Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Referral of proposed action

What is a referral?

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) provides for the protection of the environment, especially matters of national environmental significance (NES). Under the EPBC Act, a person must not take an action that has, will have, or is likely to have a significant impact on any of the matters of NES without approval from the Australian Government Environment Minister or the Minister's delegate. (Further references to 'the Minister' in this form include references to the Minister's delegate.) To obtain approval from the Environment Minister, a proposed action should be referred. The purpose of a referral is to obtain a decision on whether your proposed action will need formal assessment and approval under the EPBC Act.

Your referral will be the principal basis for the Minister's decision as to whether approval is necessary and, if so, the type of assessment that will be undertaken. These decisions are made within 20 business days, provided sufficient information is provided in the referral.

Who can make a referral?

Referrals may be made by or on behalf of a person proposing to take an action, the Commonwealth or a Commonwealth agency, a state or territory government, or agency, provided that the relevant government or agency has administrative responsibilities relating to the action.

When do I need to make a referral?

A referral must be made for actions that are likely to have a significant impact on the following matters protected by Part 3 of the EPBC Act:

- World Heritage properties (sections 12 and 15A)
- National Heritage places (sections 15B and 15C)
- Wetlands of international importance (sections 16 and 17B)
- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A)
- Protection of the environment from nuclear actions (sections 21 and 22A)
- Commonwealth marine environment (sections 23 and 24A)
- Great Barrier Reef Marine Park (sections 24B and 24C)
- A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
- The environment, if the action involves Commonwealth land (sections 26 and 27A), including:
    - actions that are likely to have a significant impact on the environment of Commonwealth land (even if taken outside Commonwealth land);
    - actions taken on Commonwealth land that may have a significant impact on the environment generally;
- The environment, if the action is taken by the Commonwealth (section 28)
- Commonwealth Heritage places outside the Australian jurisdiction (sections 27B and 27C)

You may still make a referral if you believe your action is not going to have a significant impact, or if you are unsure. This will provide a greater level of certainty that Commonwealth assessment requirements have been met.

To help you decide whether or not your proposed action requires approval (and therefore, if you should make a referral), the following guidance is available from the Department's website:

- the Policy Statement titled Significant Impact Guidelines 1.1 – Matters of National Environmental Significance. Additional sectoral guidelines are also available.
- the Policy Statement titled Significant Impact Guidelines 1.2 - Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies.

- the draft Policy Statement titled Significant Impact Guidelines: Coal seam gas and large coal mining developments—Impacts on water resources.
- the interactive map tool (enter a location to obtain a report on what matters of NES may occur in that location).

Can I refer part of a larger action?

In certain circumstances, **the Minister may not accept a referral for an action that is a component of a larger action and may request the person proposing to take the action to refer the larger action for consideration under the EPBC Act (Section 74A, EPBC Act).** If you wish to make a referral for a staged or component referral, read 'Fact Sheet 6 Staged Developments/Split Referrals' and contact the Referral Business Entry Point (1800 803 772).

Do I need a permit?

Some activities may also require a permit under other sections of the EPBC Act or another law of the Commonwealth. Information is available on the Department's web site.

Is your action in the Great Barrier Reef Marine Park?

If your action is in the Great Barrier Reef Marine Park it may require permission under the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act). If a permission is required, referral of the action under the EPBC Act is deemed to be an application under the GBRMP Act (see section 37AB, GBRMP Act). This referral will be forwarded to the Great Barrier Reef Marine Park Authority (the Authority) for the Authority to commence its permit processes as required under the Great Barrier Reef Marine Park Regulations 1983. If a permission is not required under the GBRMP Act, no approval under the EPBC Act is required (see section 43, EPBC Act). The Authority can provide advice on relevant permission requirements applying to activities in the Marine Park.

The Authority is responsible for assessing applications for permissions under the GBRMP Act, GBRMP Regulations and Zoning Plan. Where assessment and approval is also required under the EPBC Act, a single integrated assessment for the purposes of both Acts will apply in most cases. Further information on environmental approval requirements applying to actions in the Great Barrier Reef Marine Park is available from http://www.gbrmpa.gov.au/ or by contacting GBRMPA's Environmental Assessment and Management Section on (07) 4750 0700.

The Authority may require a permit application assessment fee to be paid in relation to the assessment of applications for permissions required under the GBRMP Act, even if the permission is made as a referral under the EPBC Act. Further information on this is available from the Authority:

Great Barrier Reef Marine Park Authority

2-68 Flinders Street PO Box 1379
Townsville QLD 4810
AUSTRALIA

Phone: + 61 7 4750 0700
Fax: + 61 7 4772 6093

www.gbrmpa.gov.au

What information do I need to provide?

Completing all parts of this form will ensure that you submit the required information and will also assist the Department to process your referral efficiently. If a section of the referral document is not applicable to your proposal enter N/A.

You can complete your referral by entering your information into this Word file.

Instructions

Instructions are provided in blue text throughout the form.

Attachments/supporting information

The referral form should contain sufficient information to provide an adequate basis for a decision on the likely impacts of the proposed action. You should also provide supporting documentation, such as environmental reports or surveys, as attachments.

Coloured maps, figures or photographs to help explain the project and its location should also be submitted with your referral. Aerial photographs, in particular, can provide a useful perspective and context. Figures should be good

quality as they may be scanned and viewed electronically as black and white documents. Maps should be of a scale that clearly shows the location of the proposed action and any environmental aspects of interest.

Please ensure any attachments are below three megabytes (3mb) as they will be published on the Department's website for public comment. To minimise file size, enclose maps and figures as separate files if necessary. If unsure, contact the Referral Business Entry Point (email address below) for advice. Attachments larger than three megabytes (3mb) may delay processing of your referral.

Note: the Minister may decide not to publish information that the Minister is satisfied is commercial-in-confidence.

How do I submit a referral?

Referrals may be submitted by mail or email.

Mail to:

Referral Business Entry Point
Environment Assessment Branch
Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
CANBERRA ACT 2601

- If submitting via mail, electronic copies of documentation (on CD/DVD or by email) are required.

Email to: epbc.referrals@environment.gov.au

- Clearly mark the email as a 'Referral under the EPBC Act'.
- Attach the referral as a Microsoft Word file and, if possible, a PDF file.
- **Follow up with a mailed hardcopy including copies of any attachments or supporting reports.**

What happens next?

Following receipt of a valid referral (containing all required information) you will be advised of the next steps in the process, and the referral and attachments will be published on the Department's web site for public comment.

The Department will write to you within 20 business days to advise you of the outcome of your referral and whether or not formal assessment and approval under the EPBC Act is required. There are a number of possible decisions regarding your referral:

The proposed action is NOT LIKELY to have a significant impact and does NOT NEED approval

No further consideration is required under the environmental assessment provisions of the EPBC Act and the action can proceed (subject to any other Commonwealth, state or local government requirements).

The proposed action is NOT LIKELY to have a significant impact IF undertaken in a particular manner

The action can proceed if undertaken in a particular manner (subject to any other Commonwealth, state or local government requirements). The particular manner in which you must carry out the action will be identified as part of the final decision. You must report your compliance with the particular manner to the Department.

The proposed action is LIKELY to have a significant impact and does NEED approval

If the action is likely to have a significant impact a decision will be made that it is a *controlled action*. The particular matters upon which the action may have a significant impact (such as World Heritage values or threatened species) are known as the *controlling provisions*.

The controlled action is subject to a public assessment process before a final decision can be made about whether to approve it. The assessment approach will usually be decided at the same time as the controlled action decision. (Further information about the levels of assessment and basis for deciding the approach are available on the Department's web site.)

The proposed action would have UNACCEPTABLE impacts and CANNOT proceed

The Minister may decide, on the basis of the information in the referral, that a referred action would have clearly unacceptable impacts on a protected matter and cannot proceed.

Compliance audits

If a decision is made to approve a project, the Department may audit it at any time to ensure that it is completed in accordance with the approval decision or the information provided in the referral. If the project changes, such that the

likelihood of significant impacts could vary, you should write to the Department to advise of the changes. If your project is in the Great Barrier Reef Marine Park and a decision is made to approve it, the Authority may also audit it. (See "*Is your action in the Great Barrier Reef Marine Park,*" p.2, for more details).

For more information

- call the Department of Sustainability, Environment, Water, Populations and Communities Community Information Unit on 1800 803 772 or
- visit the web site www.environment.gov.au/epbc

All the information you need to make a referral, including documents referenced in this form, can be accessed from the above web site.

Referral of proposed action

Project title: Rye Park Wind Farm

1 Summary of proposed action

NOTE: You must also attach a map/plan(s) and associated geographic information system (GIS) vector (shapefile) dataset showing the location and approximate boundaries of the area in which the project is to occur. Maps in A4 size are preferred. You must also attach a map(s)/plan(s) showing the location and boundaries of the project area in respect to any features identified in 3.1 & 3.2, as well as the extent of any freehold, leasehold or other tenure identified in 3.3(i).

1.1 **Short description**

The proposed Rye Park Wind Farm involves the construction and operation of up to 126 wind turbines, together with the associated wind farm infrastructure including access tracks, operation and maintenance facilities and electrical infrastructure required to connect the project to the existing national electricity grid.

1.2 **Longitude and Latitude**

Several coordinate points have been selected across the site along the wind farm boundary. The selected coordinate points are listed in the Attached Table 2. A map of the selected coordinate points and the site boundary is shown in the Attached Figure 1. The GIS files of the above points and site boundary is attached in the Attached GIS folder.

1.3 **Locality and property description**

The project site is generally located to the north of Yass and southeast of Boorowa, New South Wales. The site sits on the edge of the Southern Tablelands and the South West Slopes in the vicinity of the rural township of Rye Park. The site is approximately 250 km south west of Sydney and is located on freehold and leasehold land within and adjacent to agricultural areas, predominantly used for grazing sheep and cattle.

1.4	**Size of the development footprint or work area (hectares)**	The rural properties associated with the development of the wind farm and overhead powerlines have a total land area of approximately 14,000 hectares. At the time of this assessment, the proposal included scope for the development of 126 turbines. The proposal would result in the removal of vegetation under the development footprint, including the turbine towers and surrounding hardstand and crane operation areas, substation and control building and access tracks. Electrical cabling would be installed within areas disturbed for the access tracks. The actual development footprint within the project area has been determined based on worse case impact areas (i.e. the maximum amount of vegetation that would be removed as part of the action). Under this scenario, approximately 240 hectares of vegetation would be cleared. However it should be noted that some total habitat loss figures are *overestimated* due to overlaps of infrastructure, for example tracks crossing hardstand areas and tracks within overhead transmission easements. Therefore the realised development footprint is likely to be less than 240 hectares. Clearing of vegetation for this action does not constitute large-scale blanket clearing, but rather a series of relatively discrete footprints across the development corridor. Infrastructure, specifically turbines and overhead powerline poles, can be micro-sited to avoid sensitive areas and therefore the clearance footprints will not affect large areas of good quality vegetation.
1.5	**Street address of the site**	N/A

1.6 **Lot description**

Land Lot and DP numbers for the project site is listed in the Attachment **Error! Not a valid result for table.**. A map of all involved landowner land parcels as listed in **Error! Not a valid result for table.** is shown in maps included in Attached Figures 2 and 3.

1.7 **Local Government Area and Council contact (if known)**

The project area is located within the boundaries of the following three Local Government Areas (LGAs): Yass Valley, Upper Lachlan and Boorowa. Council representatives involved with the project who are also community consultation committee members are listed below;

Yass Valley	- Councillor Ann Daniel
Upper Lachlan	- Councillor James Wheelwright
Boorowa	- Mayor Wendy Tuckerman

1.8 **Time frame**

Specify the time frame in which the action will be taken including the estimated start date of construction/operation.

The duration of the construction phase would be approximately 12-18 months. The date for start of construction is yet to be confirmed but could be as early as 2015, pending project approval.

1.9	**Alternatives to proposed action** Were any feasible alternatives to taking the proposed action (including not taking the action) considered but are not proposed?	X	No
			Yes, you must also complete section 2.2
1.10	**Alternative time frames etc** Does the proposed action include alternative time frames, locations or activities?		No
		X	Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).
1.11	**State assessment** Is the action subject to a state or territory environmental impact assessment?		No
		X	Yes, you must also complete Section 2.5
1.12	**Component of larger action** Is the proposed action a component of a larger action?	X	No
			Yes, you must also complete Section 2.7
1.13	**Related actions/proposals** Is the proposed action related to other actions or proposals in the region (if known)?	X	No
			Yes, provide details:
1.14	**Australian Government funding** Has the person proposing to take the action received any Australian Government grant funding to undertake this project?	X	No
			Yes, provide details:
1.15	**Great Barrier Reef Marine Park** Is the proposed action inside the Great Barrier Reef Marine Park?	X	No
			Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

NOTE: It is important that the description is complete and includes all components and activities associated with the action. If certain related components are not intended to be included within the scope of the referral, this should be clearly explained in section 2.7.

2.1 Description of proposed action

This should be a detailed description outlining all activities and aspects of the proposed action and should reference figures and/or attachments, as appropriate.

The proposed Rye Park Wind Farm will involve the construction and installation of the following infrastructure components, including;

- up to 126 wind turbines, each with:
  - a capacity between 1.5 and 3.0 MW;
  - three blades mounted on a tubular steel tower, with a combined height of blade and tower limited to a maximum tip height of 157 metres;
  - an adjacent pad mounted wind turbine transformer, crane hardstand area, and related turbine lay down area;
- a new 330 kV wind farm connection substation located adjacent to the existing TransGrid 330 kV transmission line (Yass – Bannaby) that traverses the southern section of the site;
- up to two new 22 or 33/330 kV collection substations located across the wind farm;
- a new overhead powerline approximately 35 km in length, rated at up to 330 kV (nominal) capacity, running north-south along the length of the wind farm site to the two collection substations. The new powerline would be mounted on a single pole type structure and may be single-circuit or double-circuit as required;
- underground and overhead 22 or 33 kV electrical cabling linking the wind turbines to the on-site collection substations and connection substation. This will include the crossing of existing roads such as Rye Park Rugby Road toward the northern end of the site and Blakney Creek Road toward the southern end of the site;
- an operation and maintenance facility incorporating a control room and equipment storage facilities;
- temporary concrete batching plants and construction facilities;
- access tracks required for each wind turbine and the related facilities above;
- minor upgrades to local roads, as required for the delivery, installation and maintenance of wind turbines and the related facilities above; and
- up to six permanent monitoring masts for wind speed verification, weather and general monitoring purposes. The permanent monitoring masts may be either static guyed or un-guyed structures and will be to a minimum height of the wind turbine hubs.

Calculation of impact areas includes a 50 m radius around each turbine, 45 m buffer for overhead powerlines, an 8 m buffer for underground powerlines and centrelines of proposed tracks and a 2 m buffer for existing tracks.

The operational phase of the project would require site access for personnel by light truck or standard four-wheel drive vehicles on a regular basis. A number of permanent onsite maintenance staff may be required.

The indicative infrastructure layout and survey area for the project are mapped in the Attached Figure 4.

2.2 Alternatives to taking the proposed action

This should be a detailed description outlining any feasible alternatives to taking the proposed action (including not taking the action) that were considered but are not proposed (note, this is distinct from any proposed alternatives relating to location, time frames, or activities – see section 2.3).

N/A

2.3 Alternative locations, time frames or activities that form part of the referred action

If you have identified that the proposed action includes alternative time frames, locations or activities (in section 1.10) you must complete this section. Describe any alternatives related to the physical location of the action, time frames within which the action is to be taken and alternative methods or activities for undertaking the action. For each alternative location, time frame or activity identified, you must also complete (where relevant) the details in sections 1.2-1.9, 2.4-2.7, 3.3 and 4. Please note, if the action that you propose to take is determined to be a controlled action, any alternative locations, time frames or activities that are identified here may be subject to environmental assessment and a decision on whether to approve the alternative.

There are no alternative locations, time frames or activities that form part of the referred action.

2.4 Context, planning framework and state/local government requirements

Explain the context in which the action is proposed, including any relevant planning framework at the state and/or local government level (e.g. within scope of a management plan, planning initiative or policy framework). Describe any Commonwealth or state legislation or policies under which approvals are required or will be considered against.

The Environmental Assessment for the Rye Park Wind Farm was prepared in accordance with Part 3A of the Environmental Planning and Assessment Act 1979. On 13 March 2014 the NSW Department of Planning and Infrastructure advised that the Environmental Assessment was adequate for public exhibition.

On 21 March 2014, by order of the Minister for Planning and Infrastructure published in the NSW Government Gazette, the project ceased to be a transitional Part 3A project and became a 'State Significant Development'. Accordingly, the environmental assessment requirements and the statement of environmental assessment under Part 3A are taken to be environmental assessment requirements and an Environmental Impact Statement under the corresponding provisions of Part4 (clause 6(3)(b), Schedule 6A Transitional arrangements—repeal of Part 3A, Environmental Planning and Assessment Act 1979).

While the proposal is not expected to be a Controlled Action under the Commonwealth Environment Protection Biodiversity Conservation Act, this submission is made to obtain certainty for the proponent.

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

If you have identified that the proposed action will be or has been subject to a state or territory environmental impact statement (in section 1.11) you must complete this section. Describe any environmental assessment of the relevant impacts of the project that has been, is being, or will be carried out under state or territory legislation. Specify the type and nature of the assessment, the relevant legislation and the current status of any assessments or approvals. Where possible, provide contact details for the state/territory assessment contact officer.
Describe or summarise any public consultation undertaken, or to be undertaken, during the assessment. Attach copies of relevant assessment documentation and outcomes of public consultations (if available).

The attached Biodiversity Assessment (BA) provides an assessment of impact under s.5a of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This specifies factors to be considered for species, populations and ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The BA also characterises the nature and potential magnitude of impacts on matters of national significance (MNES) including threatened and migratory species, communities and populations listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in accordance with the *Significant Impact Guidelines* (DEWHA 2009). The BA is in the process of being assessed by the NSW Department of Planning and Infrastructure and has been deemed adequate for public exhibition.

In addition, the BA was preceded by a Biodiversity Constraints Analysis to spatially identify key ecological values that represent a constraint to the proposal.

The development envelope of the project has been progressively refined over the course of the assessment phase with indicative turbine locations sited and indicative alignment options investigated. A series of field surveys have been undertaken between 2011 and 2013 to assess the biodiversity value of the project area.

An initial assessment was based on field work conducted in October and November 2011. Additional survey work was undertaken in 2012 -2014 following changes to the proposed wind farm layout and powerline route options and to undertake further targeted survey work for threatened species as a requirement of NSW Office of Environment and Heritage.

As mentioned in Section 1.4, overall impact areas have been determined based on worse case infrastructure footprints provided by the proponent. Therefore the impact assessment has been applied to the worst case scenario which incorporates the powerline route and assessment of all 126 turbine footings and associated infrastructure (i.e. proposed tracks, overhead powerlines, and substations).

2.6 Public consultation (including with Indigenous stakeholders)

Your referral must include a description of any public consultation that has been, or is being, undertaken. Where Indigenous stakeholders are likely to be affected by your proposed action, your referral should describe any consultations undertaken with Indigenous stakeholders. Identify the relevant stakeholders and the status of consultations at the time of the referral. Where appropriate include copies of documents recording the outcomes of any consultations.

General Community Consultation

As the project area covers a large number of stakeholder properties, a considerable effort has been placed on community consultation. The consultation process with project stakeholders included;

- Establishment of a Community Consultation Committee with six meetings held to date.
- Community information workshop held in Yass November 2009.
- Consultation with residents within 2km of a proposed turbine.
- Release of seven project newsletters to date.
- Community information day held in Rye Park July 2012 (with 51 people attending throughout the day).
- Numerous face to face meetings including follow up phone calls and emails with a wide range of community stakeholders and landowners since 2009.
- Establishment of a project website.
- Various media information placements locally.

Indigenous Community Consultation

The Archaeology and Heritage Assessment and Aboriginal community consultation program for the project was undertaken in accordance with the NSW DECC Interim Guidelines for Aboriginal Community Consultation – Requirements for Applicants (NSW DEC 2004).

A copy of the Archaeology and Heritage Assessment for the project is available in Attached Document 20 to Document 22 inclusive.

Written notification of the proposal was supplied to the following Registered Aboriginal Parties for this project;

- Buru Ngunawal Aboriginal Corporation
- Gundungurra Aboriginal Heritage Association Inc
- Carl and Tina Brown
- Gunjeewong Cultural Heritage Aboriginal Corporation
- Onerwal Local Aboriginal Land Council

The field survey and assessment was undertaken in partnership with selected Aboriginal stakeholders. A draft copy of the assessment was provided to the Aboriginal stakeholders for review and comment.

2.7 A staged development or component of a larger project

If you have identified that the proposed action is a component of a larger action (in section 1.12) you must complete this section. Provide information about the larger action and details of any interdependency between the stages/components and the larger action. You may also provide justification as to why you believe it is reasonable for the referred action to be considered separately

from the larger proposal (eg. the referred action is 'stand-alone' and viable in its own right, there are separate responsibilities for component actions or approvals have been split in a similar way at the state or local government levels).

N/A

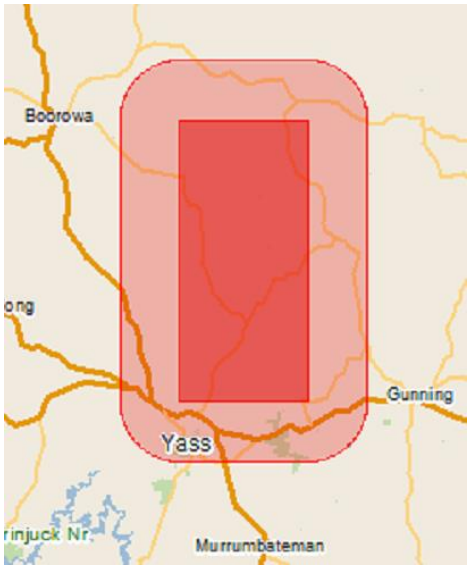
3 Description of environment & likely impacts

3.1 Matters of national environmental significance

The online Protected Matters Search Tool was used in February 2014 to determine matters of national environmental significance that may occur within the project area (DoE 2014). The area used for the Protected Matters Search includes the proposed project area, plus a 10km buffer.

A summary of the results of the search is provided in Table 1 and discussed in the following sections.

Table 1. Summary of the results of the EPBC Act Protected Matters Search (10 km buffer).

Search area (10 km buffer)	Matters of national environmental significance listed under the EPBC Act 1999	Identified within the search area
	World Heritage Properties	None
	National Heritage Properties	None
	Wetlands of International Significance	3
	Great Barrier Reef Marine Park	None
	Commonwealth Marine Areas	None
	Threatened Ecological Communities	3
	Threatened Species	19
	Migratory Species	12
	Commonwealth Lands	4
	Commonwealth Heritage Places	1
	Listed Marine Species	13
	Whales and other Cetaceans	None
	Critical Habitats	None
	Commonwealth Reserves	None
	Places on the Register of the National Estate	35
	State and Territory Reserves	3
	Regional Forest Agreements	1
	Invasive Species	37
	Nationally Important Wetlands	None
	Key Ecological Features (Marine)	None

3.1 (a) World Heritage Properties

Description

There are no World Heritage Properties located within the project area nor would any be expected to be indirectly impacted as a consequence of the development.

Nature and extent of likely impact

N/A

3.1 (b) National Heritage Places

Description

There are no National Heritage Properties located within the project area nor would any be expected to be indirectly impacted as a consequence of the development.

Nature and extent of likely impact

N/A

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Three Wetlands of International Importance were listed on the Protected Matters Search and included: 1) Banrock Station wetland complex (located in South Australia), Coorong and Lakes Alexandrina and Albert (located in South Australia), and the Riverland (located between Renmark in South Australia and the Victorian and New South Wales borders). None of these wetlands are located within the project area and they are greater than 500km from the project site.

Nature and extent of likely impact

Given the location and nature of the proposal the action will not impact any Ramsar wetlands.

3.1 (d) Listed threatened species and ecological communities

Description

The Protected Matters Search Tool indicates that 3 listed threatened ecological communities and 19 threatened species may occur within the project area. The species and the likelihood of each species being present in the project area are provided in Table 2.

Table 2. Threatened species identified within the EPBC Protected Matters Search.

Species Name	Common Name	Conservation Status		Habitat Preference	Likelihood of Occurrence Within the Project area
		EPBC Act	TSC Act (NSW)		
Threatened Ecological Communities					
Grey Box *(Eucalyptus microcarpta)* Grassy Woodlands and derived native grasslands		E	EEC	Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, *Eucalyptus microcarpa* (Inland Grey Box), is often found in association with *E. populnea* subsp. *bimbil* (Bimble or Poplar Box), *Callitris glaucophylla* (White Cypress Pine), *Brachychiton populneus* (Kurrajong), *Allocasuarina luehmannii* (Bulloak) or *E. melliodora* (Yellow Box), and sometimes with *E. albens* (White Box).	**None.** This community does not occur within the project area.
Natural Temperature Grasslands of the Southern Tablelands		E	EEC	Natural Temperate Grassland is a naturally treeless or sparsely-treed community, in which the most obvious components are various species of native grasses. Intact sites have a diversity of wildflowers (forbs) including lilies, orchids, peas, daisies and many	**None.** This community does not occur within the project area.

				more. Sites may contain a low density of trees or shrubs and may also contain wet areas that are habitat for wetland flora species.	
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grasslands		CE	EEC	An open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box *Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi*.	**High.** This community is present within the project area.
Plants					
Yass Daisy	*Ammobium craspedioides*	V	V	Found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region, at Lake Burrinjuck, Bookham, Rye Park and Dalton. Found in moist or dry forest communities, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. goniocalyx*, *E. macrorhyncha*, *E. mannifera*, *E. melliodora*, *E. polyanthemos*, *E. rubida*).	**Possible.** Not recorded in the project area during targeted surveys in areas of potential habitat.
Hoary Sunray	*Leucochrysum albicans var. tricolor*	E		Perennial daisy growing in grasslands and grassy woodlands, often colonising disturbed sites such as road verges, but does not persist well in grazed situations. Flowers spring-summer. May be locally common, and is not listed as threatened in NSW. Recorded around Goulburn. (Var albicans recorded at Lake Bathurst).	**Unlikely.** Recorded 2.5 km west of the site, but not recorded within the project area during targeted surveys in potential habitat.
Omeo Stork's Bill	*Pelargonium sp. striatellum*	E	E	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	**None.** No suitable habitat.
Button Wrinklewort	*Rutidosis leptorrhynchoides*	E	E	Known from 17 populations in the ACT region (10 within the ACT, 6 near Queanbeyan and 1 near Goulburn (NSW) and 9 in Victoria). Occurs in Box Gum Woodland, secondary grassland derived from Box Gum Woodland or in natural temperate grassland; and often in the ecotone between the two communities. Associated eucalypts at NSW and ACT sites include Blakely's Red Gum (*Eucalyptus blakelyi*), Long-leaved Box (*E. goniocalyx*), Yellow Box (*E. melliodora*), Red Box (*E. polyanthemos*) and Apple Box (*E. bridgesiana*). Many sites are associated with Kangaroo Grass (*Themeda triandra*).	**Unlikely.** No records within 50 km of the site.
Birds					

Regent Honeyeater	*Anthochaera phrygia*	E, Mi	E	There are now only a small number of known breeding sites in NSW, the most important of which are: Warrumbungles NP, Pilliga NR, Barraba district, central coast around Gosford, Hunter Valley, and Capertee Valley. Most records are from box-ironbark eucalypt associations and it appears to prefer wetter fertile sites within these associations. It is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box. It also occurs in riparian forests of River She-oak and wet lowland coastal forests dominated by Swamp Mahogony and Spotted Gum. The species can undertake large-scale nomadic movements in the order of hundreds of kilometres.	**Possible.** Potential habitat available, but not recorded in the project area during targeted surveys.
Australasian Bittern	*Botaurus poiciloptilus*	E	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. Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	**Unlikely.** No suitable habitat.
Swift Parrot	Lathamus discolor	E	E	This species breeds in Tasmania, migrating to south and eastern NSW in autumn/winter where it inhabits eucalypt forests and woodlands, particularly Box-Ironbark Forests of central Victoria and southern NSW. Mostly occurs on the south-west slopes. It feeds on nectar flowers of eucalypts and lerp-insects, also soft fruits and berries sometimes foraging in grass. Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box.	**Possible.** Potential habitat available, but not recorded within the project area during targeted survey.
Superb Parrot	*Polytelis swainsonii*	V	V	There are now only a small number of known breeding sites in NSW, the most important of which are: Warrumbungles NP, Pilliga NR, Barraba district, central coast around Gosford, Hunter Valley, and Capertee Valley (DECCW 2010). Most records are from box-ironbark eucalypt associations. It is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box. It also occurs in riparian forests of River She-oak and wet lowland coastal forests dominated by Swamp Mahogony and Spotted Gum. The species can undertake large-scale nomadic movements in the order of	**High.** Recorded within the project area during field surveys.

				hundreds of kilometres.	
Australian Painted Snipe	*Rostratula australis*	E	E	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. 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. The species is likely to be nomadic in response to suitable conditions, such as floods.	**Unlikely.** No fresh water wetlands available within the project area. Little permanent water available and project area does not regularly support wet pastures.
Mammals					
South-eastern (Corben's) Long-eared Bat	*Nyctophilus corbeni*	V	V	Inhabits a variety of vegetation types, including mallee, bulloke *Allocasuarina leuhmanni* and box eucalypt dominated communities, but it is distinctly more common in box-ironbark/ cypress-pine vegetation that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	**Unlikely.** Potential habitat available, but not recorded during Anabat surveys and the project area is outside the known distribution of this species.
Koala	*Phascolarctos cinereus*	V	V	This species was historically abundant in the south of NSW, although now occurs in sparse and possibly disjunct populations. It occurs in woodland communities, coastal forests, woodlands of the tablelands and western slopes and the riparian communities of the western plains. May also utilise isolated paddock trees. Primary feed tree species listed for the central and southern tablelands are Ribbon Gum and River Red Gum, secondary species include Candle Bark, Blakely's Red Gum, White Box, Yellow Box and Brittle Gum.	**Possible.** Potential habitat available (secondary feed trees only), but not recorded during targeted surveys.
Reptiles					
Pink-tailed Worm-lizard	*Aprasia parapulchella*	V	V	This species is only known from the Central and Southern Tablelands, and the South Western Slopes. It inhabits sloping, open woodland areas with predominantly native grass groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Typically these areas are well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks in burrows below these rocks; the burrows usually have been constructed by and are often still inhabited by small black ants and termites.	**Possible.** Marginal and limited habitat available, but not recorded during targeted surveys.
Striped Legless Lizard	*Delma impar*	V	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	**High.** Recorded on one occasion during targeted surveys.

				recorded at sites dominated by introduced species (such as *Phalaris aquatica, Nasella trichotoma* and *Hypocharis radicata*) and sites with a history of grazing and pasture improvement. Shelters in grass tussocks, thick ground cover, soil cracks, under rocks, spider burrows, and ground debris such as timber.	
Insects					
Golden Sun Moth	*Synemon plana*	CE		This species is distributed in an area of NSW between Queanbeyan, Gunning, Young and Tumut. 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 (*Austrostipa* spp.) or Kangaroo Grass (*Themeda australis*).	**High.** Recorded in project area.
Frogs					
Booroolong Frog	*Litoria booroolongensis*	E	E	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. 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.	**Unlikely.** No permanent streams available within the project area for this species.
Southern Bell Frog	*Litoria raniformis*	V	E	Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys.	**None.** No suitable habitat.
Fish					
Silver Perch	*Bidyanus Bidyanus*	CE	V	Only one remaining secure and self-sustaining population occurs in NSW in the central Murray River downstream of Yarrawonga weir, as well as several anabranches and tributaries. Inhabits lowland, turbid and slow-flowing rivers.	**None.** No suitable habitat.
Murray Cod	*Maccullochella peelii*	V		The Murray Cod is found throughout the Murray/Darling Basin system where it inhabits a wide range of warm water habitats, from clear, rocky streams to slow-flowing turbid rivers and billabongs. Generally, they are found in waters up to 5m deep and in sheltered areas with cover from rocks, timber or overhanging banks. The species is highly dependent on wood debris for habitat, using it to shelter from fast-flowing water.	**None.** No suitable habitat.
Macquarie Perch	*Macquaria australasica*	E	V	The Macquarie Perch is a riverine, schooling species. It prefers deep, rocky holes with considerable cover and a substrate of small boulders, pebbles and gravel. Occurs within rivers, dams and tributaries in Southern NSW, but mainly in the upper reaches of rivers and	**None.** No suitable habitat.

				streams where siltation levels are low. The species appears to prefer pools with cover.	

Nature and extent of likely impact

The likely extent of impact on EPBC listed threatened species, populations, and ecological communities within the project area was primarily evaluated in the Biodiversity Assessment (BA):

- '*Rye Park Wind Farm Biodiversity Assessment V1.4,January 2014*' – Refer Attachment Document 1 to Document 19 inclusive.

This report includes extensive general and targeted flora and fauna surveys extending over three years, to cover a variety of seasons and environmental conditions. Species considered to have potential for impact were subject to more detailed assessment to characterise impacts and assist in the development of specific recommendations, as required to avoid significant impacts. The below summaries of the impact of the proposal to species with potential to occur within the project area are taken from the BA.

Note: Maps are provided as part of the BA, those relevant to matters of national environmental significance are provided in Appendix E of the BA and include:

- Maps of vegetation types within the project area – Refer Appendix E.2 of the BA.
- Maps of threatened species locations within the project area – Refer Appendix E.3 of the BA.
- Maps of Superb Parrot locations and primary flight paths within the project area – Refer Appendix E.3 of the BA.
- Maps of Golden Sun Moth survey effort and locations the species was observed within the project area – Refer Appendix E.3 of the BA.

Of the threatened species / communities returned from the EPBC Protected Matters search (refer Table 2), one community and seven species were identified as either known in the project area, or with potential to be present, based on known distribution or habitat requirements. Table 3 summarises the nature and significance of the potential impacts to the EPBC listed threatened species or communities that are known, likely or may possibly occur in the project area as well as the survey effort that was implemented to determine the extent of impact to these species.

Table 3. Threatened species / communities returned from the EPBC Protected Matters search with potential for impact from the proposal.

Species / Community	Nature of Potential Impact	Survey Effort Implemented to Quantify Impact for Each Species.
Box Gum Woodland	Habitat clearance.	Approximately 180 person hours were spent in total on the general flora survey incorporating 59 quadrat/random meander sites and 128 inspection points. This included survey of all Box Gum Woodland in the project area. Infrastructure was designed to avoid good condition areas for Box Gum Woodland (i.e. turbines / transmission line moved out of Box Gum Woodland remnants or removed from layout altogether). The community has a long history of grazing, with much of the development located within low condition areas. The survey effort employed is considered adequate to the nature and quality of habitat found within the project area.
Yass Daisy	Habitat clearance of potential habitat, but not known habitat.	Approximately 7 and 5.5 person hours were spent on targeted searches within potential habitat during the November 2011 and November 2013 surveys.
Regent Honeyeater	Habitat clearance of potential habitat, but not known habitat.	A total of 36 bird utilisation surveys (2 ha search area of 20 minutes duration) were conducted across the project area during November 2011 and November 2012. All birds were also recorded during other targeted bird surveys for the Superb Parrot and Swift Parrot. Total effort = greater than 45 person hrs.

Species / Community	Nature of Potential Impact	Survey Effort Implemented to Quantify Impact for Each Species.
	Collision risk.	
Swift Parrot	Habitat clearance of potential habitat, but not known habitat. Collision risk.	All potential habitat targeted for survey during July 2013. 10 search areas surveyed by 2 people. Total effort = 15.75 person hrs.
Superb Parrot	Habitat clearance / collision risk.	Targeted surveys were completed across the entire project area during the known breeding time of this species (November 2013). A total of 25 transects (1km x 500m) were walked looking for Superb Parrots. Each transect was 1 hr in duration. Total effort = 25 person hrs. Flight path mapping was undertaken for 3 days using 8 people stationed at vantage points within the project area to view potential movement of parrots. Total effort = 72 person hrs.
Koala	Habitat clearance of potential habitat, but not known habitat.	The Spot Assessment Technique (RapSAT) was employed to look for scats and evidence of Koalas. A total of 7 grids were surveyed in potential habitat. Each grid consisted of 3 to 5 plots spaced 500m apart. A total of 33 plots were searched.
Pink-tailed Worm-Lizard	Habitat clearance of potential habitat, but not known habitat.	Targeted active searching (rock, log, branch rolling) was undertaken in appropriate habitat in November 2011. Habitat is limited in the project area and all known appropriate habitat was searched. A total of 11 surveys of 20-60 minutes duration were undertaken. Total effort = 4 person hrs.
Striped Legless Lizard	Habitat clearance.	10 artificial shelter sites (tiles) were installed in July 2013. Each shelter site consisted of 50 tiles spaced 10 m apart. Each shelter site was checked 10 times each between September and December 2013. Two funnel trap sites were installed in November 2013 in potential habitat. A total of 24 traps were installed over 4 nights. Total effort = 96 trap nights.
Golden Sun Moth	Habitat clearance.	Survey effort was targeted at detecting the presence or absence of the moth in potential habitat of Box Gum woodland, Box Gum derived grasslands and to a lesser extent within native pasture. A total of 10 search areas were surveyed across the project area between 18 and 27 November 2013. Meandering traverse surveys were completed within the search areas by one person. Survey constraints reduced survey effort to between one and four visits per site.

Box Gum Woodland CEEC

The proposal would result in the clearing of Box Gum woodland CEEC which complies with the definition of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grasslands listed under the EPBC Act. Up to 10 ha of CEEC of the 3068 ha Box Gum Woodland area assessed would be permanently removed as a result of the proposal. The majority of these impacts would result from the establishment of a 45m wide easement for the 132kV overhead power line. The Box Gum Woodland CEEC community within the proposal site boundary has already been highly fragmented due to past clearing and agricultural practices.

As a precautionary approach, this assessment has considered that the worst case scenario would be the total loss of this vegetation type within the 132 kV transmission line easement; however in reality the vegetation is open woodland meaning that only a few scattered trees would need to be cleared. The understorey would also be mostly retained excluding small areas required for footings and tracks. It is considered likely that the community would maintain its existing functionality following construction given that the amount (up to 10 ha) to be removed by the proposal is small when compared to the large areas (potentially 69 ha) that will not be impacted by the development.

Where occurrences of EEC are along established roads or tracks it may be possible to further avoid or minimise impacts in these areas. Impacts to areas in transmission line clearing corridors may also have the potential to be avoided or minimised by micrositing infrastructure with input from an ecologist. Where new tracks, turbines or other infrastructure are placed within identified areas of CEEC impacts are unavoidable

and offsetting these impacts would be required. Higher offset ratios apply to higher value habitat, providing an incentive throughout the construction process to minimise impacts in high value areas.

Management measures, provided in Section 4, require that direct removal of CEEC is limited to discrete areas and installation of infrastructure would be located with input from an ecologist to minimise impacts in these area where avoidance is not possible. It is considered that the minor clearance coupled with the implementation of specific measures, including provision for offsetting the impact, the proposed action will not have a significant impact on this community

Yass Daisy

Most populations occur in the Yass District, at Lake Burrinjuck, Bookham, Rye Park and Dalton (DoE 2009). The Yass Daisy has been recorded within 2.5 kilometres west and south-east of the subject site. Current threats to the species include agricultural developments, intensification of grazing regimes, invasion of weeds, road works (particularly widening or re-routing) and inappropriate mowing or slashing in cemetery sites (OEH 2013).

Box Gum Woodland and derived grassland in moderate or good condition is considered to be the most likely habitat for this species. Targeted transects for threatened flora were conducted in higher quality areas of Box Gum Woodland and derived grassland within the originally proposed eastern substation site (removed during layout modifications to avoid sensitive areas). Random meanders were substituted for transects within the high quality habitat given the large area to be covered and the nature of the impacts in this area (limited to the establishment of transmission pole footings and an access track). Both methods are considered acceptable under the Draft Threatened Species Survey Guidelines (DECC 2004). These surveys failed to locate any threatened flora. In addition, five flora quadrat surveys were conducted in moderate or good condition Box Gum Woodland and failed to detect any threatened flora. No threatened flora were detected during the other 54 quadrat/random meander sites and 128 inspection points (approximately 180 person hours) conducted across the broader site or while travelling between these sites.

The areas of potential habitat for the Yass Daisy have a long and continuing grazing history. The proposal would result in the permanent loss of up to 12 ha of moderate and good condition Box Gum Woodland, which provides potential habitat for the threatened Yass Daisy. This potential habitat is considered unlikely to support the species given the species was not detected during targeted searches; these areas considered as potential habitat are now assessed as low importance for the Yass Daisy. The proposal will not result in significant impact to this species.

Regent Honeyeater

The survey guidelines for Australia's threatened birds (DEWHA, 2010) suggest bird searches of woodland patches with heavily flowering trees, especially around waterpoints, such as creeklines. Woodland patches within the impact area were surveyed during bird surveys, especially areas supporting the larger Yellow Box trees which were flowering at different times of the survey and supported mistletoe. The method employed such as listening for calls during the known breeding season within the most appropriate habitat type available within the impact area is considered adequate to detect this species.

This species was not detected during bird surveys of the project area and the project area is not considered to support primary breeding and foraging habitat (i.e. wetter areas supporting Box-ironbark Eucalypt associations or feed trees). Two species of mistletoe were recorded on site, but are not widely distributed and occur in low densities. However, as this species is nomadic and movement patterns are often linked to availability of resources, it can be assumed that they may travel through the project area to other foraging grounds. Therefore it is considered there may be a potential operational risk of blade-strike to this species; however, at the time of survey this species was not observed to utilise the project area.

Little information is available on the migration patterns of this highly mobile species; however records across NSW indicate a strong presence of this species to the south, east and north-east of the project area

in better quality habitat (i.e. National Parks) and could be considered an important landscape connection. This area traverses Namadgi NP, Morton NP, Nattai NP and Blue Mountains NP (Figure 5). It is expected the movement of this species would commonly occur through this connection where better quality foraging resources exist.

Given the species was not detected during surveys, core breeding habitat is not available on site, foraging resources are generally limited (i.e. not wetter more fertile areas), and known records indicate movement of the species east of the project area, the proposal is not considered to adversely affect the existence of this species.

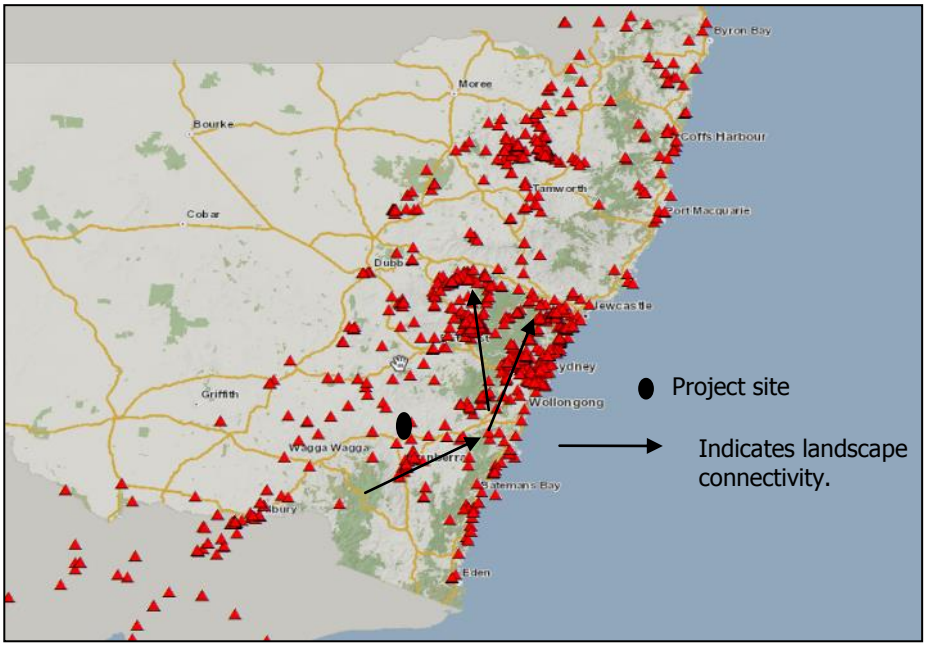


Figure 5. Known records for the Regent Honeyeater in relation to the project area, detailing movement patterns to the east (OEH 2013, Bionet – Atlas of NSW Wildlife)

Swift Parrot

The Swift Parrot was not recorded within the project area during targeted surveys for the species. The species migrates to the Australian south-east mainland between March and October to forage.

Only two known feed trees for this species are present within the project area, Yellow Box and Mugga Ironbark. Yellow Box is located within Box Gum Woodland habitat as scattered trees. Mugga Ironbark is rare to the project area and was only identified in one location in the north of the site as scattered individuals; this area will not be impacted by the proposal. In general, the areas surveyed are heavily degraded and exist as either open woodland over grassland (with no mid- or understorey stratums) or as derived grassland with scattered trees. The abundance of flowering feed trees within the project area for the Swift Parrot are therefore low in abundance and the species is more likely to use roadside vegetation or larger remnants where greater diversity of feed trees are present.

As impacts to Box Gum Woodland have been largely avoided in the project design and little habitat is present within the project area for the Swift Parrot, apart from those areas targeted for survey in July 2013 in which the species was not detected, the project area is not considered to support an important foraging area for this species.

Database searches indicate there are no Swift parrot records within Murrumbateman CMA, but records are scattered for the Upper Slopes CMA. Records across NSW indicate a strong presence of this species to west of the project area where more Box Gum Woodland would be located (i.e. towards Boorowa) or along the

east coast where more Ironbark species are located (Figure 6). It is expected the movement of this species would commonly occur through these connections where better quality foraging resources exist, given the species was not detected within the project area during targeted surveys.

As a result the project area is not considered to support important foraging habitat for these species, especially as the species was not observed during targeted surveys, and impact to this species from the proposal will not be significant.

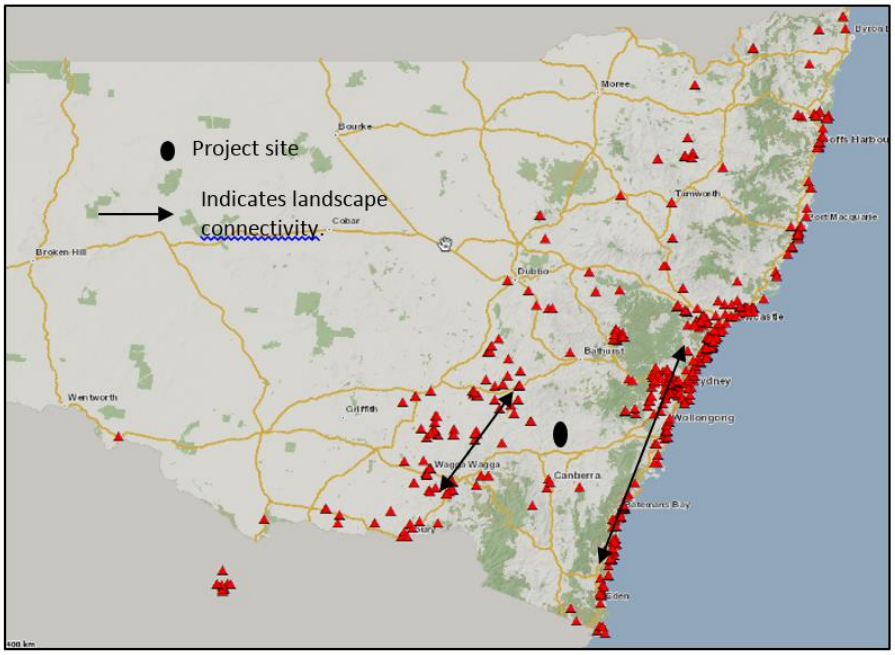


Figure 6. Known records for the Swift Parrot in relation to the project area, detailing most records common to the west of the project area or along the east coast (OEH 2013, Bionet – Atlas of NSW Wildlife).

Superb Parrot

Superb Parrots were recorded during the November 2011 and 2013 surveys at Rye Park; they were not recorded in April 2012 or July 2013. Thus, Superb Parrots were observed to use habitats in the project area and locality during their breeding season (September to January). It can be assumed that they disperse to other foraging grounds outside of nesting season.

General results

The results of Superb Parrot transects and flight path mapping suggest that Superb Parrots are commonly recorded to the west of the project area, especially along Rye Park Road, and are likely to utilise habitat outside or adjacent to the western boundary of the project area within open grassland or Box Gum Woodland, except for a discrete area in the southern end of the project area where parrots were commonly recorded This location is the only one within the project area that was primarily used by the Superb Parrot as habitat on a regular basis (discussed in more detail below). Refer to Appendix E.2 of the BA for locations of parrots in the project area and primary flight paths.

Primary flight paths appear to run in a north-south alignment along the western edge of the project area, or from the western edge of the project area further west towards Boorowa (Appendix E.2 of the BA). It is expected that Superb Parrots are moving regularly between the western edge of the project area and Boorowa (a known important breeding area for the species), but are not coming from further east of the project area for the following reasons:

- Parrots were regularly observed in higher numbers and larger flocks then at the project area when travelling to Boorowa during the survey week.

  - This habitat west of the project area supports greater expanses of foraging resources including commercial crops and wider open grassland habitat with scattered trees that once constituted Box Gum Woodland. The Inland Scribbly Gum on ridgelines which comprised most of the vegetation type within the project area was not utilised by the parrot.
- Habitat on the eastern side of the project area was not observed to be utilised by the Superb Parrot during transect surveys and parrots were not recorded flying from the west, where they were observed, to the east across ridges.
  - This conclusion has been made as observers stationed to the west of the project area observed birds, whereas observers stationed east of these observers within the project area did not observe birds. Further reasoning for this conclusion is provided in Table 7-7.

It is therefore concluded that Superb Parrots are common to the west of the project area, but are not moving across the ridges proposed for turbines and are not undertaking large-scale movements at higher elevations (i.e. at rotor-swept-area height) in this direction and risk of collision impact is low overall. Movement nearby the project area consists of local movements within discrete areas where foraging habitat is available. Superb Parrots generally followed corridors of vegetation and flew below canopy height (i.e. less than 20 m). In particular, Rye Park Road is regularly utilised by the parrot and is considered important roadside vegetation for this species in the locality. The species was recorded in higher abundance along this road than anywhere else within the project area.

Known database records of the Superb Parrot in NSW are located to the west of the project area, but are generally absent from the project area. These records suggest the parrot relies on movement to the west and outside of the project area confirming the flight path mapping results from this current survey (Figure 7).

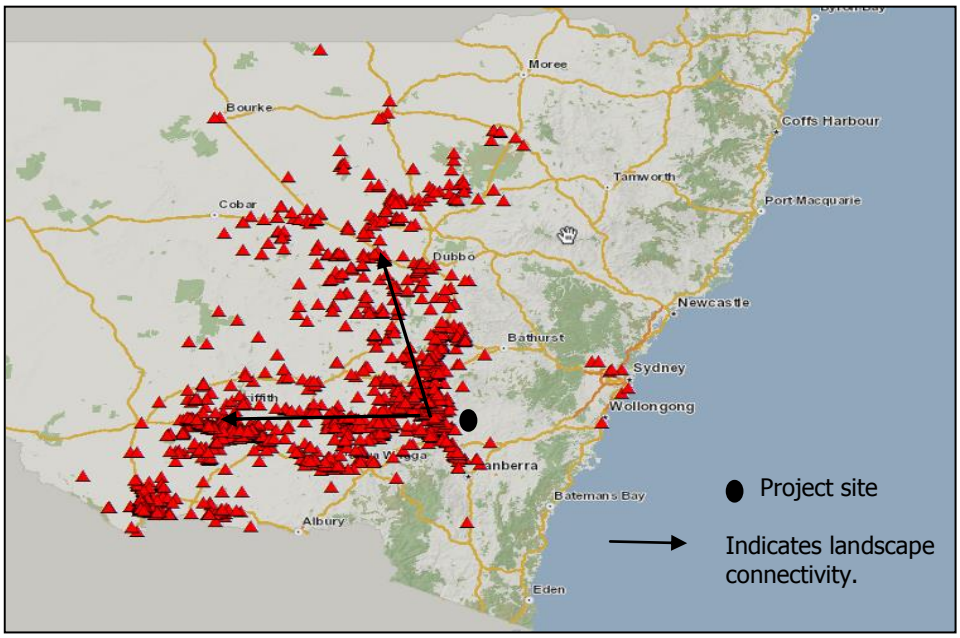


Figure 7. Known records for the Superb Parrot in relation to the project area, detailing movement patterns to the west (OEH 2013, Bionet – Atlas of NSW Wildlife).

Potential impact area – Southern section of project area

The total clearance impact to Box Gum Woodland habitat would be 25 ha, with 1,555 ha remaining within the project area; however, the greatest impact to this species is considered to occur where the Superb Parrot was observed regularly in one area at the southern end of the project area, with 17 flight observations made in this area over the three days of flight path mapping. Most of the movement appeared to be localised to the distribution of Box Gum Woodland habitat and Native Pasture south of RYP_106 and

north or RYP_120 within this area. However, as Superb Parrots are making localised movements in this area and staying within Box Gum Woodland habitat they are considered unlikely to collide with turbines as they are not making long range and large-scale movements. Their foraging movements comprise of tree hopping and rest-stops and it is considered the spacing of turbines at a minimum of 300 m would allow safe passage of this species within the area during these types of movement. The potential collision risk to this species overall is therefore not considered to result in a significant impact to this species, especially as the majority of the population within the locality occurs outside the project area and was observed flying within the tree canopy or below 20 m on most occasions.

However in light of the above, recommendations have been made to include the Superb Parrot within an operational Bird and Bat Management Plan. It should also be noted that a proposed transmission line that extended further west of the current transmission line in this area has been removed from the layout to avoid impact, as much as possible, to Box Gum Woodland and threatened species occupying this habitat.

Nest trees

Two of the three identified nest trees also occur within the southern section of the project area, however these nests are buffered by at least 600 m to the nearest turbine. Additionally, two potential nest trees were also mapped in the same vicinity. Transmission lines are proposed in the areas of identified nest trees and recommendations to apply a minimum of 100 m buffer to both known and potential nests trees is prescribed. Tracks and transmission lines will require micro-siting with the aid of an ecologist within these areas. The third nest tree is identified outside the western boundary of the project area along Flakney Creek Road and no impact to this tree will result from the proposal. Impacts to known breeding resources of the Superb Parrot will therefore be avoided.

Clearing has the potential to affect breeding habitat, namely hollow-bearing trees (especially Yellow Box) in Box Gum Woodland. Hollows suitable for breeding by the Superb Parrot within the project area are generally scattered across the landscape as a result of the cleared and fragmented nature of the remnant Box Gum woodland. However, the southern section of the site is the primary area breeding is expected to occur due to the presence of the known nest trees, as described above. Hollow-bearing trees suitable for the Superb Parrot were mapped in potential habitat; suitable hollows were either trunk or branch hollows that were not exposed (i.e. not jagged at the entrance and open) and of suitable size for this species. As a result of the proposal, three hollows designated as potential Superb Parrot breeding habitat would be removed by the proposal; however no evidence of parrots utilising these hollows was observed at the time of survey.

In summary, the greatest potential for impact to breeding habitat occurs along the proposed 132kV transmission line within the southern section of the project area; however, the magnitude of impact for habitat loss for Superb Parrot is likely to be low to moderate (around 1% of available hollows to be cleared) and unlikely to lead to a long-term decrease in population size, reduce the area of occupancy or fragment the existing population. All known hollows used for breeding at the time of the surveys will be retained as part of the proposal and buffered at least 100m to transmission line infrastructure and 600m to the nearest turbine.

Design measures were undertaken to avoid areas identified as important to the Superb Parrot and to maintain connectivity throughout the project area. Further recommendations have been made for hollow-bearing tree pre-clearance surveys, and micro-siting of infrastructure to avoid hollow-bearing trees, where possible. Recommendations are also given to offset all hollows that are cleared during the construction phase. Thus, it seems unlikely that habitat loss for Superb Parrot at Rye Park would place the local population at risk of extinction.

Koala

The extent of vegetation clearance for the Koala is primarily limited to discrete areas, primarily for transmission line corridors. Clearance for wind turbines will be nil to minor as main access tracks and

turbine sites are located in cleared or non-forested areas; however, there will be some clearing required for installation of the more minor turbine access tracks that will connect to the main access network. However, the nature of the clearing will not affect fragmentation in the landscape and a substantial amount of similar habitat will remain in the project area that will not be affected by the proposal.

For example, the main access tracks to potential turbine sites are already cleared, with many tracks already 20 m wide due to existing agricultural land practices; hence clearing is minimal in these areas and the project will not increase fragmentation. Of the habitat available, Inland Scribbly Gum habitat of all condition classes (i.e. poor-good) is considered most appropriate for this species of which up to 90 ha may be cleared by the proposal; however at least 3,753 ha of the same vegetation type will remain within the project boundary which also connects to larger areas of the similar habitat within the surrounding landscape.

The main threats to the Koala are the ongoing loss, fragmentation and degradation of habitat, vehicle strike, disease and predation by the domestic dog (DoE 2013). As direct clearance of habitat for the Koala is defined to limited areas the proposal will not increase the main threats of loss of habitat and fragmentation. Furthermore, vehicle strike is not anticipated as the movement of trucks transporting turbines will be temporary and confined to the construction stage; due to steep terrain and land access trucks will be moving at slow speeds within the project area at this time. Vehicle movement will be limited during the operational phase of the project to a single 4WD vehicle for routine maintenance checks. Therefore, the proposal will also not enhance other key threats from indirect impacts of vehicle strike.

Given evidence of the Koala was not detected during the 33 RapSAT surveys, the Koala is not expected to occupy the habitat on a permanent basis or in high numbers if it were to occur in the project area the severity of impact is not considered to be adverse on the Koala. Additionally, a substantial amount of available habitat will remain within the project area and locality and the proposal will not fragment habitat for this species. Therefore, the proposal will not significantly impact on this species.

Pink-tailed Worm-lizard

Potential habitat is limited for the Pink-tailed Worm-lizard in the project area. Rocky outcrops generally occur on hill crests in cleared and forested areas and are sparsely distributed, occurring mostly in the northern portion of the site; however the sites are heavily grazed and degraded. The majority of the project site has either no surface rock or outcropping bedrock. Some limited areas have surface rock and potential habitat with largely exotic forb vegetation cover, but are dominated by large weeds which provide dense ground level shading and are unlikely to provide suitable habitat for this species. As a result, primary habitat for this species does not occur within the project area and the species was not recorded during targeted surveys. The survey effort of 11 active searches (rock rolling) is considered adequate for the extent and quality of habitat available within the project area.

Given the discrete nature of the development, the marginal habitat on-site and the grazing regime within these areas, and the extent of similar nearby habitat, removal of potential habitat is considered to be a low risk for this species. The action will not result in significant impact to this species.

Striped Legless Lizard

One individual of the Striped Legless Lizard was recorded at one artificial shelter site placed at turbine RYP_27 in the northern section of the project area (refer Appendix E.2 of the BA). The species was located on a grazed ridge top supporting a grassland of exotic and native species. Common species included: Spear grasses (*Austrostipa* sp.), Thistles (*Sonchus* sp.), Cat's Ear (*Hypochaeris radicata*), and Rye Grass (*Lolium perenne*), with some embedded rock consisting of approximately 10-15% cover. No Kangaroo Grass (*Themeda australis*) was observed in the area at the time the tiles were laid. The observation of the Striped Legless Lizard was made on the ninth check of the ten checks completed.

Given the species was detected once, it could occur in other areas of grassland habitat of the project area and impact to known habitat of this species could result from the proposal. To determine the extent of

impact management measures have been prescribed to undertake more detailed micro-habitat survey of the site (referencing habitat attributes where the species was located) prior to the end of March 2014 to determine the extent of similar habitat within the project area and quantify the extent of clearance impact. These survey results would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible.

Assuming the Striped Legless Lizard could occur in all grassland habitats of the project area, the total impact to potential habitat of this species is 66 ha (including Box Gum Woodland Derived grassland and native pasture habitat). Of these habitat types, 5887 ha is available within the project area and therefore the ability to offset impact to this species within the immediate project area is achievable. The proposal commits to offsetting all impact to this species which is likely to have a positive effect on this species given the offset site will require management and therefore halt the current impacts associated with grazing in the project area that continue to reduce the habitat quality for this species.

As the species was not located at the other nine tile sites, the overall impact to this species is not expected to be significant especially when considering the amount of available habitat remaining within the project area. Furthermore, the ability to offset the impact will ensure the species is conserved in the locality. In light of this, the proposal is unlikely to have an adverse effect on the life cycle of the Striped Legless Lizard such that a viable local population of the species is likely to be placed at risk of extinction.

Golden Sun Moth

The Golden Sun Moth was observed at seven of the ten sites surveyed and approximately 200 moths were observed in total (refer Appendix E.2 of the BA). In particular, the southern section of the site appears to support larger numbers of Golden Sun Moth, as well as the area surveyed east of RYP_72. The habitat within these sites was variable and supported a mixture of native grasses and exotic grasses including Weeping Grass, Brush-tail Spear Grass, Wattle Matrush, Wallaby Grasses and localised patches of bracken. Large areas could also be dominated by the annual *Vulpia* spp. These grasses occur in different assemblages across the areas surveyed and abundance of native versus exotic grass cover is related to grazing pressure. The abundance of Wallaby Grasses also varied, from a low abundance and patchy distribution to being more dominant with a tussocky structure (especially in the south of the project area). Condition of habitat therefore varied in the sites surveyed.

The survey results identify that the project area supports small populations of Golden Sun Moth in localised areas that are generally widespread throughout the area in the typical habitat described above. However, within the site Golden Sun Moths were also observed to occupy areas not typical for the species in that they were observed on rocky hillsides, elevated sites, areas where superphosphate has been regularly applied and in grassland areas derived from ecological communities other than Box Gum Woodland. Habitat quality was variable across the areas surveyed, but all sites where moths were observed supported Wallaby Grasses (even if in low abundance).

The Golden Sun Moth survey was confined to areas where potential habitat was most likely to coincide with areas to be impacted by the proposed development. As a consequence of limitations posed by the relatively short survey period for Golden Sun Moth, the large area covered by the proposed wind farm site, and the travel time required between sites, the surveys were targeted at detecting the presence or absence of the moth in higher potential and more typical habitat of Box Gum woodland, Box Gum derived grasslands and to a lesser extent within native pasture. However, based on the above, it is assumed that the area occupied by the species is more extensive than that observed in the current survey as not all areas dominated by native pasture were examined. Potential habitat was recorded to extend beyond the areas likely to be disturbed at most sites where Golden Sun Moths were observed.

The locations moths were observed are currently impacted by transmission lines, access tracks and substation infrastructure, but no turbines. For the transmission line, several concrete poles would need to be erected, requiring vegetation clearing and excavation within small discrete footprints. Spoil would be

temporarily stockpiled next to each pole during excavation. Poles and transmission lines would be laid along the ground prior to being raised. During construction and operation, vehicles would travel underneath the lines. For these infrastructure types, the proposal has potential to primarily directly impact the emerged phase of the Golden Sun Moth during habitat clearance (i.e. not below ground other than for pole excavation). However, as the species was detected on site in variable quality habitats it is likely it could occur elsewhere not assessed during the November 2013 survey.

Therefore, as a precautionary measure, the habitat in which the species was located and all contiguous habitat of similar structure and condition has been delineated as potential habitat. This includes all Box Gum Woodland, derived grassland and native pasture habitats across the project area. To determine the extent of impact in this habitat type and specifically quantify habitat for this species within the project area, management measures have been prescribed to undertake further preconstruction surveys of the final infrastructure layout in accordance with the relevant survey guidelines (Significant Impact Guidelines for the critically endangered Golden Sun Moth *Synemon plana;* DEWHA 2009a) for this species. The results of these surveys would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible. The management protocols for this species would be documented within a management plan, to be implemented as part of the construction process.

Assuming the Golden Sun Moth could occur in all potential habitat (i.e. all grassland habitats) of the project area, the current total impact for this species is 66 ha. Of these habitat types, 5,887 ha is available within the project area and therefore the ability to offset impact to this species within the immediate area of proposed infrastructure is achievable. Offset sites would target better quality areas of Wallaby Grasses.

Furthermore, there are 15 known populations of the Golden Sun Moth in the general area between Yass and Boorowa, including at Rye Park (DEWHA 2009b) and this species has recently been shown to be more widespread than currently thought, particularly within the Yass Valley region. Recent survey results at another wind farm in the region (Yass Valley Wind Farm) have also shown the species to occur in high numbers (i.e. > 200 individuals). These populations at Yass Valley and Rye Park are additional to the 15 known populations stated above. In light of the above, a significant impact to this species is not expected and impacts are considered manageable.

Cumulative impact for species / communities known, or with potential to occur within the project area

There are three operating wind farms within approximately 65 km of the project area. These comprise a total of 54 wind turbines (Cullerin Range Wind Farm: 15, Gunning Wind Farm: 31, Crookwell Wind Farm: 8). Gullen Range Wind Farm is currently under construction: 80 turbines approximately 55km from the project area. Several other wind farms are proposed within a maximum distance of 60 km from the project area including Rugby Wind Farm, Bango Wind Farm, Conroys Gap Wind Farm, and Rye Park Wind Farm).

The nature of wind farms is that they are not suited to heavily wooded environments and infrastructure is therefore located primarily within degraded and already fragmented landscapes. The location of the Rye Park Wind Farm is such that it has been sited, through several iterations of the design process, to avoid high value biodiversity areas supporting good condition woodland or threatened species habitat resulting in the majority of infrastructure being sites in exotic or grassland habitat. On this basis, the proposal is not considered to significantly contribute to cumulative habitat loss impacts, especially considering vegetation loss will be offset and long-term management of the offset areas within an already degraded landscaped will maintain or improve biodiversity within the area.

Box Gum Woodland CEEC

The infrastructure layout has been designed to primarily avoid impact to good condition CEEC and management measures prescribe that direct removal of Derived Grassland CEEC is limited to only one site where an underground cable and access track is proposed.

Residual impacts to the Box Gum Woodland CEEC will be mitigated through an offset package developed specifically to ensure an overall 'improve or maintain' environmental outcome for the project. Proposed

offsets will contribute to the long-term protection and improvement of the Box Gum Woodland CEEC in the locality and, by contributing to landscape connectivity, within the wider region also.

Yass Daisy, Koala, Pink-tailed Worm-lizard

The Yass Daisy, Koala and Pink-tailed Worm-lizard are not expected to occur on site or be affected by the proposal given they were not detected through targeted surveys. Therefore, the proposal will not contribute to a cumulative impact on these species.

Regent Honeyeater, Swift Parrot, Superb Parrot

The cumulative impact from loss of habitat associated with this proposal is considered negligible for the Swift Parrot and Regent Honeyeater, given that these species do not breed within the project site and they are unlikely to rely on the low quality foraging habitat available, as evidenced by the lack of records in the locality. However, cumulative impacts from loss of habitat within the region for the Superb Parrot are possible, but minor. As part of the project design, all known breeding sites within the project area have been avoided and are buffered by at least 500m from the nearest turbine. Known foraging habitat has been largely avoided with infrastructure specifically removed (i.e. transmission line) from the primary foraging habitat identified on site for this species.

The location of the proposed wind farm turbines on largely cleared ridge top sites already compromised from long-term grazing, coupled with avoidance of clearing good condition woodland, restrict the cumulative impacts for the Superb Parrot, which has been noted to utilise habitats in the lower-lying areas and along roadsides. The offsetting of vegetation losses and hollow-bearing tree removal with the long term protection of similar vegetation in the study area will reduce the cumulative effects of the proposal on loss of habitat for this species. Managed offsets that accompany the project, will provide areas protected from degradation and managed for biodiversity improvement, as stated above.

The potential of the operational wind farm to affect movements or increase mortality rates through collision impacts for the Superb Parrot, Swift Parrot and Regent Honeyeater is considered low. Based on the discussion of bird movements for the Superb Parrot, Swift Parrot and Regent Honeyeater, visits from migratory or nomadic species are expected to be either infrequent and sporadic, or not within the area of impact. The wind farm is not expected to significantly affect migratory or nomadic species such that populations would be at risk, and is therefore not considered to add to the cumulative impact of these species for collision risk. This project, like others proposed at this time for the region, includes the commitment to an operational bird and bat management plan will address the uncertainty and provide a mechanism for operational management, if required.

Golden Sun Moth and Striped Legless Lizard

Golden Sun Moth has been found at several locations within the Rye Park Wind Farm. This species has also been recently recorded at other wind farm sites in several areas nearby (Yass WF, Bango WF, Conroy's Gap WF) and is therefore more regionally abundant than previously assumed. The Striped Legless Lizard was found at one location within the Rye Park Wind Farm and suitable habitat for this species is available within the project area.

The pattern of clearing and ability to microsite infrastructure to minimise impacts on habitat for these species as well as the commitment to offset, ensures that cumulative impacts will be managed. In the long term, these regional wind farm projects will provide ongoing biodiversity improvements in the form of managed offset lands. Given the context of land degradation, this is considered a benefit of the project.

3.1 (e) Listed migratory and marine species

Description

Fourteen migratory and 13 marine species were identified in the EPBC Protected Matters Search report. The likelihood of each species being present is provided in Table 4. Migratory species are not necessarily considered threatened, but are noted as benefiting from a nationally coordinated approach to conservation.

Table 4. Migratory and marine species identified within the EPBC Protected Matters Search.

Species Name	Common Name	Conservation Status		Habitat Preference	Likelihood of Occurrence within the Project area
		EPBC Act	TSC Act (NSW)		
Migratory Marine Species					
Apus pacificus	Fork-tailed Swift	Mi, Ma		Asian origin. This species is primarily aerial during its stay in Australia.	**Unlikely.** This species was not identified during site surveys. It is considered that potential habitat is present on site, although it is noted that this species generally occurs west of the Great Diving Range. The proposed action is outside this species migratory range and therefore it is highly unlikely to occur. No impacts are expected for this species.
Pandion cristatus	Osprey	Mi, Ma		Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within 1 km of the sea.	**None.** No suitable habitat available within the project area. No impacts are expected for this species.
Migratory Terrestrial Species					
Haliaeetus leucogaster	White-bellied Sea-Eagle	Mi, Ma		White-bellied Sea-Eagles are a common sight in coastal and near coastal areas of Australia. Birds are normally seen, perched high in a tree, or soaring over waterways and adjacent land. In addition to Australia, the species is found in New Guinea, Indonesia, China, south-east Asia and India.	**Possible.** Known to occur within the region.
Hirundapus caudacutus	White-throated Needletail	Mi, Ma		White-throated Needletails often occur in large numbers over eastern and northern Australia. They arrive in Australia from their breeding grounds in the northern hemisphere in about October each year and leave somewhere between May and August. They are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees. The White-throated Needletail feeds on flying insects, such as termites, ants, beetles and flies. They catch the insects in flight in their wide gaping beaks. Birds usually feed in rising thermal currents associated with	**Possible.** Known to occur within the region.

				storm fronts and bushfires and they are commonly seen moving with wind fronts. White-throated Needletails are non-breeding migrants in Australia.	
Lathamus discolor	Swift Parrot	Mi, Ma	E	**Possible.** Refer Table 2 – threatened species.	
Merops ornatus	Rainbow Bee-eater	Mi, Ma		Open forests, woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland. Often, but no always, located in close proximity to permanent water.	**High.** One individual recorded just west of the project area during field surveys.
Monarcha melanopsis	Black-faced Monarch	Mi, Ma		The Black-faced Monarch is found along the coast of eastern Australia, becoming less common further south. The Black-faced Monarch is found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March.	**Unlikely.** Suitable habitat not present within the project area or wider region. No impacts are expected for this species.
Myiagra cyanoleuca	Satin Flycatcher	Mi, Ma		The Satin Flycatcher is found along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin Flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant. The Satin Flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests. The Satin Flycatcher is a migratory species, moving northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in spring.	**Possible.** Few records known for the region, but foraging habitat on site is marginal and not typical to that preferred by this species. No breeding habitat available within the project area.
Rhipidura rufifrons	Rufous Fantail	Mi, Ma		The Rufous Fantail is a summer breeding migrant to south-eastern Australia. It is found in northern and eastern coastal Australia, being more common in the north. The Rufous Fantail is found in rainforest, dense wet forests, swamp woodlands and mangroves, preferring deep shade, and is often seen close to the ground. Strongly migratory in the south of its range, it moves northwards in winter, and virtually disappears from Victoria and New South Wales at this time.	**Unlikely.** Suitable habitat not present within the project area or wider region. No impacts are expected for this species.
Xanthomyza phrygia	Regent Honeyeater	Mi	E	**Possible.** Refer Table 2 – threatened species.	
Migratory Wetland Species					
Ardea alba	Great Egret	Mi, Ma		The Eastern Great Egret has been reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small,	**Unlikely.** This species was not identified during field surveys and has not been recorded in the region. Potential habitat is absent from this site and it is

				natural and artificial). These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs.	considered the species would not occur there. Any migratory movements would follow wetland corridors, thereby avoiding the site. No impacts are expected for this species.
Ardea ibis	Cattle Egret	Mi, Ma		The Cattle Egret is found in grasslands, woodlands and wetlands, and is not common in arid areas. It also uses pastures and croplands, especially where drainage is poor. Will also forage at garbage dumps, and is often seen with cattle and other stock. The Cattle Egret is partially migratory, moving during winter.	**Possible.** Known to occur within the region.
Gallinago hardwickii	Latham's Snipe	Mi, Ma		In Australia, Latham's Snipe occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. They usually inhabit open, freshwater wetlands with low, dense vegetation (e.g. swamps, flooded grasslands or heathlands, around bogs and other water bodies). Latham's Snipe does not breed within Australian jurisdiction.	**Unlikely.** Not known for the locality or region. Habitat is not present in areas that would be affected by the wind farm and the species have not been recorded from the locality. Local movements would be more likely restricted to wet habitat corridors and wetlands which occur adjacent to the site. It is expected any long-distance movements would follow wetland corridors and thereby predominantly avoid the site. No impacts are expected for this species.
Rostratula australis	Australian Painted Snipe	E, Mi, Ma	E	**Unlikely.** Refer Table 2 – threatened species.	

Nature and extent of likely impact

Table 5 summarises the nature and significance of the potential impacts to those listed threatened species that are known, likely or may possibly occur in the project area.

Table 5. Migratory and Marine species returned from the EPBC Protected Matters search with potential for impact from the proposal.

Species	Potential Impact	Survey effort implemented to quantify impact for each species.
White-bellied Sea-Eagle	Collision risk.	A total of 36 bird utilisation surveys (2 ha search area of 20 minutes duration) were conducted across the project area during November 2011 and November 2012. All birds were also recorded during other targeted bird surveys for the Superb Parrot and Swift Parrot. Total bird survey effort = greater than 45 person hrs. A total of 74 100 x 100m habitat assessment quadrats were undertaken across the project area to quantify quality of habitat as well as greater than 180 hrs of flora survey to document vegetation types and habitat availability. This information was used to assess habitat suitability for all species with potential to occur on-site.
White-throated Needle-tail	Collision risk.	
Rainbow Bee-eater	Collision risk.	
Satin Flycatcher	Collision risk.	
Cattle Egret	Collision risk.	

White-bellied Sea-eagle

The White-bellied Sea-eagle was not identified at the site during field surveys. This species has been recorded along the Murrumbidgee River system near the site at Burrinjuck Dam and Yass. Potential habitat is absent from the site. The risk to this species from the proposed action is low, however should the species occur on site it is considered that there is potential for collision risk.

This migratory species may cross the ridges within the study area while migrating from larger wetland systems in the west to wetlands on the coast, or between Lake Burrinjuck and wetlands in the north, and therefore be at risk of blade-strike. However given that wetland habitats do not occur locally, bird movements across the site are likely to be diffuse and irregular, rather than concentrated and seasonal. Long-distance migratory birds are likely to have attained a travelling altitude greater than the turbine height. Further, water birds are probably likely to follow riparian corridors, rather than travel over ridge systems in agricultural land. The ridges do not directly bisect large water bodies therefore do not fragment or isolate areas of habitat.

It is considered that habitat removal and collision impacts are considered to pose very low and low risks respectively to the White-bellied Sea-eagle. Further, impact to the lifecycle of this species is considered low risk as suitable habitat does not occur on the site and these species would be likely to follow rivers and wetlands, rather than travel over ridges to reach suitable breeding and foraging grounds. Overall, the proposed action is unlikely to have a significant impact on the White-bellied Sea-eagle.

White-throated Needletail (*Hirundapus Caudacutus*)

The White-throated Needletail was not observed on site during field surveys. This species has been recorded in the region in the Bugongo State Forest, approximately 30 kilometres south of the site. Potential habitat is present on site and it is considered possible that the species could occur on site. The proposed action poses the risk of blade-strike to this species. The risk to individuals and populations of this species is considered to be moderate-high and low respectively.

This species is known to fly at great heights and has been recorded flying c.1000-2000m ASL over the Australian Alps, making it unlikely that the species would regularly encounter wind turbines blades, or be impacted by the minor loss in aerial foraging habitat. The development would not substantially modify, destroy or isolate an area of White throated Needletail habitat. Further, the proposed action is likely to pose a low risk to the lifecycle of this species over the population, though any impacts are unlikely to seriously disrupt the lifecycle of the species resulting in population scale impacts.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater was observed once adjacent to the project area, but has also been recorded within the region, however records of the species are few. Potential habitat for this species is largely absent from the project area given that most of the infrastructure traverses grassland or pasture habitat. Some woodland habitat is present but is considered marginal for this species given its degraded nature in a largely agricultural landscape. This species is most at risk from blade-strike from the proposed action, rather than habitat loss.

Due to the high manoeuvrability of the species it is considered unlikely that the proposal would result in impact such that there would be a population scale effect on the Rainbow Bee-eater. The Rainbow Bee-eater is a common and secure species and widespread within its Australian and global distribution. Monitoring during wind farm operation would target this species to document collision impacts and ensure that adaptive measures would be adopted if mortalities are found to occur.

Satin Flycatcher

This species was not recorded within the project site during field surveys, but the species has been recorded in the region north-east of Yass, however records of the species are few.

The project site provides marginal foraging habitat, but no breeding habitat. Habitat is marginal over most of the site due to the extent of clearing. The species favours heavily vegetated gullies and taller woodlands during breeding, and uses woodlands, scrubs, trees in open country during migration. The site does not provide optimal habitat for this species and habitat use is expected to be infrequent. On this basis, the proposed action would not substantially modify, destroy or isolate an area of important Satin Flycatcher habitat.

A species evaluation indicated there is potential for wind turbine collisions if this species were to occur within the project area. However, as optimal habitat for this species is unavailable (i.e. heavily vegetated gullies and taller woodlands) and records of this species in the locality are few, mortality rates affecting the lifecycle of a significant proportion of the populations of this species is not anticipated.

During the operational phase of the wind farm a monitoring and adaptive management program would be developed and implemented to monitor collision risks of threatened and migratory species. If collisions of any threatened or migratory species are detected management measures are required to ensure impact does not exceed acceptable levels such that whole populations would be placed at risk (outlined in Section 4 of this referral).

Cattle Egret

This species was not identified at the site during field surveys and is not known within the 10 km locality of the project boundary, but the species has been recorded near Murrumbidgee River south-west of the site. The presence of this species is possible on lowland pasture and dams. This migratory species may cross the ridges within the study area while migrating from larger wetland systems in the west to wetlands on the coast, or between Lake Burrinjuck and wetlands in the north, and therefore be at risk of blade-strike. However given that wetland habitats do not occur locally, bird movements across the site are likely to be diffuse and irregular. Long-distance migratory birds are likely to have attained a travelling altitude greater than the turbine height. Further, water birds are more likely to follow riparian corridors, rather than travel over ridge systems in agricultural land. The ridges do not directly bisect large water bodies and therefore do not fragment or isolate areas of habitat.

The population estimate for Australia, New Guinea and New Zealand is 100 000 birds (Maddock & Geering 1994), with a trend that suggests an ongoing increase in range and population. The species is widely distributed globally, with the range of the bird continuing to expand, particularly around the Pacific basin.

Habitat removal and collision impacts are considered to pose very low and low risks respectively to the Cattle

Egret. Further, impact to the lifecycle of this species is considered low risk as suitable habitat does not occur on the site and these species would be likely to follow rivers and wetlands, rather than travel over ridges to reach suitable breeding and foraging grounds. Overall, the proposed action is unlikely to have a significant impact on the Cattle Egret.

3.1 (f) Commonwealth marine area

(If the action is in the Commonwealth marine area, complete 3.2(c) instead. This section is for actions taken outside the Commonwealth marine area that may have impacts on that area.)

Description

There are no Commonwealth marine areas located within, or in the vicinity of, the project area.

Nature and extent of likely impact

Due to the location and nature of the proposed action there will be no impacts to any Commonwealth marine area.

3.1 (g) Commonwealth land

(If the action is on Commonwealth land, complete 3.2(d) instead. This section is for actions taken outside Commonwealth land that may have impacts on that land.)

Description

Four areas listed as Commonwealth Land were detailed on the Protected Matters Search. No Commonwealth Land is located within the project area.

Nature and extent of likely impact

N/A

3.1 (h) The Great Barrier Reef Marine Park

Description

The proposal is not occurring in or near to the Great Barrier Reef Marine Park and will not impact upon it in any manner.

Nature and extent of likely impact

N/A

3.1 (i) A water resource, in relation to coal seam gas development and large coal mining development

Description
N/A

Nature and extent of likely impact

N/A

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

3.2 (a)	**Is the proposed action a nuclear action?**	X	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment		

3.2 (b)	**Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?**	X	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment		

3.2 (c)	**Is the proposed action to be taken in a Commonwealth marine area?**	X	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))		

3.2 (d)	**Is the proposed action to be taken on Commonwealth land?**	X	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))		

3.2 (e)	**Is the proposed action to be taken in the Great Barrier Reef Marine Park?**	X	No
			Yes (provide details below)
	If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))		

3.3 Other important features of the environment

3.3 (a) Flora and fauna

The project area for Rye Park wind farm is largely cleared and has been historically used for agricultural purposes. Areas of sparse native vegetation remain or wooded areas are generally comprised of regrowth vegetation. Pockets of more dense vegetation occur on the steeper slopes.

Eleven vegetation types occur within the Rye Park project area:

- Inland Scribbly Gum – Red Stringybark open forest.
- Blakely's Red Gum - Yellow Box grassy tall woodland (categorised as Box Gum Woodland).
- Blakely's Red Gum - Yellow Box grassy tall woodland derived grassland (categorised as Box Gum Woodland).
- Argyle Apple – *Acacia mearnsii* valley open forest.
- Brittle Gum - peppermint open forest.
- Red Box Woodland.
- Phragmites Swamp.
- Sifton Bush Shrubland.
- Native Pasture.
- Exotic Pasture.
- Planted Vegetation.

A total of 143 fauna species were recorded within the Rye Park project area. In summary the total numbers for each fauna group included:

- Ninety-nine bird species.
- Fifteen mammal species (excluding microbats) of which five are introduced species.
- Twelve microbat species.
- Fifteen reptile species.
- Two amphibian species.

One threatened ecological community and 16 threatened fauna species were recorded during the field surveys. The threatened fauna species included: one invertebrate species, one reptile species, nine birds, and three microbats (Table 6).

Table 6. Threatened ecological community and threatened fauna species detected at Rye Park wind farm.

Species	Status	Habitat
Box Gum Woodland and Derived Grassland	E TSC CE EPBC	An open woodland community with species of White Box *Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi*.
Golden Sun Moth *Synemon plana*	E TSC CE EPBC	Grassy Box Gum Woodlands and natural temperate grasslands.
Striped Legless Lizard *Delma impar*	V TSC V EPBC	Temperate lowland grasslands, secondary grasslands and occasionally open Box Gum Woodland.
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoria*	V TSC	Occurs in eucalypt woodlands, mallee and drier open forest, preferring woodlands lacking dense understorey
Diamond Firetail *Stagonopleura guttata*	V TSC	Woodland remnants of grassy eucalypt woodlands, including Box-Gum, grassland and riparian areas, and sometimes lightly wooded farmland.
Flame Robin *Petroica phoenicea*	V TSC	Native vegetation with an open understory. It breeds in upland forests and woodlands and migrates to more open lowland habitats in winter.
Gang-gang Cockatoo *Callocephalon fimbriatum*	V TSC	Varies from open forests and woodlands to heavily timbered and mature wet forest.
Hooded Robin (South eastern form) *Melanodryas cucullata cucullata*	V TSC	Woodland remnants with high habitat complexity and uses stumps, posts or fallen timber.
Painted Honeyeater *Grantiella picta*	V TSC	Dry open forests and woodland with mistletoe.
Scarlet Robin *Petroica boodang*	V TSC	Dry eucalypt forests and temperate woodland. Fallen timber is an important habitat feature

Species	Status	Habitat
Speckled Warbler *Pyrrholaemus saggitatus*	V TSC	Eucalypt woodland with a grassy understorey.
Superb Parrot *Polytelis swainsonii*	V TSC V EPBC	Box Gum Woodland and can nest in isolated paddock trees.
Varied Sittella *Daphoenositta chrysoptera*	V TSC	Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches.
White-fronted Chat *Epthianura albifrons*	V TSC	Open grassland habitats inland form the coast or damp open habitats.
Eastern Bent-wing Bat *Miniopterus orianae oceanensis*	V TSC	Forage over canopy in range of forest types. Breeds in caves and mine tunnels.
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V TSC	Forages below or near the canopy and along tracks, uncommon on ridge tops where soil fertility is low. Roosts in tree hollows and buildings.
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V TSC	Wide-ranging species across northern and eastern Australia. It roosts in tree hollows.

The potential impacts to EPBC listed flora, fauna and ecological communities known or likely to occur within the project area are discussed in Section 3.1 (d).

3.3 (b) Hydrology, including water flows

The landform within the project area is characterised as an undulating plateau with rounded hills and peaks, entrenched meandering streams with chain of ponds tributaries. No major rivers or wetlands occur within the project area. The closest rivers are Yass River to the south of the project and Boorowa River to the north-west. The proposal will not influence water flows to these river systems or interfere with the natural hydrology of the locality.

3.3 (c) Soil and Vegetation characteristics

The project area lies within the South Eastern Highlands IBRA Murrumbateman subregion. Soils in this subregion are classified as mottled yellow and brown texture contrast soils with strongly bleached topsoils. Dark organic loams and clay loams on valley floors. Saline patches present (OEH, 2011).

The vegetation for this subregion is classified as Blakely's Red Gum, Yellow Box, on lower slopes, Red Stringybark, Bundy and White Gum on ridges. Areas of Apple Box, and Mottled Gum. Limited swampy flats and valley floor grasslands (OEH 2011).

3.3 (d) Outstanding natural features

There are no natural features within the project area that are considered to be of outstanding, significant or notable environmental value.

3.3 (e) Remnant native vegetation

Rye Park wind farm is situated within a landscape which, apart from the steeper inaccessible slopes, is predominantly cleared or has been highly modified by past and current agricultural practices. Within the area to be impacted by the proposal, remnant treed vegetation is mostly comprised of scattered Yellow Box. Other more dense naturally occurring treed areas such as the Inland Scribbly Gum Forest that occurs on the steeper slopes consist of mostly young regrowth vegetation. The majority of the vegetation likely to be affected by the proposal consists of highly disturbed, low diversity exotic or native grassland.

Table 7. shows the vegetation recorded within the project area, the extent of hectares to be impacted and the total hectares of each vegetation community remaining within the project area.

Table 7. Total Impact area for vegetation types recorded within the project area.

Vegetation types	Permanent habitat loss within each condition class (ha)					Total within project area (ha)
	Good	**Moderate**	**Poor**	**Unknown**	**Total**	
Box Gum Woodland	10	1	14	0	25	1,555
Box Gum Woodland Derived Grassland	0	1	6	0	6	1,513
Inland Scribbly Gum Forest	41	30	19	0	90	3,753
Argyle Apple Forest	0	0	0	0	0	59
Brittle Gum Forest	0	0	2	0	2	175
Sifton Bush Shrubland	14	15	2	0	30	1,720
Native pasture	2	22	36	0	60	4,374
Exotic/planted	0	0	23	0	23	887
					235.93	**14,035.99**

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

N/A

3.3 (g) Current state of the environment

Include information about the extent of erosion, whether the area is infested with weeds or feral animals and whether the area is covered by native vegetation or crops.

The project area is characterised by cleared farmland, mostly derived from Box Gum Woodland on the lower slopes and flats with Inland Scribbly Gum Dry Forest vegetation on the steeper sheltered slopes. Vegetation condition varies considerably throughout the project area and includes woodland and fragmented woodland which has been logged and is regenerating, native pasture with scattered trees, pasture dominated by exotic species, and to a lesser degree relatively undisturbed forest. Woodland areas do not support a mosaic of tree ages and largely consist of regrowth and single age stands. The majority of the site has been subject to long-term grazing which has reduced native flora species diversity. In many areas, the canopy layer is present but the mid- or shrub-layer is absent.

Forests and woodlands in the study area have been progressively ring-barked and felled over the past two centuries to provide pasture. Clearing and agriculture has produced a range of direct and indirect impacts to flora habitats, including microclimate, loss of pollinator and dispersal fauna, erosion of soils, particularly wind erosion from exposed ridge tops, elevated soil nutrients and rising saline groundwater.

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, areas subjected to pasture improvement and sheep or cattle grazing. In many areas grazing is likely to have reduced or eliminated selectively grazed or grazing-sensitive species such as native grasses, terrestrial orchids, native legumes, wattles and other shrubs.

Many areas of the site have been grazed and show evidence of this in the low diversity of native pasture species and forbs. As a result, the project area carries a high proportion of exotic weed and pasture species. Common weeds associated with grazing are widespread and have invaded areas of more intact woodland and forest vegetation. Large areas of the site are now dominated by the colonising species Sifton Bush, declared noxious in many NSW council areas. The major exotic species are grasses, clovers, Capeweed, and Paterson's Curse.

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

One Commonwealth Heritage Place was returned from the EPBC Protected Matters Search. The Yass Post Office is listed on the Commonwealth Heritage List for its association with a town which dates back to the early years of settlement in central New South Wales. The Yass Post Office is located in the township of Yass approximately 40 kilometres south of the proposed action and no impacts to this heritage listed place are expected. No other known heritage places exist within the site.

3.3 (i) Indigenous heritage values

Indigenous heritage values relating to the proposed action have been evaluated and are documented in the report – Rye Park Wind Farm Aboriginal Cultural Heritage Assessment Report (New South Wales Archaeology Pty Ltd). The report concluded;

- The 13 Aboriginal sites identified in the subject area were assessed to be representative of extremely low density artefact distribution. Their cultural and archaeological heritage value is low. The AHIMS site #51-4-0058 is likewise assessed to be of low archaeological heritage significance. The archaeological status of the three SPAs is uncertain, and accordingly, their cultural and archaeological values are unknown.
- The Aboriginal object locales comprised of stone artefacts (and any undetected and subsurface artefacts) do not surpass archaeological and cultural significance thresholds which would act to preclude the construction of the proposed wind farm.
- Based on a consideration of the predictive model applicable to the environmental context in which impacts are proposed, and the results of the study, it is concluded that the proposed impact areas do not warrant further investigation such as subsurface test excavation.

A copy of the Archaeology and Heritage Assessment for the project is available in Attached Document 20 to Document 22 inclusive.

3.3 (j) Other important or unique values of the environment

Describe any other key features of the environment affected by, or in proximity to the proposed action (for example, any national parks, conservation reserves, wetlands of national significance etc).

Bango Nature Reserve (Bango NR) in the Yass Valley LGA, created in 2010, is approximately 440 ha and managed under the *Draft Plan of Management for The Gunning Reserves* (POM) (NPWS 2011). Bango NR is located adjacent to the south-western border of the project area. None of the other reserves covered by the POM are near the proposal site. Vegetation in the reserve includes dry open forest with Apple Box *(Eucalyptus bridgesiana)* or Red Stringybark *(E.macrorrhyncha)* and Scribbly Gum *(E.rossii).* It is considered likely that Box Gum Woodland also occurs on lower slopes and drainage lines in the reserve but this has not been ground-truthed.

Several threatened species have been recorded in the reserve: Yass Daisy, Gang-gang Cockatoo, Scarlet Robin and Varied Sittella. As the reserve appears to support forest (and potentially woodland) in moderate and good condition, it is considered to be of moderate conservation significance. It should be noted that no part of the reserve would be directly impacted by the proposal, i.e. no vegetation would be cleared within the reserve therefore no direct impact upon vegetation communities of conservation significance, threatened species habitat or connectivity. Therefore, any impact of the proposal on Bango NR would arise from the operational phase.

Based on the threatened fauna recorded in the reserve, (Gang-gang Cockatoo, Scarlet Robin and Varied Sittella), the siting of turbines close to reserved habitat is not considered a high operational risk (i.e. blade-strike) and collision is considered unlikely for these species.

3.3 (k) Tenure of the action area (eg freehold, leasehold)

The majority of the wind farm study area is freehold land, with a large number of private properties being involved with the proposed development.

3.3 (l) Existing land/marine uses of area

The land use of the region is dominated by agriculture including sheep and cattle grazing for meat and wool production. Large areas have been cleared for production. Other farming activities include breeding studs for cattle, alpaca, sheep and horses, poultry production and olive farms and wine groves. The demographic

has shifted from a primarily farming community to a mix including hobby farmers and rural lifestyle residents.

3.3 (m) Any proposed land/marine uses of area

The majority of the land in the project area will continue to be used as it is currently. Within the development envelope, infrastructure of wind turbines and transmission lines will be installed that produces and transmits electricity to connect with the existing grid. Infrastructure components have a small footprint and will be spaced widely, so are not expected to substantially modify the current land use.

4 Measures to avoid or reduce impacts

Note: If you have identified alternatives in relation to location, time frames or activities for the proposed action at Section 2.3 you will need to complete this section in relation to each of the alternatives identified.

Provide a description of measures that will be implemented to avoid, reduce, manage or offset any relevant impacts of the action. Include, if appropriate, any relevant reports or technical advice relating to the feasibility and effectiveness of the proposed measures.

For any measures intended to avoid or mitigate significant impacts on matters protected under the EPBC Act, specify:

- what the measure is,
- how the measure is expected to be effective, and
- the time frame or workplan for the measure.

Examples of relevant measures to avoid or reduce impacts may include the timing of works, avoidance of important habitat, specific design measures, or adoption of specific work practices.

Provide information about the level of commitment by the person proposing to take the action to implement the proposed mitigation measures. For example, if the measures are preliminary suggestions only that have not been fully researched, or are dependent on a third party's agreement (e.g. council or landowner), you should state that, that is the case.

Note, the Australian Government Environment Minister may decide that a proposed action is not likely to have significant impacts on a protected matter, as long as the action is taken in a particular manner (section 77A of the EPBC Act). The particular manner of taking the action may avoid or reduce certain impacts, in such a way that those impacts will not be 'significant'. More detail is provided on the Department's web site.

For the Minister to make such a decision (under section 77A), the proposed measures to avoid or reduce impacts must:

- clearly form part of the referred action (eg be identified in the referral and fall within the responsibility of the person proposing to take the action),
- be must be clear, unambiguous, and provide certainty in relation to reducing or avoiding impacts on the matters protected, and
- must be realistic and practical in terms of reporting, auditing and enforcement.

More general commitments (eg preparation of management plans or monitoring) and measures aimed at providing environmental offsets, compensation or off-site benefits CANNOT be taken into account in making the initial decision about whether the proposal is likely to have a significant impact on a matter protected under the EPBC Act. (But those commitments may be relevant at the later assessment and approval stages, including the appropriate level of assessment, if your proposal proceeds to these stages).

Measures to avoid impacts

During early investigations of the project area vegetation type and condition were mapped within the entire development envelope[1], not just the development footprint (impact area). The biodiversity survey effort samples the development envelope. Constraints mapping is produced to identify high moderate and low constraint areas. This strategy provides flexibility for future changes in the layout, context regarding

[1] The development envelope is the broad area within which infrastructure could potentially be located.

biodiversity impact assessment, and maximises avoidance of high conservation areas early in the layout design.

In order to minimise the potential impacts upon sensitive environments and species, an initial layout was assessed in relation to outcomes of the ecological field survey and constraints mapping. The initial layout resulted in a number of turbines and / or roads and cables being located within remnant native vegetation areas. From site surveys and aerial photo interpretation it was apparent that modifications could be made to the design to ensure that impacts to native species and habitat could be avoided and / or minimised. These important environments were considered in the reshaping process to provide the most sensitive environmental outcome possible, while still ensuring that the project was economically viable and socially responsible.

The current layout that is presented in this referral has continuously gone through an iterative process, with turbines locations being repositioned, deleted and in some cases added to areas previously thought unviable. The purpose of this process is to design a layout that efficiently harnesses the energy in the wind with minimal impacts to the existing environment (including ecology, heritage and land use productivity as well as visual and noise amenity for surrounding residents).

Along with the relocation or deletion of turbines, the associated access tracks were also modified. While the impact of an access track is far less than a turbine, every attempt was made to reroute access tracks away from native vegetation. In some cases, however, it was concluded that the impact caused in clearing a small area of vegetation on the top of the ridge would have a lower impact than relocating the track on the side of the slope where the overall impact of the cut and fill required to construct the track would have an impact over a much larger area.

Design measures to avoid impacts associated with vegetation clearing including loss of Box Gum Woodland EEC and fauna habitat, are given in Table 8. Design measures to avoid blade-strike impacts associated with the operational phase of a wind farm including proximity to nest trees, are given in Table 9. These design measures are already part of the proposal. Recommendations given in Table 10 are supplementary to the design measures incorporated by the proponent.

Table 8. Design measures by the proponent to avoid vegetation clearing in areas identified to have a high risk of impact to threatened ecological communities or fauna species.

Constraint type	Design measures to avoid impact
EEC: Box Gum Woodland	The following turbines moved out of Box Gum Woodland remnants: RYP_14, RYP_111, RYP_116 and RYP_108. At least 4 km of transmission line in the southern section of the project area in the vicinity of RYP_120 removed. Proposed substation in the south-east corner of the site moved.
Fauna habitat: Patch size and integrity	RYP_36, RYP_53 moved to a 50 m buffer from high conservation value fauna habitat
Fauna habitat: Connectivity	RYP_59, RYP_55, RYP_54, RYP_60 removed from layout due to high conservation value fauna habitat. RYP_64, RYP_107 moved to a 50 m buffer from high conservation value fauna habitat.
Proximity to Superb Parrot, Painted Honeyeater habitat. Potential habitat for Golden Sun Moth and Striped Legless Lizard.	132 kV transmission line in the southern section of the project area in the vicinity of RYP_120 traverses good quality Box Gum Woodland habitat used by these species. This part of the transmission line was removed from the infrastructure layout.

Table 9. Design measures by the proponent to avoid high and moderate operational risks to bird and bat species.

Operational constraint types	Risk description	Design measures to avoid impact
High risk locations		
Proximity to nests	Proximity to Wedge-tailed Eagle nest tree: RYP_91, RYP_92.	RYP_91 removed from layout. RYP_92 shifted further south.

Operational constraint types	Risk description	Design measures to avoid impact
	Proximity to Superb Parrot nest tree: RYP_117, RYP_118.	RYP_117 and RYP_118 removed from layout.
Landscape position	RYP_10 was a high risk to all birds that may fly in the rotor sweep area because of isolated position on a low hill between two much taller ridges.	RYP_10 has been removed from layout and replaced by RYP_16.
Landscape position	These two turbines were outliers from the rest of the layout and were positioned on peaks in a key movement corridor.	Turbines have been relocated to be in close proximity to other turbines in the development envelope area.
Moderate risk locations		
Landscape position	Turbines in higher risk locations for blade-strike such as along an escarpment or at the head of a valley	RYP_28-30, RYP_32, RYP_36, RYP_41, RYP_52, RYP_56, RYP_83 have been repositioned in line with the recommendation to move turbines back from heads of valleys or escarpments.
Layout position	Turbines in higher risk locations such as isolated (>800 m) from other turbine clusters.	RYP_113 and RYP_115 removed from layout, repositioned to RYP_124 and RYP_145.
Proximity to Bango Nature Reserve	Proximity to Bango Nature Reserve.	Turbines shifted for a 70 m buffer from reserve.

Measures to minimise impacts

Mitigation measures recommended to minimise impacts during the design, construction and operational phase of the wind farm proposal are highlighted in Table 10. These measures to minimise impact were developed to ensure potential impacts are minimised at: 1) a broad level in which general management or control measures can be applied to the entire proposal; or 2) at a defined level in which management or control measures can be applied to particular areas, individual species, faunal groups, or a vegetation type.

In particular, a Flora and Fauna Management Plan as well as an adaptive Bird and Bat Management Plan will be prepared prior to construction. These management plans will focus on migratory and at risk bird and bat species, and any threatened species found during further survey work. Management strategies for the construction phase of the proposal need to be developed and incorporated into the Flora and Fauna Management Plan. Prescriptions for inclusion in the plan are set out in the tables below. These measures are required to ensure a significant impact is avoided.

The construction footprint should be kept to a minimum for least impact on flora and fauna. The proponent commits to upfront offset ratios before clearing proceeds which is an incentive to achieve 'minimal clearance' during the detailed design and construction phases.

Measures to offset impacts

Measures to offset impacts are provided within Table 11 to ensure that an overall 'maintain or improve' outcome is met for the proposal; where impacts cannot be avoided, or sufficiently minimised, the residual impact will be offset in perpetuity. Appendix F of the BA details the biodiversity offset principles developed by the former DECCW (now OEH) and how these guide the identification and management of the offset site. Appendix F of the BA also details how offsets are proposed to be identified, managed, and the offset ratios to be applied. An Offset Plan would be developed with input from OEH and the CMA and finalised prior to any construction impacts.

The Offset Plan would achieve:

- For common vegetation types a ratio of approximately 1:2 (cleared: offset) is proposed. Where vegetation is listed as an endangered community, such as the Box Gum Woodland EEC, a ratio of 1:5 to 1:10 (cleared:offset) is proposed, depending on the quality of habitat.

- Hollows removed would be offset at a ratio of 1:1 (offset site vegetation must contain the same number of hollows).
- The offset site would be protected in perpetuity and appropriate management actions attached to the land title. For example, fencing and signage maintained, minimum biomass to be retained (through controlled grazing if appropriate), regular weed control and pest fauna management.

Table 10. Design measures to avoid and minimise impacts for Rye Park wind farm.

