Yellow Box, Blakely's Red Gum Woodland or isolated paddock trees. Nest in small colonies, often with more than one nest in a single tree. May forage up to 10 km from nesting sites. Feed in trees and understorey shrubs and on the ground and their diet consists mainly of grass seeds and herbaceous plants. Regularly recorded in North Canberra and areas of NSW to the north of the ACT during the breeding season, however unlikely to occur as far east as the subject site (COG, 2002, COG, 2009, DECCW Wildlife Atlas).	Yes	Low	No	Low: Species is unlikely to occur so far east and marginal foraging habitat such as is found at the subject site is abundant in the adjacent land and wider locality.
Bush Stone-curlew <i>Burhinus grallarius</i> E TSC	This is a species of open woodland, forest edges and sparsely treed ranges throughout most of mainland Australia. (Schodde and Tidemann, 2007). Roost on ground during day in litter, fly up to 20km to forage (Schodde and Tidemann, 2007).	Marginal	Low	No	Low: Nearest records are over 100km to the east and west, unlikely to occur.
Brown Treecreeper (eastern subspecies) <i>Climacteris picumnus victoriae</i> TSC - V	Occurs in eucalypt woodlands, mallee and drier open forest of eastern Australia, preferring woodlands lacking dense understorey (Schodde and Tidemann 2007). Feeds on insects in the leaf litter and trunks of trees. Nests in tree hollows, stumps or rotted fence posts. Requires relatively intact woodland areas.	Yes	Moderate	No	Moderate

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Hooded Robin (south-eastern form) <i>Melanodryas cucullata cucullata</i> TSC -V	Widespread, occurring in pairs or solitary in lightly timbered country (Schodde and Tidemann 2007). Spends much of its time on the ground in woodland foraging for insects. It frequents places with dead trees and fallen timber (Schodde and Tidemann 2007), nesting on dead limbs or stumps. Populations are unable to survive in remnants smaller than 100-200 ha (DECCW 2010). Recorded near Queanbeyan.	Yes	Low	No	Low: Species likely to occur adjacent to the site but unlikely to forage or nest on site. The mitigation measure to enhance connectivity across the transmission corridor would lead to a net benefit for this species
Flame Robin <i>Petroica phoenicea</i> TSC - V	Ranges from Queensland border to SE South Australia and Tasmania. In NSW, it breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes, and in winter, many birds move to drier more open habitats on the inland slopes and plains. Prefers clearings or areas with open understoreys, with a groundlayer dominated by native grasses. In winter lives in dry forests, open woodlands and in pastures and native grasslands, with or without scattered trees. Forms mixed species flocks in the non-breeding season. Recorded between Sutton and Bungendore.	Yes	High	Yes	Moderate:
Scarlet Robin <i>Petroica phoenicea</i> TSC - V	Found SE Queensland to SE South Australia, Tasmania and SW Western Australia. In NSW, it occurs from the coast to the inland slopes. Primarily resident in mature and regrowth forests and woodlands up to 1000m, but some adults and young birds disperse to more open habitats in the lower valleys and plains of the tablelands and slopes after breeding. Habitat understorey is usually open and grassy with few scattered shrubs. Abundant logs and fallen timber are important habitat components. In autumn and winter many live in open grassy woodlands, and grasslands or grazed paddocks with scattered trees, joining mixed flocks of other small insectivorous birds. Pairs defend a breeding territory and mainly breed July-January. Recorded between Sutton and Bungendore.	Yes	High	No	Moderate

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Pink Robin <i>Petroica rodinogaster</i> TSC - V	The Pink Robin is found in Tasmania and the uplands of eastern Victoria and far south-eastern NSW, almost as far north as Bombala. On the mainland, the species disperses north and west and into more open habitats in winter, regularly as far north as the ACT area, and sometimes being found as far north as the central coast of NSW. Inhabits rainforest and tall, open eucalypt forest, particularly in densely vegetated gullies (DECCW 2010).	Yes	Low	No	Low
White-fronted Chat <i>Epthianura albifrons</i> TSC - V	White-fronted Chats are distributed across southern Australia from Western Australia to NSW. This species inhabits salt marshes, heaths, lake edges, agricultural land and other damp habitats with low vegetation. Often feeds in flocks where insect prey is at high densities. Breeding begins in late winter and several clutches can be raised during the breeding season in low nests built in shrubs. Breeding birds can form loose colonies with nests being as close as 5m. Generally sedentary however nomadic movements are thought to occur, particularly in the drier parts of its range.	Yes	High	Yes	High
Speckled Warbler <i>Pyrrholaemus saggitatus</i> TSC - V	Inhabits woodlands and dry forests, generally in inland Australia, particularly those with grassy understorey, often on ridges or gullies. Sedentary, living in pairs or trios and nests on the ground in grass tussocks, dense litter and fallen branches. Forages on the ground and in the understorey for arthropods and seeds. Occupy small remnants, but are yet to be recorded breeding in revegetated areas. Requires relatively intact woodland areas with litter and fallen timber. Recorded at Sutton and Queanbeyan.	Yes	High	Yes	Low-moderate: Only possible impact to this species would be due to fragmentation. The mitigation measure to enhance connectivity across the transmission corridor would lead to a net benefit for this species
Varied Sittella <i>Daphoenositta chrysoptera</i> TSC - V	A sedentary species inhabiting eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and <i>Acacia</i> woodland. The Varied Sittella feeds on arthropods gleaned from crevices in rough or decorticated bark, dead branches, standing dead trees, and from small branches and twigs in the tree canopy. It builds a cup-shaped nest of plant fibres and	Yes	High	No	Low: Potential impact to this species is fragmentation. The mitigation measure to enhance connectivity across the proposed transmission corridor would lead to a net

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
	cobweb in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years (DECCW 2010).				benefit for this species
Diamond Firetail <i>Stagonopleura guttata</i> TSC - V	Occurs predominantly west of the Great Dividing Range (Blakers <i>et al.</i> 1984). Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde and Tidemann 2007), nesting in pairs or communally in shrubs and small trees. Restricted largely to ungrazed or lightly grazed woodland remnants of grassy eucalypt woodlands, including Box-Gum and Snow Gum Woodlands, and grassland and riparian areas, and sometimes lightly wooded farmland. May form large flocks during winter and autumn. Recorded at Sutton, Queanbeyan and Bungendore.	Yes	Moderate-high	No	Moderate
Olive Whistler <i>Pachycephala olivacea</i> TSC - V	The Olive Whistler inhabits the wet forests on the ranges of the east coast. It has a disjunct distribution in NSW chiefly occupying the beech forests around Barrington Tops and the MacPherson Ranges in the north and wet forests from Illawarra south to Victoria. In the south it is found inland to the Snowy Mountains and the Brindabella Range. Mostly inhabit wet forests above about 500m. During the winter months they may move to lower altitudes. It forages in trees and shrubs and on the ground, feeding on berries and insects (DECCW 2010).	No	Nil	No	Nil
Square-tailed Kite <i>Lophoictinia isura</i> TSC - V	This species has a large and sparsely populated range throughout mainland Australia and is a breeding migrant to the south east from July to December. It occurs primarily in coastal and sub-coastal open forest, woodlands and mallee. It has been recorded inland along timbered watercourses and adjacent areas (DECCW 2010). The species hunts small passerines, especially honeyeaters in the tree canopy. Resident pairs have large hunting ranges of greater than 100 km ² (DECCW 2010). Nests are a platform of sticks up to 90cm in diameter in a fork of a tall tree in forest or woodland (Schodde & Tidemann 2007). No close records.	Yes	Low-moderate	No	Low

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Spotted Harrier <i>Circus assimilis</i> TSC - V	Occurs throughout Australian mainland, except in dense forests of the coast and ranges. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. Most common in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Yes	Moderate	No	Low
White-bellied Sea-eagle <i>Haliaeetus leucogaster</i> EPBC - M	Soars on air currents, hovers low over prey, makes angled power dives, travels large distances overland. While inland lakes and other large water bodies would be targeted for foraging and nests would be constructed near water, this species may move over the site.	Yes	Low-moderate	No	Nil
Little Eagle TSC - V	Found throughout mainland except dense forests of the Dividing Range escarpment. Occupies open eucalypt forest, woodland or open woodland. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Yes	Moderate	No	Nil
Powerful Owl <i>Ninox strenua</i> TSC - V	Breeding pairs defend large (up to 1000 ha), permanent territories (Blakers <i>et al.</i> 1984), usually centred around gullies (Fleay 1968). Nests in large tree hollows (Emison <i>et al.</i> 1987). Arboreal mammals form about 80% of the diet of this species (birds form most of the rest), with the Common Ringtail Possum, Greater Glider and Sugar Glider being the most favoured species (Blakers <i>et al.</i> 1984). Recorded c. 20km to south.	Yes (marginal)	Low	No	Nil
Barking Owl <i>Ninox connivens</i> TSC - V	This species is found throughout Australia except for the central arid regions and Tasmania. It has declined across much of its range across NSW and is most frequently recorded on the western slopes and plains (DECCW 2010). It occurs in dry box-dominated forest and woodlands and roosts in dense foliage of <i>Acacia</i> , <i>Casuarina</i> or <i>Eucalyptus</i> species. It nests in large hollows (20-46 cm diameter) of large, old eucalypts including River Red Gum, White Box, Red Box and Blakely's Red Gum (DECCW 2010; NPWS 2003a). Nest and roost sites are usually near	Yes	Low-moderate	No	Nil

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
	watercourses or wetlands (NPWS, 2003a). The species have also been recorded in remnants of forest and woodland and in clumps of trees at farms, towns and golf courses (NPWS, 2003a). Have large territories of 30 to more than 200 ha (DECCW 2010; NPWS, 2003a). Recorded c. 20km to south.				
Regent Honeyeater <i>Xanthomyza phrygia</i> TSC – E EPBC – E, M	Distributed through the eastern third of New South Wales. Inhabits eucalypt forests and woodlands (Blakers <i>et al.</i> 1984). A generalist forager, feeding mainly on the nectar from a wide range of eucalypts (particularly prolifically flowering box and ironbark species) and mistletoes but also eats invertebrates and exotic fruits (Blakers <i>et al.</i> 1984). Large numbers can appear in an area to take advantage of a food source. Key eucalypt species include Yellow Box and Blakely's Red Gum and Red Stringybark.	Yes	Low-moderate	No	Low:
Painted Snipe <i>Rostratula benghalensis/australis</i> EPBC – V, M	In NSW, this species has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. It is most common in the Murray-Darling Basin (DECCW 2010). It inhabits inland and coastal ephemeral and permanent freshwater wetlands, especially where there is a cover of vegetation. It has been recorded on the margins of wetlands, dams and even sewage ponds, also found in wet pastures, marshy areas, irrigation systems, tea tree scrub and adjacent open woodlands (Pizzey and Knight 2003). The species is likely to be nomadic in response to suitable conditions, such as floods (DECCW 2010)	No	Nil	No	Nil
Australasian Bittern <i>Botaurus poiciloptilus</i> TSC - V	Little is known of the behaviour of this cryptic waterbird. May be nomadic as it has been observed occupying ephemeral wetlands. Seeds and invertebrates are foraged for on the water's edge.	No	Nil	No	Nil
Blue-billed Duck <i>Oxyura australis</i> TSC - V	This species is widespread in NSW although is most common in the southern Murray-Darling Basin area. During spring and summer birds travel up to 300km from non-breeding areas on the Murray River system and coastal lakes to breed in deep swamps of inland NSW. They are often seen in coastal areas in summer and during drought (DECCW	No	Nil	No	Nil