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
Design Phase						
General measures	Project area	N/A	Ensure all infrastructure will be sited entirely within the areas assessed in the Biodiversity Assessment.	After final alignments / development envelopes confirmed	• If infrastructure is required outside of the areas surveyed in this biodiversity assessment, more survey and assessment will be required.	Avoid
General Measures	Project area	High risk birds and bats	Turbine infrastructure design to minimise operational impacts on birds and bats.	Prior to operation	• If possible, red flashing lights[2] should be fitted to turbine towers to reduce insect attraction and potentially night-flying birds. • No guy lines to be fitted to turbine towers. • Flags and/or marker balls to be fitted to wind monitoring mast guy lines • Turbines (e.g. nacelles) should minimise perching opportunities.	Minimise
Striped Legless Lizard habitat	Identified areas of potential habitat for the Striped Legless Lizard (i.e. all grassland habitats)	Striped Legless Lizard	Further targeted survey in all grassland habitat of the project area to avoid and minimise impacts.	Prior to construction (February 2014)	• Undertake detailed micro-habitat survey of the site (referencing habitat attributes where the species was located) March 2014. • Use survey results to minimise impacts and ensure offsetting requirements, where avoidance is not possible. • Document management protocols for this species within a management plan, to be implemented as part of the construction process.	Avoid, minimise, offset
Superb Parrot nest trees and impacts to breeding, Painted Honeyeater foraging habitat	Where all nests trees and Painted Honeyeater records identified in Appendix E.4.	Superb Parrot	Avoid impact to known and potential nests trees and construction impacts during breeding period for the Superb Parrot. Avoid	Prior to construction (for avoidance of nests trees); During construction (for no clearance near nests trees during this	• Maintain a 100 m buffer around identified and potential Superb Parrot nest trees (refer Appendix E.4) in the southern section of the project area. • Micro-site all transmission lines and access tracks near known nest trees and Yellow Box trees between RYP_110 and RYP_120.	Avoid, minimise

[2] Although lighting effects are poorly understood at this time, migrating birds and bats appear to be attracted to steady burning lights and red flashing lights are said to decrease insect activity and reduce bird and bat activity at turbines.

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
			impacts to foraging habitat (Yellow Box) for the Pained Honeyeater.	time)		
Raptor nest trees	Where all nests trees identified in Appendix E.4.	Wedge-tailed Eagle, Nankeen Kestrel	Avoid impact to known nests trees.	Prior to construction	• Maintain a 100 m buffer around identified nest trees.	Avoid
Good condition fauna habitat	Project area	All species, primarily threatened woodland birds	Avoid impact to woodland and forest habitat.	Prior to construction	• Maintain a 70 m buffer around turbines in good condition fauna habitat, especially turbines RYP_17 in the north of the project and turbines near Bango NR (RYP_123 & RYP_126).	Avoid
Construction Phase						
Golden Sun Moth habitat	Identified areas of potential habitat for the Golden Sun Moth (i.e. all grassland habitats)	Golden Sun Moth	Further targeted survey in all grassland habitat of the project area avoid and minimise impacts.	Prior to construction	• Undertake preconstruction surveys of the final infrastructure layout in accordance with the relevant survey guidelines (Significant Impact Guidelines for the critically endangered Golden Sun Moth *Synemon plana;* DEWHA 2009). • Results of these surveys would be used to minimise impacts by micro-siting infrastructure and ensure offsetting requirements, where avoidance is not possible. • Document management protocols for this species within a management plan, to be implemented as part of the construction process.	Avoid, minimise, offset
Box Gum Woodland and Good quality fauna habitat	Project area, particularly good condition EEC/CEEC between RYP_110 and RYP 120 and within transmission line south of RYP_110	Box Gum Woodland areas and threatened species	Prevent unauthorised clearance. Minimise track and transmission line impacts in areas of high conservation value.	During construction	• Clearly define works areas nearby or within Box Gum Woodland areas to strictly defined permitted clearance zone. • Minimise track width, where possible, to the minimum required for safe access and operation. • Install the 33kV powerlines (co-aligned with roads) as underground, where possible. • Removal of topsoil and subsoil for trenching to be replaced and revegetate disturbed areas with local native grasses (i.e. Kangaroo Grass, Wallaby Grass or Spear Grass).	Minimise
Woodland bird	Around the	Brown Treecreeper,	Minimise track and	During construction	• Clearly define works areas nearby this area.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
habitat	transmission line and turbines near RYP_102-110	Diamond Firetail, Flame Robin, Hooded Robin, Scarlet Robin and Speckled Warbler	transmission line impacts in areas of high conservation value for these species.		• Micro-site all infrastructure in this location with the input from an ecologist.	
Hollow-bearing Trees	Project area where targeted hollow-bearing tree survey not previously undertaken	Threatened hollow dependent fauna	Targeted hollow-bearing trees survey to accurately record the number of hollows to be cleared to ensure impacts are offset.	After final alignments / development envelopes confirmed	• Pre-clearance survey within final development envelope and alignment for hollow-bearing trees. • Infrastructure micro-sited to avoid hollow-bearing trees, where possible. • For hollow-bearing trees to be cleared a management plan should be prepared by an ecologist detailing: procedures to minimise impacts to, and relocate resident fauna; timing of works to avoid breeding periods, where possible; number and type of hollow-bearing trees to be removed and offset (to be included in Flora & Fauna Management Plan). • Where hollow-bearing trees are to be cleared a standard pre-clearance survey, such as that described in *Biodiversity Guidelines* (**ngh**environmental / RTA 2011), should be undertaken and details of hollow-bearing trees cleared including number and size of hollows and number of hollow-bearing trees recorded.	Minimise
Reptile Species habitat	Project area	All reptiles, primarily Pink-tailed Worm-lizard	Pre-clearance surveys in Box Gum Woodland and native pasture to identify rocky outcrops for avoidance, where possible.	During construction and as required	• Turbines and infrastructure would be micro-sited to avoid rocky outcrops in this habitat, where possible. • Where rocky outcrops cannot be avoided, replace rock in nearby areas in consultation with an ecologist. • Fallen timber > 50cm to be left in place or moved to a nearby area to retain fauna habitat.	Minimise
General Measures	Project area	All species and vegetation communities	Minimise clearance and disturbance.	During construction and as required	• Clearly define works areas and restricting impacts to these. Including vehicle and equipment parking and access routes. • Co-locating underground and overhead 33kV powerlines with the track network to minimise additional impact area, where possible. • Establish construction compound in a disturbed area. • Use disturbed areas for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and deposition and retrieval of spoil, wherever practicable.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
					• Fill in trenches as soon as possible. Trenches left open overnight to be inspected at first light for trapped fauna. Trapped fauna to be released appropriately in a nearby location. • Hollow-bearing trees and sensitive features to be retained to be communicated to staff via inductions and other methods.	
Riparian Area Management	Project area	All species and vegetation communities	Minimise clearance and disturbance.	During construction	• Creek crossing to be designed in accordance with: NSW Fisheries Policy and Guidelines for Fish Friendly Waterway Crossings (2003). • Creek works not to be undertaken when heavy rain is forecast and should be avoided when there is flow. • Implement sedimentation and erosion controls in accordance with best practice guidelines.	Minimise
Weed Management	Project area	All species and vegetation communities	Pre-construction inspection for noxious weeds within project area. Prevention of spread of weeds and pathogens. Weed monitoring.	Before commencement of works and as required Monitoring – late spring / early summer after construction	• Control noxious weeds in works area according to plans and control measures of the LGAs. • Minimise use and adhere to best practice guidelines for herbicide treatment in environmentally sensitive areas (i.e. Box Gum Woodland). • Establish a machinery hygiene plan to ensure vehicle and machinery is absent of organic matter pre- and post-site access. • Sign environmentally sensitive areas (i.e. CEEC areas) and designate clean-down area for entry / exit points into these areas. • Monitoring and weed control in areas of known noxious or invasive species. • Understorey vegetation in easements should be managed to maintain composition and quality to prevent weed invasion	Minimise
Pollution Prevention	Project area	All species and vegetation communities	Prevention of contaminants and erosion outside works zones.	As required	• Establish a spill plan to prevent chemicals or pollutants from having an adverse effect on the environment. • Backfill cable trench where cement is used; at least 20 cm of cement free topsoil to be replaced as the top layer in the	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
					back fill. • Establish an erosion and sediment control plan so appropriate controls are in place prior to commencement of works.	
Site Management	Project area	All species and vegetation communities	Stabilisation of soil, rehabilitation and revegetation to be undertaken progressively to re-establish ground cover.	As required	• Lightly mulch exposed soils with chipped vegetation or sterile hay in areas dominated by exotic groundcover species. Sow with an appropriate cover crop in consultation with land owners. • Lightly mulch exposed soils with chipped vegetation or sterile hay in areas dominated by native grasses using local provenance species. • Fertiliser should not be used to promote revegetation in areas dominated by native grasses.	Minimise
Operational Phase						
Flora & Fauna Management Plan	Project area	All species and vegetation communities	To avoid significant impact to flora and fauna outside of the accepted clearance boundaries and prevent 'unassessed' impacts occurring.	Implement prior to construction	• An ecological professional to develop and implement a Flora and Fauna Management Plan to report on and manage impacts. • The management plan should highlight ecological important areas (vegetation communities and threatened fauna species habitat) and their management. • Specific areas requiring monitoring or management should be highlighted as well as timing for monitoring. • Weed species should be highlighted along with prescriptions for their management.	Minimise
Adaptive Bird & Bat Management Plan	Project area	Superb Parrot, Painted Honeyeater, Regent Honeyeater, Wedge-tailed Eagle, Little Eagle, Eastern Bent-wing Bat, Yellow-bellied Sheathtail-bat, Gould's Wattled Bat and White-striped Freetail Bat.	Development of an 'insurance' monitoring program to address uncertainty inherent in the assessment.	Implement prior to construction. Survey and monitor during 'high risk' periods, when species may be moving through or foraging in the area	• An ecological professional to develop and implement a Bird and Bat Monitoring Program to report on, and manage impacts with potential to be significant. • Monitoring surveys should include an understanding of breeding activity (i.e. nest locations) and foraging movements. • Baseline (pre-construction) and operational collision and abundance data would be collected, focused on higher risk species and higher risk locations in order that actions can be taken to address unforseen impacts, should they occur.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
					• Management Plan methods would utilise AusWEA (2006) best practice guidelines. • Management Plan should include management response options (i.e. restriction of lambing on ridges with high raptor activity to reduce collision risks) to be implemented where significant impacts are anticipated.	
Habitat Connectivity	Transmission Line Easement	All common species, as well as threatened fauna, particularly threatened parrots, gliders and bats	Minimise fragmentation of landscape connectivity.	After construction	• Promote growth of vegetation under the transmission line to the maximum allowable height to maintain fauna habitat connectivity. • Understorey vegetation in easements should be managed to maintain composition and quality to prevent weed invasion. • Near areas of intact woodland or forest a spacing of 600m should be considered for turbines.	Minimise

Table 11. Offset measures to maintain or improve biodiversity for Rye Park Wind Farm.

Item	Area	Target Species	Objective	Timing	Proponent Commitment
Construction Phase					
Development of offset strategy and offset plan	Project Area	Box Gum Woodland, Hollow-bearing trees, Threatened species habitat	Proponent will develop an offset plan to offset all permanent native vegetation removal to maintain or improve biodiversity in the longer term.	Prior to construction	• Develop an offset strategy and finalise prior to any construction impacts an ecological professional, in accordance with Appendix F • Develop an offset plan prior to operation, demonstrating the suitability of the final offset site and providing detailed management actions specific to the site. • Ensure the offset strategy complies with the *Principles for the use of biodiversity offsets in NSW* guidance document. • The offset ratio will be determined with reference to: the conservation status of the vegetation, the condition of the vegetation, and the actual threatened species habitat value lost (i.e. known threatened species habitat, not potential habitat). • Where vegetation is listed as an EEC, a ratio of 1:5 to 1:10 is proposed, depending on quality of habitat. • Where non-threatened vegetation is cleared an offset ratio to be applied at 1:2. • Where hollow-bearing trees are to be cleared and cannot be avoided an offset ratio to be applied at 1:1 and is supplementary to other areas offset. • Include provisions for offsetting Commonwealth listed EEC to demonstrate compliance with the Commonwealth offset policy.

5 Conclusion on the likelihood of significant impacts

Identify whether or not you believe the action is a controlled action (ie. whether you think that significant impacts on the matters protected under Part 3 of the EPBC Act are likely) and the reasons why.

5.1 Do you THINK your proposed action is a controlled action?

x	No, complete section 5.2
	Yes, complete section 5.3

5.2 Proposed action IS NOT a controlled action.

Specify the key reasons why you think the proposed action is NOT LIKELY to have significant impacts on a matter protected under the EPBC Act.

On the basis of the biodiversity investigations, the proposal is not considered likely to have a significant impact on EPBC listed species or communities. The proposal will incur minor impact through clearing and habitat loss on some threatened entities and potential collision risk to migratory birds are possible, however the conclusions of the assessment consider the proposal will not result in an adverse impact to any species or communities such that whole populations would be at risk of extinction. Given that woodland vegetation has predominantly been avoided, the site exists within a degraded environment subject to ongoing agricultural pressures, and proposed management measures will be adopted to mitigate and monitor risks the proposal is not considered to constitute a controlled action.

5.3 Proposed action IS a controlled action

Type 'x' in the box for the matter(s) protected under the EPBC Act that you think are likely to be significantly impacted. (The 'sections' identified below are the relevant sections of the EPBC Act.)

	Matters likely to be impacted
	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
	Protection of the environment from Commonwealth actions (section 28)
	Commonwealth Heritage places overseas (sections 27B and 27C)

Specify the key reasons why you think the proposed action is likely to have a significant adverse impact on the matters identified above.

6 Environmental record of the responsible party

NOTE: If a decision is made that a proposal needs approval under the EPBC Act, the Environment Minister will also decide the assessment approach. The EPBC Regulations provide for the environmental history of the party proposing to take the action to be taken into account when deciding the assessment approach.

		Yes	No
6.1	**Does the party taking the action have a satisfactory record of responsible environmental management?** **Provide details** Epuron is a leading Australian renewable energy company with a focus on development of utility-scale wind and solar energy and has been developing projects in NSW since 2003. Epuron has a successful track record in developing wind farms including the Conroys Gap, Cullerin Range, Gullen Range, Silverton Wind Farm and White Rock Wind Farm. The Cullerin Range Wind Farm is now in operation and the Gullen Range Wind Farm is under construction.	x	
6.2	**Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?** **If yes, provide details**		x
6.3	**If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?** **If yes, provide details of environmental policy and planning framework** The proposed wind farm would be developed with project specific Environmental Management Plans as per the Statement of Commitments included in the Environmental Assessment. The action would be undertaken in accordance with stringent environmental management plans and regular monitoring would occur to ensure that impacts are minimised or managed.	x	
6.4	**Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?** **Provide name of proposal and EPBC reference number (if known)** • White Rock Wind Farm (EPBC 2011/5854) • Silverton Wind Farm (EPBC 2009/4847) • Gullen Range Wind Farm (EPBC 2008/3947) • Conroys Gap Wind Farm (EPBC 2006/2733) • Cullerin Range Wind Farm (EPBC 2006/2687) • Liverpool Range Wind Farm (EPBC 2014/7136)	x	

7 Information sources and attachments

(For the information provided above)

7.1 References

DoE (2009). Yass Daisy in Species Profile and Threats Database. Department of the Environment. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/spratlookupspecies.pl?name=Yass+Daisy&searchtype=Wildcard

DoE (2013). *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT) in Species Profile and Threats Database, Department of the Environment. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104

DoE (2014). EPBC Act Protected Matters Search Tool. Department of the Environment. Available from: http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/protected

DECC (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Department of Environment and Conservation, NSW.

DEWHA (2009a) *Significant Impact Guidelines for the critically endangered Golden Sun Moth (Synemon plana)* [online], Department of Environment, Water, Heritage and the Arts. Available from http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth.pdf

DEWHA (2009b) *Background Paper to EPBC Act Policy Statement 3.12 - Significant Impact Guidelines for the critically endangered Golden Sun Moth (Synemon plana)* [online], Department of Environment, Water, Heritage and the Arts. Available from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25234

DEWHA (2010). Survey Guidelines for Australia's Threatened Birds. Department of Environment, Water, Heritage and the Arts.

OEH (2011). South Eastern Highlands Bioregion. Office of Environment and Heritage. Available from: http://www.environment.nsw.gov.au/bioregions/SouthEasternHighlandsBioregion.htm

OEH (2013). NSW Bionet – Atlas of NSW Wildlife. Office of Environment and Heritage. Available from: http://www.bionet.nsw.gov.au/

Maddock, M. & D. Geering (1994). Range expansion and migration of the Cattle Egret. *Ostrich*. 65:191-203.

nghenvironmental (2012) Rye Park Wind Farm Biodiversity Constraints Analysis, report prepared for Epuron Pty Ltd.

nghenviornmental. (2014). Rye Park Wind Farm Biodiversity Assessment, report prepared for Epuron Pty Ltd.

NPSW (2011) *Draft Plan of Management for The Gunning Reserves*, Office of Environment and Heritage NSW, Sydney [online]. Available from http://www.environment.nsw.gov.au/resources/planmanagement/draft/110751GunningReservesDraftPOM.pdf

7.2 Reliability and date of information

For information in section 3 specify:

- source of the information;
- how recent the information is;
- how the reliability of the information was tested; and
- any uncertainties in the information.

The source of the information is from the material referenced above and from publicly available information from the Commonwealth Department of the Environment website or the NSW Office of Environment and Heritage website. The current biodiversity assessment for Rye Park wind farm is in its final stages of completion (2014); this assessments conducted within the biodiversity assessment were used to compile this EPBC referral. No known uncertainties in the information exist.

7.3 Attachments

Indicate the documents you have attached. All attachments must be less than three megabytes (3mb) so they can be published on the Department's website. Attachments larger than three megabytes (3mb) may delay the processing of your referral.

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the project locality (section 1)	✓	See attached Figures 1 to 4 inclusive
	GIS file delineating the boundary of the referral area (section 1)	✓	See attached folder 'GIS'
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3)	✓	See attached Figures 1 to 4 inclusive
If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)		
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)		
	copies of any flora and fauna investigations and surveys (section 3)	✓	See attached Documents 1 to 19 inclusive
	technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)	✓	See attached Documents 1 to 19 inclusive
	report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)	✓	See attached Documents 20 to 22 inclusive

8 Contacts, signatures and declarations

NOTE: Providing false or misleading information is an offence punishable on conviction by imprisonment and fine (s 489, EPBC Act).

Under the EPBC Act a referral can only be made by:

- the person proposing to take the action (which can include a person acting on their behalf); or
- a Commonwealth, state or territory government, or agency that is aware of a proposal by a person to take an action, and that has administrative responsibilities relating to the action[3].

Project title:

8.1 Person proposing to take action

This is the individual, government agency or company that will be principally responsible for, or who will carry out, the proposed action.

If the proposed action will be taken under a contract or other arrangement, this is:

- the person for whose benefit the action will be taken; or
- the person who procured the contract or other arrangement and who will have principal control and responsibility for the taking of the proposed action.

If the proposed action requires a permit under the Great Barrier Reef Marine Park Act[4], this is the person requiring the grant of a GBRMP permission.

The Minister may also request relevant additional information from this person.

If further assessment and approval for the action is required, any approval which may be granted will be issued to the person proposing to take the action. This person will be responsible for complying with any conditions attached to the approval.

If the Minister decides that further assessment and approval is required, the Minister must designate a person as a proponent of the action. The proponent is responsible for meeting the requirements of the EPBC Act during the assessment process. The proponent will generally be the person proposing to take the action[5].

Name	Brian Hall
Title	Senior Project Manager
Organisation	Rye Park Wind Farm Pty Ltd
ACN / ABN (if applicable)	ABN 11 153 598 586
Postal address	Level 11, 75 Miller Street, North Sydney, NSW, 2060
Telephone	(02) 8456 7400
Email	b.hall@epuron.com.au
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence. I agree to be the proponent for this action.
Signature	Brian Hall — Date 25.03.2014

[3] *If the proposed action is to be taken by a Commonwealth, state or territory government or agency, section 8.1 of this form should be completed. However, if the government or agency is aware of, and has administrative responsibilities relating to, a proposed action that is to be taken by another person which has not otherwise been referred, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.*

[4] *If your referred action, or a component of it, is to be taken in the Great Barrier Reef Marine Park the Minister is required to provide a copy of your referral to the Great Barrier Reef Marine Park Authority (GBRMPA) (see section 73A,* EPBC Act*). For information about how the GBRMPA may use your information, see http://www.gbrmpa.gov.au/privacy/privacy_notice_for_permits.*

[5] *If a person other than the person proposing to take action is to be nominated as the proponent, please contact the Referrals Business Entry Point (1800 803 772) to obtain an alternative contacts, signatures and declarations page.*

8.2 Person preparing the referral information (if different from 8.1)

Individual or organisation who has prepared the information contained in this referral form.

Name	Nick Graham-Higgs
Title	Director
Organisation	NGH Environmental Pty Ltd
ACN / ABN (if applicable)	ABN 31 124 444 622
Postal address	P.O. Box 470, Bega NSW 2550
Telephone	0427 260 819
Email	Nick.gh@nghenvironmental.com.au
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence.

Signature  Date 20.03.2014

REFERRAL CHECKLIST

NOTE: This checklist is to help ensure that all the relevant referral information has been provided. It is not a part of the referral form and does not need to be sent to the Department.

HAVE YOU:

- ❑ ✓ Completed all required sections of the referral form?
- ❑ ✓ Included accurate coordinates (to allow the location of the proposed action to be mapped)?
- ❑ ✓ Provided a map showing the location and approximate boundaries of the project area?
- ❑ ✓ Provided a map/plan showing the location of the action in relation to any matters of NES?
- ❑ ✓ Provided a digital file (preferably ArcGIS shapefile, refer to guidelines at Attachment A) delineating the boundaries of the referral area?
- ❑ ✓ Provided complete contact details and signed the form?
- ❑ ✓ Provided copies of any documents referenced in the referral form?
- ❑ ✓ Ensured that all attachments are less than three megabytes (3mb)?
- ❑ ✓ Sent the referral to the Department (electronic and hard copy preferred)?

Attachment A

Geographic Information System (GIS) data supply guidelines

If the area is less than 5 hectares, provide the location as a point layer. If the area greater than 5 hectares, please provide as a polygon layer. If the proposed action is linear (eg. a road or pipline) please provide a polyline layer.

GIS data needs to be provided to the Department in the following manner:

- Point, Line or Polygon data types: ESRI file geodatabase feature class (preferred) or as an ESRI shapefile (.shp) zipped and attached with appropriate title
- Raster data types: Raw satellite imagery should be supplied in the vendor specific format.
- Projection as GDA94 coordinate system.

Processed products should be provided as follows:

- For data, uncompressed or lossless compressed formats is required - GeoTIFF or Imagine IMG is the first preference, then JPEG2000 lossless and other simple binary+header formats (ERS, ENVI or BIL).
- For natural/false/pseudo colour RGB imagery:
    - If the imagery is already mosaiced and is ready for display then lossy compression is suitable (JPEG2000 lossy/ECW/MrSID). Prefer 10% compression, up to 20% is acceptable.
    - If the imagery requires any sort of processing prior to display (i.e. mosaicing/colour balancing/etc) then an uncompressed or lossless compressed format is required.

Metadata or 'information about data' will be produced for all spatial data and will be compliant with ANZLIC Metadata Profile. (http://www.anzlic.org.au/policies_guidelines#guidelines).

The Department's preferred method is using ANZMet Lite, however the Department's Service Provider may use any compliant system to generate metadata.

All data will be provide under a Creative Commons license (http://creativecommons.org/licenses/by/3.0/au/)

Attachments

List of Documents:

Document 01_RYP_Biodiversity Assessment_Final_Report_V1 4_24_Jan 2014.pdf
Document 02_RYP_Biodiversity Assessment_Final_Appendices_V1 28_Jan 2014.pdf
Document 03_RYP_Biodiversity Assessment_Appendix E.1_Location of Infrastructure.pdf-1390886663_Part1.pdf
Document 04_RYP_Biodiversity Assessment_Appendix E.1_Location of Infrastructure.pdf-1390886663_Part2.pdf
Document 05_RYP_Biodiversity Assessment_Appendix E.2_Flora effort_results.pdf-1390449440_Part1.pdf
Document 06_RYP_Biodiversity Assessment_Appendix E.2_Flora effort_results.pdf-1390449440_Part2.pdf
Document 07_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part1.pdf
Document 08_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part2.pdf
Document 09_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part3.pdf
Document 10_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part4.pdf
Document 11_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part5.pdf
Document 12_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part6.pdf
Document 13_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part7.pdf
Document 14_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part8.pdf
Document 15_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part9.pdf
Document 16_RYP_Biodiversity Assessment_Appendix E.3_Fauna effort_results.pdf-1390886523_Part10.pdf
Document 17_RYP_Biodiversity Assessment_Appendix E.4_Constraints Maps_Part1.pdf
Document 18_RYP_Biodiversity Assessment_Appendix E.4_Constraints Maps_Part2.pdf
Document 19_RYP_Biodiversity Assessment_Appendix E.4_Constraints Maps_Part3.pdf
Document 20_RYP_Aboriginal & European Heritage_January 2013_Part1.pdf
Document 21_RYP_Aboriginal & European Heritage_January 2013_Part2.pdf
Document 22_RYP_Aboriginal & European Heritage_January 2013_Part3.pdf

List of Figures:

Figure 1_RYP_EPBC_Project_Boundary_190214.jpg
Figure 2_RYP_EPBC_LotDP_North_200214.jpg
Figure 3_RYP_EPBC_LotDP_South_200214.jpg
Figure 4_RYP_EPBC_Layout Map_150114

Involved Landowner Parcels

Table 1: Lot & DP of involved landowner parcels (see attached Figures 2 and 3)

Lot/DP	Lot/DP	Lot/DP	Lot/DP	Lot/DP
1/211320	50/754102	92/754136	133/754102	181/754102
1/222985	54/754102	93/754136	133/754136	182/754102
1/575206	55/754102	94/754136	134/754102	185/754102
1/601586	55/754136	95/754136	135/754136	201/754102
1/705655	56/754102	96/754136	137/754136	202/754102
1/746015	56/754136	98/754102	140/754136	203/754102
1/1180139	58/754099	101/754099	142/754136	207/754142
2/222985	58/754102	102/754099	143/754106	208/754142
2/232571	59/754099	103/754099	143/754136	209/754122
2/601586	59/754102	103/754136	144/754106	210/118333
2/705655	60/754102	104/754099	144/754136	214/754145
2/1066057	61/754136	104/754142	147/754136	215/754142
2/1180139	62/754136	105/754099	149/754136	216/754142
3/1066057	63/754099	107/754099	150/754136	222/754122
4/1066057	63/754136	108/754099	152/754136	223/754122
12/754102	64/754102	108/754136	153/754136	224/754122
16/754102	70/754102	110/754136	155/754136	228/754122
17/754136	71/754102	114/754136	156/754102	229/754122
18/754136	72/754136	115/754099	157/754102	235/754145
22/754102	75/754099	115/754142	157/754136	239/754145
23/754102	78/754102	117/754099	158/754136	240/754145
29/754102	79/754136	117/754102	160/754136	242/754145
30/754102	80/754099	117/754136	161/754136	249/754145
31/754102	80/754102	120/754102	162/754136	250/754145
32/754122	80/754136	123/754136	163/754136	257/754106
34/754136	81/754136	126/754136	165/754102	260/754106
35/754102	81/754142	127/754136	166/754102	269/754142
39/754142	82/754136	128/754136	167/754102	281/754142
40/754142	88/754136	129/754099	175/754102	295/754106
41/754102	89/754136	129/754136	176/754102	335/754106
46/754099	90/754102	130/754099	177/754099	337/754106
47/754136	91/754102	131/754099	177/754102	338/754106
48/754099	91/754136	131/754136	178/754099	339/754106
48/754102	92/754099	132/754099	178/754102	340/754106
48/754136	92/754102	132/754102	179/754102	341/754106

Lot/DP
347/754106
353/754106
357/754106
360/754106
361/754106
364/754106
368/754106
A/417584
A/439287
B/417584
B/439287
D/440134
E/418849
F/418849
N/439287

Project Boundary Coordinate Points

Table 2: Wind Farm Boundary EPBC Co-ordinate Points (see attached Figure 1)

ID	Longitude (°)	Latitude (°)	Easting	Northing (m)
1	149.049	-34.7354	687577.96	6154390.77
2	149.042	-34.7345	686977.15	6154499.31
3	149.044	-34.7253	687165.53	6155519.99
4	149.046	-34.7183	687308.11	6156292.06
5	149.042	-34.7179	687000.76	6156346.18
6	149.042	-34.7178	686978.35	6156350.13
7	149.042	-34.7158	687022.03	6156570.28
8	149.043	-34.7109	687130.22	6157115.02
9	149.032	-34.7093	686119.28	6157308.3
10	149.034	-34.7025	686250.44	6158060.26
11	149.032	-34.7023	686091.38	6158088.44
12	149.033	-34.6976	686181.47	6158606.35
13	149.027	-34.697	685673.61	6158689.62
14	149.018	-34.6958	684850.14	6158837.43
15	149.02	-34.6863	685025.61	6159892.8
16	149.015	-34.6849	684619.28	6160053.75
17	149.008	-34.6822	683988.79	6160364.43
18	149.008	-34.6821	683971.23	6160374.37
19	149.009	-34.6813	684027.59	6160461.35
20	149.009	-34.6813	684015.36	6160463.6
21	149.01	-34.6802	684109.11	6160582
22	149.011	-34.679	684270.09	6160711.72
23	149.011	-34.6789	684206.81	6160723.85
24	149.011	-34.6786	684210.25	6160759.04
25	149.011	-34.6783	684215.91	6160789.99
26	149.011	-34.6781	684194.62	6160816.26
27	149.01	-34.6778	684189.31	6160844.45
28	149.011	-34.6776	684198.06	6160874.01
29	149.011	-34.6773	684214.25	6160899.43
30	149.011	-34.6771	684232.47	6160926.03
31	149.011	-34.6769	684256.25	6160951.19
32	149.011	-34.6767	684281.71	6160968.09
33	149.012	-34.6764	684309.5	6160996.28
34	149.012	-34.6757	684356.59	6161082.22
35	149.013	-34.6749	684423.99	6161166.08
36	149.013	-34.6744	684405.67	6161221.49
37	149.013	-34.6741	684399.25	6161253.47
38	149.013	-34.6733	684392.55	6161344.7
39	149.013	-34.673	684393.53	6161371.08
40	149.013	-34.673	684393.53	6161371.12
41	149.013	-34.6728	684394.5	6161396.74
42	149.013	-34.6721	684416.06	6161479.86
43	149.013	-34.671	684472.73	6161600.45
44	149.014	-34.6694	684531.24	6161771.04
45	149.014	-34.6692	684522.69	6161797.51
46	149.013	-34.6688	684477.58	6161842.69
47	149.014	-34.6684	684498.33	6161881.55
48	149.013	-34.6684	684476.78	6161890.19
49	149.013	-34.6687	684423.05	6161852.76
50	149.012	-34.6689	684341.68	6161836.08
51	149.012	-34.6688	684311.21	6161839.13
52	149.011	-34.6689	684289.56	6161828.91
53	149.011	-34.6692	684264.8	6161805.99
54	149.011	-34.669	684259.53	6161817.75
55	149.012	-34.6619	684395.61	6162603.83
56	149.008	-34.6613	683982	6162680.33

57	149.008	-34.6613	683956.88	6162684.93
58	149.002	-34.6605	683422.23	6162783.78
59	149.002	-34.6603	683427.93	6162803.2
60	149.003	-34.6513	683604.68	6163803.09
61	149.002	-34.6511	683504.31	6163823.16
62	149.001	-34.651	683397.96	6163842.48
63	149	-34.6508	683291.62	6163861.78
64	149.001	-34.6443	683412.65	6164582.28
65	148.99	-34.6429	682419.49	6164755.62
66	148.99	-34.6427	682423	6164775.53
67	148.991	-34.6414	682449.65	6164926.57
68	148.991	-34.6412	682453.06	6164946.03
69	148.994	-34.6255	682753.98	6166678.34
70	148.991	-34.6251	682505.32	6166724.42
71	148.992	-34.6196	682602.58	6167339.53
72	148.992	-34.6196	682592.62	6167341.29
73	148.992	-34.6156	682667.48	6167783.19
74	148.993	-34.6157	682762.64	6167766.11
75	148.994	-34.6112	682846.84	6168266.75
76	148.997	-34.6115	683062.91	6168226.64
77	148.997	-34.6117	683078.88	6168203.79
78	148.998	-34.6119	683227.67	6168175.44
79	148.998	-34.6143	683187.33	6167908.27
80	149.005	-34.6153	683863.42	6167789.56
81	149.007	-34.6093	683982.8	6168454.81
82	149.003	-34.6088	683657.47	6168518.3
83	149.003	-34.6087	683639.42	6168521.82
84	149.003	-34.6086	683642.93	6168541.58
85	149.003	-34.6086	683642.98	6168541.57
86	149.003	-34.6052	683707.48	6168907.23
87	149.003	-34.6052	683707.45	6168907.24
88	149.003	-34.6052	683707.45	6168907.26
89	149.003	-34.6052	683703.76	6168907.95
90	149.003	-34.6052	683648.81	6168918.6
91	149.001	-34.6049	683499.29	6168947.31
92	149	-34.6047	683370.54	6168970.38
93	149	-34.6047	683367.61	6168970.92
94	149.001	-34.6005	683452.99	6169442.43
95	149.001	-34.6001	683460.89	6169485.77
96	149.001	-34.6001	683460.85	6169485.78
97	149.001	-34.6001	683460.85	6169485.8
98	148.997	-34.5996	683133.25	6169543.56
99	148.997	-34.5994	683133.92	6169563.27
100	148.997	-34.5994	683133.96	6169563.26
101	148.998	-34.5939	683242.59	6170179.37
102	148.999	-34.5875	683367.36	6170886.79
103	148.999	-34.5875	683367.33	6170886.8
104	148.999	-34.5875	683367.33	6170886.82
105	148.999	-34.5874	683347.43	6170890.53
106	148.999	-34.5861	683372.47	6171038.04
107	148.99	-34.5849	682500.12	6171189.31
108	148.994	-34.5598	682964.46	6173963.58
109	149.004	-34.5612	683862.41	6173788.68
110	149.003	-34.566	683770.78	6173260.8
111	149.019	-34.5677	685176.21	6173049.75
112	149.019	-34.5677	685176.22	6173049.75
113	149.019	-34.5675	685179.64	6173069.64
114	149.021	-34.5551	685419.85	6174441.48
115	149.025	-34.5557	685801.15	6174366.83
116	149.027	-34.5474	685999.13	6175275.93
117	149.028	-34.5476	686086.07	6175257.32
118	149.029	-34.5442	686164.23	6175634.23
119	149.027	-34.5439	685992.04	6175668.53
120	149.027	-34.5439	685972.29	6175672.47

121	149.028	-34.5401	686065.42	6176090.36
122	149.023	-34.5394	685628.84	6176177.78
123	149.024	-34.5335	685757.47	6176828.64
124	149.023	-34.5333	685671.96	6176845.99
125	149.023	-34.5332	685676.53	6176867.65
126	149.014	-34.5317	684836.88	6177041.64
127	149.014	-34.5302	684872.97	6177216.68
128	149.005	-34.5289	684003.47	6177373.77
129	149.003	-34.5399	683763.68	6176157.79
130	149.002	-34.5401	683759.79	6176138.01
131	149.001	-34.5399	683642.27	6176160.8
132	148.997	-34.5393	683263.97	6176234.15
133	148.997	-34.5393	683263.98	6176234.17
134	148.997	-34.5371	683305.76	6176480.89
135	148.997	-34.5357	683284.99	6176628.53
136	148.996	-34.5352	683185.26	6176687.86
137	148.995	-34.5344	683066.71	6176776.09
138	148.994	-34.534	683018.3	6176830.53
139	148.995	-34.5327	683048.33	6176970.07
140	148.994	-34.5324	682978.11	6176999.3
141	148.993	-34.5304	682953.08	6177229.47
142	148.993	-34.5291	682955.78	6177371.22
143	148.993	-34.5286	682897.84	6177427.06
144	148.993	-34.5272	682942.83	6177580.4
145	148.986	-34.5261	682234.66	6177721.39
146	148.986	-34.5259	682238.35	6177741.15
147	148.986	-34.5259	682238.35	6177741.15
148	148.988	-34.5157	682460.18	6178869.75
149	148.989	-34.5093	682597.96	6179570.93
150	148.987	-34.509	682367.99	6179614.98
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152	148.989	-34.5035	682566	6180216.21
153	148.988	-34.5005	682549.06	6180555.06
154	148.99	-34.4984	682748.25	6180777.26
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158	148.997	-34.4984	683329.22	6180765.81
159	148.997	-34.4977	683362.47	6180842.81
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162	149.002	-34.4919	683809.48	6181481.08
163	149.003	-34.4879	683882.45	6181919.35
164	149.003	-34.4851	683957.55	6182236.74
165	149.007	-34.4813	684302.02	6182650.55
166	149.009	-34.4816	684495.74	6182615.31
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168	149.01	-34.4769	684582.24	6183126.31
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170	149.01	-34.4767	684582.44	6183151.17
171	149.01	-34.4767	684582.45	6183151.16
172	149.01	-34.4767	684591.03	6183157.1
173	149.01	-34.4751	684621.58	6183330.91
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176	149.007	-34.4746	684304.69	6183388.25
177	149.007	-34.4746	684282.53	6183392.24
178	149.007	-34.4746	684282.28	6183392.28
179	149.005	-34.4744	684114.25	6183422.69
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184	148.997	-34.47	683442.77	6183921.15

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187	148.997	-34.4717	683406.42	6183729.12
188	148.997	-34.4719	683402.53	6183708.68
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218	148.934	-34.4482	677680.74	6186447.7
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236	148.918	-34.4431	676224.88	6187046.96
237	148.918	-34.4436	676190.71	6186984.16
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239	148.915	-34.4438	675969.25	6186969.84
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242	148.912	-34.4434	675645.31	6187015.61
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244	148.908	-34.4414	675274.67	6187253.03
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262	148.934	-34.48	677574.34	6182924.46
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276	148.942	-34.5112	678267.86	6179451.66
277	148.939	-34.5108	678020.54	6179497.4
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279	148.937	-34.518	677827.33	6178700.91
280	148.937	-34.518	677827.28	6178700.92
281	148.937	-34.518	677827.27	6178700.88
282	148.937	-34.518	677807.56	6178704.58
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285	148.929	-34.5168	677039.8	6178850.01
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316	148.947	-34.536	678657.88	6176684.56
317	148.947	-34.537	678641.09	6176579.93
318	148.948	-34.5372	678745.46	6176559.94
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321	148.941	-34.5483	678112.56	6175336.73
322	148.952	-34.5497	679069.05	6175160.86
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324	148.95	-34.5521	678962.26	6174902.63
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326	148.949	-34.5595	678805.94	6174075.28
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342	148.958	-34.5814	679584.35	6171638.67
343	148.958	-34.5813	679561.92	6171641.44
344	148.956	-34.5887	679407.37	6170826.27
345	148.952	-34.5882	679059.83	6170885.37
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347	148.952	-34.5887	679067.93	6170834.06
348	148.953	-34.5888	679081.75	6170818.7
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380	148.964	-34.6051	680079.68	6168992.77
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384	148.967	-34.6142	680355.48	6167978.37
385	148.966	-34.618	680284.67	6167562.96
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387	148.958	-34.617	679501.38	6167685.29
388	148.957	-34.619	679454.98	6167461.32
389	148.955	-34.6188	679240.13	6167495.43
390	148.954	-34.6232	679149.06	6167003.67
391	148.954	-34.6233	679105.59	6166990.94
392	148.953	-34.6282	679002.98	6166457.13
393	148.949	-34.6277	678707.47	6166514.01
394	148.949	-34.6277	678687.54	6166517.82
395	148.948	-34.6275	678559.62	6166542.38
396	148.947	-34.6316	678472.66	6166090.48
397	148.943	-34.631	678068.26	6166164.31
398	148.943	-34.632	678066.6	6166054.49
399	148.943	-34.6325	678079.98	6165997.2
400	148.943	-34.6331	678095.99	6165928.54
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* Easting and Northing in MGA94 Zone 55				

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Rye Park Wind Farm

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TABLES

FIGURES

ACRONYMS

AoS	Assessment of Significance
CMA	Catchment Management Authority
CRA	Comprehensive Regional Assessment
C'wth	Commonwealth Government of Australia
DE	Development envelope (all areas in which infrastructure is currently proposed).
EEC	Endangered Ecological Community – as defined by either the NSW *Threatened Species Conservation Act 1995* or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (C'wth)
ha	hectares
km	kilometres
m	metres
NES	Matters of National environmental significance under the EPBC Act
NPW Act	*National Parks And Wildlife Act 1974* (NSW)
NSW	New South Wales
OEH	(NSW) Office of Environment and Heritage, formerly Department of Environment, Climate Change and Water
POM	Plan of Management
SEWPAC	The Commonwealth Department of Sustainability, Environment, Water, Population and Communities
SIS	Species Impact Statement
sp/spp	Species/multiple species
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
WoNS	Weeds of National Significance

EXECUTIVE SUMMARY

The Rye Park wind farm proposal consists of up to 126 wind turbines and associated infrastructure to be developed over an approximately 14,000 hectare project area. The proposed number of turbines may be reduced in the future, however the calculations for magnitude of impact remain based on the 'worst-case scenario' (126 turbines) at the time of this assessment. The wind farm is proposed for the locality of Rye Park, north of the town of Yass in south-western NSW. The region is dominated by agricultural activities (sheep and cattle production), and large areas are extensively cleared. There are also extensive areas of remnant and regrowth native vegetation in the Rye Park area.

Several field survey programs were undertaken at different times between November 2011 and December 2013 to document vegetation and fauna habitat types and condition, to identify potential habitat for threatened species and, where this occurred, to undertake targeted surveys. In particular, several targeted surveys were undertaken within July 2013 and November 2013. The results of these surveys have informed detailed constraints mapping within the development envelopes and the proposed infrastructure layout has been developed iteratively in response to ecological and other constraints.

The project area includes areas of endangered ecological communities (EECs). Several species of threatened birds and bats were detected during field surveys. To assess impacts, three main types of wind farm impacts were analysed: vegetation clearing for construction and ongoing operational impacts through collision (blade-strike) and habitat alienation for birds and bats. In design planning to avoid impacts, key issues considered for flora were avoidance of high conservation values areas, while key issues considered for fauna were maintenance of connectivity across the landscape and the avoidance of known 'high risk' turbine locations for blade-strike (e.g. near nest sites). The magnitude of impact has been quantified and a worst-case vegetation clearing estimate provided for each affected vegetation community.

In developing measures to minimise impacts, consideration has been given to quantifying the loss of critical habitat such as loss of EEC habitat, threatened species foraging or breeding habitat, or hollow-bearing trees so that a 'maintain or improve' biodiversity outcome can be achieved through offsets. The risk of significant impact was classed as low, moderate or high for ecological communities and species listed under the *Threatened Species Conservation Act 1995* and the *Environmental Protection and Biodiversity Conservation Act 1999* known or likely to occur in the project area. Low and moderate risks were considered manageable, and the following higher risk species were subject to detailed impact assessment, including assessments of significance:

- Yass Daisy (vulnerable TSC Act, vulnerable EPBC Act).
- Box Gum Woodland (endangered TSC Act, critically endangered EPBC Act).
- Superb Parrot (vulnerable TSC Act, vulnerable EPBC Act).
- Regent Honeyeater (endangered TSC Act, endangered EPBC Act).
- Little Eagle (vulnerable TSC Act).
- Eastern Bentwing Bat (vulnerable TSC Act).
- Yellow-bellied Sheathtail-bat (vulnerable TSC Act)
- Golden Sun Moth (endangered TSC Act, critically endangered EPBC Act).
- Striped Legless Lizard (vulnerable TSC Act, vulnerable EPBC Act).
- White-throated Needletail (migratory EPBC Act).

With the implementation of recommendations, which include micro-siting infrastructure to avoid impact on known threatened species habitat and implementation of an offset plan to address impacts that cannot be avoided or sufficiently minimised, a significant impact to the listed communities and species is

considered unlikely. Focus species and communities will be further managed in relevant plans or monitored through an adaptive monitoring program, for example, a Flora and Fauna Management Plan and Bird and Bat Management Program.

1 INTRODUCTION

The Rye Park wind farm proposal consists of up to 126 wind turbines and associated infrastructure over an approximately 14, 000 hectare project area. The wind farm is proposed for the locality of Rye Park, north of the town of Yass in south-western NSW. The project area is located on the edge of the Southern Tablelands and South West Slopes of NSW, across three local government areas (LGAs): Boorowa; Yass Valley; and Upper Lachlan. The region is dominated by agricultural activities (sheep and cattle production), and large areas are extensively cleared. There are also extensive patches of remnant and regrowth native vegetation in the Rye Park area.

This assessment concentrates on the impacts of the following five primary infrastructure components of the proposal:

- Wind turbine footings and placement.
- Creation of new tracks and widening of existing tracks.
- Installation of low voltage powerlines (33kV).
- Installation and clearing corridor for high voltage (132kV) electricity transmission line.
- Construction of substations.

The indicative infrastructure layout and development envelope is mapped in Appendix E.1.

1.1 OBJECTIVE OF THIS ASSESSMENT

This Biodiversity Assessment aims to provide an ecological impact assessment in accordance with the Director-General's Requirements (DGRs) for the Rye Park wind farm, NSW and Commonwealth legislation relating to threatened and protected species. Specifically, this assessment:

- Identifies threatened species, populations and communities listed under NSW and Commonwealth legislation that have the potential to occur on site.
- Maps existing vegetation type and condition and fauna habitat type and condition.
- Documents survey methods and effort with reference to species and communities identified in the DGRs.
- Demonstrates an avoidance, particularly regarding ecological values of high significance.
- Provides a worst case estimate of vegetation to be cleared, with a break down by vegetation and habitat type.
- Assesses the significance of proposed impacts to native vegetation, listed threatened species, populations and communities and their habitats, including consideration of habitat connectivity and wind-farm specific impacts such as blade-strike.
- Where required, includes details of how flora and fauna impacts would be managed during construction and operation phases of the project.
- Demonstrates how the project achieves a biodiversity outcome consistent with "maintain or improve" principles.
- Addresses the risk of weed spread and identifies suitable mitigation measures to address the risk.
- Considers the offsetting requirements and identifies suitable offset areas.

This report documents the findings of onsite ecological studies undertaken for the purposes of impact assessment. The report incorporates relevant information from the *Rye Park Wind Farm Biodiversity Constraints Analysis* (**ngh**environmental 2012) as well as providing a comprehensive impact assessment on

threatened entities for the final infrastructure layout, pursuant to NSW and Commonwealth guidelines. A summary of relevant guidelines and legislative considerations are given in Section 2.

1.2 BACKGROUND

This section describes the project area in the context of the Interim Biogeographic Regionalisation for Australia (IBRA), Mitchell Landscapes, Catchment Management Authority (CMA) Area and local government area. This section also provides a site description and an overview of previous assessments undertaken for the project.

1.2.1 IBRA subregion

The IBRA provides an Australia-wide regionalisation for patterns of biodiversity based on climate, geomorphology, landform, lithology and other characteristics (Environment Australia 2000). Each of the 89 IBRA regions is divided into subregions, which group biogeographic patterns at a higher resolution.

The project area lies across the boundary of two IBRA regions: NSW South Western Slopes and South Eastern Highlands. The South Western Slopes region comprises the western foothills and isolated ranges of the Great Dividing Range dominated by eucalypt forests and woodlands. The South Eastern Highlands region comprises the steep ranges of the Great Dividing Range with a variety of rainforest, sclerophyll forest, woodland and grassland communities (ACT Commissioner for the Environment 2000). Both regions have extensive areas of clearing for agriculture including grazing and cropping with significant loss of biodiversity (SEWPAC 2009; ACT Commissioner for the Environment 2000).

The project area lies within the Murrumbateman subregion of the South Eastern Highlands IBRA region. This subregion is characterised by undulating topography with rounded hills and plateaus, dark loams on valley floors with woodlands, grasslands and swamp vegetation types (Morgan 2001). Threatening processes to biological diversity in the Murrumbateman subregion include clearing of native vegetation, grazing pressure and exotic weeds. Ecosystems are particularly at risk from increasing fragmentation. Key actions have been identified to halt the decline in biodiversity, including protecting and linking woodland fragments. There are few recovery actions in place for threatened species recovery in the Murrumbateman subregion, although it is noted that off-park conservation (e.g. voluntary conservation agreements on private land) makes a significant contribution to ecological recovery within the greater South Eastern Highlands bioregion (SEWPAC 2009).

The project area also lies within the Northern Inland Slopes (formerly the Upper Slopes) subregion of the South Western Slopes IBRA region. This subregion is characterised by steep granite hills with small basalt outcroppings, shallow soils and dry forest types (Morgan 2001). The Northern Inland Slopes has been subject to clearing for agriculture and forestry and remnant vegetation largely occurs as isolated blocks on steep rocky hills. There are major river floodplains in the region which, as well as providing fertile land targeted for agricultural clearing, act as a natural barrier to plant and animal dispersal. Grassy woodlands are particularly threatened as they often occur in the fertile valleys of the subregion. Biodiversity is a risk from increasing fragmentation as well as exotic and environmental weed invasion (NRE 1998).

1.2.2 Mitchell landscapes

Mitchell Landscapes are areas of broadly homogeneous landscapes in terms of geomorphology, soils and broad vegetation types. The proposal site is mostly located within the Dalton Hills Mitchell Landscape extending slightly into the Boorowa Volcanics Mitchell Landscape to the west. The Dalton Hills landscape

is characterised by linear ranges and undulating hills on steep dipping, folded Ordovician quartzose greywacke, slate, chert and phyllite. Typically vegetation is dominated by Yellow box (*Eucalyptus melliodora*), White Box (*Eucalyptus albens*), Grey Box (*Eucalyptus microcarpa*), Red Stringybark (*Eucalyptus macrorhyncha*) and Inland Scribbly Gum (*Eucalyptus rossii*) and grassy woodlands originally dominated by kangaroo grass (*Themeda australis*) which have been extensively modified by grazing and cultivation. River Oak (*Casuarina cunninghamiana*) occurs along most streams with river red gum (*Eucalyptus camaldulensis*) appearing in the north (DECC 2008).

1.2.3 Catchment areas

The proposal site at the intersection of four sub-regions of two CMA:

- Upper Slopes and Murrumbateman sub-regions of the Lachlan CMA.
- Upper Slopes and Murrumbateman sub-regions of the Murrumbidgee CMA.

Key biodiversity issues in both CMAs include reducing fragmentation, managing weeds and pest vertebrates and providing conservation outcomes for native grasslands and woodlands and associated flora and fauna species on private land (CMA 2012).

1.2.4 Land-use and environment

Sensitive area mapping

Local Councils (Boorowa, Upper Lachlan and Yass) were consulted as to whether 'sensitive area mapping' was available and relevant to the Rye Park locality. No such mapping is held by these Councils. Various 'natural resource sensitivity' maps layers are held which have some relevance to biodiversity. The Upper Lachlan Shire Council Biodiversity Planning Framework details the methodology used for determining the 'natural resources sensitivity-biodiversity map' used in the Upper Lachlan LGA; conservation significance is based on native vegetation, riparian corridors, regional corridors and geological significant areas (Upper Lachlan Shire Council, 2008). Other map layers relate to salinity, riparian areas and water courses.

Areas in the Rye Park locality in close proximity to the site are mapped as medium and high conservation value under this Planning Framework mapping. No regional corridors are identified in proximity to the Rye Park site. While regional biodiversity corridors have been identified in the eastern part of the Upper Lachlan LGA, no study has been undertaken to identify them elsewhere in the LGA.

In general, the mapping is broad and it is considered that the onsite field survey and research specific to the proposed Rye Park wind farm provides more accurate information on the biodiversity attributes of the site, including regional corridors and landscape connectivity. This is discussed further in Section 7.3.

Vegetation communities, plants and animals of the local government areas

Boorowa

Nine vegetation types have been recorded in the Boorowa LGA. Approximately 85% of native vegetation has been cleared (mostly for agricultural activities) and remnants are considered highly fragmented. Remnant vegetation includes Box Gum woodland, Red Stringybark-Red Box forest and Long-leaved Box-Candlebark open forest or woodland. Much remnant vegetation occurs as dry forest on shallow or skeletal soils on rocky ridgelines. Remnant woodland patches generally occur as isolated paddock trees or small patches of less than 2 ha, mostly on private land. Threatened species known to occur in the Boorowa LGA include Tarengo Leek Orchid *(Prasophyllum petilum)* and a number of mammals and birds such as the

Squirrel Glider *(Petaurus norfolcensis)* and Barking Owl *(Ninox connivens connivens)* (ACT Commissioner for the Environment 2009).

Upper Lachlan

Of the 53 vegetation types recorded in the Upper Lachlan LGA, 20 are considered vulnerable (i.e. approaching 70% clearance of pre-1750 extent). Clearing and fire have been major pressures on native vegetation. Remnant vegetation includes Box Gum Woodland, Natural Temperate Grassland and Tableland Dry Grassy Woodland. A number of threatened plant species have been recorded in the Upper Lachlan LGA including the orchid Buttercup Doubletail *(Diuris aequalis)*, which is listed as nationally vulnerable and endangered in NSW. Threatened animal species known to occur in the LGA include birds, amphibians, fish and mammals such as the Squirrel Glider and Eastern Bentwing-bat *(Miniopterus oriane oceansis)*, both listed in NSW (ACT Commissioner for the Environment 2009).

Yass Valley

The Southern CRA (Comprehensive Regional Assessment) identified 36 vegetation communities in the Yass Valley LGA including 14 considered vulnerable in 1999. Clearing for agriculture and wood harvesting appear to have been the main pressures on native vegetation in the Shire over the last decade. Remnant vegetation in Yass Valley LGA includes Box Gum Woodland, Natural Temperate Grassland and Tablelands Dry Shrub/Grass Forest. Forests dominated by Ribbon Gum and River Red Gum also occur; these are important feed trees for Koala (NSW threatened species). Other threatened fauna known to occur in the LGA include microbats, arboreal mammals, reptiles, amphibians, invertebrates and woodland birds such as Superb Parrot *(Polytelis swainsonii)* and Diamond Firetail *(Stagonopleura guttata)*. A number of threatened plant species have been recorded in the Yass Valley including Yass Daisy *(Ammobium craspedioides)*, which is listed under NSW and Commonwealth legislation (ACT Commissioner for the Environment 2009).

Bango Nature Reserve

Bango Nature Reserve (Bango NR) in the Yass Valley LGA, created in 2010, is approximately 440 ha and managed under the *Draft Plan of Management for The Gunning Reserves* (POM) (NPWS 2011). Bango NR is located adjacent to the south-western border of the project area. None of the other reserves covered by the POM are near the proposal site. Vegetation in the reserve includes dry open forest with Apple Box *(Eucalyptus bridgesiana)* or Red Stringybark *(E.macrorrhyncha)* and Scribbly Gum *(E.rossii).* It is considered likely that Box Gum Woodland also occurs on lower slopes and drainage lines in the reserve but this has not been ground-truthed (NPWS 2011).

The threatened Yass Daisy *(Ammobium craspedioides)* has been recorded in the Bango NR. This species is associated with dry forest, Box Gum Woodland and secondary grassland (i.e. grassland derived from clearing these communities). Three threatened fauna are known to occur in Bango NR: the Gang-gang Cockatoo *(Callocephalon fimbriatum)*, Scarlet Robin *(Petroica boodang)* and Varied Sittella *(Daphoenositta chrysoptera).*

Land-use

The land use of the region is dominated by agriculture including sheep and cattle grazing for meat and wool production. Large areas have been cleared for production. Other farming activities include breeding studs for cattle, alpaca, sheep and horses, poultry production and olive farms and wine groves. The demographic has shifted from a primarily farming community to a mix including hobby farmers and rural lifestyle residents (Boorowa Council n.d., Upper Lachlan Shire Council n.d., Yass Valley Council n.d.).

1.2.5 Site description

The site boundary is mapped in Appendix E.1, and is made up of the estate boundaries of involved properties. The whole site is termed the 'project area' and encompasses approximately 14,000 ha. The development envelope has been progressively refined over the course of the assessment phase from broad ridgeline and proposed track and electricity transmission line zones to a 100m buffer around the indicative infrastructure layout. The final impact assessment presented in this report relates to discreet turbine and associated infrastructure locations.

The tenure of land in the project area is private freehold and is currently used for commercial agriculture (predominately sheep grazing) and farm residences. The proposal site is characterised by cleared farmland mostly derived from Box Gum Woodland on the lower slopes and flats with Inland Scribbly Gum Dry Forest vegetation on the steeper sheltered slopes. Remnant stands of the original vegetation remain as paddock trees or larger scattered patches of forest/woodland on the lower slopes with more extensive forested areas on the ridge tops. The pasture ranges from exotic to native species dominated. This pattern of vegetation and use of the land is common across the locality.

2 LEGISLATIVE AND POLICY CONTEXT

2.1 NSW ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) provides for a co-ordinated approach to development and includes the objective to encourage protection of the environment including threatened species, population and ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Section 5A of the EP&A Act provides a list of factors that must be considered in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats. These factors are known as the 7-part test, or Assessment of Significance (AoS).

The proponent obtained DGRs to guide the assessment of impacts of the Rye Park wind farm, under Section 75F, Part 3A of the EP&A Act (DGRs are discussed further in Section 2.8). Part 3A has since been repealed with transitional arrangements are in place to deal with such projects. It is understood that the submission will be assessed by the NSW Department of Planning and Infrastructure (DP&I), under the provisions of Part 3A.

The recommendations in this report would form Statements of Commitment (SoCs), formulated to avoid impacts where possible, minimise where avoidance is not possible and offset residual impacts to ensure the 'improve or maintain' environmental outcome for the project is met.

2.2 NSW THREATENED SPECIES CONSERVATION ACT 1995

The TSC Act lists threatened flora and fauna species, populations and ecological communities ('threatened entities') and key threatening processes in Schedules 1 through to 3. The TSC Act gives provisions for recovery plans, threat abatement plans and action statements. The Director-General (D-G) for the Office of Environment and Heritage (OEH) must consider the effect of the proposal based on the factors listed in Section 94, which match those in Section 5A of the EP&A Act (AoS). The D-G may grant a licence to harm threatened entities, which may include conditions. Such a licence would form part of the consent conditions for a proposal.

This report considers threatened entities and critical habitat that may occur in the project area and the affect that the proposal may have upon them, including key threatening processes. Assessments of significance are undertaken in accordance with the *Threatened Species Assessment Guidelines: the assessment of significance* (DEC 2007).

2.3 NSW NATIONAL PARKS AND WILDLIFE ACT 1974

The D-G for the OEH is the authority for the protection and care of protected fauna (Part 7) and native plants (Part 8), including threatened entities (Part 8A). This report considers threatened fauna and flora that may occur in the project area and the affect that the proposal may have upon them.

The *National Parks and Wildlife Act 1974* (NPW Act) also provides a mechanism for conservation on private land under Part 4 Division 69. A Conservation Agreement provides legally binding protection for private land, with conditions attached to the land title.

2.4 NSW FISHERIES MANAGEMENT ACT 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve fish stocks and key fish habitats including threatened species, populations and ecological communities of fish and marine vegetation. The FM Act is administered by the Director-General of the Department of Industry and Investment. There are a range of activities that may come under the jurisdiction of this act.

The FM Act covers freshwater and marine habitats and species. Freshwater includes any body of freshwater that is naturally or artificially stored. Any dredging or reclamations works (which includes removing material from land submerged by water, filling in or depositing any material onto land submerged by water or draining water to reclaim land) requires consideration under the FM Act, unless it is an artificial waterbody not connected to a natural waterbody.

Division 8 provides that the passage of fish must not be blocked by obstructions unless a permit under the Act has been obtained. This affects proposals that include water crossings.

Part 7A provides for the listing of threatened species, populations and ecological communities (threatened entities) and key threatening processes. Any development should consider harm to threatened entities as required by the EP&A Act. If harm is likely to be significant, Section 221K outlines the content of a species impact statement under the FM Act.

2.5 STATE ENVIRONMENTAL PLANNING POLICY NO. 44 – KOALA HABITAT PROTECTION (SEPP 44)

State Environmental Planning Policy No. 44 – Koala Habitat Protection (SEPP 44) encourages the conservation and management of natural vegetation that provides habitat for Koalas. Koalas are listed under the TSC Act as a vulnerable species. Yass Valley Council is subject to this SEPP and cannot approve development in an area affected by the policy without an investigation of core koala habitat. SEPP 44 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.

This report considers whether any part of the project area could be described as potential or core koala habitat under SEPP 44.

2.6 ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (CWTH)

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) lists for protection native flora and fauna species of national conservation significance including threatened and migratory species, communities and populations, termed 'Matters of National Environmental Significance' (MNES). If there is potential for a MNES to be impacted because of a proposed development, the nature and potential magnitude of impact must be characterised according to the *Significant Impact Guidelines* (2006). This will determine whether an action is likely to have a significant impact on MNES, in which case the proposal must be referred to the Federal Minister for the Environment for assessment and approval.

This report considers MNES that may occur in the project area and the affect that the proposal may have upon them.

2.7 GUIDELINES

The guidelines used in the preparation of this report include:

- *Draft Guidelines for Threatened Species Assessment* (DEC, 2005).
- *Biodiversity Offset Principles* (OEH).
- *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*, Working Draft (Department of Environment and Conservation NSW, November 2004).
- *National Wind Farm Development Guidelines – public consultation* draft (EPHC 2009).
- *Australian Wind Energy Association Best Practice Guidelines* (AusWind 2006).
- *Cumulative Risk for Threatened and Migratory Species* (Department of Environment and Heritage, C'th 2006)

In particular, the assessment considered the five main steps listed in the *Draft Guidelines for Threatened Species Assessment 2005* in the following way:

- **Step 1 - Preliminary assessment** – Desktop and database searches were undertaken to assess the conservation value of the area to threatened species / communities.
- **Step 2 - Field survey and assessment** – Surveys were completed within April and November (autumn and spring) to sample the broad development envelope and were designed according to desktop assessment results. The guidelines suggest that where development occurs over a large area the sampling regime must encompass the geographic extent of the development and sample the full range of environments that occur. This approach was applied and is detailed further below (Section 3.1 Strategic Assessment Approach).
- **Step 3 – Evaluation of impacts**: This is presented in Section 7, Appendix B and Appendix C of this report.
- **Step 4 – Avoid, mitigate and then offset:** Constraint mapping was undertaken to highlight areas of high conservation value so these could be avoided where possible. Where infrastructure falls within areas supporting some conservation value, specific mitigation measures have been developed to manage or offset the impact (Section 8).
- **Step 5 – Key thresholds:** To determine the extent of impacts and key thresholds of conservation significant entities the AoS (Appendix C) was applied to species considered high risk as it covers the main points identified in *Appendix 3 of the Guidelines: Identifying potential effects of the proposal on threatened species, populations or ecological communities or their habitats* as well as additional points that are useful in characterising impacts and developing mitigation strategies, where possible.

2.8 DIRECTOR GENERAL REQUIREMENTS

DGRs were issued by the NSW DP&I on 14 February 2011 to guide the format of this assessment (Appendix H). They have been addressed by the objectives of this assessment and by using the guidelines identified (discussed above). Recommended survey requirements were further issued by Department for Environment, Climate Change and Water, now OEH (addressed in Section 3.3.4), and received by **ngh**environmental on 11 June 2013.

3 APPROACH AND SURVEY METHODS

The potential impacts of the proposal have been identified based on desktop assessment and field surveys, including aerial photo interpretation and GIS mapping.

3.1 STRATEGIC ASSESSMENT APPROACH

Wind farm development has several characteristics that have bearing on the survey and impact assessment approach:

- The infrastructure layout is refined several times from the commencement of the project, to reflect constraints (such as biodiversity), maximise wind yield and incorporate changes in involved land owners and increasing site knowledge that may influence civil infrastructure placement. Survey coverage cannot be restricted to a specific infrastructure layout.
- The infrastructure footprint is small in comparison to the spread of infrastructure. That is, over a series of ridgelines spanning 40 km, the infrastructure will represent a small and disparate proportion of the area within the site boundaries, comprised of narrow access tracks, electricity easements and discrete turbine footings and hardstand areas. This provides an opportunity to avoid and minimise impacts on higher conservation value areas, by micro-siting infrastructure around such areas. However, it also presents issues related to survey coverage. Biodiversity survey effort per area of impact is high but survey effort in comparison to the development envelope can appear low.
- The impacts occur both on a very local scale (habitat clearance for a footing) as well as a landscape scale (influence on bird/bat movements or migration). The different types and scale of impact are required to be assessed which results in a very large number of species with potential to occur and be impacted.
- A large number of assumptions are required to be made throughout the assessment because, while a lot of information on the biodiversity impacts of wind farms is available, limitations in the data include:
    - Wind farm biodiversity monitoring data is not collected in a standard manner and is not generally available to the public, making comparisons difficult.
    - No other site can be expected to contain the site specific features of our site, which will influence the resultant impacts.

The approach adopted in this assessment reflects these characteristics as well as addressing the relevant assessment guidelines (DEC 2005).

The Rye Park survey and assessment approach incorporates the following specific elements:

- Constraints mapping – to avoid, minimise and only as a last result offset impacts, constraints mapping is carried out early in the process to ensure key biodiversity constraints are avoided where possible and to guide specific follow up surveys. Refined layout development further minimises impact on constraint areas.
- Development envelope – a broad envelope within which infrastructure could potentially be located is assessed. The survey effort is a sampling within this area. Vegetation and habitat types are identified and surveys are stratified to sample the envelope. This provides flexibility for small changes in layout. It also provides a precautionary bias in that, survey locations are not randomised

within habitat or vegetation types but rather are targeted to better areas of habitat, to maximise the potential to detect rare and cryptic species. Following this broad assessment the infrastructure layout was refined and targeted follow up surveys were then focused within a more discrete area; this area was defined as the infrastructure footprint plus an additional 100 m- 200 m buffer.

- Broad vegetation type mapping – this provides a context for the impact assessment and demonstrates the type and extent of vegetation available within the site boundary for use in an offset package.
- Risk assessment – species with potential to occur are filtered in Appendix B, to ensure that the assessment is focused on those species with more than a low risk of impact. Although not a standard component of a Major Project assessment, the AoS test has been applied to species where a high impact is anticipated. This systematic and transparent test characterises the anticipated impact in a way that provides the best opportunity to develop specific mitigation measures to manage impacts – be they avoidance of habitat or the implementation of specific protocols, as appropriate.

3.2 DESKTOP ASSESSMENT

3.2.1 Database searches

A desktop assessment was undertaken involving database searches of NSW and Commonwealth listed entities. The desktop assessment included searches of the following databases:

1) Atlas *of NSW Wildlife database*, searched by the Upper Slopes sub- region of the Lachlan CMA (searched 14 October 2011). For flora species additional searches were also undertaken for the Murrumbateman sub-region of the Lachlan CMA and the Upper Slopes and Murrumbateman sub regions of the Murrumbidgee CMA (16 August 2012) to account for the lesser dispersal capabilities of plants as the proposal site occurs close to the boundary of these sub-regions.
2) EPBC Act *Protected Matters Search Tool,* using the project area boundary as the search area with a 10 km buffer (searched 14 October 2011).

Topographic maps, air photographs, previous surveys and records contained in national and state databases were also consulted to identify known and potential values. Key web-based databases including the Atlas of Australian Wildlife, NSW Threatened Species database and the Commonwealth Species Profile and Threats (SPRAT) were consulted in the preparation of this report.

Threatened species, populations, and vegetation communities evaluations

A threatened species evaluation has been undertaken to evaluate the presence of habitat in the project area and the likelihood of occurrence and impact from the proposal development for each species and community returned from database searches (NSW Wildlife Atlas and EPBC Protected Matters Search). The potential for these entities to occur in the project area was evaluated post field work based on specific habitat preferences and project area characteristics.

In the evaluation, the presence of habitat rated as either:

Present: Potential or known habitat is present within the project area.

Marginal: Habitat present is not typical but may be suitable, or habitat is typical but condition is poor or microhabitat requirements are not present.

Absent: No potential or known habitat is present within the project area.

There are four categories for likelihood of occurrence:

None: Species known or predicted to occur within the locality but no suitable habitat present within the project area.

Unlikely: Species known or predicted within the locality. Suitable habitat may be present in the project area but the proximity of nearest records suggests it is unlikely to occur.

Possible: Suitable habitat present and the species could occur in the project area based on the proximity of nearest records.

Present: Species was recorded during the field investigations.

Based on the habitat present and the likelihood of occurrence categories above, a threatened species will be placed into one of the four categories for potential for impact:

No: The proposal would not result in an impact to this species.

Low: The proposal is unlikely to result in an impact to this species. No AoS is considered necessary for this species.

Moderate: The proposal could impact this species or its habitats but risks are considered highly manageable. No AoS is considered necessary for this species. Management measures have been developed to address the risks.

High: The proposal is likely to impact this species or its habitats. An AoS has been applied to these entities to properly characterise the impact and provide information then used to either develop management measures to protect the entity or justify avoidance of the entity.

In the evaluation, one of four categories was assigned to each of the listed threatened or migratory species in terms of risk of impact. The risk level was based on evaluating the type and extent of habitat available and likelihood of the species occurring based on its known habitat requirements and ecology. Therefore evaluation of threatened entities has been undertaken at two points: evaluation of likelihood of occurrence and then evaluation of risk of impact.

Based on the categories described above, species that were considered to have a moderate or high risk of impact are considered for further assessment. Impacts to moderate risk species are considered manageable without the need for an Assessment of Significance, but which may require further mitigation measures, as suggested in Section 8 Recommendations. An AoS is applied to high risk species of which mitigation measures are also given for managing risk, which may be included as statements of commitment to be undertaken pending project approval.

3.3 FIELD SURVEY METHODS

A series of field surveys have been undertaken between 2011 and 2013 to assess the biodiversity value of the project area and include:

- A broad two-day reconnaissance was undertaken by two ecologists over 26-27 October 2011, prior to field surveys, to understand the variability of the site and general habitat

types and condition. Establishment of access points during this visit enhanced the efficiency of the field survey program to follow.

- A suite of field surveys were undertaken over five days within the development envelope and project area between 31 October and 4 November 2011.
- Further flora and fauna surveys, including assessments of new areas and targeted surveys of higher constraint areas, were undertaken over five days between 10 and 14 April 2012.
- Additional surveys were also undertaken on 27 May 2013 to investigate alternate substation sites and overhead power line options.
- Follow-up targeted surveys for the threatened Swift Parrot and mapping of habitat features (i.e. hollow-bearing trees) were undertaken between 8 and 12 July 2013 to determine potential presence of the species within the project area during its winter migration to the mainland from Tasmania.
- Follow-up targeted surveys for the Superb Parrot was undertaken between 4 and 9 November 2013 to assess flight paths and local use of the site during the breeding season.
- Additional general bird surveys, Anabat surveys and nocturnal surveys were undertaken in specific higher risk locations between 4 and 9 November 2013 to increase survey effort.
- Follow-up targeted surveys for the Koala between 4 and 9 November 2013 and 18 and 22 November 2013. RapSAT searches were conducted to determine the potential presence of the species within the project area.
- Artificial tile surveys were installed in July 2013 for the Striped Legless Lizard, with tiles checked weekly or fortnightly between November and December 2013 to determine presence of the species within the project area.
- Targeted Golden Sun Moth surveys during November and December 2013 during the known flying time of the species to determine the presence of the species within the project area.
- Targeted surveys for the threatened Yass Daisy and Hoary Sunray within a proposed transmission line in the southern section of the project area between 4 and 6 November 2013.

The field survey methods employed in the above surveys are detailed below. The methods utilised were selected with regard to: 1) their suitability to the assessment required, the project area and access limitations; 2) current NSW and EPBC Act survey assessment guidelines; and 3) specific survey approaches requested by OEH.

3.3.1 Flora survey methods

Survey personnel

The flora surveys were conducted by four botanists. Refer to Appendix G for personnel qualifications and experience:

- Dave Maynard (site reconnaissance, November 2011 and 2013 surveys).
- Paul McPherson (November 2011 surveys).
- Jackie Miles (November 2011 surveys, April 2012 surveys).
- Chris Weston (November 2011 surveys).

The maps 'Flora survey effort' in Appendix E.2 show the flora survey locations across the development envelope. Survey methods included inspection points, quadrat surveys, random meanders and targeted searches.

Detailed survey methods

Quadrats

In each vegetation type and condition class, a 0.04 ha standard quadrat (20 m x 20 m) was used to survey vegetation structure and floristics. Geological and topographical features were also noted. All species that occurred within the quadrat were recorded and cover abundance scores allocated according to a modified Braun Blanquet cover abundance scale[1].

Random meanders

Formal random meanders (after Cropper 1993) within relatively homogeneous vegetation of up to 30 minutes duration and covering up to 1 hectare were undertaken at a number of the quadrat and inspection sites in each vegetation type, recording floristics, with structural and physical data. This method complements the quadrat data by improving comprehensiveness in terms of the number of species and variation within types, and improves opportunities for detecting significant or sparsely distributed plant species.

Inspections

In addition to the traverse and plot-based survey sites, the majority of the subject site was inspected on foot or by vehicle to confirm vegetation types, map the distribution of EECs and search for threatened species. EECs and areas of natural vegetation in better condition were given particular attention. Dominant species occurring at the sites were recorded to adequately confirm the vegetation type and condition where necessary.

Highly disturbed habitats including areas of improved pasture and cultivated paddocks, were surveyed to record general species composition. Because of their low likely conservation significance, these highly modified areas were not inspected in detail.

Targeted searches

Dedicated searches in specific habitat areas were undertaken during quadrats and random meanders for threatened species which were assessed as having at least a moderate potential to be present at the site.

Specific targeted searches for threatened flora were conducted in higher quality areas of Box Gum Woodland and derived grassland near RYP_120 (refer Appendix E.2) and within the originally proposed eastern substation site (removed during layout modifications to avoid sensitive areas). These surveys failed to locate any threatened flora. In addition, five flora quadrat surveys were conducted in moderate or good condition Box Gum Woodland. The timing of all targeted surveys was considered appropriate for the detection of targeted threatened species in particular, the Yass Daisy and Hoary Sunray.

Targeted searches were conducted on foot within the majority of areas. Within the originally proposed eastern substation site, evenly spaced transects 10 m apart were conducted on foot across the entire development area as the entire area would have needed to be cleared to accommodate the proposed substation. Within the proposed transmission line near RYP_120, foot based random meanders were conducted across the majority of the development area as the impacts in this area are more discrete, being limited to the establishment of footing for transmission towers and an access track. Both the evenly spaced

[1] modified from that described by Mueller-Dombois and Ellenberg (1974).

transect and random meander methods are consistent with the Draft Threatened Species Survey Guidelines (DECC 2004).

A vehicle based random meander was conducted in areas of good condition Box Gum Woodland that showed evidence of being heavily grazed prior to the survey given the high levels of visibility and lower likelihood of the species being present.

Understorey condition assessment

Condition assessment was undertaken at all survey points within the original development envelope of the proposal to adequately quantify impacts by both vegetation type and condition. This included all quadrats and a number of inspection points. Vegetation across the broader site boundary has not been assigned a condition class as surveys of the detail necessary to ascertain condition were not undertaken in these areas. As such, where infrastructure locations have been revised to avoid environmental constraints, and are now outside of the original development envelope, vegetation condition has not been necessarily determined and a precautionary (higher condition value) has been assigned for the purpose of calculating potential impacts.

Vegetation surveyed using quadrat, random meander and inspection techniques in woodland, shrubland and grassland were rated according to a four-point condition class scale, focusing on floristic integrity in the understorey:

Exotic	Groundlayer dominated by exotics, no native overstorey present.
Poor	Groundlayer dominated by one or two native grass species, < 5 native non-grass species OR native overstorey present and groundlayer dominated by exotics.
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 grassy groundcover, such as Box Gum Woodland.

The Dry Forest community identified on site however, was distinctly different to grassy woodland vegetation. This vegetation type was observed on many of the ridge tops, is distinctly different in structure to woodland vegetation and is generally characterised by a low diversity within the understorey. For this vegetation type, condition classes were based on the ratio of native species to exotics as per below:

Exotic	Groundlayer dominated by exotics (exotics > natives), no native overstorey present.
Poor	Groundlayer dominated by exotics, native overstorey present.
Moderate	Some exotics present in the groundlayer but mostly native dominated.
Good	Groundlayer dominated by native species, few exotics present.

With the exception of the 'exotic', the remaining classes would all fall within the 'moderate to good' definition specified within the biometric guidelines[2] due to the dominance of native vegetation in the ground layer or having a native overstorey with a percent foliage cover greater than 25% of the lower value of the over-storey percent foliage cover benchmark of that vegetation type. The exotic class would equate to 'low' condition vegetation under these guidelines.

Vegetation typing and nomenclature

The identification of specific vegetation types is based on the NSW Vegetation Classification and Assessment developed for the South Western Slopes (Upper Slopes) Bioregion by Benson (2008) and Benson *et al.* (2010), which provides the most recent classification for the project area. Botanical nomenclature follows Harden (1990-2002), except where recent taxonomic changes have occurred. Noxious weeds identified are those declared for the Boorowa Shire Council control area under the *Noxious Weeds Act 1993*.

3.3.2 Fauna survey methods

Survey personnel

The majority of fauna surveys were conducted by the below personnel. Refer to Appendix G for personnel qualifications and experience.

- Bianca Heinze (lead ecologist November 2011, April 2012, November to December 2013 surveys).
- Freya Gordon (lead ecologist November 2011 and November 2013 surveys).
- Deb Frazer (lead ecologist July 2013 and November 2013 surveys).
- Nathaniel O'Rourke (ecologist November to December 2013 surveys).
- Amy Evans (ecologist November 2013 surveys).
- Alana Gordijn (assistant November 2013 surveys).
- Vanessa Place (assistant November 2013 surveys).
- Andrew Morrison (ecologist April 2012 surveys).
- Bryson Lashbrook (ecologist November 2011 surveys).
- Kate Carroll (ecologist November 2011 surveys).
- Brooke Marshall (site reconnaissance, technical officer November 2011 surveys).

A large number of personnel were required for Koala surveys and Superb Parrot flight path mapping during the November 2013 surveys. Experienced sub-contractors were utilised for this survey and included:

- George Madani (bird and reptile expert, November 2013 surveys).
- Rena Goborov of Wildlife Unlimited (bird and reptile expertise, November 2013 surveys).
- Rohan Bilney of Wildlife Unlimited (bird and reptile expertise, particularly owls, November 2013 surveys).

[2] The biometric assessment methodology was developed by OEH and classes vegetation condition more broadly in only two categories: low and moderate – good.

An expert in Golden Sun Moth survey was employed to undertake targeted surveys for this species and included:

- Kris Nash (Nov – Dec 2013 surveys).

General fauna survey methods

Habitat assessment (November 2011, April 2012)

Standard forms were used to record information about the vegetation structure and habitat components of a site, including leaf litter, fallen timber, hollow-bearing trees, rock features, presence of water and canopy connectivity. During the field survey, habitat quality was classified into three categories of either high, moderate or low. Fauna habitat quality[3] is rated on the presence of the following components:

- Diverse structure, that is, structural components at a range of stratum levels (understorey, midstorey, canopy) and age or size classes (trees of different ages, fallen timber of different sizes).
- Shelter and refuge, that is, low shrub or tussock, rocky outcrops, hollow logs (ground dwelling fauna).
- Mature trees, which are more likely to bear hollows and mature hollow-bearing trees, which are more likely to bear multiple hollows of a range of sizes, including those with large internal dimensions. Mature trees also produce more foraging resources for nectar and seed eating fauna.
- Habitat complexity, including ecotones[4] between vegetation types, or areas with different management regimes, which produce a habitat mosaic. Within a habitat patch, there may be a recently disturbed area, as well as a mature area with little recent disturbance. This increases the range of foraging and shelter opportunities within a habitat.
- Key habitat components such as hollow-bearing trees.

Hollow-bearing tree survey (November 2011, July 2013)

Hollow-bearing tree surveys were undertaken as a sub-set of habitat assessments in November 2011, and fed into habitat quality results. Three quadrat sizes were used to survey for hollow-bearing trees in different habitat types:

- Scattered trees in paddocks were surveyed in 100x100 m quadrats.
- Trees in woodland were surveyed in 25x25 m quadrats.
- Trees in forest were surveyed in 10x10 m quadrats.

[3] Habitat 'quality' and vegetation 'condition' classes are not interchangeable, as different criteria are used to distinguish fauna and flora values.

[4] Ecotones are transition zones, where one environments grades into another.

These methods were designed to enable an estimation of hollow density across the different habitat types within the project area, therefore providing an understanding of habitat value for hollow-dependent species.

Hollow bearing trees supporting medium or large hollows were further mapped in July 2013 where they occurred within 100 m of indicative turbine locations or transmission line easements in good-moderate condition forest habitat. This survey was undertaken to determine 1) the quality of habitat for breeding or roosting for threatened hollow-dependent fauna (i.e. owls, Squirrel Glider, Parrots) in potential habitat of these species; and 2) the proximity of hollows to proposed infrastructure.

Bird utilisation survey (November 2011, April 2012, July 2013, November 2013)

- The area search method was used for bird surveys with 30 minutes duration.
- Birds were recorded by sight and vocalisations. Field guides were used for visual identification including Pizzey & Knight (2003) and Simpson and Day (1999). Song-based identification was based on Bird Observers Club of Australia recordings (1998).
- Species present within the search area, flying overhead and outside the search area were recorded.
- As well as species observed, the following variables were recorded: number of individuals; distance from observer; flight height; and bird behaviour. Flight height was broken into four classes: 0-20 m above the ground, 21-40 m, 41-140 m and greater than 140 m above the ground. The third class (40-140 m) represents the potential turbine blade-sweep area.
- The timing of surveys was from early morning to mid-afternoon.

Reptile active searching surveys (November 2011)

- Depending on habitat extent and quality, searches varied between 15 and 45 minutes.
- Two species were targeted: Pink-tailed Worm-lizard *(Aprasia parapulchella)* and Striped Legless Lizard *(Delma impar)*.
- Active searching was undertaking in suitable habitat including rolling rocks, logs, and other debris. Rocks and logs were scanned for basking individuals prior to active searching. The species was targeted in rocky outcrops particularly those on slopes within grassland and woodland. Striped Legless Lizard was targeted by rolling debris (rocks, logs, bark, etc.) in areas of potential habitat.
- The temperature recorded during the November 2011 reptile searches ranged between 19 to 24 degrees and was therefore adequate to detect threatened reptile species.

Microbat Anabat surveys (November 2011, April 2012, November 2013)

Microbats were surveyed using an Anabat detector (passive survey). The detector was left in place overnight in locations chosen to maximise the potential for detecting multiple species of bats, such as in likely flyways through vegetation, along drainage lines and near dams. Recording was typically from approximately 30 minutes before sunset to daybreak the following morning.

Nocturnal surveys (November 2011, April 2012)

<u>Evening listening / stagwatching</u>

Evening listening involved watching potential hollow-bearing trees and listening for fauna activity, particularly owls, for approximately 30 minutes before and after sunset.

Call playback

Call playback was undertaken following the methods of NPWS (2004) targeting Powerful Owl, Barking Owl, and Squirrel Glider. Most surveys were in the early evening. This included an initial listening period of 10 minutes, then playing calls for 5 minutes, followed by an equal listening period. Additionally, one call playback of 10 minutes duration was undertaken for Booroolong Frog.

Spotlighting

Foot-based and vehicle-based spotlighting was undertaken using an area search method searching for nocturnal, arboreal and scansorial vertebrate fauna along the edge and through the middle of patches of vegetation. Spotlighting was conducted using hand-held 12v 50w spotlights. Surveys were of variable duration from 15 minutes to two hours. The length of vehicle-based transects was determined by length of track suitable for spotlighting. Spotlight surveys were undertaken by two to four people.

Targeted fauna survey methods

Squirrel Glider cage-trapping and targeted nocturnal surveys (April 2012, November 2013)

Cage-trapping surveys were undertaken in April 2012. Two sites were installed; one near RYP_92 (8 traps x 4 nights) and the other near RYP_105 (8 traps x 3 nights). Traps were set in good quality woodland and forest areas to target the most appropriate potential habitat available for this species. A total of 56 trap nights were completed. Traps were mounted between two and five metres above the ground and set using standard bait mix (peanut butter, oats and honey).

General nocturnal surveys were undertaken during November 2011 and April 2012 which included surveying for the Squirrel Glider. A total of 9.5 hours of evening listening / call playback, and 17.25 hours of spotlighting (foot and vehicle) were completed.

Further targeted nocturnal surveys were undertaken for the Squirrel Glider in areas of potential habitat (i.e. in areas supporting higher densities of hollows within forest) during 4 to 9 November 2013 to supplement existing survey results. Spotlighting and call playback were undertaken in Inland Scribbly Gum Forest predominantly within ridge top habitat using the methods described above under *General survey fauna methods* for call playback and spotlighting. These targeted surveys were undertaken near the vicinity of turbine sites RYP_66, RYP_84, RYP_90, and RYP_104 and totalled 5.5 hours of survey.

Swift Parrot surveys (July 2013)

Swift Parrot surveys were undertaken during winter between 9 and 12 July 2013. The primary objective of the winter bird survey was to capture the seasonal migration of the Swift Parrot to the mainland from Tasmania. While woodland bird surveys are not optimal during winter, surveys were also undertaken at this time to supplement existing results by increasing the dataset, but to also gain knowledge on bird species for the wind farm within different seasons. However, more focus was placed on surveying for the Swift Parrot. The following method was implemented:

- Ten surveys were undertaken in potential habitat (moderate to good condition Box Gum Woodland or Inland Scribbly Gum – Red Stringybark Open Forest) within or nearby the proposed impact areas (Appendix E.3).
- The areas targeted for survey included larger remnant vegetation with good connectivity in proposed impact areas.

- The potential habitat was searched for 45 to 60 minutes duration using the most appropriate search method for the shape of the available habitat (area search or linear transect).
- Surveys were undertaken by two surveyors at opposite ends of the search area. This was to increase the chance of detecting parrots in the event a parrot rapidly flew through the search area at one end and could not be identified, therefore allowing another chance of identification at the opposite end.
- Surveys were undertaken early morning and late afternoon until dusk.
- All birds were recorded by sight and vocalisations; however, particular attention was made to be watchful for the Superb Parrot as well as the Swift Parrot.
- Species present within the search area, flying overhead and outside the search area were recorded.
- As well as species observed, the following variables were recorded: number of individuals; distance from observer; flight height; and bird behaviour. Flight height was broken into four classes: 0-20 m above the ground, 21-40 m, 41-140 m and greater than 140 m above the ground.
- Notes on the availability of hollow-bearing trees suitable to parrot species were recorded within the habitat searched.

Temperatures during the field week were relatively mild for a winter survey within a cold climate region. Temperatures were cool early morning and late afternoon; however, days were generally sunny with warm temperatures recorded during the day with little wind. Mist was experienced on two days and was often thick within the valleys, but clear on ridge-tops and would dissipate around 10-11 am (Table 3-1).

Table 3-1 Weather details during Swift Parrot field surveys

Date	Temperature during surveys	Cloud	Wind	Rain	Comments
9 July 2013	3-6 degrees in morning.	30 % cloud cover	Gentle breeze	Nil	Slightly overcast – reasonably clear
10 July 2013	11-15 degrees in afternoon.	80 % cloud cover	Gentle breeze	Nil	Overcast – misty
11 July 2013		100 % cloud cover	Mild breeze	Nil	Overcast – misty
12 July 2013		20 % cloud cover	Calm	Nil	Slightly overcast – reasonably clear

Superb Parrot surveys (November 2013)

Superb Parrot surveys were undertaken between 4 and 9 November 2013. The primary objective of the survey was to capture the breeding season of the Superb Parrot to determine if the species was utilising hollows within or nearby proposed infrastructure for breeding, and to determine local movements and potential flight paths of the species. Damon Oliver of OEH (Senior Team Leader, Ecosystems and Threatened Species) was consulted during September 2013 to discuss survey effort and design of the Superb Parrot survey. Transect survey locations were proposed and reviewed by Damon Oliver before surveys were undertaken.

The following method was implemented:

Transect surveys

- Twenty-five transect surveys were conducted across the project area either within or nearby impact infrastructure (Appendix E.3). Two transects could not be surveyed due to access limitations (SP13 and SP16).
- The areas targeted for survey include both low and higher quality habitat. Site selection was prioritised to capture the following:
    - Prioritise typical Superb Parrot habitat (i.e. Box Gum Woodland, Derived Grassland and pasture with scattered tree habitat), while also surveying some 'atypical habitat' (i.e. dry grass forest);
    - Larger remnant habitat with good connectivity in proposed impact areas;
    - Areas where Superb Parrots have previously been recorded;
    - To stratify sites along the length of the wind farm, but also near turbines;
    - To select sites to the west of the wind farm near known records and in closer proximity to potential foraging grounds (cropping paddocks)
    - To allow some sites to be surveyed to the west and east of a turbine simultaneously.
- A 1 km transect line was walked in 1 hour, counting any Superb Parrots within 250m in front and perpendicular to the transect line as per the method requested by OEH (pers. comm. Damon Oliver, September 2013).
- All transect surveys were conducted from sunrise until no later than 10 am, except for two transects which were undertaken between 10 and 11am. Access limitations prevented these sites from being surveyed before 10am; however, weather was still considered suitable (not too hot) when these surveys were conducted and Superb Parrots were still observed flying and foraging throughout the day during the survey week. Due to cooler temperatures experienced at higher elevations such as Rye Park, bird activity on the wind farm site appears more prevalent when temperatures warm later in the morning (i.e. 8am to 11am).
- All other birds were also recorded by sight and vocalisations during the 1 km transect which increased bird survey effort substantially across the entire project area (i.e. 25 hours total transect time).

Mapping nest trees

- During transect surveys the areas parrots were identified were further investigated for evidence of breeding and presence of nest trees.
- Trees regularly used by the parrot were watched at dusk and dawn between 8 and 9 November 2013, and again on 21 and 22 November 2013.
- Nest trees were mapped and recorded by GPS. Trees that were unconfirmed as nest sites but appeared regularly visited by the parrot were mapped as potential nest trees.

Flight path mapping

- Flight path mapping was completed between 7 to 9 November 2013.
- Areas where Superb Parrots were regularly observed within the project area were targeted for flight path mapping. These areas were defined by reviewing all known records of the species, as well as locations the parrot was observed during transect surveys.
    - It became apparent during transect surveys that areas to the west of the project area, particularly along Rye Park Road, Frogmore Road, and Flakney Creek Road were regularly used by the parrot, as well as an area in the south of the project area.
- A team of eight to ten observers were stationed at independent locations in these higher activity areas at the same time to record movement and direction of flight of the parrot (Appendix E.3).
    - Some observers were stationed to the west of the proposed infrastructure, while other observers were stationed further east within the project area to determine if birds moved west to east over the higher ridge tops (i.e. across the location of proposed turbines). In particular, two observers were stationed at vantage points for viewing areas of 'highest activity' with a spotting telescope (i.e. on a proposed turbine location) to determine if parrots were moving across the ridgeline.
- Flight path mapping surveys were undertaken from sunrise until 10 am on three consecutive days, except for sites 1, 2, 9 and 10 which were surveyed for two consecutive days (these sites were considered lower activity areas or lower constraint areas).
- For each observation (i.e. individual bird or flock of birds) the time birds were observed, direction of movement, distance moved (if possible), flight height, habitat and general behaviour of observed parrots were recorded. Each flight path was plotted on aerial imagery in the field.
- Additionally, observations were made of birds throughout the survey week while driving to and from the site, driving between sites within the project area, and during other survey work. Particular attention was given to identify any observed parrot throughout the duration of the field week and note its flight path direction. These general observations provided a clear understanding of the locations Superb Parrots were utilising the most across the project area.

Table 3-2 Weather details during Superb Parrot field surveys.

Date	Temperature (min)	Temperature (max)	Cloud	Wind	Rain (mm)
4/11/2013	-0.5 degrees	21 degrees	30% cloud cover	Light wind	0
5/11/2013	1.0 degrees	23.5 degrees	20% cloud cover	Light wind	0
6/11/2013	1.0 degrees	28 degrees	10% cloud cover	Light wind	0
7/11/2013	5.0 degrees	31.5 degrees	30% cloud cover	Moderate wind	0
8/11/2013	10 degrees	25 degrees	80% cloud cover	Moderate wind	0
9/11/2013	6 degrees	24 degrees	100% cloud cover	Strong wind	0

Koala RapSAT surveys (November 2013)

Discussions on the extent of potential impact to the Koala and level of survey effort required were undertaken with Mike Saxon (OEH) on 10 September 2013. During these discussions it was noted that:

- The extent of clearance is primarily limited to discrete areas, primarily for transmission line corridors. Clearance for wind turbines will be nil to minor as main access tracks and turbine sites are located in cleared or non-forested areas; however, there will be some clearing required for installation of the more minor turbine access tracks that will connect to the main access network;

- The nature of the clearing will not affect fragmentation in the landscape; and
- A substantial amount of similar habitat will remain in the project boundary and will not be affected by the proposal.

For example, the main access tracks to potential turbine sites are already cleared, with many tracks already 20 m wide due to existing agricultural land practices; hence clearing is minimal in these areas and the project will not increase fragmentation. Of the habitat available, Inland Scribbly Gum habitat of all condition classes (i.e. poor-good) is considered most appropriate for this species of which up to 55 ha may be cleared by the proposal; however at least 4350 ha of the same vegetation type will remain within the project boundary which also connects to larger areas of the similar habitat within the surrounding landscape.

Given the severity of impacts is not considered to be adverse on the Koala and the potential area to survey for the Koala is extremely large it was discussed that representative areas of better habitat be sampled (Mike Saxon pers. comm. 10 September 2013) given that if the Koala was in the project boundary it is most likely to inhabit the better quality areas.

The following survey method is based on these prior discussions:

- Koala scat surveys were undertaken using the field aspects of Rapid Spot Assessment Technique (RapSAT) as described by Phillips and Callaghan (2011).
- RapSAT searches were completed between 9 to 12 July 2013, 4 to 9 November 2013 and 18 to 22 November 2013.
- Each survey grid was primarily located in areas of potential habitat (i.e. where remnant patch size is relatively large and contiguous) where these will be impacted (i.e. areas proposed for vegetation clearance); this method enabled a representative sample of the habitat to be surveyed across the entire project area.
- Each individual grid location consisted of a group of individual sites which ranged from three to five sites. Within each grid sites were located at approximately 500 m intervals up to a maximum of a 1 km x 1 km grid, or within a linear alignment where the layout of infrastructure within the Rye Park wind farm landscape did not support this grid formation. In total, 33 RapSAT searches were completed.
- The RapSAT method involves searching for scats or evidence of Koalas at the base of 30 trees per site.

Striped Legless Lizard artificial tile surveys (November to December 2013)

An artificial shelter survey using concrete tiles was undertaken for targeted reptile surveys. Five tile sites were installed on 11 July 2013 during winter and another five sites were installed on 10-11 October 2013. Tiles were checked for presence of reptiles during spring-summer 2013. The primary objective of the reptile survey was to determine the presence or absence of the Striped Legless Lizard.

Rod Pietsch of OEH (Senior Threatened Species Officer) was consulted during October 2013 to discuss survey effort and design of the tile survey. It was concluded an additional five tile sites as well as another two funnel trap sites (methodology discussed below) would be installed to supplement the existing tile sites set up in July 2013. The protocol for checking sites was developed in consultation with Rod Pietsch.

Additionally, the survey effort was also based on EPBC survey guidelines for the Striped Legless (SEWPaC 2011). In particular, site selection was based on these guidelines which state “surveys should be conducted in areas that appear to be the most suitable habitat for the species at a site. Surveys are best done in vegetated areas not areas of open bare ground” (?). The artificial shelter methodology was also selected

as detection rates using artificial shelter sites are nearly double that of pit-falling when undertaken during spring (SEWPaC 2011).

EPBC Act survey guidelines suggest rock-rolling primarily during peak activity (late spring and early summer under warm, but not overly dry, conditions) for the Pink-tailed Worm-lizard. This method was undertaken for the species during the initial BA, however, the artificial tile survey is believed to mimic rock structure and was therefore used to supplement survey effort for this species also.

The following methodology was implemented:

- Artificial tile grids were installed in ten locations. Each site consisted of 50 terracotta concrete tiles in a grid of 10 x 5, with tiles spaced every 10 m. A total of 500 tiles were installed across the project area.
- As per the EPBC Act survey guidelines, sites were spaced across the project area in the most suitable habitat for the species; these areas were nearby Box Gum Woodland, within derived grassland and native pasture. Grassland areas that were considered inappropriate habitat were either dominated by exotic species only, were heavily grazed at the time of survey, were dominated by bare ground and/or supported no tussock forming grass species.
- Sites were checked once or twice per week between the period of 1 November to 20 December 2013, totalling 10 checks per site. Checks were delayed when high rainfall was forecast. The number of checks per week was specifically discussed and developed in consultation with Rod Piestch of OEH as this checking protocol deviated from that specified in the EPBC survey guidelines for this species.
- Sites were checked as early in the morning as possible before species were active. Due to time constraints some checks extended into the afternoon, however all checks were completed when ambient temperatures did not exceed 28°C as per the EPBC Act guidelines (Table 3-3).
- A 30-minute active hand search was also undertaken in tussocks within the location of the tile survey during checks.
- All reptile species and number of individuals observed were identified and recorded.

Table 3-3 Weather details for each Striped Legless Lizard tile check.

Date	Temperature range at the time tiles were checked	Cloud	Wind	Rain
5/11/2011	18 – 26 degrees	Nil	Nil	Nil
15/11/2013	18 – 25 degrees	30% cloud cover	Nil	Nil
19/11/2013	12 – 24 degrees	30% cloud cover	Slight breeze	Nil
22/11/2013	14 – 24 degrees	80% cloud cover	Moderate wind	Nil
27/11/2013	12 – 22 degrees	10% cloud cover	Slight breeze	Nil
3/12/2013	20 – 27 degrees	10% cloud cover	Moderate wind	Nil
6/12/2013	7.5 – 15 degrees	50% cloud cover	Moderate to strong wind	Nil
10/12/2013	13 – 20 degrees	40% cloud cover	Moderate wind	Nil
13/12/2013	18 – 26 degrees	10% cloud cover	Moderate wind	Nil
17/12/2013	18 – 22 degrees	Nil	Slight breeze	Nil

Striped Legless Lizard funnel trap surveys (November 2013)

- Funnel trap surveys were undertaken between 4 and 8 November 2013.
- Twelve funnel traps were installed at two sites (Appendix E.3); these sites were chosen to supplement tile surveys but were placed in accessible locations so they could be checked daily.
- Funnel traps were connected by drift-net fencing, with six rows of two funnel traps; each row was approximately 7 m long.
- Funnel traps were installed for a total duration of four nights and five days.
- Traps were checked during the morning and afternoon daily.
- All reptile species and number of individuals observed were identified and recorded.

Golden Sun Moth surveys (November 2013)

The current survey was undertaken with consideration of the guidelines outlined in EPBC Act policy statement 3.12. Significant impact guidelines for the critically endangered Golden Sun Moth (*Synemon plana*) (DEHWA 2009a) and with reference to NSW Guidelines for Threatened Species (DEC 2004). Commonwealth guidelines for Golden Sun Moth recommend each site be visited up to four times under suitable conditions at approximately weekly intervals to determine presence or absence and relative distribution. NSW guidelines recommend that sites should be surveyed a minimum of three times when detection probability for a threatened species is high, but that for rare species it is more efficient to survey more sites less intensively.

As a consequence of limitations posed by the relatively short survey period, the large area covered by the proposed wind farm site and the travel time required between sites, the survey was confined to areas where potential Golden Sun Moth habitat was most likely to coincide with areas with potential to be impacted by the proposed development. Areas where vegetation mapping indicated that Box Gum woodland and/or Box Gum derived grasslands coincided with proposed development were therefore the focal point of the surveys. Surveys were extended where possible to include native pasture (not derived from Box Gum woodland) where it adjoined Box Gum woodland or adjoined sites where moths were observed.

The following methodology was implemented:

- As a consequence of the limitations described, survey effort was targeted at detecting the presence or absence of the moth in potential habitat of Box Gum woodland, Box Gum derived grasslands and to a lesser extent within native pasture.
- A total of 10 search areas were surveyed across the project area between 18 and 27 November 2013 (Appendix E.3).
- Meandering traverse surveys were completed within the search areas by one person. This approach was adopted because of the patchy nature of the habitat and to ensure thorough coverage of areas containing potential habitat.
    - The most likely habitat within each subject site, i.e. patches dominated by wallaby grasses, grassland with an open structure, less disturbed areas along fences and creek edges, moist sites along gully banks, ridge tops and sheltered areas on the sides of ridges, were a particular focus of the survey.
    - The observer kept a steady pace across each search area, stopping and turning at suitable locations for several minutes to check for flying golden sun moths. A GPS watch (Garmin NX310) was used to record the location of the traverses. Golden sun moths flying up to a linear distance of 25 m were visible at most locations, i.e. a total distance of 50 m width in a corridor. The approximate locations of individual moths or small clusters were recorded on aerial imagery in the field.
- Where the moth was found to occur, an assessment was undertaken to determine the extent of potential habitat within the search area. Where the moth was not observed, an assessment of the potential for occupation based on an assessment of habitat quality is provided.
- Survey constraints reduced survey effort to between one and four visits per site. To increase efficiency, as much of each site was thoroughly surveyed as was feasible, although with less intensity (less repetition) than recommended by Commonwealth guidelines. The adequacy of the survey effort in relation to the conclusions is considered further in the discussion of the results.
- Surveys relating to access track sites were generally confined to a linear corridor approximately 30 m in width while those relating to transmission line corridors were approximately 200 m in width. Site compounds and substation sites were surveyed according to the area covered by the installation.
- Five reference sites or sites where moths were observed early during the current survey were examined prior to the first survey and after the last survey on each day where feasible, to confirm that moths were flying in the vicinity of each search area (Appendix E.3).
- General weather conditions on each of the survey days were suitable for the detection of flying Golden Sun Moth (Table 3-4).

Table 3-4 Weather details for each Golden Sun Moth survey

Survey Date	Time	Rain (mm)*[1]	Temperature (ºC)	Wind (km/h)*	Cloud 8th*	Weather Conditions#
18 November	10:15 – 15:30	0	15 – 22* 18 – 22#	11 – 19	1 – 4	Sunny but cloud increasing during the day, warm, slight breeze at times with moderate gusts in the afternoon
19 November	10:20 – 15:30	0	16 – 28* 22 – 27#	Calm	0	Sunny, warm to hot, calm conditions, occasional light breeze. Temperature rose quickly after 10:00

Survey Date	Time	Rain (mm)*[1]	Temperature (ºC)	Wind (km/h)*	Cloud 8th*	Weather Conditions#
20 November	10:15 – 15:00	0	20 – 29.5* 26 – 32#	Calm - 6	1 – 2	Hot, mostly sunny, generally calm but with increasing wind and cloud
23 November	10:30 – 15:20	2mm 22 Nov	No record* 21 – 24#	No record	No record	Warm, mostly sunny, calm with occasional light breeze, cloud increasing
27 November	10:40 – 15:15	4mm 26 Nov	17.5 – 27.5* 18 – 27#	Calm - 6	0	Warm to hot, slight breeze at times, sunny. Temperature rose quickly after 11:00
3 December	09:50 – 15:15	0	21 – 32* 25 – 32#	Calm	0	Hot, mostly calm with occasional wind gusts later, sunny with some high cloud at times
8 December	10:30 – 14:00	2.2mm 6 Dec	Max 30.5* 21 – 25#	No record	No record	Some high cloud early, warm, generally calm with occasional wind gusts

***** As recorded by the Bureau of Meteorology at YASS (station 070358) generally or at 09:00 and at 15:00. Some records not available.

As recorded in the field during survey period. Temperature records from a hand held thermometer or by the electronic thermometer located in the car used to access each site.

[1] In previous 48 hours

Threatened Large Forest Owls call playback survey and spotlighting (November 2013)

General nocturnal surveys were undertaken during November 2011 and April 2012 which included surveying for large forest owls. A total of 9.5 hours of evening listening / call playback, and 17.25 hours of spotlighting (foot and vehicle) were completed.

Further targeted nocturnal surveys were undertaken for the Powerful Owl and Barking Owl in areas of potential habitat (i.e. in areas supporting higher densities of hollows within forest) during 4 to 9 November 2013 to supplement existing survey results. Spotlighting and call playback were undertaken within forest habitat that was considered to support a greater abundance of prey species or roosting sites for these species. Nocturnal surveys were completed using the methods described above under *General survey fauna methods* for call playback and spotlighting. These targeted surveys were undertaken near the vicinity of turbine sites RYP_66, RYP_84, RYP_90, and RYP_104 and totalled 5.5 hours of survey.

3.3.3 Survey effort

Flora survey effort

Approximately 180 person hours was spent in total on the general flora survey incorporating 59 quadrat/random meander sites and 128 inspection points. The location of the survey sites are shown on the maps in Appendix E.2. Approximately 7 and 5.5 person hours was spent on specific targeted searches within the originally proposed substation site and higher quality areas in the vicinity of RYP_120 during the November 2011 and November 2013 surveys respectively.

Fauna survey effort

Table 3-5 documents the fauna survey effort employed for both general surveys as well as targeted species-specific surveys for the project area.

Table 3-5 Fauna effort summary

Turbine number references (i.e. RYP_92) relate to map sets provided in Appendix E.3.

Survey Type	Target Species	Date	Sampling Method	Survey Effort	Comment
Habitat Assessment	All species, predominantly threatened	November 2011	100 x 100 quadrat	• 54 quadrats	
		April 2012	100 x 100 quadrat	• 20 quadrats	
Hollow-bearing Trees	All hollow-dependent fauna	November 2011	100 x 100 quadrat	• 35 quadrats	
		April 2012	100 x 100 quadrat	• 2 quadrats	
		November 2013	HBTs mapped within 100m of infrastructure in mod-good condition vegetation	• 7 search areas	
Birds	All birds	November 2011	Utilisation Surveys	• 18 surveys of 30 minutes duration **Total effort = 9 person hrs**	
		April 2012	Utilisation Surveys	• 6 surveys of 20 minutes duration **Total effort = 2 person hrs**	
		November 2013	Utilisation Surveys	• 8 surveys of 20 minutes duration **Total effort = 2.7 person hrs**	All birds observed during Superb Parrot transects were also recorded substantially increasing survey effort for birds in general (25 hrs).
	Swift Parrot / All birds	July 2013	Point-count method	• 10 search areas • 6 surveys at 60 mins each (2 people) (1 site visited twice) • 5 surveys at 45mins each (1 person) (3.75 person hrs) **Total effort = 15.75 person hrs**	Surveys undertaken to coincide with the winter migration of the Swift Parrot to mainland from Tasmania.
	Superb Parrot	November 2013	1km transects Flight path mapping	• 25 transects of 1 hr duration **Total effort = 25 person hrs** • 3 days x 8 people of flight path mapping **Total effort = 72 person hrs**	Method and survey effort developed in consultation with Damon Oliver (OEH Threatened Species Team Leader)

Survey Type	Target Species	Date	Sampling Method	Survey Effort	Comment
Reptiles and Amphibians	All species, primarily Pink-tailed Worm-lizard	November 2011	Active searching (rock, log, branch rolling)	• 11 surveys of 20 – 60 minutes duration **Total effort = 4 person hrs**	
	All species, primarily Striped Legless Lizard	November 2012	Funnel Traps	• 2 sites off Flakney Ck Rd along proposed TL **Total effort = 24 traps x 4 nights (96 traps nights)**	Method and survey effort developed in consultation with Rod Piestch (OEH Senior Threatened Species Officer)
	Striped Legless Lizard	November to December 2012	Artificial Tiles	• 10 sites of 50 tiles each • 10 independent checks **Total effort = 50 tiles x 10 sites (500 tiles) checked 10 times each**	
	All Frogs	November 2011	Frog vocalisation survey	• 10 minutes duration	
Microbats	All microbats	November 2011	Anabat surveys	• 9 overnight surveys	
		April 2012	Anabat surveys	• 6 overnight surveys	
		November 2013	Anabat surveys	• 7 overnight surveys	Additional survey effort developed in consultation with Martin Henery (OEH Conservation Planner)
Squirrel Glider	Squirrel Glider	April 2012	Cage trapping	• 2 trap sites near RYP_92 and RYP_105 **Note: RYP_105 is now removed from layout* **Total effort = 8 traps x 4 nights, 8 traps x 3 nights (56 trap nights)**	
Golden Sun Moth	Golden Sun Moth	November 2012		**Total effort = 10 sites visited between 1 and 4 times each.**	
Koala	Koala	July 2013, November 2013	Spot Assessment Technique (RapSAT)	**Total effort =** 7 grids (33 plots)	Method and survey effort developed in consultation with Rod Piestch (OEH Senior Threatened Species Officer)
Nocturnal Survey					

Survey Type	Target Species	Date	Sampling Method	Survey Effort	Comment
Evening listening / stagwatch	Forest Owls Squirrel Glider	November 2011	N/A	• 3 surveys each by 2-3 people for 30 minutes **Total effort = 3.5 person hrs**	
		April 2012		• 6 surveys by 60 minutes **Total effort = 6 person hrs**	
Call Playback (including listening period)	Forest Owls Squirrel Glider	November 2011		• 5 surveys of 20 minutes duration **Total effort 1.6 person hrs**	
		April 2012		• 3 surveys of 30 minutes duration **Total effort = 1.5 person hrs**	
		November 2013		• 4 surveys of 30 minutes duration **Total effort = 2 person hrs**	Additional survey effort developed in consultation with Martin Henery (OEH Conservation Planner)
Spotlighting	Squirrel Glider Arboreal mammals	November 2011	Vehicle and foot surveys	• 3 vehicle-based surveys • 5 foot-based surveys between 15 minutes and 2 hours **Total effort = 11.75 person hrs**	
		April 2012	Foot surveys	9 foot-based surveys between 30 and 50 minutes **Total effort = 5.5 person hrs**	
		November 2013	Foot surveys	4 foot-based surveys between 30 and 60 minutes **Total effort = 3.5 person hrs**	Additional survey effort developed in consultation with Martin Henery (OEH Conservation Planner)

3.3.4 OEH recommended survey requirements

Table 3-6 addresses each species-specific survey requirement recommended by OEH (received by **ngh**environmental 11 June 2013). The table considers the survey effort implemented for this assessment and provides a justification for any deviation from the OEH requirements (for, example, where no suitable habitat for the species occurs or where the level of impact that would be imposed by the wind farm is manageable with regard to the species).

After the initial November 2011 survey was undertaken, further targeted surveys were undertaken to fill survey effort gaps and to determine the presence / absence of a species. OEH requested specific survey requirements for the Superb Parrot, Koala, Striped Legless Lizard, Squirrel Glider, threatened forest owls, threatened microbats, woodland birds, and Golden Sun Moth. Substantial targeted surveys were therefore undertaken in November to December 2013 for the above species; the survey effort and survey locations for these species-specific surveys were developed in consultation with OEH and documented in *Rye Park Biodiversity Assessment - targeted fauna survey V2 2013)*.

Additional to the surveys already undertaken, additional survey work is planned both prior to approval and prior to construction (pending project approval) to address remaining uncertainty or inform management of impacts (particularly during construction). These additional surveys are specified in the recommendations of this Biodiversity Assessment, in Section 8.

Table 3-6. Species specific survey requirements issued by OEH

Species	OEH recommended survey requirements (paraphrased)	Surveys in accordance with OEH	Justification for any deviation from OEH requirements
Flora			
Box Gum Woodland	Identify the extent and condition of this community in the study area and locality.	Yes.	59 quadrat/random meander sites and 128 inspection points (approximately 180 person hours). Vegetation type mapped to the site boundaries. Condition mapped for the development envelope. Infrastructure was designed to avoid good condition areas for Box Gum Woodland (Section 8) (i.e. turbines moved out of Box Gum Woodland remnants or removed from layout altogether). The community has a long history of grazing, with much of the development located within low condition areas. The survey effort employed is considered adequate to the nature and quality of habitat found within the project area.
Silky Swainson Pea, Mountain Swainson Pea, Tarengo Leek Orchid, Crimson Spider Orchid, Yass Daisy.	Systematic surveys using 10m transects through woodland and grassland areas. Surveys should be undertaken during the flowering periods.	Yes, within the originally proposed substation site. Random meanders substituted for transects within proposed transmission line routes	59 quadrat/random meander sites and 128 inspection points (approximately 180 person hours) Box Gum Woodland and derived grassland in moderate or good condition is considered to be the most likely habitat these species would be found. Targeted transects for threatened flora were conducted in higher quality areas of Box Gum Woodland and derived grassland within the originally proposed eastern substation site (removed during layout modifications to avoid sensitive areas). Random meanders were substituted for transects within the high quality habitat in between RYP_109 and RYP_120 given the large area to be covered and the nature of the impacts in this area (limited to the establishment of transmission pole footings and an access track). Both methods are considered acceptable under the Draft Threatened Species Survey Guidelines (DECC 2004). These surveys failed to locate any threatened flora. In addition, five flora quadrat surveys were conducted in moderate or good condition Box Gum Woodland and failed to detect any threatened flora. No threatened flora were detected during the other 54 quadrat/random meander sites and 128 inspection points (approximately 180 person hours) conducted across the broader site or while travelling between these sites.
Fauna			
Regent Honeyeater	Diurnal fixed-width transects or point counts surveys and call playback during breeding season. Surveys can be conducted at any time of year, but optimal conditions during spring and summer.	No. But the species was indirectly surveyed through utilisation bird surveys.	26 bird surveys (11.5 person hours) were conducted across the project area during November 2011 and November 2012. Primary breeding and foraging habitat is not widely available within the project area (i.e. riparian areas of Red Ironbark, Red Gum and Casuarinas, or wetter areas supporting Box-ironbark Eucalypt associations). Two species of mistletoe were recorded on site, but are not widely distributed and occur in low densities. Casuarina and Red Gum are not recorded on site. Potential foraging habitat is primarily present within the Box Gum Woodland within the project area. The Guidelines suggest bird searches of woodland patches with heavily flowering trees, especially around waterpoints, such as creeklines. Woodland patches within the impact area were surveyed during bird

Species	OEH recommended survey requirements (paraphrased)	Surveys in accordance with OEH	Justification for any deviation from OEH requirements
			surveys. The method employed such as listening for calls during the known breeding season (November) within the most appropriate habitat type available within the impact area is considered adequate to detect this species. Given that core breeding habitat is not available on site, foraging resources are generally limited (i.e. not wetter more fertile areas), and known records indicate movement of the species east of the project area, the proposal is not considered to adversely affect the existence of this species
Swift Parrot	Diurnal fixed-width transects and/or point-count surveys during Autumn-Winter.	Yes.	10 point-count surveys undertaken during July 2013 during the species winter migration to the mainland from Tasmania.
Brown Treecreeper, Diamond Firetail, Hooded Robin, Speckled Warbler, Grey-crowned Babbler, Little Lorikeet, Black-chinned Honeyeater, Turquoise Parrot, Varied Sittella.	Diurnal bird census in the early morning or late afternoon at a minimum of three locations within the subject site. Surveys should be 45 minutes duration and separated by a period of one week. Can be undertaken at any time of the year, but not in high-wind and/or rainy days.	Yes.	42 bird surveys (29.45 person hours) were conducted across the project area during November 2011, April 2012, July 2013, and November 2013, with emphasis on wooded areas. The survey effort undertaken is above that recommended by OEH. Additionally, infrastructure has been designed to avoid high habitat value areas for woodland birds (Section 8) and to maintain habitat connectivity (i.e. turbines moved out of Box Gum Woodland remnants or removed from layout altogether).
Scarlet Robin, Flame Robin	As above, but surveys are optimal between July-January, but can be undertaken at any time of the year.	Yes.	As above.
Gang-gang Cockatoo, Glossy Black-cockatoo	Diurnal bird surveys, using a combination of stag-watching and listening for calls of the birds returning to nests in the late afternoon during the known breeding season. Surveys should target hollow-	No. But both species were not observed during bird surveys	Both species were not observed during bird surveys despite a total of 42 bird surveys undertaken, indicating they are unlikely to be a permanent resident of the project area. Both foraging (Casuarina) and nesting resources for the Glossy Black-cockatoo are absent from the project area and the species is not expected to occur there. The gang-gang was not observed during bird surveys and therefore stag watch surveys were not considered necessary for this species. The survey effort employed is considered adequate for the extent and quality of habitat found within the project area.

Species	OEH recommended survey requirements (paraphrased)	Surveys in accordance with OEH	Justification for any deviation from OEH requirements
	bearing trees (hollows > 10 cm).		
Superb Parrot.	Undertake surveys during breeding season using 1 km transects within the project area to determine local flight paths and usage of the project area. Undertake flight path mapping at advantage points across the project area.	Yes.	Surveys deviated from initial OEH requirements but subsequent transect and flight path mapping methodology was developed in consultation with OEH specific to this species.
Barking Owl, Powerful Owl	Nocturnal call playback (1 site per 100 ha). Identify and map all hollow-bearing trees and estimate the availability within the locality.	Slight deviation	10 nocturnal surveys conducted (spotlighting, evening listening, and call playback). Nocturnal call playback was undertaken in suitable potential habitat for these species in accordance with the draft guidelines for threatened species assessment (DEC 2005); however, call playback targeted potential habitat of this species and was not undertaken every 100 ha across the project area given much of the habitat in other unsurveyed areas was unsuitable or marginal. These species are considered further in the impact assessment.
Squirrel Glider	Live-trapping in trees, with traps spaced 50-100m apart, for minimum of 4 nights. Infra-red cameras are supported as a trade-off survey intensity.	Yes.	Cage trapping (56 trap nights) was conducted at two locations of suitable habitat in April 2012, with 9.5 hrs of evening listening, and 20.75 hrs of spotlighting (foot and vehicle) also completed in total. Additional survey effort completed in November 2013 was developed in consultation with OEH and constituted targeted spotlighting in areas of potential habitat that were considered the most appropriate habitat for this species. This species is considered further in the impact assessment.
Koala	Undertake regularised Grid Based Spot Assessment Technique (RapSAT). Map potential Koala habitat in the study area.	Yes.	Survey effort and location of RapSAT grids were developed in consultation with OEH prior to field surveys.
Spotted-tailed Quoll	Use digital infrared cameras in suitable habitats, such as	No.	The project area does not support habitat for this species. The spotted-tailed Quoll was given a low potential impact rating as rocky habitats (i.e. boulders and cliff faces) required for breeding by quolls are not present within

Species	OEH recommended survey requirements (paraphrased)	Surveys in accordance with OEH	Justification for any deviation from OEH requirements
	drainage lines. Install cameras for a minimum of four weeks.		the project area. While this species can also den in large logs and hollows these habitat features are absent from the impact area. Therefore impact of the proposal is negligible and intense survey effort was not warranted.
Eastern False Pipistrelle, Eastern Bentwing-bat, Greater Broad-nosed bat, Yellow-bellied Sheathtail-bat, Greater Long-eared Bat.	Conduct surveys using Anabat recorders and stag-watching. Identify important foraging habitat in the study area and locality. Hollow-bearing tree surveys of the subject site, study area, and locality.	Yes.	23 Anabat surveys were undertaken in 22 different locations. Hollow-bearing trees were mapped in areas of mod-good condition habitat considered potential habitat for these species. As it is difficult to determine abundance or flight paths from Anabat survey there are limitations to determining important foraging habitat given the mobility of microbat species. It is therefore considered that forest and woodland areas in general represent a constraint for these species, as do hollow-bearing trees. However, infrastructure has been designed to avoid high habitat value areas (woodland habitat) to mitigate impact to microbats. Microbats were considered further in the impact assessment and were noted as focus species for a bird and bat monitoring program.
Grassland Earless Dragon	Spider tubes should be used to survey areas of suitable habitat (natural temperate grassland or nearby secondary grassland dominated by Wallaby Grass). 10-wk survey season from February to April with tubes checked twice a week.	No.	11 herpetofauna searches in suitable habitat including active searching and rolling of rocks, logs and other debris. In the project area, rocky outcrops generally occur on hill crests in cleared and forested areas and are sparsely distributed, occurring mostly in the northern portion of the site. Primary habitat for these species does not occur within the project area. The survey effort is considered adequate for the extent and quality of habitat available within the project area.
Pink-tailed Worm-lizard, Little Whip Snake	Rock rolling and active searching under logs and debris. Undertake surveys between mid-August and end of October. Daily temperatures to not exceed 25 degrees. Surveys in the locality for habitat of the species.	Yes, for the Pink-tailed Worm-lizard.	
Striped Legless Lizard	Pitfall trapping in suitable habitat (natural temperate grassland or nearby secondary grassland dominated by Kangaroo Grass). Trapping	Yes.	Survey effort and location of artificial tiles sites were developed in consultation with OEH prior to field surveys.

Species	OEH recommended survey requirements (paraphrased)	Surveys in accordance with OEH	Justification for any deviation from OEH requirements
	should last for 6 weeks (mid-November to mid-late December). Roof tiles should also be used 4 months prior to checking.		
Golden Sun Moth	Surveys should target areas with greater than 40% *Austrodanthonia* (Wallaby Grass) in ground cover. Conduct surveys when known populations in the local area are in flight.	Yes.	Surveys undertaken by Kris Nash, an expert in Golden Sun Moth survey especially within the ACT region.

3.4 SURVEY LIMITATIONS

Assumptions	Where required, we have assumed a precautionary approach, assuming a species is present unless good reasons preclude its use of the site. We have stated explicitly the assumptions, where made, and the limitations of our approach or survey. Where required, we have developed measures to address uncertainty; chiefly these include a monitoring program to respond to unforseen operational impacts to birds and bats. Information on the ecology and flight paths, as well as movement patterns are not available for some species and in this instance specific impacts cannot be quantified and such species need further consideration within a monitoring program. Additionally, several specific surveys are proposed, to confirm the assumptions of this assessment and make any necessary changes, if required, to ensure that impacts are kept below key thresholds.
Competency	Suitably qualified and licensed individuals carried out the survey work; refer to Appendix G for staff qualifications and experience.
Accessibility	Night work was targeted toward forest and woodland safely accessible at night. Some forested areas in the northern part of the proposal area were not surveyed at night due to unsafe access in the dark. Detailed habitat assessments were undertaken in these areas during the day. Not all areas within the development envelope were able to be accessed efficiently for vegetation survey, due mostly to the presence of a very dense shrub layer or steepness of the terrain. In these areas, inspection from nearby inspection points[5] utilising high powered binoculars was used to confirm vegetation types. Condition for these areas was extrapolated from other known areas of similar vegetation that had been surveyed in detail. The survey effort maps clearing illustrate the location of all survey and inspection points.
Timing	The field surveys were undertaken in mid spring and autumn, and considered suitable for detecting the majority of target species. Some summer flowering flora species may have gone undetected however, the precautionary approach outlined below has been utilised in these instances.
Scope	The fauna survey focussed on habitat assessment to identify areas that may harbour threatened species, rather than undertaking a comprehensive trapping program. Targeted follow-up surveys in April then focussed on better quality habitat.
Hollow-bearing trees	Data was obtained from hollow-bearing tree quadrats and targeted search area surveys and has been averaged and extrapolated for the remainder of the site.

[5] The flora survey effort map shows all flora inspection points.

	This is likely to lead to either over-estimates or under-estimates in some areas with different disturbance or land management regimes.
Precautionary approach	As it is difficult to rule out the presence of any particular species without extensive surveys, a precautionary approach has been adopted. That is, if suitable habitat is present and desktop assessment has determined the species could occur in the area, the species has been assumed to have potential to utilise habitat within the proposed alignment.
GIS	A common issue when displaying survey effort and results point data is that some points obscure other points which are located in the same or similar locations. An innovative GIS approach has been applied to randomly disperse such points which are co-located. The effect of this is to move co-located points up to around 200m from their original location. This assists the reader to distinguish co-located points. However, it should be noted that the location of survey effort and results point data is approximate only, and that in some cases, the moved points may therefore overlay onto adjacent vegetation type or habitat conservation value.

3.5 GIS MAPPING

Figures have been produced by **ngh**environmental using ArcView 10. Geo-referenced aerial imagery and development envelopes were provided by Epuron.

No existing vegetation mapping (including any sensitive area mapping) exists for the proposal site. Vegetation and habitat mapping have been hand-digitised by **ngh**environmental based on aerial imagery and field records. Vegetation type and condition has been mapped for the development envelope that was current at the time of the field survey. Vegetation types (excluding condition) have also been mapped within the broader site boundary, based on the inspection data recorded in the field and extrapolation from known vegetation types and their topographic context within the landscape.

3.6 LANDSCAPE CONNECTIVITY ANALYSIS

As impacts on habitat connectivity can fragment populations, affecting their ability to access important resources and undertake genetic exchange, a landscape connectivity analysis was undertaken. This was done with reference to aerial imagery, considering the spatial configuration of vegetation including percentage vegetation cover and connectivity across the landscape. The field surveys also provided an opportunity to ground truth assumptions about local connectivity.

3.7 CONSTRAINTS ANALYSIS

A Biodiversity Constraints Analysis was prepared by **ngh**environmental (2012) to spatially identify key ecological values that represent a constraint to the proposal. A constraint, for the purposes of this assessment, is an environmental condition that reduces the suitability of a site to accommodate the proposed development. Constraints mapping was undertaken as a means to guide the development of the infrastructure layout to minimise biodiversity impacts. It also provides a means to group management strategies. For example; areas within which infrastructure should be avoided, areas requiring further

survey, areas requiring specific management measures, and areas requiring standard management measures.

The biodiversity constraints in the project area have been identified and assessed based on desktop assessment and field surveys, including aerial photo interpretation and GIS mapping. Aerial photo interpretation was used to extrapolate data in areas that were not directly assessed within the field. In this instance knowledge of the surrounding areas was considered adequate to make a judgement call on the constraint level applied. The result of the constraints analysis is provided in Section 6.

The biodiversity constraints within the development envelopes at Rye Park wind farm have been classified and mapped according to three constraint classes (Table 3-7). Constraints maps are intended to inform more detailed project development to avoid and minimise impacts, where possible and are provided in Appendix E.4. The layout was iteratively refined by the Proponent in response to the identified constraints throughout the assessment phase of the project. Constraint maps have been adjusted several times throughout the project to include new information from field surveys as they are completed.

Table 3-7 Constraint classes

Level of Constraint	Description	Management Options
High	• Impacts in these areas are significant. • Impacts would be difficult, costly, or require large offset areas, and should be avoided as a preference. • Further survey and targeted assessment required in these areas to determine extent of impact.	• Preference is to avoid direct or indirect impacts in these areas. • Undertake detailed follow up surveys and assessment to determine the significance of likely impacts and resultant management option, if impact is proposed for these areas.
Moderate	• Impacts have potential to be significant if not managed carefully. • Further survey work to guide mitigation and management strategies.	• Mitigate through specific management actions (i.e. micrositing, pre-clearance surveys for HBTs). • Offsetting may require a larger offset ratio. • Undertake detailed follow up surveys and assessment to determine the significance of likely impacts and resultant management option.
Low	• Impacts highly unlikely to be significant in these areas. Infrastructure is most appropriately located in these areas.	• Standard mitigation actions required. • Offset residual impacts (a lower offset ratio will apply).

4 RESULTS: FLORA

4.1 EXISTING ENVIRONMENT

4.1.1 Site conditions: disturbance and weeds

Many areas of the site have been grazed and show evidence of this in the areas extensively cleared of overstorey vegetation often with a low diversity of native pasture species and forbs. Common weeds associated with grazing are widespread and have invaded areas of more intact woodland and forest vegetation.

Large areas of the site that have been subject to previous clearing are now dominated by the colonising species Sifton Bush (*Cassinia arcuata*), which often forms an almost impenetrable shrub layer. This species is a declared noxious weed in many shires within NSW however, it is not declared within the Boorowa Local Control Area (LCA) within which the site occurs. Two noxious weeds declared for the Boorowa LCA were detected during the surveys:

- Scotch Thistle (*Opopordum acanthium*) was detected within the development envelope in the vicinity of RYP_1, slightly west of RYP_34 to 44 and in the far north-east of the site to the east of RYP_23 south to RYP_33.
- Blackberry (*Rubus fruticosus* aggregate) was detected west of the proposed 132kV transmission line along Colondal Lane.

Most areas of forest have a low diversity of tree age groups, being mostly dense young regrowth as a result of previous clearing.

4.2 VEGETATION COMMUNITIES

Eleven vegetation types occur within the development envelope:

- Inland Scribbly Gum – Red Stringybark open forest.
- Blakely's Red Gum - Yellow Box grassy tall woodland.
- Blakely's Red Gum - Yellow Box grassy tall woodland derived grassland.
- Argyle Apple – Acacia mearnsii valley open forest.
- Brittle Gum - peppermint open forest.
- Red Box Woodland.
- Phragmites Swamp.
- Sifton Bush Shrubland.
- Native Pasture.
- Exotic Pasture.
- Planted vegetation.

These vegetation types are described below. The natural vegetation types are classified according to the communities described for the South Western Slopes Bioregion (Upper Slopes) in Benson (2008) and Benson *et al.* (2010). Vegetation types that do not represent a natural vegetation type (e.g. highly modified) have been given a generic name. The distribution of these communities is displayed on the flora result maps in Appendix E.2. A species list for the site is provided as Appendix A.

Inland Scribbly Gum – Red Stringybark open forest (ID349)

Figure 4-1 Inland Scribbly Gum – Red Stringybark open forest at the site

This community is the most common and widespread wooded community across the site. It occurs primarily on ridge tops and upper slopes and is characterised by the dominance or presence of Inland Scribbly Gum (*Eucalyptus rossii*) with other common tree species including Red Stringybark and Long-leaved Box (*E. goniocalyx*) with occasional Broad-leaved Peppermint (*E. dives*) (Figure 4-1). The understorey is typically sparse with a low diversity of native shrubs commonly including, Daphne Heath (*Brachyloma daphnoides*), Urn Heath, Grey Guinea Flower, *Daviesia leptophylla,* Prickly Broom-heath (*Monotoca scoparia*), *Hovea heterophylla* and Sifton Bush (*Cassinia arcuata*). The ground cover is generally dry and sparse and is dominated by tussock grasses such as Robust Wallaby Grass (*Joycea palida*), Spear Grass (*Austrostipa scabra* subsp. *falcata*) and Wallaby Grasses (*Austrodanthonia* spp.). The sedges *Lomandra filiformis* subsp. *filiformis*, *Lomandra filiformis* subsp. *coriacea* and *Lomandra multiflora* subsp. *multiflora* can be common. Forbs are generally sparse.

This community is considered to be common and widespread in the region. Across the site this community is generally intact and in good condition. Areas in poor condition occur where the community has been previously impacted by clearing and grazing pressure such as in the vicinity of RYP_83 and the transmission line north-west of RYP_102.

A similar community containing Mugga Ironbark (*E. sideroxylon*) occurs at the site and is likely equivalent to Mugga Ironbark – Inland Scribbly Gum – Red Box shrub/grass open forest (ID 289). There are limited occurrences of tFigurehis community within the development envelope where it forms an intergrade with Inland Scribbly – Red Stringybark open forest and for the purposes of this assessment it has been included within this vegetation type.

Blakely's Red Gum - Yellow Box grassy tall woodland (ID277)

Figure 4-2 Blakely's Red Gum – Yellow Box grassy tall woodland at the site

This community typically occurs on the lower slopes and valleys and is dominated by Yellow-Box (*Eucalyptus melliodora*) and Blakely's Red Gum (*Eucalyptus blakelyi*) (Figure 4-2). A shrub layer may be present or more often absent with common species including Silver Wattle (*Acacia dealbata*), Grey Guinea Flower (*Hibbertia obtusifolia*), Urn Heath (*Melichrus urceolatus*) and Silver Tea-tree (*Leptospermum multicaule*). More intact remnants of this community in good condition occur along established roadsides and at a few locations within the development envelope (refer to Section 4.3, below). In these situations a diverse groundlayer may be present such as north of RYP_120 where grazing sensitive forbs such as Scaly Buttons (*Leptorhynchos squamatus*), Tiger Orchid (*Diuris sulphurea*), Native St John's Wort (*Hypericum gramineum*) and Common Sunray (*Triptilodiscus pygmaeus*) persist. Kangaroo Grass (*Themeda australis*) also forms a common component of the ground cover.

Most of the remnants within the development envelope and across the broader site boundary occur in highly modified native or exotic pasture and are in poor condition. This includes the transmission line north of RYP_73 and south of RYP_144. In these instances the groundcover is often dominated by Spear Grass or Wallaby Grass with a low diversity of native forbs.

This community is listed as an EEC under the TSC Act with better quality remnants also qualifying for the national listing under the EPBC Act. Areas of this community in good condition can also provide habitat for threatened flora.

Blakely's Red Gum - Yellow Box grassy tall woodland (ID277) derived grassland

Figure 4-3 Blakely's Red Gum - Yellow Box grassy tall woodland derived grassland at the site

This community is effectively native pasture but occurs in situations where it is likely to have been derived from Blakely's Red Gum - Yellow Box grassy tall woodland that has been cleared of overstorey vegetation (Figure 4-3). Similarly to the woodland community that it is derived from, the majority of the community within the development envelope and across the broader site is in poor condition as a result of past land management practices. Dominant grasses include Speargrass, Wallaby Grass, Wheat Grass (*Elymus scaber*) and Weeping Grass (*Microlaena stipoides*). Native forb diversity is generally low and restricted to grazing tolerant species such as Native Geranium (*Geranium solanderi*), Bluebells (*Wahlenbergia* spp.) and Small-leaved Poranthera (*Poranthera microphylla*).

No occurrences of this community in good condition occur within the area to be impacted however, a small area in the far south-east of the broader site boundary (east of RYP_124) exhibits relatively high species diversity.

This community is also considered to comprise the EEC under both state and federal legislation and similarly areas of this community in good condition can provide habitat for threatened flora.

Argyle Apple – Acacia mearnsii valley open forest (ID344)

Figure 4-4 Argyle Apple – Acacia mearnsii valley open forest at the site

This community is distinguished by the dominance of Argyle Apple (*Eucalyptus cinerea*). It often forms pure stands and occurs naturally in a patchy distribution across lower lying areas of the landscape, as it does at the proposal site (Figure 4-4). Parramatta Wattle (*Acacia parramattensis*) is a common small tree. Within the site boundary this community is characterised by a native grassy understorey with species including Wallaby Grasses, Speargrass, Purple Wiregrass (*Aristida ramosa*) and Robust Wallaby Grass. A moderate diversity of forbs is also generally present with common species including Bluebells, Native St John's Wort, Ivy Goodenia (*Goodenia hederacea* subsp. *hederacea*), *Solenogyne dominii* and Raspwort (*Gonocarpus tetragynus*).

This community occurs within the development envelope around RYP_66 and the access track to the north and is in moderate and good condition. It is mostly restricted to this area and does not occur widely across the broader site.

This community is common and widespread within the region and is not listed as threatened. It can however, provide important habitat values for a range of fauna species.

Brittle Gum - peppermint open forest (ID296)

Figure 4-5 Brittle Gum - peppermint open forest at the site

Highly modified examples of this community occur in the vicinity of RYP_71 and RYP_72 and within the proposed transmission line in this area and also around RYP_2 and RYP_4 in the far north of the site. It is characterised by the dominance of Brittle Gum (*Eucalyptus mannifera*) with occasional Red Stringybark (*Eucalyptus macrorhyncha*) and within the development envelope exhibits a frequently grazed understorey of mostly low diversity native grasses and forbs (Figure 4-5). Dominant grasses include Weeping Grass and *Austrodanthonia racemosa*. Forb species are almost entirely exotic.

All occurrences of this community within the development envelope and broader site boundary are in low condition.

This community is considered to be common and widespread in the region.

Red Box Woodland

Figure 4-6 Red Box Woodland at the site

This community was identified along the eastern section of an access route to RYP_51. This access route is no longer part of the proposal and this community does not occur within the development envelope. It is characterised by the dominance of Red Box (*Eucalyptus polyanthemos*) and exhibited a reasonable diversity of native shrubs, grasses and forbs in the ground cover and was considered to be in good condition (Figure

4-6). Red Box can form a component of a number of vegetation types including Box Gum Woodland however, due to the absence of Yellow Box or Blakely's Red-Gum, it was not considered to comprise the EEC and is considered a variant of one of the more common vegetation types at the site.

Phragmites Swamp

Figure 4-7 Exotic infested swamp vegetation at the site

A swampy area dominated by Phragmites (*Phragmites australis*) was identified to the east of the proposed transmission line in the south of the site. This area was highly localised and it had a high proportion of exotic species including Willows (*Salix* spp.) (Figure 4-7).

This vegetation could be considered to form a component of the Tussock grass- sedgeland fen – rushland – reedland wetland community (ID335) described by Benson *et al.* (2010). It is common in wet situations on valley floors and often has a high component of exotic species due to disturbance and surrounding land uses. Very few sites are in near-natural condition and the extant protected is unknown (Benson *et al.* 2010). For these reasons it is considered to have conservation significance. This community is not located within the development envelope and would not be impacted by the proposal.

Sifton Bush Shrubland

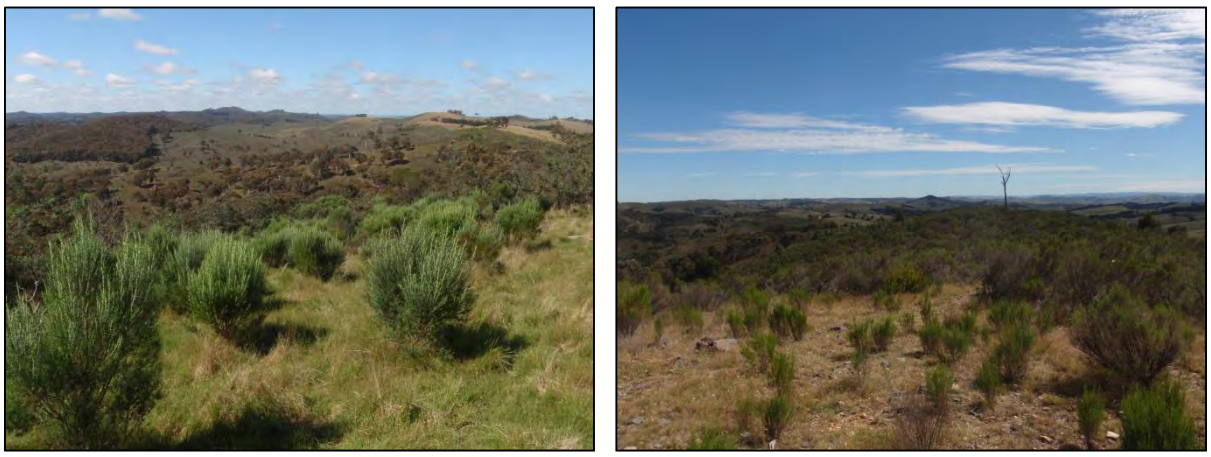


Figure 4-8 Sifton Bush dominated vegetation at the site

This community occupies previously cleared and disturbed areas where Sifton Bush (*Cassinia arcuata*) has vigorously colonised and is now the dominant species (Figure 4-8). Other shrubs are commonly scattered throughout the Sifton Bush including Silver Wattle, Early Wattle (*Acacia genistifolia*), Grey Guinea Flower, Silver Tea-tree and Nodding Blue Lily (*Stypandra glauca*). It often occurs on rocky ridge tops and upper slopes and can have a good diversity of native grasses, sedges and forbs in the understorey, as livestock appear to avoid it in most cases, keeping grazing pressure low. As such, the majority of this vegetation type within the development envelope is considered to be in good condition with some more disturbed areas in moderate condition. Dominant forbs include those that are common to the other vegetation types that this community would be derived from including Common Sunray, Bluebells, Ivy Goodenia, Native St John's Wort, Stinking Pennywort and Raspwort. Rock Ferns (*Cheilanthes sieberi*) and sedges such as Wattle Mat-rush (*Lomandra filiformis* subsp. *coriacea*) and *Juncus filicaulis* are also common and widespread. Native grasses are mostly comprised of Wallaby Grasses, Speargrass, Purple Wiregrass and Robust Wallaby Grass. Less commonly species such as *Poa sieberiana* var. *cyanophylla* and *Austrostipa densiflora* also occur.

This community has no conservation significance as Sifton Bush is considered to be a highly invasive plant and tends to occupy areas where threatened flora habitat potential is low.

Native Pasture – Exotic Pasture – Planted Vegetation

Figure 4-9 Native pasture at the site

Native Pasture was the term applied to all areas of native dominated grasslands derived from common vegetation types that were not considered to be part of an EEC (Figure 4-9). The majority of areas within the development envelope were in poor – moderate condition with a reasonably low diversity of native grasses and forbs although some areas (particularly rocky outcrops) exhibited a higher diversity. Areas with scattered paddock trees were also included in this community when not derived from an EEC. These areas were typically dominated by Speargrass and Wallaby Grasses with other native grasses commonly found in the other vegetation types forming a sub component. Native forb diversity is generally low and restricted to grazing tolerant species such as Native Geranium, Bluebells and *Cymbonotus* sp. similarly found in the Blakely's Red Gum - Yellow Box grassy tall woodland derived grassland at the site.

Exotic pastures and planted vegetation consisted of mostly non-native pasture grasses and trees such as Pines (*Pinus* sp.) planted as wind breaks. These communities were common and widespread across the site.

4.3 CONSERVATION STATUS OF COMMUNITIES THAT OCCUR

The conservation status of each of the natural vegetation types present as remnants in the development envelope is summarised in Table 4-1, based on data presented in Benson *et al.* (2010).

Table 4-1 Conservation status of natural vegetation types in the development envelope

Vegetation type	Pre-1750 Extant (ha)	Extant area (ha)	Total area reserved or protected (ha)	Conservation status
Inland Scribbly – Red Stringybark open forest (ID349)	80,000	40,000 (50% of 1750 extent)	3,089 (3.9% of 1750 extent)	Not listed as threatened
Mugga Ironbark – Inland Scribbly Gum – Red Box shrub/grass open forest (ID 289)	20,000	8,000 (40% of 1750 extent)	1,130 (5.65% of 1750 extent)	Not listed as threatened
Blakely's Red Gum - Yellow Box grassy tall woodland (ID277)	500,000	30,000 (6% of 1750 extent)	1,101 (0.3% of 1750 extent)	TSC Act – endangered EPBC Act – critically endangered
Argyle Apple – Acacia mearnsii valley open forest (ID344)	4,500	1,300 (29% of 1750 extent)	176 (3.9% of 1750 extent)	Not listed as threatened
Brittle Gum - peppermint open forest (ID296)	30,000	18,000 (60% of 1750 extent)	7,212 (24% of 1750 extent)	Not listed as threatened
Tussock grass- sedgeland fern – rushland – reedland wetland community (ID335)	6,000	1,000 (17% of 1750 extent)	Not known to be protected	Not listed as threatened

Table 4-1 shows the high level of depletion and poor protection status of the majority of the natural vegetation types which would have originally occupied much of the development envelope. Applying the general JANIS reservation target of 15% of the original extent for each forest type (JANIS 1997), almost all of the vegetation types within the proposal area are under-represented in the conservation reserve system. Under JANIS criteria, 60% of the remaining stands of vulnerable types and 100% of endangered types should be reserved or otherwise protected.

The impact of this depletion is compounded by the severe fragmentation and continuing degradation of remaining stands. Blakely's Red Gum - Yellow Box grassy tall woodland is a listed EEC and remnants are threatened by a range of processes including further clearing, firewood cutting, livestock grazing, weed invasion, inappropriate fire regimes, soil disturbance, increased nutrient loads, soil acidification and salinisation and loss of connectivity (NSW SC 2002).

4.4 DATABASE SEARCHES

Threatened species database searches returned one tree, eight shrubs, one fern, 15 forbs (including four orchids), one sedge and one grass listed as threatened and Five EECs that occur or have the potential to occur in the Upper Slopes and Murrumbateman sub-regions of the Lachlan CMA and the Upper Slopes and Murrumbateman sub-regions of the Murrumbidgee CMA. The 10 km EPBC Act search identified an

additional forb listed as nationally threatened. A threatened species evaluation has been undertaken to evaluate the presence of habitat in the project area and the likelihood of occurrence and impact from the proposal for each species and community returned from database searches. This evaluation is presented in Appendix B.1.

Threatened species or EECs that are considered possible to occur and have at least marginal or (potential or known) habitat present in the project area are given in Table 4-2 below.

Table 4-2 Threatened flora species or Endangered Ecological Communities that could possibly occur in the project area

Species	Status	Habitat	Further Assessment of Significance (Y / N)
Threatened flora			
Hoary Sunray *Leucochrysum albicans var. tricolor*	E EPBC	Grasslands and grassy woodlands, often colonising disturbed sites such as road verges.	No
Yass Daisy *Ammobium craspedioides*	V TSC V EPBC	Moist or dry forest communities, Box Gum Woodland and secondary grassland derived from clearing of these communities. Can persist in lightly grazed situations.	Yes
Tarengo Leek Orchid *Prasophyllum petilum*	E TSC E EPBC	Box Gum Woodland and Natural Temperate Grassland.	No
Endangered Ecological Communities			
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grasslands	EEC TSC CEEC EPBC	Open woodland community occurring on the slopes and in valleys at the proposal site	Yes

4.5 THREATENED FLORA

No threatened flora species were detected during the surveys.

Targeted searches for the three species identified in Table 4-2 were conducted in higher quality areas of Box Gum Woodland and derived grassland within the proposed transmission corridors between RYP_109 and RYP_120 and within the originally proposed eastern substation site (removed during layout modifications to avoid sensitive areas). The targeted surveys failed to locate any threatened flora despite the suitable timing of the surveys.

4.6 ENDANGERED ECOLOGICAL COMMUNITIES

Of the vegetation that occurs in the development envelope, one community that would meet the definition of a listed EEC occurs:

- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Box Gum Woodland; EPBC and TSC).

Since Box Gum Woodland habitat coincides with prime farmland, this community has 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. Areas of the EEC and where they occur within the development envelope, are outlined in Table 4-3 below and correspond with the vegetation mapping in flora results in Appendix E.2.

NSW Endangered Ecological Community (EEC)

The White Box, Yellow Box, Blakely's Red Gum Woodland EEC listed under the TSC Act includes:

- Woodland areas 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.

All areas mapped as either Box Gum Woodland or Box-Gum Derived Grassland would be considered part of this community.

Commonwealth Critically Endangered Ecological Community

The Commonwealth 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.
- The understorey is predominantly native.
- The patch is greater than 0.1 ha.

OR 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:

- 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.

Areas that are mapped as being Box Gum Woodland or Box-Gum Derived Grassland in 'good' condition would correspond to this community.

Table 4-3 Box Gum Woodland EEC in the development envelope, and location (where known)

EEC	Average condition	Location	Status
Box Gum Woodland	Moderate	Access to RYP_12	EEC – TSC Act
Box Gum Woodland and derived grassland	Poor	Within the construction compound east of RYP_132. Patches within the transmission easements south of RYP_144.	EEC – TSC Act
Box Gum Woodland	Good: (along Blakney Creek Road) Poor: (from Blakney Creek Rd across pasture)	Turbines are no longer proposed in this area	CEEC - EPBC Act EEC - TSC
Derived Grassland	Moderate	Access track from the Rye Park Dalton Road west of RYP_89	EEC - TSC Act

EEC	Average condition	Location	Status
Derived Grassland	Poor	Access track and underground power south-east of RYP_101	EEC - TSC Act
Box Gum Woodland	Good	North of RYP_120 and along overhead transmission line routes to the north-west towards RYP_109.	CEEC - EPBC Act
Box Gum Woodland and derived grassland	Good	Originally proposed eastern substation site (removed during layout modifications to avoid sensitive areas).	CEEC - EPBC Act
Box Gum Woodland and derived grassland	Poor	Access to and within southern substation and construction compound site.	EEC - TSC Act

4.7 BIOMETRIC STATUS

The Biobanking assessment pathway was not used for this assessment. However, the following text relates the vegetation condition classes used in this assessment to those defined under the NSW OEH Biometric guidelines (DECC 2008a).

Under the Biometric guidelines, native woody vegetation is in low condition if:

- The over-storey per cent foliage 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% ploughed or fallow.

Native grassland or herbfield is in low condition if:

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

If native vegetation is not in low condition then it is considered to be in moderate to good condition. Hence, treeless native pasture derived from woodland and dominated by native grasses is also considered 'moderate to good' condition under this system. All areas of EEC identified within the development envelope would be considered moderate to good condition under this system.

5 RESULTS: FAUNA

5.1 HABITAT TYPES AND CONDITION

Habitat in the project area can be broken into four main types (excluding exotic pasture). The four habitat types are:

- Woodland.
- Forest.
- Mixed native/exotic pasture with scattered trees.
- Native pasture.

The distribution of these habitat types in the development envelope is shown on the map in fauna results in Appendix E.3, and described below.

Habitat condition within the project area was variable due to different soil types, disturbance histories and land management. Habitat condition depends on the availability of micro-habitat resources, such as hollow-bearing trees, and habitat extent and connectivity to other areas. Generally the habitat quality was higher in the southern portion of the proposal area, and more degraded in the northern portion. Areas where habitat types intersect, providing ecotones, tended to provide the highest habitat quality.

5.1.1 Pasture with scattered trees

This takes the form of cleared land with remnant trees scattered throughout paddocks. The trees are distributed fairly uniformly or in small clumps. This habitat type has been found to be important for a range of fauna as both habitat and for connectivity within a wider habitat matrix. Remnant paddock trees are often older than surrounding regenerated woodland and forest and thus provide an important source of hollow-bearing trees, on which many of Australia's fauna are dependent. Amongst the fauna to utilise this habitat type onsite are threatened birds (such as Superb Parrot) and disturbance-tolerant common farmland bird species such as common parrots, Australian Magpie, and Australian Raven.

5.1.2 Woodland

Areas of woodland tended to be grazed regrowth, and thus habitat condition was negatively affected by lack of mature trees, loss of fallen timber and litter and simplification of the understorey. Good quality woodland remnants mostly occur along drainage lines and roadsides. The site contains dry sclerophyll woodland with a mixture of rough and smooth barked trees, some hollow-bearing trees and mistletoe. Mistletoes are parasitic plants that grow on other trees and provide important resources for a range of birds including nomadic honeyeaters (e.g. Painted Honeyeater, Regent Honeyeater) (Cooper and McAllen 1999). The structure of woodland is generally simple with the open canopy dominated by eucalypts, a grassy groundcover with fallen timber and litter. While a relatively high diversity of bird life was observed in some woodland areas, a high level of clearing or fragmentation and a general lack of large hollows suggests that habitat quality for conservation significant mammals, such as Squirrel Gliders, was low.

5.1.3 Forest

The majority of forest in the project area is dense regrowth forest with young trees and a simple habitat structure with few micro-habitat resources. Deeper gullies and slopes tended to have more mature forest

and therefore provided higher quality habitat, however these areas are mostly outside of the development envelope. Areas of dry forest have similar habitat features to those present in the woodland (such as fallen timber), as well as additional understorey strata, such as a small tree layer and shrubby mid storey. Dry forest usually forms a more closed canopy than woodland and features a more developed understorey, which provides refuge. The line between pasture with scattered trees and woodland, and woodland and forest, is based on qualitative assessment of the degree of canopy cover and understorey structure. In many cases, the habitat in the project area intergrades between habitat types without clear distinction. Depending on hollow availability and connectivity/size of patch, woodland and forest patches provide habitat for a range of fauna including possums, microbats and birds (such as Brown Treecreeper, Southern Boobook and White-throated Gerygone).

5.1.4 Native pasture

Native Pasture habitat varies in quality across the project area from areas more dense with native species, to areas highly degraded with invasive exotic species in which some native grass persist. Ground structure also varies considerably due to grazing pressure and different land management practices between landholders. The structure increases in quality in areas where grazing pressure is low and tussock forming grass species are larger and patches of clumping grasses is more evident. Better quality Native Pasture is evident in the southern section of the project area. Areas of native pasture have potential to provide habitat for a range of reptiles (such as Striped Legless Lizards) and resources for many birds (such as Diamond Firetails).

5.1.5 Habitat features

Additional habitat units occur within some of the above units:

- Hollow-bearing trees.
- Rocky outcrops.
- Aquatic areas.

Hollow-bearing trees

Quadrat plot results

Hollow-bearing trees occur as scattered mature trees over pasture and through woodland and forest. Raw survey data for hollow-bearing tree plots is provided in Appendix A.3. In 35 plots, 114 hollow-bearing trees were recorded; most with a diameter at breast height at or greater than 60 cm. The majority of hollows were of small to medium hollow entrance size, most likely to be utilised by small to medium birds and microbats, rather than owls and gliders. The density of hollow-bearing trees within wooded areas is shown in Table 5-1.

Search area results (i.e. searches within 100 m of infrastructure within good condition woodland / forest)

Within the hollow-bearing tree survey undertaken in good condition woodland / forest areas in July and November 2103, a total of 121 hollows were recorded. Appendix A.3 details the raw data for all trees recorded. Both Box Gum Woodland and Inland Scribbly Gum Forest was surveyed in this assessment and hollow density between vegetation types is substantially different. The results of hollow-bearing tree surveys are further discussed in the impact assessment chapter (refer Section 7.4).

Rocky outcrops

Rocky outcrops are particularly important for reptiles as they provide shelter and cover, as well as a habitat for insects, a food source for many species. In the project area, rocky outcrops generally occur on hill crests in cleared and forested areas. These are sparsely distributed and occur mostly in the northern portion of the project area between turbines RYP_97 - 101, RYP_81 - 83, RYP_31, RYP_33, RYP_36 RYP_12 and RYP_3. Rocky outcrops in the project area tend to be mostly large embedded rocks that were unable to be turned for survey. Some rocky outcrops also featured small (10-15 cm), flattish, loose rocks such as slate. Several rocky outcrops were in mostly open areas on hill crests or well-drained upper slopes featuring partially embedded and loose small to medium rocks; such rocky outcrops have potential to provide habitat for the Pink-tailed Worm-lizard.

Aquatic areas (dams, watercourses)

Aquatic areas are habitat for fish, frogs and waterbirds. Any water source is generally an important habitat component for all fauna, including microbats. Dams provide habitat for species with capacity to disperse between the water bodies. Dams and watercourses generally occur outside of the turbine development envelope at lower elevations. Dams in the project area vary in condition from poor to moderate in habitat quality for amphibians and water birds. Dams in poor condition are in areas currently being grazed, where sheep and cattle accessing the dam trample vegetative growth and stir up sediments. Dams that offer better quality habitat have grass and trees along the edges and may also feature aquatic vegetation such as sedges or bulrush; such dams were observed to be used by species such as Australasian Grebe *Tachybaptus novaehollandiae* and Common Froglet *Crinia signifera*. However, being a small water body the quality of habitat offered by a farm dam is transient, changing with the grazing regime and seasonal rainfall. The transmission lines and tracks would cross numerous small ephemeral drainage lines which provide transient habitat for aquatic species. Permanent streams suitable for fish were not observed within the development envelope.

Threatened fish listed under the FM Act are not anticipated in the minor creeklines of the project area. The development is not expected to have an adverse impact on riparian habitats; however recommendations to design creek crossings in accordance with NSW Fisheries Policy and Guidelines for Fish Friendly Waterway Crossings (2003) are provided in Section 8.

Table 5-1 Results of hollow-bearing tree (HBT) plots in the development envelope, stratified by forest, woodland and paddock

	No. of hollows	Plot size_1	No. plots_1	No. hollows_1	Plot size_2	No.plots_2	No. hollows_2	Av. No. HBT per plot	Av. HBT per hectare
Forest	54	25x25	16	(54)	n/a	n/a	n/a	3.4	13.5
Woodland	53	25x25	16	(53)	n/a	n/a	n/a	3.3	13.3
Paddock	7	100x100	4	(7)	25x25	3	0	1	1

5.1.6 Landscape connectivity

The term 'landscape connectivity' describes the broad spatial configuration of areas of vegetated lands and includes a consideration of barriers to connectivity such as roads, clearing and rows of turbines (Lindenmayer & Fischer 2006; Brett Lane & Associates 2005). Connectivity is maintained through intact forest and woodland, 'corridors' of vegetation and 'stepping stones' (i.e. scattered trees; or patches of shrubs or trees that act as stepping stones across an otherwise cleared landscape). For example, Superb Parrot was seen along roadsides and riparians areas in the project area, using these areas as corridors to travel through their home ranges.

A desktop landscape connectivity analysis indicates the proposal area may be very important for north-south connectivity toward Brindabella and Namadgi National Parks. Vegetation in the project area also facilitates an east-west linkage toward extensive areas of forest approximately 100 km to the east (Abercrombie River and Tarlo River National Parks). Between the project area and the additional forested areas to the east, vegetation is patchy and scattered. There are extensive areas of clearing immediately west of the project area. A specific assessment of landscape connectivity and barrier effects of wind farms is given in Section 7).

5.2 FAUNA SPECIES RECORDED DURING FIELD SURVEYS

A total of 143 fauna species were recorded during the field surveys and these are listed in Appendix A.2. In summary the total numbers for each fauna group included:

- Ninety-nine bird species.
- Fifteen mammal species (excluding microbats) of which five are introduced species.
- Twelve microbat species.
- Fifteen reptile species.
- Two amphibian species.

5.2.1 Birds

Ninety-nine bird species were recorded within the project area all during surveys, including utilisation surveys, Superb Parrot transect surveys, Swift Parrot surveys and general opportunistic observations. Species recorded are listed in Appendix A.2. The project area supports foraging, nesting and roosting habitat for a variety of bird species. Nesting for hollow-dependent species is most abundant in areas of Inland Scribbly Gum Forest and to a lesser degree in scattered paddock trees in remnant Box Gum Woodland habitat. Theses habitat types as well as grassland areas provide foraging habitat for some bird species. Aquatic areas for birds are limited across the project area and restricted to farm dams and some minor creeks and drainage lines. Wetland bird species were not commonly observed as the habitat value of farm dams is limited for these species.

Species common to the site included farmland species of Australian Magpie (*Gymnorhina tibicen*), Australian Raven (*Corvus coronoides*), Crimson Rosella (*Platycercus elegans*), Eastern Rosella (*Platycercus eximius*), Laughing Kookaburra (*Dacelo novaeguineae*), Red Wattlebird (*Anthochaera carunculata*), Sulphur-crested Cockatoo (*Cacatua galerita*), Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*), and Grey Fantail (*Rhipidura fuliginosa*). One nocturnal species, the Southern Boobook (*Ninox novaeseelandiae*), was recorded during the field surveys.

Five species of raptors were seen in the project area, all considered common in the region:

- Brown Falcon (*Falco berigora*).
- Nankeen Kestrel (*Falco cenchroides*).
- Black-shouldered Kite (*Elanus axillaris).*
- Brown Goshawk (*Accipiter fasciatus*).
- Wedge-tailed Eagle (*Aquila audax*).

Raptors were seen in a variety of landscape positions, mostly in pasture with scattered trees or along the edges of forest or woodland. An inactive Wedge-tailed Eagle nest was found along the upperslope of between RYP_90 and RYP_92 (Appendix E.3). A pair of Wedge-tailed Eagles would usually have two or more nests in their breeding territory, and they may alternate their use of nests (pers. comm. Jerry Olsen to Bianca Heinze 20 April 2010). Thus, it is likely another nest occurs within a few kilometres of this one. A Nankeen Kestrel nest was observed along Flakney Creek Road in November 2013 near a proposed transmission line and access tracks.

Nine threatened bird species were recorded within the project area. These species are listed below and further discussed in Section 7. The locations of each threatened species is shown in Appendix E.3 and documented in Table 5-4.

- Diamond Firetail (*Stagonopleura guttata*).
- Speckled Warbler (*Pyrrholaemus sagittatus*).
- Flame Robin (*Petroica phoenicea*).
- Scarlet Robin (*Petroica multicolour*).
- Hooded Robin (*Melanodryas cucullata cucullata*).
- Painted Honeyeater (*Grantiella picta*).
- Varied Sittella (*Daphoenositta chrysoptera*).
- White-fronted Chat (*Epthianura albifrons*).
- Superb Parrot (*Polytelis swainsonii*).

Bird utilisation results

A total of 36 utilisation surveys were undertaken within the project area. A total of 70 species of birds were observed utilising the proposed wind farm site during the surveys. Table 5-2 represents the number of species observed at each site and in which height zone they were observed during the utilisation surveys across the three years they were undertaken. Approximately 90% of the flight height of all birds observed is predominantly below 10 m or within 0-20 m. Less than 10% of flights were within 41-140 m zone or above, indicating that most flights were below the rotor-swept-area and therefore below the area of potential impact.

Table 5-3 shows the numbers of individual birds of each species observed flying at rotor-swept-area. A total of five species were observed across all sites flying within the rotor-swept-area, or about 2% of the total number of birds observed during all surveys. These species included the: Nankeen Kestrel, Sulphur-crested Cockatoo, Wedge-tailed Eagle, Welcome Swallow and White-browed Woodswallow. The Sulphur-crested Cockatoo and the White-browed Woodswallow where the most abundant species flying within the rotor-swept-area during the surveys. These species accounted for almost 70% of observations for all the five birds flying within the rotor-swept-area (42% for Sulphur-crested Cockatoo and 25% for White-browed Woodswallow).

Of these species, the Wedge-tailed Eagle and Nankeen Kestrel were observed above or within the rotor-swept-area every time they were recorded (i.e. 100% of the time).

The raw height data for each species observed within each utilisation survey site is presented in Appendix A.4.

Table 5-2 Bird utilisation survey results and the number of species recorded in each height category. 41-140m and > 140m represent the rotor-swept-area (i.e. area of potential collision)

Site	Easting	Northing	No. Species	<10m	0-20m	21-40m	41-140m	>140m
Nov-11								
1	686029	6156391	6	0	6	0	0	0
2	686319	6155682	9	0	8	1	0	0
3	687129	6152576	18	0	17	0	1	0
4	686435	6154142	5	0	3	2	0	0
5	684432	6151587	8	0	6	2	0	0
6	681598	6163997	12	0	12	0	0	0
7	685052	6154832	10	0	9	1	0	0
8	686400	6158045	19	0	18	1	0	0
9	686538	6157244	7	0	7	0	0	0
10	686341	6159223	12	0	12	0	0	0
11	681975	6170733	6	0	5	1	0	0
12	682094	6170102	9	0	9	0	0	0
13	682113	6171579	9	0	9	0	0	0
14	680599	6181026	4	0	4	0	0	0
15	677245	6184125	4	0	3	1	0	0
16	678102	6182954	8	0	6	1	0	1
17	677294	6183731	10	0	10	0	0	0
18	677245	6184125	5	0	5	0	0	0
Total			161	0	149	10	1	1
Percentage				**0.00**	**92.55**	**6.21**	**0.62**	**0.62**
Jul-13								
19	685100	6156806	24	10	12	2	0	0
20	684337	6155325	8	3	4	0	1	0
21	684507	6154254	7	1	3	3	0	0
22	685085	6153044	14	7	5	1	1	0
23	684290	6154206	10	8	2	0	0	0
24	686102	6156162	5	3	2	0	0	0
25	682064	6170388	9	3	5	1	0	0
26	681390	6167591	8	1	6	1	0	0
27	681314	6165295	6	0	6	0	0	0
28	681305	6182534	11	5	6	0	0	0
Total			102	41	51	8	2	0
Percentage				**40.20**	**50.00**	**7.84**	**1.96**	**0.00**
Nov-13								
29	684527	6154269	19	17	2	0	0	0
30	682782	6151506	7	5	1	0	1	0
31	686076	6156231	2	2	0	0	0	0
32	679390	6182800	10	4	6	0	0	0
33	686342	6155645	4	0	4	0	0	0
34	679041	6182828	5	3	2	0	0	0
35	681234	6182433	12	6	6	0	0	0
36	622693	6151902	9	3	5	1	0	0
Total			68	40	26	1	1	0
Percentage				**58.82**	**38.24**	**1.47**	**1.47**	**0.00**

Table 5-3 Bird species recorded in rotor-swept-area (41-140m and > 140m) during bird utilisation surveys

Species	% of all observations within RSA from all surveys	Abundance (%) of each individual species at RSA height	% observations of birds at RSA of all bird observations in all height categories
Nankeen Kestrel	100	8	0.13
Sulphur-crested Cockatoo	10	42	0.66
Wedge-tailed Eagle	100	8	0.13
Welcome Swallow	40	17	0.26
White-browed Woodswallow	10	25	0.40
	2%	**100%**	**2 %**

5.2.2 Mammals

Fifteen mammal species were recorded within the project area during surveys, including five introduced species). Species recorded are listed in Appendix A.2. The species recorded are common to the area and included five native ground-dwelling species of Black Wallaby (*Wallabia bicolor*), Common Wombat (*Vombatus ursinus*), Eastern Grey Kangaroo (*Macropus giganteus*), Eastern Wallaroo (*Macropus robustus robustus*), Red-necked Wallaby (*Macropus rufogriseus*), and Short-beaked Echidna (*Tachyglossus aculeatus*).

Arboreal mammals recorded included Sugar Glider (*Petaurus breviceps*), Common Ringtail possum (*Pseudocheirus peregrines*), and Common Brushtail Possum (*Trichosur vulpecular*). Of these three arboreal species, the Brushtail Possum was the most common species observed but appeared to be present in particular patches of forest and woodland, rather than being common throughout this habitat. Abundance of the Brushtail Possum increased in forest areas of greater structural diversity (i.e. more hollows and understorey species). The Sugar Glider and Common Ringtail Possum were either observed in very low numbers or not at all in some forest areas during spotlighting surveys.

One Water Rat (*Hydromys chrysogaster*) was observed during funnel trap surveys within a nearby drainage area supporting dense sedges.

5.2.3 Microbats

Eleven microbat species confirmed to be present and one unconfirmed species identified to genus level were recorded within the project area (Appendix A.2).

The most common species recorded by Anabats were attributed to the Large Forest Bat (*Vespadelus darlingtoni*), the Southern Freetail Bat (*Mormopterus sp.4)* and Eastern Freetail Bat (*Mormopterus ridei*), with a total of 2734 calls, 751 call, and 86 calls respectively.

The most records were recorded from areas nearby Inland Scribbly Gum Forest; however habitat for microbats is present across the entire project area and given the mobility of these species it is possible they could occur within all habitat types; however, no caves were recorded within the study area which are required by the Eastern Bentwing bat for roosting or breeding.

Three threatened microbat species were recorded within the project area. These species are listed below and further discussed in Section 7.

- Eastern Bentwing Bat (*Miniopterus oriane (schreibersii) oceansis*).
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*).
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*).

5.2.4 Reptiles

Fifteen reptile species were recorded within the project area during surveys (including one unidentified gecko species). Species recorded are listed in Appendix A.2. The most common species recorded by observation were the Eastern Beared Dragon (*Pogona barbata*) and Shingleback (*Tiliqua rugosa*). Species commonly detected during funnel traps surveys and tile searches included: Delicate Skink (*Lampropholis delicata*), Southern Rainbow Skink (*Carlia tetradactyla*), and Common Delma (*Delma inornata*), with a total of 354, 277 and 261 observations respectively. Abundance of reptile species across the tile sites were generally similar, with tile plot 2 and 9 recording the most captures at 51 and 55 records respectively.

One threatened reptile species was recorded within the project area at tile plot 10 (near RYP_27), the Striped Legless Lizard (*Delma impar*). This species is further discussed in Section 7. The location of the Striped Legless Lizard is shown in Appendix E.3 and documented in Table 5-4.

Habitat for reptiles includes woodland and grassland areas supporting scattered rocky outcrops; however, rocky outcrops are minimal across the project area or are rocks are small and loosely scattered. Woody debris is common to the inland Scribbly Gum Forest, however very low reptile diversity was observed in this habitat type when searching through dense leaf litter during the 33 Koala scat searches.

5.2.5 Amphibians

Two amphibian species were recorded within the project area during surveys and included the Common Froglet (*Crinia signifera*) and Peron's Tree Frog (*Litoria peronii*). No threatened amphibians were recorded within the project area. Habitat for amphibians is limited across the project area and restricted to farm dams and some minor creeks and drainage lines.

5.3 CONSERVATION SIGNIFICANT FAUNA SPECIES

5.3.1 Database search results

The Commonwealth and State online database searches and NSW Wildlife Atlas threatened species records returned two amphibian, five microbat, 33 bird, one invertebrate, five marsupial and three reptile species listed as threatened in the Upper Slopes sub-region of the Lachlan CMA.

A threatened species evaluation has been undertaken to evaluate the presence of habitat in the project area and the likelihood of occurrence for each species returned from database searches. This species evaluation was used to determine which species could be impacted by the proposed wind farm development and for which further impact assessment was required. The species evaluation is presented in Appendix B.2 and those species requiring further assessment is provided in Section 7.

The evaluation concluded that 17 threatened species have potential to be present on parts of the project area, based on habitat and site quality and known distribution. Sixteen threatened species were recorded during the field surveys including: one invertebrate species, one reptile species, nine birds, and three microbats (Table 5-4). Locations of observations are shown in Appendix E.3.

Table 5-4 Threatened or migratory listed species that are known or could occur in the project area

Species	Status	Habitat	Likelihood of occurrence	Location in project area	Further Assessment of Significance (Y / N)
Invertebrates					
Golden Sun Moth *Synemon plana*	E TSC CE EPBC	Grassy Box Gum Woodlands and natural temperate grasslands.	Present	South of RYP_144 near proposed transmission line; north of RYP_73; west of RYP_99; south of RYP_101 near proposed transmission line; west of RYP_120 and RYP_127; and east of RYP_131.	Yes
Amphibians					
Sloane's Froglet *Crinia sloanei*	V TSC	Periodically inundated areas in grassland, woodland and disturbed habitats.	Possible	N/A	No
Reptiles					
Pink-tailed Legless or Worm Lizard *Aprasia parapulchella*	V TSC V EPBC	Open woodland with predominantly native grasses and natural temperate grasslands on well-drained slopes with scattered, partially-buried rocks.	Possible	N/A	No
Rosenberg's Goanna *Varanus rosenbergi*	V TSC	Heath, open forest and woodland.	Possible	N/A	No
Striped Legless Lizard *Delma impar*	V TSC V EPBC	Temperate lowland grasslands, secondary grasslands and occasionally open Box Gum Woodland.	Present	RYP_27	Yes
Birds					
Barking Owl *Ninox connivens*	V TSC	Dry box-dominated forest and woodlands and roosts in dense foliage of *Acacia, Casuarina* or *Eucalyptus* species.	Possible	N/A	No

Species	Status	Habitat	Likelihood of occurrence	Location in project area	Further Assessment of Significance (Y / N)
Black-chinned Honeyeater *Melithreptus gularis gularis*	V TSC	Drier open forests or woodlands most often dominated by box and ironbark eucalypts.	Possible	N/A	No
Brown Treecreeper (eastern subspecies) *Climacteris picumnus victoria*	V TSC	Occurs in eucalypt woodlands, mallee and drier open forest, preferring woodlands lacking dense understorey	Present	RYP_102-104 in November 2011, April 2012, and November 2013.	No
Diamond Firetail *Stagonopleura guttata*	V TSC	Woodland remnants of grassy eucalypt woodlands, including Box-Gum, grassland and riparian areas, and sometimes lightly wooded farmland.	Present	In paddock tree east of the transmission line between RYP_101 and RYP_102 in November 2011 (outside project area); north of RYP_102 in November 2013 (outside project area).	No
Flame Robin *Petroica phoenicea*	V TSC	Native vegetation with an open understory. It breeds in upland forests and woodlands and migrates to more open lowland habitats in winter.	Present	Near RYP_95 in November 2011 and April 2012; near RYP_103 during November 2013; near Flakney Ck Rd in November 2013.	No
Gang-gang Cockatoo *Callocephalon fimbriatum*	V TSC	Varies from open forests and woodlands to heavily timbered and mature wet forest.	Possible	N/A	No
Grey-crowned Babbler (eastern subspecies) *Pomatostomus temporalis temporalis*	V TSC	Box Gum Woodlands, open forests, scrub lands, even farmlands and suburbs.	Possible	N/A	No
Hooded Robin (South eastern form) *Melanodryas cucullata cucullata*	V TSC	Woodland remnants with high habitat complexity and uses stumps, posts or fallen timber.	Present	RYP_103 and around RYP_106 and RYP_107 in April 2012; near RYP_120 in November 2013; east of RYP_53 in November 2013.	No
Little Eagle *Hieraaetus morphnoides*	V TSC	Open eucalypt forest, woodland or open woodland.	Possible	N/A	No

Species	Status	Habitat	Likelihood of occurrence	Location in project area	Further Assessment of Significance (Y / N)
Little Lorikeet *Glossopsitta pusilla*	V TSC	Open eucalypt forest and woodland.	Possible	N/A	No
Painted Honeyeater *Grantiella picta*	V TSC	Dry open forests and woodland with mistletoe.	Present	All records in November 2013: west of RYP_4; Flakney Ck Rd; and west of RYP_106 to RYP_120.	Yes
Powerful Owl *Ninox strenua*	V TSC	Dry sclerophyll forest including Argyle Apple and roosts in dense mid-canopy trees or tall shrubs, often associated with drainage lines.	Possible	N/A	No
Regent Honeyeater *Xanthomyza phrygia*	V TSC	Box-ironbark eucalypt associations including Yellow Box and Blakely's Red Gum.	Possible	N/A	Yes
Scarlet Robin *Petroica boodang*	V TSC	Dry eucalypt forests and temperate woodland. Fallen timber is an important habitat feature	Present	In forest south of RYP_105 (now removed from layout) in November 2011; south of RYP_56 in April 2012; and near Flakney Ck Rd in November 2013.	No
Speckled Warbler *Pyrrholaemus saggitatus*	V TSC	Eucalypt woodland with a grassy understorey.	Present	Near RYP_106 and RYP_107 in April 2012 and November 2013; east of RYP_42 in November 2013.	No
Spotted Harrier *Circus assimilis*	V TSC	Grassy open woodland and riparian woodland.	Possible	N/A	No
Square-tailed Kite *Lophoictinia isura*	V TSC	Open forest, woodlands and mallee.	Possible	N/A	No
Superb Parrot *Polytelis swainsonii*	V TSC V EPBC	Box Gum Woodland and can nest in isolated paddock trees.	Present	On transmission line between RYP_101 and RYP_102 in November 2011; Flakney Ck Rd in November 2013, and south of project area between RYP_110 and RYP_120 in November 2013; several records along access roads outside of project area and to west of project area in November 2011 and November 2013. Nests near RYP_120 and east of RYP_143.	Yes

Species	Status	Habitat	Likelihood of occurrence	Location in project area	Further Assessment of Significance (Y / N)
Swift Parrot *Lathamus discolour*	E TSC E EPBC	Eucalypt forests and woodlands.	Possible	N/A	No
Turquoise Parrot *Neophema pulchella*	V TSC	Grassy woodland and open forest including Box Gum Woodland.	Possible	N/A	No
Varied Sittella *Daphoenositta chrysoptera*	V TSC	Eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches.	Present	RYP_106 and RYP_107 in April 2012 and November 2013.	No
White-fronted Chat *Epthianura albifrons*	V TSC	Open grassland habitats inland form the coast or damp open habitats.	Present	Outside of impact area in April 201; north of RYP_27 and west of RYP_120 in November 2013.	No
Mammals (excluding microbats)					
Koala *Phascolarctos cinereus*	V TSC	Eucalypt woodland and forest communities.	Possible	N/A	No
Squirrel Glider *Petaurus norfolcensis*	V TSC	Mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest.	Possible	N/A	No
Microbats					
Eastern Bent-wing Bat *Miniopterus orianae oceanensis*	V TSC	Forage over canopy in range of forest types. Breeds in caves and mine tunnels.	Present	RYP_104 and in the forest south of this site, near RYP_143, RYP_82, RYP_80, RYP_25 and RYP_9 in November 2011. One location in April 2012 (RYP_105 – now removed from layout). At RYP_84 and RYP_90 during November 2012.	Yes
Eastern False Pipistrelle *Falsistrellus tasmaniensis*	V TSC	Forages below or near the canopy and along tracks, uncommon on ridge tops where soil fertility is low. Roosts in tree hollows and buildings.	Present	RYP_80 in November 2011	No
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*	V TSC	Wide-ranging species across northern and eastern Australia. It roosts in tree hollows.	Present	Near RYP_7 in November 2011	Yes

5.3.2 Invertebrates

Golden Sun Moth

The Golden Sun Moth was observed at seven of the ten sites surveyed, with approximately 200 moths observed in total. The habitat targeted for survey included Box Gum Woodland, Derived Grassland and areas of Native Pasture. Moths were found in a variety of habitats, but all sites where they were recorded supported Wallaby Grass. Table 5-5 details the number of moths observed at each location, their general abundance and the extent of surrounding habitat near the locations they were found.

This species is further discussed within the impact assessment chapter of this report, refer Section 7.

Table 5-5 Results of Golden Sun Moth survey for each search area.

Search area ID	Impact Type	Number moths observed	Abundance	Number surveys undertaken in search area	Habitat Quality	Conclusion
GSM 1	Upgrades to existing sealed & unsealed road	Nil	None	2	Unsuitable	Unlikely to support moths. Potential habitat limited.
GSM 2	Site Compound	Nil	None	1	Unsuitable	Not suitable habitat. Repeat surveys not required.
GSM 3	Underground cabling / OH TL / access route	~ 25	Moderate	3	Variable - Moderate	Moth's presence corresponds with tops of rises and areas where wallaby grass is dominant. Similar habitat in surrounding areas.
GSM 4	Access track	~ 9	Low	2	Moderate	Localised population. Landowner sprays superphosphate aerially, but does not plough. Suitable habitat in search area. Adjoining suitable habitat to east of search area.
GSM 5	Access track	Nil	None	1	Unsuitable	Not suitable. Repeat surveys not required.
GSM 6	Underground cabling / OH TL / access route	~ 89	Widespread	2	Suitable	Habitat best on western route than eastern route of transmission line. Habitat extends to south.
GSM 7	Access track	~ 9	Low	3	Suitable - limited	Moths probably more widespread in area. However, direct area of survey shows habitat within a band across centre part of the slope, extending beyond the boundary of the proposed disturbance to the north.
GSM 8	Underground cabling / OH TL / access route	~ 8	Low	3	Variable - Moderate	Suitable habitat south of Rye Pk - Dalton Rd, unsuitable habitat to the north of this road. Small localised population occurs in the sheltered area at the southern eastern end of the search area. Heavily grazed property. With management habitat could extend further.
GSM 9	Underground cabling / OH TL / access route	~ 19	Moderate	4	Suitable	Habitat is widespread throughout the southern part of this site beyond the disturbance area. It is probable the area supports a widespread population. Moths observed near mast and in southern end of site.

Search area ID	Impact Type	Number moths observed	Abundance	Number surveys undertaken in search area	Habitat Quality	Conclusion
GSM 10	Underground cabling / OH TL / access route. Substation to the west of railway line.	~ 42	Widespread	3	Suitable	Habitat widespread. Wallaby grass better in this area. Most moths observed along access tracks between the railway and Reference site 3.

5.3.3 Reptiles

Threatened reptile species detected within project area

Striped Legless Lizard

One individual of the Striped Legless Lizard was recorded at one tile site at RYP_27 in the northern section of the project area. The species was located on a grazed ridge top supporting a predominantly exotic grassland, with some native species.

This species is discussed within the impact assessment chapter of this report, refer Section 7.

Other threatened reptile species with potential to occur

Two other species were listed on the database searches as having the potential to occur within the project area, including the Pink-tailed Worm-lizard (*Aprasia parapulchella*) and Rosenberg's Goanna (*Varanus rosenbergi*).

Potential habitat for the Pink-tailed Worm-lizard was targeted during reptile searches in which active searching within grasslands and rock-rolling was undertaken. In particular, areas supporting rockier habitats (loose scattered or embedded rocks of loose to medium size) were targeted by rock-rolling. Temperature recorded during the November 2011 reptile searches ranged between 19 to 24 degrees. This temperature range is adequate for detecting reptile activity of this species.

In the project area, rocky outcrops are sparsely distributed occurring mostly in the northern portion of the site. Based on the limited distribution of rocky outcrops and the non-detection of the species during targeted rock-rolling the species is considered unlikely to inhabit the site.

While potential habitat is present for the Roesenberg's Goanna in forest and woodland habitat it is considered unlikely this species would be significantly impacted given the species is large home range. Termite mounds are in low abundance across the site and no records are known for this species within the locality.

5.3.4 Birds

Threatened bird species detected within project area

Brown Treecreeper

The Brown Treecreeper was detected between RYP_102 and RYP_104 using an ecotonal area between forest and cleared land. The cleared land on the most northern peak (RYP_102) consists of a ring-barked

forest, with dead standing and fallen trees. The Inland Scribbly Gum Forest provides habitat for this species. The Brown Treecreeper is dependent on hollows for breeding and dead timber for foraging (provides habitat for invertebrate prey) (Noske 1991).

Diamond Firetail

Two pairs (four individuals) of Diamond Firetail were observed preparing nests in a communal nest tree on the lower slope east of the transmission line between RYP_101 and RYP_102 in open grassy habitat. The species forages for seeds and insects on the ground in open grassy Eucalyptus dominated communities (Garnett & Crowley 2000). The habitat components considered important to this species are water and shelter near feeding areas during the day and dense shrubbery for roosting by night (Schodde and Tidemann 2007).

Speckled Warbler

Three Speckled Warblers were seen around RYP_106 and RYP_107 and east of RYP_42 within Inland Scribbly Gum Forest and on the edge of disturbed woodland that lies adjacent good condition Scribbly Gum Forest. Speckled Warblers are a sedentary species that inhabit grassy eucalypt forests and woodlands, utilising a home range of around 10 ha (OEH 2012). They are thought to require large relatively undisturbed remnants to persist; here the species was seen in an area that appears to be highly fragmented habitat. However, the shrubs and small patches of vegetation are in close proximity and well connected to a large forest/ woodland remnant.

Flame and Scarlet Robins

The Flame Robin was observed foraging in Inland Scribbly Gum Forest near RYP_95 and near RYP_103. Flame Robins occur in small to large groups and migrate seasonally between dry and wet forests in the highlands and lowlands. The Flame Robin was also observed outside the project area (to the west) on Flakney Creek Road.

One pair of Scarlet Robins was recorded within Inland Scribbly Gum Forest south of RYP_105 (now removed from layout) in November 2011 and several observations (<5) were made of the species in an area south of RYP_56 in April 2012 and November 2013. The species was also recorded along Flakney Creek Road outside the project area. Scarlet Robins are sedentary and occur either singly or in pairs in permanent territories. They breed in scrubby eucalypt forests but may forage in more open habitat (Schodde & Tidemann 2007). The Scarlet Robin utilises open areas in their habitat and some studies have found higher abundance of Scarlet Robins along forest edges than the interior (Berry 2001).

Hooded Robin

A pair of Hooded Robins were seen near RYP_103, around RYP_106 and RYP_107, near RYP_120 and east of RYP_53 in open grassy habitat adjoining other forest areas. The Hooded Robin requires structurally diverse microhabitat within woodland habitats, utilising fallen timber and stumps for foraging invertebrates. The species is sedentary and occupies territories between 10 ha (during breeding season from July to November) and 30 ha at other times (OEH 2012).

Painted Honeyeater

Painted Honeyeaters were predominantly observed west of RYP_106 to RYP_120 in the southern section of the project area within Box Gum Woodland in trees supporting flowering mistletoe in November 2013. Approximately 10-12 individuals were observed foraging in this area. A transmission line was proposed for this area but has been removed from the layout. Individuals of this species were also observed west of RYP_4 and along Flakney Creek Road. The species was not recorded within the project area during previous surveys and is not common to the area. No records for this species are known for the locality.

Varied Sittella

A group of eight Varied Sittellas were observed foraging through shrubby vegetation around RYP_106 and RYP_107 and on the edge of Inland Scribbly Gum Forest. The Varied Sittella forages under bark and in crevices along trees branches, preferring rough-bark species (OEH 2012). The species is sedentary and moves about a relatively large home range in small family groups. Despite this apparent mobility, Varied Sittella appears to be highly sensitive to habitat fragmentation (OEH 2012).

White-fronted Chat

A pair of White-fronted Chats were observed in a low lying paddock outside of the development area alongside an existing track that would provide access to RYP_83 and RYP_143. An individual was observed near RYP_27 and another west of RYP_120 in native pasture habitat. White-fronted Chats are sedentary and are usually found in small groups foraging along the ground for invertebrates in their grassland habitat. They nest in low shrubs, included isolated patches of exotic shrubs.

Superb Parrot

The Superb Parrot was regularly observed during November 2011 and November 2013 surveys, but primarily outside of the project area to the west of the site along Rye Park road, Flakney Creek Road, or other roads west of the project area. The area the species was commonly observed within the project area is located to the south between RYP_110 and RYP_120 within Box Gum Woodland or native pasture habitat.

Three nest trees were identified for this species: two north of RYP_120 within the same area birds were regularly recorded and the other nearby Flakney Creek Road along a proposed transmission line. Two potential nest trees were also identified north of RYP_120 in which individual birds were observed to be interested in a hollow, but did not appear to be nesting at the time.

The Superb Parrot was not observed during April 2012 or July 2013 indicating the parrot moves away from the inland slopes during winter.

<u>Superb Parrot Transects</u>

Superb Parrots were detected at five of the 25 transect surveys completed in November 2013. The areas the parrots were detected correspond with the areas birds were also observed during prior surveys in November 2011 (Table 5-6). Three of these transects in which parrots were observed lie outside the project area to the west (SP3, SP17, SP18). The other two sites (SP25 and SP26) are located within the project area at the southern end. All transects parrots were observed within support Box Gum Woodland or open grassy habitat supporting scattered trees. No parrots were observed within transects that were nearby or traversed Inland Scribbly Gum Forest.

Table 5-6 Transects Superb Parrots were observed during November 2013.

Transect ID	Date	Number and sex recorded m = male; f = female; j = juvenile	Habitat	Behaviour and flight height
SP3 (outside project area near Frogmore Rd)	4/11/2013	2 (m), 2 (f), 3 (juv)	Road reserve and paddock with scattered trees. Grass in groundlayer. Box Gum Woodland.	Stayed in general area, local movements below canopy (< 10m). Significant activity at HBT. Flying within canopy, perching, calling.

Transect ID	Date	Number and sex recorded m = male; f = female; j = juvenile	Habitat	Behaviour and flight height
SP17 (outside project area near Flakney Ck Rd)	5/11/2013	1 (f)	Paddock with scattered trees. Grass in groundlayer.	Flew overhead landed in Yellow Box. Flying south toward Rye Park rd (<15m).
SP18 (outside project area near Flakney Ck Rd)	5/11/2013	3 (m), 2 (f)	Paddock with scattered trees. Grass in groundlayer.	3 in tree, 2 flying south toward Rye Park rd (< 10m)
SP25 (south of project area near RYP_120)	6/11/2013	2 (m), 1 (f), 4 (?)	Predominantly scattered trees in paddock with grass, no shrubs.	5 foraging in tree; 1 flying north (~ 15m), 1 flying south ~ 20 m)
SP26 (south of project area near RYP_120)	22/11/2013	5 (f), 3 (m), 4 (?)	Gully with Box Gum Woodland and scattered trees. Grassland. Dense Shrubs. Nest tree.	Flying locally (i.e. within 100m). Flying < 15m.

Flight Path Mapping

Superb Parrots were detected at six of the ten flight path mapping stations in which individual observers were stationed in November 2013. A total of 48 flight observations were recorded; one flight observation could consist of an individual bird, or group of birds moving in the same direction. Most observations of Superb Parrots were recorded within the vicinity of Site 1, 4 and 8 with 10, 24 and 18 flight observations recorded respectively (Table 5-7, Appendix E.3).

The majority of flights were localised to discrete patches where foraging habitat was available. The average flight height of the Superb Parrot was 20m and most observations were of the parrot making short movements within the tree canopy or flying low over paddocks hopping between scattered trees. The Superb Parrots flight height was below 30m at all sites, except for Site 8 where flight heights of 40 m and 50 m were recorded.

Appendix E.3 defines the primary flight path corridors were parrots were observed to regularly fly and is based on all the raw data from each individual flight path recorded. Appendix A.4 details the raw data for each individual flight observation.

The results of transect and flight path mapping for this species is discussed further within the impact assessment chapter of this report, refer Section 7.

Table 5-7 Flight path mapping viewing stations Superb Parrots were observed during November 2013

Viewing station ID	Date	Number of observations	Average and maximum flight height (m)	Habitat at site
Site 1	7-8 Nov 2013	10	20 average 30 maximum	Frogmore Road. Scattered trees in paddock.
Site 3	7-9 Nov 2013	1	20 maximum	Top of low ridge west of High Rock Rd. Within paddock with scattered trees.
Site 4	7-9 Nov 2013	24	11 average 20 maximum	Flakney Creek Road. Scattered trees in open paddock.
Site 6	7-9 Nov 2013	1	20 maximum	High Rock Road. Scattered trees in paddock. Adjacent treed road reserve.
Site 8	7-9 Nov 2013	17	30 average 50 maximum	Box Gum Woodland and scattered trees over pasture.

Viewing station ID	Date	Number of observations	Average and maximum flight height (m)	Habitat at site
Site 10	9 Nov 2013	1	30 maximum	Rye Pk - Dalton Rd. Box Gum Woodland along road reserve with paddocks adjoining road.

Other threatened bird species with potential to occur

Swift Parrot

The project area intersects the South-west Slopes of NSW Important Bird Area (IBA), which includes the localities of Bowning, Boorowa, Rugby and the town of Yass. The Swift Parrot is known to occur within this IBA. The far north and far southern portions of the project area would be within the IBA.

Targeted surveys were undertaken in July 2013 to capture the species known winter migration period from Tasmania to the mainland. Ten surveys were undertaken within Box Gum Woodland and Inland Scribbly Gum Woodland at this time. The extent and location of survey sites were limited by the amount of available habitat within or nearby impact areas. The species was not detected during targeted surveys and the foraging resources are considered marginal as preferred feed trees of this species are few or scattered within the project area.

This species and the available habitat is discussed further within the impact assessment chapter of this report, refer Section 7.

Glossy Black Cockatoo and Gang-gang Cockatoo

Habitat for the Glossy Black Cockatoo is not available within the wind farm site and habitat for the Gang-gang Cockatoo is marginal as mature forest supporting larger hollow-bearing trees is not widely available within the project area. It is considered these species are unlikely to occur within the project area on a regular basis.

Database records show the Gang-gang Cockatoo has been recorded within Bango Nature Reserve but no-where else within the locality and the Glossy Black Cockatoo is not known for the locality.

For the Glossy Black Cockatoo, both foraging (Casuarina) and nesting resources are absent from the project area. Inland populations feed on a wide range of sheoaks, including Drooping Sheoak, *Allocasuaraina diminuta* and *A. gymnanthera*; these species are unavailable in the project area. Large hollow-bearing eucalypts suitable for this species to nest are also absent. It is highly unlikely this species would occur within the project area.

The Gang-gang is reported to occur in in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests in summer (this habitat type is not present onsite), whereas in winter it can move to lower altitudes, preferring more open eucalypt forests and woodlands, particularly in box-ironbark assemblages of the inland slopes. Regarding the latter habitat type, while Box Gum woodland may support some habitat for this species, this habitat is considered very marginal and extensive bird surveys have been undertaken in these areas. No Gang-gang Cockatoos were recorded during all bird surveys, despite the species being known to occur within Bango Nature Reserve.

Impact to these species from the proposal are therefore not expected and they are not discussed further in this report.

Powerful Owl and Barking Owl

A record is known for the Powerful Owl south of the project area within the locality and the closest Barking Owl records is 40 km of the site. However, given the mobility and large home ranges of these owls they were considered to have potential to occur within the project area. Ten nocturnal surveys were undertaken for these species consisting of targeted call playback and spotlighting in potential habitat across the project area. In particular, an area of Inland Scribbly Gum Forest near RYP_104 was considered to provide the best quality habitat for this species within the project area as it supported several hollow bearing trees. This area was specifically targeted for call playback and spotlighting along with other areas of potential habitat.

Hollow-bearing trees were mapped within areas of better quality vegetation considered the most appropriate nesting locations within the project area for these owls (i.e. within moderate and good condition vegetation). There is a general lack of large hollows across the project area and it is considered there is no suitable breeding habitat. The majority of hollows are of small to medium hollow entrance size, most likely to be utilised by small to medium birds and microbats, rather than owls.

The Powerful Owl and Barking Owl were not detected by call or direct observation during the field surveys and are not considered to regularly utilise the project area, however these species are discussed in more detail with regard to impact in Section 7.

Regent Honeyeater

Records of the Regent Honeyeater are present within the locality and the species is known to utilise box-ironbark eucalypt associations. It is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box. As the species can undertake large-scale nomadic movements in the order of hundreds of kilometres the species has the potential to occur within the project area. The species was not detected during bird surveys of the project area, but has potential to be impacted from the proposal from collision when it migrates.

This species is discussed further within the impact assessment chapter of this report, refer Section 7.

Black-chinned Honeyeater

The Black-chinned Honeyeater occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). The Black-chinned Honeyeater has not been recorded within the locality and records of this species are primarily located to the west of the project area north of Boorowa. The species was not detected during surveys of the site. Substantial survey was undertaken for other species (Superb Parrot and Swift Parrot) in the potential habitat (Box Gum Woodland) this species would occur within if present on site. The Black-chinned Honeyeater was not detected during bird surveys and as it is a gregarious species usually seen in pairs and small groups of up to 12 birds, it is unlikely this species inhabits the project area on a permanent basis.

Little Lorikeet and Turquoise Parrot

The Little Lorikeet forages primarily in the canopy of open Eucalypt forest and woodland, yet also finds food in *Angophora, Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, such as paddocks, roadside remnants and urban trees are also reported to be used by the species.

The Turquoise Parrot is typically recorded west of the escarpment in the tablelands and on the western slopes, extending to the coastal districts. It occurs in grassy woodland and open forest carrying a mixed

assemblage of White Box, Yellow Box, Blakely's Red Gum, Red Box and Red Stringybark. The species will also utilise the edges of woodland, timbered ridges and creeks in farmland.

Both these species were not observed during bird surveys and are not expected to utilise habitat within the project area. Both species are gregarious, travelling and feeding in small flocks and it is considered they would've been readily observed if they occurred within the project area. Records indicate these species are more prevalent at least 200km west of the project area.

Little Eagle

The Little Eagle is found throughout the Australian mainland except the most densely forested parts of the Dividing Range escarpment. The species occupies open eucalypt forest, woodland or open woodland. The distribution of the species is known to include the project area. While the species was not detected during surveys of the project area, the species is a medium sized raptor that exhibits soaring and prospecting foraging behaviour at higher elevation and may therefore be at risk from collision with turbines.

This species is discussed further within the impact assessment chapter of this report in regard to collision risk, refer Section 7.

Square-tailed Kite and Spotted Harrier

The Square-tailed Kite is found in a variety of timbered habitats including dry woodlands and open forests and shows a particular preference for timbered watercourses. The Spotted Harrier occurs in grassy open woodland including *Acacia* and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. Given the species have large home ranges and are known to forage in open woodland habitats it is possible they could occur within the project area.

However, both species were not observed during bird surveys of the project area and are not known to occur within the immediate project area.

Grey-crowned Babbler

The Grey-crowned Babbler is known to occur on the western slopes of the Great Dividing Range. Records in NSW show this species west of the project area near Boorowa. No records are known for the locality however the species is known to forage in Box Gum Woodland in the areas it is located and was therefore considered a 'potential' species that could occur within the project area. The species is gregarious and forages on the ground on invertebrates on tree trunks and branches and by foraging amongst litter and tussocks. The species was not observed during bird surveys and is not expected to utilise habitat within the project area.

Migratory species

One migratory species listed under the EPBC Act was recorded onsite, the Satin Flycatcher (*Myiagra cyanoleuca*), foraging in forest along the ridge near RYP_95. One migratory species, the Rainbow Bee-eater (*Merops ornatus*) was recorded west of the project area on Flakney Creek Road.

Several other bird species which migrate seasonally but are not listed under the EPBC Act were also recorded, including:

- Noisy Friarbird (*Philemon corniculatus*) (common in the project area).
- Silvereye (*Zosterops lateralis*) (recorded once along the slope in woodland).
- Fan-tailed Cuckoo (*Cacomantis flabelliformis*) (recorded on three occasions in woodland, forest and along the edge of woodland utilising both ridges and slopes).

One other migratory EPBC species was not recorded within the project area but was considered to have the potential to occur and included the:

- White-throated Needletail (*Hirundapus caudacutus*).

5.3.5 Mammals

Other threatened species with potential to occur

Koala

There are a number of local records for Koala, but most are located outside of the project area. However, given the cryptic nature of the species and the presence of one primary feed tree (*Eucalyptus viminalis*) and six secondary feed trees (*E. rubida, E. albens, E. melliodora, E. Blakelyi, E. bridgesiana, E. mannifera)* listed under the Central and Southern Tablelands management areas within the Recovery Plan for the Koala (2008), it was considered there is potential for this species to occur. These feed tree species would primarily occur within Box Gum Woodland. However, the Koala has also been recorded in other areas of forest and could inhabit Inland Scribbly Gum Forest, although this vegetation type does not typically support feed trees for this species.

Thirty-three RapSAT scat searches were undertaken across the project area for the Koala within woodland habitat and no evidence of the Koala was detected during these searches.

Schedule 2 of SEPP 44 lists Koala feed tree species to be considered under the SEPP. No Feed tree species listed under SEPP 44 were recorded in the project area and the area is not considered core Koala habitat under this SEPP.

Squirrel Glider

There are a number of local records for the Squirrel Glider to the south and east of the project area and the species was therefore considered to have potential to occur. Cage trapping, targeted call playback and spotlighting were undertaken for the Squirrel Glider in potential habitat across the project area. In particular, an area of Inland Scribbly Gum Forest near RYP_104 was considered to provide the best quality habitat for this species within the project area as it supported several hollow bearing trees. Cage traps and spotlighting specifically targeted this area along with other areas of potential habitat.

The Squirrel Glider was not detected by call or direct observation during the field surveys.

5.3.6 Microbats

Microbats – Eastern Bentwing, Eastern False Pipistrelle and Yellow-bellied Sheathtail Bat

Five calls of the Eastern False Pipistrelle and four calls of the Yellow-bellied Sheathtail-bat were recorded at RYP_80 in an area comprising Inland Scribbly Gum Forest, but nowhere else where Anabat surveys were undertaken.

Thirty-six calls of the Eastern Bentwing Bat were recorded near RYP_104 and in the forest south of this site, near RYP_143, RYP_82, RYP_80, RYP_25 and RYP_9 in November 2011, and five calls were recorded at one location in April 2012 (RYP_105 – now removed from layout). Less than 10 calls were recorded at each site the Eastern Bentwing Bat was noted. Sites the Eastern Bentwing Bat was recorded primarily correspond with Inland Scribbly Gum Forest, however the location near RYP_9 supports more open habitat of native pasture.

The Eastern False Pipistrelle forages below or near the canopy and along tracks and is reported to be uncommon within ridgetop forests where soil fertility is low. The species is highly mobile, with a large foraging range. Both the Yellow-bellied Sheathtail Bat and the Eastern Bentwing Bat forage above the canopy and open areas, in particular the Eastern Bentwing bat can travel up to several hundred kilometres to over-wintering roosts. Both of these species are fast fliers when foraging over the forest canopy.

The Eastern False Pipistrelle and Yellow-bellied Sheathtail-bat both utilise hollow-bearing trees for roosting, whereas the Eastern Bentwing Bat roosts in caves. The Eastern Bentwing Bat maternity cave at Wee Jasper is approximately 40 km south of the site.

A risk assessment was conducted for both common and threatened microbats recorded within the project area (Appendix A.6). As both the Eastern Bentwing Bat and Yellow-bellied Sheathtail bat forage above the canopy and are fast fliers they are considered to be at higher risk of collision from the proposed wind farm These species are discussed further within the impact assessment chapter of this report, refer Section 7.

6 CONSTRAINTS ANALYSIS

A constraints analysis was applied to the project area and was based on three constraint classes; high, moderate or low. Key ecological issues identified from several rounds of field survey and assessment within the project area were used to inform the constraints analysis and the impact assessment. The key ecological issues relate to the presence of an EEC, threatened flora and fauna habitat, landscape connectivity, as well as threatened and 'high risk' fauna species (with regard to potential wind farm impacts).

Table 6-1 details the application of identified ecological issues into a constraint class. The implications of the development on these ecological issues are further investigated in the impact assessment section of this report (Section 7), with recommendations provided in Section 8. Further survey work has been recommended in areas identified as Golden Sun Moth and Striped Legless Lizard habitat; after which these areas may be elevated or downgraded into another constraint class pending survey results.

Low constraint areas have not been listed within Table 6-1 as these are considered to be of low conservation value and include all other areas not marked as high or moderate constraint. Low constraint areas include:

- Disturbed and / or common vegetation communities, including:
  - Exotic-dominated pasture.
  - Native vegetation in poor condition, including degraded areas of forest and woodland.
  - Habitat in poor, poor-moderate and moderate condition classes.
- Disturbed or developed areas such as existing track and disturbance footprints, including where these occur within higher conservation value areas.

Appendix E.4 shows the locations of each constraint class for flora and fauna. Please note, that several constraints may occur within the same area and the highest constraint level takes precedent in this instance.

Table 6-1 Identified ecological issues for the project area and their constraint class

Constraining Value	Constraint	Description / Location
EEC : Box Gum Woodland		
• Moderate-good condition EEC / CEEC	**High**	• Access to RYP_12; Access track from the Rye Park Dalton Road west of RYP_89; North of RYP_120 and along overhead transmission line routes to the north-west towards RYP_109.
• Poor condition EEC	**Moderate**	• Within the construction compound east of RYP_132. Patches within the transmission easements south of RYP_144; Access track and underground power south-east of RYP_101; Access to and within southern substation and construction compound site.
Hollow-bearing trees		
• Mature habitat supporting larger patches of hollow-bearing trees in moderate-good or good condition vegetation	**High**	• Near RYP_104, near vicinity of RYP_84. These areas supported a higher density of hollow-bearing trees and are not directly impacted by the proposed infrastructure. However, these areas have been highlighted to prevent micro-siting of the turbine within this area at a later stage.

Constraining Value	Constraint	Description / Location
Turbines sited near edge of continuous good condition forest		
• Turbines sited on the edge of good condition forest habitat.	**High**	• Where good condition habitat is present in the vicinity of proposed turbines, this has been marked as a high constraint. This includes areas of: RYP 143 through to RYP_101 (central section of project area) and an area between RYP_104 and RYP_145. • The turbine itself is not considered to be sited within a high constraint area as during the design phase the turbines were sited within the most disturbed area, however the adjacent habitat has been highlighted to prevent micro-siting of the turbine within the nearby good condition habitat at a later stage.
Turbines surrounded by patchy (partially disturbed) good condition woodland / forest		
• Turbines surrounded by woodland habitat, presenting potential fauna avoidance impact in this area.	**Moderate**	• RYP_17. This turbine is surrounded by woodland habitat, however this area was surveyed in detail and no unique or important habitat was observed in this area. Hollow-bearing trees were not noted within 100 m of this turbine and the area generally consists of regrowth vegetation. However there may be potential impact to woodland birds if they avoid the turbine during the operational phase of the project.
Breeding habitat for Superb Parrot		
• Identified known and potential nest trees for the Superb Parrot	**High**	• A 100 m buffer has been applied to all known (three trees) and potential nest trees (two trees) where they occur in the project area. These are recorded in the southern section of the project area in the general vicinity north of RYP_120.
Striped Legless Lizard habitat		
• Known Striped Legless Lizard habitat where individual species was observed	**High**	• The Striped Legless Individual was recorded at RYP_27. A 500 m buffer has been applied to the location the species was recorded.
• Potential Striped Legless Lizard habitat	**Moderate**	• All other grassland areas of the project area the species was not recorded is designated as potential habitat, including Box Gum Woodland, Derived Grassland and Native Pasture.
Golden Sun Moth habitat		
• Known Golden Sun Moth habitat where individual species were observed	**High**	• RYP_27: a 200 m buffer has been applied to the location the species was recorded.
• Potential Golden Sun Moth habitat	**Moderate**	• All other grassland areas of the project area the species was not recorded is designated as potential habitat, including Box Gum Woodland, Derived Grassland and Native Pasture.

Constraining Value	Constraint	Description / Location
Important habitat and movement corridor for Superb Parrot and Painted Honeyeater		
• Known Superb Parrot and Painted Honeyeater foraging habitat and potential movement corridor *Note: Golden Sun Moth also recorded in this area.*	**High**	• This area is located in the southern section of the project area generally south of RYP_106 and north of RYP_120. • This area supports the best quality Box Gum Woodland located in the project area and was the primary location the Superb Parrot and Painted Honeyeater were located within the project area. This area supports foraging habitat and is a potential local movement corridor for both species. The Superb Parrot nests trees are also in this area.
Important threatened species habitat (woodland bird records in this area)		
• Known habitat of several threatened woodland birds	**Moderate**	• An area north of RYP_104 is known habitat for several threatened woodland birds and these birds appeared to be in higher abundance in this area. While habitat for these species is abundant in the project area and impact to these species is not considered significant, the siting of infrastructure should be minimised as much as possible in this area.