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
	2010). Feeding occurs in permanent freshwater wetlands and swamps with deep water and dense aquatic vegetation. Nesting occurs in <i>Cumbungi</i> over deep water or in dense wetland vegetation.				
Freckled Duck <i>Stictonetta naevosa</i> TSC - V	Requires wetland habitats, preferring large permanent swamps. Endemic to south eastern and south western Australia. It inhabits plankton rich wetlands, and is typically gregarious (DECCW 2010).	No	Nil	No	Nil
White-throated Needletail <i>Hirundapus caudacutus</i> EPBC - M	High-flying, vertical flight and diving displays. May form large flocks. Occurring in Australia in large numbers during the non-breeding season (October – August) they roost in trees and forage on flying insects, commonly in thermals associated with storm fronts or bush fires (DEWHA 2009).	Yes	High	No	Nil
Rainbow Bee-eater <i>Merops ornatus</i> EPBC - M	May form large flocks. Occurring in Australia in large numbers during the non-breeding season (October – August) they roost in trees and forage on flying insects, commonly in thermals associated with storm fronts or bush fires (DEWHA 2009).	Yes	Moderate	No	Nil
Satin Flycatcher <i>Myiagra cyanoleuca</i> EPBC - M	Typically a species of densely vegetative gullies in tall forests (Pizzey and Knight 2003).	No	Nil	No	Nil
Fork-tailed Swift <i>Apus pacificus</i> EPBC - M	This species breeds from central Siberia eastwards through Asia and winters south to Australia. Uncommon in eastern Australia. It spends most of its time in the air feeding on insects, occasionally roosting on cliffs or in large trees (Pizzey and Knight 2003). It spends most of its life in the air feeding on insects. It occurs throughout mainland Australia, mostly west of the divide.	Yes	Moderate	No	Nil
Cattle Egret <i>Ardea ibis</i> EPBC - M	Migratory/dispersive, suitable habitat nearby. Primarily inhabits wetlands and paddocks (Pizzey and Knight 2003).	Yes	Moderate	No	Low
Great Egret <i>Ardea alba</i> , EPBC - M	Migratory/dispersive, suitable habitat nearby. Primarily inhabits wetlands and paddocks (Pizzey and Knight 2003).	Yes	Moderate	No	Low

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Mammals					
Spotted-tailed Quoll <i>Dasyurus maculatus</i> TSC – V EPBC – E	Found in a variety of forest types, although generally preferring moister environments such as rainforest and wet sclerophyll forest (DECCW 2010). Large areas of undisturbed habitat which provide a variety of key food and other resources such as large hollow logs, or small caves at ground level for dens are required. Recorded east of Queanbeyan.	Yes	Low-moderate	No	Low: Potential impact to this species is fragmentation. The mitigation measure to enhance connectivity across the proposed transmission corridor would lead to a net benefit for this species
Eastern Pygmy-possum <i>Cercartetus nanus</i> TSC – V	Occurs at elevations of 300m to above 1,000m. In southern NSW, this species is principally recorded in drier forest and heath, often with a diverse shrubby ground cover. Myrtaceous trees, Banksia and hollows are potential resources for this species. Recorded between Canberra and Bungendore.	Yes (marginal)	Low	No	Low: Potential impact to this species is fragmentation. The mitigation measure to enhance connectivity across the proposed transmission corridor would lead to a net benefit for this species
Squirrel Glider <i>Petaurus norfolcensis</i> TSC – V	Inhabits dry sclerophyll forest and woodland, distributed largely along the east coast and immediate inland districts. Feeds on insects, nectar and exudates from leaves and trees (<i>Eucalyptus</i> and <i>Acacia</i>). No close records.	Yes (marginal)	Low	No	Low
Yellow-bellied Glider <i>Petaurus australis</i> TSC – V	Restricted to tall mature eucalypt forest (Van Dyck and Strahan 2008), where it uses tree hollows for shelter and feeds on plant and insect exudates and arthropods, collected mostly under exfoliating bark. It may prefer forest of high species diversity. Eucalypts that provide hollows, sap flow and that flower in winter are preferred by this species. These include ribbon gum and bloodwood (<i>Eucalyptus viminalis</i> and <i>Corymbia gummifera</i>) and winter flowering ironbarks. It is principally distributed on the coast although several inland records exist. No records close to site.	Yes (marginal)	Low	No	Low

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Koala <i>Phascolarctos cinereus</i> TSC - V	Solitary with distinct home ranges. Consumes a diverse range of eucalypts (Van Dyck and Strahan 2008) typically present on high nutrient soils (Klippel, 1992). Large areas of continuous forest or woodland are required by this species. Recorded at Queanbeyan, Collector and Sutton.	Yes	Moderate	No	Moderate
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i> TSC - V	It is widely distributed in eastern NSW from the Dividing Ranges through to the coast (Van Dyck and Strahan 2008). It is found in a variety of forest types including wet sclerophyll forest and coastal mallee. It appears to prefer wet sclerophyll forest although also utilises open forest at lower altitudes (Churchill 2008; Hall and Richards 1979). Absent from small patches of remnant forest, preferring continuous forest, although have been recorded foraging or moving through open/cleared landscapes (Churchill 2008). Roosts in tree hollows (Phillips & Inwards 1985). Recorded at and east of Queanbeyan.	Yes	Moderate	No	Moderate
Eastern Bentwing-bat <i>Miniopterus schreibersii oceanensis</i> TSC - V	Common although vulnerable species that is likely to be widely distributed throughout the region. It roosts and raises its young in caves and mine tunnels (Van Dyck and Strahan 2008). The species appears to forage above the forest canopy in a diverse range of forest types (Van Dyck and Strahan 2008). Females undertake annual migration to congregate at maternity caves. Recorded east of Queanbeyan.	Yes	Moderate	No	Nil: No roosting habitat and negligible foraging habitat would be impacted by the proposal
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i> TSC - V	This wide-ranging species roosts in tree hollows, burrows and buildings, foraging above the canopy (DECCW, 2009). It appears to be a summer migrant to the southern mainland and occurs in a range of sclerophyll forest and woodland (Churchill, 1998)	Yes	Low	No	Low: The closest record of this species is 90km to the south west. It is unlikely that this species would occur on site.
Large-footed Myotis <i>Myotis macropus</i> TSC - V	This species is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found inland, except along major rivers (DECCW 2010). It forages on the surface of water bodies such as rivers, lakes and swamps. It roosts in small groups in tree hollows, caves, mine, tunnels and old buildings	No	Low	No	Low

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
	near water (Churchill 2008; Hall & Richards 1979). Recorded at Queanbeyan.				
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> TSC - V	This species is recorded from a range of habitats, from woodland to rainforest (Hall & Richards 1979). It is known to roost in tree hollows (Richards 1983) but has also been found in roof spaces. Its diet includes slow-flying insects. It may prefer riparian areas adjacent to cleared areas in which to forage.	Yes	Low	No	Low: Records of this species occur towards the coast over km from the site
Greater Long-eared Bat <i>Nyctophilus timoriensis</i> TSC - V EPBC V	Inhabits a variety of vegetation types including dry and riparian forest, mallee and woodland communities. Roosts in tree hollows, crevices or under loose bark. Hunts within the understorey or on the ground (DECCW 2010).	Yes	Low	No	Low: Only one record for this species exists within 140km of the site and it lies 90km to the south west. It is unlikely that this species would occur on site.
Reptiles					
Little Whip Snake <i>Suta flagellum</i> TSC - V	This species is found within an area bounded by Crookwell in the north, Bombala in the south, Tumbarumba to the west and Braidwood to the east (DECCW 2010). It occurs in Natural Temperate Grasslands and grassy woodlands, including those dominated by Snow Gum or Yellow Box as well as secondary grasslands derived from clearing of woodlands. It is commonly found on well-drained hillsides with loose scattered rocks. Recorded between Sutton and Bungendore.	Yes	Moderate	No	Moderate
Pink-tailed Worm-lizard <i>Aprasia parapulchella</i> TSC - V	Inhabits open grassland habitats that have a substantial cover of small rocks (Osborne and Jones 1995). Show a preference for sunny aspects, avoiding south facing slopes, only at sites with good numbers of ants under rocks (DECCW 2010). Favoured sites have relatively open vegetation, including grassland sites supporting no native grasses. Shelters under small rocks which are exposed to sunlight and shallowly embedded in the soil. Recorded at Queanbeyan.	Yes (marginal)	Low-moderate	No	Moderate

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Striped Legless Lizard <i>Delma impar</i> TSC - V	Populations of this species are known in the Goulburn, Yass, Queanbeyan, Cooma and Tumut areas. It inhabits temperate lowland grasslands, secondary grasslands and occasionally in open Box-Gum Woodland. It has been recorded at sites dominated by introduced species (such as <i>Phalaris aquatica</i> , <i>Nasella trichotoma</i> and <i>Hypochaeris radicata</i>) and sites with a history of grazing and pasture improvement (Smith and Robertson 1999). Shelters in grass tussocks, thick ground cover, soil cracks, under rocks, spider burrows, and ground debris such as timber. The key to their survival in rural areas may be the availability of shelter during disturbance events (Smith and Robertson 1999). Peak activity occurs Nov-Dec (Coulson 1995).	Yes (marginal)	Low-moderate	No	Moderate
Rosenberg's Goanna <i>Varanus rosenbergi</i> TSC - V	This species occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. It is found in heath, open forest and woodland. It is known to nest in termite mounds and feeds on carrion, birds, eggs, reptiles and small mammals. Individuals require large areas of habitat. Recorded at Sutton.	Yes	Moderate	No	Low: No termite mounds on site one found in Sweeneys Reserve 1km off site – no sign of nesting. Species is unlikely to cross the subject site as there is no cover or habitat to be accessed on the site or on the other side. Mitigation by enhancing connectivity across the proposed transmission corridor would lead to a net benefit.

Species and status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Recorded during survey?	Potential to be impacted
Grassland Earless Dragon <i>Tympanocryptis pinguicolla</i> TSC – E EPBC – E	Preferred habitat is naturally treeless grasslands on black clay, brown clay loams and podzolic soils, particularly those containing <i>Themeda</i> , <i>Austrodanthonia</i> and <i>Austrostipa</i> spp. that have not been extensively grazed. Threats include habitat clearing, grazing, rock removal, changed fire regimes and weed invasion (DECCW 2010)	Yes Marginal History and intensity of grazing compromises the habitat for this species	Low	No	Low Pasture structure doesn't represent the preferred habitat for this species (diverse native grassland with a mixture of native tussock and clear areas)
Invertebrates					
Golden Sun Moth <i>Synemon plana</i> TSC – E EPBC – CE	This species is distributed in an area of NSW between Queanbeyan, Gunning, Young and Tumut (DECCW 2010). It occurs in grassy Box-Gum woodlands and natural temperate grasslands, typically low, open and dominated by several wallaby grass species. Also may be associated with spear-grasses (<i>Austrostipa</i> spp.) or Kangaroo Grass (<i>Themeda australis</i>).	Yes (marginal)	Low	No	Low: Habitat marginal (some <i>Danthonia</i> occurs but history of grazing lowers habitat quality) and outside the predicted range for this species (DEWHA 2008)

Appendix E Flora species list

The survey area was stratified into 4 relatively homogeneous survey zones based on Proposal elements, vegetation structure and topography:

- SW** Solar farm - native pasture (granitic soils and sandy alluvium, western area): sites 1-7
- SE** Solar farm - native pasture (alluvium and metasediments, eastern area: sites 8-13, 15, 16
- TP** Transmission line corridor – native pasture: site 22
- TF** Transmission line corridor and solar farm site – dry forest remnants: sites 14, 17, 20
- TW** Transmission line corridor – Frost Hollow Woodland remnants: sites 18, 19, 21

Cover/abundance assessments are based on visual estimates of foliage cover (after Carnahan 1997), scored using a modified Braun-Blanquet 6-point scale:

- | | |
|---|--|
| 1 | 1 to a few individuals present, less than 5% cover |
| 2 | many individuals present, but still less than 5% cover |
| 3 | 5 - <20% cover |
| 4 | 20 - <50% cover |
| 5 | 50 - <75% cover |
| 6 | 75 - 100% cover. |

Where the cover/abundance of a particular species varies markedly over the random meander survey area, a range of values is provided. In these cases, abundance is based on a standard 20 metre x 20 metre quadrat scale.