7 IMPACT ASSESSMENT

7.1 APPROACH TO IMPACT ASSESSMENT

The following impact assessment section has been divided into:

1) General information relating to the types of impacts associated with wind farms with reference to available research and its application to the Rye Park wind farm site, where relevant (Section 7.2); and
2) Detailed information on the specific impacts to flora and fauna from the proposed Rye Park wind farm including impacts from vegetation clearing, fauna habitat loss and collision or barrier effects (Section 7.3 and 7.4).

7.2 TYPES OF IMPACTS – CURRENT RESEARCH

There are three primary adverse effects of wind farms upon biodiversity (Macintosh and Downie 2006):

1. Vegetation clearance (habitat loss);
2. Blade-strike (bird and bat collision with turbines and barotrauma); and
3. Alienation or barrier effects (behaviour change in fauna).

7.2.1 Vegetation clearance (habitat loss)

Impact to vegetation relates primarily to clearing associated with construction. Operation of the wind farm has little impact on vegetation as the supporting infrastructure is in place, with operational turbines occupying a vertical plane. During construction, the majority of clearing occurs through supporting infrastructure such as tracks, cable trenches, overhead transmission lines, turbine footings, crane hard stands and crane operational areas. This supporting infrastructure may require substantial clearing of vegetation.

Across a broad area, key issues are effects upon landscape connectivity for fauna and impact upon over-cleared vegetation communities, such as EECs. Furthermore, with clearing come impacts including vegetation and soil compaction, erosion and sedimentation risks, weed spread and others.

7.2.2 Blade-strike

A range of direct and indirect impacts of wind farms on birds and bats have been recognised in recent years, with mortality via direct collision with moving turbine rotors being an obvious impact (Madders and Whitfield 2006; Smales 2006).

Collision risk can be defined as the likelihood of individual species migrating, feeding or roosting in the proximity of a wind farm which may lead to collisions with wind turbines and other infrastructure (Drewitt and Langston 2006). The number and behaviour of birds, topography and the specifications and layout of the wind farm are all factors influencing collision risk (Smales 2006). Collision with rotor blades generally occurs when birds are approaching the rotor with a tail-wind, which reduces their ability to take evasive action. Mortality or injury can also result from birds being driven down to the ground by the force of the wake behind the rotor (Sharp 2010).

Industry research reveals that the species that appear to be most susceptible to population scale impacts due to blade-strike are common species (i.e. not listed as threatened in state or Commonwealth

legislation). However, evidence shows that operational impacts affect particular species disproportionately, compared to habitat loss or stationary elevated structures (Willis *et al.* 2010). While research on Australian wind farms is lacking, evidence to date suggests the species most affected by collision mortality fall into the following groups (MacMahon 2010, Roaring 40s Renewable Energy 2010, Smales 2006):

- Large sedentary raptors.
- Fast high flying microchiropteran bats.
- Fast high flying non-passerines.

Available data from operational wind farm monitoring (i.e. carcass searches) at Australian wind farms is presented in Table 7-1. Based on the data in this table below, carcass searches at operational wind farms have found an average mortality of 0.71 birds and 0.55 bats per turbine per year, although these rates are imperfect given the limited datasets.

Table 7-1Table 7-1 also shows that although a range of species have been recorded from carcasses searches, four species are disproportionately represented (shaded grey in Table 7-1): White-throated Needletail, Wedge-tailed Eagle, White-striped Freetail Bat and Gould's Wattled Bat.

Collision risk modelling has been developed for birds and involves the use of avoidance rates for each species modelled based on observed flights around turbines, with most species assumed to have an avoidance rate of 98-99%. This means that out of 100 flights near a turbine, an individual of a species of bird would take avoidance action to avoid the turbine and rotors 98 or 99 times (i.e. 1 in 100 likelihood of collision with turbine rotors). These avoidance rates are generally considered to be accurate for the majority of bird species (Biosis Research 2009), but Wedge-tailed Eagles have a considerably lower avoidance rate at between 90% and 95% (Smales 2009, MacMahon 2010). This is supported by carcass search data presented in Table 7-1. If Elmoby Ecology (2012) data is excluded for species analysis (as small sample size skews fine analysis), the figures in the table provide an average of 0.05 Wedge-tailed Eagle, 0.03 White-throated Needletail and 0.09 Gould's Wattled Bat deaths per turbine per year.

Table 7-1 Collisions per turbine per year from five Australian wind farms

Species	Elmoby Ecology 2012 (2 turbines, 6 mths)	Hydro Tasmania 2012 (62 turbines, 1 yr)	Roaring 40s 2011 (62 turbines, 1 yr)	Roaring 40s 2012 (62 turbines, 1 yr)	nghenvironmental (unpubl.) (15 turbines, 2 yrs)	Av.
Brown Falcon	1	0	0	0.03	0	
Silvereye	0	0.02	0	0	0	
Australian Pelican	0	0.02	0	0	0	
White-throated Needletail	0	0.02	0.02	0.08	0	
Wedge-tailed Eagle	0	0	0.02	0.05	0.13	
Swamp Harrier	0	0	0	0.011	0	
Pied Currawong	0	0	0	0	0.03	
Australian Magpie	0	0	0.35	0	0.003	
Other bird species	0		0.4	0.35		
ALL BIRDS	2	0.05	0.79	0.52	0.2	0.71
White-striped Freetail Bat	1	0	0	0	0.27	
Gould's Wattled Bat	0	0.05	0.15	0.11	0.07	
Large Forest Bat		0	0	0	0.03	
Other bat species				0.02	0.03	
ALL BATS	2	0.05	0.15	0.13	0.4	0.55

Raptors

Raptors are generally considered the most vulnerable group of birds in Australia (Roaring 40s Renewable Energy 2010), particularly the Wedge-tailed Eagle (as well as the White-bellied Sea-eagle, however this species is uncommon or rare in the project area). Particular bird groups, such as raptors and waterbirds are considered at greater risk of collision because of their flight heights, size and behaviour. A review of avian collision mortality in the United States by Erickson et al. (2001) found that most avian fatalities were nocturnal migrant passerines.

The flying heights of bird species varies considerably; many birds rarely, if ever, reach rotor-swept height, while others do so routinely and some frequently fly above that height (Sharp 2010). In relation to the Rye Park wind farm proposal, the highest tip of the blade is at 157 m and the lowest point of the blade to the ground will be 40 m. At risk flight heights (i.e. within the rotor-swept area) are therefore between 40 m and 157 m. The tips of turbine rotors generally travel at speeds of between 200 and 300 km/h (Smales 2006).

Different types of flight, such as hovering, circling, vertical and horizontal flights made by different species of birds, and by birds engaged in different activities, may pose quite different risks of collision (Smales 2006). Collision risk may vary within the same bird species; depending on the bird's age, behaviour and stage of annual cycle, e.g. a Wedge-tailed Eagle when searching for food to support its young. Weather conditions (e.g. fog, rain and wind) and the time of day or night also have an influence on collision risk (Drewitt and Langston 2006; Smales 2006).

Microchiropteran Bats

Bat-strike interactions are likely during the operation of proposed wind turbines in the project area. Although it is not exactly known which species may fly within the rotor-swept area, it is expected that several species may have interactions with turbines. Little is known about the effect of operating turbines on bat behaviour, whether bats avoid turbines or not, and the actual number of bat-strikes that have been caused by operational wind farms in Australia. Some recent wind farm studies overseas have suggested that bats may be impacted by a sudden change in localised air pressure created by turbines, after bats had been found with fatal injuries consistent with Barotrauma (Baerwald et al. 2008). Barotrauma is likely to be caused by the sudden air pressure change at turbine blades to which microchiropteran bats are more susceptible than birds (Baerwald *et al.* 2008).

In Europe and North America, migrating bats are most susceptible to collision with high numbers of fatalities during migration periods (Cryan and Barclay 2009). Horn *et al* (2008) studied bat activity around wind turbines at a facility in Virginia USA, where hundreds of migrating bats had collided with turbines. The turbines were located along a heavily forested ridge, and activity was monitored with thermal imaging cameras. Out of 998 bat observations of bats interacting with turbines, 41 avoidances (4.108%) were observed and five collisions (0.501%) were recorded. In the remaining 952 observations, bats flew around the blades or investigated them. Whether or not these figures would apply to an Australian situation is unknown, an extrapolation of the US activity may give the only possible indication of the potential for fatalities at the proposed Rye Park wind farm proposal.

In Australia, there are relatively few migrating bats. However, evidence from carcass searches suggests that even when microchiropteran bats are using echolocation for moving through their environment certain species are still at risk of collision with turbine rotors. In terms of blade-strike, Australian species that appear to be most at risk are those that forage above canopy (i.e. in open areas) and move through their environment at high speeds, such as the White-striped Freetail Bat. These species are more likely to travel at blade-sweep height and either fail to detect the moving blades, or are less able to quickly manoeuvre around them (this is discussed in more detail in Section 7.5.3).

7.2.3 Alienation / barrier effect

Alienation involves changes in behaviour (such as avoiding nesting or foraging resources) and habitat utilisation (such as diverging around the broad area where turbines are located). A barrier effect may cause birds and microchiropteran bats to alter their flight pathways to avoid the wind farm area, i.e. the ridgelines and hilltops where the turbines are located. Barrier effects may affect local sedentary birds in their daily traverses for foraging, roosting and breeding sites or may cause migratory birds to shift migratory flyways. Alienation of hunting habitat for raptors such as Wedge-tailed Eagle may be of particular concern (Smales 2006). Siting and configuration of turbines is the primary issue; inappropriate layout (such as lines of turbines between important habitat features) can create a 'barrier effect', resulting in habitat loss or fragmentation (Brett Lane & Associates 2009).

Although the zone of disturbance around individual turbines can be relatively small, the cumulative area of this zone around large wind farms such as that proposed has the potential to be substantial (Sharp 2010). Turbines are generally placed to maximise wind values and to minimise turbulence from topographic features and other turbines. In practice, this means there are usually large and variable spaces between turbines (Smales 2006). Rows of turbines throughout the project area could in effect act as multiple barriers to the movement of birds and bats. Birds and bats may be forced to change their flight behaviour to avoid collisions with turbines, subsequently impacting on their breeding and foraging success (Drewitt and Langston 2006).

7.3 FLORA IMPACTS SPECIFIC TO RYE PARK WIND FARM

7.3.1 Vegetation clearance

At the time of this assessment, the proposal included scope for the development of 126 turbines. This may be reduced, however the calculations for magnitude of impact remain based on the worst-case scenario (126 turbines). The proposal would result in the removal of vegetation under the development footprint, including the turbine towers and surrounding hardstand and crane operation areas, substation and control building and access tracks. Electrical cabling (33kV) would be installed within areas disturbed for the access tracks.

Estimates of permanent habitat loss for each of the affected vegetation types are presented in the tables below (Table 7-2 through Table 7-4), based on the final indicative infrastructure layout provided by the proponent (several layout revisions have taken place to reduce impacts since the beginning of site investigations – refer Section 8).

Overall impact areas have been determined based on worse case infrastructure footprints provided by the proponent. Impact areas by vegetation type were calculated using GIS mapping software, however it should be noted that some total habitat loss figures are likely to be *overestimated* due to overlaps of infrastructure, for example tracks crossing hardstand areas and tracks within overhead transmission easements. It should be noted that for the purposes of these calculations, exotic dominated pasture is not considered to constitute habitat.

Endangered Ecological Community (Box Gum Woodland EEC/CEEC)

Moderate and good condition EEC areas

Within the project area few areas were defined as moderate or good condition EEC areas. Good condition areas estimated to be cleared account for approximately 10 ha of the 3,068 ha Box Gum Woodland area assessed. One area in the south of the project area (in the vicinity of RYP_110 and RYP_120 and to the west of these) consists of higher diversity Box Gum woodland and would be directly impacted by the proposal due to the establishment of a 45m wide easement for the 132kV overhead transmission line and some smaller areas for access tracks. Of all the Box Gum Woodland mapped, this area supported the largest patches of this community within the project area and the highest abundance of mature box trees. This area was also identified as important habitat for the Superb Parrot and Painted Honeyeater. These areas have high conservation value and also qualify as the Commonwealth Box Gum Woodland CEEC and have been mapped as a high constraint. Approximately 2 ha of moderate condition Box Gum Woodland would also be permanently cleared by the proposal. Although modified, areas in moderate condition are considered to have potential for recovery and have also been mapped as a high constraint.

The infrastructure layout has been refined to avoid, where possible, Box Gum Woodland habitat, especially moderate to good condition areas. As a result the turbines RYP_14, RYP_108, RYP_111, and RYP_116, were moved out of Box Gum Woodland remnants. In particular, at least 4 km of proposed transmission line has been removed to avoid good condition EEC in the southern section of the project area.

The EEC over the vast majority of the project area is characterised by low diversity native pasture in poor condition. Of the EEC within the project area (3,068 ha), the estimated amount of poor condition EEC to be cleared accounts for 28 ha. Predominately, the areas to be impacted contain a moderate to low tree density with an understorey of native grass dominated pasture with a relatively low native forb and shrub diversity (0 – 11 non-grass species in poor and moderate condition). This structural and understorey configuration is common and widespread in farmland throughout the region, and particularly within high elevation areas on the ridgetops of the project area. The areas of habitat within the site are already fragmented due to previous clearing, grazing pressure, the planting of exotic pastures, the ingress of weeds and the occurrence of other vegetation communities in habitats not suitable for Box Gum Woodland. The long history of grazing, fertiliser use and weed invasion means that the potential for natural regeneration is likely to be very low. Given the low conservation value of this vegetation and the highly localised and limited impacts associated with the proposal, impacts to poor condition Box Gum Woodland are not expected to be significant.

As a precautionary approach, this assessment has considered that the worst case scenario would be the total loss of this vegetation type within the 132 kV transmission line easement; however in reality the vegetation is open woodland meaning that only scattered trees would need to be cleared. The understorey would also be mostly retained excluding small areas required for footings and tracks. It is considered likely that the community would maintain its existing functionality following construction.

Where occurrences of EEC are along established roads or tracks it may be possible to further avoid or minimise impacts in these areas. Impacts to areas in transmission line clearing corridors of the study areas may also have the potential to be avoided or minimised by micrositing infrastructure with input from an ecologist. Where new tracks, turbines or other infrastructure are placed within identified areas of EEC impacts are unavoidable and offsetting these impacts would be required. Higher offset ratios apply to higher value habitat, providing an incentive throughout the construction process to minimise impacts in high value areas.

Offsetting is recommended by this report to maintain or improve the biodiversity values associated with the EEC/CEEC within the proposal site. Large areas potentially exist within the site boundary that if properly managed can assist with the recovery of this community, arresting existing threats and managing the land for biodiversity outcomes in perpetuity. With the implementation of the controls and recommendations of this report the proposal is considered unlikely to have a significant impact on the Box Gum Woodland EEC/CEEC.

Box Gum Woodland provides habitat for several threatened fauna species, particularly the Superb Parrot, Painted Honeyeater, Golden Sun Moth, and Striped Legless Lizard. These species were detected in this habitat type within the project area. The value of Box Gum Woodland habitat specific to these species is considered in more detail below (Section 7.4).

Non-threatened Vegetation Types

The total vegetation clearance (impact footprint) for the project area is approximately 236 ha, with approximately 14,000 ha of vegetation within the entire project area. Native Pasture is the most common vegetation type within the project area totalling 4,374 ha, of which a total of 60 ha will require clearance for the proposal. Of this 60 ha, only 2 ha is categorised as good condition, 22 ha as moderate condition and 36 as poor condition. Much of the Native Pasture vegetation across the project area has, and continues to be heavily grazed resulting in the presence of many exotic grasses. Native forb diversity is generally low and restricted to grazing tolerant species. Clearing and grazing practices over the long-term have reduced the condition of this vegetation type and condition will remain the same until grazing is reduced or removed from the landscape. While the Native Pasture habitat is generally degraded and supports lower biodiversity value for fauna in general, there are several threatened species that are reliant on a particular habitat attribute or suite of native grasses and can occur within degraded habitats, such as the Striped Legless Lizard and Golden Sun Moth which were both detected within the project area. In particular, these species are found in areas supporting Speargrass and Wallaby Grasses which were recorded within this vegetation type at Rye Park wind farm. The value of Native Pasture habitat to specific fauna species is considered in more detail below (Section 7.4).

The second most common vegetation association is Inland Scribbly Gum totalling 3,753 ha within the project area of which a total of 91 ha will require clearance for the proposal. Of this 91 ha, 41 ha is categorised as good condition, 30 ha as moderate condition, and 19 ha as poor condition. The typical location of good quality vegetation of this community was on ridge tops or steep slopes. While turbines are proposed for areas supporting Inland Scribbly Gum Forest, these areas will primarily be affected by clearing associated with access tracks and transmission lines rather than clearing for turbines. In particular, wide access tracks of up to 20 m (including existing clearance on each side of the road) on the top of ridge in this vegetation type are already present in most parts of the development footprint as a result of existing farming practices and while they will require upgrading, they will not require additional clearance for the proposal. The majority of the turbines are sited within already cleared areas on ridge tops and dense forest has been avoided during the design phase of the project. This vegetation type is common to the project area and similar condition vegetation is also known to extend east of the project area.

Inland Scribbly Gum provides habitat for woodland birds and arboreal mammals. While an open grassy understorey lacking shrub or mid-canopy stratums is typical to this vegetation type, much of this vegetation community showed evidence of grazing and regeneration of grasses and forbs was low at the time of the survey resulting in a lack of structure and ground foraging resources for woodland birds. The lack of foraging resources (i.e. native grasses) appears to have affected woodland bird diversity. Woodland bird diversity increased where this vegetation type was near other shrubland vegetation.

Other areas of good condition vegetation were found in Sifton Bush Shrubland (14 ha), however, this community occupies previously cleared and disturbed areas where Sifton Bush has vigorously colonised and is now the dominant species outcompeting other native species. Sifton Bush is considered to be a highly invasive plant and tends to occupy areas where threatened flora habitat potential is low.

Table 7-2 Estimated impact area of the development by vegetation type

Infrastructure	Quantity	Width (m)	Length (m)	Area (ha)	BGW (ha)	DGL (ha)	ISG (ha)	AA (ha)	BGF (ha)	SB (ha)	NP (ha)	EX (ha)
Turbine footing	126	20	20	5	0	0	1	0	0	1	3	0
Crane hardstand (in woodland and forest)	22	28	45	3	0		3	0	0			
Crane hardstand (in pasture areas)	104	28	45	13		0				4	8	1
New tracks (permanent formed width)	1	8	125,755	101	8	6	20	0	1	11	48	6
Existing tracks (widening)	1	2	40,705	8	0	1	2	0	0	1	4	1
Transmission (33kV)	1	0	125,587	0	0	0	0	0	0	0	0	0
Transmission (132kV) (in woodland and forest)	1	45	18,222	82	16		65	0	1			
Connection substations	1	200	300	6	0	6	0	0	0	0	0	0
Wind farm substations	3	100	100	3	0	1	0	0	0	0	2	0
Construction compound, staging and storage	1	200	250	5	0	2	0	0	0	0	3	0
Vegetation remaining within site boundary				**14,036**	1,555	1,513	3,753	59	175	1,720	4374	887

KEY:

BGW Box Gum Woodland
DGL Box Gum Woodland Derived Grassland
BGF Brittle Gum Forest
AA Argyle Apple Forest
ISG Inland Scribbly Gum Forest
SB Sifton Bush Shrubland
NP Native pasture
EX Exotic

Table 7-3 Estimated permanent impact areas by vegetation condition[6]

Vegetation types	Permanent habitat loss within each condition class (ha)					Total of each vegetation type within the site boundary (ha)
	Good	Moderate	Poor	Unknown	Total	
Box Gum Woodland	10	1	14	0	25	1,555
Box Gum Woodland Derived Grassland	0	1	6	0	6	1,513
Inland Scribbly Gum Forest	41	30	19	0	90	3,753
Argyle Apple Forest	0	0	0	0	0	59
Brittle Gum Forest	0	0	2	0	2	175
Sifton Bush Shrubland	14	15	2	0	30	1,720
Native pasture	2	22	36	0	60	4,374
Exotic/planted	0	0	23	0	23	887
					235.93	**14,035.99**

Table 7-4 Estimated TSC Act EEC permanent impact areas by condition class

EEC	Permanent habitat loss within each condition class (ha)			
	Good	Moderate	Poor	Unknown
Box Gum Woodland and Derived Grassland	10	2	28	0
Total area within the site boundary	**353**	**27**	**357**	**2,331**

7.3.1 Impacts to threatened flora species

Yass Daisy

The Yass Daisy is a rare perennial herb, 30-60 cm high, inhabiting sclerophyll woodland, forest and roadsides (Harden 1992). It appears to be unaffected by light grazing, with some populations persisting in grazed sites (OEH 2011). In surveys conducted in the Boorowa Shire, all of the occurrences of this species were on land characterised by a light grazing regime. The Yass district is the centre of distribution for this species (Fallding 2002). Most populations occur in the Yass District, at Lake Burrinjuck, Bookham, Rye Park and Dalton (DSEWPC 2008). The Yass Daisy has been recorded within 2.5 km west and south-east of the project area. Current threats to the species include agricultural developments, intensification of grazing

[6] All of the condition classes in Table 7-3 and Table 7-4 (good, moderate and poor) excluding the 'exotic' class would equate to the 'moderate to good' definition specified within the Biometric Guidelines due to the dominance of native vegetation in the groundlayer or having a native overstorey with a percent foliage cover greater than 25% of the lower value of the over-storey percent foliage cover benchmark of that vegetation type. Exotic dominated vegetation would equate to 'low' condition

regimes, invasion of weeds, road works (particularly widening or re-routing) and inappropriate mowing or slashing in cemetery sites (OEH 2012).

Targeted searches were undertaken for this species in higher quality areas of Box Gum Woodland and derived grassland immediately north of RYP_120 and within the proposed overhead transmission line routes to the north-west of RYP_120 and south west of RYP_110. These areas have a long and continuing grazing history. Much of the total area of disturbance would involve tree clearing for a 45m wide easement for the 132kV overhead powerlines. The groundlayer habitat under the powerlines would be largely undisturbed, with the exception of small areas required for pole footings and a maintenance track. In view of the limited extent and pattern of clearing and the low impact on groundlayer vegetation within the transmission line, the works are not expected to add to the existing level of fragmentation or isolation of potential Yass Daisy habitat. The proposal would result in the permanent loss of up to 12 ha of moderate and good condition Box Gum Woodland, which provides potential habitat for the threatened Yass Daisy.

The potential habitat at the subject site is considered unlikely to support the species given the species was not detected during targeted searches; these areas considered as potential habitat are now assessed as low importance for the Yass Daisy. The proposal will not result in significant impact to this species.

7.4 FAUNA HABITAT LOSS IMPACTS SPECIFIC TO RYE PARK WIND FARM

As a worst-case scenario, the proposal involves the permanent removal of up to approximately 235.93 ha of potential habitat for a variety of species, including 92 ha of forest, 26 ha of woodland, 30 ha of shrubland, 60 ha of native pasture and 23 ha of exotic vegetation. Given the proposal is linear in structure, involves narrow clearance corridors and as such does not result in large consolidated areas of clearing, the proposed habitat removal is unlikely to be considered large with respect to the remaining areas of potential habitat present throughout the project area.

7.4.1 Habitat Loss (Hollow-bearing trees and landscape connectivity)

Hollow-bearing trees are present across the project area, and may occur in all habitat types and condition classes. Using the estimates above of vegetation community extent and total clearing (Table 7-3), an approximation of the number of hollow-bearing trees that may occur within the project area and the number that may be cleared by the proposal is given in Table 7-5. The average number of hollow-bearing trees per hectare for each vegetation type is derived from Table 5-1 and is based on the hollow-bearing tree data recorded from the 35 plots surveyed.

In general, hollow density within Box Gum Woodland is low given this community is largely fragmented and exists as scattered trees. In particular, large hollows in this vegetation type occur in low abundance. While large mature trees occur across the project area in Box Gum Woodland they often supported no hollows, or small hollows and were often in Yellow Box trees. The results indicate that the trees within Box Gum Woodland take years to develop large hollows compared to other vegetation types and Yellow Box is particularly important in this immediate area of the proposal. It is therefore expected that the larger Yellow Box trees within the project area are selectively used by hollow-dependent species for nest and roost sites.

Much of the Inland Scribbly Gum Forest is regrowth vegetation within the areas to be impacted by the proposal and hollows range from being low in abundance to occurring more densely in patches where the vegetation appears more mature. There are pockets of mature vegetation that support a high abundance of hollows, including several large branch and trunk hollows, however these exists as small pockets between larger areas of regrowth forest supporting either no, or smaller hollows. This patchy distribution

of hollows is likely to be a result of different clearing regimes within the project area. Areas where mature vegetation was recorded and supported a high density of forest occur near RYP_104 and in the vicinity of RYP_84. These areas are not directly impacted by the proposed infrastructure, however they have been highlighted as a high constraint area to prevent micro-siting of the turbine within this area at a later stage.

While it is recognised that hollow-bearing trees within the Inland Scribbly Gum forest could be utilised by some bird species, hollows typically preferred by threatened large forest owls, threatened arboreal mammals, and parrot species such as the Glossy-black Cockatoo need to occur in better quality forest vegetation to be utilised by these species. In general, the majority of hollows were of small to medium hollow entrance size within forest remnants, most likely to be utilised by small to medium birds and microchiropteran bats, rather than owls and gliders.

Recommendations have been made to the proposal in order to avoid impact upon fauna connectivity and habitat patch size and integrity, as well as hollow-bearing trees, where possible. These provisions include pre-clearance surveys and micro-siting of infrastructure. Additionally, recommendations have been made to include 100 m buffers to known Superb Parrot nest sites (including potential nest sites), as well as to micro-site all transmission lines and access tracks near all Yellow Box trees between the area of RYP_110 and RYP_120 even they do not appear to contain a hollow; this area corresponds with good quality Box Gum Woodland. This recommendation will act to preserve Yellow Box trees in the landscape which will develop hollows in the long-term and of which are believed to be an important nesting resource in the project area.

Table 7-5 Estimates of number of hollow-bearing trees (HBT) in project area (HBT extent) and the number and percentage of total that may be cleared by the proposal

Vegetation	Av. HBT per hectare	Veg extent (ha)	HBT extent	Clearing (ha)	No. HBT cleared	Percentage of total
Forest	13.5	4654	62829	53	715.5	1.1%
Woodland	13.5	3048	41148	21	283.5	0.7%
Paddock	1	7307	7307	30	30	0.4%
Total worst-case HBT cleared			111284		1029	0.9%

Note: Forest amalgamates Argyle Apple, Brittle Gum and Scribbly Gum forest types. Woodland is equivalent to Box Gum Woodland and paddock combines Box Gum Woodland derived grassland and native pasture.

7.4.2 Impacts to mammal species (excluding microbats)

Koala

The extent of vegetation clearance for the Koala is primarily limited to discrete areas, primarily for transmission line corridors. Clearance for wind turbines will be nil to minor as main access tracks and turbine sites are located in cleared or non-forested areas; however, there will be some clearing required for installation of the more minor turbine access tracks that will connect to the main access network. However, the nature of the clearing will not affect fragmentation in the landscape and a substantial amount of similar habitat will remain in the project area that will not be affected by the proposal.

For example, the main access tracks to potential turbine sites are already cleared, with many tracks already 20 m wide due to existing agricultural land practices; hence clearing is minimal in these areas and the project will not increase fragmentation. Of the habitat available, Inland Scribbly Gum habitat of all condition classes (i.e. poor-good) is considered most appropriate for this species of which up to 90 ha may

be cleared by the proposal; however at least 3,753 ha of the same vegetation type will remain within the project boundary which also connects to larger areas of the similar habitat within the surrounding landscape.

The main threats to the Koala are the ongoing loss, fragmentation and degradation of habitat, vehicle strike, disease and predation by the domestic dog (SEWPAC 2013). As direct clearance of habitat for the Koala is defined to limited areas the proposal will not increase the main threats of loss of habitat and fragmentation. Furthermore, vehicle strike is not anticipated as the movement of trucks transporting turbines will be temporary and confined to the construction stage; due to steep terrain and land access trucks will be moving at slow speeds within the project area at this time. Vehicle movement will be limited during the operational phase of the project to a single 4WD vehicle for routine maintenance checks. Therefore, the proposal will also not enhance other key threats from indirect impacts of vehicle strike.

Given evidence of the Koala was not detected during the 33 RapSAT surveys, the Koala is not expected to occupy the habitat in high numbers and severity of impact is not considered to be adverse on the Koala (if it were to occur). Additionally, a substantial amount of available habitat will remain within the project area and locality and the proposal will not fragment habitat for this species. Therefore, the proposal is not considered to significantly impact on this species.

Squirrel Glider

Habitat assessment undertaken by **ngh**environmental ecologists has identified that habitat available to the Squirrel Glider is of marginal quality within the proposed wind farm's project boundaries. Mature growth open forest and woodland supporting structural diversity is not widely available. The proposal will affect a minor amount of potential closed forest habitat (Inland Scribbly Gum Forest) that is considered to be of low quality with regard to habitat for arboreal mammals. The species prefers mixed species stands with a shrub or *Acacia* mid-storey and requires structural integrity to satisfy dietary requirements; their diet varies seasonally and consists of *Acacia* gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein (NSW Scientific Committee 2008). Patches of mature forest are present, but scarce. The available habitat is predominantly young regrowth in many locations, lacks structural integrity and foraging feed resources, apart from canopy eucalypt species. The canopy is characterised by the dominance of Inland Scribbly Gum (*Eucalyptus rossii*) with Red Stringybark (*E. macrorhyncha*) as the second dominant. The winter flowering Long-leaved Box (*E. goniocalyx*) occurs within the canopy in patches, but is less common and accounts for approximately 10% of the overstorey. Consequently, the availability of feeding sap and nectar resources is low and a good winter supply of nectar is unavailable. Squirrel Gliders often move through the landscape according to foraging resource availability, however the potential habitat (Inland Scribbly Gum Forest) for this species is consistent in diversity and structure across the project boundary. Such uniformity of potential habitat would suggest foraging resources remain consistent across the project boundary and are generally in low abundance for the reasons stated above; hence if the Squirrel Glider is present, densities are expected to be low throughout the year.

Similar to the Koala, construction disturbance and vegetation clearance impacts will occur from the proposal, however these impacts are considered minor due to the nature of clearing and the location of clearing in the context of the available habitat remaining within the landscape. Potential habitat for the Squirrel Glider is limited to a number of proposed turbine sites and the access tracks that will connect these to the main access network (none is present in transmission line easements, the main access track network or proposed substation locations). Within the area of available habitat for this species, clearance for wind turbines will be nil in many locations and minor in other areas, as the main access tracks and turbine sites are predominantly located in cleared or non-forested areas with many tracks already 20m wide due to existing agricultural land practices. The species typically requires sufficient connectivity of tree cover within

their maximum gliding distance (70m) (Van der Ree *et al.* 2003) to move through the landscape. The proposal will not fragment existing habitat given the minor amount of clearance and access tracks will be no larger than 70m wide.

In total 90 ha (41 ha of good condition) of Inland Scribbly Gum will be removed for the proposal, with 3,753 ha remaining within the project area. Given the Squirrel Glider was not detected during targeted field survey, clearance impacts are not considered to be adverse on this species, and a substantial amount of available habitat will remain within the project area and locality, the proposal is not considered to significantly impact on this species.

7.4.3 Impacts to reptile species

Striped Legless Lizard

This species is typically said to inhabit temperate lowland grasslands, secondary grasslands and occasionally in open Box Gum Woodland. However, the species has also been recorded in degraded habitats such as sites dominated by introduced species (such as *Phalaris aquatica, Nasella trichotoma* and *Hypocharis radicata*) and sites with a history of grazing and pasture improvement (Smith and Robertson, 1999). This species is mostly associated with grasslands supporting a dense cover of perennial tussock grasses, particularly spear grass (*Stipa bigeniculata*) and Kangaroo Grass (*Themeda triandra*) (Osborne et al. 1993, O'Shea 2005). The highest densities of the species have been reported from sites with a *Themeda* ground cover of more than 70 % (Osborne et al. 1993).

One individual of the Striped Legless Lizard was recorded at tile plot 10 (RYP_27) in the northern section of the project area. The species was located on a grazed ridge top supporting a predominantly exotic grassland, with some native species. Common species included: Spear grasses (*Austrostipa* sp.), Thistles (*Sonchus* sp.), Cat's Ear (*Hypochaeris radicata*), and Rye Grass (*Lolium perenne*), with some embedded rock consisting of approximately 10-15% cover. No Kangaroo Grass (*Themeda australis*) was observed in the area at the time the tiles were laid. The observation of the Striped Legless Lizard was made on the ninth tile check of the ten tile checks completed.

The Striped Legless Lizard tile surveys sampled areas of potential habitat across the project area to determine presence or absence of the species. The survey was confined to areas where potential habitat was most likely to coincide with areas to be impacted by the proposed development. As the species was detected the habitat in which it was located and all contiguous habitat of similar structure and condition has been assessed as potential habitat for this species.

Given the species was detected once, it could occur in other areas of grassland habitat of the project area and impact to known habitat of this species could result from the proposal. To determine the extent of impact, management measures have been developed and are prescribed and include undertaking more detailed microhabitat survey of the site (referencing habitat attributes where the species was located) prior to the end of February 2014 to determine the extent of similar habitat within the project area and quantify the extent of clearance impact. These survey results would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible.

Assuming the Striped Legless Lizard could occur in all grassland habitats of the project area, the total impact to potential habitat of this species is 66 ha (including Box Gum Woodland Derived grassland and native pasture habitat). Of these habitat types, 5,887 ha is available within the project area and therefore the ability to offset impact to this species within the immediate project area is achievable.

7.4.4 Impacts to invertebrate species

Golden Sun Moth

The Golden Sun Moth shows a preference for natural temperate grasslands or derived grasslands (derived from Box Gum Woodland) that are dominated by a low and open cover of native wallaby grasses (*Rytidosperma* spp., formerly *Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.), and the introduced Chilean needle grass (*Nassella neesiana*) (Richter *et al.* 2013; DEWHA 2009b). Golden Sun Moths appear to favour slightly sloping, north facing sites with minimal shading. Areas of bare or sparsely covered ground between grass tussocks (inter-tussock space) are thought to be important in helping males locate females and therefore high biomass renders habitat less suitable. Sites that have been pasture improved, fertilised or ploughed are unlikely to provide habitat for Golden Sun Moth.

The Golden Sun Moth was observed at seven of the ten sites surveyed and approximately 200 moths were observed in total. In particular, the southern section of the site appears to support larger numbers of Golden Sun Moth, as well as the area surveyed east of RYP_72. The habitat within these sites was variable and supported a mixture of native grasses and exotic grasses including Weeping Grass, Brush-tail Spear Grass, Wattle Matrush, Wallaby Grasses and localised patches of bracken. Large areas could also be dominated by the annual *Vulpia* spp. These grasses occur in different assemblages across the areas surveyed and abundance of native versus exotic grass cover is related to grazing pressure. The abundance of Wallaby Grasses also varied, from a low abundance and patchy distribution to being more dominant with a tussocky structure (especially in the south of the project area). Condition of habitat therefore varied in the sites surveyed.

The survey results identify that the project area supports small populations of Golden Sun Moth in localised areas that are generally widespread throughout the area in the typical habitat described above. However, within the site Golden Sun Moths were also observed to occupy areas not typical for the species in that they were observed on rocky hillsides, elevated sites, areas where superphosphate has been regularly applied and in grassland areas derived from ecological communities other than Box Gum Woodland. Habitat quality was variable across the areas surveyed, but all sites where moths were observed supported Wallaby Grasses (even if in low abundance).

The Golden Sun Moth survey was confined to areas where potential habitat was most likely to coincide with areas to be impacted by the proposed development. As a consequence of limitations posed by the relatively short survey period for Golden Sun Moth, the large area covered by the proposed wind farm site, and the travel time required between sites, the surveys were targeted at detecting the presence or absence of the moth in higher potential and more typical habitat of Box Gum woodland, Box Gum derived grasslands and to a lesser extent within native pasture. However, based on the above, it is assumed that the area occupied by the species is more extensive than that observed in the current survey as not all areas dominated by native pasture were examined. Potential habitat was recorded to extend beyond the areas likely to be disturbed at most sites where Golden Sun Moths were observed.

The locations moths were observed are currently impacted by transmission lines, access tracks and substation infrastructure, but no turbines. For the transmission line, several concrete poles would need to be erected, requiring vegetation clearing and excavation within small discrete footprints. Spoil would be temporarily stockpiled next to each pole during excavation. Poles and transmission lines would be laid along the ground prior to being raised. During construction and operation, vehicles would travel underneath the lines. For these infrastructure types, the proposal has potential to primarily directly impact the emerged phase of the Golden Sun Moth during habitat clearance (i.e. not below ground other than for

pole excavation). However, as the species was detected on site in variable quality habitats it is likely it could occur elsewhere not assessed during the November 2013 survey.

Therefore, as a precautionary measure, the habitat in which the species was located and all contiguous habitat of similar structure and condition has been delineated as potential habitat. This includes all Box Gum Woodland, derived grassland and native pasture habitats across the project area. To determine the extent of impact in this habitat type and specifically quantify habitat for this species within the project area, management measures have been prescribed to undertake further preconstruction surveys of the final infrastructure layout in accordance with the relevant survey guidelines (Significant Impact Guidelines for the critically endangered Golden Sun Moth *Synemon plana;* DEWHA 2009a) for this species. The results of these surveys would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible. The management protocols for this species would be documented within a management plan, to be implemented as part of the construction process.

However, assuming the Golden Sun Moth occurs in all grassland habitats of the project area, the current total impact for this species is 66 ha. Of these habitat types, 5,887 ha is available within the project area and therefore the ability to offset impact to this species within the immediate area of proposed infrastructure is achievable. Offset sites would target better quality areas of Wallaby Grasses.

Furthermore, there are 15 known populations of the Golden Sun Moth in the general area between Yass and Boorowa, including at Rye Park (DEWHA 2009b) and this species has recently been shown to be more widespread than currently thought, particularly within the Yass Valley region. Recent survey results at another wind farm in the region (Yass Valley Wind Farm) have also shown the species to occur in high numbers (i.e. > 200 individuals). In light of the above, a significant impact to this species is not expected and impacts are considered manageable.

7.4.5 Impacts to woodland bird species

Eight threatened woodland bird species were recorded within the project area during the surveys and include:

- Brown Treecreeper.
- Diamond Firetail.
- Flame Robin.
- Hooded Robin.
- Scarlet Robin.
- Speckled Warbler.
- Varied Sittella.
- White-fronted Chat.

Table 7-6 details the amount of habitat present within the project area for these bird species and the amount likely to be impacted by the proposal. Given the habitat present for these species within the project area in comparison to that to be cleared, it is unlikely that the proposal would result in a significant reduction in habitat for these species. In addition, areas of good quality woodland or forest, including patches comprising movement corridors, have been avoided in the majority of instances. As a result woodland and forest patches would not become fragmented as a result of the proposal.

In particular, the area of mosaic habitat around the transmission line and turbines near RYP_102-110, where a number of threatened woodland birds were observed, was considered in detail. Constraint mapping was expanded outside of the proposed development envelope in order to allow for design

changes to avoid and minimise clearing of vegetation in this area. When mapping the habitat value / constraint in this area, the following was taken into account:

- The ecology of the NSW threatened species (six woodland birds) identified in the area.
- The type and extend of suitable habitat.
- Connectivity between habitat patches provided by shrubland, areas of bracken regrowth, paddock trees, woodland and forest.
- The patterns of movement through the landscape that were observed during surveys.

Recommendations have been made including micro-siting all infrastructure in this location with the aid of an ecologist.

Collision with turbines is not considered a risk for these species as these species were not recorded within the rotor-swept-area during utilisation data or during general observations. These species were observed to stay below 15 m the majority of the time, with many records observed of these species on, or near the ground.

Table 7-6 Likely habitat loss impacts to threatened birds recorded within the project area.

Species	Habitat within project area	Total habitat (ha) within project area	Total habitat to be impacted within project area	% of total habitat to be impacted
Brown Treecreeper	Predominantly Inland Scribbly Gum Forest	3,753	90	2.4%
Diamond Firetail	Box Gum Woodland Native Pasture	7,442	91	1.2 %
Flame Robin	Inland Scribbly Gum Forest Native Pasture	8,127	150	1.8 %
Hooded Robin	Inland Scribbly Gum Forest Native Pasture	8,127	150	1.8 %
Scarlet Robin	Inland Scribbly Gum Forest Native Pasture	8,127	150	1.8 %
Speckled Warbler	Inland Scribbly Gum Forest	3,753	90	2.4 %
Varied Sittella	Inland Scribbly Gum Forest	3,753	90	2.4 %
White-fronted Chat	Native Pasture	4,374	60	1.3 %

7.5 FAUNA COLLISION RISK SPECIFIC TO RYE PARK WIND FARM

7.5.1 Impacts to bird species

The flying heights of bird species varies considerably; many birds rarely, if ever, reach rotor-swept height, while others do so routinely and some frequently fly above that height (Sharp 2010). In relation to the Rye Park project, the wind turbines under consideration have a typical hub height of 90 m – 101 m and a typical blade length of between 45 to 56 m. The tallest wind turbine tip height combination under consideration is 157 m. At risk flight heights (i.e. within the rotor-swept area) are therefore between 40 m and 157 m. The tips of turbine rotors generally travel at speeds of between 200 and 300 km/h (Smales 2006). The species listed below are considered to be most at risk from collision risk. Where appropriate, the impact of habitat loss for these species is also discussed.

- Superb Parrot.
- Powerful Owl and Barking Owl.
- Painted Honeyeater.
- Swift Parrot (Migratory).
- White-throated Needletail (Migratory).
- Regent Honeyeater (Migratory).
- Rainbow Bee-eater (Migratory).

Superb Parrot

The Superb Parrot forages in Box Eucalypt Woodland, particularly that dominated by Yellow Box (*E. melliodora*) or Grey Box (*E. microcarpa*). After breeding, Superb Parrots generally move away from their breeding habitat in mid-January (Webster 1988, 1997). Large flocks of adult and immature birds roam widely in search of food, and may be observed in various habitats at this time (Webster 1988). Superb Parrots were recorded during November 2011 and 2013 surveys at Rye Park; they were not recorded in April 2012 or July 2013. Thus, Superb Parrots were observed to use habitats in the project area and locality during their nesting season (September to January). It can be assumed that they disperse to other foraging grounds outside of nesting season.

General results

The results of Superb Parrot transects and flight path mapping suggest that Superb Parrots are commonly recorded to the west of the project area, especially along Rye Park Road, and are likely to utilise habitat outside or adjacent the western boundary of the project area within open grassland or Box Gum Woodland, except for a discrete area in the southern end of the project area where parrots were commonly recorded This location (near Site 8 viewing station) is the only one within the project area that was primarily used by the Superb Parrot as habitat on a regular basis (discussed in more detail below).

Primary flight paths appear to run in a north-south alignment along the western edge of the project area, or from the western edge of the project area further west towards Boorowa (Appendix E.4). It is expected that Superb Parrots are moving regularly between the western edge of the project area and Boorowa (a known important breeding area for the species), but are not coming from further east of the project area for the following reasons:

- Parrots were regularly observed in higher numbers and larger flocks then at the project area when travelling to Boorowa during the survey week.
    - This habitat west of the project area supports greater expanses of foraging resources including commercial crops and wider open grassland habitat with scattered trees that once constituted Box Gum Woodland. The Inland Scribbly Gum on ridgelines which comprised most of the vegetation type within the project area was not utilised by the parrot.
- Habitat on the eastern side of the project area was not observed to be utilised by the Superb Parrot during transect surveys and parrots were not recorded flying from the west, where they were observed, to the east across ridges.
    - This conclusion has been made as observers stationed to the west of the project area observed birds, whereas observers stationed east of these observers within the project area did not observe birds. Further reasoning for this conclusion is provided in Table 7-7.

It is therefore concluded that Superb Parrots are common to the west of the project area, but are not moving across the ridges proposed for turbines and are not undertaking large-scale movements at higher

elevations (i.e. at rotor-swept-area height) in this direction and risk of collision impact is low overall. Rather, movement nearby the project area consists of local movements within discrete areas where foraging habitat is available. Superb Parrots generally followed corridors of vegetation and flew below canopy height (i.e. less than 20 m). In particular, Rye Park Road is regularly utilised by the parrot and is considered important roadside vegetation for this species in the locality. The species was recorded in higher abundance along this road than anywhere else within the project area.

Known database records of the Superb Parrot in NSW are located to the west of the project area, but are generally absent from the project area. These records suggest the parrot relies on movement to the west and outside of the project area confirming the flight path mapping results from this current survey (Figure 7-1).

Potential impact area – Southern section of project area

The total clearance impact to Box Gum Woodland habitat would be 25 ha, with 1,555 ha remaining within the project area; however, the greatest impact to this species is considered to occur where the Superb Parrot was observed regularly in one area at the southern end of the project area (near viewing station site 8), with 17 flight observations made in this area over the three days of flight path mapping. Most of the movement appeared to be localised to the distribution of Box Gum Woodland habitat and Native Pasture south of RYP_106 and north or RYP_120 within this area. It is possible the parrot is using the Box Gum Woodland that runs in a north to north-east direction as a movement corridor for local movements to forage and breed in this area. This habitat coincides with proposed infrastructure of turbines RYP_106 to RYP_110 and an area proposed for a transmission line. This is also the only location parrots were recorded flying at higher elevations (up to 50m). As a result the turbines RYP_106 to RYP_110 have been highlighted as a high constraint for potential collision risk.

However, as Superb Parrots are making localised movements in this area and staying within Box Gum Woodland habitat they are considered unlikely to collide with turbines as they are not making long range and large-scale movements. Their foraging movements comprise of tree hopping and rest-stops and it is considered the spacing of turbines at a minimum of 300 m would allow safe passage of this species within the area during these types of movement. The potential collision risk to this species overall is therefore not considered to result in a significant impact to this species, especially as the majority of the population within the locality occurs outside the project area and was observed flying within the tree canopy or below 20 m on most occasions.

However in light of the above, recommendations have been made to include the Superb Parrot within an operational Bird and Bat Management Plan. It should also be noted that a proposed transmission line that extended further west of the current transmission line in this area has been removed from the layout to avoid impact, as much as possible, to Box Gum Woodland and threatened species occupying this habitat.

Nest trees

Two of the three identified nest trees also occur within this southern section of the project area, however these nests are buffered by at least 600 m to the nearest turbine. Additionally, two potential nest trees were also mapped in the same vicinity. Transmission lines are proposed in the areas of identified nest trees and recommendations to apply a minimum of 100 m buffer to both known and potential nests trees is prescribed. Tracks and transmission lines will require micro-siting with the aid of an ecologist within these areas. The third nest tree is identified outside the western boundary of the project area along Flakney Creek Road and no impact to this tree will result from the proposal. Impacts to known breeding resources of the Superb Parrot will therefore be avoided.

Clearing has the potential to affect breeding habitat, namely hollow-bearing trees (especially Yellow Box) in Box Gum Woodland. Hollows suitable for breeding by the Superb Parrot within the project area are generally scattered across the landscape as a result of the cleared and fragmented nature of the remnant Box Gum woodland. However, the southern section of the site is the primary area breeding is expected to occur due to the presence of the known nest trees, as described above. Appendix E.4 shows mapped hollow-bearing trees within moderate to good quality vegetation and displays quality of hollows as low to high. Hollows mapped as high quality were considered suitable for the Superb Parrot; these hollows were either trunk or branch hollows that were not exposed (i.e. not jagged at the entrance and open) and of suitable size for this species. As a result of the proposal, three hollows designated as high quality within potential Superb Parrot habitat would be removed by the proposal; however no evidence of parrots utilising these hollows was observed at the time of survey.

In summary, the greatest potential for impact to breeding habitat occurs along the proposed 132kV transmission line within the southern section of the project area; however, the magnitude of impact for habitat loss for Superb Parrot is likely to be low to moderate (around 1% of available hollows to be cleared) and unlikely to lead to a long-term decrease in population size, reduce the area of occupancy or fragment the existing population.

Design measures (Section 8) were undertaken to avoid areas identified as important to the Superb Parrot and to maintain connectivity throughout the project area. Further recommendations have been made for hollow-bearing tree pre-clearance surveys, and micro-siting of infrastructure to avoid hollow-bearing trees, where possible. Recommendations are also given to offset or replace (with artificial hollows) all hollows that are cleared during the construction phase. Thus, it seems unlikely that habitat loss for Superb Parrot at Rye Park would place the local population at risk of extinction.

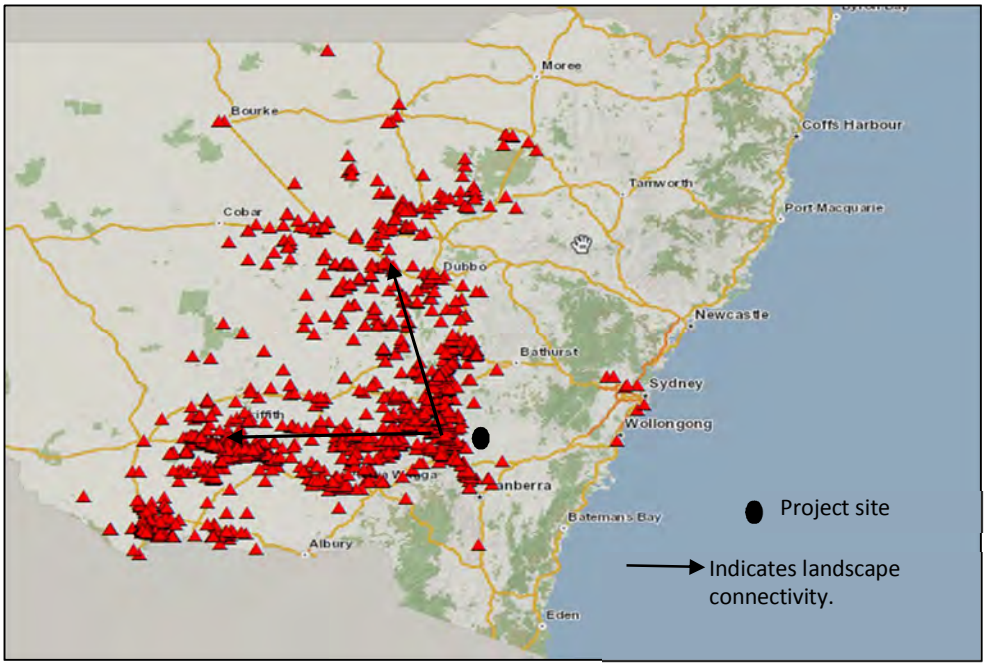


Figure 7-1 Known records for the Superb Parrot in relation to the project area, detailing movement patterns to the west (OEH 2013, Bionet – Atlas of NSW Wildlife)

Table 7-7 Flight path mapping stations Superb Parrots were recorded and the corresponding viewing station used to determine if Superb Parrots were moving from the west (where they were regularly observed) to the east across the project area (refer Appendix E.4 for flight path mapping results and location of viewing stations)

Viewing station Superb Parrots recorded	Corresponding viewing station used to determine if Superb Parrots were moving from the west to east across the project area	Comment on observed flight paths
Site 1	Site 2	Site 2 was located east of site 1 on a ridge in an area of proposed turbines. While several observations were made of Superb Parrots at Site 1, no observations were made at Site 2 indicating the parrots did not move east across the ridgeline during the survey.
Site 3	None	One flight observation was made at Site 3 on one of the three days of survey. One parrot was observed to fly south away from proposed infrastructure to a patch of forest classified as Box Gum Woodland. The lack of observations at this site indicates the area is not regularly used as a flight path and parrots are not moving west to east across the project area. These results are supported by the non-detection of the parrot at SP12 transect which lies just east of this viewing station.
Site 4	Site 5	Site 5 was located on a ridge in the middle of an area of proposed turbines that extend north and south of this viewing station. This viewing station was considered an important vantage point and a spotting telescope was used to improve viewing range. While several observations were made of Superb Parrots at Site 4 outside the project area, no observations were made at Site 5 indicating the parrots did not move east across the ridgeline during the survey.
Site 6	Site 7	One flight observation was made at Site 6 on one of the three days of survey. Two parrots were observed to fly south-west away from proposed infrastructure to an individual tree. Site 7 was considered an important vantage point and a spotting telescope was used to improve viewing range. No observations were made from Site 7 of parrots moving from Site 6 across the project area. The lack of observations at Site 6 and the non-detection of parrots at Site 7 indicates the area is not regularly used as a flight path and parrots are not moving west to east across the project area. These results are supported by the non-detection of the parrot at SP21 transect which lies just east of Site 6.
Site 8	Site 7	Site 7 was considered an important vantage point primarily for Site 8 which recorded the highest activity of parrots in the project area. Several observations were made of Superb Parrots at Site 8, no observations were made at Site 7. Flight observations at Site 8 indicate a probable movement corridor between RYP_106 and RYP_120 which encompasses Box Gum Woodland and native pasture habitat. However birds do not appear to be coming further from the north near RYP_104 (i.e. where Site 7 viewing station was located) as no observations were made at this location.
Site 10	Site 3	One flight observation was made at Site 10 on one of the three days of survey. Three parrots were observed flying along Rye Park – Dalton Road in a north – south direction. Superb Parrots were regularly observed within roadside vegetation along Rye Park Road during surveys. No parrots were observed flying east across the project area from Site 10 or Site 3, but rather birds were observed flying north or south outside the project area. The lack of records at both sites indicates parrots were not regularly moving across the project area in this area.

Powerful Owl and Barking Owl

Habitat for threatened large forest owls is marginal within the wind farm site, especially for the Powerful Owl. Several rounds of design layout changes have been undertaken to remove the majority of turbines away from woodland / forest areas. In recent surveys (July 2013), hollow bearing trees were mapped where they occurred within 100m of indicative turbine locations in high quality forest habitat. This survey confirmed one location only (near RYP_104) supports mature eucalypt species with numerous hollows of varying size near a proposed turbine site. This area will not require clearance for this turbine and has been identified as a high constraint area to avoid. The areas where turbines remain are unlikely habitat for these species given the lack of flora diversity and mature woodland / forest. Large hollow-bearing trees and suitable nesting and roost sites are absent in these areas.

Both the Powerful Owl and Barking Owl roost in dense foliage in large trees or dense mid-canopy trees including rainforest species of streamside gallery forests, casuarina species, Angophora or large *Acacia* species, or for the Powerful Owl the turpentine tree. Roost sites are often in sheltered moist gullies or watercourses. The proposal will not affect habitat of this type nor is it available within the project boundary.

For both species hollows have to be large for nesting surrounded by canopy trees and sub-canopy, or understorey trees or tall shrubs. In particular, the Powerful Owl requires hollows greater than then 45 cm wide and 100 cm deep. Those of a size used by owls for nesting and roosting form in trees greater than 150 cm trunk diameter and probably greater than 200 years old (Lindenmayer et al. 1991, Milledge et al. 1991).

Both species predominantly forage on medium-sized arboreal marsupials such as the Common Ringtail Possum and Sugar Glider. However, the Powerful Owl predominantly forages on the Greater Glider in escarpment and tableland forests which has been reported to comprise 80% of its diet. Tree hollows used by many of the Powerful Owls main prey species is said to form in trees greater than 120 years old (NSW Department of Environment and Conservation 2006) which are not available within the project area.

Depending on forest productivity, several major prey species (the gliders and large possums) are each likely to require at least 1-2 hollow trees per hectare, and up to 10-20+ den trees per hectare in the best habitat (Gibbons & Lindenmayer 1997). Hollows of at least medium size in these densities are not present across the project area. While the Common Brush-tailed Possum occurs within the project area and would be a prey species, results of Koala scat searches suggest the possum does not occur in high densities given scats can be easily identified but were rarely observed within any of the Koala scat search areas. The possum was also not readily detected during 17.25 hrs of spotlighting surveys across forested areas of the site.

Based on these factors (paucity of mature habitat, abundance of prey species), the project area does not support roosting or breeding habitat and is unlikely to provide important foraging habitat, especially for the Powerful Owl. The Barking Owl is more likely to forage through the area than the Powerful Owl but no records are known for this species within at least 40 km of the project area. The proposal is therefore not considered to have a significant impact on these species.

Painted Honeyeater

The Painted Honeyeater is nomadic and occurs at low densities throughout its range. Some north-south migratory movements have been reported for the Painted Honeyeater in which the species moves north to Queensland in winter and is considered a breeding spring to summer visitor in NSW. Within NSW the greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range. The species inhabits Boree, Brigalow and Box Gum Woodlands and Box-Ironbark Forests and is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias (OEH 2012).

Painted Honeyeaters were predominantly observed west of RYP_106 to RYP_120 in the southern section of the project area within Box Gum Woodland in trees supporting flowering mistletoe in November 2013. The species was not recorded within the project area during previous surveys and is not common to the area. No records for this species are known for the locality and the closest concentrations of records are at Cooatmundra and near Wagga Wagga, indicating the records observed at the project area are outside the known distribution for this species.

Approximately 10-12 individuals were observed foraging in Box Gum Woodland in the south of the site on a regular basis in November 2013. Individuals of this species were also along Flakney Creek Road (outside the project area) and west of RYP_4, however Box Gum Woodland is not widely available in the north of the site and is reduced to scattered trees, therefore the lower numbers observed at RYP_4 are reflective of the amount of available habitat.

The Painted Honeyeater's movements are correlated with the flowering and fruiting of mistletoes at different localities. The detection of the Painted Honeyeater in the project area this year and not the other years may be a result of the species needing to fly further east (i.e. increasing its distribution) in pursuit of foraging resources given that dry weather was experienced further inland in 2013 which may have reduced its flowering resources.

The area used by Painted Honeyeaters in the south of the project area also corresponds to the Box Gum Woodland habitat being used by Superb Parrots. As mentioned for Superb Parrots, a transmission line was proposed for this area but has been removed from the layout to avoid the better quality Box Gum Woodland within the site; most of the records observed for this species were in this area and consequently the majority of habitat utilised by this species has been avoided. The remaining Box Gum Woodland habitat will be affected by the existing transmission lines but this area is highly fragmented and trees supporting mistletoe are in lower abundance (i.e. scattered across paddocks). Recommendations have been made to micro-site the transmission line in areas of Yellow Box trees supporting mistletoe in this area to avoid further impact to potential foraging resources for this species. The impact of the proposal to Box Gum Woodland habitat for this species is therefore considered low.

It is unknown if the species will continue to be a regular inhabitant of the Rye Park wind farm, although it can be assumed that the species can travel between the project area and other foraging grounds given its presence in November 2013. It is unknown what heights the species flies at when making migrating movements, but it is possible the species would fly at blade height as it is capable of migrating long distances. Although, when present within an area for foraging it is expected the species would remain at canopy level where it forages within mistletoe, which was the behaviour observed during this assessment. All observations of this species were made opportunistically in which flight height was recorded; the maximum flight height recorded for this species was 15 m. However in light of the above, recommendations have been made to include the Painted Honeyeater within an operational Bird and Bat Management Plan.

Swift Parrot

The Swift Parrot was not recorded within the project area during targeted surveys for the species. The species migrates to the Australian south-east mainland between March and October to forage. On the mainland this species predominantly inhabits dry sclerophyll eucalypt forests and woodlands, in particular, temperate box ironbark woodlands. The South-west Slopes of NSW IBA supports a significant wintering population of the endangered Swift Parrot. For this species a specific risk window exists during their migration period (winter), in terms of the operational impact of the wind farm.

During the non-breeding season this Swift Parrot feeds extensively on nectar and lerp and other items from eucalypt foliage. Mugga Ironbark (*E. sideroxylon*), Red Ironbark (*E. tricarpa*), Yellow Box (*E. melliodora*),

White Box (*E. albens*), Grey Box (*E. macrocarpa*) and Yellow Gum (*E. leucoxylon*) are important sources of nectar in the box-ironbark forests and woodlands of NSW (Kennedy & Tzaros, 2005). Grey Box, River Red Gum (*E. camaldulensis*) and White Box are major sources of lerps in these areas at times.

Of these feed trees only two are known for the project area, Yellow Box and Mugga Ironbark. Yellow Box is located within Box Gum Woodland habitat as scattered trees. Mugga Ironbark is rare to the project area and was only identified in one location in the north of the site as scattered individuals; this area will not be impacted by the proposal. In general, the areas surveyed are heavily degraded and exist as either open woodland over grassland (with no mid- or understorey stratums) or as derived grassland with scattered trees. The abundance of flowering feed trees within the project area for the Swift Parrot are therefore low in abundance and the species is more likely to use roadside vegetation or larger remnants where greater diversity of feed trees are present.

As impacts to Box Gum Woodland have been largely avoided in the project design and little habitat is present within the project area for the Swift Parrot, apart from those areas targeted for survey in July 2013 in which the species was not detected, the project area is not considered to support an important foraging area for this species.

Database searches indicate there are no Swift parrot records within Murrumbateman CMA, but records are scattered for the Upper Slopes CMA. Records across NSW indicate a strong presence of this species to west of the project area where more Box Gum Woodland would be located (i.e. towards Boorowa) or along the east coast where more Ironbark species are located (Figure 7-2). It is expected the movement of this species would commonly occur through these connections where better quality foraging resources exist, given the species was not detected within the project area during targeted surveys.

As a result the project area is not considered to support important foraging habitat for these species, especially as the species was not observed during targeted surveys, and impact to this species from the proposal will not be significant.

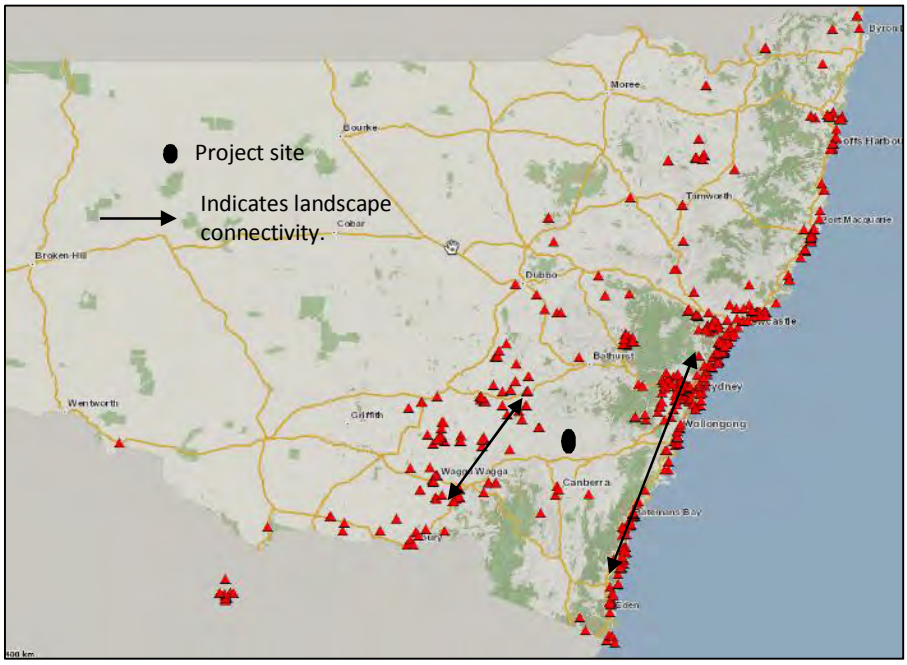


Figure 7-2 Known records for the Swift Parrot in relation to the project area, detailing most records common to the west of the project area or along the east coast (OEH 2013, Bionet – Atlas of NSW Wildlife)

White-throated Needletail

White-throated Needletail was not recorded during surveys, but based on records in the Atlas of Living Australia there is potential for the species to occur. The species is a seasonal migrant present in Australia outside of breeding season, and may occur in large flocks foraging aerially at heights of up to 1,000 m above the ground (SEWPAC 2012). As the species breeds overseas, the potential for impact would be upon migration resulting in potential collision risk during the operational phase of the wind farm. It appears to collide with wind turbines in some areas and the species has been affected at other wind farms around eastern Australia, with one Bird Monitoring Report recording that "no other non-raptor species had more than four mortality events over the 3 year period" (Roaring 40s Renewable Energy 2010).

Based on the collision data presented in Table 7-1, on average there may be around four collisions of White-throated Needletails per year at Rye Park. However, an even temporal distribution of mortality events of this species is unlikely given the natural flux in numbers across season and weather conditions. Although the species' total population is unknown, it is thought to be abundant in areas where it is found (SEWPAC 2012). Given the huge area of occupancy of this species, the Rye Park wind farm is unlikely to affect an ecologically significant proportion of the population.

Regent Honeyeater

The Regent Honeyeater primarily inhabits temperate woodland and open forest of the inland slopes of south-east Australia, particularly Box-Ironbox woodland. The species prefers the wettest, most fertile sites within these associations such as along creek flats, broad river valleys and foothills. The species is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box (Menkhorst et al. 1999). Potential foraging habitat is primarily present within the Box Gum Woodland within the project area, which includes the feed tree Yellow Box.

There are three known key breeding regions for this species including: Chiltern-Albury in north-east Victoria; Capertee Valley, NSW; and the Bundarra-Barraba region, NSW. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands, although other lesser used breeding sites also occur. The species is known to make large-scale nomadic movements across the landscape, which is thought to coincide with the flowering times of different eucalypt species on which they feed.

The Guidelines suggest bird searches of woodland patches with heavily flowering trees, especially around waterpoints, such as creeklines. Woodland patches within the impact area were surveyed during bird surveys, especially areas supporting the larger Yellow Box trees which were flowering at different times of the survey and supported mistletoe. The method employed such as listening for calls during the known breeding season within the most appropriate habitat type available within the impact area is considered adequate to detect this species.

This species was not detected during bird surveys of the project area and the project area is not considered to support primary breeding and foraging habitat (i.e. wetter areas supporting Box-ironbark Eucalypt associations or feed trees). Two species of mistletoe were recorded on site, but are not widely distributed and occur in low densities. However, as this species is nomadic and movement patterns are often linked to availability of resources, it can be assumed that they may travel through the project area to other foraging grounds. Therefore it is considered there may be a potential operational risk of blade-strike to this species; however, at the time of survey this species was not observed to utilise the project area.

Records across NSW indicate a strong presence of this species to the south, east and north-east of the project area in better quality habitat (i.e. National Parks) and could be considered an important landscape connection. This area traverses Namadgi NP, Morton NP, Nattai NP and Blue Mountains NP (Figure 7-3). It is expected the movement of this species would commonly occur through this connection where better quality foraging resources exist.

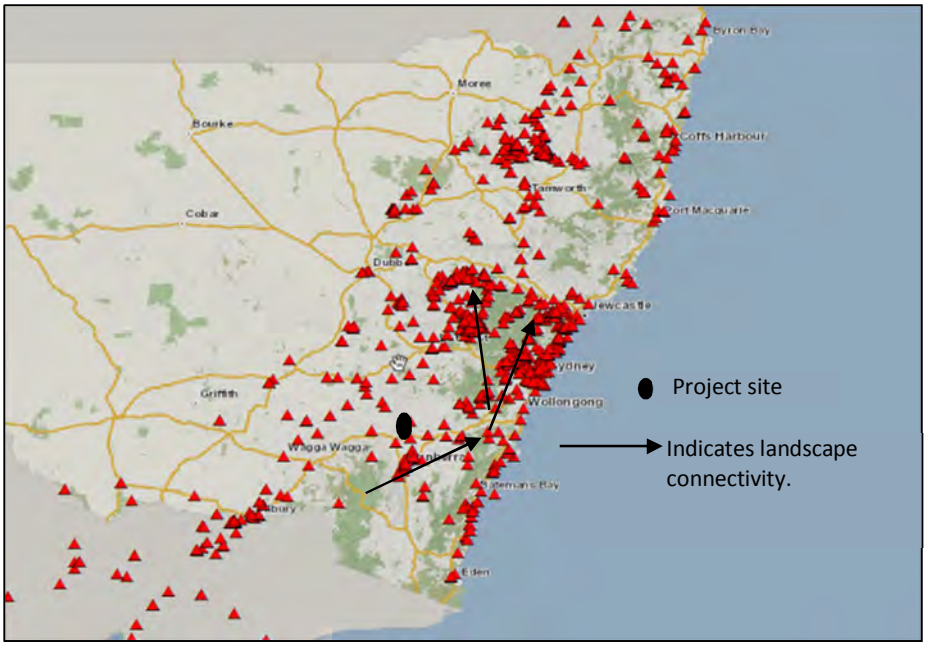


Figure 7-3 Known records for the Regent Honeyeater in relation to the project area, detailing movement patterns to the east (OEH 2013, Bionet – Atlas of NSW Wildlife)

Rainbow Bee-eater

The Rainbow Bee-eater inhabits a variety of habitats including open woodlands, it also occurs in riverbanks, sandspits, road cuttings, beaches and golf courses. The species is a summer breeding migrant (Sept-Apr) to south-eastern Australia, but winters in northern Australia, Solomon Islands, PNG and Indonesia, moving in large flocks (SEWPAC 2012). This species was detected outside the project area to the west on Flakney Creek Road. Potential habitat for this species is present on site and this species is considered most at risk from blade-strike during operation. However, as the Rainbow Bee-eater is a common and secure species and widespread within its Australian and global distribution and given the high manoeuvrability of the species it is considered unlikely that the proposal would result in impact such that there would be a population scale effect on the Rainbow Bee-eater.

7.5.2 Impact to raptor species – collision risk

The flights heights and behaviour of raptor species typically places them at risk of potential collision with turbines. Two species were considered to be at higher risk from collision at the Rye Park wind farm due to their foraging behaviour in which they soar and dive from heights above or within the rotor-swept-area. The wedge-tailed Eagle was recorded within the project area, however the Little Eagle was not recorded but has the potential to occur based on known database records for the locality.

Wedge-tailed Eagle

Although Wedge-tailed Eagle (*Aquila audax*) does not have a rating under legislation, it is recognised as an at risk and flagship raptor species in relation to wind farm developments. As mentioned, Wedge-tailed Eagles exhibit a lower collision avoidance rate than other species of birds. Reasons for this including size, manoeuvrability and hunting style are discussed in the literature. In large part the higher risk seems attributable in part to flight behaviour and the use of territories. If turbines are placed within the core territory of an individual Wedge-tailed Eagle, for example, then the likelihood of a collision is greatly increased for this individual due to the high proportion of flights made within the rotor-swept area by the species and their regular use of updraughts in certain landscape positions (often coinciding with turbine placements). To minimise risk to Wedge-tailed Eagles, proposed turbine locations at Rye Park were classed as high or moderate risk based on landscape position, such as on an escarpment, at the head of a valley or atop an isolated peak away from other turbines. Turbines in high risk locations have been moved (refer to Section 8).

Little Eagle

While Little Eagles have not been recorded in the Australian carcass search literature cited herein, it is a medium sized raptor with similar soaring and prospecting foraging behaviour (Aumann 2001) as the Wedge-tailed Eagle and may be similarly at risk from turbines in certain landscape positions. As for Wedge-tailed Eagles, juvenile Little Eagles with turbines near nests would be most at risk.

Little Eagles were not recorded during surveys at Rye Park but are known to occur in the locality. Should a Little Eagle forage or nest in the project area, the proposal has potential to affect the species during the operational phase. That is, the turbine rotors present a collision risk to the species. As no Little Eagle nests were found within 100 m of surveyed proposed turbine locations, the risk to fledging Little Eagles is considered low. Adult birds, including raptors, have generally shown an ability to habituate to the turbines by taking avoidance action around rotors or by modifying their behaviour (such as approach a root at the head of a gully from below rather than above – EBS Ecology 2012). Further, the carcass monitoring results reviewed (refer Table 7.1) suggest common species are most at risk of colliding with turbines. Thus on the basis of probability it appears unlikely that a viable local population of Little Eagle at Rye Park would be placed at risk of extinction from the wind farm proposal. However, this species should be a focal species of an operational Bird and Bat Management Plan to confirm the assumptions of this assessment, addressing inherent uncertainty.

7.5.3 Impact to microbat species – collision risk

Bats forage around woodland vegetation, in open space and over open water, dependent on the species foraging strategies. Many bat species use an 'edge-space' aerial foraging strategy focussed on treed habitat and water bodies, and are expected to stay within close proximity to these features (Churchill 2008). This is generally the case for the bat species recorded during the field survey.

Linear features such as roads, drains and ridges have been recorded to have high bat activity (often associated with vegetation or water) and bats have been observed to navigate and forage along the length of these features (Churchill 2008). Higher bat activity levels were generally observed in wooded areas of the project area, where bat foraging and roosting habitat is higher. Suitable bat roosting habitat is present in the forest vegetation of the project area, specifically the Inland Scribbly Gum Forest which comprises the bulk of the vegetation in the project area.

Bat-strike interactions are likely during the operation of proposed wind turbines in the project area. Although it is not specifically known which species may fly within the rotor-swept area, a risk assessment that considers the flight height of bat species recorded for the project area was completed using flight characteristics currently presented in literature (Appendix A.6). As a result of the risk assessment, four species were considered to be most at risk of collision from the proposal based on their conservation rating, flight height and flight characteristics and included: 1) two threatened bats, the Yellow-bellied Sheathtail Bat and Eastern Bentwing Bat; and 2) two non-threatened bats, the White-striped Freetail Bat and Gould's Wattled Bat. These species are discussed in more detail below.

Without a more detailed knowledge of the bat species present, their distribution and their behaviours in the project area (pre/post construction and during operation) it is difficult to accurately assess the impacts of the proposed wind farm on bats. Therefore, ongoing monitoring of bat populations is recommended to gain a better understanding of their utilisation of the site and confirm the assumptions of this assessment.

Eastern Bentwing Bat

The Eastern Bentwing Bat inhabits a diverse range of forest types and roosts and raises its young in caves and mine tunnels. The species appears to be widely distributed throughout NSW. The Eastern Bentwing Bat is reported to be a fast and direct flier that forages above the canopy and in open areas and will travel up to several hundred kilometres to over-wintering roosts (Churchill 2008, Lloyd *et al.* 2006), which place it at risk of collisions. In overseas studies, the most affected group of microbats are migrating bats (Cryan and Barclay 2009).

Thirty-six calls of the Eastern Benting Bat were recorded within the project area primarily within Inland Scribbly Gum Forest along the ridgeline supporting turbines RYP_80 to RYP_143. This habitat type is considered the most suitable within the project area for temporary roosting sites and a total of 90 ha will be removed, with 3753 ha remaining within the site boundary.

Given the mobility of the species it could forage anywhere within the project area, and the relatively small areas of forest, woodland and grassland habitat to be removed or modified over the project area are not considered to adversely affect the foraging ability of this species. The species is considered more at risk from the proposal from potential collision with operational turbines. The flight height and migratory movements of this species make it potentially vulnerable to blade-strike.

The layout has two distinct areas of turbines with a spacing of approximately 5 km between them. Spacing between turbines in the current layout is generally around 300-500 m. The distance between turbine clusters and also the distance between individual turbines is likely to allow for safe passage between turbines, without creating a barrier effect.

The risk of the proposal impacting on breeding populations (i.e. maternity caves) is low as the nearest maternity cave is 40 km away. There is a staging area and maternity cave in the region (near Bungendore approximately 65 km away and Wee Jasper approximately 40 km away, respectively) for Eastern Bentwing Bat; these are used by a large proportion of the female and juvenile population. It is possible that the local population of Eastern Bentwing Bats may spike slightly when a large proportion of the female and juvenile population migrate to and from the maternity cave (November and February-March); however Anabat results were recorded within November 2011 and 2013 and suggest a relatively low abundance of this species within the project area at this time.

It appears unlikely that the local population would be placed at risk of extinction from the wind farm proposal given that the proposal is not near Wee Jasper or the Bungendore staging area and a relatively low number of calls of this species were detected. However, this species should be a focal species of an

operational Bird and Bat Management Plan to confirm the assumptions of this assessment, addressing inherent uncertainty.

Yellow-bellied Sheathtail-bat

Four calls of the Yellow-bellied Sheathtail-bat were recorded within the project area within one location. Although this species occurs across much of Australia, it is never found in large numbers. The species migrates from northern Australia into south-eastern Australia during the summer months (Churchill 2008), but as it flies predominately above the tree canopy, it is rarely trapped or detected via AnaBat. This species is considered an occasional seasonal visitor that may roost temporarily in tree hollows within the project area. The flight height of this species make it potentially vulnerable to turbine strike, however given it is an infrequent visitor, the overall risk to the species is considered low. However, this species should be a focal species of an operational Bird and Bat Management Plan to confirm the assumptions of this assessment, addressing inherent uncertainty.

White-striped Freetail-bat and Gould's Wattled Bat

Although the White-striped Freetail-bat does not have a rating under legislation, it is recognised as an at risk bat species in relation to wind farm developments due to their foraging and flight behaviour. The White-striped Freetail Bat is a relatively large microbat that pursues prey in open air above canopy height (around 50 m above ground – within RSA) at high speed (up to 60 km per hour). Due to speed and wing structure, they are not a highly manoeuvrable bat (Churchill 2008). Observations show that the species is a relatively straight path flier and appear to have limited ability to turn (McKenzie et al 2002). The echolocation call design of the White-striped Freetail Bat, which provides individuals with information to navigate through their environment, is a slow low frequency pulse which provides a low resolution picture (Herr 1998). Its echolocation call design is used for target detection of prey rather than navigating cluttered environments, hence the species' utilisation of open habitat (Rhodes 2006). The characteristics of its echolocation calls as well as flight and wing design mean White-striped Freetail Bat have a poor ability to detect and avoid obstacles (such as rotors) during pursuit flight. While White-striped Freetail Bats occupy a wide range of habitats including woodland, forest, agricultural land and grasslands (Churchill 2008), habitat preferences are correlated with open areas in canopy gaps and along the edge of vegetation and it is more active on upper slopes (Lloyd *et al.* 2006).

Like the White-striped Freetail Bat, the Gould's Wattled Bat does not have a rating under legislation, but it is a relatively large microbat and a fast, high flier with restricted manoeuvrability (Herr 1998) the may put it at higher collision risk. The Gould's Wattled Bat also have an echolocation call design which provides a low resolution image of its environment ideally suited to fast flying in open areas (Herr 1998) meaning this bat too has a poor ability to detect and avoid obstacles while pursuing prey, particularly mobile ones such as rotors. This species hunts most in the sub-canopy and along flyways, particularly on upper slopes (Lloyd *et al.* 2006), so turbines located between closely linked patches of bush or within patches are likely to present the highest risk to Gould's Wattled Bat.

While these species are not threatened they should also be a focal species of an operational Bird and Bat Management Plan. Management measures to reduce risk to common species will also be considered at the operational stage of the proposal.

7.5.4 Alienation or Barrier effects (susceptible fauna species)

Each bird species and/or individuals response to turbines is likely to differ based on their own sensitivities or tolerances. There have been no published studies of the effects of wind farms on the behaviour of Australian birds, so it is difficult to evaluate the extent to which bird communities will be adversely affected. The distance over which disturbance effects can extend from a wind farm varies considerably. A distance of 600 m is often reported as the zone of disturbance around turbines, however this ranges, e.g. from 80 m (for a grassland songbird), to 800 m (for waterfowl) and 4 km (for seabirds) (Sharp 2010).

The most obvious approach to mitigate the risks posed by a wind farm on bird movements and behaviour would be to space turbines at a distance that allow birds to fly between them. There are no generally accepted minimum separation distances for turbines. The Rye Park layout has two distinct areas of turbines with a spacing of approximately 5 km between them, and in specific areas clusters of turbines are separated by at least 1 km to the next cluster. Spacing between individual turbines within clusters in the current layout is generally around 300 - 500m. There is no evidence to suggest that this spacing is sufficient to manage the risk of potential bird strike, but it is generally considered that the greatest the distance allowed between turbines, the better. For the majority of birds recorded within the project area, such as woodland birds which were not recorded to make large movements above the canopy, the distance between turbine clusters and also the distance between individual turbines is likely to allow for safe bird passage between turbines, without creating a barrier effect. Additionally, the arrangement of turbines into clusters in may better enable birds to use the gaps between turbine clusters when travelling across the landscape.

Landscape connectivity and protected areas

Bango Nature Reserve

Bango NR lies east of RYP_123 and RYP_126. Most of the vegetation recorded in the reserve is common in the region although Box Gum Woodland is considered likely to occur. Several threatened species have been recorded in the reserve: Yass Daisy, Gang-gang Cockatoo, Scarlet Robin and Varied Sittella. As the reserve appears to support forest (and potentially woodland) in moderate and good condition, it is considered to be of moderate conservation significance. It should be noted that no part of the reserve would be directly impacted by the proposal, i.e. no vegetation would be cleared within the reserve therefore no direct impact upon vegetation communities of conservation significance, threatened species habitat or connectivity. Therefore, any impact of the proposal on Bango NR would arise from the operational phase.

Based on the threatened fauna recorded in the reserve, (Gang-gang Cockatoo, Scarlet Robin and Varied Sittella), the siting of turbines close to reserved habitat is not considered a high operational risk (i.e. blade-strike) and collision is considered unlikely for these species.

In terms of objectives in reserve management that have potential to conflict with the siting of wind turbines nearby, the POM states that the "Promotion of visitor understanding and appreciation of the values of the Reserves is important ..." (NPWS 2011 p.25) and pack camping is allowed in Bango NR (although not promoted). However there are no guidance documents in terms of appropriate setbacks for turbines near conservation areas. Given that biodiversity risk appears to be low (in terms of vegetation clearing or operational risk) **ngh**environmental (2012a) recommended turbines be setback between 150-200 m from the reserve boundary in order to minimise conflict with reserve objectives. However the proposal has a setback of around 70 m.

7.5.5 Buffers for birds and bats

Bird and bat activity levels are generally concentrated around areas of vegetation. A minimum buffer of 70 m from the turbine blades is recommended for areas of high habitat value for birds and bats and is now a recent standard recommended by OEH.

The activity of the majority of bat species utilising the project area is likely to be highest in moderate or moderate-good quality wooded areas (i.e. Inland Scribbly Gum Forest). Wooded areas are more likely to be used for foraging and roosting by a greater abundance and diversity of birds then areas supporting degraded woodland over pasture, or those absent of trees. A 70 m buffer around areas of high habitat value will reduce the potential for ongoing risks to birds and bats (e.g. collision, disturbance and barotrauma) during the operational phase of the proposal. Limited open water surfaces were present within the project area; however any present could also be buffered. If turbines are placed within this buffer zone, the risk of bird and bat interactions with turbines increases.

Nest sites are focus areas for bird activity including behaviour which has potential to represent a risk to birds where turbines are located, such as display flight and juvenile birds learning to fly. A standard prescription is to apply a 100 m buffer around nest sites for key birds and to avoid locating turbines in these areas. It is considered that tracks and other infrastructure can be micro-sited to avoid impacting such features.

One Wedge-tailed Eagle nest was identified during the survey, further survey work may reveal other nest sites. Given the activity of Wedge-tailed Eagles during the survey it is expected breeding pairs utilise habitat within the project area, or close to the area. A 100 m buffer has been applied to this Wedge-tailed Eagle nest near RYP_92 and it is recommended that consideration of a buffer greater than 100 m is applied due to larger size and habitat utilisation differences of this bird. Therefore a minimum of 100 metre buffer is recommended, with preference for up to 500 m (if possible). Similarly, one Nankeen Kestrel nest was identified on Flakney Creek Road at the eastern end near a proposed transmission line and a 100 m buffer has also been applied to this nest.

As described above in Section 7.5.1, three Superb Parrot nest trees were identified within the project area during the survey and a 100 m buffer has been applied to these and other potential nest trees for this species.

7.5.6 Key threatening processes under TSC Act

The proposal may increase the impact of the following key threatening processes relevant to the species discussed above:

- Clearing of native vegetation.
- The invasion of native vegetation by exotic perennial grasses.
- Loss of hollow-bearing trees.
- Removal of dead wood and dead trees.

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 majority of the project area is already cleared and highly modified by agricultural practices. The proposal would remove up to 31 ha of

predominately low quality Box Gum Woodland and derived grassland, an endangered ecological community. The significance of this clearing has been discussed above.

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. The Box Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog, and Paspalum. Unnecessary disturbance of areas containing exotic perennial grasses within and adjacent to the works should be avoided so as not to increase the impact of this Key Threatening Process in the area. Cleaning of vehicles and plant prior to arrival on the site (and departure if working in areas containing these species) would help to ameliorate this impact, by preventing the introduction and spread of additional weeds. Section 8 identifies further safeguards to minimise risks from weeds, and the proposal is not expected to significantly increase the impact of this Key Threatening Process in the study area.

In addition to the design measures already implemented, a number of recommendations are given to minimise and offset the impacts of the proposal upon the individual fauna species assessed. Recommendations have been given to minimise the impact of the proposal to an acceptable level, specifically in relation to hollow bearing trees. With implementation of recommendations, the proposal would not exacerbate existing key threatening processes.

7.5.7 Indirect and peripheral impacts

As well as direct clearing impacts, vegetation surrounding the development footprint would be affected by vehicle access and parking, materials laydown and stockpiles. Peripheral impacts may include smothering of vegetation, soil compaction and erosion. Compaction of soil can impede vegetative growth and the successful re-establishment of groundcover in disturbed areas. The works have the potential to introduce and spread weed species. Common pasture weeds are widespread across the site however, listed noxious weeds and Weeds of National Significance (WoNS) are scarce. With the implementation of specific weed control measures, the risk of spreading and introducing additional weed species is considered to be manageable.

Pollution risks are associated with the use of concrete, fuels and lubricants and construction chemicals. These risks are considered manageable with appropriate safeguards. Dust would be generated from the excavation and building activities at the construction sites, and by traffic using unsealed access routes. Dust deposition is not expected to significantly affect the habitat values of the site. Noise, vibration and activity during construction phase may disturb fauna during nesting, foraging and migration periods. This disturbance is likely to be of low magnitude temporally and spatially, considering the spread out pattern of infrastructure proposed.

Recommendation have been prescribed in Section 8 to manage these indirect impacts.

7.5.8 Cumulative impacts

There are a number of developments including wind farms in the region and the proposal may contribute to cumulative impacts from vegetation clearing and operational or alienation effects. Of particular concern locally is clearing of Box Gum Woodland and clearing of hollow-bearing trees because this adds to the cumulative and ongoing loss of this community and resource. Cumulative clearing is a key threat for the Box Gum Woodland EEC and threatened species that depend on it, such as hollow-dependent species.

In terms of operational impact, there are three operating wind farms within approximately 50 km of the project area. These comprise a total of 54 wind turbines (Cullerin Range Wind Farm: 15, Gunning Wind

Farm: 31, Crookwell Wind Farm: 8). Several other wind farms are proposed within approximately 60 km of the project area including Rugby Wind Farm, Bango Wind Farm, Conroys Gap Wind Farm, and Yass Valley Wind Farm). The cumulative operational impact of these wind farms is unknown. The difficultly in drawing conclusions about cumulative operational risk is highlighted in a report commissioned by the then Commonwealth Department of Environment and Heritage (Biosis 2006), *Wind Farm Collision Risk for Birds: Cumulative Risks for Threatened and Migratory Species* (species considered included Swift Parrot and Tasmanian Wedge-tailed Eagle). Based on collision risk modelling and population viability analysis, the assessment of significance of cumulative risk from all wind farms operational in Australia at that time (wind farms operational in 2005) was inconclusive due to variation in site specific factors and poor scientific knowledge of bird populations.

Biological impacts of wind farms can be far-reaching, because of the mobility of migratory, nomadic and territorial fauna species such as bats and birds, with the biggest concern stemming from potential bird and bat collision with operating turbines (Parsons & Battley 2013). The operational and proposed wind farm localities in the district may involve overlapping raptor territories and bird and bat migration routes. However, based on the available habitat which has primarily been cleared in the local area and elsewhere in the district (especially to the west), and the absence of major wetlands, with the closest being Lake Burrinjuck (approximately 47 km to the south-west), the project area is not likely to be located on a major migratory route for wetland birds, seasonally migrating birds or microchiropteran bats. Visits from migratory or nomadic species are expected to be infrequent and sporadic. The wind farm is not expected to significantly affect migratory species such that whole populations would be at risk.

Mortality through collision of some bird species with low reproductive rates, such as raptors, could represent a 'mortality sink'. This could have the potential to affect region-level populations, although the likelihood of this is considered low. Given the low rate of bladestrike recorded at other Australian wind farms, as well as the more recently documented avoidance of turbines by Wedge-tailed Eagles at three wind farm sites in northern Tasmania (Hull & Muir 2013) mortalities are not expected to affect local or regional populations by outstripping the reproductive capacity of any species. For this reason, the proposal is not expected to significantly add to the collective impacts of wind farms in the region. If the ongoing monitoring and assessment of the operational impacts of all wind farms operating in the region becomes available, the data should however be reviewed to ensure cumulative impacts remain within acceptable limits. An adaptive monitoring and management program would be implemented to ensure that any unforeseen impact on bird or bat species are detected and addressed in a timely manner.

The location of the proposed wind farm turbines on largely cleared ridgetop sites already compromised from long-term grazing, coupled with avoidance of clearing good condition woodland, should restrict the potential to affect locally declining woodland or wetland species. The offsetting of vegetation losses with the long term protection of similar vegetation in the study area will reduce the cumulative effects of the proposal.

The impacts of the wind farm on biodiversity values would combine with existing impacts resulting from land clearing, agricultural activities, weeds and hazards. It is important to recognise that the district has experienced extensive losses to ecosystem integrity and stability. Woodland and grassland communities in particular, which coincide with prime agricultural land, and riparian and wetland communities have been heavily simplified and destabilised. It is likely that many woodland flora and fauna species have become locally extinct, and many are in continuing decline prior to wind farm development. In this instance, the development of wind farms can be seen to promote management of biodiversity in what was an already degrading landscape.

7.6 CONCLUSION OF IMPACT ASSESSMENT

Based on the extent of clearance associated with the proposal, impacts arising from the wind farm upon the EEC and species known and likely to occur in the project area are manageable and unlikely to be significant. Further survey is required for the Golden Sun Moth and Striped Legless Lizard to validate this assessment. Further surveys have been prescribed for these species and will ensure that the project is responsive to the results (exclusion zones or management prescriptions, as required). Those species considered to be most affected by the project occur within Box Gum Woodland or grassland habitats. The worst-case scenario for clearing of these habitats is estimated at 66 ha (including poor condition vegetation), with a total of 5,887 ha remaining indicating the ability to offset impact to these species within the immediate project area is achievable. AoS are provided in Appendix C for those species considered most at risk for the proposal to further support the conclusions of the above impact assessment.

Impacts have been avoided where possible through design changes based on information and constraints and recommendations have been given to confirm assumptions made in the assessment and further minimise and manage impacts during the final design, construction and operational phases of the wind farm.

Presently, the land in the project area is agricultural utilised for production which has been subject to prior clearing. The management measures and offsets presented in this report provide an opportunity to arrest existing pressures in the project area such as weeds, and conserve a portion of land for biodiversity outcomes resulting in a positive gain.

8 RECOMMENDATIONS

8.1 DESIGN MEASURES TO AVOID IMPACT

The proponent has undertaken several reviews of layout revisions to avoid impacts in areas identified as a high constraint in **ngh**environmental (2012) and subsequent correspondence. Design measures to avoid impacts associated with vegetation clearing including loss of Box Gum Woodland EEC and connectivity, are given in Table 8-1. Design measures to avoid blade-strike impacts associated with the operational phase of a wind farm including proximity to nest trees, are given in Table 8-2. These design measures are already part of the proposal. Recommendations given in Section 8 are supplementary to the design measures incorporated by the proponent.

Table 8-1 Design measures by the proponent to avoid vegetation clearing in areas identified to have a high risk of impact to threatened ecological communities or species

Constraint type	Design measures to avoid impact
EEC: Box Gum Woodland	The following turbines moved out of Box Gum Woodland remnants: RYP_14, RYP_111, RYP_116 and RYP_108. At least 4 km of transmission line in the southern section of the project area in the vicinity of RYP_120 removed. Proposed substation in the south-east corner of the site moved.
Fauna habitat: Patch size and integrity	RYP_36, RYP_53 moved to a 50 m buffer from high conservation value fauna habitat
Fauna habitat: Connectivity	RYP_59, RYP_55, RYP_54, RYP_60 removed from layout due to high conservation value fauna habitat. RYP_64, RYP_107 moved to a 50 m buffer from high conservation value fauna habitat.
Fauna habitat: Key features	RYP_96 moved slightly but still within high conservation value fauna habitat.

Table 8-2 Design measures by the proponent to avoid high and moderate operational risks to bird and bat species.

Operational constraint types	Risk description	Design measures to avoid impact
High risk locations		
Proximity to nests	Proximity to Wedge-tailed Eagle nest tree: RYP_91, RYP_92. Proximity to Superb Parrot nest tree: RYP_117, RYP_118.	RYP_91 removed from layout. RYP_92 shifted further south.
Proximity to Superb Parrot, Painted Honeyeater habitat. Potential habitat for Golden Sun Moth and Striped Legless Lizard.	Transmission line in the southern section of the project area in the vicinity of RYP_120 traverses good quality Box Gum Woodland habitat used by these species.	132 kV transmission line in part of this area removed from layout.
Landscape position	RYP_10 was a high risk to all birds that may fly in the rotor sweep area because of isolated position on a low hill between two much taller ridges.	RYP_10 has been removed from layout and replaced by RYP_16.
Landscape position	These two turbines were outliers from the rest of the layout and were positioned on peaks in a key movement corridor.	Turbines have been relocated to be within the main layout area.

Operational constraint types	Risk description	Design measures to avoid impact
Moderate risk locations		
Landscape position	Turbines in higher risk locations for blade-strike such as along an escarpment or at the head of a valley	RYP_28-30, RYP_32, RYP_36, RYP_41, RYP_52, RYP_56, RYP_83 have been repositioned in line with the recommendation to move turbines back from heads of valleys or escarpments.
Layout position	Turbines in higher risk locations such as isolated (>800 m) from other turbine clusters.	RYP_113 and RYP_115 removed from layout, repositioned to RYP_124 and RYP_145.
Proximity to Bango Nature Reserve	Proximity to Bango Nature Reserve.	Turbines shifted for a 70 m buffer from reserve.

8.2 IMPACT MITIGATION

Mitigation measures recommended to minimise impacts during the design, construction and operational phase of the wind farm proposal are highlighted in Table 8-3. These measures to minimise impact were developed to ensure potential impacts are minimised at: 1) a broad level in which general management or control measures can be applied to the entire proposal; or 2) at a defined level in which management or control measures can be applied to particular areas, individual species, faunal groups, or a vegetation type.

In particular, a Flora and Fauna Management Plan as well as an adaptive Bird and Bat Management Plan should be prepared prior to construction. These management plans would focus on migratory and at risk bird and bat species, and any threatened species found during further survey work. Particularly, the latter is required to address inherent uncertainty related to bird and bat collision risks at this site. Management strategies for the construction phase of the proposal need to be developed and incorporated into the Flora and Fauna Management Plan. Prescriptions for inclusion in the plan are set out in the tables below. These measures are required to ensure a significant impact is avoided.

The construction footprint should be kept to a minimum for least impact on flora and fauna. The proponent commits to upfront offset ratios before clearing proceeds which is an incentive to achieve 'minimal clearance' during the detailed design and construction phases.

8.3 MEASURES TO OFFSET IMPACTS

Measures to offset impacts are provided within Table 8-4 to ensure that an overall 'maintain or improve' outcome is met for the proposal; where impacts cannot be avoided, or sufficiently minimised, the residual impact will be offset in perpetuity. Appendix F details the biodiversity offset principles developed by the former DECCW (now OEH) and how these guide the identification and management of the offset site. Appendix F also details how offsets are proposed to be identified, managed, and the offset ratios to be applied. An Offset Plan would be developed with input from OEH and the CMA and finalised prior to any construction impacts.

The Offset Plan would achieve:

- For common vegetation types a ratio of approximately 1:2 (cleared: offset) is proposed. Where vegetation is listed as an endangered community, such as the Box Gum Woodland EEC, a ratio of 1:5 to 1:10 (cleared:offset) is proposed, depending on the quality of habitat.

- Hollows removed would be offset at a ratio of 1:1 (offset site vegetation must contain the same number of hollows, artificial hollows may need to be installed to achieve this ratio).
- The offset site would be protected in perpetuity and appropriate management actions attached to the land title. For example, fencing and signage maintained, minimum biomass to be retained (through controlled grazing if appropriate), regular weed control and pest fauna management.

Additional detail on the achievability of this offset is provided in Appendix F.

8.4 DECOMMISSIONING PHASE

A Flora and Fauna Management Plan would be developed prior to decommissioning to manage decommissioning impacts on biodiversity values. Biodiversity investigations would be required prior to decommissioning, to update the knowledge of site attributes and evaluate specific impact types (given the life span of the proposal is in the order of 30 years) and to minimise biodiversity impacts related to the removal of infrastructure. New measures to avoid and mitigate impacts may be required depending on: 1) the results of the investigation; and 2) outcomes of the monitoring programs implemented during the operational phase of the proposal. Any implementation of a rehabilitation plan would consider the implemented plans and the environment at the time of decommissioning.

Table 8-3. Design measures to avoid and minimise impacts for Rye Park wind farm

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
Design Phase						
General measures	Project area	N/A	Ensure all infrastructure will be sited entirely within the areas assessed in the Biodiversity Assessment.	After final alignments / development envelopes confirmed	• If infrastructure is required outside of the areas surveyed in this biodiversity assessment, more survey and assessment will be required.	Avoid
General Measures	Project area	High risk birds and bats	Turbine infrastructure design to minimise operational impacts on birds and bats.	Prior to operation	• If possible, red flashing lights[7] should be fitted to turbine towers to reduce insect attraction and potentially night-flying birds. • No guy lines to be fitted to turbine towers. • Flags and/or marker balls to be fitted to wind monitoring mast guy lines • Turbines (e.g. nacelles) should minimise perching opportunities.	Minimise
Striped Legless Lizard habitat	Identified areas of potential habitat for the Striped Legless Lizard (i.e. all grassland habitats)	Striped Legless Lizard	Further targeted survey in all grassland habitat of the project area to avoid and minimise impacts.	Prior to construction (February 2014)	• Undertake more detailed micro-habitat survey of the site (referencing habitat attributes where the species was located) prior to the end of February 2014. • Use survey results to minimise impacts and ensure offsetting requirements, where avoidance is not possible. • Document management protocols for this species within a management plan, to be implemented as part of the construction process.	Avoid, minimise, offset

[7] Although lighting effects are poorly understood at this time, migrating birds and bats appear to be attracted to steady burning lights and red flashing lights are said to decrease insect activity and reduce bird and bat activity at turbines.

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
Superb Parrot nest trees and impacts to breeding, Painted Honeyeater foraging habitat	Where all nests trees and Painted Honeyeater records identified in Appendix E.4.	Superb Parrot	Avoid impact to known and potential nests trees and construction impacts during breeding period for the Superb Parrot. Avoid impacts to foraging habitat (Yellow Box) for the Pained Honeyeater.	Prior to construction (for avoidance of nests trees); During construction (for no clearance near nests trees during this time)	• Maintain a 100 m buffer around identified and potential Superb Parrot nest trees (refer Appendix E.4) in the southern section of the project area. • Micro-site all transmission lines and access tracks near known nest trees and Yellow Box trees between RYP_110 and RYP_120.	Avoid, minimise
Raptor nest trees	Where all nests trees identified in Appendix E.4.	Wedge-tailed Eagle, Nankeen Kestrel	Avoid impact to known nests trees.	Prior to construction	• Maintain a 100 m buffer around identified nest trees.	Avoid
Good condition fauna habitat	Project area	All species, primarily threatened woodland birds	Avoid impact to woodland and forest habitat.	Prior to construction	• Maintain a 70 m buffer around turbines in good condition fauna habitat, especially turbines RYP_17 in the north of the project and turbines near Bango NR (RYP_123 & RYP_126).	Avoid
Construction Phase						
Golden Sun Moth habitat	Identified areas of potential habitat for the Golden Sun Moth (i.e. all grassland habitats)	Golden Sun Moth	Further targeted survey in all grassland habitat of the project area avoid and minimise impacts.	Prior to construction	• Undertake preconstruction surveys of the final infrastructure layout in accordance with the relevant survey guidelines (Significant Impact Guidelines for the critically endangered Golden Sun Moth *Synemon plana;* DEWHA 2009). • Results of these surveys used to minimise impacts and ensure offsetting requirements, where avoidance is not possible. • Document management protocols for this species within a management plan, to be implemented as part of the construction process.	Avoid, minimise, offset
Box Gum Woodland and Good quality fauna habitat	Project area, particularly good condition EEC/CEEC between RYP_110 and RYP 120 and within transmission	Box Gum Woodland areas and threatened species	Prevent unauthorised clearance. Minimise track and transmission line	During construction	• Clearly define works areas nearby or within Box Gum Woodland areas to strictly defined permitted clearance zone. • Minimise track width, where possible, to the minimum required for safe access and operation.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
	line south of RYP_110		impacts in areas of high conservation value.		• Install the 33kV powerlines (co-aligned with roads) as underground, where possible. • Removal of topsoil and subsoil for trenching to be replaced and revegetate disturbed areas with local native grasses (i.e. Kangaroo Grass, Wallaby Grass or Spear Grass).	
Woodland bird habitat	Around the transmission line and turbines near RYP_102-110	Brown Treecreeper, Diamond Firetail, Flame Robin, Hooded Robin, Scarlet Robin and Speckled Warbler	Minimise track and transmission line impacts in areas of high conservation value for these species.	During construction	• Clearly define works areas nearby this area. • Micro-site all infrastructure in this location with the input from an ecologist.	Minimise
Hollow-bearing Trees	Project area where targeted hollow-bearing tree survey not previously undertaken	Threatened hollow dependent fauna	Targeted hollow-bearing trees survey to accurately record the number of hollows to be cleared to ensure impacts are offset.	After final alignments / development envelopes confirmed	• Pre-clearance survey within final development envelope and alignment for hollow-bearing trees. • Infrastructure micro-sited to avoid hollow-bearing trees, where possible. • For hollow-bearing trees to be cleared a management plan should be prepared by an ecologist detailing: procedures to minimise impacts to, and relocate resident fauna; timing of works to avoid breeding periods, where possible; number and type of hollow-bearing trees to be removed and offset (to be included in Flora & Fauna Management Plan). • Where hollow-bearing trees are to be cleared a standard pre-clearance survey, such as that described in *Biodiversity Guidelines* (**ngh**environmental / RTA 2011), should be undertaken and details of hollow-bearing trees cleared including number and size of hollows and number of hollow-bearing trees recorded.	Minimise
Reptile Species habitat	Project area	All reptiles, primarily Pink-tailed Worm-lizard	Pre-clearance surveys in Box Gum Woodland and native pasture to identify rocky outcrops for avoidance, where possible.	During construction and as required	• Turbines and infrastructure would be micro-sited to avoid rocky outcrops in this habitat, where possible. • Where rocky outcrops cannot be avoided, replace rock in nearby areas in consultation with an ecologist. • Fallen timber > 50cm to be left in place or moved to a nearby area to retain fauna habitat.	Minimise
General Measures	Project area	All species and vegetation communities	Minimise clearance and disturbance.	During construction and as required	• Clearly define works areas and restricting impacts to these. Including vehicle and equipment parking and access routes.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
					• Co-locating underground and overhead 33kV powerlines with the track network to minimise additional impact area, where possible. • Establish construction compound in a disturbed area. • Use disturbed areas for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and deposition and retrieval of spoil, wherever practicable. • Fill in trenches as soon as possible. Trenches left open overnight to be inspected at first light for trapped fauna. Trapped fauna to be released appropriately in a nearby location. • Hollow-bearing trees and sensitive features to be retained to be communicated to staff via inductions and other methods.	
Riparian Area Management	Project area	All species and vegetation communities	Minimise clearance and disturbance.	During construction	• Creek crossing to be designed in accordance with: NSW Fisheries Policy and Guidelines for Fish Friendly Waterway Crossings (2003). • Creek works not to be undertaken when heavy rain is forecast and should be avoided when there is flow. • Implement sedimentation and erosion controls in accordance with best practice guidelines.	Minimise
Weed Management	Project area	All species and vegetation communities	Pre-construction inspection for noxious weeds within project area. Prevention of spread of weeds and pathogens. Weed monitoring.	Before commencement of works and as required Monitoring – late spring / early summer after construction	• Control noxious weeds in works area according to plans and control measures of the LGAs. • Minimise use and adhere to best practice guidelines for herbicide treatment in environmentally sensitive areas (i.e. Box Gum Woodland). • Establish a machinery hygiene plan to ensure vehicle and machinery is absent of organic matter pre- and post-site access. • Sign environmentally sensitive areas (i.e. CEEC areas) and designate clean-down area for entry / exit points into these areas. • Monitoring and weed control in areas of known noxious or invasive species.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
					• Understorey vegetation in easements should be managed to maintain composition and quality to prevent weed invasion	
Pollution Prevention	Project area	All species and vegetation communities	Prevention of contaminants and erosion outside works zones.	As required	• Establish a spill plan to prevent chemicals or pollutants from having an adverse effect on the environment. • Backfill cable trench where cement is used; at least 20 cm of cement free topsoil to be replaced as the top layer in the back fill. • Establish an erosion and sediment control plan so appropriate controls are in place prior to commencement of works.	Minimise
Site Management	Project area	All species and vegetation communities	Stabilisation of soil, rehabilitation and revegetation to be undertaken progressively to re-establish ground cover.	As required	• Lightly mulch exposed soils with chipped vegetation or sterile hay in areas dominated by exotic groundcover species. Sow with an appropriate cover crop in consultation with land owners. • Lightly mulch exposed soils with chipped vegetation or sterile hay in areas dominated by native grasses using local provenance species. • Fertiliser should not be used to promote revegetation in areas dominated by native grasses.	Minimise
Operational Phase						
Flora & Fauna Management Plan	Project area	All species and vegetation communities	To avoid significant impact to flora and fauna outside of the accepted clearance boundaries and prevent 'unassessed' impacts occurring.	Implement prior to construction	• An ecological professional to develop and implement a Flora and Fauna Management Plan to report on and manage impacts. • The management plan should highlight ecological important areas (vegetation communities and threatened fauna species habitat) and their management. • Specific areas requiring monitoring or management should be highlighted as well as timing for monitoring. • Weed species should be highlighted along with prescriptions for their management.	Minimise
Adaptive Bird & Bat Management Plan	Project area	Superb Parrot, Painted Honeyeater, Regent Honeyeater, Wedge-tailed Eagle,	Development of an 'insurance' monitoring program to address	Implement prior to construction. Survey and monitor during 'high risk' periods,	• An ecological professional to develop and implement a Bird and Bat Monitoring Program to report on, and manage impacts with potential to be significant.	Minimise

Item	Area	Target Species	Objective	Timing	Proponent Commitment	Avoid or Minimise Impact
		Little Eagle, Eastern Bent-wing Bat, Yellow-bellied Sheathtail-bat, Gould's Wattled Bat and White-striped Freetail Bat.	uncertainty inherent in the assessment.	when species may be moving through or foraging in the area	• Monitoring surveys should include an understanding of breeding activity (i.e. nest locations) and foraging movements. • Baseline (pre-construction) and operational collision and abundance data would be collected, focused on higher risk species and higher risk locations in order that actions can be taken to address unforseen impacts, should they occur. • Management Plan methods would utilise AusWEA (2006) best practice guidelines. • Management Plan should include management response options (i.e. restriction of lambing on ridges with high raptor activity to reduce collision risks) to be implemented where significant impacts are anticipated.	
Habitat Connectivity	Transmission Line Easement	All common species, as well as threatened fauna, particularly threatened parrots, gliders and bats	Minimise fragmentation of landscape connectivity.	After construction	• Promote growth of vegetation under the transmission line to the maximum allowable height to maintain fauna habitat connectivity. • Understorey vegetation in easements should be managed to maintain composition and quality to prevent weed invasion. • Near areas of intact woodland or forest a spacing of 600m should be considered for turbines.	Minimise

Table 8-4. Offset measures to maintain or improve biodiversity for Rye Park Wind Farm

Item	Area	Target Species	Objective	Timing	Proponent Commitment
Construction Phase					
Development of offset strategy and offset plan	Project Area	Box Gum Woodland, Hollow-bearing trees, Threatened species habitat	Proponent will develop an offset plan to offset all permanent native vegetation removal to maintain or improve biodiversity in the longer term.	Prior to construction	• Develop an offset strategy and finalise prior to any construction impacts an ecological professional, in accordance with Appendix F • Develop an offset plan prior to operation, demonstrating the suitability of the final offset site and providing detailed management actions specific to the site. • Ensure the offset strategy complies with the *Principles for the use of biodiversity offsets in NSW* guidance document. • The offset ratio will be determined with reference to: the conservation status of the vegetation, the condition of the vegetation, and the actual threatened species habitat value lost (i.e. known threatened species habitat, not potential habitat). • Where vegetation is listed as an EEC, a ratio of 1:5 to 1:10 is proposed, depending on quality of habitat. • Where non-threatened vegetation is cleared an offset ratio to be applied at 1:2. • Where hollow-bearing trees are to be cleared and cannot be avoided an offset ratio to be applied at 1:1 and is supplementary to other areas offset. • Include provisions for offsetting Commonwealth listed EEC to demonstrate compliance with the Commonwealth offset policy.

9 REFERENCES

ACT Commissioner for the Environment (2000) 'Bioregions' *State of the Environment Report, Australian Capital Region* [online]. Accessible from http://www.begavalley.nsw.gov.au/environment/soe/Region/subregions/bioregions/ibra.htm [accessed 3 August 2012]

ACT Commissioner for the Environment (2009) *Regional State of the Environment Report 2004-2009, Australian Capital Region* [online]. Available at http://www.envcomm.act.gov.au/soe/rsoe2009/ [accessed 10 August 2012]

Atlas of Living Australia (2012) *Mapping and Analysis* [online]. Available at http://spatial.ala.org.au/ [accessed throughout August 2012]

Aumann T (2001) Breeding biology of raptors in riparian environments in the south-west of the Northern Territory, Australia. *Emu* 101, 305-315.AusWEA (2002) *Fact Sheet 8: Wind Farms & Bird & Bat* Impacts, Australian Wind Energy Association

Baerwald E., D'Amours G H, Klug B J and Barclay R M R (2008) Barotrauma is a significant cause of bat fatalities at wind turbines, Current Biology Vol 18; No16.

Baerwald, E. and Barclay, R. (2009) 'Geographic variation in activity and fatality of migratory bats at wind energy facilities' *Journal of Mammalogy,* 90: 6: 1341-1349

Baerwald, E., D'Amours, G., Klug, B. and Barclay, R. (2008) 'Barotrauma is a significant cause of bat fatalities at wind turbines' *Current Biology* 18: 18: 695-696

Baker-Gabb, D. (2011) *National Recovery Plan for Superb Parrot Polytelis swainsonii,* [online] Victorian Government Department of Sustainability and Environment, Melbourne. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/recovery/pubs/polytelis-swainsonii-recovery-plan.pdf [accessed 19 August 2012]

Barclay, R., Baerwald, E., Gruver, J. (2007) 'Variation in bird and bat fatalities at wind energy facilities: assessing the effects of rotor size and tower height' *Canadian Journal of Zoology*, 85: 381-387

Barrett, G.W., Ford, H.A. and Recher, H.F. (1994) 'Conservation of woodland birds in a fragmented rural landscape' *Pacific Conservation Biology,* 1: 245-256

Benson, J., Richards, P., Waller, S. and Allen, C. (2010) 'New South Wales Vegetation classification and Assessment: Part 3 Plant communities of the NSW Brigalow Belt south, Nandewar and west New England Bioergions and update of NSW Western Plains and South-western Slopes plant communities, Version 3 of the NSW VCA database', *Cunninghamia* 11: 4: 457-579

Berry, L. (2001) 'Edge effects on the distribution and abundance of birds in a southern Victorian forest', *Wildlife Research*, 28: 239 – 245

Biosis Research (2005) *Bird and Bat Collision Risk Assessment for proposed Butoni Wind Farm, Sigatoka, Fiji* [online], report prepared for Sinclair Knight Merz. Available from http://www.skmconsulting.com/Site-Documents/Migration-General/_NR_rdonlyres_C151177A-C523-4A16-AAC7-55419D15665D_0_AppendixCBirdandBatCollisionRiskAssessmentReport.pdf [accessed 10 August 2012]

Biosis Research (2006) *Wind farm collision risk for birds: cumulative risks for threatened and migratory species* [online], report prepared for Department of Environment and Heritage, Australia.

Available from http://www.environment.gov.au/epbc/publications/wind-farm-bird-risk.html [accessed 28 August 2012]

Biosis Research (2009) *Wedge-tailed Eagle Collision Risk Assessment*, report prepared for Pacific Hydro [online]. [accessed 8 July 2010].

Birds Australia (2005-2007) Birdata: Important Bird Areas, accessed online at http://www.birdata.com.au/iba.vm in December 2011

Boorowa Council (undated) *Boorowa Council* [online]. Available at http://www.boorowa.nsw.gov.au/ [accessed: 10 August 2012]

Brett Lane and Associates. (2005). *Wind Farms and Birds: Interim standards for risk assessment, Australian Wind Energy Association Report*. AusWEA (Australian Wind Energy Association).

Brett Lane and Associates. (2009). Summary of investigation of Wedge-tailed Eagle breeding: Challicum Hills Wind Farm. Ecological Research and Management.

Churchill, S. (1998) *Australian Bats*, first edition, New Holland Publishers, NSW

Churchill, S. (2008) *Australian Bats*, second edition, Allen & Unwin, NSW

CMA (2012) Catchment Management Authorities – Lachlan, Murrumbidgee [online], Catchment Management Authority, NSW Government. Available from http://www.cma.nsw.gov.au/ [accessed 27 August 2012]

Cryan, P. and Barclay, R. (2009) 'Causes of bat fatalities at wind turbines: hypotheses and predictions', *Journal of Mammalogy*, 90: 6: 1330-1340

DEC (2004). Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Department of Environment and Conservation, NSW.

DECC (2008). Recovery Plan for the Koala (*Phascolarctos cinereus*). Department for Environment and Climate Change, Sydney.

DEH (2005) *Threat abatement plan for beak and feather disease affecting endangered psittacine species* [online], Department of Environment and Heritage, Commonwealth of Australia. Available from http://www.environment.gov.au/biodiversity/threatened/publications/tap/pubs/beak-feather-tap.pdf [accessed 26 August 2012]

DEWHA (2008) *Energy markets – renewable power stations: operating plants* [online interactive map], Department of Environment, Water, Heritage and the Arts. Available from http://www.ga.gov.au/renewable/map.php?type=operating [accessed 28 August 2012]

DEWHA (2009a) *Significant Impact Guidelines for the critically endangered Golden Sun Moth (Synemon plana)* [online], Department of Environment, Water, Heritage and the Arts. Available from http://www.environment.gov.au/epbc/publications/pubs/golden-sun-moth.pdf [accessed 10 August 2012]

DEWHA (2009b) *Background Paper to EPBC Act Policy Statement 3.12 - Significant Impact Guidelines for the critically endangered Golden Sun Moth (Synemon plana)* [online], Department of Environment, Water, Heritage and the Arts. Available from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=25234 [accessed 26 September 2012]

Drewitt A and Langston R (2006) Assessing the impacts of wind farms on birds, Ibis 148:29–42.

EBS Ecology (2012) *Proposed Keyneton Wind Farm: Avifauna and Raptor Nest Assessment*, [online] report prepared for Pacific Hydro. Available online at http://www.pacifichydro.com.au/files/2012/06/App-C-Avi-Raptor-.pdf [accessed 10 August 2012]

Elmoby Ecology (2012) Hepburn wind Farm: Bird and Bat Mortality Survey Interim Report 11th January 2011 – 9th January 2012

Entura (2011) *Cattle Hill Wind Farm DPEMP: Eagle Supplement – Addendum* [online], report prepared for NP Power. Available online at http://epa.tas.gov.au/Documents/NP%20Power%20Cattle%20Hill%20Wind%20Farm%20DPEMP%20Supplement%20Eagles%20Additional%20Information.pdf [accessed 10 August 2012]

Environment Australia (2000) *Revision of the interim biogeographic regionalisation for Australia (IBRA) and development of version 5.1: Summary Report,* [online]. Available from: http://live.greeningaustralia.org.au/nativevegetation/pages/pdf/Authors%20E/4_Environment_Australia_2000.pdf [accessed 3 August 2012]

Erickson, W., Johnson, J., Strickland, D., Young, D.Jnr., Sernka, K. And Good, R. (2001) *Avian collisions with wind turbines: a summary of existing studies and comparisons to other sources of avian collision mortality in the United States*, National Wind Co-ordinating Committee Resource Document, Washington DC

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.

Gibbons, P. and Lindenmayer, D.B. (1997). Conserving Hollow-dependent Fauna in Timber production Forests. Environmental Heritage Monograph no. 3, NSW NPWS, Sydney.

Harden, G.J. (Ed.) (1992). *Flora of New South Wales* Volume 3. Kensington, NSW: University of NSW Press.

Herr, A. (1998) *Aspects of the ecology of insectivorous forest-dwelling bats (Microchiroptera) in the western slopes of the Australian alps*, Thesis submitted to Charles Sturt University for the degree of Doctor of Philosophy [online]. Available from http://csusap.csu.edu.au/~aherr/thesis/thesis.pdf [accessed 19 August 2012]

Hull, C., and Muir, S. (2013). Behavior and Turbine Avoidance Rates of Eagles at Two Wind Farms in Tasmania, Australia. *Wilielife Society Bulletin* 37(1): 49-58.

Horn, J.W., Arnett, E.B. and Kunz, T.H. (2008) Behavioural responses of bats to operating wind turbines. *J. Wildl. Mgmt*. 72: 123-132.

Howe, R. (1984) 'Local Dynamics of Bird Assemblages in Small Forest Habitat Islands in Australia and North America' *Ecology*, 65: 5 1585-1601

Hydro Tasmania Consulting (2010) *Cattle Hill Wind Farm: Eagle Utilisation Assessment* [online], report prepared for NP Power. Available online at: http://epa.tas.gov.au/Documents/Cattle_Hill_DPEMP_Appendices_H1_H2.pdf [accessed 10 August 2012]

Hydro Tasmania Consulting (2012) Bluff Point Wind Farm and Studland Bay Wind Farm Annual Environmental Performance Report 2012, report prepared for Woolnorth Wind Farm Holding Pty Ltd

ISSC (2005) *ISSC 3 Guidelines for managing vegetation near power lines* [online], Industry Safety Steering Community, Department of Energy, Utilities and Sustainability, NSW. Available from http://www.trade.nsw.gov.au/energy/electricity/networks/safety/electricity_network_safety_issc_3_guideline_for_managing_vegetation_nea_power_lines.pdf [accessed 29 August 2012]

Kennedy, S. and Tzaros, C. (2005). Foraging ecology of the swift parrot (*Lathamus discolor*) in the Box-Ironbark forests and woodlands of Victoria. *Pacific Conservation Biology*: 11, 158-173

Langston, R.H.W. & Pullan, J.D. (2003) Windfarms and birds: an analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues, Birdlife International report to the Bern Convention: Convention on the Conservation of European Wildlife and Natural habitats, Strasbourg, France

Lindenmayer, D.B., Cunningham, R.B., Tanton, M.T., Smith, A.P. and Nix, H.A. (1991). Characteristics of hollow-bearing trees occupied by arboreal marsupials in the montane ash forests of the Central Highlands of Victoria, south-east Australia. Forest Ecology and Management **40**: 289-308.

Lindenmayer, D. and Fischer, J. (2006) *Habitat fragmentation and Landscape Change: An Ecological and Conservation Synthesis*, CSIRO Publishing

Lloyd, A., Law, B. and Goldingay, R. (2006) 'Bat activity on riparian zones and upper slopes in Australian timber production forests and the effectiveness of riparian buffers' *Biological Conservation*, 129: 207-220

Macintosh, A. and Downie, C. (2006) *Wind Farms: the facts and the fallacies*, Discussion Paper Number 91, The Australian Institute

MacMahon, A. (2010) *Expert Witness Statement: Yaloak South Wind Farm: Review of Wedge-tailed Eagle Assessment* [online]. Available from http://www.moorabool.vic.gov.au/CA257489001FD37D/Lookup/YaloakWindFarmApplication/$file/Ecology%20Australia%20Expert%20Witness%20Statement.pdf [accessed 10 August 2012]

McKenzie, N., Start, A. and Bullen, R. (2002) 'Foraging ecology and organisation of a desert bat fauna', *Australian Journal of Zoology*, 50: 529-548

Madders, M., and Whitfield, D. (2006). Upland raptors and the assessment of wind farm impacts. *Ibis*, 148:43-56.

Menkhorst, P., Schedvin, N., and Geering, D. (1999). Regent Honeyeater Recovery Plan 1999 – 2003. Natural Heritage Trust, Department of Natural Resources and Environment, Melbourne.

Milledge, D.R., Palmer, C. and Nelson, J. (1991). 'Barometers of change': the distribution of large owls and gliders in Mountain Ash forests of the Victorian central Highlands and their potential as management indicators. In Lunney, D. (Ed.), Conservation of Australia's Forest Fauna, Royal Zoological Society of NSW, Sydney.

Morgan (2001) Delineation and description of the Eastern Environmental Subregions (provinces) in New South Wales Study, NPWS, Hurstville.

Mueller-Dombois, D. and Ellenberg, H (1974) *Aims and methods of vegetation ecology*. John Wiley & Sons, New York.

nghenvironmental (2012a) *Rye Park Wind Farm Biodiversity Constraints Analysis*, report prepared for Epuron Pty Ltd.

nghenvironmental (2012b) *Bird and Bat Adaptive Management Plan: Gullen Range Wind Farm* [online], report prepared for Goldwind. Available from http://www.gullenrangewindfarm.com/wp-content/uploads/2011/08/GUL_BBMP_Final-V4-1.pdf [accessed 28 August 2012]

Noske, R.A. (1991) 'A demographic comparison of cooperatively breeding and non-cooperative treecreepers (Climacteridae)' *Emu* 91, 73-86

NPSW (2011) *Draft Plan of Management for The Gunning Reserves*, Office of Environment and Heritage NSW, Sydney [online]. Available from http://www.environment.nsw.gov.au/resources/planmanagement/draft/110751GunningReservesDraftPOM.pdf [accessed July 2012]

NRE (1998) *Victoria's Biodiversity Strategy*, [online]. Available from: http://www.nre.vic.gov.au/plntanml/biodiversity/index.htm [accessed 3 August 2012]

NSW Department of Environment and Conservation (NSW) (2006). NSW Recovery Plan for the Large Forest Owls: Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*) DEC, Sydney.

NSW Scientific Committee (2008). Squirrel Glider (*Petaurus norfolcensis*) - A review of current information in NSW.

NSW Scientific Committee (2008) *Brown Treecreeper – vulnerable species listing*, accessed at http://www.environment.nsw.gov.au/determinations/BrownTreecreeperVulSpListing.htm

NSW Scientific Committee (2010) *Flame Robin – vulnerable species listing – final determination*, http://www.environment.nsw.gov.au/determinations/flamerobinFD.htm

OEH (2013). NSW Bionet – Atlas of NSW Wildlife. Available from: http://www.bionet.nsw.gov.au/ {accessed between July 2013 and January 2014}.

OEH (2012) *Threatened Species Profile Search* [online], NSW Office of Environment and Heritage. Available from: http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10519 [accessed between 13 August and 31 August 2012, January 2014]

OEH (2011). Bioregions of NSW. Available online at: http://www.environment.nsw.gov.au/bioregions/Bioregions.htm [accessed 2 August 2012]

Osborne, W.S., Kukolic, K. & Williams, K.D., 1993. Conservation of reptiles in lowland native grasslands in the Southern Tablelands of New South Wales and the Australian Capital Territory. In Lunney, D. & Ayers,D., (eds) Herpetology in Australia: A diverse discipline, pp. 151-158. Transactions of the Royal Zoological Society of New South Wales.

O'Shea, M. (2005). Methods for assessment and techniques for management of Striped Legless Lizard *(Delma impar*) populations in South-eastern Australia. Thesis submitted at University of Victoria.

Parsons, S., and Battley, P. (2013). Impacts of wind energy developments on wildlife: a southern hemisphere perspective, New Zealand Journal of Zoology, 40 (1): 1-4.

Popa-Lisseanu, A.G. & Voight, C.C. (2009) 'Bats on the move' *Journal of Mammalogy,* 90: 6: 1283-1289

Rhodes, M. (2006) *The ecology and conservation of the White-striped Freetail Bat* (Tadarida australis) *in urban environments*, Doctor of Philosophy Thesis, Australian School of Environmental Studies. Griffith University

Richards, G. (2005) *An Assessment of the bat fauna at the proposed Capital Wind Farm, NSW*, Greg Richards and Associates, report prepared for Connell Wagner Pty Ltd, accessed at http://majorprojects.planning.nsw.gov.au/

Richter, A., Osbourne, W., Hnatiuk, S. And Rowell, A. *Moths in fragments: insights into the biology and ecology of the Australian endangered golden sun moth* Synemon plana *(Lepidoptera: Castniidae) in natural temperate and exotic grassland remnants* in Journal of Insect Conservation Vol. 17, No. 4, August 2013.

Roaring 40s Renewable Energy (2011) *Bluff Point Wind Farm and Studland Bay Wind Farm Annual Environmental Performance Report 2010* [online]. Available from http://www.hydro.com.au/environment/wind-environment-program [accessed June - October 2012]

Roaring 40s Renewable Energy (2010) *Bluff Point Wind Farm and Studland Bay Wind Farm Annual Environmental Performance Report 2009* [online]. Available from http://www.hydro.com.au/environment/wind-environment-program [accessed June - October 2012]

Saunders, D.L. and Tzaros, C.L. (2011). National Recovery Plan for the Swift Parrot *Lathamus discolor*, Birds Australia, Melbourne.

Schodde, R. and Tidemann, S. C., Eds. (2007) *Readers Digest Complete Book of Australian Birds*, Readers Digest Services, Sydney

SEWPAC 2009 *Biodiversity Assessment – South East Highlands*, [online]. Available from http://www.anra.gov.au/topics/vegetation/assessment/vic/ibra-south-eastern-highlands.html [accessed July 2012]

SEWPAC (2012) *Species Profile and Threats Database* [online]. Available from http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl [accessed November 2011 - October 2012]

SEWPAC (2013). *Phascolarctos cinereus* (combined populations of Qld, NSW and the ACT) in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: http://www.environment.gov.au/sprat. Accessed Tue, 17 Sep 2013

Sharp A. (2010) Briefing note on the effects of wind farms on bird and bat populations, Lower North Natural Resource Management Group, Department for Environment and Heritage, Government of South Australia.

Smales, I. (2006) Impacts of avian collisions with wind power turbines: an overview of the modelling of cumulative risks posed by multiple wind farms, Biosis Research. Report prepared for Department of Environment & Heritage

Smales, I. (2009) *Expert Witness Statement of Ian John Smales, Stockyard Hill Wind Farm* [online]. Available from http://www.iberica2000.org/documents/EOLICA/REPORTS/Yaloak_Expert_witness_statement_of_%20Ian_Smales.pdf [accessed 10 August 2012]

Smales, I. (2010) *Mortlake Wind Farm Planning Panel: Expert Witness Statement of Ian John Smales*, prepared for Acciona Energy Oceania by Biosis Research, accessed at

http://www.mortlakewindfarm.com.au/documents/ISmalesExpertWitnessStatementMortlake04032010.pdf

Smith, W., & Robertson, P. (1999). National Recovery Plan for the Striped Legless Lizard 1999-2003. NSW National Parks and Wildlife Service & Wildlife Profiles Pty Ltd, June 1999

Sovacool, B.K. (2009) 'Contextualising avian mortality: a preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity' *Energy Policy* 37: 6: 2241-2248

Upper Lachlan Shire Council (undated) *Upper Lachlan Shire Council* [online]. Available at http://upperlachlan.local-e.nsw.gov.au/ [accessed: 10 August 2012]

Van der Ree R, Bennett AF (2003). Homerange of the Squirrel Glider (*Petaurus norfolcensis*) in a network of remnant linear habitats. *Journal of Zoology*, London 259, 327-336.

Webster, R. (1988). The Superb Parrot - A survey of the breeding distribution and habitat requirements. Australian National Parks and Wildlife Service, Canberra; Report Series No. 12.

Webster, R. (1997). Assessment of Superb Parrot nesting habitat along the Edward River (Millewa and Gulpa Island State Forests. State Forests of New South Wales and Department of Land and Water Conservation, Deniliquin.

Willis, C.K., Barclay, R.M., Boyles, J.G., Brigham, R.M., Brack, V.Jr., Waldien, D.L. and Reichard, J. (2009) 'Bats are not birds and other problems with Sovacool's (2010) analysis of animal fatalities due to electricity generation' *Energy Policy* 38: 2067-2069

Yass Valley Council (undated) *Yass Valley Council* [online]. Available at: http://www.yassvalley.nsw.gov.au/ [accessed: 10 August 2012]

APPENDICES

APPENDIX A SPECIES LISTS AND TREE PLOT DATA

A.1 FLORA

*Introduced species are preceded by an asterisk.

Where uncertainty exists, the taxon name is preceded by a question mark (?).

Species name	Common name	Family
TREES		
Acacia dealbata ssp *dealbata*	Silver Wattle	Fabaceae
Acacia implexa	Lightwood or Hickory	Fabaceae
Acacia parramattensis		Fabaceae
Allocasuarina littoralis	Black Sheoak	Casuarinaceae
Callitris endlicheri	Black Cypress Pine	Cupressaceae
Eucalyptus blakelyi	Blakely's Red Gum	Myrtaceae
Eucalyptus bridgesiana	Apple Box	Myrtaceae
Eucalyptus cinerea	Argyle Apple	Myrtaceae
Eucalyptus dives	Broad-leaved Peppermint	Myrtaceae
Eucalyptus goniocalyx	Bundy, Long-leaved Box	Myrtaceae
Eucalyptus macrorhyncha	Red Stringybark	Myrtaceae
Eucalyptus mannifera	Brittle Gum	Myrtaceae
Eucalyptus melliodora	Yellow Box	Myrtaceae
Eucalyptus polyanthemos ssp *polyanthemos*	Red Box	Myrtaceae
Eucalyptus rossii	Scribbly Gum	Myrtaceae
Eucalyptus rubida ssp. *rubida*	Candlebark	Myrtaceae
Eucalyptus sideroxylon	Red Ironbark	Myrtaceae
Eucalyptus viminalis	Ribbon or Manna Gum	Myrtaceae
Exocarpos cupressiformis	Native Cherry	Santalaceae
SHRUBS, SUB-SHRUBS		
Acacia genistifolia	Early Wattle	Fabaceae
Acacia gunnii	Ploughshare Wattle	Fabaceae
Acacia rubida	Red-stem Wattle	Fabaceae
Amyema miquelii	a mistletoe	Loranthaceae
Amyema pendulum	a mistletoe	Loranthaceae
Billardiera scandens	Hairy Apple-berry	Pittosporaceae
Boronia algida		Rutaceae
Boronia nana var. *hyssopifolia*		Rutaceae
Brachyloma daphnoides	Daphne Heath	Epacridaceae
Cassinia aculeata	Dolly Bush	Asteraceae

Species name	Common name	Family
Cassinia arcuata	Sifton Bush	Asteraceae
Cassinia laevis	Cough Bush	Asteraceae
Cassinia longifolia	Dogwood	Asteraceae
Comesperma sphaerocarpum		Polygalaceae
Daviesia leptophylla		Fabaceae
Dillwynia phylicoides		Fabaceae
Dillwynia sericea		Fabaceae
Gompholobium huegelii	Pale Wedge Pea	Fabaceae
Gompholobium minus	Small Gompholobium	Fabaceae
Grevillea lanigera	Woolly Grevillea	Proteaceae
Hibbertia obtusifolia	Guineaflower	Dilleniaceae
Hibbertia riparia	Guineaflower	Dilleniaceae
Hovea heterophylla		Fabaceae
Indigofera australis	Austral Indigo	Fabaceae
Kunzea parvifolia	Violet Kunzea	Myrtaceae
Leptospermum multicaule		Myrtaceae
Melichrus urceolatus	Urn Heath	Epacridaceae
Monotoca scoparia	Prickly Broom Heath	Epacridaceae
Muellerina eucalyptoides	a mistletoe	Loranthaceae
Persoonia chamaepeuce		Proteaceae
Pimelea glauca	Shrubby Rice-flower	Thymeleaceae
Pimelea linifolia ssp *caesia*		Thymeleaceae
Platylobium formosum ssp *formosum*	Handsome Flat-pea	Fabaceae
Pultenaea subspicata		Fabaceae
**Rosa rubiginosa*	Sweet Briar	Rosaceae
**Solanum ?nigrum*	Black-berry Nightshade	Solanaceae
Tetratheca bauerifolia		Tremandraceae
FERNS		
Cheilanthes austrotenuifolia		Sinopteridaceae
Cheilanthes sieberi ssp *sieberi*	Rock or Mulga Fern	Sinopteridaceae
Pteridium esculentum	Bracken	Dennstaedtiaceae
VINES AND TWINERS		
Convolvulus angustissimus ssp. *angustissimus*	Bindweed	Convolvulaceae
Hardenbergia violacea	Native Sarsaparilla	Fabaceae
Thysanotus patersonii	Twining Fringe Lily	Anthericaceae
FORBS		
**Acetosella vulgaris*	Sheep Sorrel	Polygonaceae

Species name	Common name	Family
**Anagallis arvensis*	Scarlet Pimpernel	Primulaceae
**Arctotheca calendula*	Capeweed	Asteraceae
Arthropodium minus	Small Vanilla Lily	Anthericaceae
Brachyscome spathulata		Asteraceae
Brachyscome ptychocarpa		Asteraceae
Burchardia umbellata	Milkmaids	Colchicaceae
Caleana major	Flying Duck Orchid	Orchidaceae
Calochilus robertsonii	Purplish Beard Orchid	Orchidaceae
**Centaurium* sp.	Centaury	Gentianaceae
**Cerastium glomeratum*	Chickweed	Caryophyllaceae
Cheiranthera cyanea	Finger Flower	Pittosporaceae
Chrysocephalum apiculatum	Yellow Buttons	Asteraceae
**Cirsium vulgare*	Black or Spear Thistle	Asteraceae
Coronidium oxylepis ssp. *lanatum (Helichrysum collinum)*		Asteraceae
Cotula australis	Carrot Weed	Apiaceae
Crassula sieberiana	Australian Stonecrop	Crassulaceae
Cymbonotus ?lawsonianus	Bears Ear	Asteraceae
Daucus glochidiatus		Apiaceae
Dianella longifolia	Blue Flax Lily	Phormiaceae
Dianella revoluta	Black-anther Flax Lily	Phormiaceae
Dichondra repens	Kidney Weed	Convolvulaceae
Diuris maculata s. lat.	Leopard Orchid	Orchidaceae
Diuris sulphurea	Tiger Orchid	Orchidaceae
Drosera auriculata		Droseraceae
Drosera peltata	Sundew	Droseraceae
**Echium plantagineum*	Patterson's Curse	Boraginaceae
Euchiton gymnocephalus	Slender Cudweed	Asteraceae
Euchiton sphaericus	Common Cudweed	Asteraceae
Galium gaudichaudii		Rubiaceae
?Geranium potentilloides var. *abditum*		Geraniaceae
Geranium retrorsum		Geraniaceae
Geranium solanderi var. *solanderi*		Geraniaceae
Gonocarpus tetragynus	Raspwort	Haloragaceae
Goodenia bellidifolia ssp. *bellidifolia*		Goodeniaceae
Goodenia hederacea ssp *hederacea*		Goodeniaceae
Haloragis heterophylla	Variable Raspwort	Haloragaceae
Hydrocotyle laxiflora	Stinking Pennywort	Apiaceae

Species name	Common name	Family
Hypericum gramineum	Native St John's Wort	Clusiaceae
**Hypochaeris glabra*		Asteraceae
**Hypochaeris radicata*	Cat's Ear, Flatweed	Asteraceae
Isotoma fluviatilis		Lobeliaceae
**Leontodon taraxacoides*	Lesser Hawkbit	Asteraceae
Leptorhynchos squamatus ssp *squamatus*	Scaly Buttons	Asteraceae
**Linaria pelisseriana*	Pelisser's Toadflax	Scrophulariaceae
**Marrubium vulgare*	Horehound	Lamiaceae
Microseris lanceolata s. lat. (or sp. 3)	Murnong, Yam Daisy	Asteraceae
Microtis unifolia	Common Onion Orchid	Orchidaceae
**Onopordum acanthium*	Scotch Thistle	Asteraceae
Opercularia aspera	Stinkweed	Rubiaceae
Oxalis perennans	Native Oxalis	Oxalidaceae
**Parentucellia latifolia*	Red Bartsia	Scrophulariaceae
Patersonia sericea		Iridaceae
**Petrorhagia nanteuilii*	Proliferous Pink	Caryophyllaceae
Phyllanthus hirtellus	Thyme Spurge	Phyllanthaceae
Poranthera microphylla		Euphorbiaceae
Ranunculus lappaceus	Common Buttercup	Ranunculaceae
Rumex brownii	Native Dock	Polygonaceae
**Salvia verbenaca*	Wild Sage	Lamiaceae
Scutellaria humilis	Dwarf Skullcap	Lamiaceae
Senecio tenuiflorus		Asteraceae
**Sherardia arvensis*	Field Madder	Rubiaceae
Solenogyne dominii		Asteraceae
Solenogyne gunnii		Asteraceae
**Sonchus oleraceus*	Sow Thistle	Asteraceae
**Spergularia rubra*	Sandspurry	Caryophyllaceae
Stackhousia monogyna	Creamy Candles	Stackhousiaceae
Stackhousia viminea		Stackhousiaceae
Stellaria pungens	Prickly Starwort	Caryophyllaceae
Stuartina muelleri	Spoon Cudweed	Asteraceae
Stylidium graminifolium s. str.	Trigger Plant	Stylidiaceae
Stypandra glauca	Nodding Blue Lily	Anthericaceae
**Taraxacum officinale*	Dandelion	Asteraceae
Thelymitra carnea	Pink Sun Orchid	Orchidaceae
Thelymitra ixioides ssp. *ixioides*	Spotted Sun Orchid	Orchidaceae
Thelymitra nuda	Plain Sun Orchid	Orchidaceae

Species name	Common name	Family
Thelymitra ? X truncata		Orchidaceae
Thysanotus tuberosus	Fringe Lily	Anthericaceae
**Tolpis umbellata*		Asteraceae
Tricoryne elatior	Yellow Autumn Lily	Anthericaceae
**Trifolium arvense*	Hare's Foot Clover	Fabaceae
**Trifolium campestre*	Hop Clover	Fabaceae
**Trifolium dubium*	Suckling Clover	Fabaceae
**Trifolium glomeratum*	Ball Clover	Fabaceae
**Trifolium repens*	White Clover	Fabaceae
**Trifolium subterraneum*	Sub Clover	Fabaceae
Triptilodiscus pygmaeus		Asteraceae
**Urtica urens*	Stinging Nettle	Urticaceae
**Verbascum virgatum*	Twiggy Mullein	Scrophulariaceae
Veronica perfoliata	Diggers Speedwell	Plantaginaceae
Veronica plebeia	Common Speedwell	Scrophulariaceae
Viola betonicifolia	Narrow-leaved Violet	Violaceae
Wahlenbergia communis	Tufted Bluebell	Campanulaceae
Wahlenbergia gracilis	Sprawling Bluebell	Campanulaceae
Wahlenbergia multicaulis	Tadgell's Bluebell	Campanulaceae
Wahlenbergia stricta	Tall Bluebell	Campanulaceae
Wurmbea sp.	Early Nancy	Colchicaceae
Xerochrysum viscosum	Sticky Everlasting	Asteraceae
GRASSES		
**Aira caryophyllea*	Hair Grass	Poaceae
**Aira elegantissima*	Hair Grass	Poaceae
**Anthoxanthum odoratum*	Sweet Vernal Grass	Poaceae
Aristida ramosa var. *ramosa*		Poaceae
Austrodanthonia auriculata	Wallaby Grass	Poaceae
Austrodanthonia carphoides		Poaceae
Austrodanthonia eriantha	Wallaby Grass	Poaceae
Austrodanthonia laevis	Wallaby Grass	Poaceae
Austrodanthonia monticola	Wallaby Grass	Poaceae
Austrodanthonia pilosa var. *pilosa*	Wallaby Grass	Poaceae
Austrodanthonia racemosa var. *racemosa*	Wallaby Grass	Poaceae
Austrostipa densiflora		Poaceae
Austrostipa scabra ssp *falcata*	Corkscrew Grass	Poaceae
Austrostipa sp.		Poaceae
**Avena fatua*	Wild Oats	Poaceae

Species name	Common name	Family
**Briza maxima*	Quaking Grass	Poaceae
**Briza minor*	Shivery Grass	Poaceae
**Bromus diandrus*	Giant Brome	Poaceae
**Bromus hordaceus*	Soft Brome	Poaceae
**Bromus molliformis*	Soft Brome	Poaceae
**Bromus racemosus*		Poaceae
**Bromus rubens*	Red Brome	Poaceae
**Cynosurus echinatus*	Dog's Tail Grass	Poaceae
**Dactylis glomerata*	Cocksfoot	Poaceae
Dichelachne micrantha	Common Plume Grass	Poaceae
Echinopogon ovatus	Hedgehog Grass	Poaceae
Elymus scaber	Common Wheat Grass	Poaceae
**Holcus lanatus*	Yorkshire Fog	Poaceae
**Hordeum leporinum*	Barley Grass	Poaceae
Joycea pallida	Robust Wallaby Grass	Poaceae
Lachnagrostis filiformis	Blown Grass	Poaceae
**Lolium perenne*	Perennial Ryegrass	Poaceae
Microlaena stipoides	Weeping Grass	Poaceae
**Nassella trichotoma*	Serrated Tussock	Poaceae
Panicum effusum	Hairy Panic	Poaceae
**Phalaris aquatica*	Phalaris	Poaceae
Phragmites australis	Common Reed	Poaceae
Poa labillardierei	Silver or Poa Tussock	Poaceae
Poa meionectes		Poaceae
Poa sieberiana var. *cyanophylla*		Poaceae
Poa sieberiana var. *sieberiana*		Poaceae
Themeda australis	Kangaroo Grass	Poaceae
**Vulpia bromoides*	Squirrel Tail Fescue	Poaceae
**Vulpia muralis*	Rat's Tail Fescue	Poaceae
**Vulpia myuros*	Rat's Tail Fescue	Poaceae
GRAMINOIDS		
Carex appressa	Tall Sedge	Cyperaceae
Carex inversa	Knob Sedge	Cyperaceae
**Juncus acutus*	Sharp Rush	Juncaceae
Juncus filicaulis		Juncaceae
Juncus remotiflorus		Juncaceae
Juncus usitatus	Common Rush	Juncaceae
Juncus sp.		Juncaceae
Lepidosperma laterale	Variable Sword-sedge	Cyperaceae

Species name	Common name	Family
Lomandra filiformis ssp *coriacea*		Lomandraceae
Lomandra filiformis ssp *filiformis*		Lomandraceae
Lomandra longifolia	Spiny Matrush	Lomandraceae
Lomandra multiflora ssp *multiflora*		Lomandraceae
Luzula meridionalis var. *densiflora*		Juncaceae
Schoenus apogon	Common Bog-rush	Cyperaceae
Xanthorrhoea glauca subsp. *angustifolia*	Grass Tree	Xanthorrhoeaceae

A.2 FAUNA

Where uncertainty exists, the taxon name is preceded by a question mark (?).

Threatened species are highlighted in bold text.

Species name	Common name
Herpetofauna	
Amphibolurus muricatus	Jacky Lizard
Carlia tetradactyla	Southern Rainbow Skink
Crinia signifera	Common Froglet
Delma impar	Striped Legless Lizard
Delma inornata	Common Delma
Diplodactylus spp.	Gecko
Diplodactylus vittatus	Eastern Stone Gecko
Egernia cunninghami	Cunningham's Skink
Lampropholis delicata	Delicate Skink
Lampropholis guichenotti	Garden Skink
Litoria peronii	Peron's Treefrog
Morethia boulengeri	Boulenger's Skink
Pogona barbata	Eastern Bearded Dragon
Pseudechis porphyriacus	Red Belly Black Snake
Tiliqua rugosa	Shingleback
Tiliqua scincoides scincoides	Blue-tongue Lizard
Mammals	
Capra hircus	Goat (feral)
Hydromys chrysogaster	Water Rat
Lepus capensis	Brown Hare
Macropus giganteus	Eastern Grey Kangaroo
Macropus robustus robustus	Eastern Wallaroo
Macropus rufogriseus	Red-necked Wallaby
Oryctolagus cuniculus	European Rabbit
Petaurus breviceps	Sugar Glider
Pseudocheirus peregrinus	Common Ringtail Possum
Sus scrofa	Feral Pig
Tachyglossus aculeatus	Short-beaked Echidna
Trichosurus vulpecula	Common Brushtail Possum
Vombatus ursinus	Common Wombat
Vulpes vulpes	Red Fox
Wallabia bicolor	Black Wallaby
Microbats	
Austronomus australis	White-striped Freetail Bat

Species name	Common name
Chalinolobus gouldii	Gould's Wattled Bat
Chalinolobus morio	Chocolate Wattled Bat
Falsistrellus tasmaniensis	**Eastern False Pipistrelle**
Miniopterus oriane (schreibersii) oceansis	**Eastern Bentwing Bat**
Mormopterus planiceps (sp.4)	Southern Freetail Bat
Mormopterus ridei	Eastern Freetail Bat
Nyctophilus spp	Long-eared Bat species
Vespadelus darlingtoni	Large Forest Bat
Vespadelus regulus	Southern Forest Bat
Vespadelus vulturnus	Little Forest Bat
Saccolaimus flaviventris	**Yellow-bellied Sheath-tail Bat**
Birds	
Acanthagenys rufogularis	Spiny-cheeked Honeyeater
Acanthiza chrysorrhoa	Yellow-rumped Thornbill
Acanthiza lineata	Striated Thornbill
Acanthiza pusilla	Brown Thornbill
Acanthiza reguloides	Buff-rumped Thornbill
Acanthiza spp.	Thornbill spp.
Acanthorhynchus tenuirostris	Eastern Spinebill
Accipiter fasciatus	Brown Goshawk
Acrocephalus stentoreus	Clamorous Reed Warbler
Alisterus scapularis	King Parrot
Anas superciliosa	Pacific Black Duck
Anthochaera carunculata	Red Wattlebird
Anthus novaeseelandiae	Richard's Pipit
Aphelocephala leucopsis	Southern Whiteface
Aquila audax	Wedge-tailed Eagle
Ardea pacifica	White-necked Heron
Artamus cyanopterus	Dusky Woodswallow
Artamus personatus	Masked Woodswallow
Artamus superciliosus	White-browed Woodswallow
Cacatua galerita	Sulphur-crested Cockatoo
Cacatua roseicapilla	Galah
Cacomantis flabelliformis	Fan-tailed Cuckoo
Chenonetta jubata	Australian Wood Duck
Cincloramphus mathewsi	Rufous Songlark
Cisticola exilis	Golden-headed Cisticola
Climacteris picumnus	Brown Treecreeper
Colluricincla harmonica	Grey Shrike-thrush

Species name	Common name
Coracina maxima	Ground Cuckoo-shrike
Coracina novaehollandiae	Black-faced Cuckoo-shrike
Corcorax melanorhamphos	White-winged Chough
Cormobates leucophaeus	White-throated Treecreeper
Corvus coronoides	Australian Raven
?Coturnix australis	Brown Quail
Coturnix pectoralis	Stubble Quail
Cracticus torquatus	Grey Butcherbird
Cuculus pallidus	Pallid Cuckoo
Dacelo novaeguineae	Laughing Kookaburra
Daphoenositta chrysoptera	**Varied Sittella**
Dicaeum hirundinaceum	Mistletoebird
Egretta novaehollandiae	White-faced Heron
Elanus axillaris	Black-shouldered Kite
Eopsaltria australis	Eastern Yellow Robin
Epthianura albifrons	**White-fronted Chat**
Eurystomus orientalis	Dollarbird?
Falco berigora	Brown Falcon
Falco cenchroides	Nankeen Kestrel
Gerygone fusca	Western Gerygone
Gerygone olivacea	White-throated Gerygone
Grallina cyanoleuca	Magpie-lark
Grantiella picta	**Painted Honeyeater**
Gymnorhina tibicen	Australian Magpie
Hirundo ariel	Fairy Martin
Hirundo neoxena	Welcome Swallow
Hylacola pyrrhopygia	Chestnut-rumped Heathwren
Lalage sueurii	White-winged Triller?
Lichenostomus chrysops	Yellow-faced Honeyeater
Lichenostomus leucotis	White-eared Honeyeater
Lichenostomus penicillatus	White-plumed Honeyeater
Malurus cyaneus	Superb Fairy-wren
Manorina melanocephala	Noisy Miner
Melanodryas cucullata	**Hooded Robin**
Melithreptus brevirostris	Brown-headed Honeyeater
Microcarbo niger	Little Comorant
Microeca fascinans	Jacky Winter
Myiagra cyanoleuca	Satin Flycatcher
Myiagra rubecula	Leaden Flycatcher
Neochmia temporalis	Red-browed Finch

Species name	Common name
Ninox novaeseelandiae	Southern Boobook
Ocyphaps lophotes	Crested Pigeon
Oriolus sagittatus	Olive-backed Oriole
Pachycephala pectoralis	Golden Whistler
Pachycephala rufiventris	Rufous Whistler
Pardalotus punctatus	Spotted Pardalote
Pardalotus striatus	Striated Pardalote
Passer domesticus	House Sparrow
Petroica boodang	**Scarlet Robin**
Petroica goodenovii	Red-capped Robin
Petroica phoenicea	**Flame Robin**
Phaps chalcoptera	Common Bronzewing
Philemon corniculatus	Noisy Friarbird
Platycercus elegans	Crimson Rosella
Platycercus eximius	Eastern Rosella
Polytelis swainsonii	**Superb Parrot**
Psephotus haematonotus	Red-rumped Parrot
Pyrrholaemus sagittatus	**Speckled Warbler**
Rhipidura fuliginosa	Grey Fantail
Rhipidura leucophrys	Willie Wagtail
Sericornis frontalis	White-browed Scrubwren
Stagonopleura guttata	**Diamond Firetail**
Strepera graculina	Pied Currawong
Strepera versicolor	Grey Currawong
Sturnus vulgaris	Common Starling
Tachybaptus novaehollandiae	Australasian Grebe
Taeniopygia bichenovii	Double-barred Finch
Threskiornis spinicollis	Straw-necked Ibis
Todiramphus sanctus	Sacred Kingfisher
Turdus merula	Blackbird
Vanellus miles	Masked Lapwing
Zosterops lateralis	Silvereye

A.3 HOLLOW-BEARING TREE DATA

Plot data from quadrat assessments

Report_ID	_ID	Habitat ass	Zone	H	Easting	Northing	Tree_plot	HBT_plot	No_tree	No_HBT	Av_DBH_cm	Max_DBH_cm
1	HBT 9	H01	55	H	681569.2	6167438	100x100	100x100	11	1		
2	HBT 27	HA37	55	H	676524	6186430		100x100		1	10	60
3	HBT 1	H13	55	H	686435	6154142	10x10	25x25	40	4		
4	HBT 14	H22	55	H	686294	6155183	10x10	25x25	9	1	20	60
5	HBT 15	H22a	55	H	686294	6155183	10x10	25x25	11	1	20	60
6	HBT 16	H22b	55	H	686221	6154920	10x10	25x25	15	5	20	60
7	HBT 17	H24	55	H	686314	6157983	10x10	25x25	8	6	40	70
8	HBT 18	H26	55	H	686330	6159099	10x10	25x25	18	11		
9	HBT 19	H26a	55	H	686330	6159099	10x10	25x25	10	9		
10	HBT 2	H9	55	H	687109	6152561	10x10	25x25	32	9	20	50
11	HBT 20	H27	55	H	686367	6160007	10x10	25x25	5	2		80
12	HBT 21	H25	55	H	686354	6157241	10x10	25x25	13	4		
13	HBT 10	H10	55	H	687117	6152887	25x25	25x25	3	0		
14	HBT 11	H8	55	H	685437	6150843	25x25	25x25	35	2		
15	HBT 12	H2	55	H	682204	6162512	25x25	25x25	10	0	30	
16	HBT 13	H3	55	H	682228	6163318	25x25	25x25	45	5	20	60
17	HBT 4	H7	55	H	681599	6167466	25x25	25x25	25	0	10	
18	HBT 5	H03a	55	H	684240	6152153	25x25	25x25	32	1	40	
19	HBT 6	H03b	55	H	684240	6152153	25x25	25x25	56	5	50	

Report_ID	_ID	Habitat ass	Zone	H	Easting	Northing	Tree_plot	HBT_plot	No_tree	No_HBT	Av_DBH_cm	Max_DBH_cm
20	HBT 7	H6	55	H	681565	6167428	25x25	25x25	75	0	15	
21	HBT 8	H12	55	H	686834	6153086	25x25	25x25	25	0	20	
22	HBT 22	Ha 20	55	H	681944	6170732		25x25		1	20	70
23	HBT 23	HA19	55	H	682051	6169756		25x25		0	20	60
24	HBT 24	Ha 34	55	H	677200	6184072		25x25		12	20	60
25	HBT 25	HA 28	55	H	681054	6182345		25x25		0	20	40
26	HBT 26	HA27	55	H	680614	6181015		25x25		4	20	60
27	HBT 28	HA33a	55	H	677202	6183439		25x25		4	15	70
28	HBT 29	HA	55	H	683973	6176690		25x25		1	15	40
29	HBT 30	HA23b	55	H	681075	6176442		25x25		5	20	50
30	HBT 31	HA32a	55	H	678018	6182673		25x25		0	20	60
31	HBT 32	HA23	55	H	680920	6176329		25x25		6	10	90
32	HBT 33	Roadside	55	H	687580	6160450		50x10		6	40	100
33	HBT 34	HB3	55	H	680915.1	6164725	100x100	100x100	26	4		
34	HBT 35	H19	55	H	685327	6154635	100x100	100x100	19	1		
35	HBT 36	H2B	55	H	684486.2	6152081		25x25		3		

Hollow-bearing tree data from search areas (i.e. surveys within 100 m of infrastructure in moderate-good condition woodland/forest or within Superb Parrot foraging area)

Hollow-bearing tree ID	Tree Data			Hollow Size			Comment	Quality	Easting	Northing
	Tree	DBH	Height	Small	Medium	Large				
H1	Stag	50	6	1			bats	0	6182534	681305
H2	Scribbly Gum	60	12	2	1		small bird, bats	0	6182528	681301
H3	Stag	20	8	1			bats	0	6182532	681275
H4	Scribbly Gum	120	12	1 branch	1 branch		Jagged - exposed, No to parrots	0	6170388	682064
H5	Scribbly Gum	100	15	1			Potential hollow - not obvious	0	6170685	682022
H6	Stag	40	4			1 trunk	bats, open	0	6170720	681948
H7	Stag	20	5		1		bats, open	0	6170728	681874
H8	Stag	50	6		2 branch	1 basal	bats, open	0	6170701	681893
H9	Stag	80	4			1 spout	bats, open	0	6170687	681911
H10	Stag	50	3		2	1	bats, open	0	6170607	681911
H11	Stag	100	5		1	2	bats, maybe parrots - lge but bit jagged	0	6170607	681885
H12	Stringybark	30	12	2			small bird	0	6170580	681920
H13	Yellow Box				1 trunk		Ok for parrots	1	6152914	685298
H14	Yellow Box				3 branch		not great for parrots	1	6153023	685147
H15	Yellow Box				1 branch		Ok for parrots	1	6156980	685129
H16	Box				1 branch	1 trunk	No for parrots	0	6157002	685118
H17	Box			2 branch			No for parrots	0	6156932	685125
H18	Box				1 tunk		Gd for parrots	2	6156896	685074
H19	Box			1 branch			No for parrots	0	6156866	685086
H20	Stag					3 branch, 1 trunk	Gd for bats, maybe branch for parrots	1	6156814	685164
H21	Stag			1 branch	1 branch		No for parrots	0	6156870	685162
H22	Stag					1 branch	Gd for parrots	2	6156853	685163

Hollow-bearing tree ID	Tree Data			Hollow Size			Comment	Quality	Easting	Northing
	Tree	DBH	Height	Small	Medium	Large				
H23	Box				1 branch		Ok for parrots	1	6156837	685169
H24	Box			2 branch			No for parrots	0	6156825	685171
H25	Box			1 branch			No for parrots	0	6156644	685167
H26	Scribbly Gum	50	12		1		Poor, jagged open	0	6165295	681314
H27	Scribbly Gum	60	10		1		Poor	0	6165286	681336
H28	Scribbly Gum	70	13	1		1 trunk	Poor, trunk long and skinny	0	6165306	681338
H29	Scribbly Gum	80	12	2	1		Bats	0	6165331	681353
H30	Stag	90	4	2			Poor, bats	0	6165332	681330
H31	Scribbly Gum	110	6			2	Ok - open trunk hollow - exposed	1	6165464	681352
H32	Scribbly Gum	120	12			1 basal	Good for bats, open for birds	0	6165467	681362
H33	Scribbly Gum	110	12		1	1 basal, 1 trunk	Gd for parrots, gliders	2	6165467	681372
H34	Scribbly Gum	90	14		2	1	Gd for parrots, gliders	2	6165481	681383
H35	Scribbly Gum	40	14	1			bats	0	6165446	681374
H36	Scribbly Gum	40	12	1 branch	1 branch		Jagged - exposed, No to parrots	0	6165453	681360
H37	Stag	40	12	1		1	Jagged - exposed, No to parrots	0	6165453	681360
H38	Scribbly Gum	60	12		1 branch, 1 trunk		Parrots, bats	2	6167313	681691
H39	Stag	40	5	1 branch, 1 trunk			Bats	0	6167327	681680
H40	Stringybark	40	8	1	1	1	bats - poor, open, jagged	0	6167338	681680
H41	Scribbly Gum	50	10			2 trunk	maybe ok for bats	0	6167335	681673
H42	Scribbly Gum	50	11	1	1		bats, open and exposed	0	6167333	681672
H43	Scribbly Gum	90	10			1 branch, 1 trunk	Gd hollow, deep and good perch	2	6167322	681704
H44	Stag	50	8		1 trunk		bats - poor, open	0	6167279	681733
H45	Stag	100	4		1		bats - poor, pot possum drey	0	6167258	681748

Hollow-bearing tree ID	Tree Data			Hollow Size			Comment	Quality	Easting	Northing
	Tree	DBH	Height	Small	Medium	Large				
H46	Scribbly Gum	130	15	2			Potential - not obvious hollow. Small bird.	1	6167453	681567
H47	Stag	100	12			1 trunk	bats - poor, open	0	6167494	681530
H48	Scribbly Gum	90	16	1		1 branch	Gd for parrots, gliders	2	6167489	681560
H49	Scribbly Gum	90	10			2 branch	Ok - jagged, exposed, no perch	0	6167516	681563
H50	Scribbly Gum	80	12			1 trunk, 1 branch	parrots, bats	2	6167544	681555
H51	Scribbly Gum	90	15			1 trunk	Long hollow, gliders, bats	2	6167537	681573
H52	Scribbly Gum	60	15			1 trunk	Gd for parrots, gliders	2	6167538	681558
H53	Scribbly Gum	80	12			1 trunk	Gd for parrots, gliders	2	6167529	681538
H54	Scribbly Gum	70	9			1 trunk	bats, hollow open	0	6167574	681538
H55	Scribbly Gum	110	12			1 trunk, 1 branch	Ok - a little open. Potential for gliders	1	6167632	681515
H56	Scribbly Gum	40	9		1 trunk, 1 branch		bats, open and exposed	0	6167602	681510
H57	Scribbly Gum	60	8	1 trunk	1 trunk		bats, open, exposed, jagged	0	6167599	681458
H58	Scribbly Gum	60	10		2 branch		poor, bats	0	6167713	681452
H59	Scribbly Gum	60	11		1	1 basal	poor, bats, open	0	6167726	681464
H60	Scribbly Gum	50	11		2	1 trunk	2 med hollows gd for parrots, gliders	2	6167727	681509
H61	Scribbly Gum	45	12		2 branch		Gd for parrots, gliders	2	6167703	681503
H62	Scribbly Gum	40	15		1 trunk		poor, bats, open	0	6167701	681521
H63	Scribbly Gum	40	15		1 trunk		poor, bats, open	0	6167736	681520
H64	Scribbly Gum	50	15	1	1 trunk		potential glider, parrot - ok	2	6167795	681506
H65	Scribbly Gum	45	12	1	1	1	potential glider, parrot - ok	2	6167821	681527
H66	Scribbly Gum	60	9		2		bats, jagged, not great	0	6167827	681530
H67	Scribbly Gum	60	10			1 trunk	poor, at head height	0	6167836	681517
H68	Scribbly Gum	40	12		1 trunk, 1 branch		ok for bats and parrots	1	6167830	681536

Hollow-bearing tree ID	Tree Data			Hollow Size			Comment	Quality	Easting	Northing
	Tree	DBH	Height	Small	Medium	Large				
H69	Scribbly Gum	110	16	1	1	1 trunk, 1 branch	Gd for parrots, gliders	2	6167886	681571
H70	Scribbly Gum	80	12		1	1 branch	Gd for parrots, gliders	2	6167889	681593
H71	Scribbly Gum	50	8	1	2		Poor, jagged open	0	6167927	681501
H72	Scribbly Gum	40	9		1 trunk		potential, poor - open	0	6167937	681490
H73	Scribbly Gum	50	10	1	1		potential, poor	0	6167960	681538
H74	Scribbly Gum	70	10		1 trunk		bats - long skinny hollow	0	6167945	681547
H75	Scribbly Gum	70	12	1 branch	1 branch		bats, poor - open	0	6167930	681548
H76	Stringybark	50	10		1 trunk		ok - bats, gliders	1	6167935	681558
H77	Scribbly Gum	60	11	1 branch	1 branch	1 trunk	Trunk - long skinny hollow, branch - poor, bats	0	6167897	681513
H78	Stringybark	60	10			1 trunk	Trunk long, exposed and open, bats	0	6167883	681512
H79	Scribbly Gum	40	11	1 trunk	1 trunk		ok for parrots, gliders	1	6167807	681566
H80	Scribbly Gum	60	6		1	1	poor, bats	0	6167787	681576
H81	Scribbly Gum	60	11			1 trunk	poor, shallow, bats	0	6167758	681524
H82	Box	130			1		Shallow - pot. For parrots?	1	6155241	684306
H83	Stringybark	110		1			Ok for small bird	0	6155049	684329
H84	Stringybark	90			1 trunk		Potential for parrots	1	6154964	684335
H85	Stringybark	130			1		No to parrots	0	6155255	684433
H86	Stringybark	130			2		Potenital. Jagged hollows - no to parrots	0	6155366	684230
H87	Stag	80	6			1 trunk	Poor - open. Ok Bats	0	6154254	684507
H88	Stringybark	90	8			1 trunk	Poor - open. Ok Bats	0	6154266	684507
H89	Stag	80	7	1	1		bats, small bird	0	6154225	684642
H90	Yellow Box	160	12	1	1	1	Gd for parrots / bats	2	6154006	684658
H91	Stingybark	130	15		1		Gd for parrots - looks worn, blue feather at base	2	6153708	684598
H92	Box	210	14			1 branch	Bit jagged, maybe ok for parrots	1	6153543	684430

Hollow-bearing tree ID	Tree Data			Hollow Size			Comment	Quality	Easting	Northing
	Tree	DBH	Height	Small	Medium	Large				
H93	Stringybark	90	12	1			Poor - open. Ok Bats	0	6154263	684547
H94	Stag	60	9	2			Poor - Ok Bats	0	6154290	684524
H95	Yellow Box	130		1			No to parrots	0	6156321	685234
H96	Stingybark	140		1	1	1	Gd for parrots	2	6156391	685202
H97	Stag	60			2		Gd for parrots	2	6156506	685212
H98	Red Box	90		1			No to parrots	0	6156542	685234
H99	Stringybark	150		several	2		Jagged - exposed, No to parrots	0	6155638	684393
H100	Stag	100		1	1		Upward spout - No to parrots	0	6155433	684368
H101	Yellow Box	100		2 spouts			Upward spout - No to parrots	0	6155437	684287
H102	Stag	110			1 trunk		Gd - in use - wear around entrance	2	6155400	684351
H103	Stag	50			1		In use by Crimson Rosella	2	6157166	684949
H104	Stag	100	10		3	1	Dead.	1	6152730	684370
H105	Stag	50	5			1 spout	Dead	1	6152817	684436
H106	Stag	50	5		1 branch		Dead	1	6153106	684322
H107	Stag	80	5	1		1	Dead	1	6152717	684447
H108	Stag	40	5			1 spout	Dead	0	6153130	684549
H109	Stag	60	10	3	1 branch		Dead	0	6153099	684445
H110 / Potential Nest tree	Stag	5	10	1	1 branch		Dead (Superb Parrot in spout?)	2	6153141	684872
H111	Box	120	10		1 branch		Live	1	6152752	684866
H112	Box	120	12		1		Live	1	6152781	684853
H113	Stringybark	100	10			1 spout	Live	0	6153283	684389
H114	Stag	40	10	1			Dead	1	6153672	684970
H115	Stag	120	10			1 spout	Dead	2	6153967	684716
H116	Stag	110	10		2 spout		Dead	1	6153743	684634
H117	Stag	40	10			1 spout	Dead	2	6153546	684866
H118	Box	140	15		2 spout		Live	1	6153254	685027

Hollow-bearing tree ID	Tree Data			Hollow Size			Comment	Quality	Easting	Northing
	Tree	DBH	Height	Small	Medium	Large				
H119 / Superb Parrot Nest	Box	120	15	1 branch			Live. 2 Superb Parrots in nest (m & f)	2	680988	6168066
H120 / Potential Nest tree	Box	100	15		1 branch	1 branch	Live. Male & Female Superb Parrots hanging around hollow	2	685038	6153631
H121 / Potential Nest tree	?						Obs Superb Parrot during flight path mapping.	2	679937	6168777

A.4 BIRD UTILISATION RAW DATA

Species	Survey Site Number																													
	1						2						3						4						5					
	<10	0-20	21-40	41-140	>140	Total	<10	0-20	21-40	41-140	>140	Total	<10	0-20	21-40	41-140	>140	Total	<10	0-20	21-40	41-140	>140	Total	<10	0-20	21-40	41-140	>140	Total
Australian Magpie	0	2	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Australian Raven	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Bronzewing	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crimson Rosella	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Dusky Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Yellow Robin	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Galah	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Shrike-thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leaden Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magpie-lark	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	2	0	0	0	2	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Miner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Painted Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Red Wattlebird	0	2	0	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richard's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Sacred Kingfisher	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Silvereye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Pardalote	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0
Sulphur-crested Cockatoo	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Superb Fairy-wren	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welcome Swallow	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
White-throated Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
White-winged Chough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Total	**0**	**24**	**0**	**2**	**0**	**26**	**0**	**4**	**3**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**19**	**0**	**0**	**0**	**21**	**0**	**4**	**0**	**0**	**0**	**4**

Species	**Survey Site Number**																													
	6						**7**						**8**						**9**						**10**					
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**
Australian Magpie	0	2	0	0	0	2	0	1	0	0	0	1	0	1	0	0	0	1	0	6	0	0	0	6	0	0	1	0	0	1
Australian Raven	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	0	6	0	0	0	6	0	6	0	0	0	6	0	0	0	0	0	0	0	2	0	0	0	2
Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crimson Rosella	0	4	0	0	0	4	0	2	0	0	0	2	0	2	0	0	0	2	0	1	0	0	0	1	0	4	0	0	0	4
Dusky Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galah	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golden Whistler	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Grey Shrike-thrush	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Leaden Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	3
Magpie-lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0
Noisy Miner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Painted Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Red Wattlebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richard's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	0	0	0	0	0	0	0	2	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Sacred Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvereye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Pardalote	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphur-crested Cockatoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Superb Fairy-wren	0	4	0	0	0	4	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Treecreeper	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
White-winged Chough	0	8	0	0	0	8	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-rumped Thornbill	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**27**	**1**	**0**	**0**	**28**	**0**	**21**	**0**	**0**	**0**	**21**	**1**	**17**	**0**	**0**	**0**	**18**	**0**	**12**	**0**	**0**	**0**	**12**	**0**	**12**	**1**	**0**	**0**	**13**

Species	**Survey Site Number**																													
	11						**12**						**13**						**14**						**15**					
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**
Australian Magpie	0	0	0	0	0	0	3	0	0			3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Australian Raven	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackbird	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	0
Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crimson Rosella	2	0	0	0	0	2	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dusky Woodswallow	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galah	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Grey Shrike-thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Leaden Flycatcher	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magpie-lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mistletoebird	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Noisy Miner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Painted Honeyeater	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Wattlebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richard's Pipit	2	0	0	0	0	2	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Songlark	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Sacred Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvereye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Striated Pardalote	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	0	0	0	0	0	0	0	4	0	0	0	4
Sulphur-crested Cockatoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Superb Fairy-wren	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	6	0	0	0	0	0	0
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4

Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Scrubwren	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Woodswallow	0	6	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-plumed Honeyeater	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1
White-winged Chough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0
Yellow-rumped Thornbill	3	0	0	0	0	3	6	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**35**	**7**	**0**	**0**	**0**	**42**	**17**	**4**	**0**	**1**	**0**	**22**	**7**	**0**	**0**	**0**	**0**	**7**	**12**	**10**	**0**	**0**	**0**	**22**	**0**	**10**	**0**	**0**	**0**	**10**

Species	**Survey Site Number**																													
	16						**17**						**18**						**19**						**20**					
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**
Australian Magpie	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	2	0	0	2	0	7	0	0	0	7
Australian Raven	0	0	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	6	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4
Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0
Crimson Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5	0	0	11	0	0	11	0	5	0	0	0	5
Dusky Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	10	0	0	0	10
Eastern Spinebill	2	0	0	0	0	2	2	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galah	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	13	5	0	0	0	0	5
Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Grey Shrike-thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Leaden Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magpie-lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	1	0	0	0	1	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Miner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0

Painted Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Wattlebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Richard's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	2	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sacred Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Silvereye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphur-crested Cockatoo	0	0	0	0	0	0	0	3	0	0	0	3	0	0	2	0	0	2	0	0	18	0	0	18	0	0	0	5	0	5
Superb Fairy-wren	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	12	2	0	0	0	0	2
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0	6	0	0	0	0	6	0	0	0	0	0	0	14	0	0	0	0	14	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
White-throated Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Chough	3	0	0	0	0	3	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	6	0	0	0	0	6	0	0	0	0	0	0
Total	**6**	**2**	**0**	**0**	**0**	**8**	**19**	**10**	**0**	**0**	**0**	**29**	**6**	**13**	**2**	**0**	**0**	**21**	**46**	**42**	**31**	**0**	**0**	**119**	**11**	**24**	**0**	**5**	**0**	**40**

Species	**Survey Site Number**																													
	21						**22**						**23**						**24**						**25**					
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**
Australian Magpie	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1	0	3	0	0	0	3
Australian Raven	0	0	2	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	6	0	0	0	0	6	4	0	0	0	0	4	0	0	0	0	0	0	4	0	0	0	0	4
Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Common Starling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crimson Rosella	0	4	0	0	0	4	0	0	14	0	0	14	3	0	0	0	0	3	0	0	0	0	0	0	0	3	0	0	0	3
Dusky Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	2	0	0	0	2	0	3	0	0	0	3	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Galah	0	0	3	0	0	3	0	3	0	0	0	3	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Shrike-thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
House Sparrow	3	0	0	0	0	3	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	2	0	0	0	2
Leaden Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magpie-lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Noisy Miner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Painted Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Wattlebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richard's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
Sacred Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvereye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5
Sulphur-crested Cockatoo	0	0	5	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Superb Fairy-wren	0	0	0	0	0	0	1	0	0	0	0	1	5	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

White-winged Chough	0	0	0	0	0	0	0	4	0	0	0	4	8	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-rumped Thornbill	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
Total	**3**	**7**	**10**	**0**	**0**	**20**	**12**	**15**	**14**	**3**	**0**	**44**	**26**	**2**	**0**	**0**	**0**	**28**	**4**	**3**	**0**	**0**	**0**	**7**	**10**	**10**	**2**	**0**	**0**	**22**

Species	**Survey Site Number**																													
	26						**27**	**2**					**28**						**29**						**30**					
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**
Australian Magpie	0	2	0	0	0	2	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
Australian Raven	0	0	0	0	0	0	0	2	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	5	0	6	0	0	0	6	0	0	0	0	0	0
Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crimson Rosella	0	3	0	0	0	3	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Dusky Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galah	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Shrike-thrush	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	1
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	2	0	0	0	2	0	0	0	0	0	0
Leaden Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magpie-lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Noisy Miner	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Painted Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Wattlebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richard's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0

Sacred Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Silvereye	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Thornbill	4	0	0	0	0	4	0	0	0	0	0	0	3	0	0	0	0	3	0	4	0	0	0	4	0	0	0	0	0	0
Sulphur-crested Cockatoo	0	0	3	0	0	3	0	4	0	0	0	4	0	4	0	0	0	4	0	0	0	0	0	0	0	1	0	0	0	1
Superb Fairy-wren	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0	0	1	0	0	0	1	0	2	0	0	0	2	0	0	0	0	0	0	0	2	0	0	0	2
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Treecreeper	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Chough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**4**	**9**	**3**	**0**	**0**	**16**	**0**	**13**	**0**	**0**	**0**	**13**	**15**	**11**	**0**	**0**	**0**	**26**	**0**	**14**	**0**	**0**	**0**	**14**	**0**	**10**	**0**	**0**	**0**	**10**

Species	**Survey Site Number**																													
	31						**32**						**33**						**34**						**35**					
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**	**<10**	**0-20**	**21-40**	**41-140**	**>140**	**Total**
Australian Magpie	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Australian Raven	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Australian Wood Duck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Brown Falcon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Goshawk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	5
Brown Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Bronzewing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crimson Rosella	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Dusky Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Galah	0	1	0	0	0	1	0	2	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0

Golden Whistler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey Fantail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Grey Shrike-thrush	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0
House Sparrow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Leaden Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Magpie-lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noisy Friarbird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1
Noisy Miner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Olive-backed Oriole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Painted Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pied Currawong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red Wattlebird	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-capped Robin	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Richard's Pipit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rufous Whistler	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
Sacred Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Silvereye	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted Pardalote	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
Striated Pardalote	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
Sulphur-crested Cockatoo	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Superb Fairy-wren	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	10
Varied Sittella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Gerygone	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-throated Treecreeper	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
White-winged Chough	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-faced Honeyeater	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow-rumped Thornbill	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**16**	**0**	**0**	**0**	**16**	**0**	**6**	**0**	**0**	**0**	**6**	**0**	**4**	**1**	**0**	**0**	**5**	**0**	**8**	**2**	**0**	**1**	**11**	**0**	**27**	**0**	**0**	**0**	**27**

Species	Survey Site Number					
	36					
	<10	0-20	21-40	41-140	>140	Total
Australian Magpie	0	12	0	0	0	12
Australian Raven	0	0	0	0	0	0
Australian Wood Duck	0	0	0	0	0	0
Blackbird	0	0	0	0	0	0
Black-faced Cuckoo-shrike	0	0	0	0	0	0
Brown Falcon	0	1	0	0	0	1
Brown Goshawk	0	0	0	0	0	0
Brown Quail	0	0	0	0	0	0
Brown Thornbill	0	0	0	0	0	0
Brown Treecreeper	0	0	0	0	0	0
Buff-rumped Thornbill	0	0	0	0	0	0
Common Bronzewing	0	0	0	0	0	0
Common Starling	0	0	0	0	0	0
Crimson Rosella	0	0	0	0	0	0
Dusky Woodswallow	0	0	0	0	0	0
Eastern Rosella	0	0	0	0	0	0
Eastern Spinebill	0	0	0	0	0	0
Eastern Yellow Robin	0	0	0	0	0	0
Fan-tailed Cuckoo	0	0	0	0	0	0
Flame Robin	0	0	0	0	0	0
Galah	0	2	0	0	0	2
Golden Whistler	0	0	0	0	0	0
Grey Butcherbird	0	0	0	0	0	0
Grey Fantail	0	0	0	0	0	0
Grey Shrike-thrush	0	0	0	0	0	0
House Sparrow	0	0	0	0	0	0
Laughing Kookaburra	0	0	0	0	0	0
Leaden Flycatcher	0	0	0	0	0	0
Magpie-lark	0	0	0	0	0	0
Mistletoebird	0	0	0	0	0	0
Nankeen Kestrel	0	0	0	0	0	0
Noisy Friarbird	0	0	0	0	0	0
Noisy Miner	0	0	0	0	0	0
Olive-backed Oriole	0	0	0	0	0	0
Painted Honeyeater	0	0	0	0	0	0
Pallid Cuckoo	0	0	0	0	0	0
Pied Currawong	0	6	0	0	0	6
Red Wattlebird	0	0	0	0	0	0
Red-capped Robin	0	0	0	0	0	0
Red-rumped Parrot	0	0	0	0	0	0
Richard's Pipit	0	0	0	0	0	0
Rufous Songlark	0	0	0	0	0	0
Rufous Whistler	0	0	0	0	0	0
Sacred Kingfisher	0	0	0	0	0	0
Satin Flycatcher	0	0	0	0	0	0
Scarlet Robin	0	0	0	0	0	0
Silvereye	0	0	0	0	0	0
Southern Boobook	0	0	0	0	0	0
Southern Whiteface	0	0	0	0	0	0
Spiny-cheeked Honeyeater	0	0	0	0	0	0

Spotted Pardalote	0	0	0	0	0	0
Striated Pardalote	0	0	0	0	0	0
Striated Thornbill	0	0	0	0	0	0
Sulphur-crested Cockatoo	0	0	0	0	0	0
Superb Fairy-wren	0	0	0	0	0	0
Varied Sittella	0	0	0	0	0	0
Wedge-tailed Eagle	0	0	0	0	0	0
Welcome Swallow	0	0	0	0	0	0
White-browed Scrubwren	0	0	0	0	0	0
White-browed Woodswallow	0	0	0	0	0	0
White-eared Honeyeater	0	0	0	0	0	0
White-faced Heron	0	0	0	0	0	0
White-plumed Honeyeater	0	0	0	0	0	0
White-throated Gerygone	0	0	0	0	0	0
White-throated Treecreeper	0	0	0	0	0	0
White-winged Chough	0	0	0	0	0	0
White-winged Triller	0	0	0	0	0	0
Willie Wagtail	0	0	0	0	0	0
Yellow-faced Honeyeater	0	0	0	0	0	0
Yellow-rumped Thornbill	0	0	0	0	0	0
Total	**0**	**21**	**0**	**0**	**0**	**21**

Species	**Total of observation in each height class for all survey sites**						**Percentage of all observation for all species**
	<10	**0-20**	**21-40**	**41-140**	**>140**	**Total**	
Australian Magpie	3	52	3	0	0	58	**7.67**
Australian Raven	2	10	4	0	0	16	**2.12**
Australian Wood Duck	0	8	0	0	0	8	**1.06**
Blackbird	1	2	0	0	0	3	**0.40**
Black-faced Cuckoo-shrike	0	12	0	0	0	12	**1.59**
Brown Falcon	0	1	0	0	0	1	**0.13**
Brown Goshawk	0	1	0	0	0	1	**0.13**
Brown Quail	2	0	0	0	0	2	**0.26**
Brown Thornbill	0	5	0	0	0	5	**0.66**
Brown Treecreeper	1	5	0	0	0	6	**0.79**
Buff-rumped Thornbill	32	20	0	0	0	52	**6.88**
Common Bronzewing	0	6	0	0	0	6	**0.79**
Common Starling	3	1	0	0	0	4	**0.53**
Crimson Rosella	9	41	25	0	0	75	**9.92**
Dusky Woodswallow	3	0	0	0	0	3	**0.40**
Eastern Rosella	2	19	0	0	0	21	**2.78**
Eastern Spinebill	5	2	1	0	0	8	**1.06**
Eastern Yellow Robin	0	1	0	0	0	1	**0.13**
Fan-tailed Cuckoo	0	3	0	0	0	3	**0.40**
Flame Robin	1	1	0	0	0	2	**0.26**
Galah	8	21	7	0	0	36	**4.76**
Golden Whistler	0	1	0	0	0	1	**0.13**
Grey Butcherbird	0	0	0	0	0	0	**0.00**
Grey Fantail	4	7	0	0	0	11	**1.46**
Grey Shrike-thrush	2	9	0	0	0	11	**1.46**

Species	Total of observation in each height class for all survey sites						Percentage of all observation for all species
	<10	0-20	21-40	41-140	>140	Total	
House Sparrow	5	0	0	0	0	5	**0.66**
Laughing Kookaburra	1	13	0	0	0	14	**1.85**
Leaden Flycatcher	1	4	0	0	0	5	**0.66**
Magpie-lark	2	1	0	0	0	3	**0.40**
Mistletoebird	1	0	0	0	0	1	**0.13**
Nankeen Kestrel	0	0	0	1	0	1	**0.13**
Noisy Friarbird	0	12	1	0	0	13	**1.72**
Noisy Miner	0	4	0	0	0	4	**0.53**
Olive-backed Oriole	0	1	0	0	0	1	**0.13**
Painted Honeyeater	2	0	0	0	0	2	**0.26**
Pallid Cuckoo	0	1	0	0	0	1	**0.13**
Pied Currawong	0	10	1	0	0	11	**1.46**
Red Wattlebird	0	6	0	0	0	6	**0.79**
Red-capped Robin	1	2	0	0	0	3	**0.40**
Red-rumped Parrot	0	2	0	0	0	2	**0.26**
Richard's Pipit	7	0	0	0	0	7	**0.93**
Rufous Songlark	2	0	0	0	0	2	**0.26**
Rufous Whistler	3	14	0	0	0	17	**2.25**
Sacred Kingfisher	0	3	0	0	0	3	**0.40**
Satin Flycatcher	0	1	0	0	0	1	**0.13**
Scarlet Robin	3	0	0	0	0	3	**0.40**
Silvereye	2	2	0	0	0	4	**0.53**
Southern Boobook	0	1	0	0	0	1	**0.13**
Southern Whiteface	4	0	0	0	0	4	**0.53**
Spiny-cheeked Honeyeater	0	1	0	0	0	1	**0.13**
Spotted Pardalote	0	4	0	0	0	4	**0.53**
Striated Pardalote	2	6	0	0	0	8	**1.06**
Striated Thornbill	20	17	0	0	0	37	**4.89**
Sulphur-crested Cockatoo	0	17	28	5	0	50	**6.61**
Superb Fairy-wren	30	19	0	0	0	49	**6.48**
Varied Sittella	0	4	0	0	0	4	**0.53**
Wedge-tailed Eagle	0	0	0	0	1	1	**0.13**
Welcome Swallow	0	3	0	2	0	5	**0.66**
White-browed Scrubwren	27	0	0	3	0	30	**3.97**
White-browed Woodswallow	0	6	0	0	0	6	**0.79**
White-eared Honeyeater	2	14	0	0	0	16	**2.12**
White-faced Heron	0	1	0	0	0	1	**0.13**
White-plumed Honeyeater	0	1	0	0	0	1	**0.13**
White-throated Gerygone	2	4	0	0	0	6	**0.79**
White-throated Treecreeper	1	8	0	0	0	9	**1.19**
White-winged Chough	11	15	0	0	0	26	**3.44**
White-winged Triller	4	0	0	0	0	4	**0.53**
Willie Wagtail	3	0	0	0	0	3	**0.40**
Yellow-faced Honeyeater	0	8	0	0	0	8	**1.06**
Yellow-rumped Thornbill	22	5	0	0	0	27	**3.57**

A.5 SUPERB PARROT RAW DATA (TRANSECTS AND FLIGHT PATH MAPPING)

Raw data for each transect surveyed and each viewing station where Superb Parrot observations recorded.

Site ID	Date	SP Observed	No.	Habitat	Flight Path Mapping	Time	Temp	Cloud	Wind
Transects									
SP1	6/11/2013	No		BGW, Brittle Gum Forest and open paddock.		8.15am	2	1	1
SP2	4/11/2013	No		BGW, derived grassland and Scribbly Gum Forest.		7.44am	2	1	2
SP3	4/11/2013	Yes (at 250 m)	2 (m), 2 (f), 3 (juv)	Rd reserve and paddock with scattered trees. Grass in groundlayer. BGW.	Stayed in general area, local movements below canopy < 10m). Significant activity at HBT. Flying wtihin canopy, perching, calling.	8.59am	2	1	2
SP4	4/11/2013	No		BGW. Generally scattered trees within paddock.		7.20am	2	1	2
SP5	4/11/2013	No		Derived grassland. Some scattered trees.		8.35am	2	1	3
SP6	4/11/2013	No		Derived grassland. Some scattered trees.		6.51am	2	1	3
SP7	4/11/2013	No		BGW. Generally scattered trees within paddock.		7.00am	2	1	2
SP8	6/11/2013	No		Scribbly Gum Forest and BGW.		10.20am	3	2	1
SP9	5/11/2013	No		BGW. Generally scattered trees within paddock.		7.04am	2	1	2
SP10	5/11/2013	No		BGW. Generally scattered trees within paddock.		9.45am	2	1	1
SP11	5/11/2013	No		BGW. Generally scattered trees within paddock.		8.20am	2	1	1

Site ID	Date	SP Observed	No.	Habitat	Flight Path Mapping	Time	Temp	Cloud	Wind
SP12	6/11/2013	No		Paddock on edge of Scribbly Gum Forest.		7.00am	2	1	1
SP13 (couldn't access)									
SP14	5/11/2013	No		BGW. Generally scattered trees within paddock.		8.30am	2	1	2
SP15	6/11/2013	No		Scribbly Gum Forest and BGW.		8.30am	2	1	1
SP16 (couldn't access)									
SP17	5/11/2013	Yes	1 (f)	Scattered trees, No shrubs, Grass, Paddock	Flew overhead landed in Yellow Box. Flying south toward Rye Park rd. (<15m)	7.21am	1	1	2
SP18	5/11/2013	Yes	3 (m), 2 (f)	Scattered trees, No shrubs, Grass, Paddock	3 in tree, 2 flying south toward Rye Park rd (< 10m)				
SP19	6/11/2013	No		Paddock on edge of Scribbly Gum Forest.		8.30am	2	1	1
SP20	6/11/2013	No		BGW. Generally scattered trees within paddock.		7.50am	1	1	2
SP21	6/11/2013	No		BGW. Generally scattered trees within paddock.		7.10am	2	1	1
SP22	6/11/2013	No		Derived grassland. Some scattered trees within paddock.		6.59am	1	1	1
SP23	5/11/2013	No		BGW. Generally scattered trees within paddock.		8.15am	1	1	2
SP24	5/11/2013	No		BGW. Generally scattered trees within paddock.		10.30am	2	1	2
SP25	6/11/2013	Yes (4 ~ 150m, 3 at 950 m)	2 (m), 1 (f), 4 (?)	Predominantly scattered trees in paddock with grass, no shrubs.	5 foraging in tree; 1 flying north (~ 15m), 1 flying south ~ 20 m)	7.30am	1	1	2

Site ID	Date	SP Observed	No.	Habitat	Flight Path Mapping	Time	Temp	Cloud	Wind
SP26	22/11/2013	Yes	5 (f), 3 (m), 4 (?)	Gully with BGW and scattered trees. Grassland. Dense Shrubs. Nest tree.	Flying locally (i.e. within 100m). Flying < 15m.	9.30am	1	3	3
SP27	5/11/2013	No				9.15am	2	1	3
Sites were observations made at viewing stations for flight path mapping									
Site 8	7-9 Nov 2013	Yes	17 obs	BGW and scattered trees over pasture	See flight path mapping datasheet	7.15am	Cool	Overcast	Breeze
Site 9	9/11/2013	Yes	1 obs	Rye Pk - Dalton Rd. BGW along rd reserve with paddocks adjoining rd.	See flight path mapping datasheet	6.30am	Cool	Overcast	Breeze
Site 1	7-8 Nov 2013	Yes	10 obs	Frogmore Rd. Scattered trees in paddock.	See flight path mapping datasheet	7.15am	Cool	Nil	Nil
Site 6	7-9 Nov 2013	Yes	1 obs	High Rock Rd. Scattered trees in paddock. Adjacent treed rd reserve.	See flight path mapping datasheet	7.11am	Cool	Nil	Nil
Site 3	7-9 Nov 2013	Yes	1 obs	Top of low ridge W of High Rock Rd. Within paddock.	See flight path mapping datasheet	6.50 am	Cool	Nil	Nil
Site 4	7-9 Nov 2013	Yes	18 obs	Flakney Ck Rd. Scattered trees in open paddock.	See flight path mapping datasheet	6.31am	Cool	Nil	Nil

Raw data for each flight observation at each viewing station where Superb Parrot observations recorded.

Site ID	Date	Time First Observed	Time Last Observed	Direction of flight	No. Individuals	Height above ground (m)	Fly over bare ground / ridge tops (Y/N)	Accuracy	General behaviour & habitat
Site 3	7/11/2013	8.30am	8.31am	Seen landing in stag 400m SW of site then flew ~500m to patch of forest in south	1	15	Yes. Flew ~500m over paddock along sloping ridge to crest of hill.	400m	Tree hopping
Site 6	7/11/2013	8.12am	9.12am	Flew over dam to SW to tree on lower slope.	1 (m), 1 (f)	20	Flew over bare ground, but not over ridge.	<50m	Local movements between trees. NW to SW in Valley.
Site 1 (1)	7/11/2013	7.30am	7.35am	Flying SE over Frogmore Rd to north	2	15	Flew over bare ground.		Flying at canopy level. Stopped to forage in trees.
Site 1 (2)	7/11/2013	7.55am	7.55am	Flew east from tree ~ 100m	1	25	Flew over bare ground.		Local movements. Foraging in tree then flew east.
Site 1 (3)	7/11/2013	8.00am	8.00am	Flew SW from tree towards ridge	1	20	Flew over bare ground.		Local movements. Foraging in tree then flew SW away from project site.
Site 1 (4)	7/11/2013	8.10am	8.12am	Local movements ~ 50m	2	<15m	Flew over bare ground.		Foraging in tree, then to woodland, then back to same tree.
Site 1 (5)	7/11/2013	8.20am	8.20am	Flew from woodland near trees SW towards Boorowa	3	30	Flew over bare ground.		Flying away from project site.
Site 1 (6)	7/11/2013	8.25am	9.11am	Flew from woodland NE of Frogmore Rd across paddock to south.	7	20	Tree hopping		Flying and stopping in trees to forage. Stayed in one tree for 1.2 hr.
Site 1 (7)	8/11/2013	6.30am	6.40am	Observed in trees south of Frogmore Rd, then flew north to woodland.	2	15	Flew over bare ground and tree canopy.		Forgaging in tree until flew north. Did not see them land.

Site ID	Date	Time First Observed	Time Last Observed	Direction of flight	No. Individuals	Height above ground (m)	Fly over bare ground / ridge tops (Y/N)	Accuracy	General behaviour & habitat
Site 1 (8)	8/11/2013	6.40am	7.20am	In tree south of Frogmore Rd and flew SE direction out of sight.	7	20	Flew over bare ground and tree canopy.		Perched in tree and still for almost 40 mins then flew away as a flock.
Site 1 (9)	8/11/2013	7.50am	7.53am	In tree south of Frogmore Rd and flew SE direction out of sight.	6	20	Flew over bare ground and tree canopy.		Perched in tree, circled local area and then flew SE of site.
Site 1 (10)	8/11/2013	8.00am	8.00am	Flew overhead from west to east.	1	15	Flew over bare ground.		Flying. Did not see them land.
Site 10	9/11/2012	8.15am	8.15am	First seen on Dalton Rye Pk Rd. Flying along road in north - south direction.	3	30	Along treed rd reserve.		Flying parrallel to Dalton - Rye Pk Rd.
Site 8 (1)	7/11/2013	7.42am	7.42am	Flying South from the north along TL west of RYP_10. Heading SW.	1 (m), 2 (f)	15	Flew over bare ground.	10	Flying over paddock in open from the north to south west away from site. No trees.
Site 8 (2)	7/11/2013	7.51am	7.51am	From NE heading south along TL	1 (f)	50	Flew over bare ground.	10	Flying above canopy level over open ground.
Site 8 (3)	7/11/2013	8.18am	8.18am	From NW to east flying south of the hills and then east over ridge	2 (m), 1 (f)	25	Flew over bare ground, then over ridge.	20	Flying just above tree line. Stopped at a 20m tall dead stag.
Site 8 (4)	7/11/2013	8.20am	8.20am	From south to north and veered NE over hill.	1	20	Edge of tree line, then over hill.	20	Flying along edge of remnant scattered tree line. Dissappeared east over ridge.
Site 8 (5)	7/11/2013	8.36am	8.36am	From NE between hill and low rise then due south.	1 (m)	40	Flew over bare ground.	20	Flew over trees and south away from turbines.
Site 8 (6)	7/11/2013	8.37am	8.37am	From NE between hill and low rise then flew west.	1 (f)	40	Flew over bare ground and tree canopy.	10	Initially flew over bare ground then skirted tree line in the west and flew over gully.
Site 8 (7)	7/11/2013	8.40am	8.40am	Flew from east of hill then flew due south.	1	40	Flew over bare ground.	20	Flew over trees and south away from turbines.

Site ID	Date	Time First Observed	Time Last Observed	Direction of flight	No. Individuals	Height above ground (m)	Fly over bare ground / ridge tops (Y/N)	Accuracy	General behaviour & habitat
Site 8 (8)	7/11/2013	8.57am	8.57am	Flew south to north to top of ridge.	1 (f)	40	Flew over bare ground.	20	Flying to ridge, circled stag and landed in it.
Site 8 (9)	8/11/2013	7.50am	7.52am	Flew south along east side of tree line then flew west.	2 (f), 1 (juv)	15	Flew over bare ground.	10	Circled tree, landed, called then flew west away from project site.
Site 8 (10)	8/11/2013	8.25am	8.25am	Flew north over scattered trees.	1	15	Flew over bare ground and tree canopy.	10	Flying slightly above canopy in a direct north path.
Site 8 (11)	8/11/2013	8.36am	8.36am	Flew NE from south	1	20	Flew over bare ground and tree canopy.	10	First observed over paddock from the south, then veered NE over scattered trees.
Site 8 (12)	8/11/2013	8.40am	8.43am	Flew from south flying north	1	20	Flew over bare ground.	10	Landed in 2 trees for 2 mins and flew north.
Site 8 (13)	8/11/2013	8.46am	8.46am	Flew from NE and headed south	1	40	Over trees then open paddock.	10	Came from over rise in NE then headed due south away from turbines.
Site 8 (14)	8/11/2013	8.52am	8.52am	Flew from NE and headed south	1 (m)	25	Over trees then open paddock.	10	Appeared from over hill in NE. Flew over scattered patach of trees then over paddock to south.
Site 8 (15)	9/11/2013	8.15am	8.15am	From west to east.	1 (m)	50	Flew over bare ground.	10	Flying over paddock.
Site 8 (16)	9/11/2013	8.28am	8.28am	From east to west.	1 (f)	50	Flew over bare ground.	10	Flying over paddock away from project site.
Site 8 (17)	9/11/2013	8.29am	8.29am	From over rise in east then flew south.	1	50	Flew over bare ground and tree canopy.	10	Flying from over rise in east then veered sharply south along edge of trees.

Site ID	Date	Time First Observed	Time Last Observed	Direction of flight	No. Individuals	Height above ground (m)	Fly over bare ground / ridge tops (Y/N)	Accuracy	General behaviour & habitat
Site 4 (1)	7/11/2013	6.50am	7.50am	On red gum then flew 100m ESE then south down rd corridor.	4	<10	Flew over small ridge.	10	Tree hopping and foraging. Feeding on ground, then flew 100m into a vegetated corridor before heading south.
Site 4 (2)	7/11/2013	7.42am	7.52am	First seen in Red Gum, flew south before feeding on ground 500m.	2	<10	Flew over small ridge.	5	Tree hopping and feeding.
Site 4 (3)	7/11/2013	7.53am	7.53am	1 female landed in tree and into hollow (possible nest?)	1	<10	Flew over small ridge.	10	Possible nesting 679937, 6168777 (mapped with HBTs)
Site 4 (5)	7/11/2013	8.09am	8.09am	Flew north into large Eucalypt and landed.	1 (f)	20	Flew into tree.	10	Flying and perching in tree.
Site 4 (6)	7/11/2013	8.42am	8.43am	Making small, local movements over Eucalypt.	1 (f)	20	Flew into tree.	10	Circling tree and landing.
Site 4 (7)	7/11/2013	8.48am	8.50am	Making small, local movements over Eucalypt.	1 (m)	<10	Flew into tree.	5	Flying and perching in tree.
Site 4 (8)	8/11/2013	6.51am	8.52am	Flying north and landed in Eucalypt ~ 1 km west.	1 (m), 1 (f)	15	Over paddock and trees.		Flying and perching in tree.
Site 4 (9)	8/11/2013	7.01am	7.13am	Flew 100m north then south along road reserve.	2 (f)	20	Along tree line.		Flying.
Site 4 (10)	8/11/2013	7.06am	7.16am	Flew south into Eucalypt for 10 mins then flew east.	1 (f), 1 (m)	15	Flew over small ridge.		Flying.
Site 4 (11)	8/11/2013	7.28am	7.28am	Flew south along veg corridor	1	15	Along tree line.		Flying and perching in tree.
Site 4 (12)	8/11/2013	7.38am	7.38am	Flew north along veg corridor	1	10	Along tree line.		Flying and perching in tree.
Site 4 (13)	8/11/2013	7.42am	7.47am	Flew in tree in road reserve and flew south along road.	2	<10	Along tree line.		Flying and perching in tree.
Site 4 (14)	8/11/2013	7.49am	7.50am	Flew north along corridor	1	10	Along tree line.		Flying and perching in tree.
Site 4 (15)	8/11/2013	7.58am	7.59am	Flew to ground, headed east	1 (m)	<10	Over paddock.		On ground, then flying.

Site ID	Date	Time First Observed	Time Last Observed	Direction of flight	No. Individuals	Height above ground (m)	Fly over bare ground / ridge tops (Y/N)	Accuracy	General behaviour & habitat
Site 4 (16)	8/11/2013	8.34am	8.35am	Flying from east to west and landed in tree plantation.	1 (m)	<10	Over paddock.		Flew to trees.
Site 4 (17)	9/11/2013	6.36am	6.37am	Flew from east to west for 500m.	2	10	Over paddock and trees.	100	Flying west away from project site towards Boorowa.
Site 4 (18)	9/11/2013	7.01am	7.02am	Flew from NW to SE	2	10	Over paddock and trees.	25	Flying.
Site 4 (19)	9/11/2013	7.28am	7.30am	Flew north along veg corridor and landed in Eucalypt in paddock.	3	6	Flew over small ridge.	5	Flying and landed in tree.
Site 4 (20)	9/11/2013	7.40am	7.41am	Flew south along veg corridor landed in tree.	1	6	Flew over small ridge.	5	Flying and landed in tree.
Site 4 (21)	9/11/2013	7.55am	7.55am	Flew from south into potential nest tree? (refer site 4 (3))	1	5	Flew over small ridge.	5	Flew into hollow.
Site 4 (22)	9/11/2013	7.56am	7.56am	Flew south and landed in Eucalypt in paddock.	1 (m)	5	Flew over small ridge.	5	Flew and landed in tree.
Site 4 (23)	9/11/2013	7.59am	8.11am	Flew 100 m west then flew ~1km north.	1 (m)	3	Flew over small ridge.	5	Flew and landed in tree.
Site 4 (24)	9/11/2013	8.17am	8.19am	Local movements in paddock and into top of potential nest tree.	2	15	Over paddock.	20	Landed, flying, tree hopping.