Species of conservation significance are bolded. Introduced species are denoted by an asterisk. Noxious weeds declared for the Southern Slopes County Council control area under the *Noxious Weeds Act 1993* are indicated with a 'Δ' symbol. Where uncertainty exists due to the unavailability of mature reproductive material, the taxon is preceded by a question mark, or plants are identified to genus level only. Botanical nomenclature follows G.J. Harden (ed) (1990-2002) *Flora of New South Wales*, UNSW Press, except where recent changes have occurred.

Scientific name	Common name	Family	Abundance				
			SW	SE	TP	TF	TW
TREES							
Acacia dealbata	Silver Wattle	Fabaceae		1		0-2	1
Acacia mearnsii	Black Wattle	Fabaceae			0-3	0-3	
Acacia melanoxylon	Blackwood	Fabaceae			1	1	0-3
Allocasuarina littoralis	Black She-oak	Casuarinaceae			1		
Eucalyptus dives	Broad-leaved Peppermint	Myrtaceae			0-3	0-3	1-3
Eucalyptus mannifera	Brittle or Red Spotted Gum	Myrtaceae				0-3	
Eucalyptus melliodora	Yellow Box	Myrtaceae			1		
Eucalyptus pauciflora	Snow Gum	Myrtaceae		1		1	0-3
Eucalyptus stellulata	Black Sallee	Myrtaceae		1			
Eucalyptus viminalis	Ribbon or Manna Gum	Myrtaceae		1			0-3
SHRUBS, SUB-SHRUBS							
Astroloma humifusum	Cranberry Heath	Ericaceae				1	
Amyema pendulum	Mistletoe	Loranthaceae				1-2	1
Brachyloma daphnoides	Daphne Heath	Ericaceae				0-2	
Dillwynia sericea	Parrot-pea	Fabaceae				1	
Hibbertia obtusifolia	Guineaflower	Dilleniaceae				1	
Leptospermum myrtifolium	Swamp Tea-tree	Myrtaceae	0-4	0-5	1		0-3
Lissanthe strigosa	Peach heath	Ericaceae				0-2	1
Δ*Lycium ferocissimum	African Boxthorn	Solanaceae		1			1
Δ*Rosa rubiginosa	Briar Rose, Sweet Briar	Rosaceae	1	1-2		1	1
FORBS							
Acaena ?echinata		Rosaceae	0-3	1			
*Acetosella vulgaris	Sheep Sorrel	Polygonaceae	0-3	0-2	0-3	0-2	2
*Arctotheca calendula	Capeweed	Asteraceae		0-2		1	
*Capsella bursa-pastoris	Shepherd’s Purse	Brassicaceae				1	
Chenopodium ?erosum	Papery Goosefoot	Chenopodiaceae		1			
*Chenopodium multifidum	Scented Goosefoot	Chenopodiaceae		1			
*Chondrilla juncea	Skeleton Weed	Asteraceae	1	1			
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae	0-2	1-2	0-2	1-2	
Chrysocephalum semipapposum	Clustered Everlasting	Asteraceae		1	1		
*Cirsium vulgare	Black or Spear Thistle	Asteraceae		1			1
*Conyza sp	Fleabane	Asteraceae	0-2	1			
Cotula australis	Carrot Weed	Asteraceae			1	0-2	0-2
Crassula sieberiana	Stonecrop	Crassulaceae	0-2	0-2	0-2	0-2	
*Cucumis myriocarpus	Paddy Melon	Cucurbitaceae	0-2				
Dichondra repens	Kidney Weed	Convolvulaceae	0-2	0-2			
Δ*Echium plantagineum	Paterson’s Curse	Boraginaceae	1				0-2
Einadia nutans	Climbing Saltbush	Chenopodiaceae	1	1		1-2	0-2
*Erodium brachycarpum	Heron’sbill	Geraniaceae	1-3	1-3		2	
*Erodium cicutarium	Common Storksbill	Geraniaceae	0-2	0-2		2	

Scientific name	Common name	Family	Abundance				
			SW	SE	TP	TF	TW
<i>*Erodium moschatum</i>	Musky Storksbill	Geraniaceae		0-2			
<i>Euchiton gymnocephalus</i>	Slender Cudweed	Asteraceae		0-2		1	
<i>Gonocarpus tetragynus</i>	Raspwort	Haloragaceae				1	
<i>Goodenia hederacea</i>	Ivy-leaved Goodenia	Goodeniaceae				0-2	
<i>*Hirschfeldia incana</i>	Buchan Weed	Brassicaceae		1			
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort	Apiaceae				1	1
<i>*Hypochaeris radicata</i>	Cat's ear, Flatweed	Asteraceae	0-2	0-2	2	0-2	2
<i>*Lepidium africanum</i>	Peppercress	Brassicaceae	0-2	0-2		1	
<i>Leptorhynchus squamatus</i> ssp <i>squamatus</i>	Scaly Buttons	Asteraceae		0-2		1	
<i>Leucochrysum albicans</i>	Hoary Sunray	Asteraceae		0-1			
<i>Lythrum hyssopifolium</i>	Hyssop Loosestrife	Lythraceae		0-2			
<i>*Malva parviflora</i>	Small-flowered Mallow	Malvaceae		0-2		1	1
<i>*Modiola caroliniana</i>	Red-flowered Mallow	Malvaceae	0-2				
<i>*?Medicago arabica</i>	Spotted Burr-medic	Fabaceae	1-3	0-2		0-2	0-2
<i>Δ*Onopordum acanthium</i>	Scotch Thistle	Asteraceae	0-3	0-2	0-2		
<i>Oxalis perennans</i>	Oxalis	Oxalidaceae				1	1
<i>*Paronychia brasiliiana</i>	Brazilian Whitlow	Caryophyllaceae	0-2		2	1	
<i>*Plantago coronopus</i>	Buck's horn Plantain	Plantaginaceae	1	1			
<i>Plantago varia</i>	Variable Plantain	Plantaginaceae	0-1	1			
<i>Pterostylis</i> sp. (rosette)	Greenhood	Orchidaceae				0-2	
<i>Pterostylis</i> sp. (<i>P. longifolia</i> type)	Greenhood	Orchidaceae				1	
<i>Rumex brownii</i>	Native Dock	Polygonaceae		1-2			
<i>Scleranthus biflorus</i>	Twin-flowered Knawel	Caryophyllaceae	0-2				
<i>Scleranthus fasciculatus</i>	Knawel	Caryophyllaceae	1				
<i>*Solanum chenopodioides</i>	Whitetip Nightshade	Solanaceae					1
<i>Solenogyne dominii</i>	Smooth Solenogyne	Asteraceae		0-2		0-2	
<i>Solenogyne gunnii</i>	Hairy Solenogyne	Asteraceae		0-2		1	
<i>*Stellaria media</i>	Starwort	Caryophyllaceae				0-2	0-2
<i>Stellaria pungens</i>	Forest Starwort	Caryophyllaceae	0-2	1			
<i>*Taraxacum officinale</i>	Dandelion	Asteraceae	0-2				
<i>*Trifolium repens</i>	White Clover	Fabaceae				0-2	
<i>*Trifolium</i> sp.	Clover	Fabaceae	0-2	1			
<i>Vittadinia gracilis</i>		Asteraceae	1	0-2	1	1	
<i>Vittadinia muelleri</i>		Asteraceae		1			
GRASSES							
<i>Aristida ramosa</i> var <i>ramosa</i>	Purple Wiregrass	Poaceae	0-2		0-2	0-4	
<i>Austrodanthonia auriculata</i>	Wallaby Grass	Poaceae	0-2				
<i>Austrodanthonia caespitosa</i>	Ringed Wallaby Grass	Poaceae		0-4			
<i>Austrodanthonia carphoides</i>	Short Wallaby Grass	Poaceae		0-3			
<i>Austrodanthonia duttoniana</i>	Wallaby Grass	Poaceae		0-3			
<i>Austrodanthonia laevis</i>	Wallaby Grass	Poaceae				2	
<i>Austrodanthonia pilosa</i>	Smooth-flowered Wallaby	Poaceae	0-2	0-4			

Scientific name	Common name	Family	Abundance				
			SW	SE	TP	TF	TW
	Grass						
<i>Austrodanthonia racemosa</i> var. <i>racemosa</i>	Wallaby Grass	Poaceae		0-3	0-2	1-3	
<i>Austrodanthonia</i> sp.	Wallaby Grass	Poaceae	0-3	0-2	0-2	2-4	0-3
<i>Austrostipa bigeniculata</i>	Spear Grass	Poaceae	0-2	0-3		0-2	
<i>Austrostipa densiflora</i>	Spear Grass	Poaceae				1-3	
<i>Austrostipa scabra</i> ssp <i>falcata</i>	Corkscrew Grass	Poaceae	0-4	1-4		2-3	0-3
<i>Bothriochloa macra</i>	Red Grass	Poaceae	0-3	0-4		0-2	0-2
<i>Chloris truncata</i>	Windmill Grass	Poaceae	0-3	0-2			
* <i>Cynodon dactylon</i>	Couch	Poaceae	0-4	0-3			0-3
* <i>Cynosurus echinatus</i>	Dog's tail Grass	Poaceae		1		1	1
* <i>Dactylis glomerata</i>	Cocksfoot	Poaceae	1				
<i>Dichelachne crinita</i>	Longhair Plumegrass	Poaceae	1			1	
* <i>Eleusine tristachya</i>	Goose Grass	Poaceae	0-3	0-2			
<i>Elymus scaber</i>	Common Wheat Grass	Poaceae				0-3	
Δ* <i>Eragrostis curvula</i>	African Lovegrass	Poaceae	0-3		1		
* <i>Holcus lanatus</i>	Yorkshire Fog	Poaceae	0-2				
* <i>Hordeum leporinum</i>	Barley Grass	Poaceae				1	
<i>Imperata cylindrica</i>	Blady Grass	Poaceae	0-4		0-3	0-4	
<i>Joycea pallida</i>	Robust Wallaby Grass	Poaceae				0-4	
<i>Lachnagrostis filiformis</i>	Blown Grass	Poaceae		1		1	1
<i>Microlaena stipoides</i>	Weeping Grass	Poaceae	0-3	0-3	1-3	0-5	1-4
Δ* <i>Nassella trichotoma</i>	Serrated Tussock	Poaceae	2	1-3	3-4	0-4	0-3
<i>Panicum effusum</i>	Hairy Panic	Poaceae	1-3	0-3	0-2	1-2	1-2
<i>Poa labillardieri</i>	Silver Tussock	Poaceae	1				
<i>Poa meionectes</i>		Poaceae				0-2	1
<i>Poa sieberiana</i> var. <i>sieberiana</i>	Snow Grass	Poaceae	1-3			0-2	
* <i>Setaria</i> sp.	Pigeon Grass	Poaceae			1		
<i>Themeda australis</i>	Kangaroo Grass	Poaceae	0-3	0-4			0-3
* <i>Vulpia ?bromoides</i>	Squirrel-tail Fescue	Poaceae	0-2	0-2			2
Unidentified grasses		Poaceae	0-2				0-3
GRAMINOIDS							
<i>Carex appressa</i>	Tall Sedge	Cyperaceae		1			
<i>Carex bichenoviana</i>	Curly Sedge	Cyperaceae	0-6	0-4			
<i>Carex ?inversa</i>	Knob Sedge	Cyperaceae	0-2				
<i>Juncus filicaulis</i>	Pinrush	Juncaceae	1	1			
<i>Juncus subsecundus</i>	Rush	Juncaceae		0-3			
<i>Juncus</i> sp	Rush	Juncaceae	0-2	1	0-2	0-3	0-3
<i>Lomandra filiformis</i> ssp <i>coriacea</i>	Wattle Mat-rush	Lomandraceae				0-3	2
<i>Lomandra longifolia</i>	Spiny Matrush	Lomandraceae		1		1	1
Unidentified sedge		Cyperaceae	0-2				
FERNS							
<i>Cheilanthes sieberi</i> ssp <i>sieberi</i>	Rock or Mulga Fern	Sinopteridaceae		0-1			