A.6 MICROBAT RISK ASSESSMENT

Scientific name	Common name	Conservation status		Seasonal Risk (eg. Migration)		Flight character		Roosting	Foraging dispersal		Breeding season	Likelihood of species behaviour resulting in collisions	Risk score
		0 = None; 1 = Threatened		0 = doesn't migrate; 1 = migrates		0 = below canopy; 1 = above canopy			0 = small foraging range, or forage low not in open areas; 1 = forage high in open areas or over large distances				
Chalinolobus gouldii	Gould's Wattled Bat		0	No	0	Above canopy & sub canopy	1	Tree hollows, buildings	Forages up to 11 km from roost sites. Will pass through open paddocks	1	Mating in late autumn / winter Juveniles fly December or January	Mod	2
Chalinolobus morio	Chocolate Wattled Bat		0	No - individuals in southern Australia do not migrate	0	Mid canopy to below canopy	0	Tree hollows, buildings and caves	Range of habitats including treeless regions	0	Birth in November	Low	0
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	1	No	0	Below or near the canopy and along tracks	0	Tree hollows and sometimes buildings	Highly mobile, with large foraging range; uncommon on ridgetop forests where soil fertility is low.	1	Females pregnant late spring to early summer Lactation December to mid-January	Moderate	2
Miniopterus schreibersii oceanensis	Eastern Bentwing Bat	V	1	Yes - travel up to several hundred kilometres to over-wintering roosts	1	Above canopy and open areas	1	Caves, disused mines	Fast and direct flight Forested areas, open areas, waterways, street lights and tracks	1	Mating in early winter Birth in spring / Summer Juveniles leave cave in march	**High**	4
Mormopterus planiceps (sp.4)	Southern Freetail Bat		0	No	0	Above canopy, below canopy, on edge of forest, and on ground.	1	Tree hollows and buildings	Capable of foraging up to 12 km from their roost - when commuting flight is rapid and direct	0	Birth December – January Young fly by March	Low	1

Scientific name	Common name	Conservation status		Seasonal Risk (eg. Migration)		Flight character		Roosting	Foraging dispersal		Breeding season	Likelihood of species behaviour resulting in collisions	Risk score
		0 = None; 1 = Threatened		0 = doesn't migrate; 1 = migrates		0 = below canopy; 1 = above canopy			0 = small foraging range, or forage low not in open areas; 1 = forage high in open areas or over large distances				
Mormopterus ridei	Eastern Freetail Bat		0	No	0	Below canopy in spaced between trees.	0	Tree hollows or under bark	Can forage in open areas but most is in reported in forested areas. Foraging range unknown.	0	Birth approximately in November - December Young fly by January to March	Low	0
Nyctophilus spp.	A Long-eared Bat		0	No	0	Below canopy and often fly close to the ground	0	Dead trees, exfoliating bark or hollows	Slow, manoeuvrable, undulating flight through dense canopy Can forage in open areas but most is in dense areas Capable of foraging up to 12 km from their roost - when commuting flight is rapid and direct	0	Birth October - November Young fly in December or January	Low	0
Tadarida australis	White-striped Freetail Bat		0	Y - migrate to northern regions during winter (non-hibernating species)	1	Above canopy	1	Large eucalypts (often in their hollows) Roosts in trees in a range of habitats from forest to open parklands	Fast and direct path High altitude feeding Can commute 50 km between roost and feeding	1	Birth mid-December to end of January Juveniles weaned by mid- February	Moderate - High	3
Vespadelus darlingtoni	Large Forest Bat		0	N	0	Below canopy, within canopy and forest floor	0	Tree hollows	Cluttered vegetation avoided. Foraging and commuting focused along trails and streams	0	Birth November – December Juveniles fly from mid- January.	Low	0

Scientific name	Common name	Conservation status		Seasonal Risk (eg. Migration)		Flight character		Roosting	Foraging dispersal		Breeding season	Likelihood of species behaviour resulting in collisions	Risk score
		0 = None; 1 = Threatened		0 = doesn't migrate; 1 = migrates		0 = below canopy; 1 = above canopy			0 = small foraging range, or forage low not in open areas; 1 = forage high in open areas or over large distances				
Vespadelus regulus	Southern Forest Bat		0	N	0	Below canopy & within canopy	0	Tree hollows and roof cavities	Agile, fluttery flight	0	Birth early summer	Low	0
Vespadelus vulturnus	Little Forest Bat		0	N	0	Below canopy	0	Roof cavities and hollows in dead timber	Agile, fluttery flight	0	Birth early summer	Low	0
Saccolaimus flaviventris	Yellow-bellied sheathtail- bat**	V	1	Unlikely	0	Above canopy but lower in open area	1	Tree hollows and buildings	High and fast over forest canopy	1	December to mid-March	Moderate - High	3

A.7 THREATENED SPECIES RECORDS

Common Name	Species Name	Date	Easting	Northing
Brown Treecreeper	*Climacteris picumnus*	04-NOV-11 9:02:57AM	686068	6156387
Brown Treecreeper	*Climacteris picumnus*	12/07/2013	684977	6157224
Brown Treecreeper	*Climacteris picumnus*	12/07/2013	686102	6156162
Brown Treecreeper	*Climacteris picumnus*	5/11/2013	676586	6178103
Brown Treecreeper	*Climacteris picumnus*	7/11/2013	686076	6156369
Brown Treecreeper	*Climacteris picumnus*	9/11/2013	677648	6168581
Diamond Firetail	*Stagonopleura guttata*	03-NOV-11 8:38:30AM	687080	6158513
Diamond Firetail	*Stagonopleura guttata*	5/11/2013	684262	6155476
Diamond Firetail	*Stagonopleura guttata*	5/11/2013	684222	6155959
Diamond Firetail	*Stagonopleura guttata*	5/11/2013	684237	6155787
Flame Robin	*Petroica phoenicea*	02-NOV-11 9:23:17AM	681550	6163834
Flame Robin	*Petroica phoenicea*	12/07/2013	686102	6156162
Flame Robin	*Petroica phoenicea*	8/07/2013	685877	6156362
Flame Robin	*Petroica phoenicea*	8/11/2013	686016	6156369
Hooded Robin	*Melanodryas cucullata cucullata*	10/07/2013	681390	6167591
Hooded Robin	*Melanodryas cucullata cucullata*	10/07/2013	684500	6154700
Hooded Robin	*Melanodryas cucullata cucullata*	7/11/2013	686016	6156369
Hooded Robin	*Melanodryas cucullata cucullata*	5/11/2013	684993	6153728
Hooded Robin	*Melanodryas cucullata cucullata*	22/11/2013	685039	6153631
Painted Honeyeater	*Grantiella picta*	5/11/2013	684294	6155482
Painted Honeyeater	*Grantiella picta*	5/11/2013	684353	6155092
Painted Honeyeater	*Grantiella picta*	6/11/2013	676121	6185520
Painted Honeyeater	*Grantiella picta*	5/11/2013	681234	6168811
Painted Honeyeater	*Grantiella picta*	5/11/2013	684821	6153750
Painted Honeyeater	*Grantiella picta*	6/11/2013	676121	6185520
Painted Honeyeater	*Grantiella picta*	7/11/2013	684527	6154269
Rainbow Bee-eater	*Merops ornatus*	9/11/2013	677648	6168581
Scarlet Robin	*Petroica multicolor*	04-NOV-11 10:50:51AM	686294	6155219
Scarlet Robin	*Petroica multicolor*	10/07/2013	685128	6156909
Scarlet Robin	*Petroica multicolor*	9/07/2013	681305	6182534
Scarlet Robin	*Petroica multicolor*	5/11/2013	685990	6155526
Scarlet Robin	*Petroica multicolor*	5/11/2013	685555	6152643
Scarlet Robin	*Petroica multicolor*	22/11/2013	685056	6153653
Speckled Warbler	*Pyrrholaemus saggitatus*	7/11/2013	681560	6179043
Speckled Warbler	*Pyrrholaemus saggitatus*	22/11/2003	685362	6153114
Superb Parrot	*Polytelis swainsonii*	01-NOV-11 5:56:59PM	677938	6148984
Superb Parrot	*Polytelis swainsonii*	03-NOV-11 8:15:50AM	683418	6159188
Superb Parrot	*Polytelis swainsonii*	02-NOV-11 8:23:03AM	679382	6168635
Superb Parrot	*Polytelis swainsonii*	31-OCT-11 6:32:09PM	675104	6183374

Common Name	Species Name	Date	Easting	Northing
Superb Parrot	*Polytelis swainsonii*	3-Nov-11	678508	6164702
Superb Parrot	*Polytelis swainsonii*	3-Nov-11	676177	6146804
Superb Parrot	*Polytelis swainsonii*	31-Oct-11	674556	6183950
Superb Parrot	*Polytelis swainsonii*	3-Nov-11	683804	6159884
Superb Parrot	*Polytelis swainsonii*	3-Nov-11	678872	6163406
Superb Parrot	*Polytelis swainsonii*	6/11/2013	676493	6177183
Superb Parrot	*Polytelis swainsonii*	6/11/2013	676404	6177568
Superb Parrot	*Polytelis swainsonii*	4/11/2013	675060	6182972
Superb Parrot	*Polytelis swainsonii*	4/11/2013	672853	6186926
Superb Parrot	*Polytelis swainsonii*	4/11/2013	673100	6186325
Superb Parrot	*Polytelis swainsonii*	4/11/2013	674506	6184099
Superb Parrot	*Polytelis swainsonii*	5/11/2013	684506	6154462
Superb Parrot	*Polytelis swainsonii*	5/11/2013	684340	6152700
Superb Parrot	*Polytelis swainsonii*	5/11/2013	684537	6154394
Superb Parrot	*Polytelis swainsonii*	5/11/2013	680881	6168686
Superb Parrot	*Polytelis swainsonii*	5/11/2013	671270	6180119
Superb Parrot	*Polytelis swainsonii*	6/11/2013	673871	6184961
Superb Parrot	*Polytelis swainsonii*	6/11/2013	676594	6176208
Superb Parrot	*Polytelis swainsonii*	6/11/2013	677668	6176208
Superb Parrot	*Polytelis swainsonii*	7/11/2013	678785	6175208
Superb Parrot	*Polytelis swainsonii*	8/11/2013	677480	6176941
Superb Parrot	*Polytelis swainsonii*	8/11/2013	676591	6176557
Superb Parrot	*Polytelis swainsonii*	8/11/2013	685170	6153365
Superb Parrot	*Polytelis swainsonii*	4/11/2013	675271	6179176
Superb Parrot	*Polytelis swainsonii*	6/11/2013	676381	6178142
Superb Parrot	*Polytelis swainsonii*	4/11/2013	678826	6163733
Superb Parrot	*Polytelis swainsonii*	5/11/2013	679261	6167934
Superb Parrot	*Polytelis swainsonii*	4/11/2013	677043	6175170
Superb Parrot	*Polytelis swainsonii*	6/11/2013	680977	6168816
Superb Parrot	*Polytelis swainsonii*	6/11/2013	676895	6176326
Superb Parrot	*Polytelis swainsonii*	6/11/2013	675259	6179183
Superb Parrot	*Polytelis swainsonii*	7/11/2013	677645	6170243
Superb Parrot	*Polytelis swainsonii*	7/11/2013	677226	6173493
Superb Parrot	*Polytelis swainsonii*	7/11/2013	675259	6179183
Superb Parrot	*Polytelis swainsonii*	4/11/2013	679781	6168640
Superb Parrot	*Polytelis swainsonii*	21/11/2013	684872	6153141
Superb Parrot / Nest	*Polytelis swainsonii*	22/11/2013	680988	6168066
Superb Parrot / Nest	*Polytelis swainsonii*	22/11/2013	685280	6153593
Varied Sittella	*Daphoenositta chrysoptera*	6/11/2013	682728	6175800
Varied Sittella	*Daphoenositta chrysoptera*	8/11/2013	686342	6155645
White-fronted Chat	*Epthianura albifrons*	4/11/2013	676270	6183177
White-fronted Chat	*Epthianura albifrons*	5/11/2013	6181565	679405
White-fronted Chat	*Epthianura albifrons*	21/11/2013	684556	6153135

Common Name	Species Name	Date	Easting	Northing
White-fronted Chat (pair)	*Epthianura albifrons*	11/10/2013	679491	6181820

APPENDIX B THREATENED SPECIES EVALUATIONS

The tables in this appendix present the habitat evaluation for threatened species, ecological communities and endangered populations returned from database searches undertaken as described in Section 3. The likelihood of occurrence is based on presence of habitat, proximity of nearest records and mobility of the species (where relevant). The assessment of potential impact is based on the nature of the proposal, the ecology of the species and its likelihood of occurrence. The following classifications are used:

Presence of habitat

Present: Potential or known habitat is present within the project area

Marginal: Habitat present is not typical but may be suitable, or habitat type is suitable but condition and microhabitat requirements of species are not present

Absent: No potential or known habitat is present within the project area

Likelihood of occurrence

None: Species known or predicted within the locality but no suitable habitat present within the study area

Unlikely: Species known or predicted within the locality. Suitable habitat may be present in the study area but the proximity of nearest records suggest it is unlikely to occur

Possible: Suitable habitat present and the species could occur in the study area based on the proximity of nearest records

Present: Species was recorded during the field investigations

Potential for impact

No: The proposal would not result in an impact to this species. No Assessment of Significance (AoS) is necessary for this species

Low: The proposal is unlikely to result in an impact to this species. No Assessment of Significance (AoS) is necessary for this species

Moderate: The proposal could impact this species or its habitats. This species is considered further in this assessment. The risk to this species is considered manageable and an AoS is not considered necessary

High: The proposal is likely to impact this species or its habitats. An AOS has been applied to these entities

Information on habitat is sourced from species profiles on the NSW OEH threatened species database or the Australian Government's Species Profiles and Threats database (SPRAT) unless otherwise stated.

Grey shading indicates species for which an Assessment of Significance was undertaken (Appendix C).

B.1 FLORA

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
Trees					
Black Gum ***Eucalyptus aggregata*** **V TSC**	Black Gum has a moderately narrow distribution, occurring mainly in the wetter, cooler and higher parts of the tablelands, for example in the Blayney, Crookwell, Goulburn, Braidwood and Bungendore districts. Grows in the lowest parts of the landscape. Grows on alluvial soils, on cold, poorly-drained flats and hollows adjacent to creeks and small rivers. Often grows with other cold-adapted eucalypts, such as Snow Gum or White Sallee (*Eucalyptus pauciflora*), Manna or Ribbon Gum (*E. viminalis*), Candlebark (*E. rubida*), Black Sallee (*E. stellulata*) and Swamp Gum (*E. ovata*). Black Gum usually occurs in an open woodland formation with a grassy groundlayer dominated either by River Tussock (*Poa labillardierei*) or Kangaroo Grass (*Themeda australis*), but with few shrubs.	Absent	None	No	×
Shrubs					
Bossiaea fragrans **TSC - CE**	Currently only known from the Abercrombie Karst Conservation Reserve, south of Bathurst on the NSW central tablelands. It is highly restricted with only two known populations. Occurs on slate and volcanic substrates within open White Box (Eucalyptus albens) Woodland.	Absent	None	No	×
Cotoneaster Pomaderris	A shrub growing to 4 m tall. Has a very disjunct distribution, being known from the Nungatta area, northern Kosciuszko National Park (near Tumut), the	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
Pomaderris cotoneaster **TSC - E** **EPBC - E**	Tantawangalo area in South-East Forests National Park and adjoining freehold land, Badgery's Lookout near Tallong, the Yerranderie area, the Canyonleigh area and Ettrema Gorge in Morton National Park. The species has also been recorded along the Genoa River in Victoria. Has been recorded in a range of habitats in predominantly forested country. The habitats include dry, shrubby open forest with deep, friable soil, amongst rock beside a creek, on rocky forested slopes and in steep gullies between sandstone cliffs. Has been associated with *Westringia sp. aff. longifolia, Grevillea lanigera, Prostanthera sp. nov., Eucalyptus radiata, Olearia sp., Kunzea ericoides* and *Acacia pravissima*.				
Dwarf Bush-pea ***Pultenaea humilis*** **TSC - V**	Rare in New South Wales and Tasmania, but relatively common in Victoria. In NSW, *Pultenaea humilis* is currently known from three confirmed localities in the NSW South Western Slopes bioregion: Woomargama National Park, Wereboldera State Conservation Area, and Murraguldrie State Forest. The extent of occurrence of *Pultenaea humilis* in NSW is estimated to be approximately 6000 km^2. However the total population of *Pultenaea humilis* in NSW is not known. *Pultenaea humilis* is found in isolated remnants of native woodland and forest communities that occur in extensively cleared agricultural landscapes. Occurs on a variety of soils ranging from sandy loams to clays.	Present	Unlikely – no records within 50km of the site	Low	×
Pale Pomaderris ***Pomaderris pallida*** **TSC - V** **EPBC - V**	A compact, rounded shrub to 1.5 m tall. Has been recorded from near Kydra Trig, north-west of Nimmitabel, Tinderry Nature Reserve, the Queanbeyan River and the Murrumbidgee River west of the ACT. A record from Byadbo in Kosciuszko National Park has not been relocated. It is also found along the Murrumbidgee River in the ACT and has been recently	Marginal	Unlikely – no records within 50km of the site	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
	recorded in eastern Victoria. This species usually grows in dry open forests and shrub communities surrounded by Brittle Gum (*Eucalyptus mannifera*) and Red Stringybark (*E. macrorhynca*) or *Callitris spp*. woodland. The mid-stratum often has *Grevillea juniperina*, *Bursaria spinosa*, *Acacia rubida*, and *Kunzea ericoides.* Found at numerous small sites along the plateau edge and very steep upper slopes and cliffs of river valleys at 480-600 m asl.				
Philotheca ericifolia **V TSC**	Known only from the upper Hunter Valley and Pilliga to Peak Hill districts of NSW. The records are scattered over a range of over 400 km between West Wyalong and the Pilliga Scrub. Grows chiefly in dry sclerophyll forest and heath on damp sandy flats and gullies. It has been collected from a variety of habitats including heath, open woodland, dry sandy creek beds, and rocky ridge and cliff tops.	Absent	None	No	×
Tumut Grevillea ***Grevillea wilkinsonii*** **TSC – E** **EPBC - E**	Has a highly restricted distribution on the NSW south-west slopes. Its main occurrence is along a 6 km stretch of the Goobarragandra River approximately 20 km east of Tumut where about 800 plants are known. The other site is a small population on private land near Gundagai where only seven mature plants survive. At the Goobarragandra River sites, it grows close to the water, at altitudes between 310 and 340 m. The majority of plants occur on steep rocky slopes less than 10m from the edge of the river. Grows in shallow crevices of granite or serpentine rock, sometimes in deeper brown loam overlying rock. The associated native vegetation includes remnant riverine shrub communities adjacent to open-forest, with the most common tree species being Blakely's Red Gum (*Eucalyptus blakelyi*), Apple Box (*E. bridgesiana*), Yellow Box (*E. melliodora*), and	Present	Unlikely – nearest records 80km south-west of the site	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
	Red Stringybark (*E. macrorhyncha*) and with Kurrajongs (*Brachychiton populneus*) growing in nearby paddocks.				
Wee Jasper Grevillea ***Grevillea iaspicula*** **TSC - E** **EPBC - E**	Found only in the Wee Jasper area, along the steep cliffs of the Goodradigbee River, and on the shores of Lake Burrinjuck near Burrinjuck village on the border of the Southern Tablelands and South Western Slopes. Although there is no evidence that the Grevillea was widespread in the recent past, it is possible that some of its original population was submerged following the damming of Lake Burrinjuck. Grows only on rocky outcrops, cave entrances, sinkholes, and cliff bases in limestone country. It occurs in *Eucalyptus* and *Brachychiton* low woodland with a generally open shrub and grass understorey. Flowering is mostly in spring, with some flowers also produced in autumn. A high proportion of the remnant populations are on private land. The distribution of this species overlaps with the "Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory" EPBC Act-listed threatened ecological community.	Absent	None	No	×
Wollemi Mint-bush ***Prostanthera cryptandroides* subsp. *cryptandroides*** **TSC - V**	Occurs in restricted areas but over a fairly broad range from the Lithgow and Sandy Hollow Districts into the Border Rivers/Gwydir Catchment and up into Queensland. It has been collected at Mt Gundangaroo near Glen Davis, on a walking track to Newnes, and on the upper Hunter River. Occurs in the Wollemi National Park and is likely to also occur within the Goulburn River National Park. Found in dry sclerophyll forested slopes and gullies, in rocky areas, especially at the base of scree slopes and sandstone boulders, and in shallow sandy loam. Associated communities include: Narrabeen Rocky Heath, Narrabeen Acacia Woodland, Narrabeen Exposed Woodland; Open Heath of *Calytrix*	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
	tetragona, Leptospermum parviflorum, Isopogon dawsonii; and Open Scrubland of *Eucalyptus dwyeri, Baeckea densifolia, Dillwynia floribunda, Aotus ericoides* and *Hemigenia cuneifolia*.				
Ferns					
Austral Pillwort ***Pilularia novae-hollandiae*** **TSC - E**	A semi-aquatic fern, resembling a small fine grass. In NSW, Austral Pilwort has been recorded from suburban Sydney, Khancoban, the Riverina between Albury and Urana (including Henty, Walbundrie, Balldale and Howlong), Oolambeyan National Park near Carathool and at Lake Cowal near West Wyalong. The populations at Lake Cowal and Oolambeyan NP are the only known extant populations in NSW, although the species is obscure and has possibly been overlooked elsewhere. The species has also been recorded in the Australian Capital Territory, Victoria, Tasmania, South Australia and Western Australia. Most of the records in the Albury-Urana area were from table drains on the sides of roads. The ACT record was from a subalpine grassy plain. This species is probably ephemeral (especially in the drier parts of its range), appearing when soils are moistened by rain. Grows in shallow swamps and waterways, often among grasses and sedges. It is most often recorded in drying mud as this is when it is most conspicuous.	Absent	None	No	×
Forbs					
Austral Toadflax ***Thesium australe*** **TSC - V**	An erect perennial herb to 40 cm high. Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
EPBC - V	and in eastern Asia. Occurs in grassland or grassy woodland, often found in damp sites in association with Kangaroo Grass (*Themeda australis*). A root parasite that takes water and some nutrients from other plants, especially Kangaroo Grass. Flowering is predominantly in spring and summer.				
Button Wrinklewort ***Rutidosis leptorrhynchoides*** **TSC - E** **EPBC - E**	Known from 17 populations in the ACT region (ten within the ACT, six near Queanbeyan and one near Goulburn (NSW)) and nine in Victoria. Occurs in box-gum woodland, secondary grassland derived from box-gum woodland or in natural temperate grassland; and often in the ecotone between the two communities. In the ACT and NSW, topography is undulating, 570–780 m above sea level and soils are red-brown clays to clay loams, shallow and stony. Tends to occupy areas where there is less competition from other plants and less shading from woodland trees. Exhibits an ability to colonise disturbed areas (eg. vehicle tracks, bulldozer scrapings and areas of soil erosion). It grows best where the grass and herb cover is relatively low, these sites usually occur on low rises with shallow soil and low moisture status. Associated eucalypts at NSW and ACT sites include Blakely's Red Gum (*Eucalyptus blakelyi*), Long-leaved Box (*E. goniocalyx*), Yellow Box (*E. melliodora*), Red Box (*E. polyanthemos*) and Apple Box (*E. bridgesiana*). Many sites are associated with Kangaroo Grass (*Themeda triandra*).	Present	Unlikely – No records within 50km of the site	Low	×
Claypan Daisy ***Brachyscome muelleroides***	The Claypan Daisy is an annual herb that grows to 14 cm tall. Occurs in the Wagga Wagga, Narranderra, Tocumwal and Walbundrie areas. Also occurs in north-central Victoria (only along the Murray from Tocumwal to the Ovens River). Only five sites have precise locality	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
TSC – V **EPBC - V**	details, and four of these are on Morundah Station in NSW. Occurs in seasonally damp situations such as shallow depressions and around the margins of swamps, lagoons and claypans, on heavy grey cracking clays to lighter clay loam soils, in grassland, grassy woodland and open forest habitats, growing in association with various grasses and seasonal aquatic plants such as *Marsilea* species. Associated species include *Pycnosorus globosus, Agrostis avenacea, Austrodanthonia duttoniana*, and *Calotis anthemoides*.				
Hoary Sunray ***Leucochrysum albicans*** **ssp *albicans* var *tricolor*** **EPBC - E**	Perennial daisy growing in grasslands and grassy woodlands, often colonising disturbed sites such as road verges, but does not persist well in grazed situations. Flowers spring-summer. May be locally common, and is not listed as threatened in NSW. Recorded around Goulburn. (Var albicans recorded at Lake Bathurst).	Present	Possible – recorded 2.5km west of the site, but not recorded during targeted surveys for the species	No	×
Narrow Goodenia ***Goodenia macbarronii*** **V TSC**	Narrow Goodenia grows on the western slopes of the Great Dividing Range in NSW, south from the Guyra and Inverell districts. It is widely distributed throughout the tablelands, western slopes and western plains. Narrow Goodenia is an annual which appears seasonally and opportunistically in ephemerally damp or wet sites and is often common at sites after good winter-rainfall periods. It favours moist, shaded, sandy sites, soils with impeded drainage, damp muddy areas of winter inundation, spring-fed paddocks and open areas where water is more available. Often found in sites with some form of recent disturbance, such as depressions and clearings made by grading and excavation along roadsides, open grazing land and paddocks inundated	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
	by weed species and areas previously cleared and grazed by cattle.				
Mountain Swainson-pea ***Swainsona recta*** **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..	Present	Unlikely – nearest record over 40km south-west of the site	Low	×
Mueller's Eyebright ***Euphrasia collina* subsp. *muelleri*** **TSC - E** **EPBC - E**	A perennial, parasitic herb or subshrub, which grows to about 50 cm tall. Once widespread in south-eastern Australia, Mueller's Eyebright is now known only from the Mornington Peninsula near Melbourne. It has been recorded in NSW in the upper Murray and McIntyre Rivers and was last recorded in NSW near Dorrigo in 1904 and near Cootamundra in 1887. Little is known about the habitat this species preferred, although there is a reference to "damp places" in an early von Mueller collection. At McKellar Flora Reserve, associated species include *Eucalyptus cephalocarpa, Hakea ulicina, Epacris impressa, Pultenaea dentata, Austrostipa muelleri*. At Greens Bush, associated species include *Leptospermum myrsinoides, Xanthorrhoea australis, Banksia marginata, Leucopogon virgatus, Monotoca scoparia*. At Wrens Flat the vegetation is open forest dominated by *Eucalyptus rubida, E. radiata, Acacia dealbata, A. melanoxylon, Bursaria spinosa, Poa sieberiana, Themeda triandra.*	Absent	None	No	×
Silky Swainson-pea		Present	Unlikely – nearest record	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
Swainsona sericea **TSC - V**	The Silky Swainson-pea is found in grassy woodland and secondary grassland in areas with low grazing pressure. As this species is a prostrate or erect perennial, growing to 10 cm tall and the stems and leaves are densely hairy the species is readily identifiable in the field and surveys can be conducted at most times of the year (excluding winter) to detect the presence of this species. It has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. There is one isolated record from the far north-west of NSW. Its stronghold is on the Monaro in Natural Temperate Grassland and Snow Gum *Eucalyptus pauciflora* Woodland. It is found in Box-Gum Woodland in the Southern Tablelands and South West Slopes and sometimes found in association with cypress-pines *Callitris* spp. Habitat on plains is unknown.		over 40km south-east of the site.		
		Note: As many areas of the site have been extensively cleared or have been grazed a lot of remnant wooded areas now support a low diversity of native pasture species and forbs. Additionally, common weeds associated with grazing have invaded areas of more intact woodland and forest vegetation. As a consequence the primary habitat for this species is largely absent from the project site. Box Gum Woodland in moderate or good condition is considered to be the most likely habitat this species would be found. Potential to be impacted is low given that this species was detectable during the surveys and not recorded, much of its habitat on site is primarily degraded, good condition Box Gum Woodland has been largely avoided, and the nearest record of this species occurs 40 km from the project site, the proposal is not considered to adversely affect a viable population of this species such that is would be placed at risk of extinction. This species was therefore considered a low risk species.			
Small Pale Grass-lily ***Caesia parviflora* var. *minor*** **TSC - E**	The Small Pale Grass-lily is an inconspicuous herb. Occurs uncommonly in Tasmania, southern Victoria and south-east South Australia with an outlying population in NSW, in Barcoongere State Forest, between Grafton and Coffs Harbour. This variety may be more common than currently known, as Pale Grass-lilies are often not identified to variety level. Found in damp places in open forest on sandstone. Flowers spring to summer.	Absent	None	No	×
Small Scurf-pea ***Cullen parvum***	Known in NSW from only two herbarium collections; one from Wagga Wagga in 1884 and the other from Jindera (near Albury) in 1967. A small population was	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
TSC - E	recently reported from near Jerilderie (although it has not been relocated). In recent years, two populations have been recorded in travelling stock reserves south-west of Wagga Wagga, and a population reputedly exists on a roadside near Galong. Large populations have been recorded in grassy gaps in the Red Gum Woodlands of Barmah State Park, just across the border in Victoria. Extensive suitable habitat probably occurs across the border in NSW. In known populations in Victoria and NSW, plants are found in grassland, River Red Gum (*Eucalyptus camaldulensis*) Woodland and even grazing country and table drains, in areas with rainfall of between 450 and 700 mm. Plants often occur near watercourses.				
Woolly Ragwort ***Senecio garlandii*** **TSC - V** **EPBC - V**	Almost entirely known from the western slopes of the Great Dividing Range in southern NSW. In NSW known from a very localised strip from West Wyalong to the Albury district, in the Central Western Slopes and South Western Slopes regions. The site of greatest abundance appears to be The Rock NR, over 340 ha, about 30 km SE of Wagga Wagga. Has also been collected at Tabletop Range, a site "15 miles ESE of The Rock", Gidginbung, "near Albury", Flowerpot Hill (4 km S of The Rock NR), Ulandra NR (7 km SE of Bethungra), Benambra SF (20 km W of Holbrook), Burrinjuck and near Temora. Occurs in dry sclerophyll forest and open woodland in association with *Eucalyptus macrorhyncha, E. goniocalyx, Acacia doratoxylon, A. implexa* and *Brachychiton populneus*. Grows on the sheltered lower slopes or upper parts of south to east-facing slopes of isolated rocky outcrops.	Marginal	Unlikely – no records within 50km of the site	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
Yass Daisy ***Ammobium craspedioides*** **TSC - V** **EPBC - V**	Found from near Crookwell on the Southern Tablelands to near Wagga Wagga on the South Western Slopes. Most populations are in the Yass region, at Lake Burrinjuck, Bookham, Rye Park and Dalton. Found in moist or dry forest communities, Box-Gum Woodland and secondary grassland derived from clearing of these communities. Grows in association with a large range of eucalypts (*Eucalyptus blakelyi*, *E. bridgesiana*, *E. dives*, *E. goniocalyx*, *E. macrorhyncha*, *E. mannifera*, *E. melliodora*, *E. polyanthemos*, *E. rubida*). Apparently unaffected by light grazing, as populations persist in some grazed sites.	Present	Possible – multiple records within 2.5km of the site	High	✓
Orchids					
Crimson Spider Orchid ***Caladenia concolor*** **TSC – E** **EPBC - E**	Crimson Spider Orchid is deciduous; producing a leaf during autumn or winter and after flowering in spring survives the dry summer and early autumn as a dormant tuber. It prefers regrowth woodland on granite ridges with a high diversity of plant species, including other orchids. Dominant trees are *E. blakelyi, E. macrorhyncha, E. polyanthemos* and *E. albens.*	Absent	None	No	×
		NOTE: High diversity woodland occurs only in the south of the site however, the dominant tree species (Yellow Box) is not typically associated with this species. **T**his species prefers better quality habitat than that available within the project site. Typical habitat for this species was not found within the project site. Further, the nearest records for this species are approximately 95km west of the site. It is considered highly unlikely that the species occurs within the project site and as such the proposal is not considered to adversely affect a viable population of this species such that is would be placed at risk of extinction. It is considered that there is no potential for impact to this species and further surveys are not required.			
Pine Donkey Orchid ***Diuris tricolor*** **TSC - V** **EPBC - V**	The Pine Donkey Orchid (formerly known as *Diuris sheaffiana*) is a terrestrial species that has a flower stalk 20-40 cm high. It is sporadically distributed on the western slopes of NSW, extending from south of Narrandera all the way to the far north of NSW.	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
	Localities include the Condobolin-Nymagee road, Wattamondara towards Cowra, Cooyal, Adelong, Red Hill north of Narrandera, Coolamon, near Darlington Point, Eugowra, Girilambone, Dubbo, Muswellbrook, and several sites west of Wagga Wagga. Disturbance regimes are not known, although the species is usually recorded from disturbed habitats. Associated species include *Callitris glaucophylla, Eucalyptus populnea, Eucalyptus intertexta*, Ironbark and *Acacia* shrubland. The understorey is often grassy with herbaceous plants such as *Bulbine* speciesIt is found in sandy soils, either on flats or small rises. Also recorded from a red earth soil in a Bimble Box community in western NSW. Usually recorded as common and locally frequent in populations, however only one or two plants have also been observed at sites. The species has been noted as growing in large colonies.				
Sand-hill Spider Orchid ***Caladenia arenaria*** **TSC - E** **EPBC - E**	The Sand-hill Spider Orchid is currently only known to occur in the Riverina between Urana and Narranderra. Occurs in woodland with sandy soil, especially that's dominated by White Cypress Pine (*Callitris glaucophylla*). Many of the associated species in the understorey are different at each of the populations, or are species that are widespread and occur in a range of habitats. It is apparent that *C. arenaria* has fairly broad habitat tolerances, occurring in *Callitris glaucophylla - Eucalyptus melliodora* (Yellow Box) woodlands, *Callitris glaucophylla – Allocasuarina luehmannii* woodlands and woodlands dominated by a mixture of *Callitris glaucophylla, E. dwyeri* (Dwyer's Redgum) and *Acacia doratoxylon* (Currawang). Soils vary from skeletal soils over sandstone to clay loams.	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
Tarengo Leek Orchid ***Prasophyllum petilum*** **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.	Present	Possible – recorded 20kms west of the site	Moderate	×
Graminoids and grasses					
A spear-grass ***Austrostipa wakoolica*** **E TSC**	Confined to the floodplains of the Murray River tributaries of central-western and south-western NSW. Grows on floodplains of the Murray River tributaries, in open woodland on grey, silty clay or sandy loam soils; habitats include the edges of a lignum swamp with box and mallee; creek banks in grey, silty clay; mallee and lignum sandy-loam flat; open Cypress Pine forest on low sandy range; and a low, rocky rise.	Absent	None	No	×
Raleigh Sedge ***Carex raleighii*** **TSC - E**	Raleigh Sedge is a small and inconspicuous perennial sedge that grows from underground stems (rhizomes) to 25 cm tall. In NSW Raleigh Sedge is found only in areas above 1200 metres on the Southern Tablelands. Most populations are in Kosciuzsko National Park (eg. Charlottes Pass area, Muellers Pass, Tantangara area and the upper Tooma and Tumut valleys). Also occurs in vicinity of Snowy Plain (private land and travelling stock reserve). The only population recently confirmed to be extant is that at Spencers Creek, below Charlottes Pass. Grows in sphagnum bogs and high mountain	Absent	None	No	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
	wetlands, as well as damp grasslands and stream-edges of sub-alpine plains.				
Ecological communities					
White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and derived native grasslands **TSC – EEC** **EPBC - CEEC**	An open woodland community (sometimes occurring as a forest formation), in which the most obvious species are one or more of the following: White Box *Eucalyptus albens*, Yellow Box *E. melliodora* and Blakely's Red Gum *E. blakelyi*.	Present	Present	High	✓
Grey Box *(Eucalyptus microcarpta)* Grassy Woodlands and derived native grasslands **TSC - EEC**	Inland Grey Box Woodland includes those woodlands in which the most characteristic tree species, *Eucalyptus microcarpa* (Inland Grey Box), is often found in association with *E. populnea* subsp. *bimbil* (Bimble or Poplar Box), *Callitris glaucophylla* (White Cypress Pine), *Brachychiton populneus* (Kurrajong), *Allocasuarina luehmannii* (Bulloak) or *E. melliodora* (Yellow Box), and sometimes with *E. albens* (White Box).	Absent	None	No	✗
Natural Temperature Grasslands of the Southern Tablelands **TSC - EEC**	Natural Temperate Grassland is a naturally treeless or sparsely-treed community, in which the most obvious components are various species of native grasses. Intact sites have a diversity of wildflowers (forbs) including lilies, orchids, peas, daisies and many more. Sites may contain a low density of trees or shrubs and may also contain wet areas that are habitat for wetland flora species.		None	No - There is no potential for impact to this community.	✗
		NOTE: Habitat for this community does not occur within the areas to be impacted by the proposal. Treeless areas are almost certainly derived from the clearing of the woodland and forest communities that occur within the project boundaries. This is evidenced by the presence of remnant paddock trees and patches of trees within cleared areas that are associated with the surrounding woodland and forest			

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
		communities and that woodland and forest occurs within similar topographic situations to the cleared areas.			
Tablelands Snow Gum, Black Sallee, Candlebark and Ribbon Gum Grassy Woodland **TSC - EEC**	An open woodland community (sometimes occurring as an open-forest formation), in which the most obvious species are one or more of the following: Snow Gum (Eucalyptus pauciflora), Black Sallee (E. stellulata), Candlebark (E. rubida) and Ribbon Gum (E. viminalis). Other tree species may occur, most frequently Swamp Gum (E. ovata), Black Gum (E. aggregata), Silver Wattle (Acacia dealbata) or Blackwood (A. melanoxylon).	Absent	None	No	×
Fuzzy Box Woodland on alluvial soils **TSC - EEC**	Tall woodland or open forest dominated by Fuzzy Box *Eucalyptus conica*, often with Grey Box *Eucalyptus microcarpa*, Yellow Box *Eucalyptus melliodora*, or Kurrajong *Brachychiton populneus*. Buloke *Allocasuarina luehmannii* is common in places. Shrubs are generally sparse, and the groundcover moderately dense, although this will vary with season.	Absent	None	No	×
Tableland Basalt Forest **TSC - EEC**	Tableland Basalt Forest is dominated by an open eucalypt canopy of variable composition. *Eucalyptus viminalis, E. radiata, E. dalrympleana* subsp. *dalrympleana* and *E. pauciflora* may occur in the community in pure stands or in varying combinations. Tableland Basalt Forest typically occurs on loam or clay soils associated with basalt or, less commonly, alluvium, fine-grained sedimentary rocks, granites and similar substrates that produce relatively fertile soils.	This vegetation community does not occur within the project site and the community was not returned on the Atlas of Wildlife search for the four CMA sub-regions that the project site spans. Additionally, the predicted and known occurrence of this community does not include that of the project site. Of the dominant Eucalypt	None	No - There is no potential for impact to this community.	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	AoS?
		species, only *Eucalyptus viminalis* was recorded on site.			

B.2 FAUNA

The following fauna were returned from database searches.

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Amphibians					
Booroolong Frog ***Litoria booroolongensis*** **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. 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. .	Absent	None	No	×
Sloane's Froglet ***Crinia Sloanei*** **V TSC**	Sloane's Froglet has been recorded from widely scattered sites in the floodplains of the Murray-Darling Basin, with the majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions in New South Wales. It has not been recorded recently in the northern part of its range and has only been recorded infrequently in the southern part of its range in NSW. It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats (DECCW 2009).	Present	Possible	Moderate Construction impacts	×
Birds					
Australasian Bittern ***Botaurus poiciloptilus*** **V TSC**	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.	Absent	Unlikely	Low	×
Barking Owl ***Ninox connivens*** **V TSC**	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 plain. It occurs in dry box-dominated	Present	Possible	Moderate habitat loss; blade-strike	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	forest and woodlands and roosts in dense foliage of *Acacia, Casuarina* or *Eucalyptus* 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 (NPWS 2003a). Nest and roost sites are usually near 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 hectares (NPWS, 2003a).				
Black-chinned Honeyeater (eastern subspecies) ***Melithreptus gularis gularis*** **V TSC**	This species is widespread west of the Great Dividing Range, although has declined throughout its range due to removal and fragmentation of habitat. It inhabits the upper levels of drier open forests or woodlands most often dominated by box and ironbark eucalypts, particularly Mugga Ironbark, White Box, Grey Box, Yellow Box and Forest Red Gum. A gregarious species usually seen in pairs and small groups of up to 12 birds and occupies large home ranges of at least 5 hectares. Local populations appear not to persist in remnants less than 200 ha in area (NSW Scientific Committee, 2001).	Present	Possible	Moderate connectivity; blade-strike	×
Black-tailed Godwit ***Limosa limosa*** **V TSC**	Primarily a coastal species. Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps	Absent	Unlikely	Low	×
Blue-billed Duck ***Oxyura australis*** **V TSC**	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. Feeding occurs in permanent freshwater wetlands and swamps with deep water and dense	Absent	Unlikely	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	aquatic vegetation. Nesting occurs in *Cumbungi* over deep water or in dense wetland vegetation.				
Brown Treecreeper (eastern subspecies) ***Climacteris picumnus victoriae*** **V TSC**	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, nesting in a tree hollow.	Present	Present	Moderate habitat loss	×
Bush Stone-curlew ***Burhinus grallarius*** **E TSC**	In NSW, it is found on lower elevation grassy woodlands of the coast or west of the divide. The area bounded roughly by Albury, Wagga Wagga, Hay and Wentworth is regarded as the stronghold for the species in NSW (DEC NSW, 2006a). This species inhabits open forests and grassy woodlands where it builds nests directly on the ground (DECCW 2010). It requires logs, fallen trees and branches, course litter and some shrubs for shelter. Foraging may occur over large home range (250-600ha) including woodlands, paddocks, grasslands, residential gardens and saltmarsh (DEC NSW, 2006a).	Absent	Unlikely	Low	×
Brolga ***Grus rubicunda*** **E TSC**	This species was formally found across Australia, except for the south-east corner. It inhibits large open wetlands, grassy plains, coastal mudflats and irrigated croplands. Breeding and foraging habitat includes shallow (< 50 cm) wetlands, mudflats and margins of deeper water bodies with emergent vegetation (e.g. canegrass, lignum or sedges) (DECCW 2009).	Absent	Unlikely	Low	×
Diamond Firetail ***Stagonopleura guttata*** **V TSC**	Occurs predominantly west of the Great Dividing Range (Blakers *et al.* 1984) although local populations are known. 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	Present	Present	Moderate habitat loss	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	and Snow Gum Woodlands, and grassland and riparian areas, and sometimes lightly wooded farmland. May form large flocks during winter and autumn.				
Flame Robin ***Petroica phoenicea*** **V TSC**	Flame Robins are found throughout south-eastern Australia, associated with areas of native vegetation with an open understory. It breeds in upland forests and woodlands and migrates to more open lowland habitats in winter. The South Western Slopes bioregion is considered the core wintering region for this species (DECCW 2010).	Present	Present	Moderate habitat loss	×
Freckled Duck ***Stictonetta naevosa*** **V TSC**	This species occurs on wetlands of inland NSW. Large temporary swamps created by floods in the Bulloo and Lake Eyre basins and the Murray-Darling system, particularly along the Paroo and Lachlan Rivers, and other rivers within the Riverina are a breeding stronghold (DECCW 2010). The species is partially migratory and may move to coastal habitats during severe inland drought. The species inhabits a variety of plankton-rich wetland types, including swamps, lakes, farm dams, sewerage ponds and floodwaters that are heavily vegetated with Cumbungi, Lignum, Canegrass or Tea-tree (DECCW 2010).	Absent	Unlikely	Low	×
Gang-gang Cockatoo ***Callocephalon fimbriatum*** **V TSC**	In NSW, this species is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the ACT. It feeds in pairs or small flocks on seeds of eucalypts and wattles, and occurs primarily in heavily timbered and mature wet forest, but occasionally in towns, farming areas (DECCW 2010). It is often a seasonal altitudinal migrant, moving to lower altitudes and more open forests and woodlands (particularly Box-Ironbark assemblages for winter. This species requires large hollows in which to breed (Gibbons and Lindenmayer, 2000)	Marginal	Possible	Moderate habitat loss; blade-strike	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Gilbert's Whistler ***Pachycephala inornata*** **V TSC**	This species is sparsely distributed over much of the arid and semi-arid zone of inland southern Australia, west of the western slopes of NSW (DECCW 2010). There are only three separate populations left in NSW. Most of the eastern population occurs in an area enclosed by a line joining Gilgandra to Cobar, then south to Narrandera, east to Wagga Wagga, north to Wellington and back to Gilgandra. In NSW the species occurs mostly in mallee shrubland in association with Spinifex and low shrubs. It also occurs in box-ironbark woodlands, Cypress Pine and Belah woodlands and River Red Gum forests. In woodland habitats, the species requires a dense shrubby understorey (DECCW 2010).	Absent	Unlikely	Low	×
Glossy Black-cockatoo ***Calyptorhynchus lathami*** **V TSC**	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of She-oak species, particularly Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*A. verticillata*) occur. Feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species), shredding the cones with the massive bill.	Absent	Unlikely	Low	×
Grey Falcon ***Falco hypoleucos*** **E TSC**	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey. Utilises old nests of other birds of prey and ravens, usually high in a living eucalypt near water or a watercourse	Absent	Unlikely	Low	×
Grey-crowned Babbler (Eastern Subspecies)	This species. In NSW this species occurs west of the Great Dividing Range and on the coast near the Hunter Valley and several locations on the north coast of NSW. It prefers Box Gum Woodlands although also inhabits open forests, scrub	Present	Possible	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Pomatostomus temporalis temporalis **V TSC**	lands, even farmlands and suburbs (DECCW 2010; Pizzey et al., 2003). The species is gregarious and forage on the ground on invertebrates on tree trunks and branches and by foraging amongst litter and tussocks. Territories of family groups range from one to fifty hectares (DECCW 2010).				
Hooded Robin (South eastern form) ***Melanodryas cucullata cucullata*** **V TSC**	This species is sparsely distributed throughout much of NSW, and is rarely found on the coast. It is sedentary and occurs in open eucalypt woodland and scrub, often in or near cleared areas (DECCW 2010). The species generally occurs in woodland remnants with high habitat complexity (Watson et al., 2001) and uses stumps, posts or fallen timber for nesting and locating prey on the ground. Territories range from 10 to 30ha (DECCW 2010).	Present	Present	Moderate habitat loss	×
Little Eagle ***Hieraaetus morphnoides*** **V TSC**	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living rees within a remnant patch, where pairs build a large stick nest in winter.	Present	Possible	High blade-strike	✓ Not recorded during surveys, but potential collision risk due to soaring characteristics.
Little Lorikeet ***Glossopsitta pusilla*** **V TSC**	Forages primarily in the canopy of open *Eucalyptus* forest and woodland, yet also finds food in *Angophoras*, *Melaleucas* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.	Present	Possible	Moderate habitat loss; blade-strike	×
Major Mitchells' Cockatoo	Inhabits a wide range of treed and treeless inland habitats, always within easy reach of water. In NSW it is found regularly	Absent	Unlikely	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Cacatua leadbeateri **V TSC**	as far east as about Bourke and Griffith, and sporadically further east than that. Feeds mostly on the ground, especially on the seeds of native and exotic melons and on the seeds of species of saltbush, wattles and cypress pines.				
Painted Honeyeater ***Grantiella picta*** **V TSC**	This species primarily occurs on the inland slopes of the Great Dividing Range, although is nomadic and may occur in low densities in other parts of NSW in suitable habitat. It inhabits dry open forests and woodland including Boree, Brigalow and Box Gum Woodlands and Box-Ironbark open forests, also paperbark and casuarinas (DECCW 2010; Pizzey et al., 2003). It is a specialist feeder on mistletoe, particularly of genus *Amyema*, and generally requires 5 or more mistletoes per hectare (DECCW 2010). Seasonal migrant, movements are linked to the fruiting of mistletoe.	Present Records in the locality	Present	High connectivity; blade-strike	✓ Recorded during surveys and foraging on mistletoe in southern section of project area.
Painted Snipe or Australian Painted Snipe ***Rostratula benghalensis*** **E TSC** **V EPBC** **M EPBC**	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).	Absent	Unlikely	Low	×
Pied Honeyeater ***Certhionyx variegates*** **V TSC**	Inhabits wattle shrub (primarily Mulga, *Acacia aneura*), mallee, spinifex and eucalypt woodlands, usually when shrubs are flowering; feeds on nectar, predominantly from various species of emu-bushes (*Eremophila* spp.); also from mistletoes and various other shrubs (e.g. *Brachysema* spp. and *Grevillea* spp.); also eats saltbush fruit, berries, seed, flowers and insects.	Marginal	Unlikely	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Powerful Owl ***Ninox strenua*** **V TSC**	This species occurs primarily in tall, moist productive eucalypt forests of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating, gentle terrain nearer the coast (DEC NSW, 2006b). Only scattered, mainly historical records are from the western slopes and plains (DECCW 2010). The species requires old hollow eucalypts in unlogged, unburnt forests for nesting, and roosts in dense mid-canopy trees or tall shrubs (She-oaks, wattles or rainforest species). Nesting and roosting habitat occurs in sheltered gullies, or within 100m of streams, creekflats or minor drainage lines (DEC NSW, 2006b). Hollows greater than 45 cm diameter and greater than 100 cm deep are required. Breeding pairs of this species defend large (300-1500 hectare), permanent territories. Optimal habitat includes a tall shrub layer with abundant hollows and supporting high densities of arboreal marsupials (DEC NSW, 2006b).	Present Records in the locality	Possible	Moderate blade-strike	×
Regent Honeyeater ***Xanthomyza Phrygia*** **E TSC** **E EPBC** **M EPBC**	There are now only a small number of known breeding sites in NSW, the most important of which are: Warrumbungles NP, Pilliga NR, Barraba district, central coast around Gosford, Hunter Valley, and Capertee Valley (DECCW 2010). Most records are from box-ironbark eucalypt associations and it appears to prefer wetter fertile sites within these associations (Menkhorst et al., 1999). It is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box (Menkhorst et al., 1999). It also occurs in riparian forests of River She-oak and wet lowland coastal forests dominated by Swamp Mahogony and Spotted Gum and (DECCW 2010). The species can undertake large-scale nomadic movements in the order of hundreds of kilometres.	Present Many records in the locality	Possible	High Habitat loss; connectivity; blade-strike	✓ Not recorded during surveys, but could forage in area on mistletoe, but most likely impact is from collision risk due to known location of records and migrating characteristics.

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Scarlet Robin ***Petroica boodang*** **V TSC**	The Scarlet Robin is found in south-eastern Australia and south-west Western Australia. In NSW it occupies open forests and woodlands from the coast to the inland slopes. Scarlet robins breed in dry eucalypt forests and temperate woodland. Fallen timber is an important habitat feature for this species.	Present	Present	Moderate Connectivity	×
Speckled Warbler ***Pyrrholaemus saggitatus*** **V TSC**	This species occurs in a wide range of eucalypt woodland communities in the hills and tablelands of the Great Dividing range. Habitats typically are structurally diverse with a grassy understorey, a sparse shrub layer and an open canopy (DECCW 2010; Watson et al., 2001). Declines have been linked to habitat fragmentation as the species appears to be locally extinct in districts where no habitat fragments larger than 100ha remain (Watson et al., 2001). Further, larger remnants (about 300ha) may be required for populations to be viable (Gardner, 2002). The species is sedentary and nests and forages on the ground. Nests are built directly on the ground amongst leaf litter and understorey vegetation and are vulnerable to predation by large birds such as Currawongs (Gardner, 2002).	Present Many records in locality	Present	Moderate Connectivity	×
Spotted Harrier ***Circus assimilis*** **V TSC**	The Spotted Harrier occurs in a variety of habitats including grassy open woodland and riparian woodland. They generally do not occur in densely forested or wooded habitats of the coast, escarpment and ranges. It is commonly associated with native grasslands.	Present Records in the locality	Possible	Low	×
Square-tailed Kite ***Lophoictinia isura*** **V TSC**	This species has a large and sparsely populated range throughout mainland Australia (Griffioen and Clarke, 2002) 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. The species hunts small passerines, especially honeyeaters in the tree	Present Records in the locality	Possible	Moderate blade-strike	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	canopy. Resident pairs have large hunting ranges of greater than 100 km² (DECCW 2010). Nests are a platform of sticks up to 90cm in diameter in a fork of a tall tree in forest or woodland (DEC NSW, 2004).				
Superb Parrot ***Polytelis swainsonii*** **V TSC** **V EPBC (Breeding likely to occur)**	This species is found throughout eastern inland NSW. On the South-western slopes the core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west (DECCW 2010). It inhabits Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. The species nests in the hollows of large trees (dead or alive) in open Box Gum Woodland or isolated paddock trees. Species known to be for used for nesting are Blakely's Red Gum, Yellow Box, Apple Box and Red Box (DECCW 2010). It forages on the ground in grassy woodland, also on fruit, seeds and blossoms of acacias, eucalypts and mistletoes (Pizzey and Knight, 2003).	Present	Present	High habitat loss; blade-strike	✓ Recorded in the project area. Potential impact to breeding and foraging habitat within the southern section of project area.
Swift Parrot ***Lathamus discolour*** **E TSC** **E EPBC**	This species breeds in Tasmania, migrating to south and eastern NSW in autumn/winter where it inhabits eucalypt forests and woodlands, particularly Box-Ironbark Forests of central Victoria and southern NSW (DECCW 2010; Smales, 2005). Mostly occurs on the south-west slopes. It feeds on nectar flowers of eucalypts and lerp-insects, also soft fruits and berries sometimes foraging in grass (Pizzey and Knight 2003). Favoured feed trees include winter flowering species such as Swamp Mahogany, Spotted Gum, Red Bloodwood, Mugga Ironbark, and White Box (DECCW 2010).	Present Records in the locality	Possible, but targeted surveys during its known migration from Tasmania did not observe the species.	Moderate blade-strike, habitat loss	×
Turquoise Parrot ***Neophema pulchella*** **V TSC**	In NSW, this species is typically recorded west of the escarpment in the tablelands and on the western slopes, extending to the coastal districts through the Hunter Valley (DECCW 2010). It occurs in grassy woodland and open forest carrying a mixed assemblage of White Box, Yellow Box,	Present Records in the locality	Possible	Low Habitat loss	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	Blakely's Red Gum, Red Box and Red Stringybark (NPWS, 1999f). The species will also utilise the edges of woodland, timbered ridges and creeks in farmland and nests in tree hollows, logs or posts (DECCW 2010). The species lives in pairs or small groups and forages on the ground.				
White-fronted Chat ***Epthianura albifrons*** **V TSC**	It occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs.	Present	Present	Low	×
Fish					
Macquarie Perch ***Macquaria australasica*** **V TSC** **E EPBC**	The Macquarie Perch is a riverine, schooling species. It prefers deep, rocky holes with considerable cover and a substrate of small boulders, pebbles and gravel. Occurs within rivers, dams and tributaries in Southern NSW (Ecology Lab, 2003), but mainly in the upper reaches of rivers and streams where siltation levels are low. The species appears to prefer pools with cover.	Absent	Unlikely	Low	×
Murray Cod ***Maccullochella peelii peelii*** **V EPBC**	The Murray Cod is found throughout the Murray/Darling Basin system where it inhabits a wide range of warm water habitats, from clear, rocky streams to slow-flowing turbid rivers and billabongs (McDowall 1996). Generally, they are found in waters up to 5 m deep and in sheltered areas with cover from rocks, timber or overhanging banks (Kearney & Kildea 2001).The species is highly dependent on wood debris for habitat, using it to shelter from fast-flowing water (Koehn 1997).	Absent	Unlikely	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Invertebrates					
Golden Sun Moth ***Synemon plana*** **E TSC** **CE EPBC**	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 (*Austrostipa* spp.) or Kangaroo Grass (*Themeda australis*).	Present (CEEC BGW) Records in the locality	Possible	High	✓ Recorded in the project area and likely to be more widespread.
Mammals (microbats)					
Eastern Bent-wing Bat ***Miniopterus orianae oceanensis*** **V TSC**	This species is a common although a vulnerable species that is likely to be widely distributed throughout the region. It roosts and raises its young in caves and mine tunnels (Strahan 1995). The species appears to forage above the forest canopy in a diverse range of forest types (Strahan 1995).	Present – foraging only	Present	High Blade-strike	✓ Recorded in project area and possible impact from collision risk, but not habitat loss.
Greater Long-eared bat (south-eastern form)/ Eastern Long-eared Bat ***Nyctophilus timoriensis*** **V TSC** **V EPBC**	The distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species (DECCW 2010). This species inhabits a variety of vegetation types, including mallee, bulloke but more commonly box/ironbark/cypress-pine communities that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland (DECCW 2010). It is a slow flying agile species and forages in the lower parts of the canopy, even amongst the shrub layers and on the ground (Menkhorst and Knight 2003). The species roosts in tree hollows, and under loose bark.	Absent (No records in locality)	Unlikely	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
Large-footed Myotis ***Myotis macropus*** **V TSC**	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 more than 100 km 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 (Hall & Richards 1979).	Marginal Records in the locality	Unlikely	Low	×
Little Pied Bat ***Chalinolobus picatus*** **V TSC**	This species occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, bimbil box (DECCW 2010). It roosts in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings. It often forages along watercourses (Menkhorst and Knight 2003) where it feeds on moths and possibly other flying invertebrates.	Present – foraging only One record in locality, 2000	Unlikely	Low	×
Yellow-bellied Sheathtail-bat ***Saccolaimus flaviventris*** **V TSC**	This species is a wide-ranging species across northern and eastern Australia. It roosts alone or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows (DECCW 2010). Seasonal movements are unknown, however the species may migrate to southern Australia in late summer and autumn.	Present Records in the locality	Present	High	✓ Recorded in project area and possible impact from collision risk, but not habitat loss.
Mammals (other)					
Brush-tailed Phascogale ***Phascogale tapoatafa*** **V TSC**	This species is found in a variety of forest types although prefers dry sclerophyll forest with a sparse groundcover (DECCW 2010). It generally occurs in areas where the annual rainfall exceeds 500mm. Have large overlapping territories between 20 – 100 hectares. It requires tree hollows with openings 25-40mm wide for nesting and utilises multiple trees throughout its lifetime. Prefer large trees and are most abundant where there are more than 2 trees per ha greater	Marginal No records in the locality	Unlikely	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	than 60cm DBH. It requires remnants greater than 25ha in dry forests and ridges.				
Eastern Pygmy-possum ***Cercartetus nanus*** **V TSC**	In NSW this species is found from the coast inland as far as the Pillaga, Dubbo, Parkes and Wagga Wagga on the western slopes. It prefers woodland and heath although has been recorded in a broad range of habitats including rainforest and sclerophyll (including Box-Ironbark) forest (DECCW 2010). This species feeds largely on nectar and pollen from banksias or other proteaceous or myrtaceous shrubs incl. Melaleucas, Tea-trees & Callistomens (DECCW 2010). This species requires hollows, cracks or fissures > 2.0 cm diameter in trees, stumps or logs, bark or disused bird's nests for breeding (DECCW 2010).	Marginal	Unlikely	Low	×
Koala ***Phascolarctos cinereus*** **V TSC**	This species was historically abundant in the south of NSW, although now occurs in sparse and possibly disjunct populations. It occurs in woodland communities, coastal forests, woodlands of the tablelands and western slopes and the riparian communities of the western plains (NPWS, 2003b). May also utilise isolated paddock trees (NPWS, 2003b). Primary feed tree species listed for the central and southern tablelands are Ribbon Gum and River Red Gum, secondary species include Candle Bark, Blakely's Red Gum, White Box, Yellow Box and Brittle Gum (NPWS, 2003b).	Marginal (Recent) records in the locality	Possible, however not recorded during 33 RapSAT searches in the project area.	Low	×
Spotted-tailed Quoll ***Dasyurus maculatus*** **V TSC** **E EPBC**	This species is found in a variety of forest types such as rainforest, wet and dry sclerophyll forest, woodland, coastal heath and scrub, sometimes Red Gum forest along inland waterways (Menkhorst and Knight, 2004). It utilises hollow-bearing trees, fallen logs, rock caves and crevices as denning and breeding sites (DECCW 2010). Mostly nocturnal it hunts mammals, birds and large arthropods. Females occupy home ranges up to about 750 hectares and males up to 3500	Marginal, records in the locality	Unlikely	Low	×
		Rocky habitats (i.e. boulders and cliff faces) required for are not present at the site. While this species can also den in large logs and hollows these habitat features are absent from the impact area. This species usually traverses their range along densely vegetated creeklines with a preference for mature wet forest habitat, which is not present within the project site. This species consumes a variety of prey, including gliders,			

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	hectares; usually traverse their ranges along densely vegetated creeklines. Given that this species has a very large home range (females occupy home ranges up to about 750 ha and males up to 3500 ha), primary breeding habitat for this species is not present, and there is a paucity of prey species within the project are, the risk of the project resulting in a significant impact to a population is 'low'. In particular, the proposal will not affect any core breeding habitat.	possums, small wallabies, rats, birds, bandicoots, rabbits and insects. These prey species are absent or in low numbers in the majority of the impact area, i.e. within cleared and grazing land affected by the proposal			
Squirrel Glider ***Petaurus norfolcensis*** **V TSC**	This species inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas (DECCW 2010). It prefers mixed species stands with a shrub or Acacia understorey although will occur in areas where no understorey if there is more than one species of Eucalypt. Feeds on insects, nectar and exudates from leaves and trees (*Eucalyptus* and *Acacia*) and requires abundant tree hollows greater than 5cm diameter (DECCW 2010). It can use patches less than 1 ha & isolated trees if within 75 m of other patches (DECCW 2010). Has a mean home range of 1.4–9 ha (Ahern & van der Ree 2003; Quin, 1995; Ree and Bennett, 2003).	Marginal Records in the locality	Possible	Low	×
Reptiles					
Pink-tailed Legless or Worm Lizard ***Aprasia parapulchella*** **V TSC** **V EPBC**	This species is only known from the Central and Southern Tablelands, and the South Western Slopes (Osborne and Jones, 1995). It inhabits sloping, open woodland areas with predominantly native grass groundlayers, particularly those dominated by Kangaroo Grass (*Themeda australis*). Typically these areas are well-drained, with rocky outcrops or scattered, partially-buried rocks. Commonly found beneath small, partially-embedded rocks in burrows below these rocks; the burrows usually have been constructed by and are	Present (CEEC BGW) Records in the locality	Possible, but not recorded during targeted rock-rolling surveys for the species.	Low	×

Species and Status	Ecology and distribution	Presence of habitat	Likelihood of occurrence	Potential to be impacted?	Aos?
	often still inhabited by small black ants and termites (Osborne and Jones, 1995). This species feeds on the larvae and eggs of these ants (DECCW 2010).				
Rosenberg's Goanna ***Varanus rosenbergi*** **V TSC**	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.	Present No records in the locality	Possible	Low	×
Striped Legless Lizard ***Delma impar*** **V TSC** **V EPBC**	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 *Phalaris aquatica, Nasella trichotoma* and *Hypocharis radicata*) 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).	Present	Present	High	✓ Recorded at one location, potential habitat in all grassland areas within the project area.

APPENDIX C ASSESSMENT OF SIGNIFICANCE

C.1 NEW SOUTH WALES

Assessments of significance pursuant to EP&A Act and the TSC Act have been undertaken for the following species, following *Threatened Species Assessment Guidelines* (DECC 2007):

Endangered Ecological Communities

- White Box Yellow Box Blakely's Red Gum Woodland

Flora

- Yass Daisy

Birds

- Superb Parrot
- Painted Honeyeater
- Regent Honeyeater
-

Raptors

- Little Eagle

Bats

- Eastern Bentwing-bat
- Yellow-bellied Sheathtail-bat

Reptiles

- Striped Legless Lizard

Invertebrates

- Golden Sun Moth

Endangered Ecological Communities - White Box Yellow Box Blakely's Red Gum Woodland (Box Gum Woodland)

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.
Not applicable.
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.
Not applicable.
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 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.**
Up to 3,068 hectares of the Endangered Ecological Community White Box- Yellow Box - Blakely's Red Gum Grassy Woodland (including derived grassland) occurs within the site boundary in varying condition. From the detailed surveys, approximately 380 hectares of this total is known to be in moderate or good condition and 357 ha in poor condition. The condition of the majority of this community at the site is unknown however it is likely that there are additional areas of the community in moderate and good condition that were not detected during the surveys. The proposal would result in the permanent loss of up to 12 hectares of moderate and good condition Box Gum Woodland EEC across the site and up to 28 hectares in poor condition. In considering percent foliage cover of the overstorey and understorey composition, all these areas would qualify as moderate to good condition EEC under the Biometric Guidelines resulting in a total permanent loss of 40 ha. Much of this impact would result from the establishment of a 45m wide easement for the 132kV overhead power line. As a precautionary approach, this assessment has considered that the worst case scenario would be the total loss of this vegetation type within the easement; however in reality the vegetation is open woodland meaning that only scattered trees would need to be cleared. The understorey would also be mostly retained excluding small areas required for footings and a maintenance track. It is considered likely that the community would maintain its existing functionality following construction. Predominately, the areas to be impacted contain a moderate to low tree density with an understorey of native grass dominated pasture with a relatively low native forb and shrub diversity (0 – 11 non-grass species in poor and moderate condition). This structural and understorey configuration is common and widespread within the locality and there are large expanses of this vegetation type with or without tree cover. The loss of this vegetation in the context of similar vegetation in the locality is not considered likely to substantially affect the extent or modify the community such that is would be placed at risk of extinction. One area in the south of the Proposal site (in the vicinity of RYP_110 and RYP_120 and to the west of these) consists of higher diversity Box-Gum woodland and would be directly impacted by the proposal due to the construction of tracks and power lines. These areas have high conservation value and also qualify as a Commonwealth listed entity. Up to 10 hectares of high conservation value Box-Gum Woodland would be permanently lost as a result of the proposal. Based on field observations, large extents (approximately 353 ha) of this vegetation occur within the proposal site. It is not considered

likely that the proposal would affect the extent or modify the community such that it would 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.

The proposal will impact upon habitat for Box Gum Woodland in the form of direct clearing of this community and the extent of this impact is discussed in Section c) above. The areas of habitat within the site are already fragmented due to previous clearing, grazing pressure, the planting of exotic pastures, the ingress of weeds and the occurrence of other vegetation communities in habitats not suitable for Box-Gum Woodland. The proposal would not further fragment or isolate habitat for this community. The majority of suitable habitat likely to be removed by the proposal is in poor condition and not considered important habitat. The extent of clearing is not anticipated to impact the long-term survival of this ecological community in the locality.

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

There are no areas of declared critical habitat within the project area or greater locality.

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

A draft national recovery plan for this community has been prepared and is currently available for public comment. The proposal is inconsistent with the objective of the draft recovery plan that aims to '*achieve no net loss in extent and condition of the ecological community throughout its geographic distribution'.* The proposal would result in a worst case net loss of approximately 40 hectares of this community. However, as discussed above, in considering the majority is in poor condition, the extent of the community on site and within the locality and the potential to improve outcomes for this community through offsetting, this is not considered to be significant.

With the correct implementation and management of an offset plan the proposal has the potential to contribute to the following Recovery Plan Objectives;

- Increasing protection of sites in good condition;
- Increasing landscape functionality of the ecological community through management and restoration of degraded sites;
- Increasing transitional areas around remnants and linkages between remnants; and
- Bringing about enduring changes in participating land manager attitudes and behaviours towards environmental protection and sustainable land management practices to increase extent, integrity and function of Box-Gum Grassy Woodland.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed herein:

- 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 hectares 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.

While the proposal contributes to clearing of native vegetation, including the potential removal of 40 ha of threatened Box Gum Woodland (although approximately half of this is derived grassland and actual clearing extents will be much less), the majority of this will occur in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. Clearing of better quality vegetation is generally restricted to proposed access tracks and powerline easements where these intersect with more closed forest communities. As most of the overstorey and shrub clearing is expected to occur in common and well-conserved forest or shrub communities, and relatively little clearing in the historically cleared Box Gum Woodland environments, the proposal is expected to contribute minimally to this key threatening process with respect to EECs.

- The invasion of native vegetation by exotic perennial grasses

A number of exotic perennial grasses, including Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog, Paspalum and African Lovegrass, were observed within the project area. The proposed development may contribute to the spread of these species within or between sites, although weed management recommendations and other mitigations have been suggested to prevent this from occurring. Recommendations have been given to reduce spread of invasive weeds into good quality woodland vegetation, including a vehicle hygiene protocol for cleaning of vehicles. The proposal is not expected to significantly increase the impact of this Key Threatening Process in the project area.

- Loss of hollow-bearing trees

Hollow-bearing trees will be removed during the vegetation clearing required for the proposed development. The majority of these will likely be in the patches of vegetation that the transmission line may pass through. Recommendations have been made to perform hollow-bearing tree targeted surveys prior to clearing to determine micrositing of infrastructure and minimise losses in Box Gum Woodland.

Flora – Yass Daisy

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 Yass Daisy is a rare perennial herb, 30-60 centimetres high, inhabiting sclerophyll woodland, forest and roadsides (Harden 1992). It appears to be unaffected by light grazing, with some populations persisting in grazed sites (OEH 2011). In surveys conducted in the Boorowa Shire, all of the occurrences of this species were on land characterised by a light grazing regime (NPWS 2002). The Yass district is the centre of distribution for this species (Fallding 2002). Most populations occur in the Yass District, at Lake Burrinjuck, Bookham, Rye Park and Dalton (DSEWPC 2008). The Yass Daisy has been recorded within 2.5 kilometres west and south-east of the subject site. Current threats to the species include agricultural developments, intensification of grazing regimes, invasion of weeds, road works (particularly widening or re-routing) and inappropriate mowing or slashing in cemetery sites (OEH 2011).

The species was not recorded during targeted searches in higher quality areas of Box-Gum Woodland and derived grassland immediately north of RYP_120 and within the proposed overhead transmission line routes to the north-west of RYP_120 and south_west of RYP_110. These areas have a long and continuing grazing history and the Yass Daisy is considered unlikely to occur there. Considering this and the low likelihood of the species being present elsewhere at the site, the works are not expected to adversely affect the life cycle of the Yass Daisy such that a viable local population of the species is 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.

Not applicable.

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 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.

Not applicable

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.

Yass Daisy

i. The proposal would result in the permanent loss of up to 12 hectares of moderate and good condition Box-Gum Woodland, which provides potential habitat for the threatened Yass Daisy. Targeted surveys were carried out in these areas and the species is considered

unlikely to occur there. Much of the total area of disturbance would involve tree clearing for a 45m wide easement for the 132kV overhead powerlines. The groundlayer habitat under the powerlines would be largely undisturbed, with the exception of small areas required for pole footings and a maintenance track.

ii. In view of the limited extent and pattern of clearing and the low impact on groundlayer vegetation within the ETL, the works are not expected to add to the existing level of fragmentation or isolation of potential Yass Daisy habitat.

iii. The potential habitat at the subject site is considered unlikely to support the species, considering land use history, condition assessments and the results of the targeted surveys. These areas are assessed as low importance for the Yass Daisy.

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

There are no areas of declared critical habitat within the project area or greater locality.

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

The principal recovery actions required cover:

- Protection of known populations from changes to land use, road works, pasture modification, grazing pressures, and inappropriate mowing regimes
- Pest plant and animal control
- Marking sites and potential habitat onto maps used for farm, development and conservation planning and management
- Searching for new populations in potential habitat (after OEH 2011, DSEWPC 2008).

The targeted surveys did not identify a population of the Yass Daisy within the site boundary. The proposal has satisfied the need to search for new populations and as none were found, no further actions are applicable.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed herein:

- 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 hectares 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 majority of the subject site is already cleared and highly modified by agricultural practices. The Proposal would remove up to 23 hectares of predominately low quality Box Gum Woodland and derived grassland, an endangered ecological community. The significance of this clearing has been discussed above.

While the proposal contributes to clearing of native vegetation, the majority of this is in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. Clearing of better quality vegetation is generally restricted to proposed access tracks and powerline easements where these intersect with more closed woodland or sandstone forest communities.

- The invasion of native vegetation by exotic perennial grasses

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. The White Box - Yellow Box –Blakely's Red Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog, and Paspalum.

Unnecessary disturbance of areas containing exotic perennial grasses within and adjacent to the works should be avoided so as not to increase the impact of this Key Threatening Process in the area. Cleaning of vehicles and plant prior to arrival on the site (and departure if working in areas containing these species) would help to ameliorate this impact, by preventing the introduction and spread of additional weeds. Section 8 identifies further safeguards to minimise risks from weeds, and the proposal is not expected to significantly increase the impact of this Key Threatening Process in the study area.

Birds – Superb Parrot, Painted Honeyeater, Regent Honeyeater

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.

Superb Parrot

The Superb Parrot forages in Box Eucalypt Woodland, particularly that dominated by Yellow Box (*E. melliodora*) or Grey Box (*E. microcarpa*). After breeding, Superb Parrots generally move away from their breeding habitat in mid-January (Webster 1988, 1997). Large flocks of adult and immature birds roam widely in search of food, and may be observed in various habitats at this time (Webster 1988). Superb Parrots were recorded during November 2011 and 2013 surveys at Rye Park; they were not recorded in April 2012 or July 2013. Thus, Superb Parrots were observed to use habitats in the project area and locality during their nesting season (September to January). It can be assumed that they disperse to other foraging grounds outside of nesting season.

The Superb Parrot was regularly observed during November 2011 and November 2013 surveys, but primarily outside of the project area to the west of the site along Rye Park road, Flakney Creek Road, or other roads west of the project area. The area the species was commonly observed within the project area is located to the south between RYP_110 and RYP_120 within Box Gum Woodland or native pasture habitat. Three nest trees were identified for this species: two north of RYP_120 within the same area birds were regularly recorded and the other nearby Flakney Creek Road along a proposed transmission line. Two potential nest trees were also identified north of RYP_120 in which individual birds were observed to be interested in a hollow, but did not appear to be nesting at the time. The Superb Parrot was not observed during April 2012 or July 2013 indicating the parrot moves away from the inland slopes during winter. Flight path mapping however, identified that the Superb Parrot is regularly observed in high numbers to the west of the project area, but less commonly within it.

However, one area was identified as being regularly utilised by the parrot which is a patch of Box Gum Woodland in the southern section of the project area. This habitat runs in a north to north-east direction and it is possible Superb Parrots are using it as a movement corridor for local movements to forage and breed in the southern section of the project area. This habitat coincides with proposed infrastructure of turbines RYP_106 to RYP_110 and an area proposed for a transmission line. However, a proposed transmission line that extended further west of the current transmission line in this area has been removed from the layout to avoid impact, as much as possible, to Box Gum Woodland habitat and a 100 m buffer has been applied to nest trees to further avoid impact. Impacts to known breeding resources of the Superb Parrot will therefore be avoided. The magnitude of impact for habitat loss for Superb Parrot is likely to be low to moderate (around 1% of available hollows to be cleared) and unlikely to lead to a long-term decrease in population size, reduce the area of occupancy or fragment the existing population.

The potential collision risk to this species overall is not considered to result in a significant impact to this species, as the majority of the population within the locality occurs outside the project area and was primarily observed flying within the tree canopy or below 20 m on most occasions.

The habitat to be affected by the proposal consists of scattered trees over pasture and given impact to all known nest trees will be avoided, the proposal is not considered to adversely affect the life cycle of this species such that it would be placed at risk of extinction.

Painted Honeyeater

The Painted Honeyeater is nomadic and occurs at low densities throughout its range. Some north-south migratory movements have been reported for the Painted Honeyeater in which the species moves north to Queensland in winter and is considered a breeding spring to summer visitor in NSW. Within NSW the greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range. The species inhabits Boree, Brigalow and Box Gum Woodlands and Box-Ironbark Forests and is a specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias.

Painted Honeyeaters were predominantly observed west of RYP_106 to RYP_120 in the southern section of the project area within Box Gum Woodland in trees supporting flowering mistletoe in November 2013. Approximately 10-12 individuals were observed foraging in this area. A transmission line was proposed for this area but has been removed from the layout. Individuals of this species were also observed west of RYP_4 and along Flakney Creek Road. The species was not recorded within the project area during previous surveys and is not common to the area. No records for this species are known for the locality.

The area used by Painted Honeyeaters in the south of the project area also corresponds to the Box Gum Woodland habitat being used by Superb Parrots. As mentioned for Superb Parrots, a transmission line was proposed for this area but has been removed from the layout to avoid the better quality Box Gum Woodland within the site; most of the records observed for this species were in this area and consequently the majority of habitat utilised by this species has been avoided. The impact of the proposal to Box Gum Woodland habitat for this species is therefore considered low and the proposal is not considered to adversely affect the life cycle of this species such that it would be placed at risk of extinction.

Regent Honeyeater

The Regent Honeyeater primarily inhabits temperate woodland and open forest of the inland slopes of south-east Australia, particularly Box-Ironbox woodland. The species prefers the wettest, most fertile sites within these associations such as along creek flats, broad river valleys and foothills. The species is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box (Menkhorst et al. 1999). Potential foraging habitat is primarily present within the Box Gum Woodland within the project area, which includes the feed tree Yellow Box.

The species was not recorded during surveys, but records of Regent Honeyeater are present within the locality and the species is known to utilise box-ironbark eucalypt associations. It is a generalist forager, which mainly feeds on the nectar from a wide range of eucalypts and mistletoes. Key eucalypt species include Mugga Ironbark, Yellow Box, Yellow Gum, Blakely's Red Gum and White Box. As the species can undertake large-scale nomadic movements in the order of hundreds of kilometres the species has the potential to occur within the project area. The species was not detected during bird surveys of the project area, but has potential to be impacted from the proposal from collision when it migrates.

As this species is nomadic and movement patterns are often linked to availability of resources, it can be assumed that they may travel through the project site to other foraging grounds. Therefore it is considered the proposal has the potential to result in loss of foraging habitat or risk of blade-strike to this species.

While records are noted for this species across eastern NSW, primary breeding and foraging habitat is not widely available within the project site (i.e. riparian areas of Red Ironbark, Red Gum and Casuarinas, or wetter areas supporting Box-ironbark Eucalypt associations). Two species of mistletoe were recorded on site, but are not widely distributed and occur in low densities. Casuarina and Red Gum are not recorded on site. Records across NSW indicate a strong presence of this species to the south, east and north-east of the project site in better quality habitat (i.e. National Parks) and could be considered an important landscape connection. This area traverses Namadgi NP, Morton NP, Nattai NP and Blue Mountains NP. It is expected the movement of this species would commonly occur through this connection where better quality foraging resources exist.

Given that core breeding habitat is not available on site, foraging resources are generally limited (i.e. not wetter more fertile areas), and known records indicate movement of the species east of the project site, the proposal is not considered to adversely affect the life cycle of this species such that it would 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.

Not applicable.

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 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.

Not applicable.

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.

Superb Parrot, Painted Honeyeater, and Regent Honeyeater

i) The total clearance impact to Box Gum Woodland habitat is 25 ha, with 1555 ha remaining within the project area; however, the greatest impact to these species is considered to occur in one area at the southern end of the project area. The proposal will not remove known nest trees for the Superb Parrot as these have been buffered by 100m from infrastructure.

ii) The Box Gum Woodland habitat is already fragmented in the project area and in the area of most interest to these species due to clearing associated with agricultural farming practices. The proposal will not contribute to further fragmentation of this habitat and will not isolate any areas of habitat.

iii) Areas of habitat to be removed for the transmission line and associated access tracks in the area of identified habitat for these will are well represented in the overall project area and surrounding locality, including within nature reserves such as Bango NR. The majority of the habitat to be removed in the project area is degraded and has been subject to ongoing disturbance from agricultural land use. However, impacts to this species have been largely avoided with the removal of part of a transmission line through the best quality Box Gum Woodland in the project area.

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

There are no areas of declared critical habitat within the project area or greater locality for the Painted Honeyeater or Regent Honeyeater.

According to the National Recovery Plan for the Superb Parrot, Box Gum Woodland on the inland slopes and tablelands is critical breeding habitat for the Superb Parrot. Therefore, critical breeding habitat occurs in the project area and would be cleared (Box Gum Woodland in the transmission line corridor). In particular, Blakely's Red Gum is the most commonly used nest tree in the locality, however Yellow Box is the most common tree within the Box Gum Woodland habitat on site, with some trees identified

as nests trees. Recommendations have been made to avoid impact to these nest trees, as described above. Therefore impact to breeding of this species will largely be avoided.

In general, further recommendations are given in this report to microsite turbines, roads and other infrastructure to avoid hollow-bearing trees. It is recommended that once the transmission line route through Box Gum Woodland is marked by surveyors, the route be thoroughly surveyed for hollow-bearing trees. Hollow-bearing tree details (e.g. number of hollows) should be recorded and standard pre-clearance protocols by undertaken. Clearing in Box Gum Woodland should not be undertaken during Superb Parrot breeding season. Where hollow-bearing trees cannot be avoided, it has been recommended that hollows be offset and/or replaced with artificial hollows.

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

Superb Parrot

Priority actions for this species include no loss of known or potential Box Gum Woodland foraging habitat and activities to assist Superb Parrot include retaining and protecting hollow-bearing trees and woodland remnants (OEH 2012). The *National Recovery Plan for Superb Parrot* (Baker-Gabb 2011) lists a number of objectives which relate mostly to research and management of the species; none are relevant here. The impact to breeding habitat is discussed in point e) above.

Painted Honeyeater

There is no recovery plan for the Painted Honeyeater, however priority actions for this species include:

- Manage grazing on sites where Painted Honeyeater habitat occurs.
- Encourage regeneration of habitat by fencing remnant stands and undertaking new plantings.
- Protect remnant woodland and open forest throughout the range of the species.
- Regenerate and replant local flora species to maintain breeding and foraging habitat.
- Conduct further research to increase understanding of habitat selection and nomadic movements of the Painted Honeyeater.

The proposal has avoided known foraging habitat where the species was identified within the project area and commits to offsetting habitat for this species, this will directly contribute to management of habitat in grazing lands and is consistent with the first priority action listed.

Regent Honeyeater

Priority actions for this species include no further loss of known woodland and forest habitat and protection of key breeding and foraging habitats (OEH 2012). The *National Recovery Plan for the Regent Honeyeater* (Menkhorst *et al.* 1999) lists a number of objectives which relate mostly to no loss of known or potential habitat, as well as activities to assist the species including monitoring and management of populations and collating data on dispersion of the species. This assessment concludes that the proposal will not result in loss of key breeding or foraging habitats.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed:

- Clearing of native vegetation.

The clearing of potential habitat, especially Box Gum Woodland or Native Pasture habitat will lead to direct habitat loss for these species, however, the majority of this is in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. The proposal commits to offsetting all impact to Box Gum Woodland which is likely to have a positive effect on these

species given the offset site will require management and therefore halt the current impacts associated with grazing in the project area that continue to degrade the habitat of this species.

- Invasion of native vegetation by exotic perennial grass

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. Box Gum Woodland in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog, and Paspalum. Recommendations for correct vehicle hygiene are prescribed and the proposal is not considered to significantly increase the impact of this Key Threatening Process.

- Loss of hollow-bearing trees

Hollow-bearing trees will be removed during the vegetation clearing required for the proposed development. The majority of these will likely be in the patches of vegetation that the transmission line may pass through. Recommendations have been made to the proposal in order to avoid impact upon hollow-bearing trees, where possible. These provisions include 100 m buffers to known nest sites, as well as 100 m buffer to potential nest sites for the Superb Parrot as a precautionary measure, pre-clearance surveys, and micrositing of infrastructure. Recommendations are also given to offset or replace (with artificial hollows) all hollows that are cleared during the construction phase. Thus, it seems unlikely that any threatened species will be significantly affected by the vegetation clearance associated with the proposed development.

- Removal of dead wood and dead trees

The removal of dead wood and dead trees from the landscape may occur as a result of the proposed development. Dead wood is likely to be used by some woodland bird species, such as threatened Robins. Dead standing trees may provide shelter for threatened bird and bat species, primarily bat species. It is unlikely that the removal of dead wood and trees will result in a significant impact to any threatened species in the region. However, recommendations are given for fallen timber greater than 50 cm to be left in place or moved to a nearby area to retain fauna habitat, where possible.

Raptors – Little Eagle

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.
Little Eagles were not recorded during surveys but are known to occur in the locality. Should a Little Eagle forage or nest in the project area, the proposal has potential to affect the species during the operational phase; the turbine rotors present a collision risk to the species. As no Little Eagle nests were found within 100 metres of surveyed proposed turbine locations, the risk to fledging Little Eagles is considered low to moderate. Adult birds, including raptors, have generally shown an ability to habituate to the turbines by taking avoidance action around rotors or by modifying their behaviour (such as approach a root at the head of a gully from below rather than above – EBS Ecology 2012). Further, the carcass monitoring results reviewed (refer Table 7-1 in main report) suggest more common species are most at risk of colliding with turbines. Thus on the basis of probability it appears unlikely that a viable local population of Little Eagle within the Project Area would be placed at risk of extinction from the wind farm proposal. However, this species should be a focal species of an operational Bird and Bat Management Plan to confirm the assumptions of this assessment, addressing inherent uncertainty.
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.
Not applicable.
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 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.**
Not applicable.
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) Section 7 of the report discuss the extent of native vegetation types to be removed or modified as a result of the proposal. In general, relatively small areas of good quality forest or woodland habitat would be removed or modified within project area, with most of the proposal affecting native pasture or Inland Scribbly Gum Forest. ii) In the project area, turbines are located on ridges, often adjacent ridges, with a spacing of approximately 2 to 5 km between them. Spacing between turbines in the current layout is generally around 300-500 m. The distance between turbine clusters and also the distance between individual turbines is expected to allow for safe passage between turbines for birds and bats, without creating a

barrier effect. There may be some alteration to movement patterns for some species, but areas of habitat are unlikely to become isolated from each other.

iii) Areas of habitat to be removed for turbines, access tracks, power infrastructure, and transmission line associated with the proposal are well represented in the overall project area and surrounding locality, including within large areas of conservation reserves and state forests such as Bango NR. The majority of the habitat to be removed in the project area is degraded and has been subject to ongoing disturbance from agricultural land use. As a result, the majority of potential habitat within the project area is considered unlikely to support the fauna species assessed, considering land use history, condition assessments and the results of the field surveys.

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

There are no areas of declared critical habitat within the project area or greater locality.

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

OEH have not identified any relevant priority actions to help recover these species (OEH 2012).

In general, design measures to avoid and mitigate impacts have included avoiding areas of high conservation value fauna habitat and this is consistent with the actions and objectives of recovery plans and priority actions developed for species considered in this assessment.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed:

- Clearing of native vegetation.

The clearing of potential habitat will lead to direct habitat loss for this species, however, the majority of this is in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. The proposal commits to offsetting all impact which is likely to have a positive effect on this species. Given the mobility of this species across the landscape, the discrete clearance footprint associated with this proposal will not limit the ability of the species to persist in the long-term.

- Removal of dead wood and dead trees

The removal of dead wood and dead trees from the landscape may occur as a result of the proposed development. Dead standing trees may provide shelter for the Little Eagle; however, it is unlikely that the removal of dead wood and trees will result in a significant impact to this species in the region given the discrete clearance footprint and the availability of resources remaining within the landscape.

Microbats – Eastern Bentwing Bat and Yellow-bellied Sheathtail-bat

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.

Eastern Bentwing Bat

The Eastern Bentwing Bat inhabits a diverse range of forest types and roosts and raises its young in caves and mine tunnels. The species appears to be widely distributed throughout NSW. The Eastern Bentwing Bat is reported to be a fast and direct flier that forages above the canopy and in open areas and will travel up to several hundred kilometres to over-wintering roosts (Churchill 2008, Lloyd *et al.* 2006), which place it at risk of collisions. In overseas studies, the most affected group of microbats are migrating bats (Cryan and Barclay 2009).

Thirty-six calls of the Eastern Bentwing Bat were recorded within the project area primarily within Inland Scribbly Gum Forest along the ridgeline supporting turbines RYP_80 to RYP_143. This habitat type is considered the most suitable within the project area for temporary roosting sites and a total of 90 ha will be removed, with 3753 ha remaining within the site boundary. The proposal has the potential to affect the species during the operational phase as a result of collisions with infrastructure. Based on carcass search results reviewed for other projects, the risk to Eastern Bentwing Bat within general habitat appears low; however in overseas studies, migratory bats are considered at higher risk. The Eastern Bentwing Bat is known as a sub- and over-canopy feeder, so the majority of foraging is expected to be below the rotor-swept area.

The risk of the proposal impacting on breeding populations (i.e. maternity caves) is low as the nearest maternity cave is 40 km away. There is a staging area and maternity cave in the region (near Bungendore approximately 65 km away and Wee Jasper approximately 40 km away, respectively) for Eastern Bentwing Bat; these are used by a large proportion of the female and juvenile population. It is possible that the local population of Eastern Bentwing Bats may spike slightly when a large proportion of the female and juvenile population migrate to and from the maternity cave (November and February-March); however Anabat results were recorded within November 2011 and 2013 and suggest a relatively low abundance of this species within the project area at this time.

Given project area is not near a known maternity caves the proposal is unlikely to have an adverse impact on the lifecycle of this species so that it would be placed at risk of extinction; however given that the bat was recorded in several locations across the wind farm, there is potential for this species to be impacted as a result of collision with turbine blades during the operation life of the wind farm. This species should be a focal species of an operational Bird and Bat Management Plan to confirm the assumptions of this assessment, addressing inherent uncertainty.

Yellow-bellied Sheathtail Bat

Four calls of the Yellow-bellied Sheathtail Bat were recorded within the project area within one location. This species is known to roost in large hollow-bearing trees in a variety of habitats. They migrate into Southern Australia during the summer months (Jan – Apr). This species forages at canopy level, but lower over open spaces at forest edges. In pursuit of prey, this species is capable of tight lateral turns (Churchill 2008). This species is considered an occasional seasonal visitor that may roost temporarily in tree hollows within the project area.

The data suggests this species is not common in the area as only four calls of this species were recorded and in one location of the project area. The flight height of this species make it potentially vulnerable to turbine strike, however, given that the species is more likely to forage near the forest edge beneath the in open habitat it is not expected the proposal will have an adverse effect on this species such that it would be placed at risk of extinction from blade-strike. In practice, the project area will also continue to have foraging habitat value for this species during the operational phase of the development, where the existing vegetation cover will largely be retained within turbine envelopes. However, some habitat

removal is expected within the project area and there may be some loss of hollow-bearing trees (roost sites) for this species, primarily within the Inland Scribbly Gum Forest vegetation.

On the basis of the results of the site survey (low call recordings), it appears unlikely that the local population would be placed at risk of extinction. However, this species should be a focal species of an operational Bird and Bat Management Plan to confirm the assumptions of this assessment, addressing inherent uncertainty.

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.

Not applicable.

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 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.

Not applicable.

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) Section 7 of the report discuss the extent of native vegetation types to be removed or modified as a result of the proposal. In general, relatively small areas of good quality forest or woodland habitat would be removed or modified within the project area, with most of the proposal affecting native pasture or cleared scattered trees over pasture. Recommendations have also been provided to protect and microsite infrastructure to avoid hollows in the first instance and then survey to accurately quantify hollows to be removed in order to offset or replace all hollows that are cleared during construction.

ii) In the project area, turbines are located on ridges, often adjacent ridges, with a spacing of approximately 2 to 5 km between them. Spacing between turbines in the current layout is generally around 300-500m. The distance between turbine clusters and also the distance between individual turbines is expected to allow for safe passage between turbines for bats, without creating a barrier effect. There may be some alteration to movement patterns for some species, but areas of habitat are unlikely to become isolated from each other. Vegetation in the landscape is already very fragmented, and bats persist in that environment because of their mobility. The small amount of clearing for each turbine location is unlikely to increase fragmentation at a landscape level, particularly for mobile bat species. Additionally, the clearing of the transmission line easement is unlikely to create an impediment to movement for the microchiropteran bat species considered in this assessment.

iii) Types of habitat to be removed for turbines, access tracks, power infrastructure, and transmission line associated with the proposal are well represented in the overall project area and surrounding locality. The majority of the habitat to be removed in the project area is degraded and has been subject to ongoing disturbance from agricultural land use.

The presence of the wind farm has the potential to represent indirect habitat loss if bats avoid the entire area of the wind farm. However, research to date (summarised in the main report) suggests that bats readily fly among turbines with only a small percentage suffering mortality from collision with turbines. There is no evidence available to suggest that bat utilisation of remnant vegetation within the turbine envelope, decreases following wind farm construction. Regardless, microchiropteran bats (species diversity and activity levels) would be a focus of the Bird and Bat Adaptive Management Plan for the project.

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

There are no areas of declared critical habitat within the project area or greater locality.

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

Eastern Bentwing Bat

OEH have identified priority actions which relate to protection of roost sites; none are relevant to the proposal.

Yellow-bellied Sheathtail Bat

Of the identified priority actions for this species, the recommendation to *Ensure the largest hollow bearing trees (including dead trees and paddock trees) are given highest priority for retention in PVP assessments and or other land assessment tools* is relevant to this proposal. This assessment has identified mitigation measures to minimise the loss of hollow bearing trees and dead trees and offset hollow bearing trees that would be removed.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed:

- Clearing of native vegetation.

The clearing of potential habitat will lead to direct habitat loss for these species, however, the majority of this is in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. The proposal commits to offsetting all impact to the vegetation that is cleared which is likely to have a positive effect on these species. Given bat species forage widely across the landscape and are highly mobile, the discrete clearance footprint is unlikely to lead to a long-term impact to these species.

- Loss of hollow-bearing trees

Hollow-bearing trees will be removed during the vegetation clearing required for the proposed development. The majority of these will likely be in the patches of vegetation that the transmission line may pass through. Recommendations have been made to the proposal in order to avoid impact upon hollow-bearing trees, where possible. These provisions include pre-clearance surveys, and micrositing of infrastructure. Recommendations are also given to offset or replace (with artificial hollows) all hollows that are cleared during the construction phase. Thus, it seems unlikely that any threatened species will be significantly affected by the vegetation clearance associated with the proposed development.

- Removal of dead wood and dead trees

The removal of dead wood and dead trees from the landscape may occur as a result of the proposed development. Dead standing trees may provide shelter bat species. It is unlikely that the removal of dead wood and trees will result in a significant impact to any threatened species in the region as the

scale of clearance of dead trees is likely to be low, with a substantial amount remaining within the project area. Especially within Inland Scribbly Gum Forest, of which a substantial amount of this vegetation type exists within the landscape.

Reptiles – Striped Legless Lizard

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.

This species is typically said to inhabit temperate lowland grasslands, secondary grasslands and occasionally in open Box Gum Woodland. However, the species has also been recorded in degraded habitats such as sites dominated by introduced species (such as *Phalaris aquatica, Nasella trichotoma* and *Hypocharis radicata*) and sites with a history of grazing and pasture improvement (Smith and Robertson, 1999). This species is mostly associated with grasslands supporting a dense cover of perennial tussock grasses, particularly spear grass (*Stipa bigeniculata*) and Kangaroo Grass (*Themeda triandra*) (Kukolic 1991; Kukolic & Osborne 1993). The highest densities of the species have been reported from sites with a *Themeda* ground cover of more than 70 % (Kukolic 1991).

One individual of the Striped Legless Lizard was recorded at tile plot 10 (RYP_27) in the northern section of the project area. The species was located on a grazed ridge top supporting a predominantly exotic grassland, with some native species. Common species included: Spear grasses (*Austrostipa* sp.), Thistles (*Sonchus* sp.), Cat's Ear (*Hypochaeris radicata*), and Rye Grass (*Lolium perenne*), with some embedded rock consisting of approximately 10-15% cover. No Kangaroo Grass (*Themeda australis*) was observed in the area at the time the tiles were laid. The observation of the Striped Legless Lizard was made on the ninth check of the ten checks completed.

Given the species was detected once, it could occur in other areas of grassland habitat of the project area and impact to known habitat of this species could result from the proposal. To determine the extent of impact management measures have been prescribed to undertake more detailed micro-habitat survey of the site (referencing habitat attributes where the species was located) prior to the end of February 2014 to determine the extent of similar habitat within the project area and quantify the extent of clearance impact. These survey results would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible.

Assuming the Striped Legless Lizard could occur in all grassland habitats of the project area, the total impact to potential habitat of this species is 66 ha (including Box Gum Woodland Derived grassland and native pasture habitat). Of these habitat types, 5887 ha is available within the project area and therefore the ability to offset impact to this species within the immediate project area is achievable. The proposal commits to offsetting all impact to this species which is likely to have a positive effect on this species given the offset site will require management and therefore halt the current impacts associated with grazing in the project area that continue to degrade the habitat of this species.

As the species was not located at the other nine tile sites, the overall impact to this species is not expected to be significant especially when considering the amount of available habitat remaining within the project area. Furthermore, the ability to offset the impact will ensure the species is conserved in the locality. In light of this, the proposal is unlikely to have an adverse effect on the life cycle of the Striped Legless Lizard such that a viable local population of the species is likely to be placed at risk of extinction, however further survey work is required to confirm the assumptions of this assessment.

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.

Not applicable.

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 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.

Not applicable.

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) Up to 66 ha potential habitat would be affected with 5887 ha remaining within the project area. Management measures specifying further micro-habitat survey of the site (referencing habitat attributes where the species was located) prior to the end of February 2014 to determine the extent of similar habitat within the project area and quantify the extent of clearance impact is required to determine the total extent of habitat to be removed and therefore the potential fragmentation impacts. These survey results would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible.

ii) As above.

iii) The habitat to be removed is considered important habitat to the Striped Legless Lizard given the species would not be capable of moving large distances. However, the impact from the proposal will be confined to relatively discrete areas of clearance and a substantial amount of habitat will remain in the project area (> 5000 ha) of which areas will be designated as offset sites to ensure the species and its habitat is conserved within the project area. The results of further habitat survey will be required to determine the importance of the habitat to be removed.

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

There are no areas of declared critical habitat within the project area or greater locality.

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

The *National Recovery Plan for Striped Legless Lizard 1999 - 2003* (Smith & Robertson 1999) lists a number of objectives which relate mostly to research and management of known populations, establishing reserves to protect the species and understanding ecological requirements and threatened processes of the species further, as well as involve community in the conservation of the species; none are relevant here.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed herein:

- Clearing of native vegetation.

The clearing of potential habitat, especially Native Pasture habitat will lead to direct habitat loss for this species, however, the majority of this is in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. The proposal commits to offsetting all impact to Box Gum Woodland which is likely to have a positive effect on this species given the offset site will require management and therefore halt the current impacts associated with grazing in the project area that continue to degrade the habitat of this species.

- Invasion of native vegetation by exotic perennial grass

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. Box Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog, and Paspalum. Recommendations for correct vehicle hygiene are prescribed and the proposal is not considered to significantly increase the impact of this Key Threatening Process.

- Removal of dead wood and dead trees

The removal of dead wood and dead trees from the landscape may occur as a result of the proposed development. It is unlikely that any threatened reptiles are reliant on dead wood within the study area, however, recommendations are given for fallen timber greater than 50 cm to be left in place or moved to a nearby area to retain fauna habitat, where possible. The proposal is therefore not considered to significantly increase the impact of this Key Threatening Process.

Invertebrates – Golden Sun Moth

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 Golden Sun Moth shows a preference for natural temperate grasslands or derived grasslands (derived from Box Gum Woodland) that are dominated by a low and open cover of native wallaby grasses (*Rytidosperma* spp., formerly *Austrodanthonia* spp.), spear grasses (*Austrostipa* spp.), and the introduced Chilean needle grass (*Nassella neesiana*) (Richter *et al.* 2013). Golden Sun Moths appear to favour slightly sloping, north facing sites with minimal shading. Areas of bare or sparsely covered ground between grass tussocks (inter-tussock space) are thought to be important in helping males locate females and therefore high biomass renders habitat less suitable. Sites that have been pasture improved, fertilised or ploughed are unlikely to provide habitat for Golden Sun Moth.

The Golden Sun Moth was observed at seven of the ten sites surveyed and approximately 200 moths were observed in total across the project area. In particular, the southern section of the site appears to support larger numbers of Golden Sun Moth, as well as the area surveyed east of RYP_72. Potential habitat was recorded to extend beyond the areas likely to be disturbed at most sites where Golden Sun Moths were observed.

The locations moths were observed are currently impacted by transmission lines, access tracks and substation infrastructure, but no turbine areas. Several concrete poles would need to be erected, requiring vegetation clearing and excavation within small discrete footprints. Spoil would be temporarily stockpiled next to each pole during excavation. Poles and transmission lines would be laid along the ground prior to being raised. During construction and operation, vehicles would travel underneath the lines. For these infrastructure types, the proposal has potential to directly impact either the underground or emerged phase of the Golden Sun Moth during habitat clearance (i.e. not below ground other than for pole excavation).

However, as the species was detected on site in variable quality habitats it is likely it could occur elsewhere not assessed during the November 2013 survey. Therefore, as a precautionary measure, the habitat in which the species was located and all contiguous habitat of similar structure and condition has been delineated as potential habitat. This includes all Box Gum Woodland, derived grassland and native pasture habitats across the project area. The current total impact to these habitat types for this species is 66 ha. Of these habitat types, 5887 ha is available within the project area and therefore the ability to offset impact to this species within the immediate area of proposed infrastructure is achievable.

There are 15 known populations of the Golden Sun Moth in the general area between Yass and Boorowa, including at Rye Park (DEWHA 2009) and this species has recently been shown to be more widespread than currently thought, particularly within the Yass Valley region. Recent survey results at another wind farm in the region (Yass Valley Wind Farm) have also shown the species to occur in high number (i.e. > 200 individuals).

To determine the extent of impact and specifically quantify habitat for this species within the project area, management measures have been prescribed to undertake further preconstruction surveys of the final infrastructure layout in accordance with the relevant survey guidelines (Significant Impact Guidelines for the critically endangered Golden Sun Moth *Synemon plana;* DEWHA 2009) for this species. The results of these surveys would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible. The management protocols for this species would be documented within a management plan, to be implemented as part of the construction process.

Given the most likely impact to this species will occur from overhead transmission lines which are generally limited to discrete impact from pole footings, a relatively large number of moths were observed across the project area, and the species is expected to be more widespread in other areas of the project area and broader locality, the action proposed is unlikely 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.

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.

Not applicable.

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 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.

Not applicable.

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) Up to 66 ha of this community would be affected with 5887 ha remaining within the project area; within the 66 ha, several concrete poles would need to be erected, requiring vegetation clearing and excavation within small discrete footprints. Spoil would be temporarily stockpiled next to each pole during excavation. Poles and transmission lines would be laid along the ground prior to being raised.

ii) Management measures specifying timing of construction outside the emergence/breeding period (i.e. between 1 March and 30 September) are also specified. If works are carried out outside of the emergence/breeding season, habitat fragmentation is not anticipated as grassy vegetation would regrow underneath the 132 kV transmission line. This requirement is an assumption of this assessment and has been included in this report's recommendations.

iii) The habitat to be removed is considered important habitat to the Golden Sun Moth given the species does not generally move more than 100m. However, the species is expected to be relatively widespread over the project area and a substantial amount of habitat will remain in the project area (> 5000 ha) or which areas will be designated as offset sites to ensure the species and its habitat is conserved within the project area. Given the species has recently being detected in more areas than first thought across the Yass Valley region, the severity of impact to this species is not as severe as first anticipated.

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

There are no areas of declared critical habitat within the project area or greater locality.

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

There is no recovery plan for the Golden Sun Moth. OEH have not identified any relevant priority actions to help recover this species (OEH 2012). However, the following relevant activities have been listed to assist the species:

- Buffer habitat areas from impacts of other activities.
- Control invasions of weeds and pasture species (Golden Sun Moth).
- Protect known populations and areas of potential habitat from clearing, fragmentation or disturbance.
- Retain habitat connectivity between populations of Golden Sun Moth.

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.

The proposal may increase the impact of the following key threatening processes relevant to the species assessed herein:

- Clearing of native vegetation.

The clearing of potential habitat, especially Box Gum Woodland habitat will lead to direct habitat loss for this species, however, the majority of this is in historically cleared and fragmented areas that have been highly degraded through long-term grazing practices. The proposal commits to offsetting all impact to Box Gum Woodland which is likely to have a positive effect on this species given the offset site will require management and therefore halt the current impacts associated with grazing in the project area that continue to degrade the habitat of this species.

- Invasion of native vegetation by exotic perennial grass

The invasion of native vegetation by exotic perennial grass is a further Key Threatening Process relevant to this proposal. The White Box - Yellow Box –Blakely's Red Gum Woodland EEC in particular is vulnerable to the introduction and spread of perennial grasses such as African Love Grass, Serrated Tussock, Phalaris, Cocksfoot, Yorkshire Fog, and Paspalum. Recommendations for correct vehicle hygiene are prescribed and the proposal is not considered to significantly increase the impact of this Key Threatening Process.

C.2 COMMONWEALTH

The following species listed under the EPBC Act are assessed in accordance with *EPBC Policy Statement 1.1, Significant Impact Guidelines*:

- Box Gum Woodland CEEC
- Yass Daisy (vulnerable)
- Superb Parrot (vulnerable)
- Striped Legless Lizard (vulnerable)
- Golden Sun Moth (critically endangered)
- Regent Honeyeater (endangered)
- White-throated Needletail (migratory)

Please note, as these species have been assessed above under the TSC Act Assessment of Significance, except for the White-throated Needletail, the impacts are summarised here to prevent duplication. It is considered the same information required for this Commonwealth assessment is also detailed in the NSW assessment.

Critically Endangered Ecological Community - Box Gum Woodland CEEC

a) Will the action reduce the extent of a community?

The proposal would result in the clearing of Box Gum woodland which forms part of the CEEC. Up to 10 hectares would be permanently removed as a result of the proposal. The majority of these impacts would result from the establishment of a 45m wide easement for the 132kV overhead power line. As a precautionary approach, this assessment has considered that the worst case scenario would be the total loss of this vegetation type within the easement; however in reality the vegetation is open woodland meaning that only scattered trees would need to be cleared. The understorey would also be mostly retained excluding small areas required for footings and a maintenance track. It is considered likely that the community would maintain its existing functionality following construction. Large extents of this vegetation occur within the proposal site. Approximately 69 hectares of this community potentially occurs in the vicinity of the area to be impacted. It is likely that additional areas occur nearby that have not been surveyed in detail.

The proposal will reduce the net amount of Box Gum Woodland for the purposes of constructing infrastructure however its overall extent within the site boundary is unlikely to be effected. Large areas of the CEEC have the potential to benefit from offsetting by the proposal resulting in long term gains in terms of the biodiversity values of this community at the site. The small amount (up to 6 hectares) to be removed by the proposal is not considered to be significant when compared to the large areas (potentially 69 hectares) that will not be impacted by the development.

b) Will the action fragment or increase fragmentation of the community, for example by clearing vegetation for roads or transmission lines?

The Box Gum Woodland CEEC community within the proposal site boundary has already been highly fragmented due to past clearing and agricultural practices. It is however, generally continuous within the existing paddock boundaries where it presently occurs. Permanent clearing will be limited to the removal of scattered trees and high diversity ground cover for the purposes of constructing access roads and turbine footings. This will result in localised fragmentation of the community. Fragmentation will not be increased at the broader scale across the proposal site.

c) Will the action adversely affect habitat critical to the survival of an ecological community which consists of, or includes, fauna species?