Scientific name	Common name	Family	Abundance				
			SW	SE	TP	TF	TW
<i>Pteridium esculentum</i>	Bracken	Dennstaedtiaceae		0-5		0-6	0-5

Appendix F Fauna species list

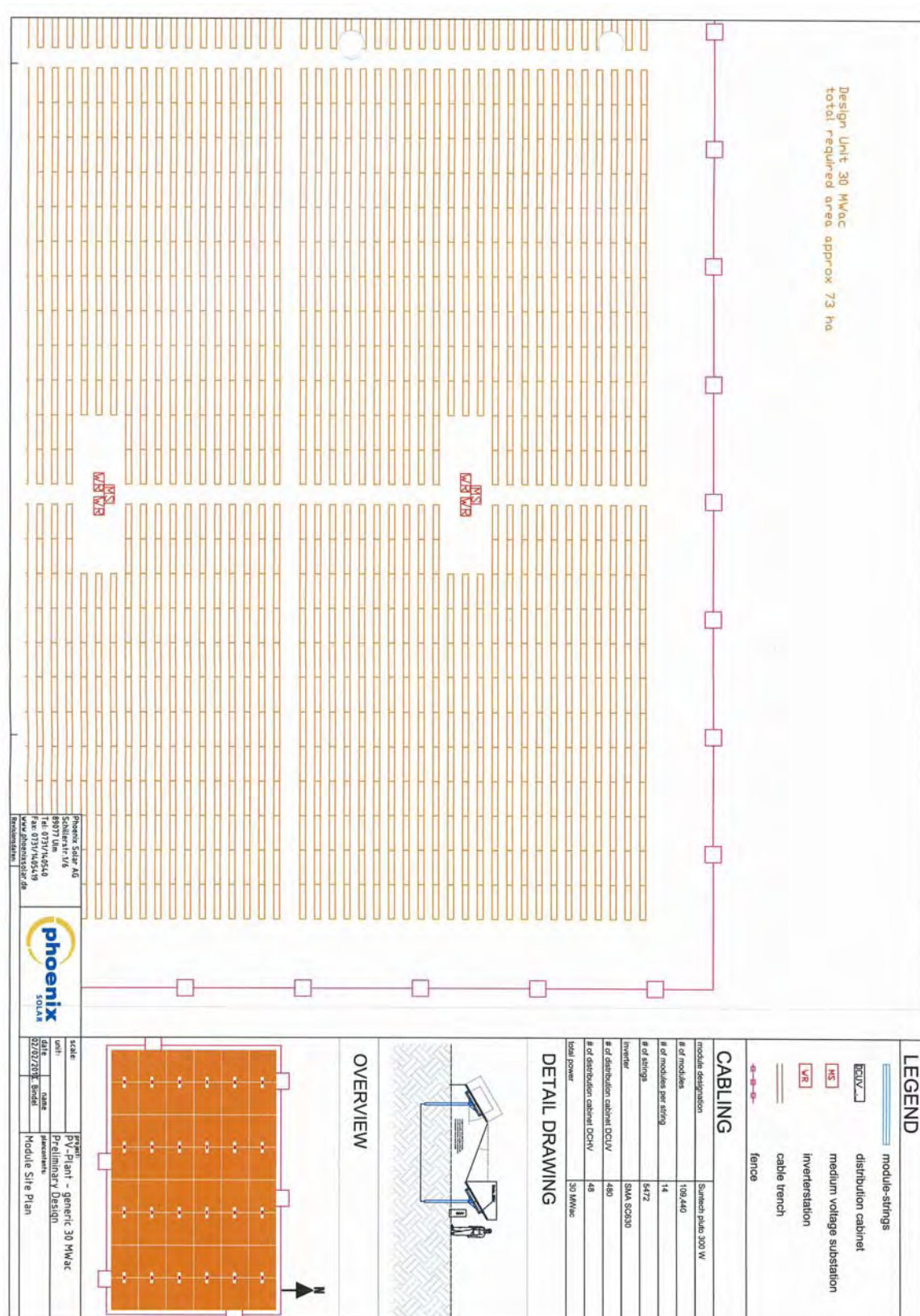
Observations

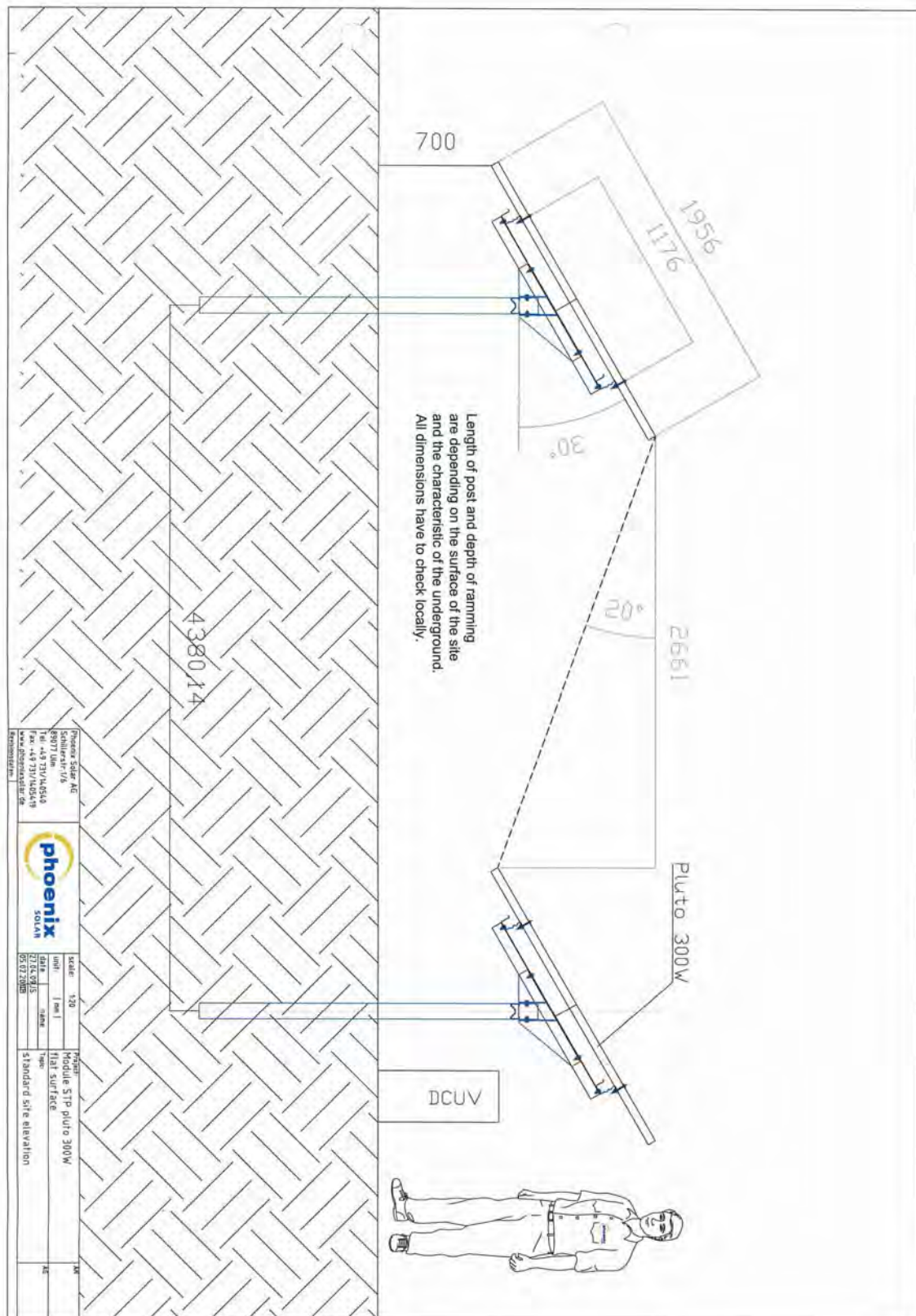
O =observed, H=heard, S=sign

Common Name	Scientific Name	Observations
Birds		
Crested Pigeon	<i>Ocyphaps lophotes</i>	O
Richard's Pipit	<i>Anthus novaeseelandiae</i>	O
Australian Magpie	<i>Gymnorhina tibicen</i>	O
Noisy Miner	<i>Manorina melanocephala</i>	H
Galah	<i>Cacatua roseicapilla</i>	O
Eastern Rosella	<i>Platycercus eximius</i>	O
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	O
Flame Robin	<i>Petroica phoenicea</i>	O
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	O
Superb Fairy-wren	<i>Malurus cyaneus</i>	O
Little Raven	<i>Corvus mellori</i>	H
Red Wattlebird	<i>Anthochaera carunculata</i>	O
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	H
Striated Thornbill	<i>Acanthiza lineata</i>	O
Striated Pardalote	<i>Pardalotus striatus</i>	H
Crimson Rosella	<i>Platycercus elegans</i>	O
Magpie-lark	<i>Grallina cyanoleuca</i>	O
Common Starling	<i>Sturnus vulgaris</i>	O
Australian Raven	<i>Corvus coronoides</i>	O
Skylark	<i>Alauda arvensis</i>	H
Stubble Quail	<i>Coturnix pectoralis</i>	O
Yellow Thornbill	<i>Acanthiza nana</i>	O
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	H
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	O
White-browed Scrubwren	<i>Sericornis frontalis</i>	O
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	H
Willie Wagtail	<i>Rhipidura leucophrys</i>	O
Australian Wood Duck	<i>Chenonetta jubata</i>	H
Speckled Warbler	<i>Chthonicola sagittata</i>	O
Pied Currawong	<i>Strepera graculina</i>	H
White-winged Chough	<i>Corcorax melanorhamphos</i>	H
Pacific Black Duck	<i>Anas superciliosa</i>	O
Australian Shelduck	<i>Tadorna tadornoides</i>	O
White-faced Heron	<i>Egretta novaehollandiae</i>	O
Welcome Swallow	<i>Hirundo neoxena</i>	O

White-fronted Chat	<i>Epthianura albifrons</i>	O
Mistletoebird	<i>Dicaeum hirundinaceum</i>	O
European Goldfinch	<i>Carduelis carduelis</i>	O
Brown Falcon	<i>Falco berigora</i>	O
Nankeen Kestrel	<i>Falco cenchroides</i>	O
Peregrine Falcon	<i>Falco peregrinus</i>	O
Mammals		
Red Fox	<i>Vulpes vulpes</i>	O
Brown Hare	<i>Lepus capensis</i>	O
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	O
Swamp Wallaby	<i>Wallabia bicolor</i>	O
Cat (feral)	<i>Felis catus</i>	O
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	O/S
Fallow Deer	<i>Cervus dama</i>	O/S
Common Wombat	<i>Vombatus ursinus</i>	O/S
European Rabbit	<i>Oryctolagus cuniculus</i>	O/S
Amphibians		
Whistling Tree Frog	<i>Litoria verreauxii verreauxii</i>	H
Common Froglet	<i>Crinia signifera</i>	H/O

Appendix G Layout and Structural Plans





Appendix H Additional Maps

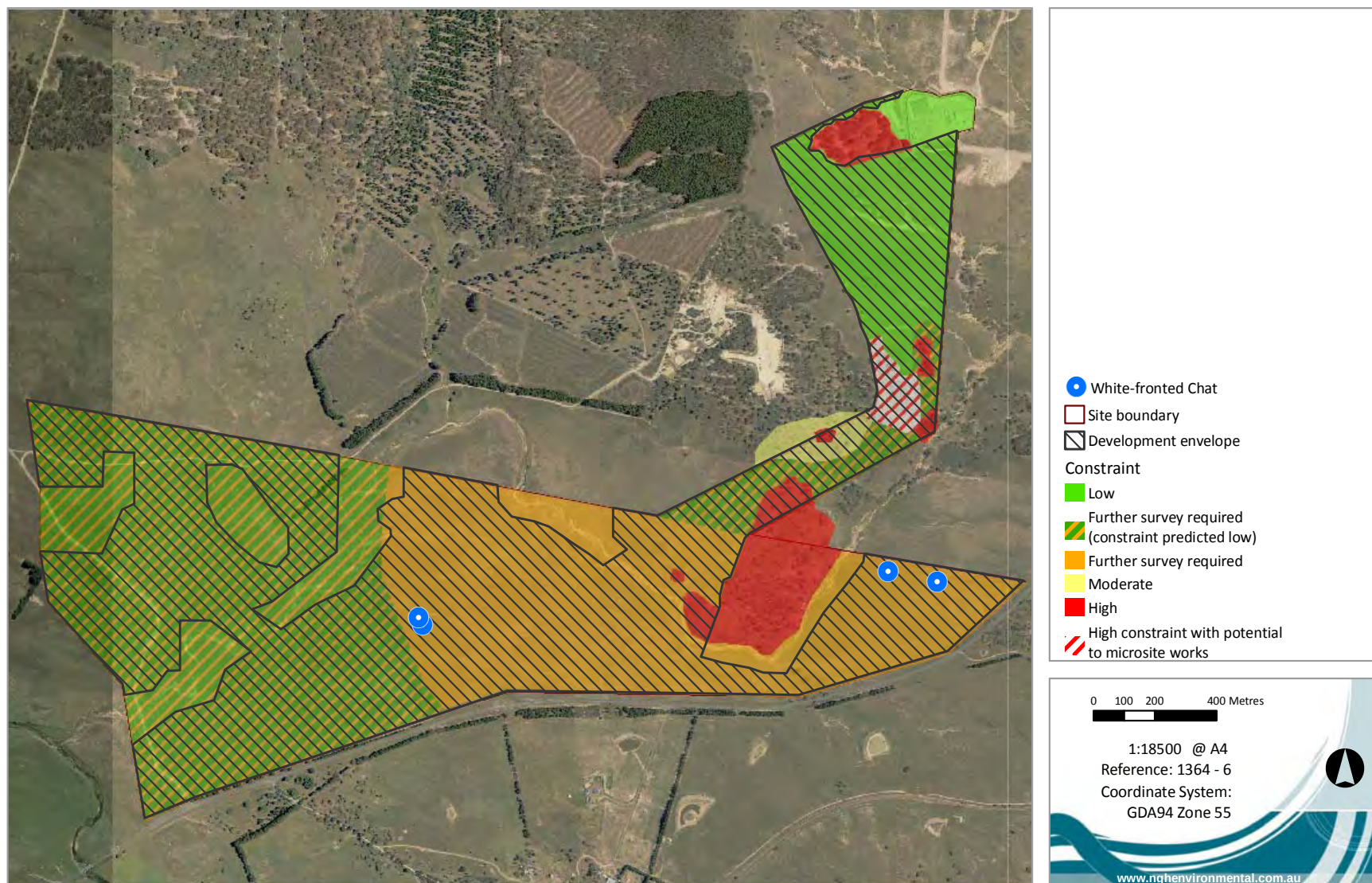


Figure 9-3 Biodiversity constraints overlaid with the development envelope

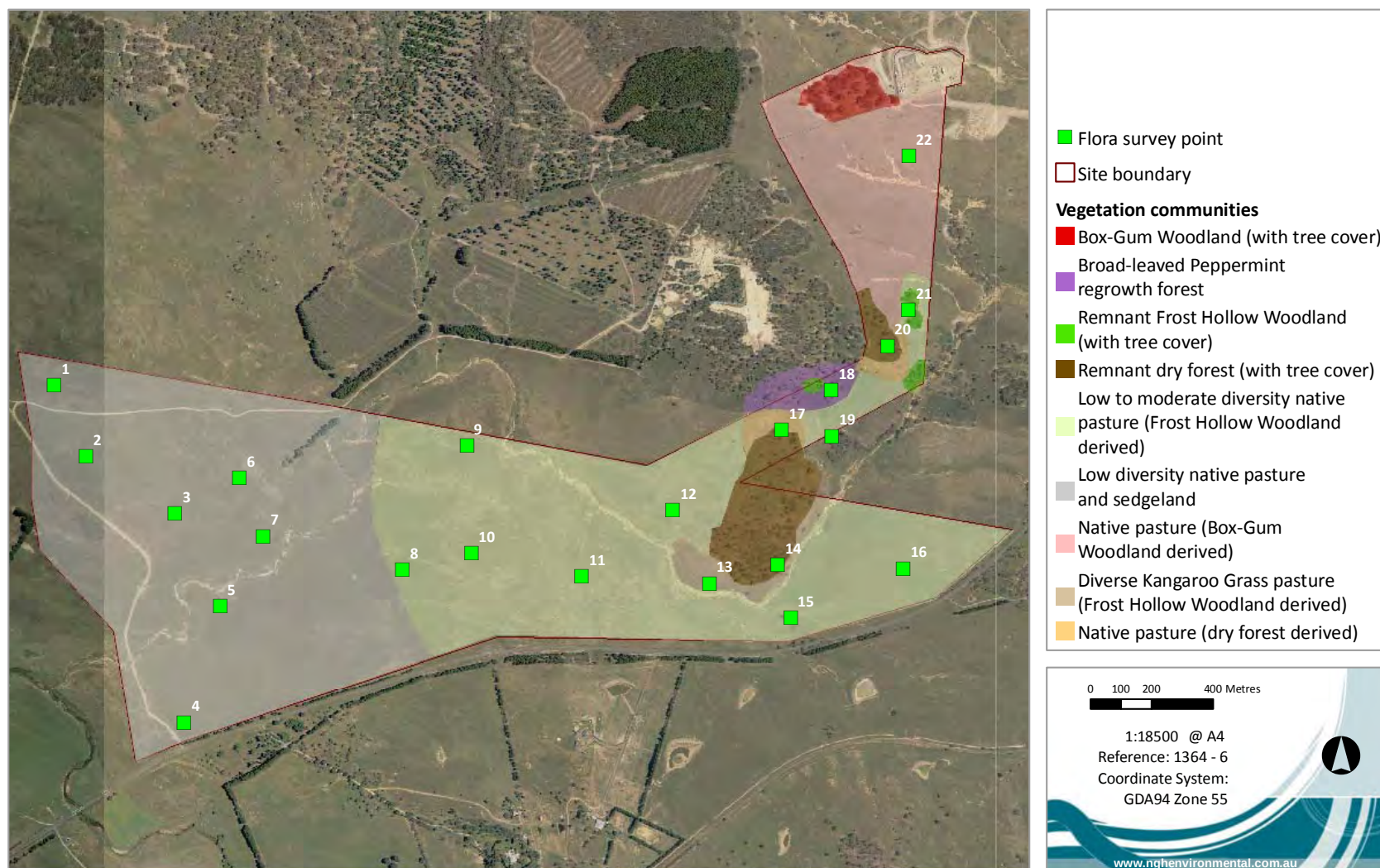


Figure 9-4 Flora survey points and vegetation type

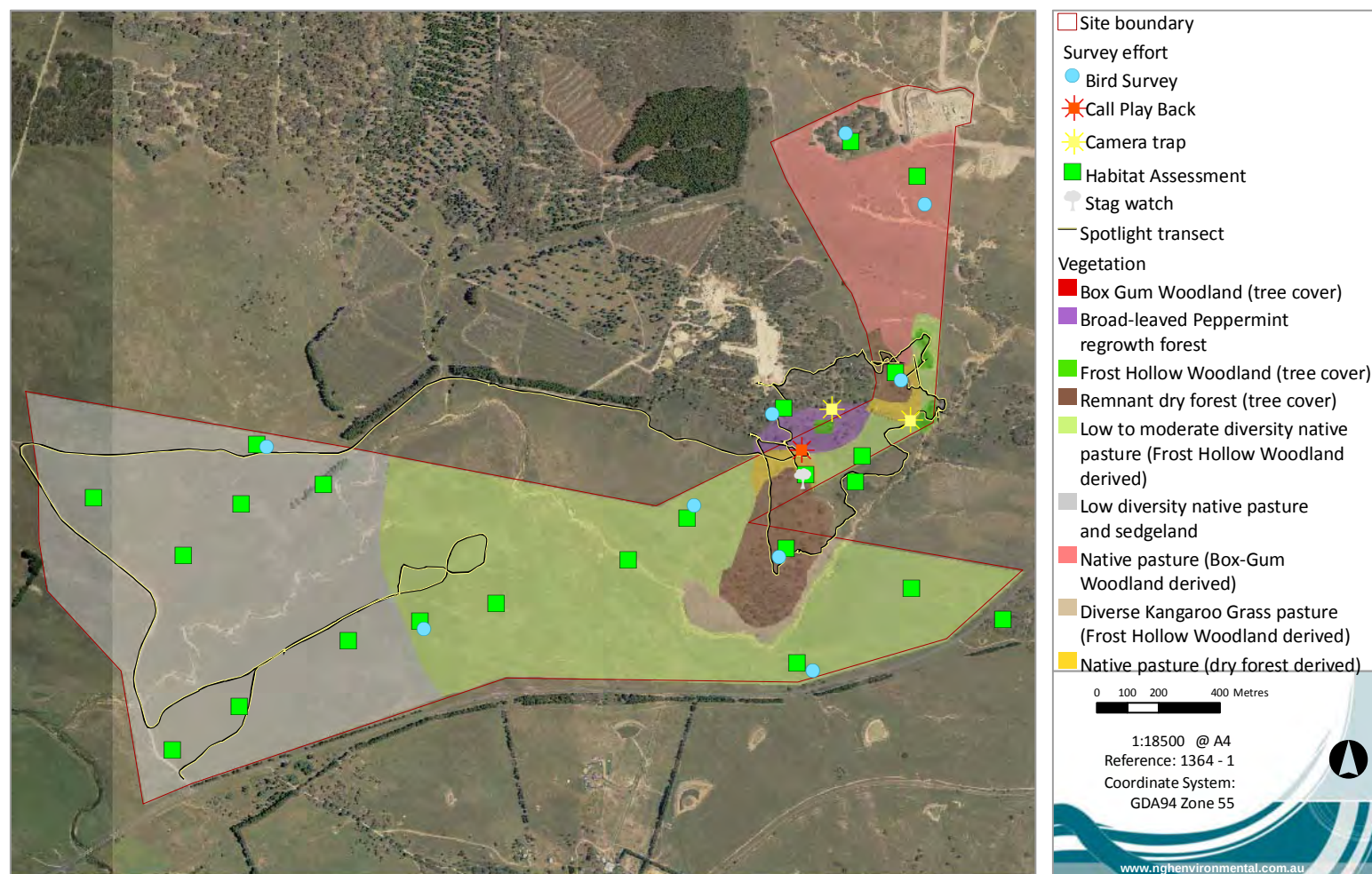
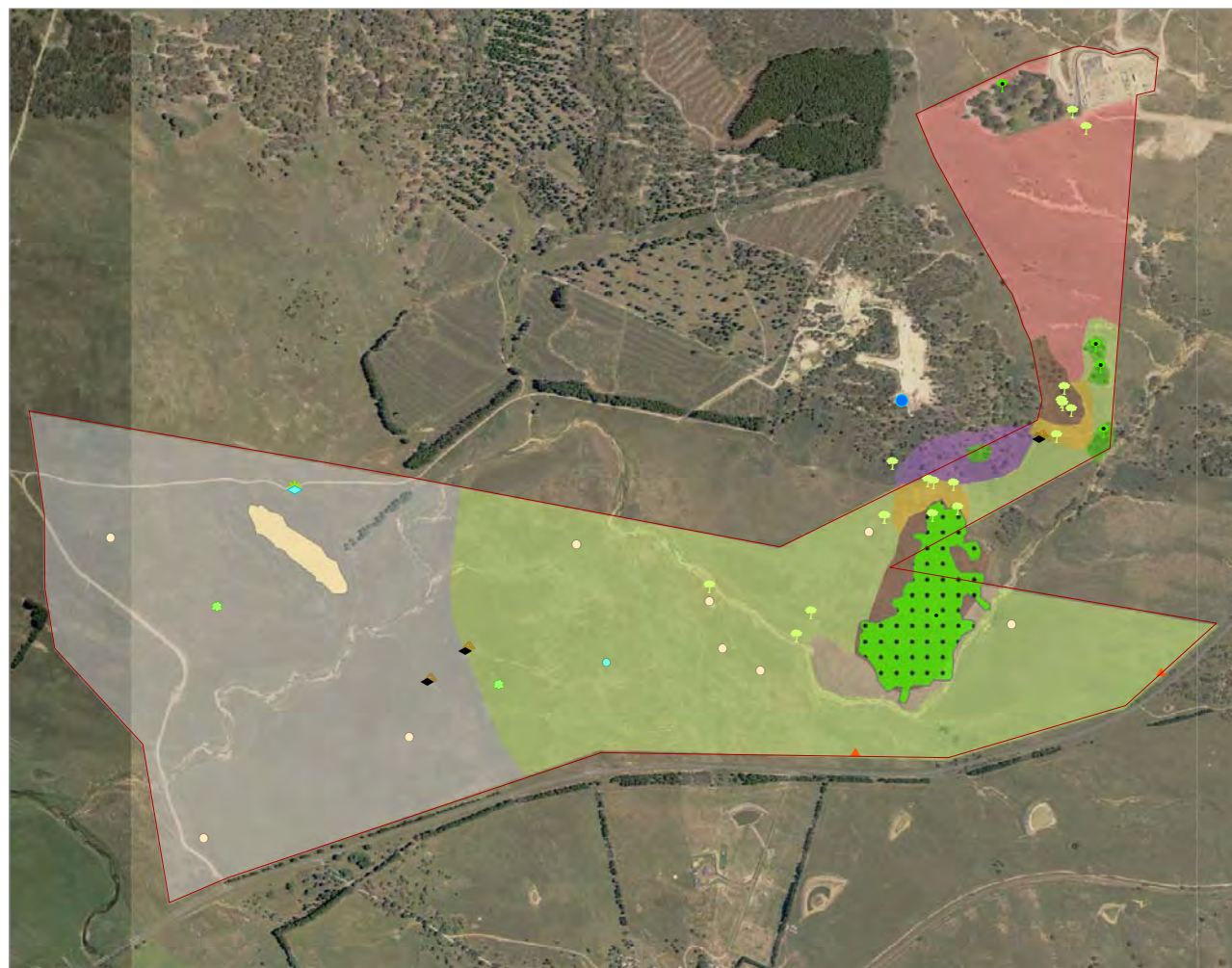