The proposal will permanently remove up to 10 hectares of predominately ground cover vegetation associated with the CEEC. Considering the large extents of similar habitat within the proposal site (potentially 69 hectares) the relatively small amount to be removed is not considered critical to the survival of the CEEC.

Assessments of significance have been carried out separately for fauna species with potential for significant impact, including species that are associated with this ecological community such as Superb Parrot.

d) Will the action modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for the community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns?

Soils and nutrient balance in parts of the subject site are already highly disturbed due to grazing and clearing impacts which have been widespread, insidious and long-term in nature. The proposal would have a short term gross impact upon soils and possibly surface water flow, within discreet areas. These impacts are manageable with the implementation of erosion and sediment controls and would be unlikely to further degrade the project area.

Transmission lines associated with the proposal are intended to be sub-surface adjacent to areas disturbed for the construction of internal roads. Roads will potentially cross a number of drainage lines including those within CEEC areas. The construction of roads may cause minor alterations to drainage patterns due to localised reduction in infiltration and runoff. However, the actions associated with the proposal are not considered likely to substantially alter hydrological patterns necessary for the community's survival.

e) Will the action cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting?

The development is unlikely to cause a substantial change in species composition in areas of CEEC, including through clearing, harvesting, disease infection, weed invasion or alteration to grazing, burning or flooding regimes. Management associated with offsetting has the potential to have a net gain in increasing the diversity of functionally important species within more extensive areas of the CEEC within the proposal site.

f) Will the action cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: - assisting invasive species, that are harmful to the listed ecological community, to become established; and - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community?

The construction phase of the proposal has the potential to introduce or assist the spread of invasive weed species. The invasion of native vegetation by exotic perennial grasses is a particular risk for the CEEC. These risks could be reduced to acceptable levels through weed hygiene protocols, pre and post works weed control, soil erosion and sedimentation control, effective and timely site rehabilitation and the avoidance of fertiliser use in areas within and adjacent to the CEEC.

Chemical pollution risks could be reduced using chemical spill kits, site sediment control structures and permanent bunding of the turbine sites. With controls in place, the works are not expected to result in significant impacts from weeds or pollutants.

g) Will the action interfere with the recovery of an ecological community?

The proposal is unlikely to interfere with the recovery of the CEEC and with the implementation of a suitable offset plan is likely to assist with the recovery of the broader extent of the community within the proposal site.

Conclusion

The proposal would result in the permanent removal of up to 10 hectares of the Box-Gum Woodland CEEC causing a localised reduction in the occurrence of this community. The majority of this impact would result from the establishment of a 45m wide easement for the 132kV overhead power line and as a precautionary approach, this assessment has considered that the worst case scenario would be the total loss of this vegetation type within the easement however, in reality, the actual impact is likely to be considerably less.The proposal will not impact on the broader extent of the CEEC within the proposal site. Localised disturbance to hydrological patterns that support the EEC may result from the proposal but are unlikely to be substantial. The risks associated with the ingress of invasive species and disease and potential impacts from chemicals and fertilizers are considered to be acceptable if the recommendations included within Section 8 of this report are adhered to.

Offsetting is recommended by this report to maintain and improve the biodiversity values associated with the CEEC within the proposal site. Large areas potentially exist within the site boundary that if properly managed can assist with the recovery of this community, arresting existing threats and managing the land for biodiversity outcomes.

With the implementation of the controls and recommendations of this report the proposal is considered unlikely to have a significant impact on the Box-Gum Woodland CEEC and would result in a net positive gain.

Critically Endangered and Endangered Species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

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

What is a population of a species?

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- **a geographically distinct regional population, or collection of local populations, or**
- **a population, or collection of local populations, that occurs within a particular bioregion.**

Golden Sun Moth

The Golden Sun Moth was observed at seven of the ten sites surveyed and approximately 200 moths were observed in total across the project area. In particular, the southern section of the site appears to support larger numbers of Golden Sun Moth, as well as the area surveyed east of RYP_72. Potential habitat was recorded to extend beyond the areas likely to be disturbed at most sites where Golden Sun Moths were observed.

However, as the species was detected on site in variable quality habitats it is likely it could occur elsewhere not assessed during the November 2013 survey. Therefore, as a precautionary measure, the habitat in which the species was located and all contiguous habitat of similar structure and condition has been delineated as potential habitat. This includes all Box Gum Woodland, derived grassland and native pasture habitats across the

project area. The current total impact to these habitat types for this species is 66 ha. Of these habitat types, 5887 ha is available within the project area.

Recommendations have been made for this species to further preconstruction surveys of the final infrastructure layout in accordance with the relevant survey guidelines (Significant Impact Guidelines for the critically endangered Golden Sun Moth *Synemon plana;* DEWHA 2009) for this species. The results of these surveys would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible. The management protocols for this species would be documented within a management plan, to be implemented as part of the construction process. Offsetting for this species is considered achievable given 5887 ha of potential habitat is available within the project area.

The most likely impact to this species will occur from overhead transmission lines which are generally limited to discrete impact from pole footings, a relatively large number of moths were observed across the project area (> 200), and the species is expected to be more widespread in other areas of the project area and broader locality, the action proposed is therefore unlikely to long-term decrease in the size of population or fragment a population.

Weed invasion could be harmful to the Golden Sun Moth. Measures have been developed to minimise the spread of weeds in the impact footprint including noxious weed control before works commence, wash down of vehicles and machinery prior to site entry *and* prior to CEEC entry, ongoing weed monitoring and control after completion of construction works. There are no known diseases associated with human impacts that may cause the Golden Sun Moth to decline.

Regent Honeyeater

The species was not recorded during surveys, but records of Regent Honeyeater are present within the locality and the species is known to utilise box-ironbark eucalypt associations. As this species is nomadic and movement patterns are often linked to availability of resources, it can be assumed that they may travel through the project site to other foraging grounds. The project area is not considered a known or important foraging ground for this species given it was not detected during surveys, but there is potential for this species to be impacted from collision with turbines when it migrates.

Records across NSW indicate a strong presence of this species to the south, east and north-east of the project site in better quality habitat (i.e. National Parks) and could be considered an important landscape connection. This area traverses Namadgi NP, Morton NP, Nattai NP and Blue Mountains NP. It is expected the movement of this species would commonly occur through this connection where better quality foraging resources exist. On this basis, the proposal is not expected to significantly impact this species from collision risk. The fact the Regent Honeyeater was not observed during substantial bird survey indicates the species does not regularly forage or move through the project area. The action proposed is therefore unlikely to long-term decrease in the size of population or fragment a population. No invasive species are known to be harmful to the Regent Honeyeater and no diseases would occur to this species as a result of the proposal.

Vulnerable Species

<u>An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:</u>

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

- **interfere substantially with the recovery of the species.**

<u>What is an important population of a species?</u>

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

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

Yass Daisy

The proposal would result in the permanent loss of up to 12 hectares of moderate and good condition Box-Gum Woodland, which provides potential habitat for the threatened Yass Daisy. Targeted surveys were carried out in these areas and the species are considered unlikely to occur there. The majority of the total area of disturbance would involve tree clearing for a 45m wide easement for the 132kV overhead powerlines. The groundlayer habitat under the powerlines would be largely undisturbed, with the exception of small areas required for pole footings and a maintenance track.

In view of the limited extent and pattern of clearing and the low impact on groundlayer vegetation within the ETL, the works are not expected to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species are likely to decline.

As the Yass Daisy was not recorded at within project area it is not considered likely to occur there based on grazing history and survey results. The proposal would not therefore be likely to lead to a long-term decrease in the size of a population of these species and would not therefore affect areas of occupancy of these species.

Current threats to the Yass Daisy include agricultural developments, intensification of grazing regimes, invasion of weeds, road works (particularly widening or re-routing) and inappropriate mowing or slashing in cemetery sites (OEH 2011). The principal recovery actions required cover:

- Protection of known populations from changes to land use, road works, pasture modification, grazing pressures, and inappropriate mowing regimes
- Pest plant and animal control
- Marking sites and potential habitat onto maps used for farm, development and conservation planning and management
- Searching for new populations in potential habitat (OEH 2011, DSEWPC 2008).

Potential habitat within the project area has been subjected to targeted surveys, and the Yass Daisy is not considered likely to occur there. The proposal is not expected to affect the recovery of the Yass Daisy or exacerbate existing threatening processes.

Superb Parrot

Superb Parrots are commonly recorded to the west of the project area, especially along Rye Park Road, and are likely to utilise habitat outside or adjacent the western boundary of the project area within open grassland or Box Gum Woodland, except for a discrete area in the southern end of the project area where parrots were commonly recorded. Superb Parrots are not moving across the ridges proposed for turbines and are not undertaking large-scale movements at higher elevations (i.e. at rotor-swept-area height) in this direction and risk of collision impact is low overall. Rather, movement nearby the project area consists of local movements within discrete areas where foraging habitat is available. Superb Parrots generally followed corridors of vegetation and flew below canopy height (i.e. less than 20 m). The species was recorded in higher abundance along this road than anywhere else within the project area.

The total clearance impact to potential habitat (Box Gum Woodland) is 25 ha, with 1555 ha remaining within the project area; however, the greatest impact to this species is considered to occur where the Superb Parrot was observed regularly in one area at the southern end of the project area which also supported two identified nest trees.

According to the National Recovery Plan, Box Gum Woodland on the inland slopes and tablelands is critical breeding habitat for the Superb Parrot. Therefore, critical breeding habitat occurs in the project area and would be cleared; however as all known nest sites will be avoided and clearance of hollows as well as impact to Box Gum Woodland will be offset. Given these considerations, in terms of direct habitat loss, the magnitude of impact is estimated to be low and unlikely to lead to a long-term decrease in the habitat resources and therefore the size of the population.

Given the species is primarily occupying habitat outside the project area and occurs in regularly high numbers in those areas, the species is not making large-scale movements across the ridges proposed for turbines, and impact to all known nest trees will be avoided, the proposal is not considered to adversely affect breeding of the population, fragment a population or affect habitat critical to the survival of the species. Furthermore, no known diseases would be introduced as a result of the proposal.

Striped Legless Lizard

The Striped Legless Lizard was recorded in one location the project area out of the ten surveyed, near RYP_27. Given the targeted tile check surveys sampled areas of potential habitat for this species, it is assumed the lizard could occur in other locations of the project area. As a result all grassland habitat in all conditions (i.e. poor to good quality) have been assumed as potential habitat for this species. Under this assumption, the proposal would affect 66 ha of habitat, with 5887 ha remaining within the project area.

Recommendations have been made for this species to undertake microhabitat survey of the site (referencing habitat attributes where the species was located) prior to the end of February 2014 to determine the extent of similar habitat within the project area and quantify the extent of clearance impact. These survey results would be used to minimise impacts and ensure offsetting requirements, where avoidance is not possible. Offsetting for this species is considered achievable given 5887 ha of potential habitat is available within the project area.

As the species was not located at the other nine tile sites, the overall impact to this species is not expected to be significant especially when considering the amount of available habitat remaining within the project area. Furthermore, the ability to offset the impact will ensure the species is conserved in the locality. In light of this, the proposal is unlikely to have an adverse effect on an important population of the Striped Legless Lizard or fragment an important population, however further survey work is required to confirm the assumptions of this assessment.

Weed invasion could be harmful to the Striped Legless Lizard. Measures have been developed to minimise the spread of weeds in the impact footprint including noxious weed control before works commence, wash down of vehicles and machinery prior to site entry *and* prior to Box Gum Woodland entry, ongoing weed monitoring and control after completion of construction works. There are no known diseases associated with human impacts that may cause the Striped Legless Lizard to decline.

Migratory Species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

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

What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

- **habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or**

- **habitat that is of critical importance to the species at particular life-cycle stages, and/or**
- **habitat utilised by a migratory species which is at the limit of the species range, and/or**
- **habitat within an area where the species is declining.**

White-throated Needletail

White-throated Needletail was not recorded during surveys, but based on records in the Atlas of Living Australia there is potential for the species to occur. The species is a seasonal migrant present in Australia outside of breeding season, and may occur in large flocks foraging aerially at heights of up to 1000 metres above the ground (SEWPAC 2012). As the species breeds overseas, the potential for impact would be upon migration resulting in potential collision risk during the operational phase of the wind farm. It appears to collide with wind turbines in some areas and the species has been affected at other wind farms around eastern Australia, with one Bird Monitoring Report recording that "no other non-raptor species had more than four mortality events over the 3 year period" (Roaring 40s Renewable Energy 2010).

The locations of turbines could coincide with areas utilised by White-throated Needletails when moving through the landscape or during aerial foraging, such as ridges with prominent updraughts. However, the species also forages along storm and wind fronts at heights of greater than 1000 metres above ground. Therefore, as a proportion of foraging habitat the turbines would not substantially modify the area of important habitat in the project area for the White-throated Needletail.

Although the species' total population is unknown, it is reported as being widespread and abundant in areas where it is found (SEWPAC 2012). Given the species does not breed in Australia and it has a huge area of occupancy and is widespread, the Rye Park wind farm is unlikely to affect an ecologically significant proportion of the population. The action proposed is therefore unlikely to long-term decrease in the size of population or fragment a population.

No invasive species are known to be harmful to the White-throated Needletail.

APPENDIX D SITE PHOTOS

Typical rocky habitat (grassed pasture, embedded rock)

Typical forest / woodland

Typical dry forest / paddock edge

Typical dry forest (moderate condition)

Typical dry forest with litter and loose rocks (moderate condition)

Typical young regrowth forest (low-moderate condition)

Typical dry forest (moderate-good condition)

Good quality roadside vegetation

Typical moderate quality pasture with scattered trees

Typical low-moderate quality grassland (pasture)

Typical shrubland in disturbed areas

Unusual large rocky features

Typical large embedded rocky outcrop

Typical low quality grassland with sparse scattered surface rocks

APPENDIX E MAPS

E.1 PROPOSED TURBINE AND INFRASTRUCTURE LAYOUT

E.2 FLORA SURVEY EFFORT AND RESULTS

E.3 FAUNA SURVEY EFFORT, RESULTS AND IMPACT

E.4 CONSTRAINT MAPS

APPENDIX F OFFSET OUTLINE

F.1 INTRODUCTION

The objective of offsetting is to ensure that an overall 'maintain or improve' outcome is met for the project; where impacts cannot be avoided, or sufficiently minimised, the residual impact will be offset in perpetuity.

The biodiversity offset principles developed by the former DECCW (now DOE) would guide the selection and management of the offset site, namely:

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

The proponent commits to the preparation of an Offset Strategy, developed with input from OEH and the CMA and finalised prior to any construction impacts.

Further, the proponent commits to the preparation of an Offset Plan, developed with input from OEH and the CMA prior to operation, demonstrating the suitability of the final offset site and providing detailed management actions specific to the site.

An Offset Strategy outline is provided below, to provide certainty around:

1. How offsets will be identified
2. How offsets will be managed
3. How offsets will be secured

These issues are outlined below.

F.1.1 Background

The DGRs for this proposal require that an Offset Package be developed where the proposal cannot adequately avoid or mitigate impacts on biodiversity. While measures have been taken to minimise impacts (refer to mitigation strategies set out in Section 8 of the main report), residual impacts remain and therefore an Offset Package is considered to be required.

The following commitments are made by the proponent to address this requirement:

1. **The proponent commits to the preparation of an <u>Offset Strategy,</u> developed with input from OEH and the CMA and finalised prior to any construction impacts.**
2. **Further, the proponent commits to the preparation of an <u>Offset Plan</u>, developed with input from OEH and the CMA prior to operation, demonstrating the suitability of the final offset site and providing detailed management actions specific to the site.**

The wording of the above commitments ensures that prior to any impact, the offset site, the offset ratios, the management measures in place and the means to secure the site have been developed with input from OEH and the CMA.

The strategy proposed in this document is based on similar strategies undertaken in consultation with OEH for renewable energy projects in NSW.

F.1.2 Scope and aim of this Draft Offset Strategy

The key aim of the provision of this information is to demonstrate, prior to project approval that the offsets required can be achieved and will be acceptable to the impact proposed. Furthermore, it sets out a clear pathway to implementation of the offsets, to provide certainty regarding the outcomes for all parties involved.

Offsets for the Rye Park wind farm project would:

• Be supported by a suitable metric.	*Standardised survey techniques used.*
• Addresses the Department's *'Principles for Biodiversity Offsets in NSW'.*	*These are addressed below.*
• Ensure that offset sites are located remote from the influence of wind turbines (and any habitat modification that could be expected in nearby habitat).	*Location criteria are included in the offset guidelines.*
• Be governed by conservation mechanisms to ensure long-term protection and management of the site, including funding arrangements.	*One Conservation Property Vegetation Plan (CPVP) proposed for each private property offset site.*
• Include a management plan to ensure management measures are appropriate.	*Guidance on development of appropriate management measures is provided below.*
• Be able to be demonstrated prior to the impact occurring (including precise quantification of impact vs offset lands and their locations).	*Commitment to upfront ratios put a limit on clearing allowed. Commitment to validate actual clearing and ensure this is offset is provided.*
• Be able to ensure a maintain or improve outcome.	*Ratios proposed are in line with guidance documents and consultants experience, as set out below.*

Specific to key components of this outline, it is noted that:

In advance of project approval, allowances have to be made for changes in the infrastructure layout. The movement of infrastructure within the development envelope is termed 'micro-siting'. Limits are placed on micro-siting by the draft standard conditions for wind farms developed by the NSW Department of Planning and Infrastructure (a location allowance of 100 metres radius for development components as long as impacts remain consistent with that assessed - http://www.planning.nsw.gov.au/standard-and-model-conditions). These changes may also affect the landowners involved in the project and therefore the ability to use suitable areas of their property in the Offset Package. In response to this issue, a 'criteria approach' has been adopted in the development of this offset outline. The criteria and methods set out

below are intended to guide the finalisation of the Offset Package whilst allowing the project the flexibility it requires to be developed.

While a Biobanking offset methodology is not proposed, the *Part 3A Transitional Project Biobanking Guidance for Offset Ratios* has been referenced where relevant below.

F.2 IMPLEMENTATION OVERVIEW

The following stages of implementing the Offset Package are proposed. These stages are detailed further in the sections below.

Stage	Timing
1. Offset Strategy	Draft Strategy pre project approval (this document). Final Strategy endorsed by agencies, prior to any impact.
a. Estimation of loss of habitat required for the project.	
b. Calculation of the required offsets, using predetermined offset ratios.	
c. Consultation and endorsement of CMA and OEH to finalise the Offset Strategy.	
2. Offset Plan	Prior to any impact.
a. Selection of offset sites	
b. For each offset site:	
○ Establishment of baseline data.	
○ Documentation of key biodiversity risks, opportunities and relevant local initiatives.	
○ Refinement of management actions specific to the site (with input from the landowner), including monitoring regime and reporting requirements.	
○ Consultation and endorsement of CMA and OEH to finalise the Offset Plan (could be documented separately for each site or in one combined document).	
3. Verification of the actual area of native vegetation clearing of the constructed wind farm and transmission line.	After construction.
4. Formalisation of the offset on the title of each involved property by way of a CPVP, including the inclusion of the management plan and its required management actions and land use restrictions.	Prior to operation.

F.3 OFFSET STRATEGY

F.3.1 Estimation of loss of habitat

The Biodiversity Assessment estimates the impact area for the proposal through calculation of habitat loss on a worst case scenario. This information is contained in Section 7 of the main report and provides an upper limit on the clearing proposed for the project and therefore required to be offset. Vegetation and habitat loss is currently grossly overestimated by the inclusion of large buffers around infrastructure and

tracks. In reality clearing for tracks will be much less and some tracks are already cleared. Similarly, where infrastructure is being placed in areas of degraded grassland/pasture these areas will not require clearing.

F.3.2 Calculation of required offsets

The proponent commits to determining an offset ratio with reference to:

- The conservation status of the vegetation (EECs would be offset at a higher ratio than common vegetation types)
- The condition of the vegetation (a standard metric has been used to collect condition data and would be used to ensure vegetation in better condition is offset at a higher ratio than degraded vegetation[1])
- Habitat values (important habitat elements or verified threatened species habitat would be offset at a higher ratio)

The offset ratios are proposed to be via negotiated agreement with OEH, rather than using the Biometric Assessment Methodology. A large amount of biodiversity survey work has been undertaken onsite. The intention is to supplement rather than redo this survey work in the calculation of offset areas. Using the Biometric Assessment Methodology at this time would duplicate survey effort.

The proposed ratios below have been developed based on **ngh**environmental's experience with the Biobanking calculator in similar vegetation types as well as in negotiations with OEH for similar renewable energy projects. They are proposed as a starting point for a negotiated agreement. They have the benefit of being transparent to the proponent and the consent authority, facilitating an upfront understanding of the offset requirements for the project in advance of impacts occurring. Where multiple factors apply and their ratios are contradictory (i.e. threatened species habitat and low condition vegetation) it is proposed that the highest offset ratio would apply. Hollow-bearing tree requirements (HBT) are supplementary to area offsets. While the Biometric Assessment Methodology has the advantage of being more clear cut, we propose a negotiated agreement that is flexible to achieving an overall beneficial outcome and is better suited to the many individual sites that are likely to be included in the final offset plan.

Proposed offset ratios

Condition class	Biometric condition[3]	Vegetation NOT OF conservation significance	Vegetation OF conservation significance	Threatened species habitat	HBT removed: nest box
Poor	Low	1 : 1	1 : 2	1 : 2	1 : 1
Moderate	Moderate- Good	1 : 1	1 : 5	1 : 5	1 : 1
Good	Moderate- Good	1 : 1	1 : 10	1 : 20	1 : 1

[1] This is a five class condition categorisation, documented within the BA and able to be easily related to the Biometric two-class condition categories.

Justification of these ratios is based on the following:

- In a recent project with Dubbo OEH office, a 1:5 ratio was endorsed by OEH for all native vegetation to be impacted; that being the ratio for the Grey –Crowned Babbler, considered to be the key significant species to be impacted. The ratios above are lower than this for degraded vegetation and higher than this for vegetation in moderate to good quality, achieving a comparative offset.
- In a recent project with Queanbeyan OEH office, a 1:10 ratio was suggested by OEH for Box Gum Woodland EEC with tree cover and 1: 5 ratio for EEC derived pasture. The ratios above are lower than this for degraded vegetation and higher than this for vegetation in good quality, achieving a comparative offset.
- In a recent project with South West OEH office, a 1:1 ratio was endorsed by OEH for a common vegetation type. The offset site included better habitat values than the development site. The ratios above include 1:1 for common vegetation types and higher ratios for threatened species habitat values, achieving a comparative offset.
- In several Biobanking Assessments undertaken using the BioBanking calculator, EECs in moderate to good biometric condition have returned ratios averaging 1:6. This can be verified as required.
- The Part 3A Transitional Project Biobanking Guidance for Offset Ratios allow a Tier 2 'no net loss' option rather than an 'maintain or improve' option, whereby lesser ratios are accepted if 'maintain or improve' cannot be achieved. This pathway must consider whether feasible alternatives to the clearing exist and the value of the resource (in this case wind energy). It is considered that the location of turbines and associated infrastructure is necessarily restricted to sites with suitable wind speed and that a lesser goal of 'no net loss' may be applicable to this project.

F.4 SELECTION OF OFFSET SITES

The proponent would establish offsets within the private land holdings of the project site.

Epuron have lease agreements with all involved landholders (where infrastructure is proposed to be located). These contracts stipulate that the land may be considered for biodiversity offsets. The intention is to select offset lands from within the project boundary in areas that will not be impacted. Broad scale mapping for the site identifies that the vegetation is representative of that that would be cleared and therefore allows a like for like offset criteria to be targeted. Additional criteria that would be used to select offset sites that will together make up the Offset Package include:

- Of sufficient combined size to achieve the set ratios above (or as negotiated with OEH)
- Complying with *Principles for the use of biodiversity offsets in NSW* guidance document (refer below for explicit reference to these principles)
- Will include provisions for offsetting Commonwealth listed EEC to demonstrate compliance with the Commonwealth offset policy.
- Selected to minimize:
    - Edge area
    - Number of land holdings
- Selected to maximize:
    - Landscape connectivity
    - Preservation of declining habitat types and resources
- Located no closer than 500 m from a wind turbine (to minimise any indirect impacts of the wind farm)

Any areas of ambiguity will be clearly stated so that a decision can be made about the overall suitability of the site. For example, it may be that exact ratios and types are not achieved but the overall package is still considered to achieve an overall neutral or beneficial outcome. If so, this will be identified and justified.

While specific sites have yet to be identified, there are large amounts of land of suitable type and condition within the project boundaries to demonstrate that offsets are achievable. In principle, agreements with landholders are in place.

F.5 FOR EACH OFFSET SITE:

F.5.1 Establishment of baseline data

The following baseline data would be collected for all sites within the Offset Package:

Desktop assessment

Evaluation of potential for threatened species to occur onsite, with reference to prior field work and database searches, below:

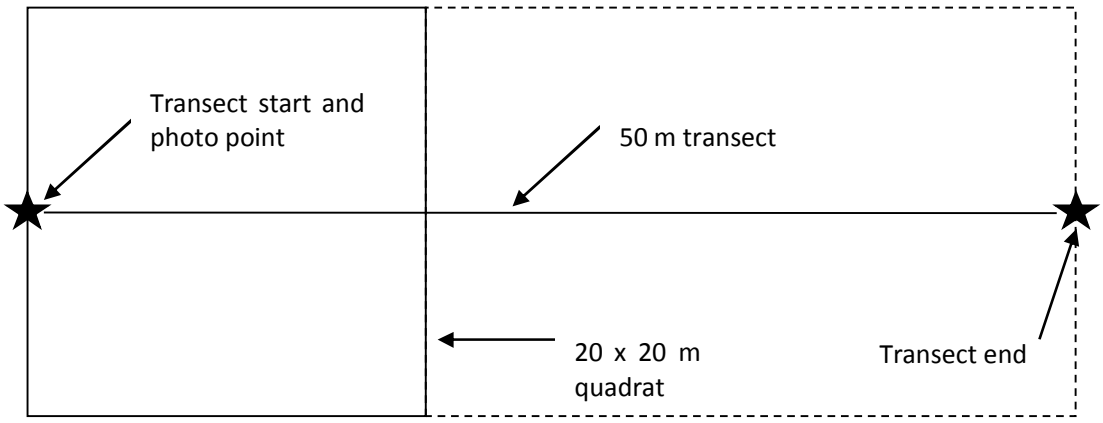
- The OEH threatened species database to identify species listed as threatened under the NSW *Threatened Species Conservation Act 1995* (TSC Act).
- The DSEWPC protected matters search tool to identify species listed as threatened or migratory under the Commonwealth *Environment Protection Biodiversity Conservation Act 1999* (EPBC Act).

Field survey

A field survey would be undertaken by an ecologist. This would include:

- Mapping of vegetation types and condition
- Establishment of monitoring plots
- Onground validation / assessment of habitats for threatened species with the potential to occur at the site

BioBanking plots would be established in accordance with the BioBanking Assessment Methodology (BBAM, DECC 2009) to collect baseline data on vegetation structure and quality. The location of the plots would be marked using 1650 mm star pickets to facilitate the replication of the plots. The ends of the star pickets would be painted white to enable easy identification in the field. Star pickets would be placed at the start and end of the 50 metre transect required by the BBAM and their co-ordinates recorded. To delineate the start point of transects, orange flagging tape would be tied to the top of the appropriate picket. The 20 x 20 metre quadrat required by the BBAM would be conducted within an area bounded by the first 20 metres of the transect and extending 10 metres either side as shown below. Photo points would be established at each of the start points of the transects, with views along the length of the transect.



Monitoring plot layout

Data evaluation

Data recorded from the BioBanking monitoring plots would be compared with the benchmark data for the vegetation type as provided in the BioBanking vegetation types benchmark database (DECC 2008). Monitoring plot data would also be entered into the BioBanking Credit Calculator (BBCC) version 2 to obtain a baseline site value score for dominant vegetation formations at each site.

F.5.2 Key biodiversity risks, opportunities and relevant local initiatives

As a background to the development of appropriate management actions for the site, key biodiversity risks, opportunities and relevant local initiatives for each site would be documented.

F.5.3 Site specific management actions

Offset site management measures are required to be specific to each area in question. These measures aim to result in an improvement in the biodiversity values of the site and are designed to be adaptive (informed by a monitoring regime). These management measures would be incorporated into a detailed management plan for each offset site (one plan per landowner).

Management measures would be developed with reference to the Biobanking Management Plan template and with input from the CMA. Examples of likely measures are included below.

Example offset site management measures

Management measure	Objective	Justification	Action	Timing
Exclusion of stock	To prevent overgrazing and encourage regeneration of native vegetation. Any exclusion fencing must take into account access to macropods to enable natural levels of grazing to continue, requirements of threatened flora species and fire regimes.	Grazing would be likely to degrade habitat.	• Install stock proof fencing around the perimeter of the Offset Site (consider access for Macropods).	• At establishment of the Offset Site. • Ongoing repairs as required.
Weed control	To minimise the occurrence of weeds within the Offset Site particularly Weeds of National Significance (WoNS) and listed noxious weeds.	Weeds compete with native species and degrade habitats.	• Survey to identify target locations for weed control. • Weed control using appropriate methodologies considering target species and landscape context.	• At establishment of the Offset Site. • Ongoing as required.
Exclusion of feral pigs	To exclude feral pigs.	Feral species can degrade habitat, compete for resources with native fauna and introduce disease.	• Install and maintain preventative fencing suitable for the target species. • Remove pigs (by trapping or other means) if detected within the Offset Site.	• At establishment of the Offset Site. • Ongoing as required.
Rabbit control	To minimise the risk of the Offset Site becoming a refuge for rabbits.	Increased rabbit numbers can reduce native regeneration and support higher numbers of pest animals such as cats and foxes. Competition and grazing by the feral European rabbit is listed as a key threatening process (KTP) under the TSC Act and EPBC Act.	• Monitor for presence of rabbits. • Conduct baiting or controlled grazing to reduce the ability of the site to act as a refuge to rabbits. • Where possible, coordinate baiting with adjacent landowners to maximise effects	• Consideration given to action on the basis of monitoring results.

Management measure	Objective	Justification	Action	Timing
Fox control	To minimize the impacts of foxes on native fauna	Numerous native species are potentially at risk of becoming threatened as a result of fox predation. Predation by the European Red Fox is listed as a KTP under the TSC Act and EPBC Act.	• Conduct fox baiting in coordination and with the assistance of LHPA and/or CMA	• March and April are considered the most effective months in which to carry out control programs when foxes are dispersing and finding new territory (LHPA) • Ongoing as required
Goat control/exclusion	To exclude goats and/or control numbers	Feral species can degrade habitat, compete for resources with native fauna and introduce disease. Competition and habitat degradation by feral goats is listed as a KTP under the TSC Act and EPBC Act.	• Install and maintain preventative fencing suitable for the target species. • Control goat numbers in coordination and with the assistance of LHPA and/or CMA	• At establishment of the Offset Site. • Ongoing as required.
Monitoring	To determine the effectiveness of management measure	Monitoring is required to determine whether current management is effective and to inform ongoing management.	• Conduct monitoring as detailed for this site. • Adapt management measures where required	• Every two years

F.5.4 Requirement to monitor the offset site

In order to ensure that biodiversity improvement is occurring within the offset sites (and therefore that a 'maintain or improve outcome' can be met over time), monitoring is required.

Monitoring is recommended to be repeated initially, every two years. As a part of monitoring surveys, a report would be prepared to document the success or otherwise of management and adaptations required to obtain better results.

Reporting is proposed every two years to the Department of Planning and Infrastructure, until such time as this is deemed acceptable to cease. The reports would also be submitted to OEH for comment.

A decision to reduce or continue reporting every two years may also be made by DPI or OEH following submission of each report. A final report should be prepared prior to decommissioning of the project, to verify that a 'maintain or improve' outcome is being met and that residual management actions can largely coincide with routine agricultural land management.

F.6 VERIFICATION OF THE ACTUAL AREA OF NATIVE VEGETATION CLEARING

Verification of the actual area of impact of the constructed wind farm and transmission line is required to be verified, prior to finalising the CPVPs. This provides an incentive throughout construction to minimise impacts and thereby reduce the offset requirement for the project. It also verifies that the actual amount and type of clearing undertaken is offset, as required.

It is expected that a detailed Flora and Fauna Management Plan would be prepared to guide construction. This would contain updated vegetation mapping specific to the final infrastructure layout (refer to note on micrositing above). Verification of the actual area of native vegetation clearing can be undertaken as an audit after construction. (Incentives to minimize clearing would be an appropriate stipulation in EPC contracts).

F.7 FORMALISATION OF INDIVIDUAL CPVPS AND FUNDING ARRANGEMENTS

Offsets would be governed by conservation mechanisms to ensure long-term protection and management of the site, including funding arrangements.

A Conservation Property Vegetation Plan (CPVP) would be implemented on each involved private land holding. The process would be driven by Epuron, with input from each landholder. The CPVP would include management actions associated with the offset area that would apply in perpetuity.

To ensure that the CPVP is binding on successors in title, an abstract of the CPVP would be registered with the Land and Property Management Authority under the *Real Property Act 1900.* The CPVP would be a legally binding agreement under both the *Native Vegetation Act 2003* and the *Threatened Species Conservation Act 1995*. The terms of the CPVP would not be affected by any changes to local or state planning rules or new listings of threatened species. A CPVP can be varied at the landholder's request, provided the variation would still improve or maintain environmental outcomes.

As the CPVP is attached to the land title, the landowner is ultimately responsible for funding the management actions required at the Offset Site and monitoring the effectiveness of their implementation.

However the Proponent would take responsibility for management and would ensure the landowner has sufficient resources and information to implement the management actions for the operational life of the project, as management of offsets would form a condition of the project's consent.

Even though a CPVP is binding in perpetuity, it is acknowledged that there is less incentive to manage the offset site after the decommissioning of the wind farm. Therefore, it is proposed that the bulk of the management actions be focused in the early years of the project. Monitoring and reporting, as outlined above, would demonstrate whether this is being satisfactorily achieved and allow a point for the consent authority to intervene.

F.8 MAINTAIN OR IMPROVE

With the effective implementation of the stages outlined above, a 'maintain or improve' outcome would be achieved for the project. By the coordinated selection of offset sites over such a large area, and their management for biodiversity improvement, a regional scale beneficial biodiversity impact is anticipated. Benefits are expected to include:

- Incentive to minimize clearing during the detailed design and construction phases of the wind farm project
- Targeted and coordinated weed and feral animal management, informed by ecologists working with landowners
- Retention of declining habitat resources including hollows, fallen timber and logs, riparian habitats
- Protection of specific habitat linkages and wildlife corridors
- Improved infrastructure to assist management including fencing and access

F.9 'PRINCIPLES FOR BIODIVERSITY OFFSETS IN NSW'.

The biodiversity offset principles developed by the former DECCW (now OEH) would guide the selection and management of the offset site, namely:

Impacts must be avoided first by using prevention and mitigation measures.	*The BA sets out mitigation measure to minimse impacts. The aim of the offset package is to ensure that where impacts cannot be avoided, or sufficiently minimised, the residual impact would be offset in perpetuity.*
All regulatory requirements must be met.	*Offset land is required as part of the approval conditions for the project. The proposed offsets would not be used to satisfy approvals or assessments under other legislation.*
Offsets must never reward ongoing poor performance.	*Monitoring would be required as part of the implementation of management actions for the offset site.*
Offsets will complement other government programs.	*The Offset Package would be finalised in consultation with OEH and the CMA, allowing any local programs or initiatives to be considered and included.*
Offsets must be underpinned by sound ecological principles.	*Selection criteria have been developed to ensure the location of offset sites is appropriate. Management measures have been outlined by an ecologist. Specific management plans would accompany each CPVP,*

	developed in consultation with the CMA and the proponent.
Offsets should aim to result in a net improvement in biodiversity over time.	*Management actions would be developed specific to each offset site (one per private property).*
Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs.	*Native vegetation clearing impacts are deemed permanent and therefore the offset sites would be preserved and managed in perpetuity.*
Offsets should be agreed prior to the impact occurring.	*The offset criteria set out in this document form part of the proposal. If approved, the commitment is carried over as a condition of consent. The commitment includes consultation with OEH and the CMA to ensure the final offset package is acceptable, prior to construction impacts.*
Offsets must be quantifiable - the impacts and benefits must be reliably estimated.	*An estimation of impact has been provided based on GIS mapping. Criteria have been proposed that provide clear quantification of offsets, based on the actual area cleared.*
Offsets must be targeted.	*Refer to selection criteria.*
Offsets must be located appropriately.	*Refer to selection criteria.*
Offsets must be supplementary.	*Offsets would be comprised of private land not currently under any form of biodiversity conservation protection. In this way the land would be additional to government reserves and programs. Refer to selection criteria.*
Offsets and their actions must be enforceable through development consent conditions, licence conditions, conservation agreements or a contract.	*A CPVP would be attached to the title of the offset land (one per landowner). To ensure that the CPVP is binding on successors in title, an abstract of the CPVP would be registered with the Land and Property Management Authority under the Real Property Act 1900. The CPVP would be a legally binding agreement under both the Native Vegetation Act 2003 and the Threatened Species Conservation Act 1995. The terms of the CPVP would not be affected by any changes to local or state planning rules or new listings of threatened species. A CPVP can be varied at the landholder's request, provided the variation would still improve or maintain environmental outcomes.*

APPENDIX G TEAM QUALIFICATIONS AND EXPERIENCE

Role, staff member	Pencil portrait
Authors	
Lead author Senior ecologist (fauna) **Bianca Heinze**	Bianca holds a bachelor degree in applied science and specialises in biodiversity assessment, particularly fauna surveys and habitat assessment. She has experience as Lead Zoologist in small and large scale projects. Bianca has been involved in fauna survey, assessment and fauna management planning for four years, including 15 wind farms in NSW and South Australia. Bianca has been involved in surveys for marine and terrestrial mammals, birds, amphibians, reptiles and microbats, including targeted species surveys such as Powerful Owl *Ninox strenua*. Bianca also has training and experience in Anabat microbat echolocation call analysis. Bianca brought with her a range of experience in the public and private sectors upon joining nghenvironmental in 2008. In addition to fauna survey, her field experience includes remote area fire fighting, park and state forest maintenance works, fuel load assessment, habitat assessment and water quality sampling. Other experience includes design and implementation of community engagement and education projects.
Co-author Ecologist (botany) **Dave Maynard**	Dave holds qualifications in science and engineering. He completed his Honours in plant systematics in conjunction with UNSW and the Botanic Gardens Trust, Sydney in 2004. Dave specialises in biodiversity assessment, particularly field based flora surveys and vegetation community mapping. He has experience as Lead Botanist in small and large scale projects for vegetation community mapping including identification and demarcation of endangered ecological communities. He has also led targeted threatened species surveys, such as Leafless Tongue Orchid *Cryptostylis hunteriana*. Prior to joining nghenvironmental, Dave held positions in government and private institutions including Botanist with the Department of Natural Resource, Environment and the Arts (NT) and Regional Manager, Horticulture with Department of Primary Industry, Fisheries and Mines (NT).
Validation Review Senior Ecologist **Deb Frazer**	Deb holds a bachelor degree in Applied Science (Biodiversity Management) and an honours degree. Deb has over 9 years' experience as an Ecologist and within biodiversity assessment, including several wind farm assessment. Deb's positions have included management and senior roles, as well as educational and research assistant positions (Bandicoot Recovery Program in SA). Deb has experience in impact assessment and fauna survey projects throughout southern NSW and South Australia. Deb has broad knowledge and demonstrated skills in environmental management; coordinating and delivering environmental programs / plans; assessment of development proposals; preparation of biodiversity and management plans and monitoring programs. She is particularly skilled in the design and execution of fauna field programs, especially monitoring programs which she has implemented in central SA.
Field team (botany)	
Ecologist **Jackie Miles**	Jackie holds bachelor degree in Zoology and has since gone on to specialise in botany. Jackie has worked on a number of large scale assessments involving botanical surveys for vegetation mapping and targeted species searches. Past projects include Comprehensive Region Assessment (CRA) full floristics surveys,

Role, staff member	Pencil portrait
	field validation for NPWS Vegetation Map for South East Forests, vegetation mapping for all NSW ski resort areas and surveys of significant remnant grassy vegetation in the Bega Valley. Jackie has co-authored a number of papers and factsheets on threatened species and ecological communities, regularly contributes information to the NSW Scientific Committee and has provided training for Council planning and works staff on conservation significant remnant vegetation. Jackie also has extensive experience in fauna surveys, including fauna surveys across the alpine region for the CRA. Jackie's expertise extends throughout south-eastern NSW.
Ecologist **Paul McPherson**	Paul holds a degree in Natural Resource Management. He has undertaken flora surveys and environmental assessments for a wide range of projects located in south coast and NSW alpine regions. Paul has lead full floristics flora surveys for a range of projects and was involved in the broadscale mapping of the vegetation of the Far South Coast region. He has authored a number of leaflet flora guides including for rainforests in south-east NSW, alpine wildflowers and coastal saltmarsh communities. Prior to joining nghenvironmental in 1996, Paul worked with the Commonwealth environment department and co-drafted the Commonwealth policy papers on the Regional Forest Agreement process and forest reserve criteria.
Ecologist **Chris Weston**	Chris holds a Bachelor of Science (Horticulture) and is currently completing an Honours project. Chris specialises in biodiversity assessment and has developed considerable knowledge of landscape and vegetation communities of inland NSW, particularly in riverine environments, south-western slopes and plains and semi-arid environments. Chris has strong interests in Botany providing teaching assistance for lectures in Botany and Plant Taxonomy at Charles Sturt University and has over 3 years experience working in Environmental Horticulture and Viticulture Research. Prior to joining **ngh**environmental Chris was working on research projects determining fire tolerance and adaptation of species within the Myrtaceae family.
Field team (fauna)	
Senior ecologist **Freya Gordon**	Freya holds a bachelor degree in environmental science and is a Senior Zoologist in our Sydney office. She has worked for the past 10 years for the Institute of Wildlife Research, The University of Sydney, designing, managing and implementing survey programs for a range of fauna species. She has conducted shorebird monitoring for Birds Australia, wildlife monitoring for Sydney Airport Corporation Limited, and managed large scale field programs in the Simpson Desert for the University of Sydney Desert Ecology Research Group.
Ecologist **Kate Carroll**	Kate holds a bachelor degree in environmental science and has a range of experience in environmental assessment and management including biodiversity assessments and Part 3A assessments. She has undertaken a variety of field surveys and assessments in the Sydney and NSW tablelands region. Kate has an ecological background with a strong focus on fauna. She has studied vertebrate biology and taxonomy. Her extensive field experience includes work with terrestrial and marine wildlife including bird watching, small mammal surveys, bat surveys, invertebrate sampling and fish surveys.
Ecologist **Bryson Lashbrook**	Bryson holds a bachelor degree in environmental science and has extensive experience in both environmental and agricultural consulting. Bryson specialises in biodiversity assessment with a focus on fauna issues. Bryson's experience with fauna includes as an assistant to the Johnstone Centre and the Institute for Land Water and Society, both at Charles Sturt University, in a number of ecology based research projects where he performed targeted reptile, mammal and bird surveys.

Role, staff member	Pencil portrait
	This includes targeted surveys in remote areas. Bryson is also highly skilled and experienced in spotlighting, bird monitoring, Elliot trapping and both harp and mist netting which he undertakes in his role with **ngh**environmental. Prior to joining **ngh**environmental in 2010, Bryson was involved with the International Centre of Water for Food Security, Environmental & Agriculture Systems, geotechnical and agricultural soil sampling, ground water and surface water monitoring, weather station supply, installation and weather station servicing and the service and repair of GPS devices and remote sensors.
Ecologist **Amy Evans**	Amy has over seven years' experience working in the environmental industry, with a focus on biodiversity assessment and approvals within NSW. Amy completed a double degree in BAppSc in Parks, Recreation and Heritage/Ecotourism, majoring in Wildlife Ecology and management in 2006. In 2010, Amy went on to complete a Grad Cert in Ornithology. Amy has experience in Review of Environmental Factors (REF's), 7 Part Tests, Environmental Impact Assessments (EIA), Flora and Fauna surveys and assessments, Anabat analysis and threatened species habitat assessments. Amy was recently seconded to the Roads and Maritime Services for three years, where she assisted in managing the implementation of the biodiversity commitments for the Hume Highway Upgrade project for NSW RMS. Prior to joining **ngh**environmental, Amy was a Ranger for the NSW National Parks and Wildlife Service. She was based at Forbes, Bathurst and the Pilliga regions for 18 months.
Ecologist **Nathaniel O'Rourke**	Nathaniel is an environmental professional with several years' professional experience. He has a bachelor degree in Environmental Science and is undertaking postgraduate studies in GIS. Nathaniel has particular interests in environmental management, grassland ecology, amphibian/reptile ecology and GIS. Nathaniel has been involved in numerous flora and fauna assessments including numerous targeted threatened reptile surveys within the ACT and surrounding region; which included wind farm and solar farm projects. He has demonstrated experience identifying and handling threatened reptiles found in this region.
Ecologist **Alana Gordijn**	Alana holds a bachelor degree in science (earth & environmental science), and has several years' experience working as an environmental professional. She has experience working on a numerous environmental planning and management projects for a range of public and private sector clients across southern NSW and the ACT. Her primary areas of practice are ecological surveying and environmental impact assessment and her most recent projects have involved renewable energy developments. She has prepared the flora and fauna sub-plan for the proposed Silverton Wind Farm and has also developed skills in the construction sector through undertaking environmental site inspections for civil contractors involved with the Gullen Range Wind Farm.
Ecologist (Fauna) **George Madani (sub-contractor)**	George Madani is a freelance wildlife ecologist and has an extensive background in wildlife ecology with ten years of field survey skills and practical research and applied management experience. He has conducted fauna surveys and field studies across various regions and habitats in Australia. His work has taken him into remote areas as the Kimberley, Cape York, Simpson and Strzlecki Deserts as well across a range of temperate sclerophyll woodlands and rainforests along the East Coast and inland into the WA Goldfields, Victorian Mallee Country and rangelands of Western NSW. He has comprehensive knowledge of and experience with the identification, distribution, habitat and ecology of terrestrial vertebrate fauna, especially reptiles, amphibians and avifauna. George has a Masters in Wildlife Health and Population Management from the University of Sydney. He has

Role, staff member	Pencil portrait
	worked with various State and Federal Government departments, universities, environmental consultancies and NGO's on projects ranging from wildlife monitoring, baseline inventory surveys to impact based assessments.
Ecologist **Rena Gaborov (sub-contractor)**	Rena holds a Bachelor of Arts (Geography) and a Master of Natural Resources. Rena has been working as a field ecologist with Wildlife Unlimited since 2008 while she concurrently completed a Master in Natural Resources. She has been involved with a number of management and conservation projects as part of her work with Wildlife Unlimited as well as with government, university and community groups. She has also led a number of projects. Her masters research involved a mark recapture population study on the threatened long-nosed potoroo and its reactions to fragmentation. Rena also coordinated a baseline vertebrate fauna survey of Palm Island, Northeast Queensland in 2009.
Ecologist **Rohan Bilney (sub-contractor)**	Rohan has over 10 years' experience in field ecology and holds a Bachelor of Environmental Science (Honours), and a PhD. His research for both Honours and PhD focused on the ecology of Sooty Owls and Powerful Owls and small mammal decline following European settlement in East Gippsland, Victoria. Through this research Rohan has become familiar with a diverse range of habitat types and regions throughout much of East Gippsland, having significant experience in remote and isolated fieldwork in both nocturnal and diurnal situations. Through a combination of his own research, recreational interest and numerous volunteer activities Rohan has trapped and handled most 'trappable' terrestrial small mammal species from forested ecosystems in south-eastern Australia, while also being familiar with all bird species. Rohan has a wide range of experience in wildlife surveys, primarily for birds and mammals in forested ecosystems in south-eastern Australia. Rohan has authored several published peer-reviewed scientific papers (including international journals) on a range of ecological aspects and individual species, particularly specializing in large forest owl ecology, small mammals and their decline, rainforest and deer. He also regularly presents talks at scientific conferences and to interest groups.
Ecologist **Kris Nash (Golden Sun Moth Survey)**	Kris Nash has been an environmental planner and ecologist since 2007, having previously worked in the field of education. She holds a bachelor degree in Education (Secondary) and a diploma in Environmental Science. Kris has worked for community groups, private consultancy firms and the ACT Government and has undertaken a broad range of ecological surveys and impact assessments for urban developments, extraction industries, industrial developments, ski field developments, roads and infrastructure projects. She has been involved in the implementation of monitoring programs for threatened fauna and native vegetation, and in collecting data for the management of kangaroos in ACT Nature Parks. Kris is an experienced field ecologist with particular expertise on the flora and fauna of box - gum woodlands and natural temperate grasslands, including Golden Sun Moth.
Senior review	
Field technician / Senior review **Brooke Marshall (CEnvP)**	Brooke has an honours degree in Natural Resources from the University of New England (UNE) where she specialised in wildlife management and ecosystem rehabilitation. Since joining nghenvironmental, Brooke has undertaken environmental impact assessment, biodiversity survey and assessment, environmental management documentation and community consultation. Brooke

Role, staff member	Pencil portrait
	has worked on large scale infrastructure projects and project managed the input of specialists, as required. She is a specialist in wind farm assessment. Brooke is an accredited Biobanking Assessor and Certified Environmental Practitioner.

APPENDIX H DEPARTMENT OF PLANNING AND INFRASTRUCTURE DIRECTOR GENERAL REQUIREMENTS

NSW GOVERNMENT | Planning

Contact: Neville Osborne
Phone: (02) 9228 6337
Fax: (02) 9228 6355
Email: neville.osborne@planning.nsw.gov.au

Our ref.: 10/23654

Mr Andrew Durran
Executive Director
Epuron Pty Ltd
Level 11
75 Miller Street
North Sydney NSW 2060

Dear Mr Durran

Subject: Director-General's Requirements for Rye Park Wind Farm (MP 10_0223)

The Department has received your application for the above project.

I have attached a copy of the Director-General's Requirements (DGRs) for the preparation of an Environmental Assessment for the project. These requirements have been prepared in consultation with relevant government authorities. I have attached a copy of the government authorities' comments for your information. I have also enclosed a list of relevant guidelines that you may wish to refer to during the preparation of the Environmental Assessment.

The DGRs have been prepared based on the information you have provided to date. Please note that under section 75F(3) of the *Environmental Planning and Assessment Act 1979*, the Director-General may alter these requirements at any time. If you do not submit an Environmental Assessment for the project within two years, the DGRs will expire.

Prior to exhibiting the Environmental Assessment that you submit for the project, the Department will review the document to determine if it adequately addresses the DGRs. The Department may consult with other relevant government authorities in making this decision. Please provide 4 hard copies and 5 CD copies of the Environmental Assessment to assist this review.

If the Director-General considers that the Environmental Assessment does not adequately address the DGRs, the Director-General may require you to revise the Environmental Assessment. Once the Director-General is satisfied that the DGRs have been adequately addressed, the Environmental Assessment will be made publicly available for at least 30 days.

If your project is likely to have a significant impact on matters of National Environmental Significance, it will require an approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This approval would be in addition to any approvals required under NSW legislation and it is your responsibility to contact the Department of Sustainability, Environment, Water, Population and Communities to determine if an approval under the EPBC Act is required for your project (http://www.environment.gov.au or 6274 1111).

Your contact officer for this proposal, Neville Osborne, can be contacted on the above contact details. Please mark all correspondence regarding the proposal to the attention of the contact officer.

Yours sincerely

14/2/11

Daniel Keary
Director, Infrastructure Projects
as delegate of the Director-General

case and representative noise/ vibration impacts;

→ in relation to wind turbine operation, determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power), including impacts under meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg effect for wind turbines). The probability of such occurrences must be quantified;

→ include monitoring to ensure that there is adequate wind speed/profile data and ambient background noise data that is representative for all sensitive receptors;

→ provide justification for the nominated average background noise level used in the assessment process, considering any significant difference between daytime and night time background noise levels at background noise levels higher than 30 dB(A);

→ identify any risks with respect to tonal, low frequency or infra-noise;

→ clearly outline the noise mitigation, monitoring and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been incorporated;

→ if any noise agreements with residents are proposed for areas where noise criteria cannot be met, provide sufficient information to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements; and

→ include a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and/or noise agreements with landowners not eventuate.

The assessment must be undertaken consistent with the following guidelines:

→ Wind Turbines - the South Australian Environment Protection Authority's *Wind Farms - Environmental Noise Guidelines* (2003);

→ Substation – *NSW Industrial Noise Policy* (EPA, 2000);

→ Site Establishment and Construction – *Interim Construction Noise Guidelines* (DECC, 2009);

→ Traffic Noise – *Environmental Criteria for Road Traffic Noise* (NSW EPA, 1999); and

→ Vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006).

- **Ecological Impacts** – the EA must include an ecological assessment considering terrestrial and aquatic ecosystems (as relevant), including groundwater dependent ecosystems, consistent with *Guidelines for Threatened Species Assessment* (DEC, 2005); The EA must:

  → identify threatened species, populations and communities listed under both State and Commonwealth legislation that have the potential to occur on site. In particular, the following must be addressed: box woodland, table basalt forest and natural temperature grassland communities, and crimson spider orchid, silky swainson-pea, Yass daisy, hoary sunray, small woodland birds, superb, turquoise & swift parrots, barking owl & powerful owl, raptors, squirrel glider, koala, spotted tailed quoll, bats and golden sun moth;

  → map existing vegetation by vegetation/ community type and include details on existing site conditions, including whether the vegetation comprises a highly modified or over-cleared landscape and the types and quality of habitat resources available. Vegetation mapping should consider any Environmentally Sensitive Area Mapping held by Boorowa Shire Council, Yass Valley Shire and the Upper Lachlan Shire Council;

  → provide details of the survey methodology employed including survey effort and representativeness for each species targeted and clear justification for species that were discounted from requiring field surveys or further assessment;

  → demonstrate a design philosophy of impact avoidance on ecological values, and in particular, ecological values of high significance;

→ provide a worst case estimate of vegetation to be cleared (in hectares), including quantifying impacts (in hectares) by vegetation type and threatened species habitat (as relevant);

→ assess the significance of impacts to native vegetation, listed threatened species, populations and communities and their habitats with consideration to local and region-based ecological implications, including habitat connectivity and distribution of species. The assessment must consider impacts to in-stream and riparian ecology from works close to waterways and/ or waterway crossings. In addition, impact of the project on birds and bats from blade strikes, low air pressure zones at the blade tips (barotrauma), and alteration to movement patterns resulting from the turbines must be assessed, including demonstration of how the project has been sited to avoid and/ or minimise such impacts;

→ include details of how flora and fauna impacts would be managed during construction and operation including adaptive management, rehabilitation/ regeneration measures and maintenance protocols;

→ demonstrate how the project (with the incorporation of all proposed measures to avoid, mitigate and/ or offset impacts) achieves a biodiversity outcome consistent with "maintain or improve" principles. Sufficient details must be provided to demonstrate the availability of viable and achievable options to offset the impacts of the project and to secure these measures in perpetuity; and

→ address the risk of weed spread and identify mitigation measures.

- **Heritage** - the EA must include an assessment of the potential impact of the project components on Aboriginal heritage values (archaeological and cultural). The EA must demonstrate effective consultation with Aboriginal stakeholders during the assessment and in developing mitigation options (including the final recommended measures) consistent with *Guidelines for Aboriginal Cultural Impact Assessment and Community Consultation* (DEC, July 2005). The EA must also consider impacts to historic (European) heritage values, as relevant.

- **Traffic and Transport** – the EA must assess the construction and operational traffic impacts of the project including:

  → details of traffic volumes (both light and heavy vehicles) and transport routes during construction and operation;

  → assess the potential traffic impacts of the project on road network function (including intersection level of service) and safety;

  → assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-dimensional traffic) during construction and operation, including full details of any required upgrades to roads, bridges, site access provisions (for safe access to the public road network) or other road features;

  → details of measures to mitigate and/or manage potential impacts, including construction traffic control, road dilapidation surveys and measures to control soil erosion and dust generated by traffic volumes;

  → details of access roads within the site including how these would connect to the existing public road network (i.e. site access) and ongoing operational maintenance requirements for on-site roads; and

  → consideration of relevant Council traffic/road policies.

- **Hazard/Risks**– the EA must include an assessment of the potential impacts on aviation safety, including the need for aviation hazard lighting, considering nearby aerodromes and aircraft landing areas, defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems, and navigation aids. Aerodromes within 30km of the turbines should be identified and impacts on obstacle limitation surfaces addressed. Attention is drawn to Airservices Australia's specific requirements (attached). In addition, the EA must assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line. Possible effects on telecommunications systems must be

PROPOSED INFRASTRUCTURE LAYOUT INDEX MAP

Rye Park Wind Farm Biodiversity Assessment

Site perimeter

Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

0 2.5 5 Kilometres

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Author: DM

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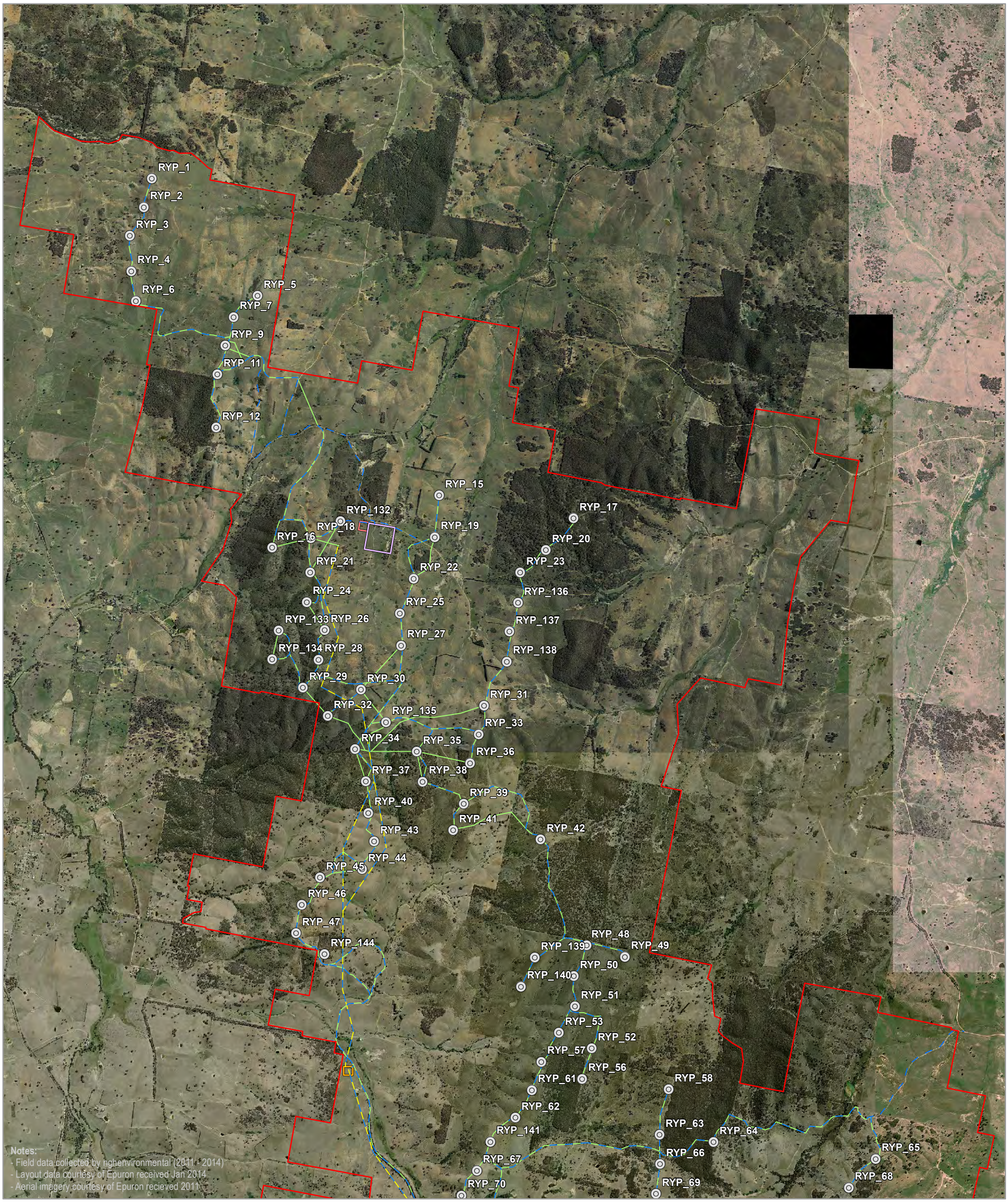

PROPOSED INFRASTRUCTURE LAYOUT MAP 1

Rye Park Wind Farm Biodiversity Assessment

Site perimeter

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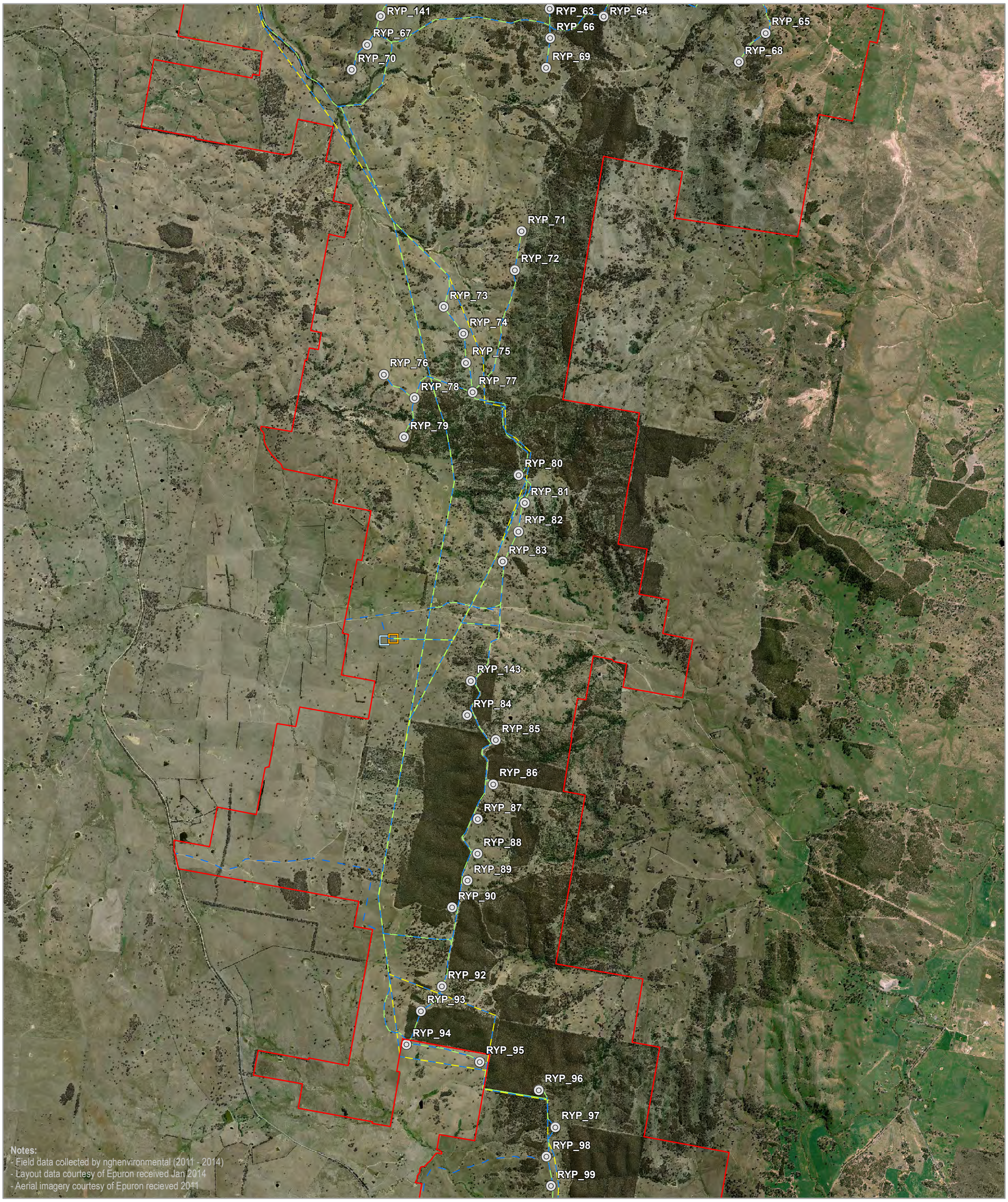

PROPOSED INFRASTRUCTURE LAYOUT MAP 2

Rye Park Wind Farm Biodiversity Assessment

Site perimeter

Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

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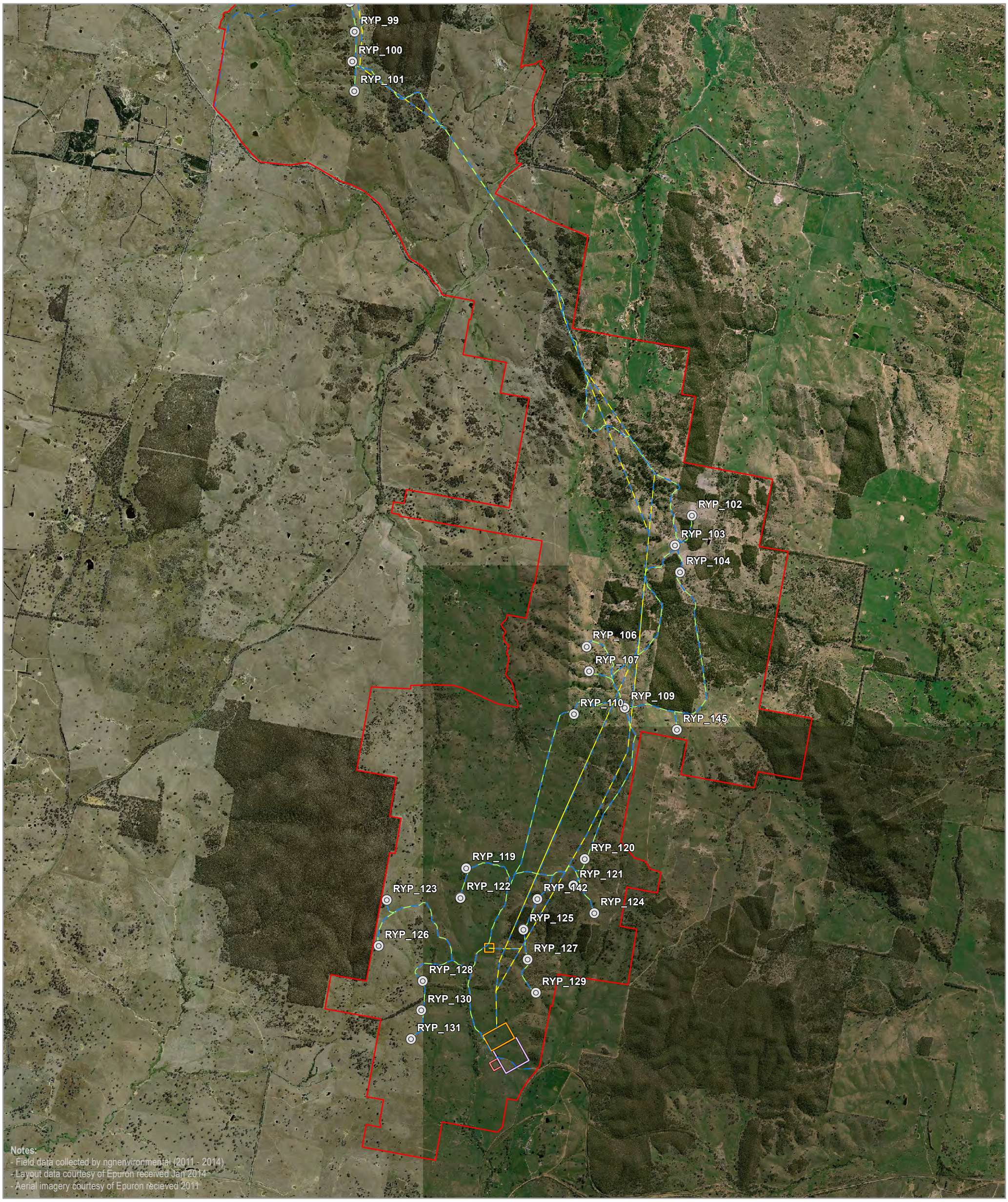

PROPOSED INFRASTRUCTURE LAYOUT MAP 3

Rye Park Wind Farm Biodiversity Assessment

Site perimeter

Infrastructure
- Turbine location
- Access track
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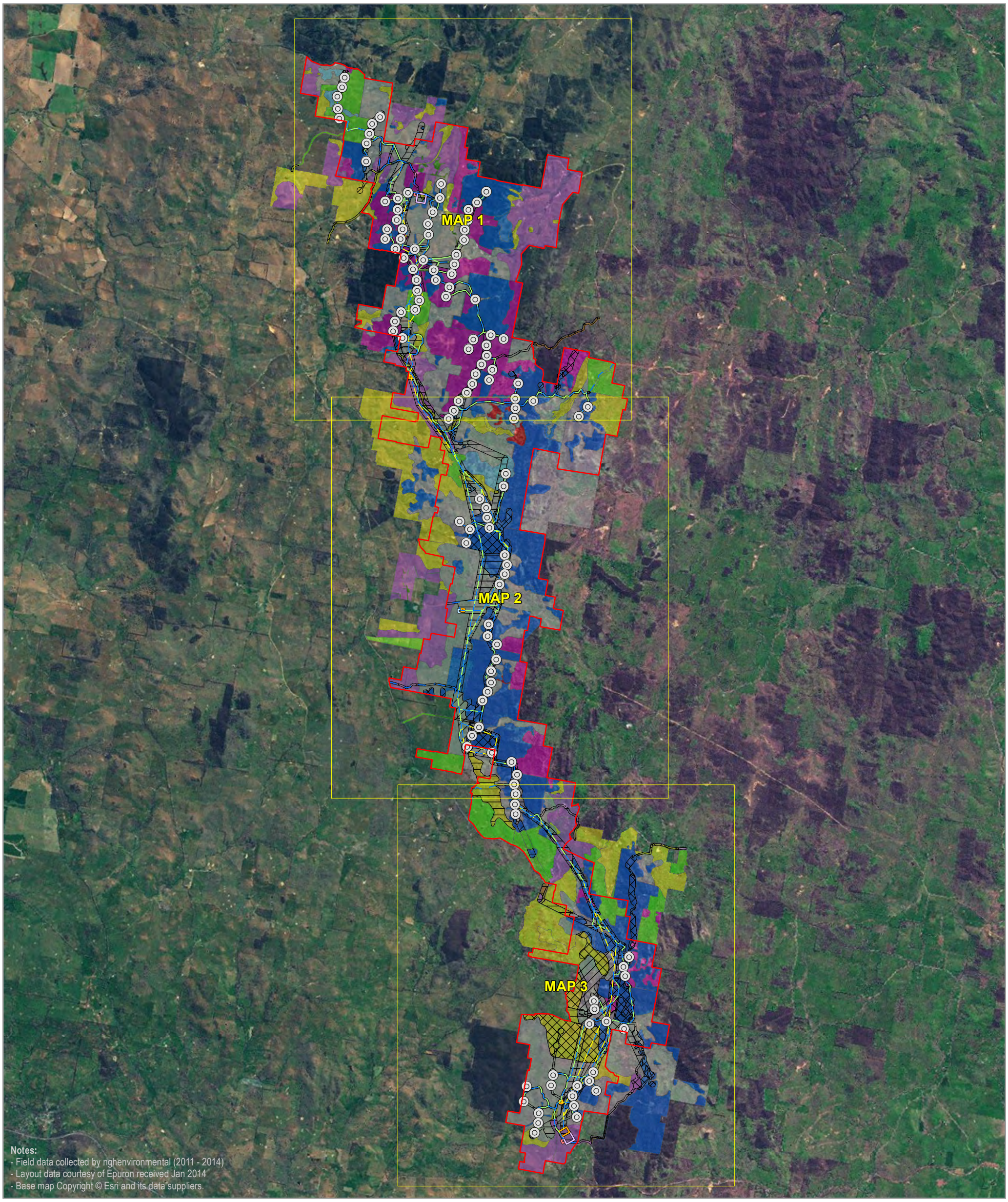

GENERAL SURVEY EFFORT AND RESULTS INDEX TO MAPS

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
  - Substation
  - Termination compound
  - O&M building
  - Construction compound
  - Concrete batching plant
- Vegetation type
  - Argyle Apple Forest
  - Box-Gum Woodland
  - Brittle Gum Forest
  - Derived Grassland
  - Exotic pasture
  - Native pasture
  - Phragmites within dam
  - Planted native vegetation
  - Red Box Woodland
  - Scribbly Gum Forest
  - Sifton Bush Shrubland
- Vegetation condition
  - Good
  - Moderate
  - Poor

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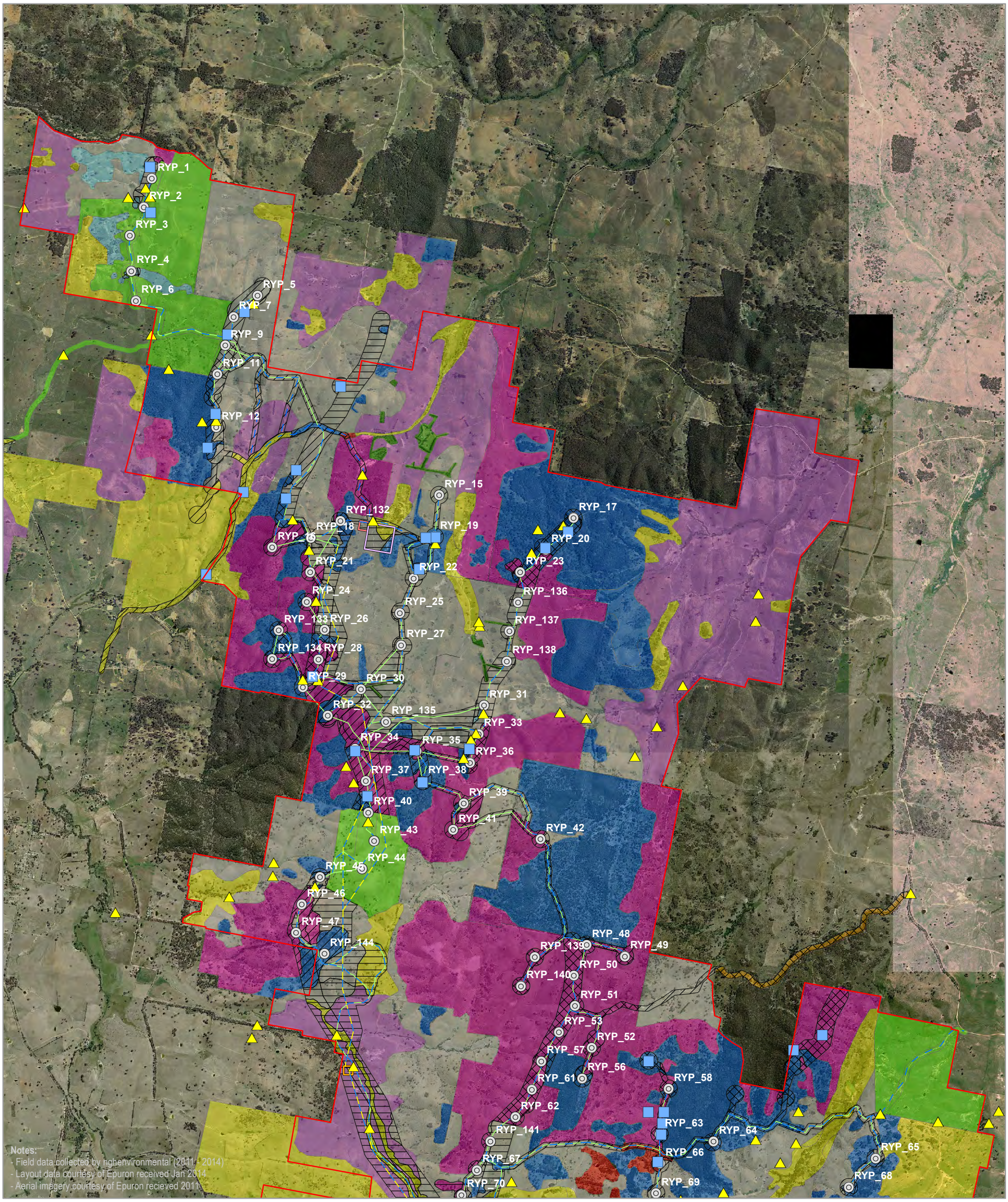

FLORA SURVEY EFFORT AND RESULTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
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- Substation
- Termination compound
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- Construction compound
- Concrete batching plant
- Flora survey effort
- Flora quadrat / random meander
- Inspection point
- Targeted transect - spring 2013
- On foot
- Vehicle based
- Vegetation type
- Argyle Apple Forest
- Box-Gum Woodland
- Brittle Gum Forest
- Derived Grassland
- Exotic pasture
- Native pasture
- Phragmites within dam
- Planted native vegetation
- Red Box Woodland
- Scribbly Gum Forest
- Sifton Bush Shrubland
- Vegetation condition
- Good
- Moderate
- Poor

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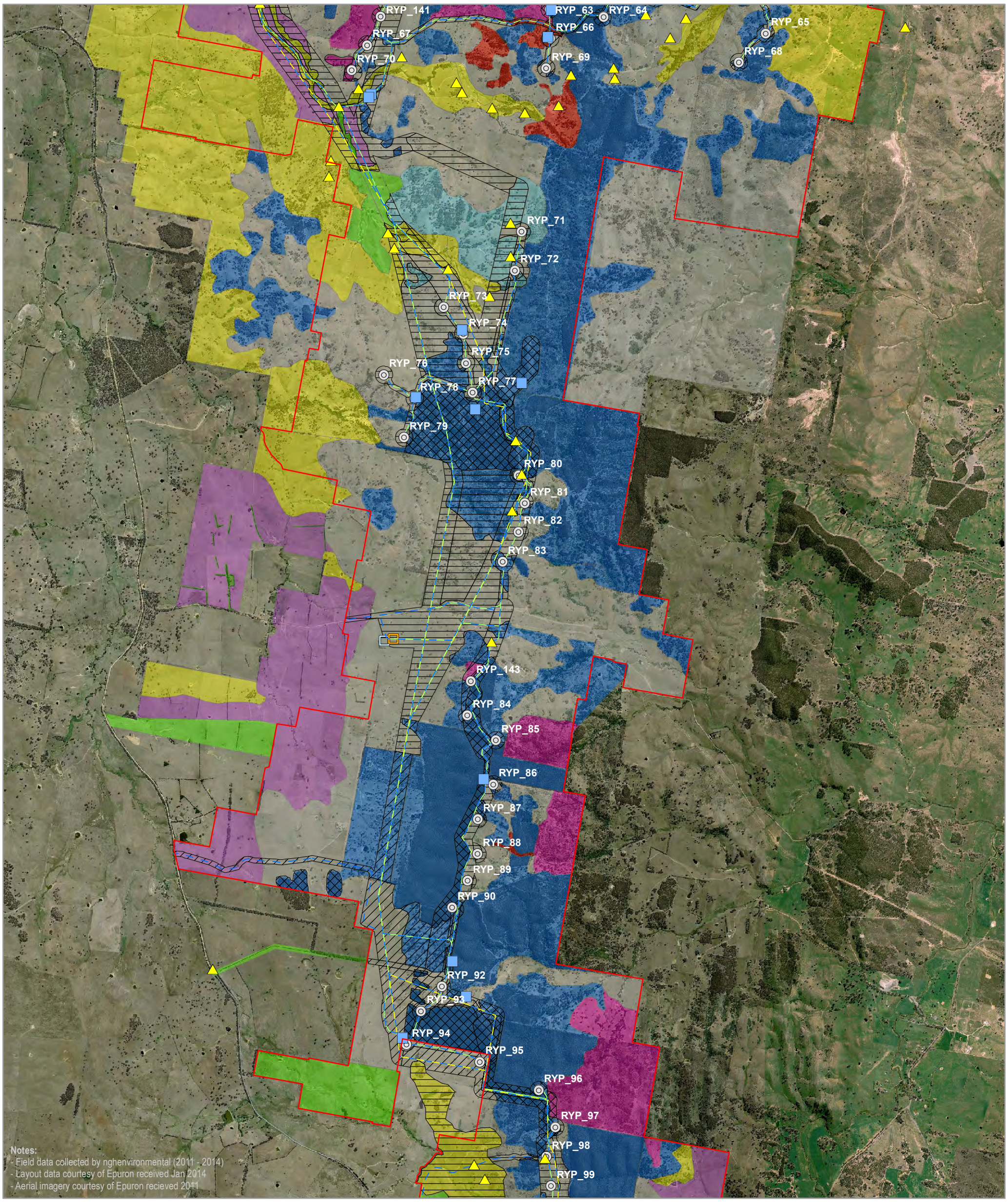

FLORA SURVEY EFFORT AND RESULTS MAP 2

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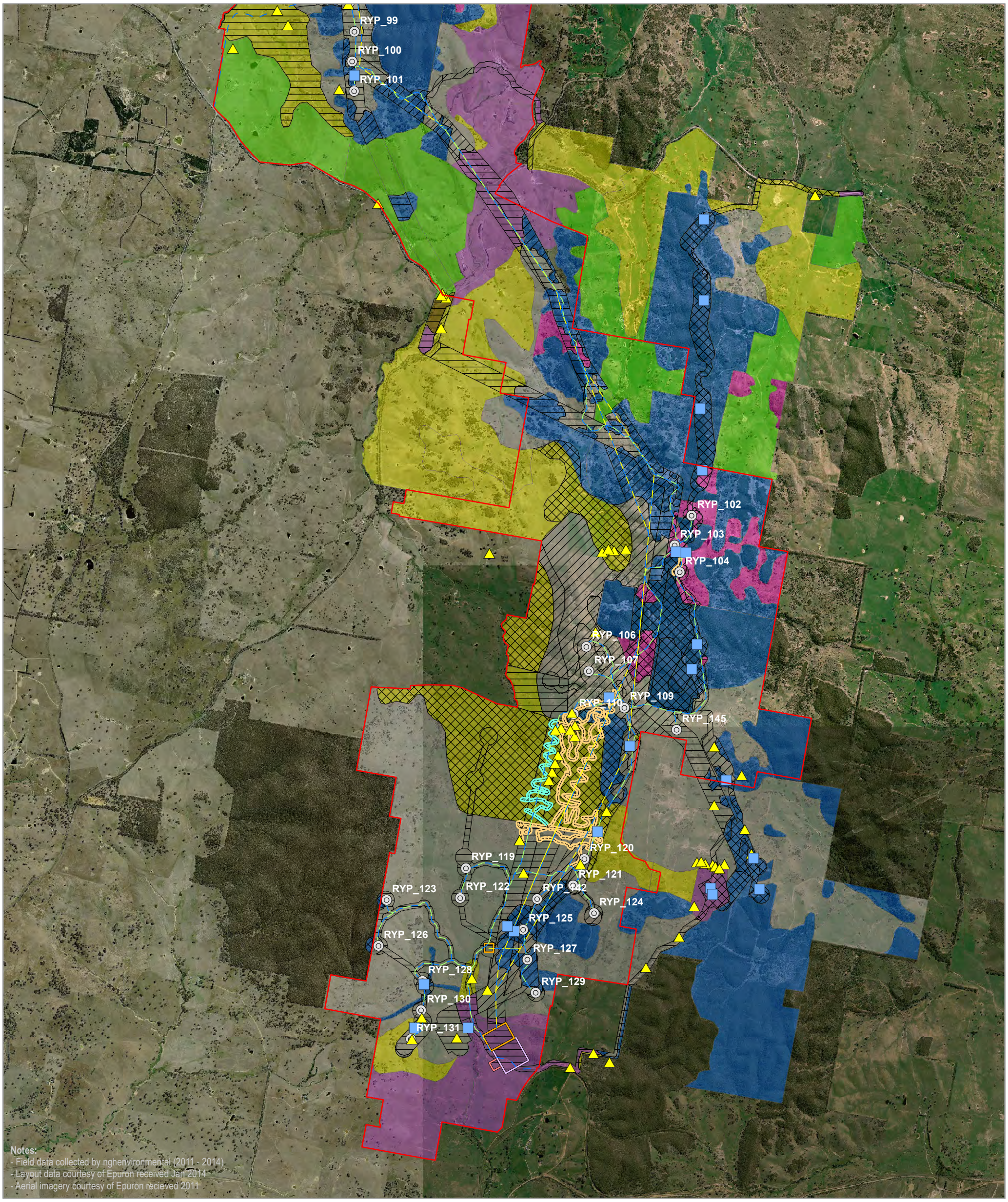

FLORA SURVEY EFFORT AND RESULTS MAP 3

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Vegetation type
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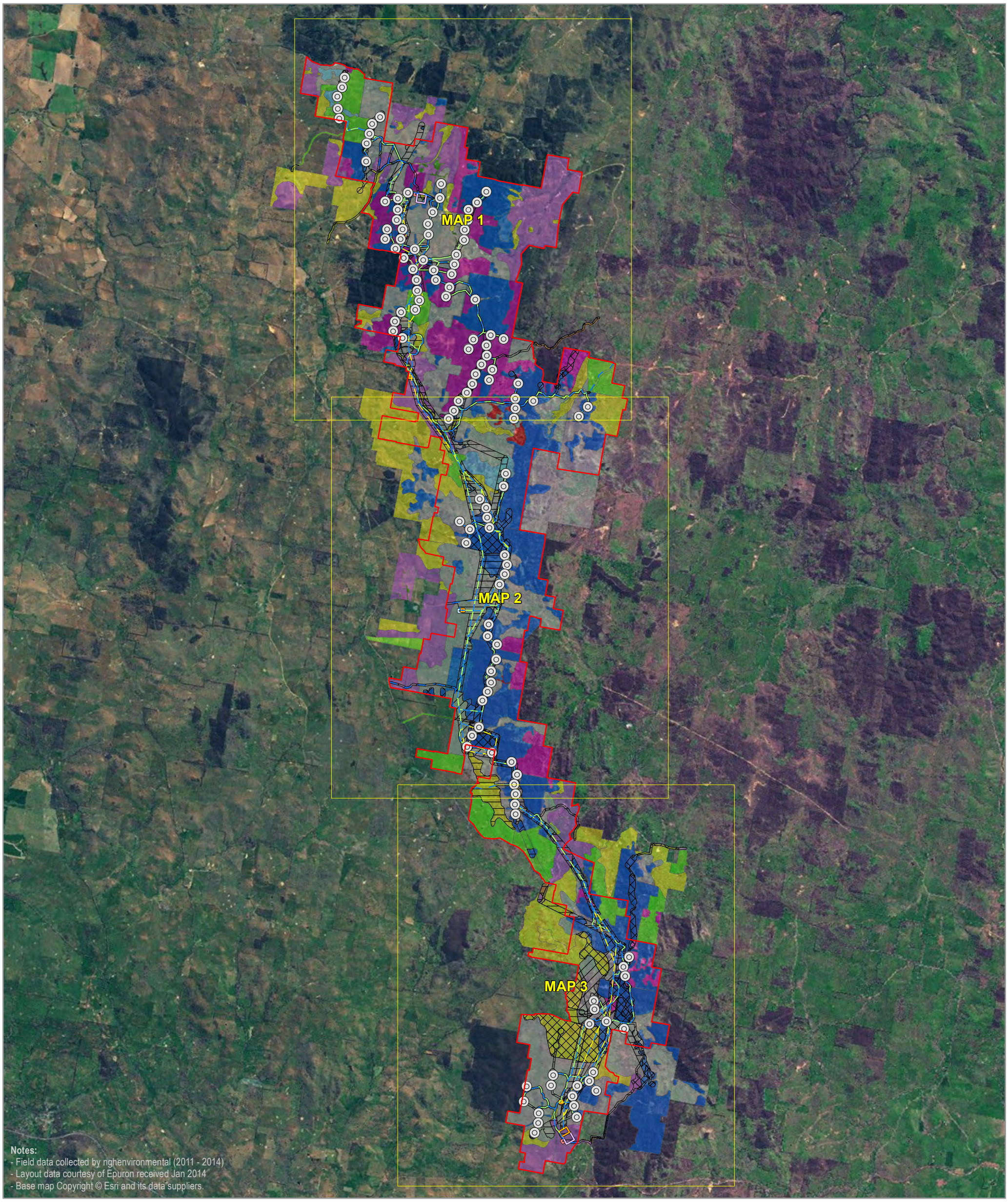

GENERAL SURVEY EFFORT AND RESULTS INDEX TO MAPS

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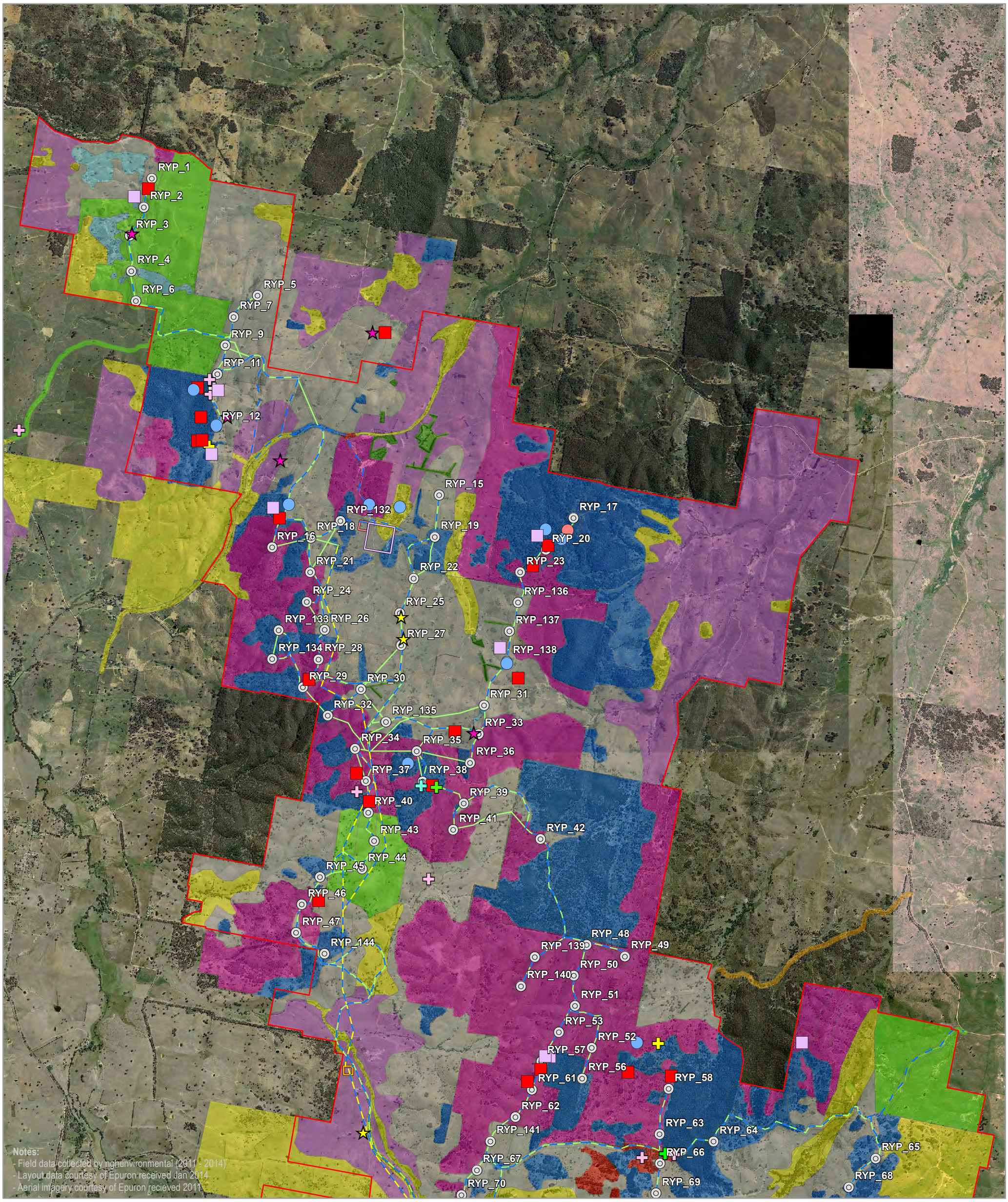

FAUNA GENERAL SURVEY EFFORT MAP 1

Rye Park Wind Farm Biodiversity Assessment

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- Fauna survey effort
  - Bird Survey
  - Swift Parrot / Bird Survey
  - Reptile Tile Plot
  - Funnel Trap
  - Reptile search
  - Habitat assessment
  - Hollow quadrats
  - Tree-mounted trap 1
  - Tree-mounted trap 2
  - Night work
  - Call Playback / spotlight
  - Anabat
  - Stag watch / listening
  - Spotlight
  - Spotlight transect
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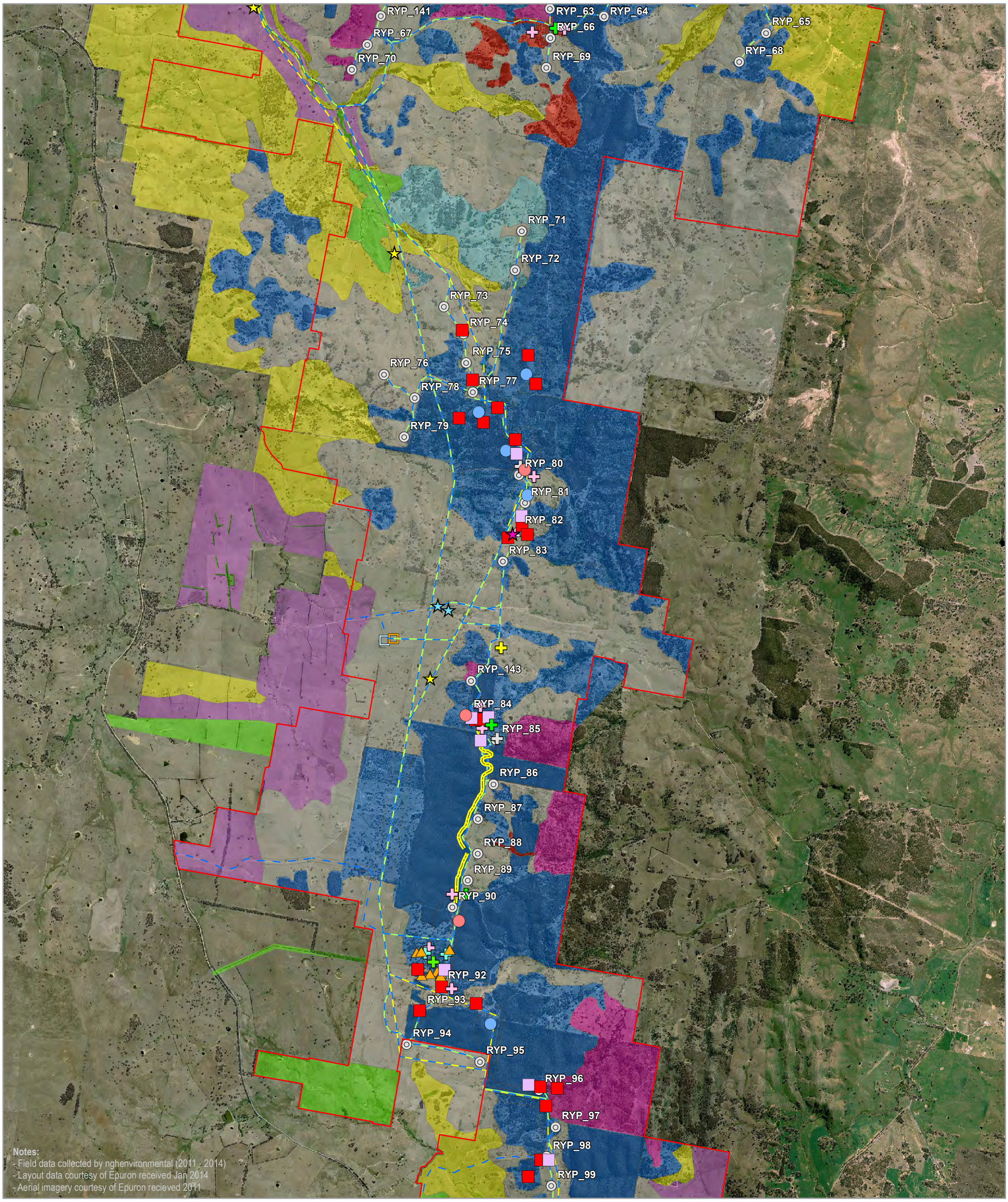

FAUNA GENERAL SURVEY EFFORT MAP 2

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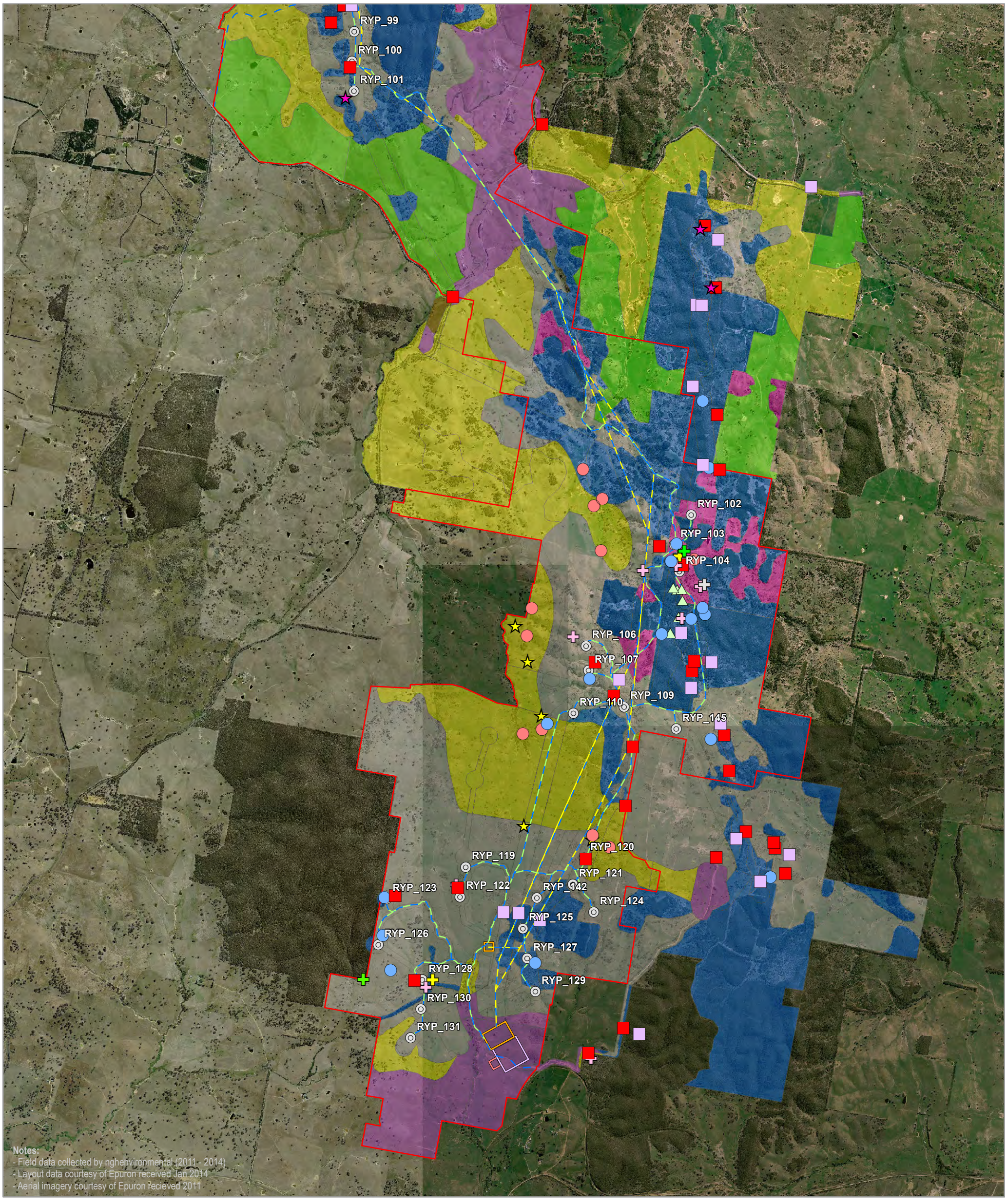

FAUNA GENERAL SURVEY EFFORT MAP 3

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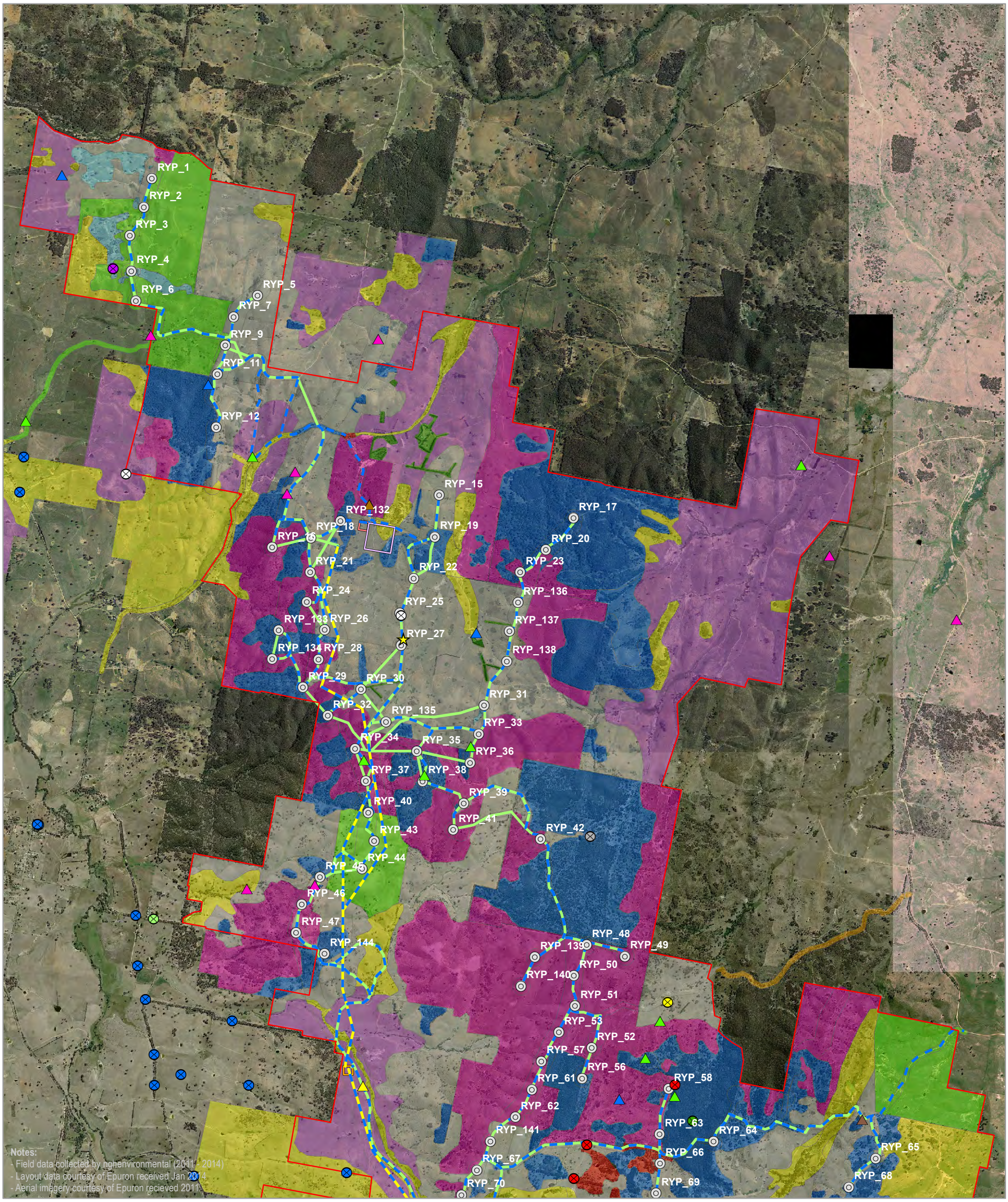