Figure 9-5 Fauna survey effort with vegetation type

HABITAT FEATURES MAP : PROPOSED SOLAR FARM, CAPITAL HILL

Prepared for:
infigen

- Site boundary
- Habitat feature
- Ephemeral pool
 - Dam
 - Rock outcrop
 - Small ephemeral wetland
 - Tea tree stand
 - Themeda patch
 - Hollow bearing tree
 - Tree
 - Wombat burrow
- Vegetation
- Box Gum Woodland (tree cover)
 - Broad-leaved Peppermint regrowth forest
 - Low to moderate diversity native pasture (Frost Hollow Woodland derived)
 - Low diversity native pasture and sedgeland
 - Native pasture (Box-Gum Woodland derived)
 - Native pasture (dry forest derived)
 - Diverse Kangaroo Grass pasture (Frost Hollow Woodland derived)
 - Remnant Frost Hollow Woodland (with tree cover)
 - Remnant dry forest with tree cover

Notes:

1.0 Layers prepared by nghenvironmental based on field work

2.0 Aerial photography provided by Infigen

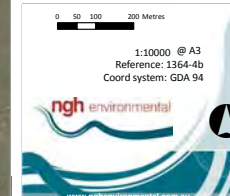


Figure 9-6 Habitat features

Appendix I Database searches

Commonwealth Matters of National Environmental Significance – report summary (biodiversity)

Search date: 8 July 2010

Search Type: Point

Buffer: 25 km

Coordinates: -35.20013,149.50821



Summary

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance (Ramsar):	1
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	2
Threatened Species:	21
Migratory Species:	23
Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Places on the RNE:	7
Listed Marine Species:	25
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None
State and Territory Reserves:	3
Other Commonwealth Reserves:	None
Regional Forest Agreements:	2

Details

Wetlands of International Significance (Ramsar)

Fivebough and Tuckerbill Swamps Within same catchment

Threatened Ecological Communities

Status Type of Presence

Natural Temperate Grassland of the Southern Tablelands of NSW and the ACT Endangered Community likely to occur within area

White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland Critically Endangered Community likely to occur within area

Threatened Species

Status Type of Presence

Birds

Anthochaera phrygia Endangered Species or species habitat likely to occur within area

Regent Honeyeater

[*Lathamus discolor*](#) Endangered Species or species habitat may occur within area

Swift Parrot

[*Polytelis swainsonii*](#) Vulnerable Species or species habitat may occur within area

Superb Parrot

[*Rostratula australis*](#) Vulnerable Species or species habitat may occur within area

Australian Painted Snipe

Frogs

Litoria aurea Vulnerable Species or species habitat likely to occur within area

Green and Golden Bell Frog

[*Litoria castanea*](#) Endangered Species or species habitat likely to occur within area

Yellow-spotted Tree Frog, Yellow-spotted Bell Frog

Litoria littlejohni Vulnerable Species or species habitat may occur within area

Littlejohn's Tree Frog, Heath Frog

[*Litoria raniformis*](#) Vulnerable Species or species habitat may occur within area

Growing Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog

Insects

[*Synemon plana*](#) Critically Endangered Species or species habitat may occur within area

Golden Sun Moth

Mammals

[*Dasyurus maculatus maculatus \(SE mainland population\)*](#) Endangered Species or species habitat may occur within area

Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)

[*Pteropus poliocephalus*](#) Vulnerable Species or species likely to occur within area

Grey-headed Flying-fox

Ray-finned fishes

[*Maccullochella peelii peelii*](#) Vulnerable Species or species habitat may occur within area

Murray Cod, Cod, Goodoo

[*Macquaria australasica*](#) Endangered Species or species habitat may occur within area

Macquarie Perch

Reptiles

[*Aprasia parapulchella*](#) Vulnerable Species or species habitat likely to occur within area

Pink-tailed Worm-lizard

[*Delma impar*](#)

Vulnerable

Species or species habitat likely to occur within area

Striped Legless Lizard

Plants*Caladenia tessellata*

Vulnerable

Species or species habitat likely to occur within area

Thick-lipped Spider-orchid, Daddy Long-legs

[*Calotis glandulosa*](#)

Vulnerable

Species or species habitat likely to occur within area

Mauve Burr-daisy

[*Diuris aequalis*](#)

Vulnerable

Species or species habitat likely to occur within area

Buttercup Doubletail

[*Dodonaea procumbens*](#)

Vulnerable

Species or species habitat likely to occur within area

Trailing Hop-bush

[*Leucochrysum albicans* var. *tricolor*](#)

Endangered

Species or species habitat likely to occur within area

Hoary Sunray

[*Thesium australe*](#)

Vulnerable

Species or species habitat likely to occur within area

Austral Toadflax, Toadflax

Migratory Species	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
<u><i>Haliaeetus leucogaster</i></u> White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
<u><i>Hirundapus caudacutus</i></u> White-throated Needletail	Migratory	Species or species habitat may occur within area
<u><i>Merops ornatus</i></u> Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
<u><i>Monarcha melanopsis</i></u> Black-faced Monarch	Migratory	Breeding may occur within area
<u><i>Myiagra cyanoleuca</i></u> Satin Flycatcher	Migratory	Breeding likely to occur within area
<u><i>Xanthomyza phrygia</i></u> Regent Honeyeater	Migratory	Species or species habitat likely to occur within area
Migratory Wetland Species		
Birds		
<u><i>Ardea alba</i></u> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<u><i>Ardea ibis</i></u> Cattle Egret	Migratory	Species or species habitat may occur within area
<u><i>Arenaria interpres</i></u> Ruddy Turnstone	Migratory	Species or species habitat known to occur within area
<u><i>Calidris acuminata</i></u> Sharp-tailed Sandpiper	Migratory	Species or species habitat known to occur within area
<u><i>Calidris canutus</i></u> Red Knot, Knot	Migratory	Species or species habitat known to occur within area
<u><i>Calidris ferruginea</i></u> Curlew Sandpiper	Migratory	Species or species habitat known to occur within area

<i>Calidris ruficollis</i> Red-necked Stint	Migratory	Species or species habitat known to occur within area
<i>Charadrius bicinctus</i> Double-banded Plover	Migratory	Species or species habitat known to occur within area
<i>Gallinago hardwickii</i> Latham's Snipe, Japanese Snipe	Migratory	Species or species habitat known to occur within area
<i>Numenius madagascariensis</i> Eastern Curlew	Migratory	Species or species habitat known to occur within area
<i>Numenius minutus</i> Little Curlew, Little Whimbrel	Migratory	Species or species habitat known to occur within area
<i>Pluvialis fulva</i> Pacific Golden Plover	Migratory	Species or species habitat known to occur within area
<i>Rostratula benghalensis s. lat.</i> Painted Snipe	Migratory	Species or species habitat may occur within area
<i>Tringa stagnatilis</i> Marsh Sandpiper, Little Greenshank	Migratory	Species or species habitat known to occur within area
Migratory Marine Birds		
<i>Apus pacificus</i> Fork-tailed Swift	Migratory	Species or species habitat may occur within area
<i>Ardea alba</i> Great Egret, White Egret	Migratory	Species or species habitat may occur within area
<i>Ardea ibis</i> Cattle Egret	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	Status	Type of Presence
Birds		
<i>Apus pacificus</i> Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
<i>Ardea alba</i> Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
<i>Ardea ibis</i> Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
<i>Arenaria interpres</i> Ruddy Turnstone	Listed	Species or species habitat known to occur within area
<i>Calidris acuminata</i> Sharp-tailed Sandpiper	Listed	Species or species habitat known to occur within area
<i>Calidris canutus</i> Red Knot, Knot	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Calidris ferruginea</i> Curlew Sandpiper	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Calidris melanotos</i> Pectoral Sandpiper	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Calidris ruficollis</i> Red-necked Stint	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Charadrius bicinctus</i> Double-banded Plover	Listed - overfly marine area	Species or species habitat known to occur within area

<i>Charadrius ruficapillus</i> Red-capped Plover	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Gallinago hardwickii</i> Latham's Snipe, Japanese Snipe	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Haliaeetus leucogaster</i> White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
<i>Himantopus himantopus</i> Black-winged Stilt	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Hirundapus caudacutus</i> White-throated Needletail	Listed - overfly marine area	Species or species habitat may occur within area
<i>Lathamus discolor</i> Swift Parrot	Listed - overfly marine area	Species or species habitat may occur within area
<i>Merops ornatus</i> Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
<i>Monarcha melanopsis</i> Black-faced Monarch	Listed - overfly marine area	Breeding may occur within area
<i>Myiagra cyanoleuca</i> Satin Flycatcher	Listed - overfly marine area	Breeding likely to occur within area
<i>Numenius madagascariensis</i> Eastern Curlew	Listed	Species or species habitat known to occur within area
<i>Numenius minutus</i> Little Curlew, Little Whimbrel	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Pluvialis fulva</i> Pacific Golden Plover	Listed	Species or species habitat known to occur within area
<i>Recurvirostra novaehollandiae</i> Red-necked Avocet	Listed - overfly marine area	Species or species habitat known to occur within area
<i>Rostratula benghalensis s. lat.</i> Painted Snipe	Listed - overfly marine area	Species or species habitat may occur within area
<i>Tringa stagnatilis</i> Marsh Sandpiper, Little Greenshank	Listed - overfly marine area	Species or species habitat known to occur within area

Commonwealth Lands

Communications, Information Technology and the Arts - Telstra Corporation Limited

Places on the RNE (not all Indigenous sites may be listed)

Historic

Bungendore Railway Station NSW

Colverwell Cemetery ACT

Manar Garden NSW

Manar House, Outbuildings and Garden NSW

Tarago Railway Station NSW

Turalla and Garden NSW

Natural

[Lake George Quaternary Site NSW](#)

Extra Information

State and Territory Reserves

Morton National Park, NSW

Scott Nature Reserve, NSW

Tallaganda National Park, NSW

Regional Forest Agreements

Australian Capital Territory

Southern RFA, New South Wales

Appendix J Qualifications

Name and role	Specialist skills and abilities
Nick Graham-Higgs B. Sc. (Ecol), MEIANZ, Assoc. Auditor (EMS Certification, Qual. Soc. Aust.) Project Director	Nick has worked as an environmental planning consultant since 1992, specialising in natural resource management. He has completed a wide range of assignments covering diverse natural and modified environments. Much of the work undertaken has been within higher altitude environments of NSW, being contracted by organisations such as Meridian, Epuron, Wind Prospects, Telstra, RTA, Snowy Hydro, Country Energy, Kosciuszko Thredbo Pty Ltd, the Parks & Wildlife Division of the Department of Environment and Climate Change (DECC), a number of councils (eg. Snowy River, Bega, Eurobodalla, Shoalhaven and Bombala Shire Councils), and a number of private clients. Work undertaken includes the preparation of varied and complex environmental planning, environmental impact assessments, natural resource surveys (flora and fauna surveys and assessments) and the preparation of environmental management plans. Nick has been Project Director of a number of Part 3A Environmental and Biodiversity Assessments, including for a number of significant renewable energy projects.
Paul McPherson Dip (Env Cont.), B. Sc (Nat. Res.) Project Officer	Since commencing at nghenvironmental in 1996, Paul has undertaken environmental assessments and prepared EIA reports for a wide range of proposals located in the Far South Coast, South Coast, Kosciuszko and Southern Tablelands regions. Paul has prepared a development constraints analysis for part of the Perisher Range, and a Human Waste Management Strategy for the Kosciuszko Main Range, and edited land rehabilitation guidelines drafted for the Australian Alps Liaison Committee. Paul has worked on a number of Part 3A Environmental Assessments for renewable energy proposals, including the Yass, Gullen and another site in southern tablelands.
Andrew Morrison B. Sc. (Res. Env. Man.) Project Officer (Zoology)	Andrew has a wide range of professional experience in land management specializing in biodiversity (pest/weed and threatened species) monitoring and management. For the five years previous to being employed with nghenvironmental Andrew has worked as a ranger in both the ACT and New Zealand. Prior to this he worked on the development of sustainable cropping systems for the CSIRO Division of Crop Adaptation. Andrew has a bachelor degree in Science Resource and Environmental Management from the ANU specialising in ecology. Andrew has worked on many threatened species recovery programs including five threatened species translocations and has designed novel monitoring techniques to assist with the evaluation of this work. He has undertaken survey projects on marine mammals, threatened invertebrates, birds, reptiles and mammals and has built up a sound knowledge of survey design and project management in the process. Andrew has undertaken zoological assessment for 3 wind farm proposals. He is also providing specialist advice in relation to a bat research program for a wind farm in the southern Highlands of NSW.

Appendix K Vegetation clearing guidelines

General clearing and trimming guidelines

- Tree and shrub removal should aim to minimise disturbance to soils, waterways and neighbouring vegetation. This may be achieved using a chainsaw for felling and a small excavator to remove the stump, working from disturbed ground where practicable.
- Non-hollow bearing vegetation should only be removed between January and July to avoid the breeding seasons of most forest and woodland fauna.
- Check for animals in the zone of disturbance before clearing and scare or remove them before beginning operations where possible. Re-check after clearing to ensure no animals have become trapped or injured during clearing operations.
- Clearly mark the limits of the vegetation to be removed and retained by differentiating with coloured flagging tape.
- Fell trees into the zone of disturbance to avoid damaging adjacent vegetation and do not push felled vegetation into areas to be retained.
- Retain tree hollows where practical when pruning branches.
- Take care when moving equipment near native vegetation to be retained.
- Mulch rather than burn cleared native vegetation. Where possible, consider distributing some logs from the felled trees into areas of vegetation to be retained where it would not be considered a fire hazard. This would provide additional habitat for ground dwelling fauna such as reptiles and small mammals.

Clearing Hollow Bearing Trees

- Medium and large trees with hollows or cracks which may be used by fauna such as mammals, birds and bats which are required to be removed should be inspected prior to removal.
- Hollow-bearing tree (HBT) removal should be conducted between January to March to avoid the breeding seasons of bats, birds and hollow-bearing dependant fauna.
- Clearly mark the HBT to be removed and/or retained by differentiating with coloured flagging tape.
- Remove all non-hollow bearing vegetation prior to the removal of HBT.
- Where possible, leave HBT standing for at least one night after other clearing to allow any fauna the opportunity to remove themselves after site disturbance.
- Before felling HBT, tap along trunk using an excavator or loader to scare animals from the hollows. Repeat several times. The aim of this is to 'substantially' shake the tree. Most fauna will exit the tree during this process.
- For medium-large hollow-bearing trees which may contain arboreal mammals, sectional removal should be used with a suitably qualified and licensed zoologist or trained wildlife carer present. This person should ensure that any fauna found is safely located to nearby habitat.

- When using sectional removal, the non-hollow-bearing branches should be removed before the hollow-bearing branches.

Use and disposal of cleared vegetation

- Non-weedy vegetation can be mulched and re-used for site stabilisation and rehabilitation. Vegetation that contains weeds should not be re-used as mulch on any part of the site.
- Large tree trunks and limbs, particularly hollows, may be useful for ground habitat restoration or resnagging projects either near or distant from the clearing site. These resources may be stored at an appropriate site until a suitable project is found.
- Mulched plant material should be shredded when it is first cut, and allowed to decompose while the works are carried out. The decomposing pile should be stockpiled in a weed free area and turned weekly to prevent overheating and possible spontaneous combustion.
- Loose mulch should not be used in areas subject to significant surface water flows during rain.
- Cleared vegetation that is not needed for mulch should be removed from the site or burnt in an open area, well away from retained trees, intact native vegetation and runoff flow paths.

Appendix L Raw Data

COORDINATES:

Collected with a Magellan Triton hand held GPS using GDA94 datum - average error 5m

ACTIVITY:

CPB= Call play back

Foot spot= foot spotlight

Vehicle spot= vehicle spotlight

LOCATION

H#= habitat assessment site (see Appendix B for site descriptions)

STAFF:

AM = Andrew Morrison

OBSERVATIONS:

O= observed

H= heard

S=sign

No. = number of that species see during the survey

Latitude	Longitude	Date	activity	Start Time 24 hr	Finish Time 24 hr	TOTAL MINUTES	Common Name	Scientific Name	Location	Staff	Observations	No.	conditions
-35.19013327	149.5231651	15/07/2010	BirdSurvey	1230	1250	20	Crested Pigeon	<i>Ocyphaps lophotes</i>	H1	AM	O	2	windy, cool - cold, cloud 2/8
-35.19013327	149.5231651	15/07/2010	Bird Survey				Richard's Pipit	<i>Anthus novaeseelandiae</i>	H1	AM	O	2	windy, cool - cold, cloud 2/8
-35.19013327	149.5231651	15/07/2010	Bird Survey				Australian Magpie	<i>Gymnorhina tibicen</i>	H1	AM	O	1	windy, cool - cold, cloud 2/8
-35.18931	149.52288	15/07/2010	opportunistic				Eastern Grey Kangaroo	<i>Macropus giganteus</i>	H1	AM	O	2	windy, cool - cold, cloud 2/8
-35.18813577	149.5202738	15/07/2010	Bird Survey	1300	1320	20	Noisy Miner	<i>Manorina melanocephala</i>	H2	AM	O	8	windy, cool - cold, cloud 2/8
-35.18813577	149.5202738	15/07/2010	Bird Survey				Australian Magpie	<i>Gymnorhina tibicen</i>	H2	AM	O	3	windy, cool - cold, cloud 2/8
-35.18813577	149.5202738	15/07/2010	Bird Survey				Galah	<i>Cacatua roseicapilla</i>	H2	AM	O	2	windy, cool - cold, cloud 2/8
-35.18813577	149.5202738	15/07/2010	Bird Survey				Eastern Rosella	<i>Platycercus eximius</i>	H2	AM	O	5	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey	1330	1350	20	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	H3	AM	O	9	windy, cool - cold, cloud 2/8
-35.19418281	149.523231	15/07/2010	Bird Survey				Flame Robin	<i>Petroica phoenicea</i>	H3	AM	O	2	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Australian Magpie	<i>Gymnorhina tibicen</i>	H3	AM	O	3	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	H3	AM	O	1	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Superb Fairy-wren	<i>Malurus cyaneus</i>	H3	AM	O	4	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Little Raven	<i>Corvus mellori</i>	H3	AM	O	2	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Red WattleBird Survey	<i>Anthochaera carunculata</i>	H3	AM	O	1	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	H3	AM	O	1	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Striated Thornbill	<i>Acanthiza lineata</i>	H3	AM	O	4	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Striated Pardalote	<i>Pardalotus striatus</i>	H3	AM	H	.	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Crimson Rosella	<i>Platycercus elegans</i>	H3	AM	O	2	windy, cool - cold, cloud 2/8
-35.19528967	149.5224843	15/07/2010	Bird Survey				Magpie-lark	<i>Grallina cyanoleuca</i>	H3	AM	H	.	windy, cool - cold, cloud 2/8
-35.19509	149.522267	15/07/2010	opportunistic				Eastern Grey Kangaroo	<i>Macropus giganteus</i>	H3	AM	S	.	windy, cool - cold, cloud 2/8
-35.198363	149.521929	15/07/2010	opportunistic				Flame Robin	<i>Petroica phoenicea</i>	H3	AM	O	2	windy, cool - cold, cloud 2/8
-35.19509	149.522267	15/07/2010	opportunistic				Fallow Deer	<i>Cervus dama</i>	H3	AM	O	>20	windy, cool - cold, cloud 2/8
-35.19509	149.522267	15/07/2010	opportunistic				Common Wombat	<i>Vombatus ursinus</i>	H3	AM	S	.	windy, cool - cold, cloud 2/8
-35.19509	149.522267	15/07/2010	opportunistic				European Rabbit	<i>Oryctolagus cuniculus</i>	H3	AM	S	.	windy, cool - cold, cloud 2/8
-35.19914748	149.5152209	15/07/2010	Bird Survey				Australian Magpie	<i>Gymnorhina tibicen</i>	H7	AM	O	1	windy, cool - cold, cloud 2/8
-35.19914748	149.5152209	15/07/2010	Bird Survey				Common Starling	<i>Sturnus vulgaris</i>	H7	AM	O	2	windy, cool - cold, cloud 2/8

Latitude	Longitude	Date	activity	Start Time 24 hr	Finish Time 24 hr	TOTAL MINUTES	Common Name	Scientific Name	Location	Staff	Observations	No.	conditions
-35.19914748	149.5152209	15/07/2010	Bird Survey				Richard's Pipit	<i>Anthus novaeseelandiae</i>	H7	AM	O	1	windy, cool - cold, cloud 2/8
-35.19914748	149.5152209	15/07/2010	Bird Survey				Australian Raven	<i>Corvus coronoides</i>	H7	AM	O	1	windy, cool - cold, cloud 2/8
-35.19914748	149.5152209	15/07/2010	Bird Survey				Skylark	<i>Alauda arvensis</i>	H7	AM	H	.	windy, cool - cold, cloud 2/8
-35.19914748	149.5152209	15/07/2010	Bird Survey				Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	H7	AM	O	1	windy, cool - cold, cloud 2/8
-35.198257	149.519061	15/07/2010	Stag watch	1740	1820	40	.	.	H6	AM	.	.	cold, clear 1/8, moon >1/4, windy to breezy
-35.197411	149.519007	15/07/2010	CPB	1830	1850	20	.	.	H6	AM	.	.	cold, clear 1/8, moon >1/4, calm
track available on request	15/07/2010	Foot spot	1850	1950	60	European Rabbit	<i>Oryctolagus cuniculus</i>	H3	AM	O	6	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Eastern Grey Kangaroo	<i>Macropus giganteus</i>	H10, H17 H3, H9, H1, H6, H9, H4, H10	AM	O	15	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Fallow Deer	<i>Cervus dama</i>	H17	AM	O	24	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Common Wombat	<i>Vombatus ursinus</i>	H9, H4, H10	AM	O	7	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Red Fox	<i>Vulpes vulpes</i>	H17	AM	O	1	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Brown Hare	<i>Lepus capensis</i> <i>Pseudocheirus</i>	H17	AM	O	2	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Common Ringtail Possum	<i>peregrinus</i> <i>Litoria verreauxii</i>	H9	AM	O	1	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Whistling Tree Frog	<i>verreauxii</i>	H9	AM	H	2	cold, clear 1/8, moon >1/4, breezy becoming calm	
track available on request	15/07/2010	Foot spot				Common Froglet	<i>Crinia signifera</i>	H9	AM	H	15	cold, clear 1/8, moon >1/4, calm	
-35.197411	149.519007	15/07/2010	CPB	1950	2010	20	.	.	H6	AM			cold, clear 1/8, moon >1/4, breezy becoming calm
track available on request	15/07/2010	vehicle spot	2010	2050	50	European Rabbit	<i>Oryctolagus cuniculus</i>	H13, H17	AM	O	3	cold, clear 1/8, moon >1/4, calm	
track available on request	15/07/2010	vehicle spot				Eastern Grey Kangaroo	<i>Macropus giganteus</i>	H17 adjacent North of subject site	AM	O	4	cold, clear 1/8, moon >1/4, calm	
track available on request	15/07/2010	vehicle spot				Swamp Wallaby	<i>Wallabia bicolor</i>		AM	O	1	cold, clear 1/8, moon >1/4, calm	
track available on request	15/07/2010	vehicle spot				Fallow Deer	<i>Cervus dama</i>	H15 adjacent North of subject site	AM	O	30	cold, clear 1/8, moon >1/4, calm	
track available on request	15/07/2010	vehicle spot				Cat (feral)	<i>Felis catus</i>		AM	O	1	cold, clear 1/8, moon >1/4, calm	
track available on request	15/07/2010	vehicle spot				Common Froglet	<i>Crinia signifera</i>	creek	AM	H	5	cold, clear 1/8, moon >1/4, calm	
track available on request	15/07/2010	vehicle spot				Stubble Quail	<i>Coturnix pectoralis</i>	H12	AM	O	1	cold, clear 1/8, moon >1/4, calm	

Latitude	Longitude	Date	activity	Start Time 24 hr	Finish Time 24 hr	TOTAL MINUTES	Common Name	Scientific Name	Location	Staff	Observations	No.	conditions
track available on request		15/07/2010	vehicle spot				Richard's Pipit	<i>Anthus novaeseelandiae</i>	H12	AM	O	1	cold, clear 1/8, moon >1/4, calm
-35.19638379	149.5179085	16/07/2010	Bird Survey	830	900	30	Australian Magpie	<i>Gymnorhina tibicen</i>	H9	AM	H	.	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Galah	<i>Cacatua roseicapilla</i>	H9	AM	O	2	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Striated Thornbill	<i>Acanthiza lineata</i>	H9	AM	O	5	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Eastern Rosella	<i>Platycercus eximius</i>	H9	AM	O	2	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	H9	AM	O	6	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	H9	AM	H	.	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Red WattleBird Survey	<i>Anthochaera carunculata</i>	H9	AM	O	2	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Superb Fairy-wren	<i>Malurus cyaneus</i>	H9	AM	O	3	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	H9	AM	O	1	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Crimson Rosella	<i>Platycercus elegans</i>	H9	AM	O	6	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Australian Raven	<i>Corvus coronoides</i>	H9	AM	H	.	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Yellow Thornbill	<i>Acanthiza nana</i>	H9	AM	O	4	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Grey Shrike-thrush	<i>Colluricincla harmonica</i>	H9	AM	H	.	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>	H9	AM	O	2	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				White-browed Scrubwren	<i>Sericornis frontalis</i>	H9	AM	O	3	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Magpie-lark	<i>Grallina cyanoleuca</i>	H9	AM	O	1	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>	H9	AM	H	.	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Willie Wagtail	<i>Rhipidura leucophrys</i>	H9	AM	O	1	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Striated Pardalote	<i>Pardalotus striatus</i>	H9	AM	H	.	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Australian Wood Duck	<i>Chenonetta jubata</i>	H9	AM	O	4	Cold, clear, frosty, still
-35.195679	149.516869	16/07/2010	Bird Survey				Speckled Warbler	<i>Chthonicola sagittata</i>	H9	AM	O	3	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Pied Currawong	<i>Strepera graculina</i>	H9	AM	O	1	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				White-winged Chough	<i>Corcorax melanorhamphos</i>	H9	AM	O	5	Cold, clear, frosty, still
-35.19638379	149.5179085	16/07/2010	Bird Survey				Pacific Black Duck	<i>Anas superciliosa</i>	H9	AM	O	2	Cold, clear, frosty, still
-35.20057901	149.5183024	16/07/2010	Bird Survey	930	950	20	Australian Magpie	<i>Gymnorhina tibicen</i>	H10	AM	O	2	clear, still
-35.20057901	149.5183024	16/07/2010	Bird Survey				Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	H10	AM	O	1	clear, still

Latitude	Longitude	Date	activity	Start Time 24 hr	Finish Time 24 hr	TOTAL MINUTES	Common Name	Scientific Name	Location	Staff	Observations	No.	conditions
-35.20057901	149.5183024	16/07/2010	Bird Survey				Skylark	<i>Alauda arvensis</i>	H10	AM	H	.	clear, still
-35.20057901	149.5183024	16/07/2010	Bird Survey				Australian Raven	<i>Corvus coronoides</i>	H10	AM	H	.	clear, still
-35.20057901	149.5183024	16/07/2010	Bird Survey				Australian Wood Duck	<i>Chenonetta jubata</i>	H10	AM	O	3	clear, still
-35.20057901	149.5183024	16/07/2010	Bird Survey				Common Starling	<i>Sturnus vulgaris</i>	H10	AM	O	5	clear, still
-35.20057901	149.5183024	16/07/2010	Bird Survey				Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	H10	AM	O	7	clear, still
-35.19772541	149.499929	16/07/2010	Bird Survey	1100	1120	20	Australian Shelduck	<i>Tadorna tadornoides</i>	H23	AM	O	6	clear, still
-35.19772541	149.499929	16/07/2010	Bird Survey				White-faced Heron	<i>novaeollandiae</i>	H23	AM	O	1	clear, still
-35.19772541	149.499929	16/07/2010	Bird Survey				Australian Wood Duck	<i>Chenonetta jubata</i>	H23	AM	O	2	clear, still
-35.19772541	149.499929	16/07/2010	Bird Survey				Pacific Black Duck	<i>Anas superciliosa</i>	H23	AM	O	2	clear, still
-35.19772541	149.499929	16/07/2010	Bird Survey				Welcome Swallow	<i>Hirundo neoxena</i>	H23	AM	O	6	clear, still
-35.19772541	149.499929	16/07/2010	Bird Survey				Common Starling	<i>Sturnus vulgaris</i>	H23	AM	O	3	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey	1140	1200	20	Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	H14	AM	O		clear, still
-35.204782	149.505903	16/07/2010	Bird Survey				Flame Robin	<i>Petroica phoenicea</i>	H14	AM	O	4	clear, still
-35.20250429	149.5055829	16/07/2010	Bird Survey				White-fronted Chat	<i>Epthianura albifrons</i>	H14	AM	O	20	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey				Welcome Swallow	<i>Hirundo neoxena</i>	H14	AM	O	3	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey				Willie Wagtail	<i>Rhipidura leucophrys</i>	H14	AM	H	.	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey				Skylark	<i>Alauda arvensis</i>	H14	AM	O	2	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey				Richard's Pipit	<i>novaezeelandiae</i>	H14	AM	O	1	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey				Little Raven	<i>Corvus mellori</i>	H14	AM	O	2	clear, still
-35.20294961	149.5056923	16/07/2010	Bird Survey				Common Starling	<i>Sturnus vulgaris</i>	H14	AM	O	3	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey	1300	1320	20	Common Starling	<i>Sturnus vulgaris</i>	H16	AM	O	1	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				Crimson Rosella	<i>Platycercus elegans</i>	H16	AM	O	2	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				MistletoeBird Survey	<i>hirundinaceum</i>	H16	AM	O	1	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				European Goldfinch	<i>Carduelis carduelis</i>	H16	AM	O	4	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				Striated Pardalote	<i>Pardalotus striatus</i>	H16	AM	H	.	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				Pied Currawong	<i>Strepera graculina</i>	H16	AM	O	2	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				Galah	<i>Cacatua roseicapilla</i>	H16	AM	H	.	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				Superb Fairy-wren	<i>Malurus cyaneus</i>	H16	AM	H	.	clear, still

Latitude	Longitude	Date	activity	Start Time 24 hr	Finish Time 24 hr	TOTAL MINUTES	Common Name	Scientific Name	Location	Staff	Observations	No.	conditions
-35.20389796	149.5195902	16/07/2010	Bird Survey				Grey Shrike-thrush	<i>Colluricincla harmonica</i>	H16	AM	H	.	clear, still
-35.20389796	149.5195902	16/07/2010	Bird Survey				Australian Wood Duck	<i>Chenonetta jubata</i>	H16 adjacent to H11 (south)	AM	H	.	clear, still
		16/07/2010	Opportunistic				Brown Falcon	<i>Falco berigora</i>		AM	O	1	clear, still
-35.200591	149.522138	16/07/2010	Opportunistic				White-fronted Chat	<i>Epthianura albifrons</i>	H17	AM	O	15	clear, still
		16/07/2010	Opportunistic				Nankeen Kestrel	<i>Falco cenchroides</i>	H22	AM	O	2	clear, still
		16/07/2010	Opportunistic				Peregrine Falcon	<i>Falco peregrinus</i>	H11	AM	O	1	clear, still