FAUNA GENERAL SURVEY RESULTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
  - Substation
  - Termination compound
  - O&M building
  - Construction compound
- Concrete batching plant
- Threatened Species Nests
  - Diamond Firetail nest
  - Superb Parrot nest
  - Wedge-tailed Eagle nest
  - Nankeen Kestrel nest
  - Potential Superb Parrot nest tree
- Birds
  - Brown Treecreeper
  - Diamond Firetail
  - Flame Robin
  - Hooded Robin
  - Scarlet Robin
  - Speckled Warbler
  - Varied Sittella
  - White-fronted Chat
  - Eastern Bentwing Bat
  - Superb Parrot
  - Painted Honeyeater
  - Rainbow Bee-eater
- Raptors
  - Black-shouldered Kite
  - Brown Falcon
  - Brown Goshawk
  - Nankeen Kestrel
  - Wedge-tailed Eagle
- Reptiles
  - Striped Legless Lizard
- Vegetation type
  - Argyle Apple Forest
  - Box-Gum Woodland
  - Brittle Gum Forest
  - Derived Grassland
  - Exotic pasture
  - Native pasture
  - Phragmites within dam
  - Planted native vegetation
  - Red Box Woodland
  - Scribbly Gum Forest
  - Sifton Bush Shrubland

0 0.5 1 Kilometres

A3 @ 1:42000
Ref: 5439 - 3
Author: DM

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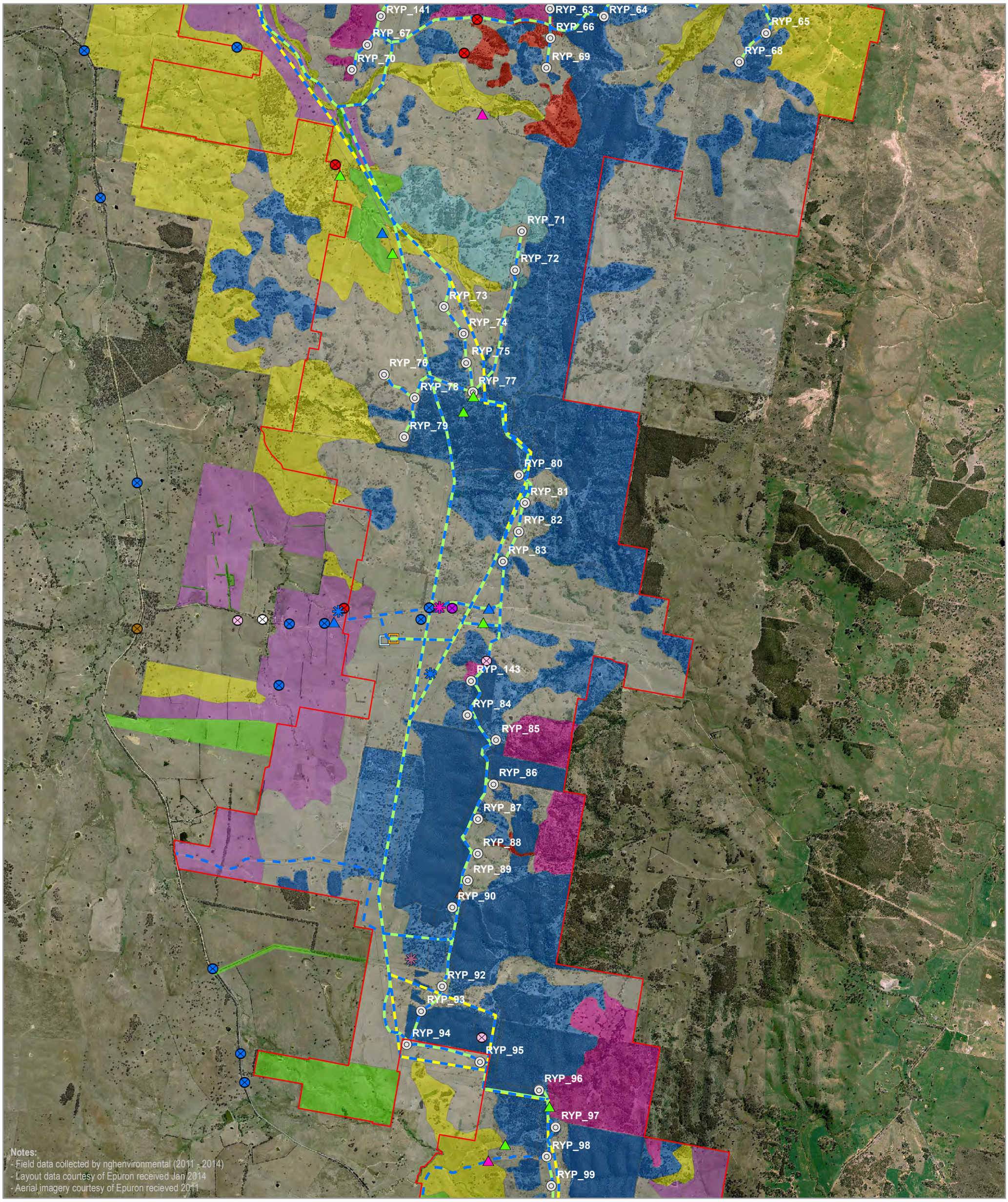

FAUNA GENERAL SURVEY RESULTS MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
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  - Construction compound
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  - Brown Falcon
  - Brown Goshawk
  - Nankeen Kestrel
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  - Native pasture
  - Phragmites within dam
  - Planted native vegetation
  - Red Box Woodland
  - Scribbly Gum Forest
  - Sifton Bush Shrubland

0 0.5 1 Kilometres

A3 @ 1:42000
Ref: 5439 - 3
Author: DM

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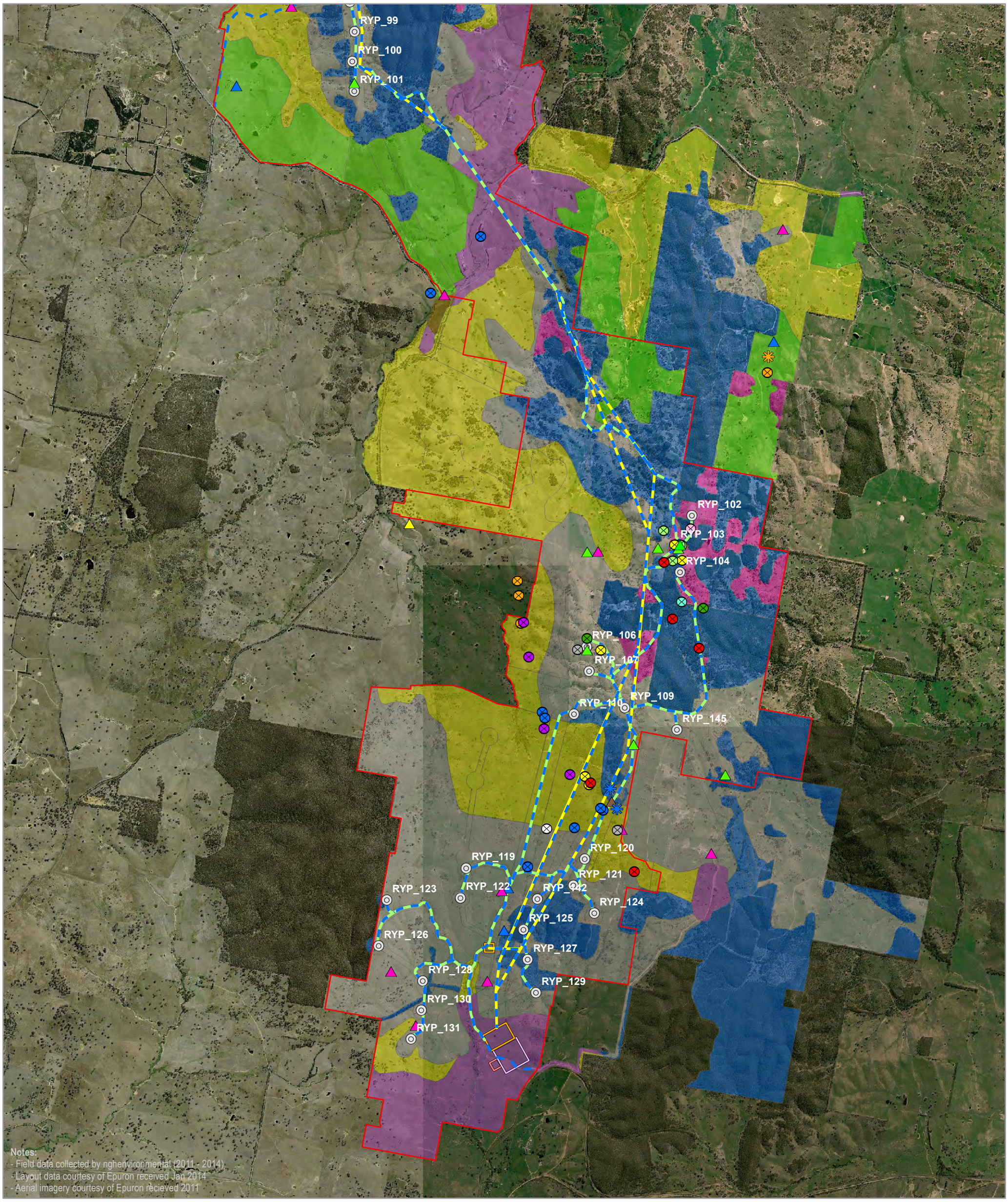

FAUNA GENERAL SURVEY RESULTS MAP 3

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
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- Planted native vegetation
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- Scribbly Gum Forest
- Sifton Bush Shrubland

0 0.5 1 Kilometres

A3 @ 1:42000
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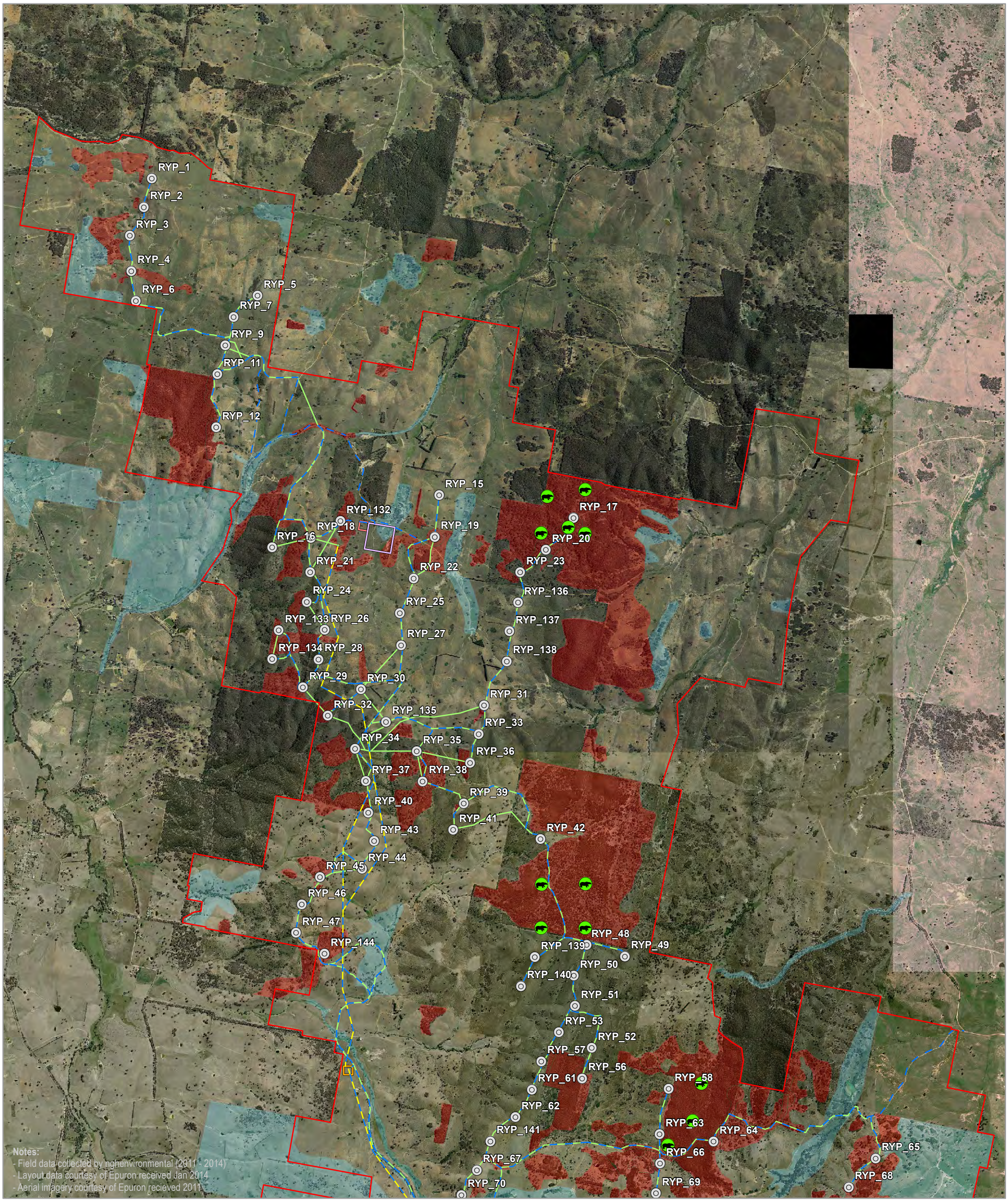

KOALA RANDOM GRID BASED SPOT ASSESSMENT TECHNIQUE SURVEY EFFORT MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Koala habitat
- Forest
- Woodland
- Koala survey

0 0.5 1 Kilometres

A3 @ 1:42000
Ref: 5439 - 5
Author: DM

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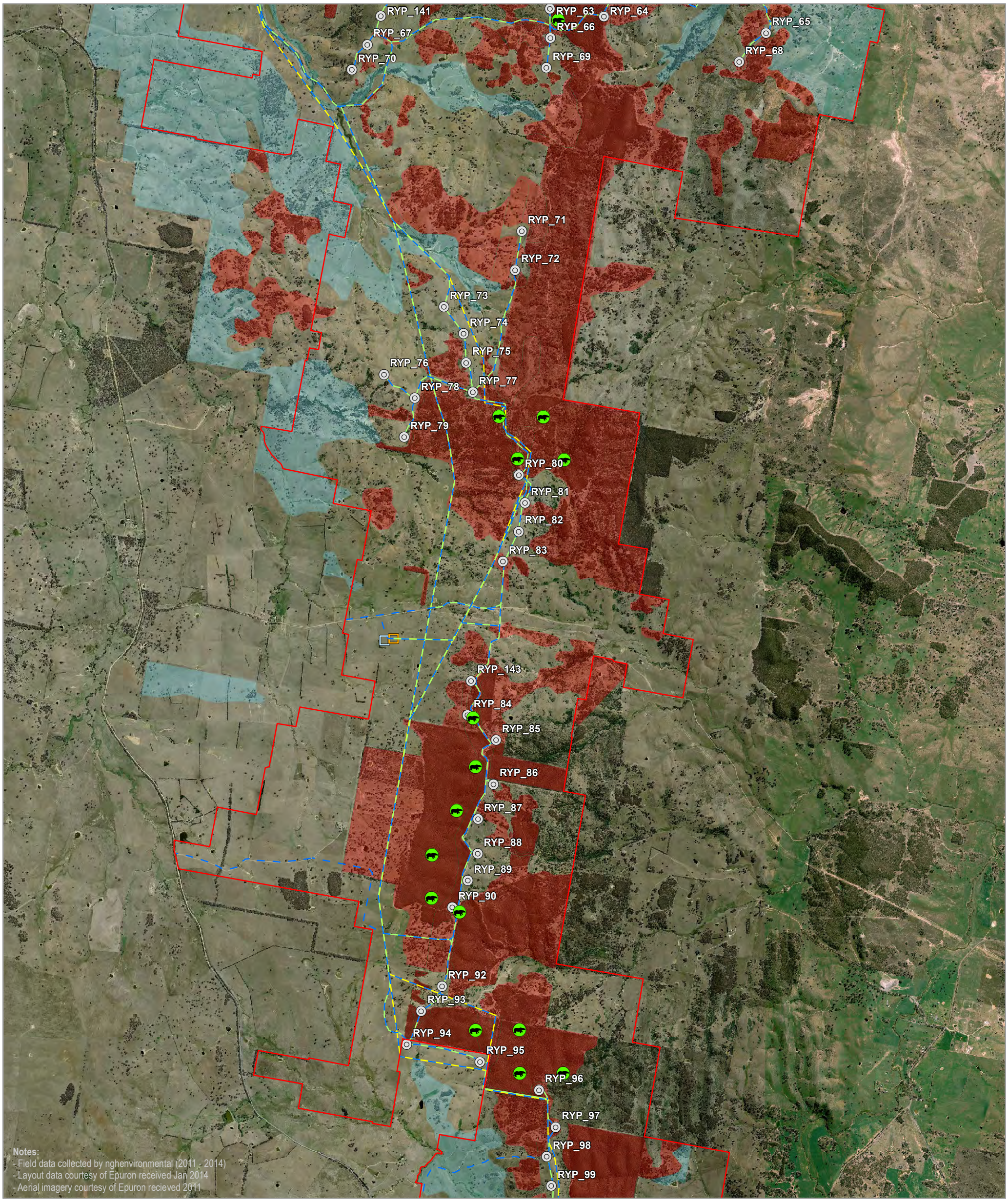

KOALA RANDOM GRID BASED SPOT ASSESSMENT TECHNIQUE SURVEY EFFORT MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Koala habitat
- Forest
- Woodland
- Koala survey

0 0.5 1 Kilometres

A3 @ 1:42000
Ref: 5439 - 5
Author: DM

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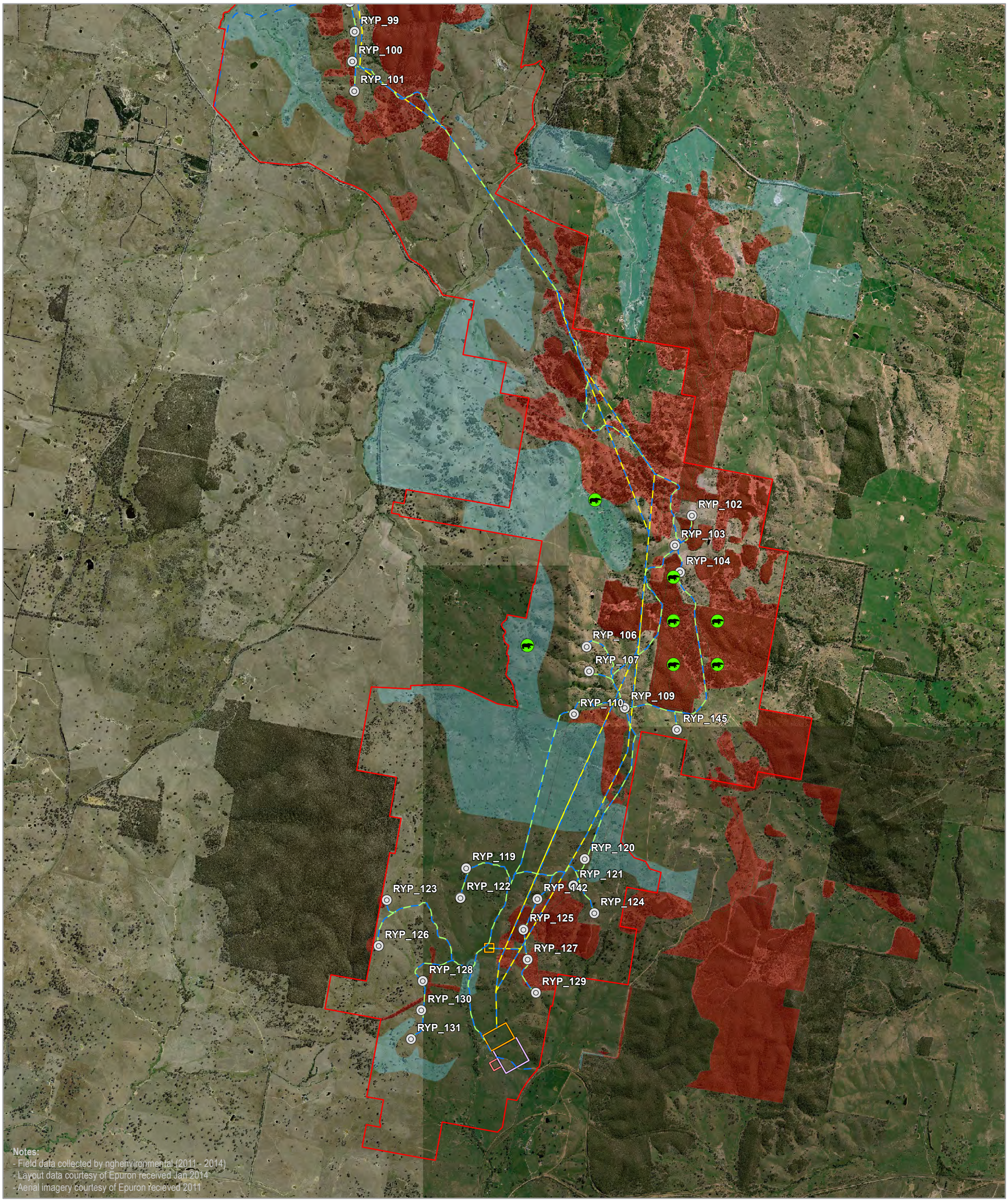

KOALA RANDOM GRID BASED SPOT ASSESSMENT TECHNIQUE SURVEY EFFORT MAP 3

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Koala habitat
- Forest
- Woodland
- Koala survey

0 0.5 1 Kilometres

A3 @ 1:42000
Ref: 5439 - 5
Author: DM

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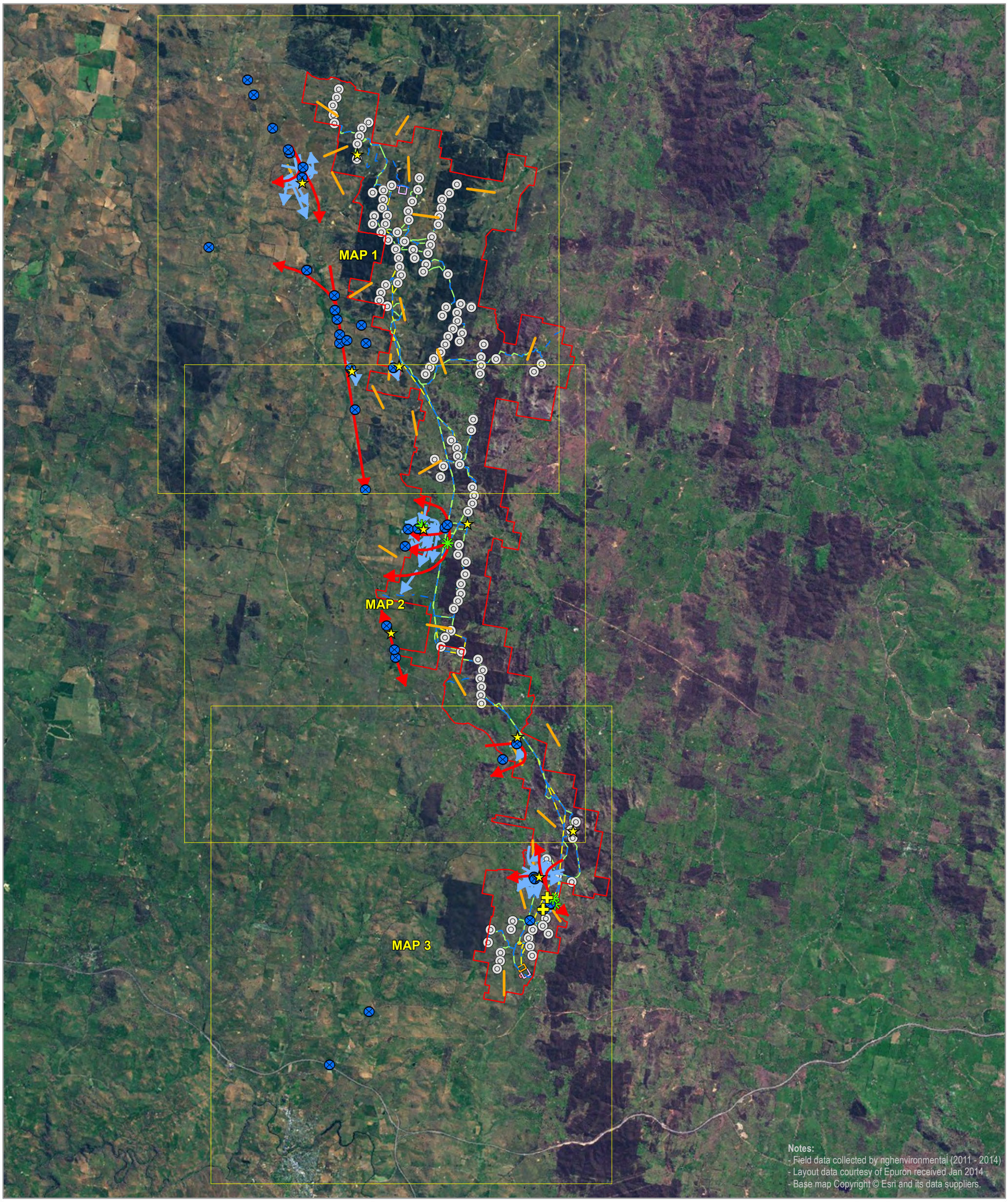

SUPERB PARROT SURVEY EFFORT AND RESULTS INDEX TO MAPS

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Flight path viewing station
- Superb Parrot transect
- Superb Parrot observation
- Superb Parrot nest
- Potential Superb Parrot nest tree
- Primary movement corridors
- Observed flight paths

0 1 2 Kilometers

A3 @ 1:150000
Ref: 5439 - 6
Author: DM

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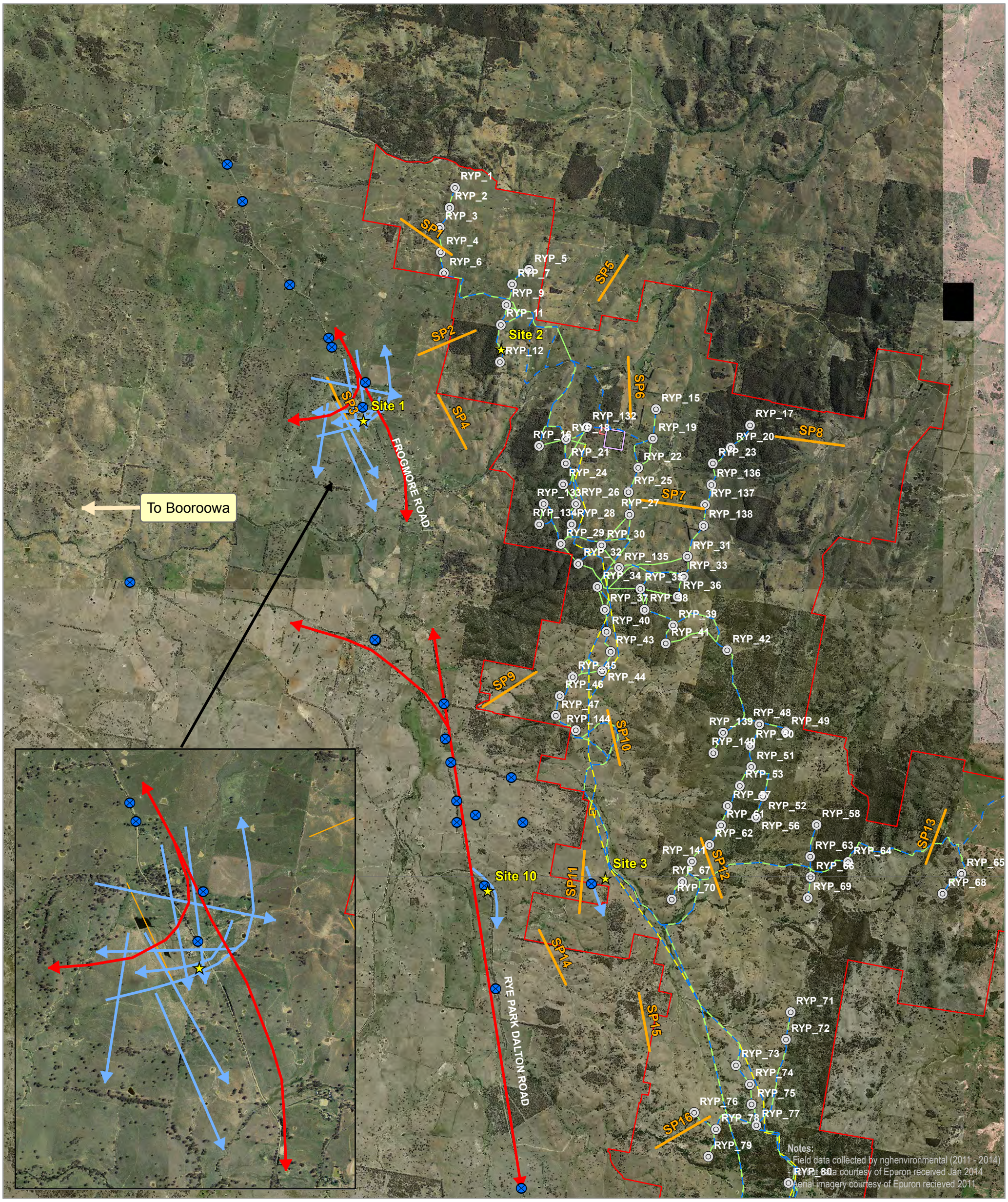

SUPERB PARROT SURVEY EFFORT AND RESULTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Flight path viewing station
- Superb Parrot transect
- Superb Parrot observation
- Superb Parrot nest
- Potential Superb Parrot nest tree
- Primary movement corridors
- Observed flight paths

0 1 2 Kilometers

A3 @ 1:60000
Ref: 5439 - 6
Author: DM

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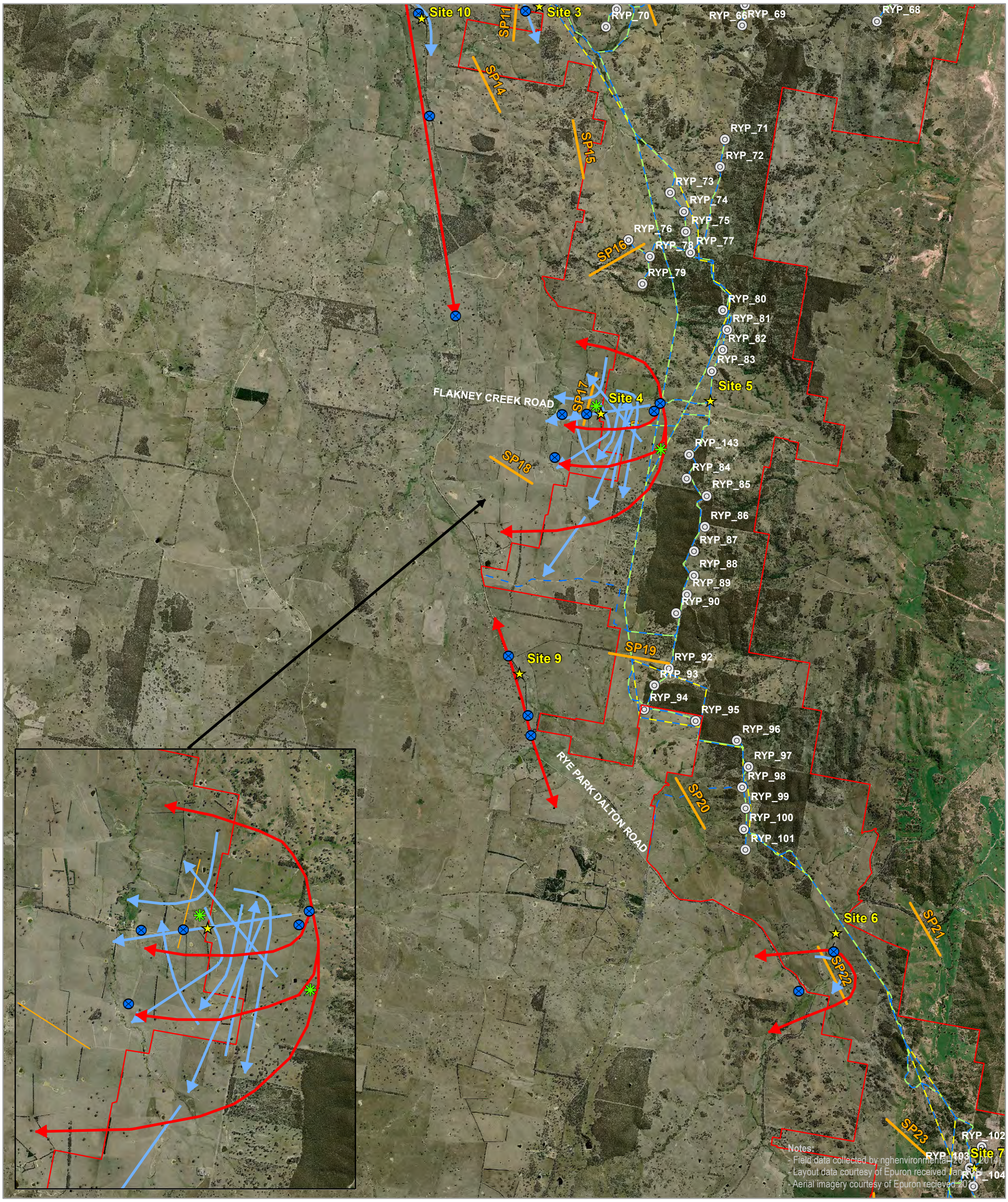

SUPERB PARROT SURVEY EFFORT AND RESULTS MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Flight path viewing station
- Superb Parrot transect
- Superb Parrot observation
- Superb Parrot nest
- Potential Superb Parrot nest tree
- Primary movement corridors
- Observed flight paths

0 1 2 Kilometers

A3 @ 1:60000
Ref: 5439 - 6
Author: DM

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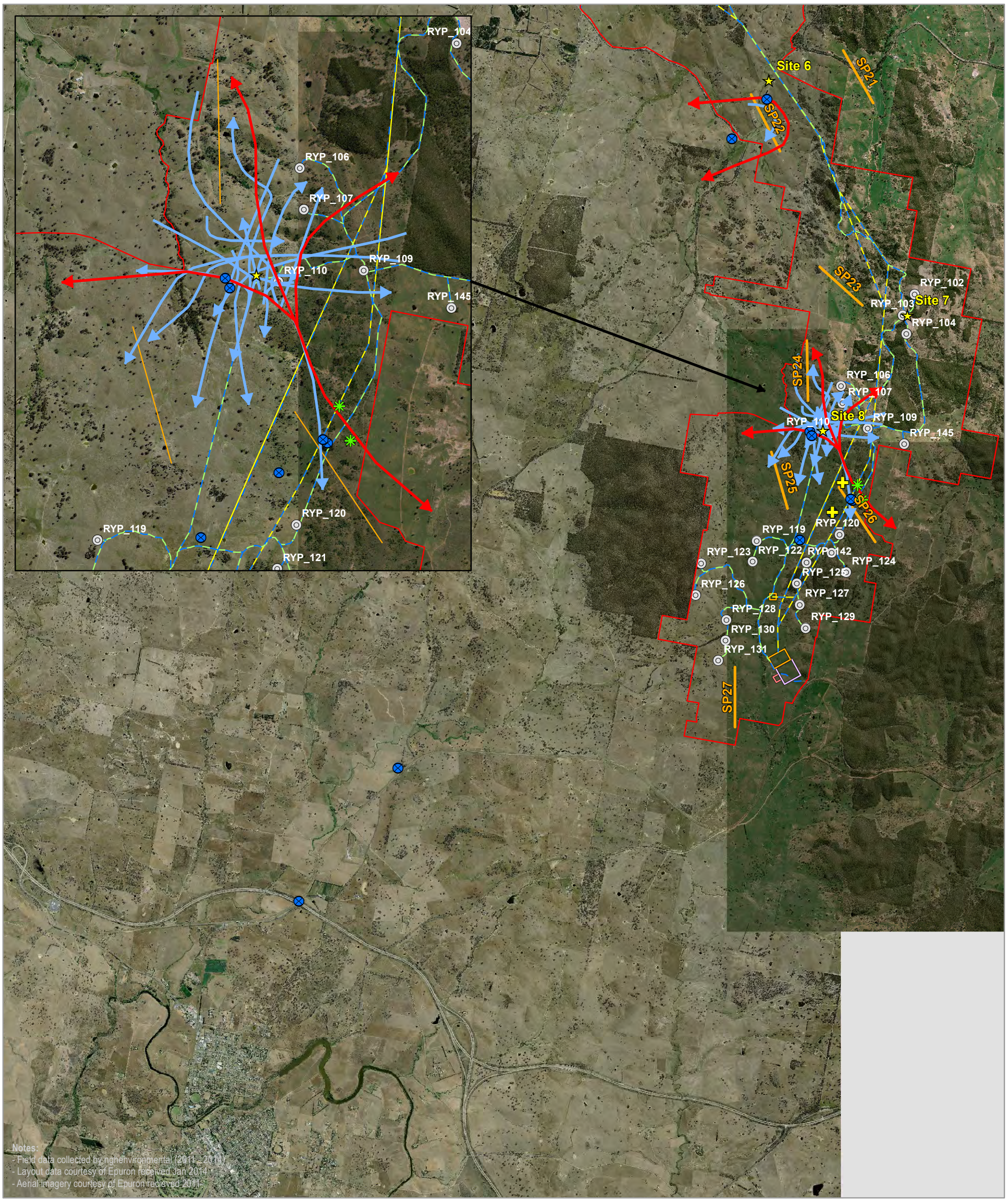

SUPERB PARROT SURVEY EFFORT AND RESULTS MAP 3

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Flight path viewing station
- Superb Parrot transect
- Superb Parrot observation
- Superb Parrot nest
- Potential Superb Parrot nest tree
- Primary movement corridors
- Observed flight paths

0 1 2 Kilometers

A3 @ 1:60000
Ref: 5439 - 6
Author: DM

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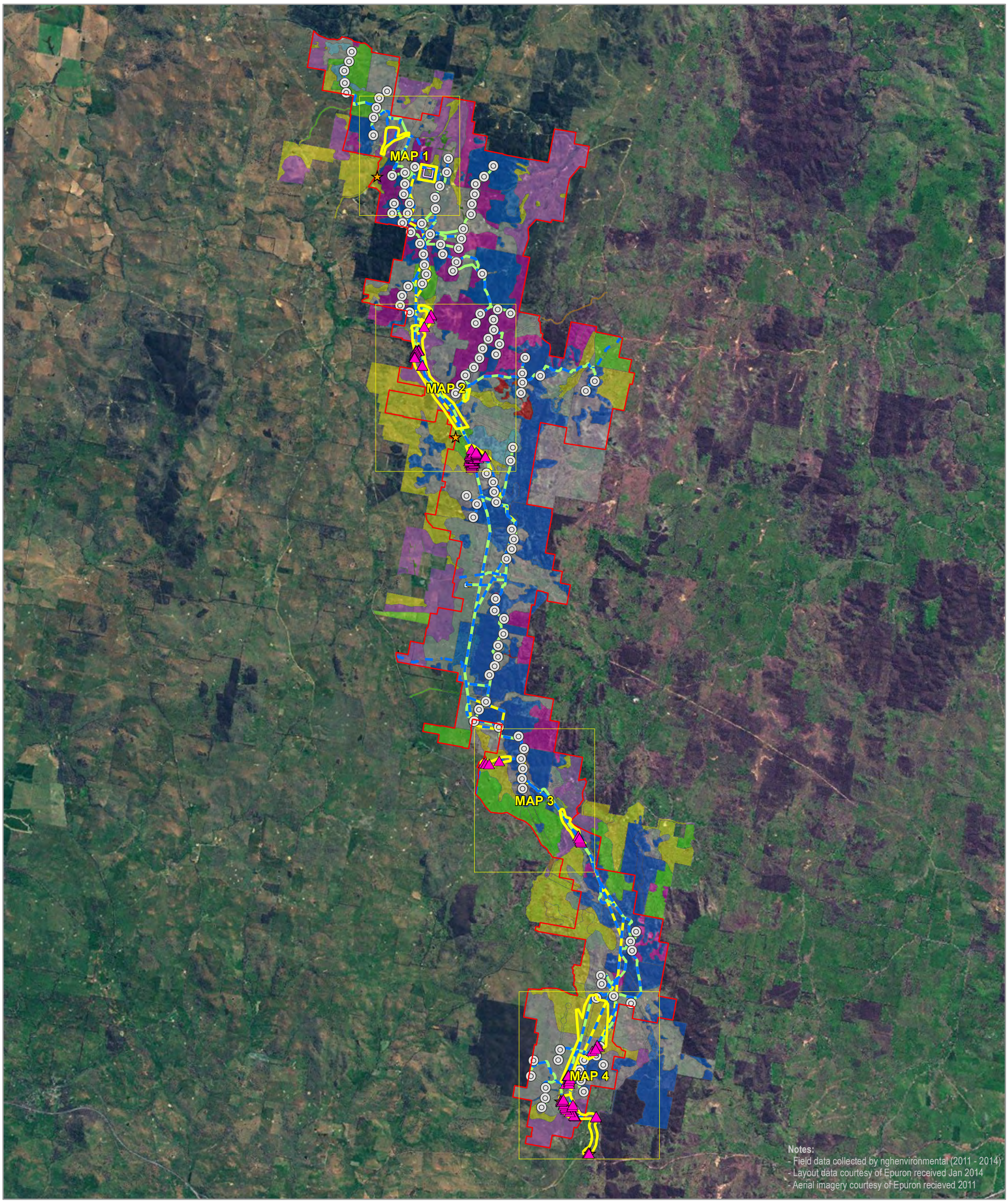

GOLDEN SUN MOTH SURVEY EFFORT AND RESULTS INDEX TO MAPS

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

Vegetation type

- Argyle Apple Forest
- Box-Gum Woodland
- Brittle Gum Forest
- Derived Grassland
- Exotic pasture
- Native pasture
- Phragmites within dam
- Planted native vegetation
- Red Box Woodland
- Scribbly Gum Forest
- Sifton Bush Shrubland
- Golden Sun Moth survey site
- Reference site
- Golden Sun Moth records

0 2.5 5 Kilometers

A3 @ 1:125000
Ref: 5439 - 7
Author: DM

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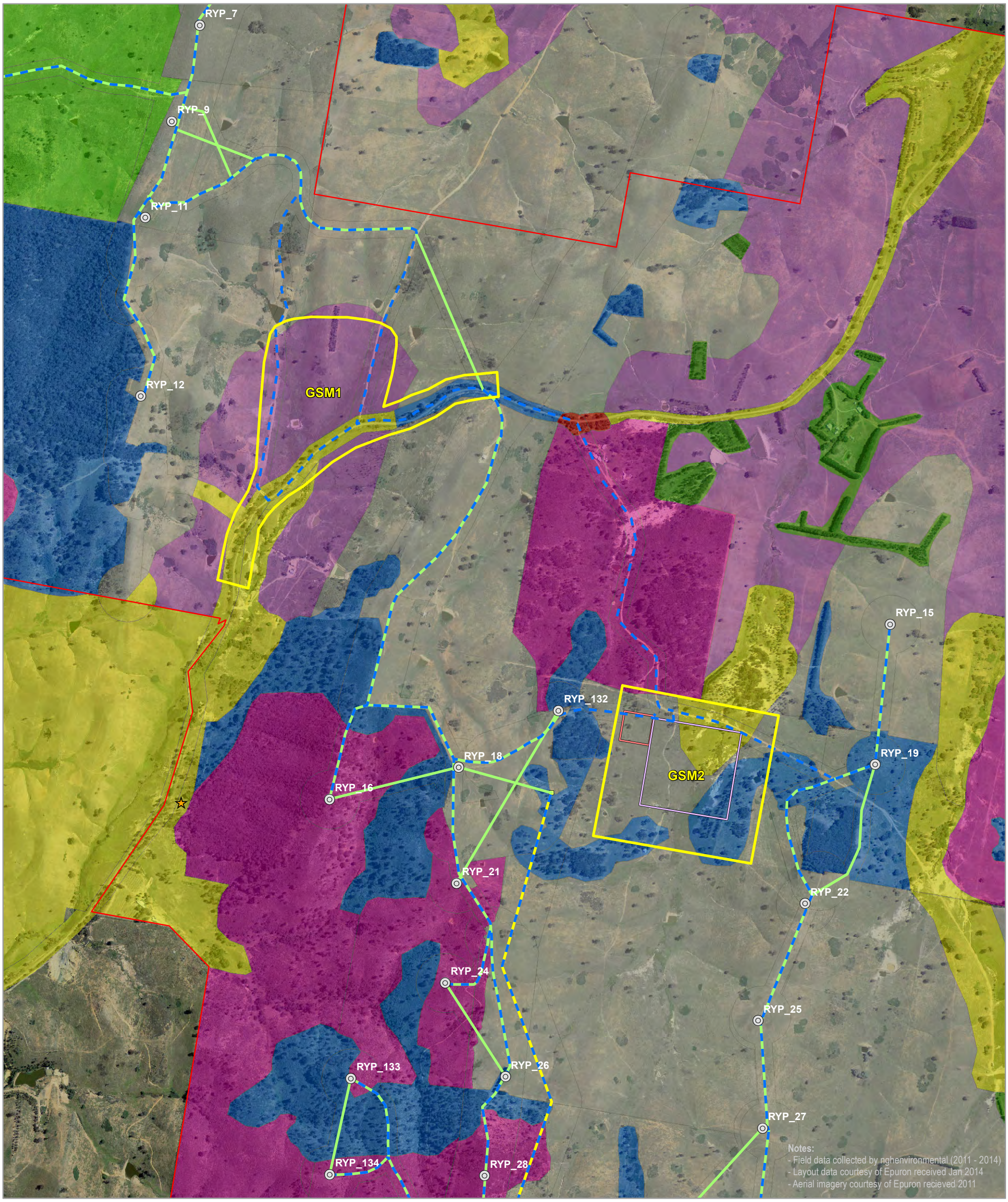

GOLDEN SUN MOTH SURVEY EFFORT AND RESULTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

Vegetation type

- Argyle Apple Forest
- Box-Gum Woodland
- Brittle Gum Forest
- Derived Grassland
- Exotic pasture
- Native pasture
- Phragmites within dam
- Planted native vegetation
- Red Box Woodland
- Scribbly Gum Forest
- Sifton Bush Shrubland
- Golden Sun Moth survey site
- Reference site
- Golden Sun Moth records

0 250 500 Meters

A3 @ 1:12500
Ref: 5439 - 7
Author: DM

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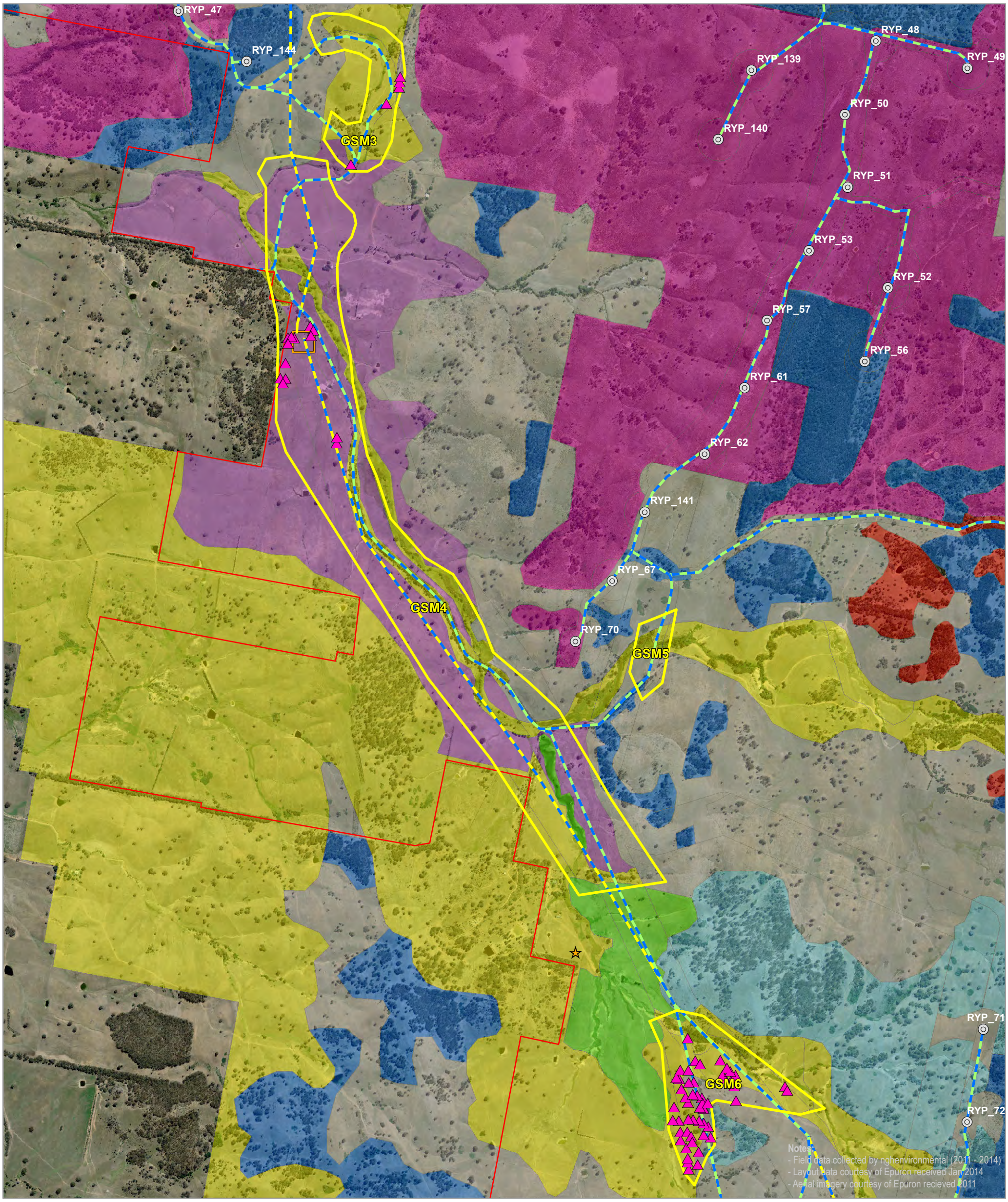

GOLDEN SUN MOTH SURVEY EFFORT AND RESULTS MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Vegetation type
- Argyle Apple Forest
- Box-Gum Woodland
- Brittle Gum Forest
- Derived Grassland
- Exotic pasture
- Native pasture
- Phragmites within dam
- Planted native vegetation
- Red Box Woodland
- Scribbly Gum Forest
- Sifton Bush Shrubland
- Golden Sun Moth survey site
- Reference site
- Golden Sun Moth records

0 250 500 Meters

A3 @ 1:17500
Ref: 5439 - 7
Author: DM

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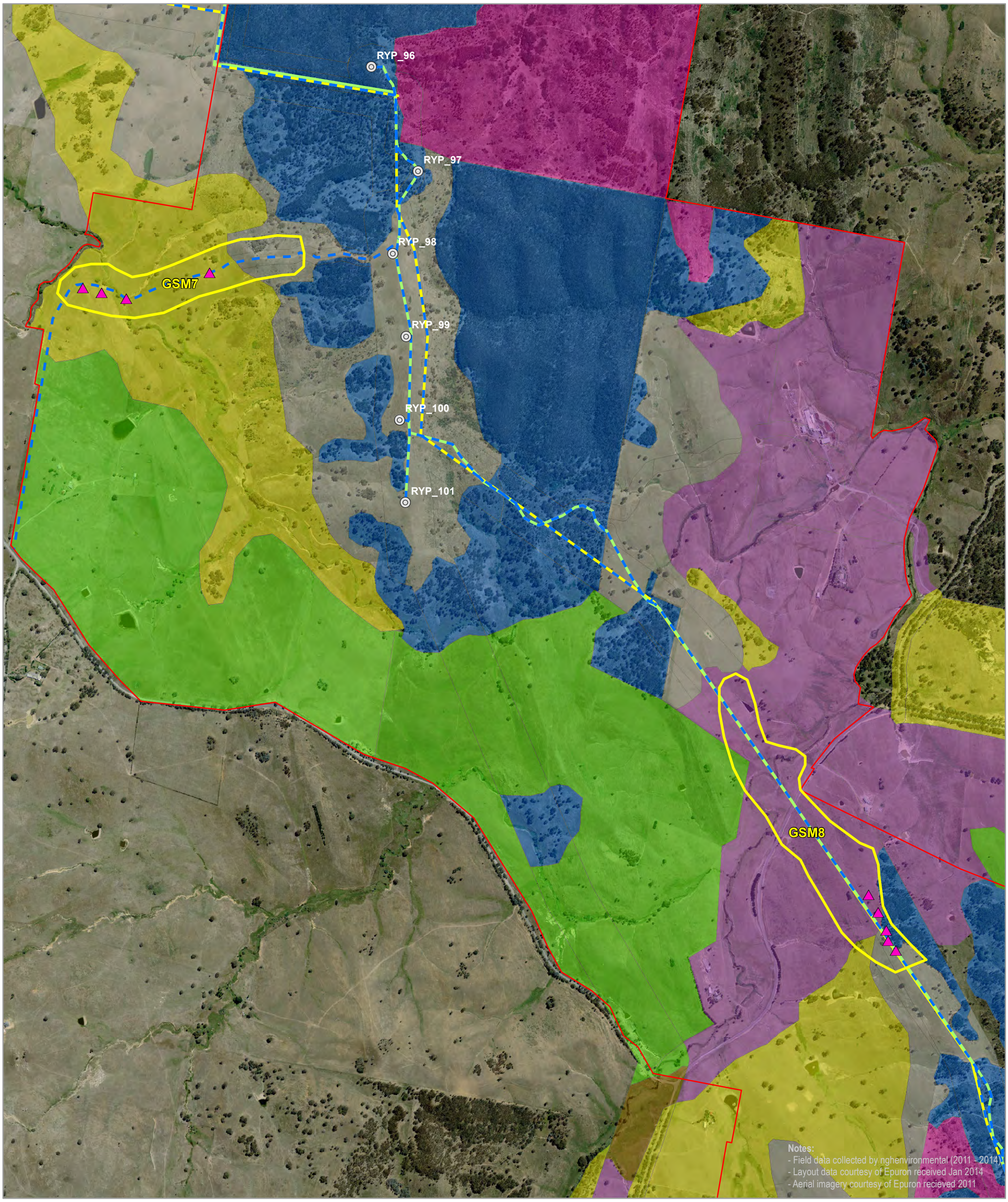

GOLDEN SUN MOTH SURVEY EFFORT AND RESULTS MAP 3

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
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Vegetation type

- Argyle Apple Forest
- Box-Gum Woodland
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- Scribbly Gum Forest
- Sifton Bush Shrubland
- Golden Sun Moth survey site
- Reference site
- Golden Sun Moth records

0 250 500 Meters

A3 @ 1:15000
Ref: 5439 - 7
Author: DM

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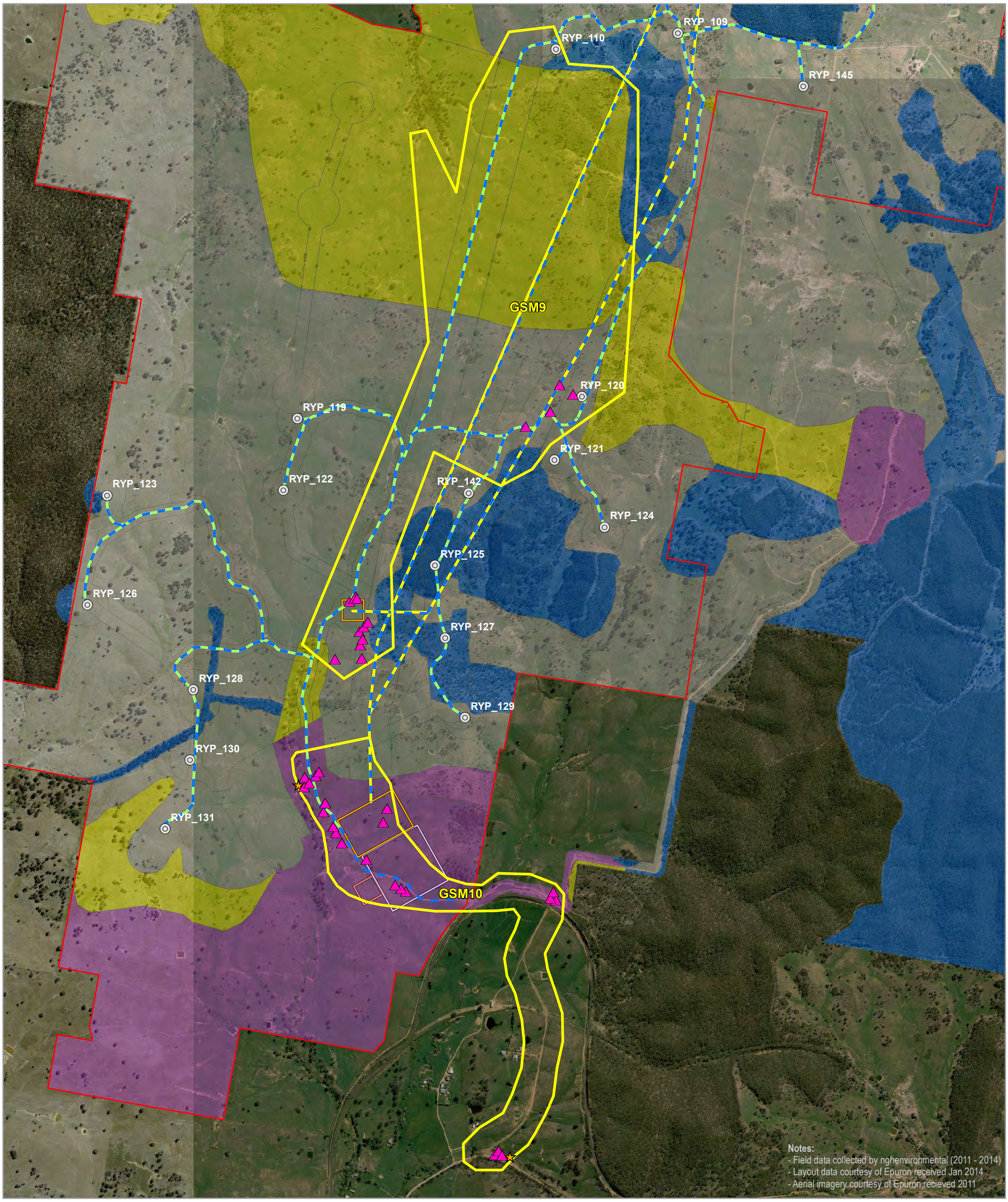

GOLDEN SUN MOTH SURVEY EFFORT AND RESULTS MAP 4

Rye Park Wind Farm Biodiversity Assessment

Site perimeter

Infrastructure

- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

Vegetation type

- Argyle Apple Forest
- Box-Gum Woodland
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- Golden Sun Moth survey site
- Reference site
- Golden Sun Moth records

0 250 500 Meters

A3 @ 1:17500
Ref: 5439 - 7
Author: DM

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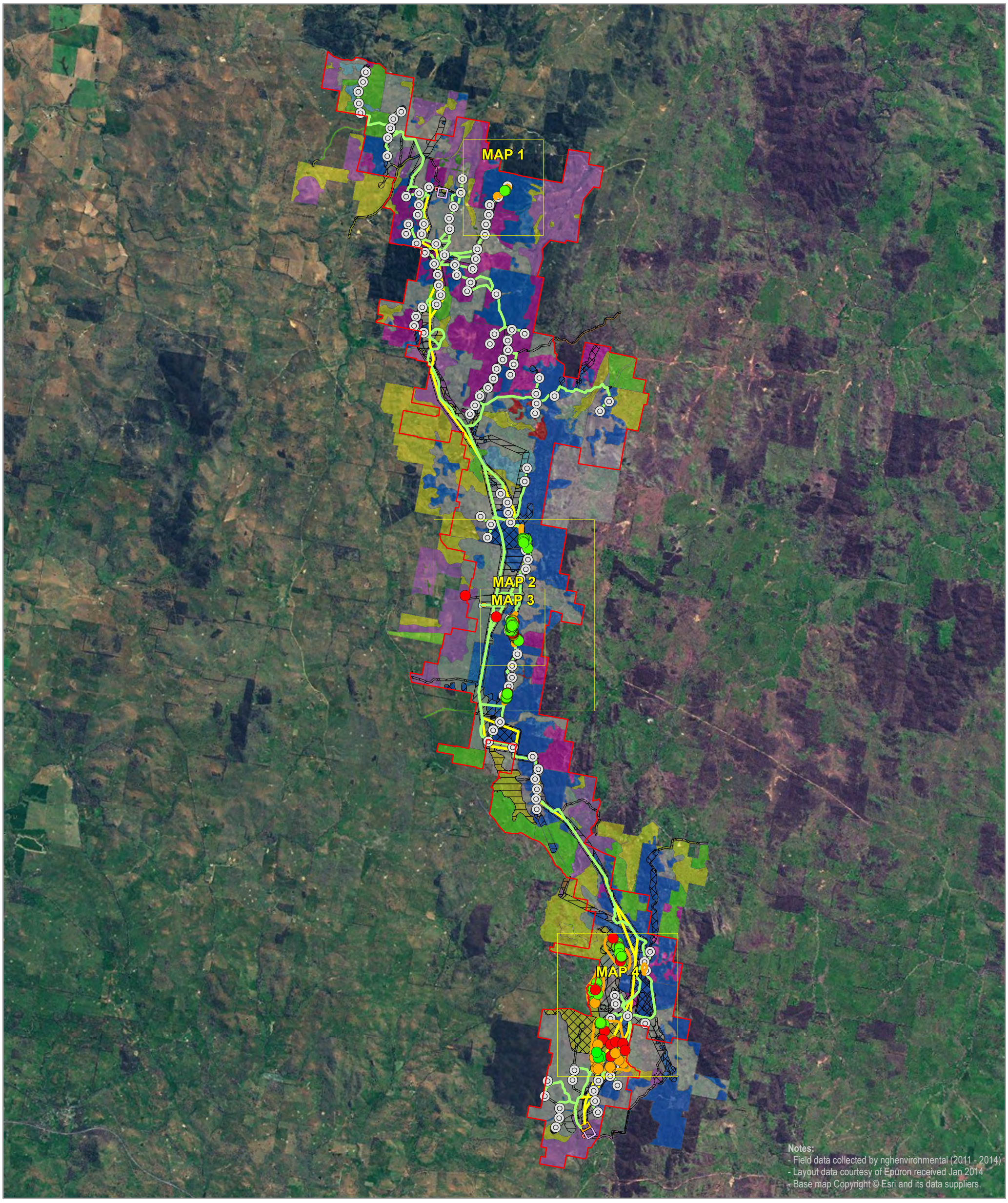

FAUNA HOLLOW_BEARING TREE SURVEY RESULTS INDEX TO MAPS

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- HBT survey areas
- Hollow-bearing trees - Quality
  - High
  - Medium
  - Low
- Vegetation condition
  - Good
  - Moderate
  - Poor
- Vegetation type
  - Argyle Apple Forest
  - Box-Gum Woodland
  - Brittle Gum Forest
  - Derived Grassland
  - Exotic pasture
  - Native pasture
  - Phragmites within dam
  - Planted native vegetation
  - Red Box Woodland
  - Scribbly Gum Forest
  - Sifton Bush Shrubland

0 2.5 5 Kilometers

A3 @ 1:125000
Ref: 5439 - 4
Author: DM

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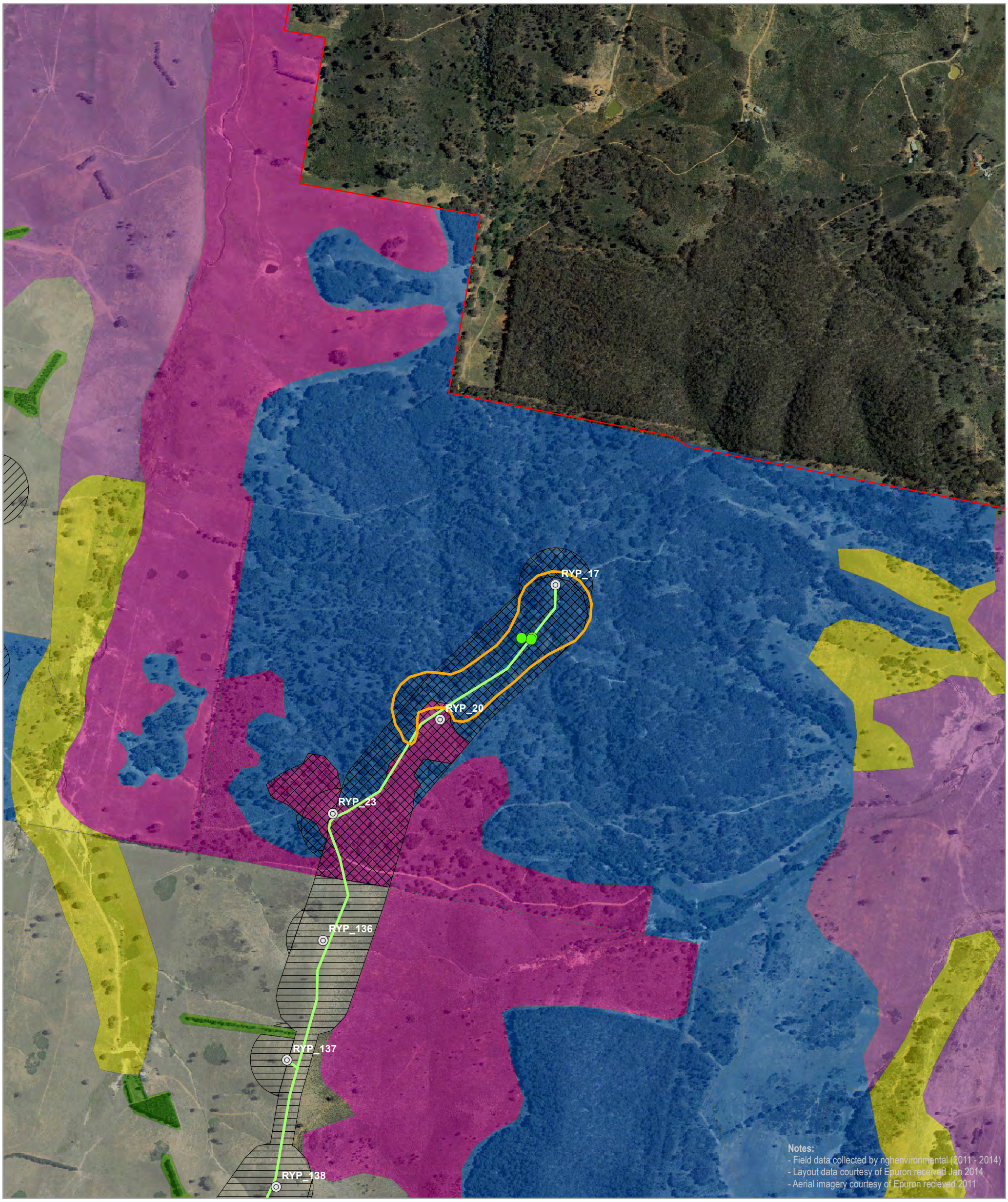

FAUNA HOLLOW_BEARING TREE SURVEY RESULTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
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- O&M building
- Construction compound
- Concrete batching plant
- HBT survey areas
- Hollow-bearing trees - Quality
- High
- Medium
- Low
- Vegetation condition
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- Moderate
- Poor
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- Derived Grassland
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- Native pasture
- Phragmites within dam
- Planted native vegetation
- Red Box Woodland
- Scribbly Gum Forest
- Sifton Bush Shrubland

0 150 300 Meters

A3 @ 1:10000
Ref: 5439 - 4
Author: DM

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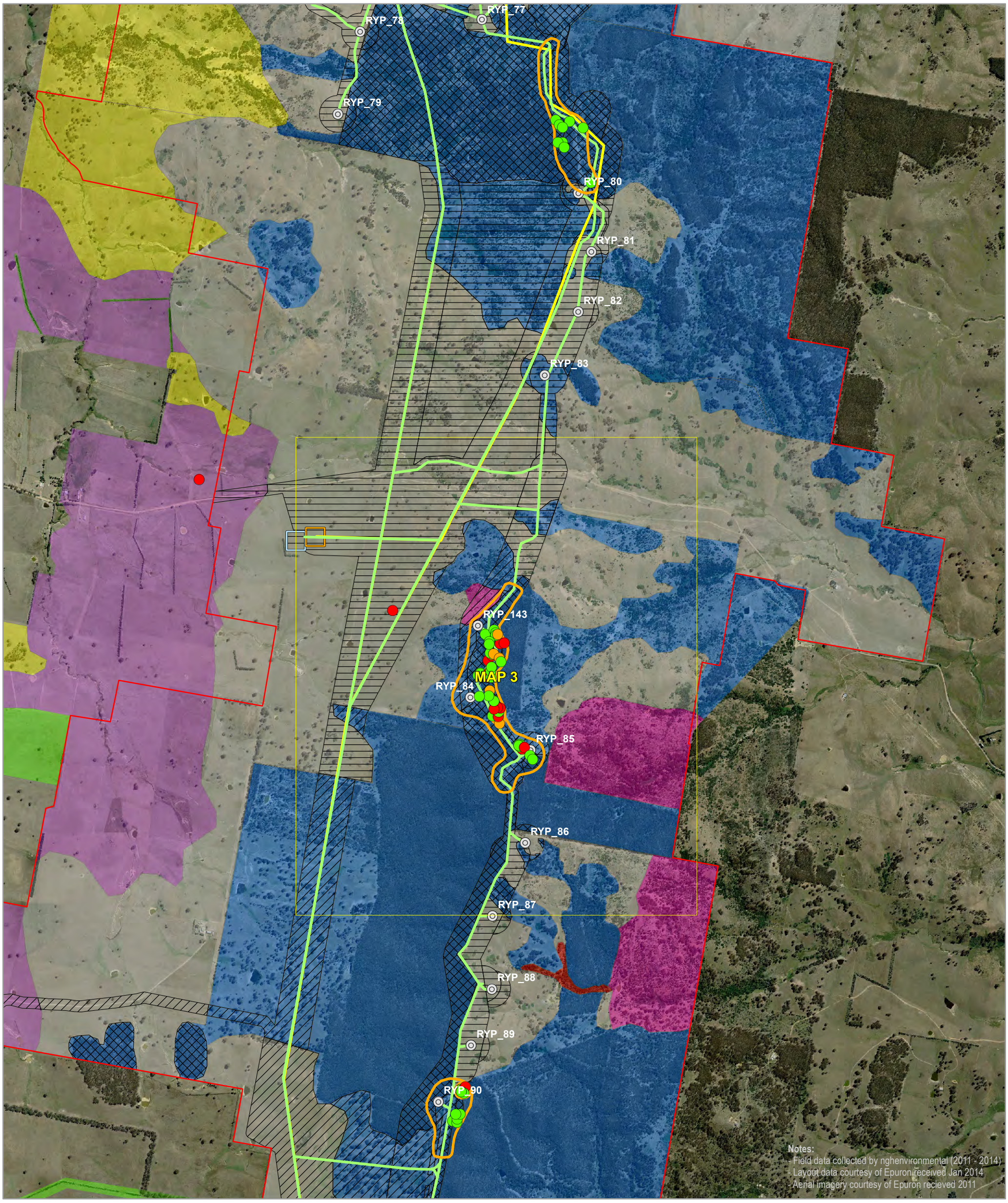

FAUNA HOLLOW_BEARING TREE SURVEY RESULTS MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- HBT survey areas
- Hollow-bearing trees - Quality
  - High
  - Medium
  - Low
- Vegetation condition
  - Good
  - Moderate
  - Poor
- Vegetation type
  - Argyle Apple Forest
  - Box-Gum Woodland
  - Brittle Gum Forest
  - Derived Grassland
  - Exotic pasture
  - Native pasture
  - Phragmites within dam
  - Planted native vegetation
  - Red Box Woodland
  - Scribbly Gum Forest
  - Sifton Bush Shrubland

0 150 300 Meters

A3 @ 1:20000
Ref: 5439 - 4
Author: DM

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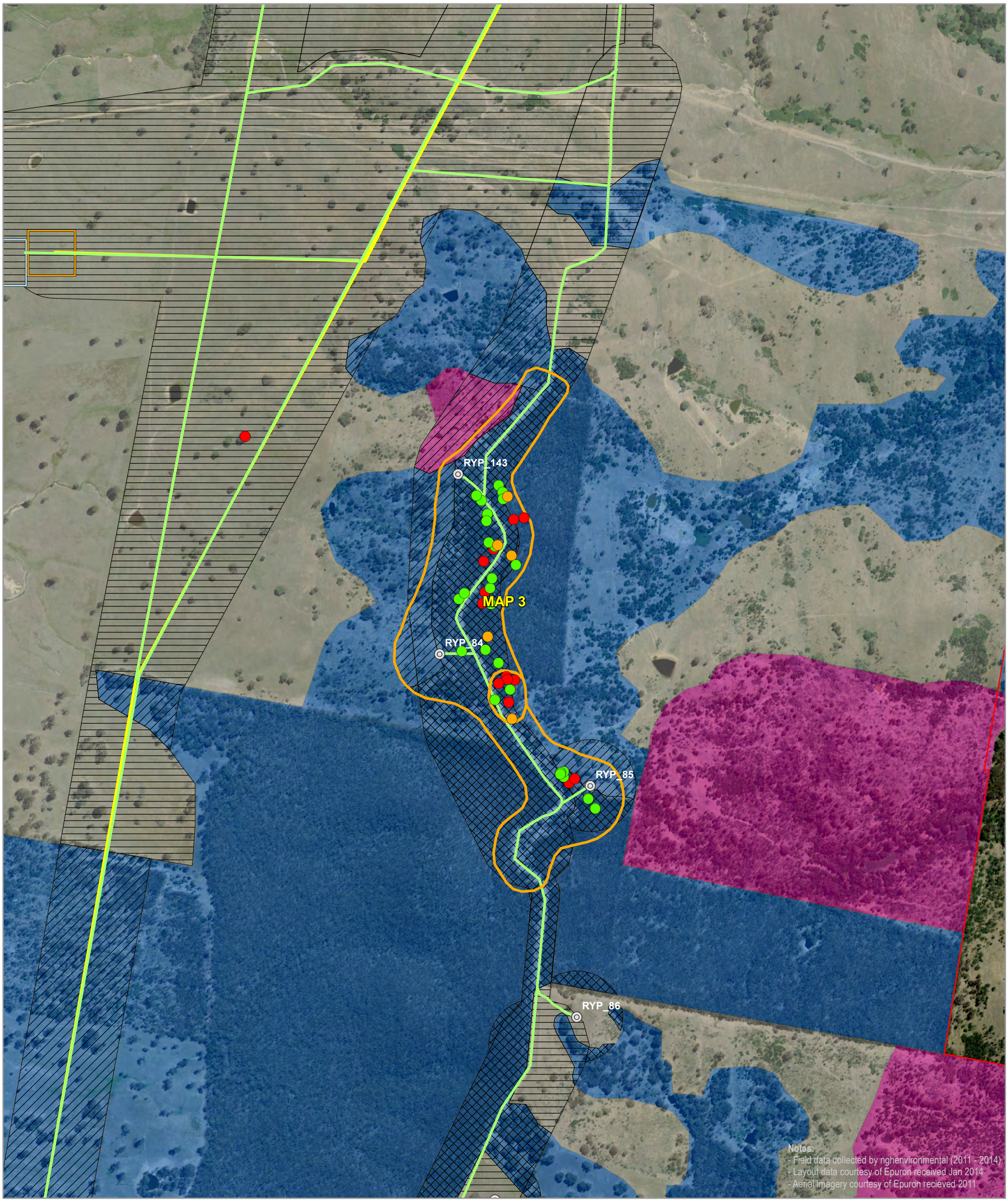

FAUNA HOLLOW_BEARING TREE SURVEY RESULTS MAP 3

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
- Turbine location
- Access track
- Underground cabling
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- Planted native vegetation
- Red Box Woodland
- Scribbly Gum Forest
- Sifton Bush Shrubland

0 150 300 Meters

A3 @ 1:8000
Ref: 5439 - 4
Author: DM

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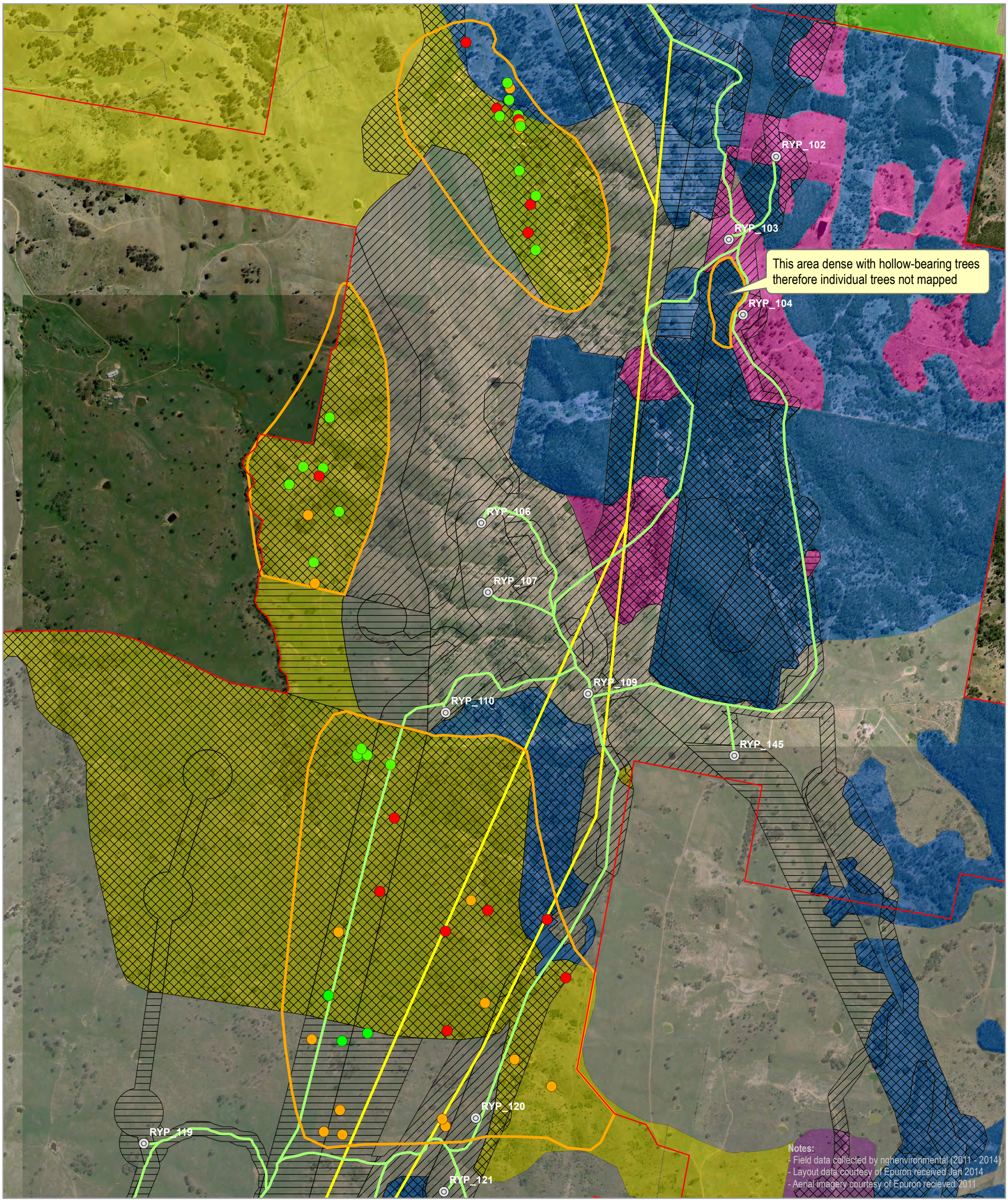

FAUNA HOLLOW_BEARING TREE SURVEY RESULTS MAP 4

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- HBT survey areas
- Hollow-bearing trees - Quality
  - High
  - Medium
  - Low
- Vegetation condition
  - Good
  - Moderate
  - Poor
- Vegetation type
  - Argyle Apple Forest
  - Box-Gum Woodland
  - Brittle Gum Forest
  - Derived Grassland
  - Exotic pasture
  - Native pasture
  - Phragmites within dam
  - Planted native vegetation
  - Red Box Woodland
  - Scribbly Gum Forest
  - Sifton Bush Shrubland

0 150 300 Meters

A3 @ 1:15000
Ref: 5439 - 4
Author: DM

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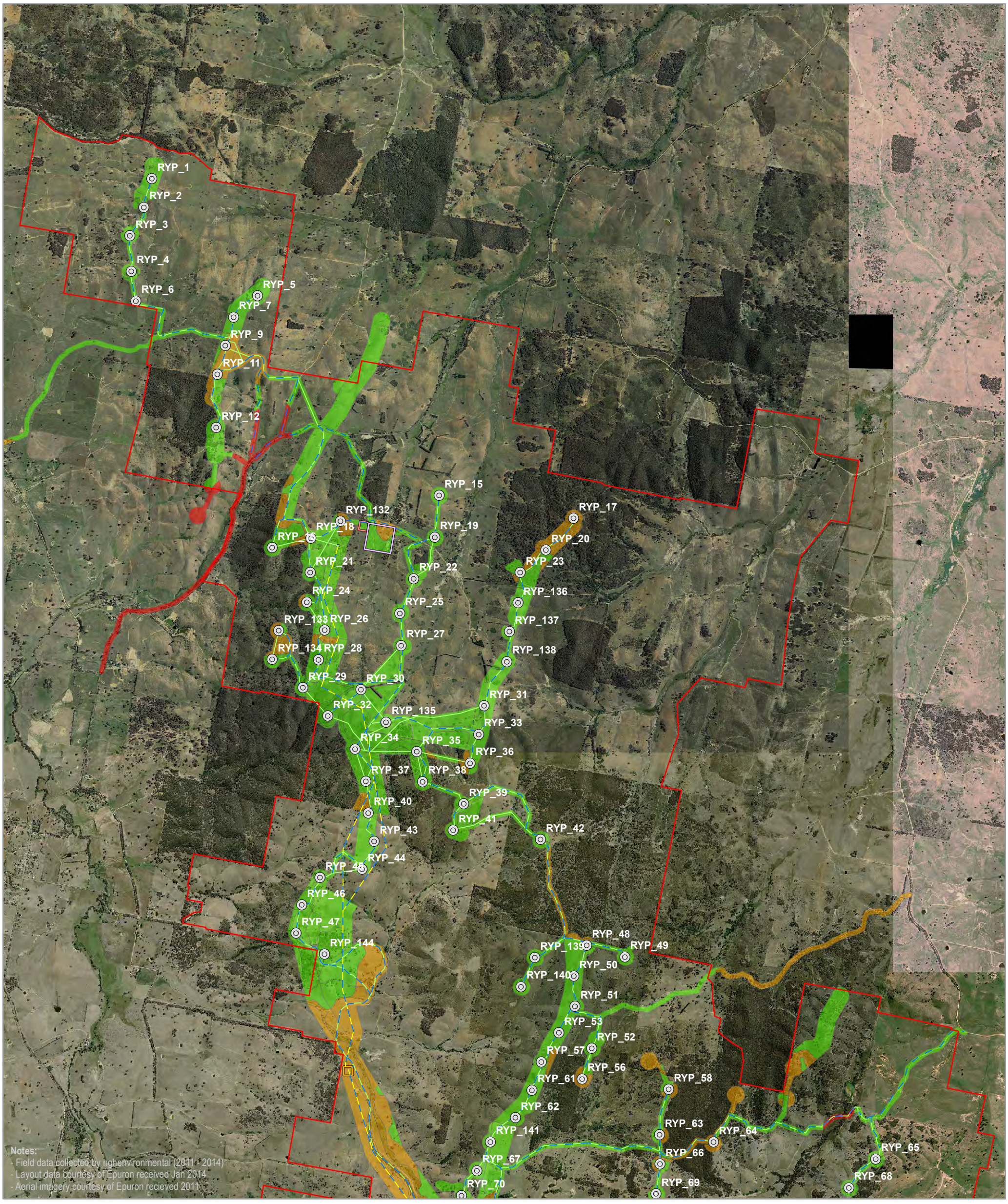

FLORA CONSTRAINTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
  - Substation
  - Termination compound
  - O&M building
  - Construction compound
  - Concrete batching plant
- Constraints
  - High
  - Moderate
  - Low

0 0.5 1 Kilometres

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Author: DM

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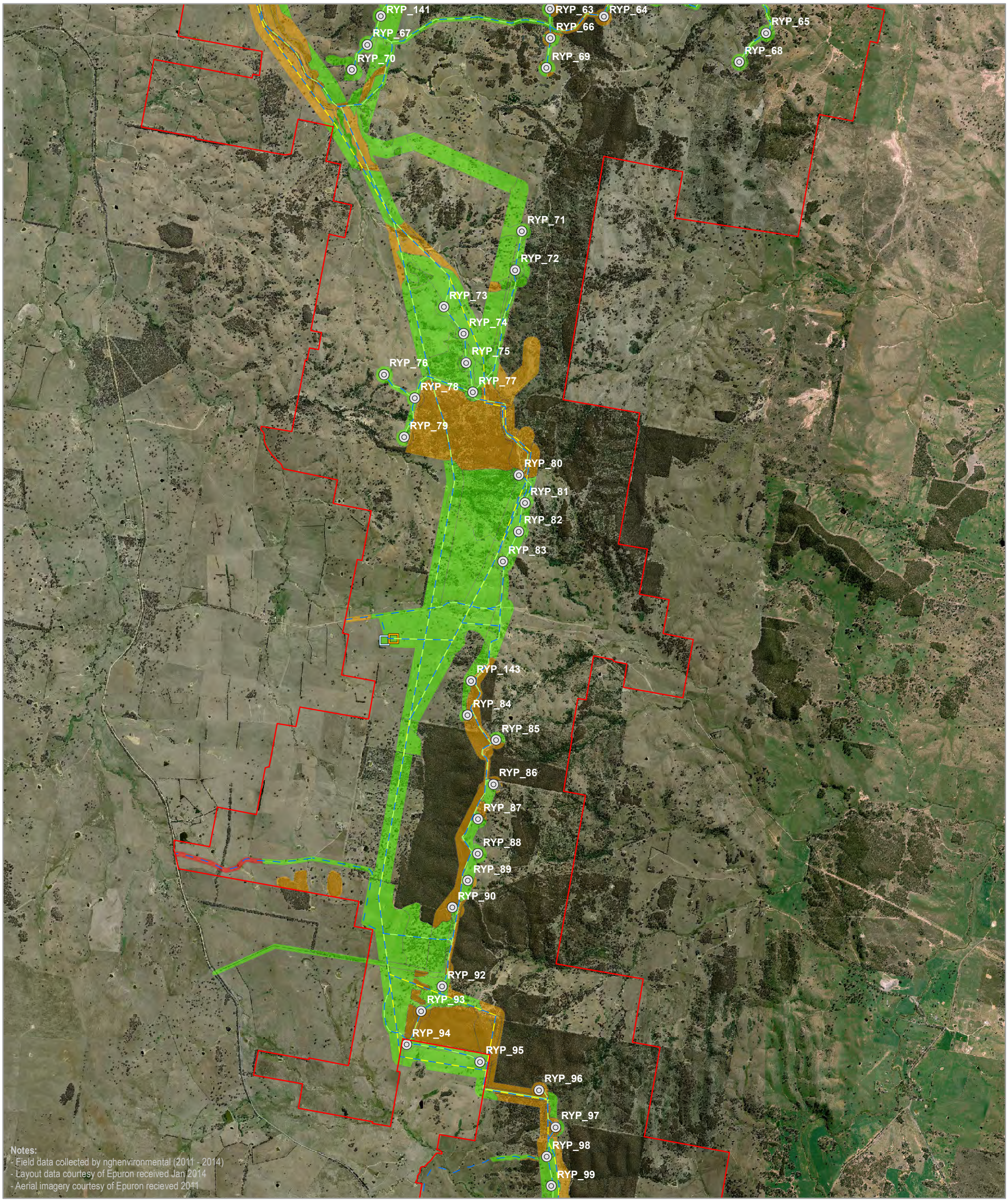

FLORA CONSTRAINTS MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant
- Constraints
  - High
  - Moderate
  - Low

0 0.5 1 Kilometres

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Ref: 5439 - 1
Author: DM

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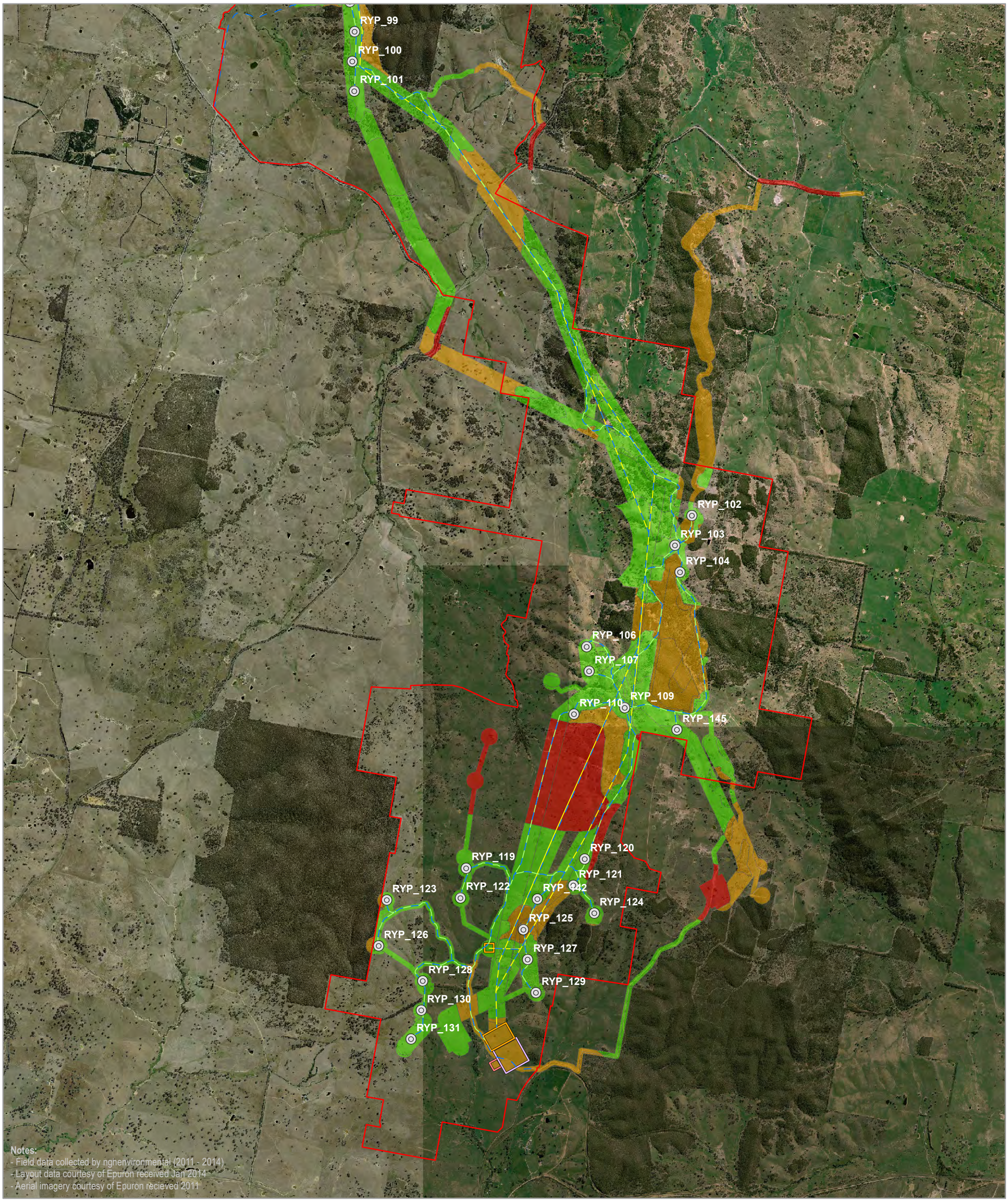

FLORA CONSTRAINTS MAP 3

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Infrastructure
  - Turbine location
  - Access track
  - Underground cabling
  - Overhead transmission line
  - Substation
  - Termination compound
  - O&M building
  - Construction compound
  - Concrete batching plant
- Constraints
  - High
  - Moderate
  - Low

0 0.5 1 Kilometres

A3 @ 1:42000
Ref: 5439 - 1
Author: DM

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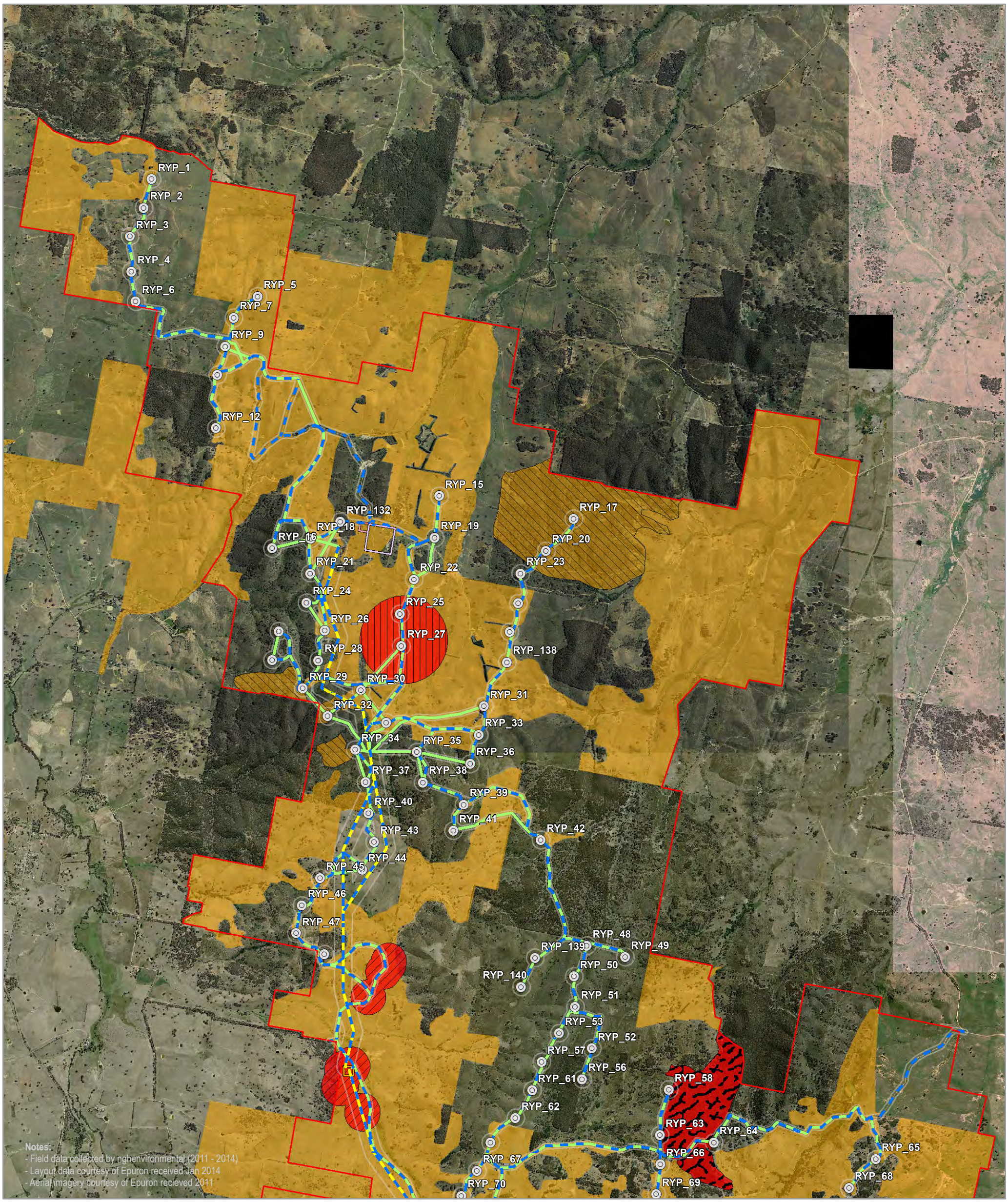

FAUNA CONSTRAINTS MAP 1

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Development envelope

Infrastructure

- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

Fauna constraints

- High constraint

Reason

- Dense area of HBTs
- GSM habitat 200m buffer
- Nest tree 100m buffer
- SLL habitat 500m buffer
- Superb Parrot/Painted Honey Eater corridor and SP nest trees
- Turbine(s) on edge of continuous good quality woodland/forest

- Moderate constraint

Reason

- Potential GSM habitat
- High number of threatened species
- Turbine(s) surrounded by patchy good condition woodland/forest

Note: Other areas not mapped within the development envelope are considered low constraint

0 0.5 1 Kilometres

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Author: DM

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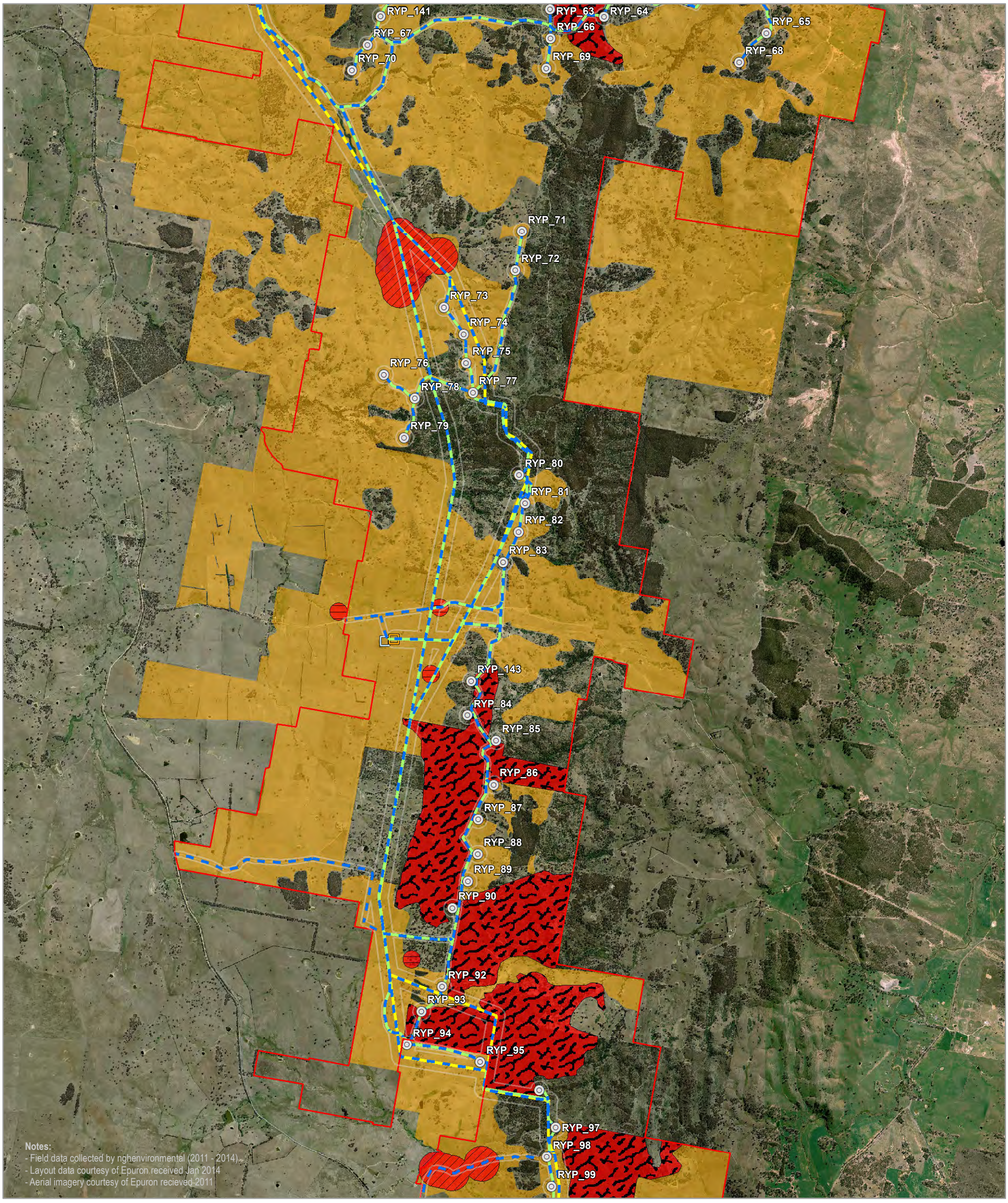

FAUNA CONSTRAINTS MAP 2

Rye Park Wind Farm Biodiversity Assessment

- Site perimeter
- Development envelope

Infrastructure

- Turbine location
- Access track
- Underground cabling
- Overhead transmission line
- Substation
- Termination compound
- O&M building
- Construction compound
- Concrete batching plant

Fauna constraints

- High constraint

Reason

- Dense area of HBTs
- GSM habitat 200m buffer
- Nest tree 100m buffer
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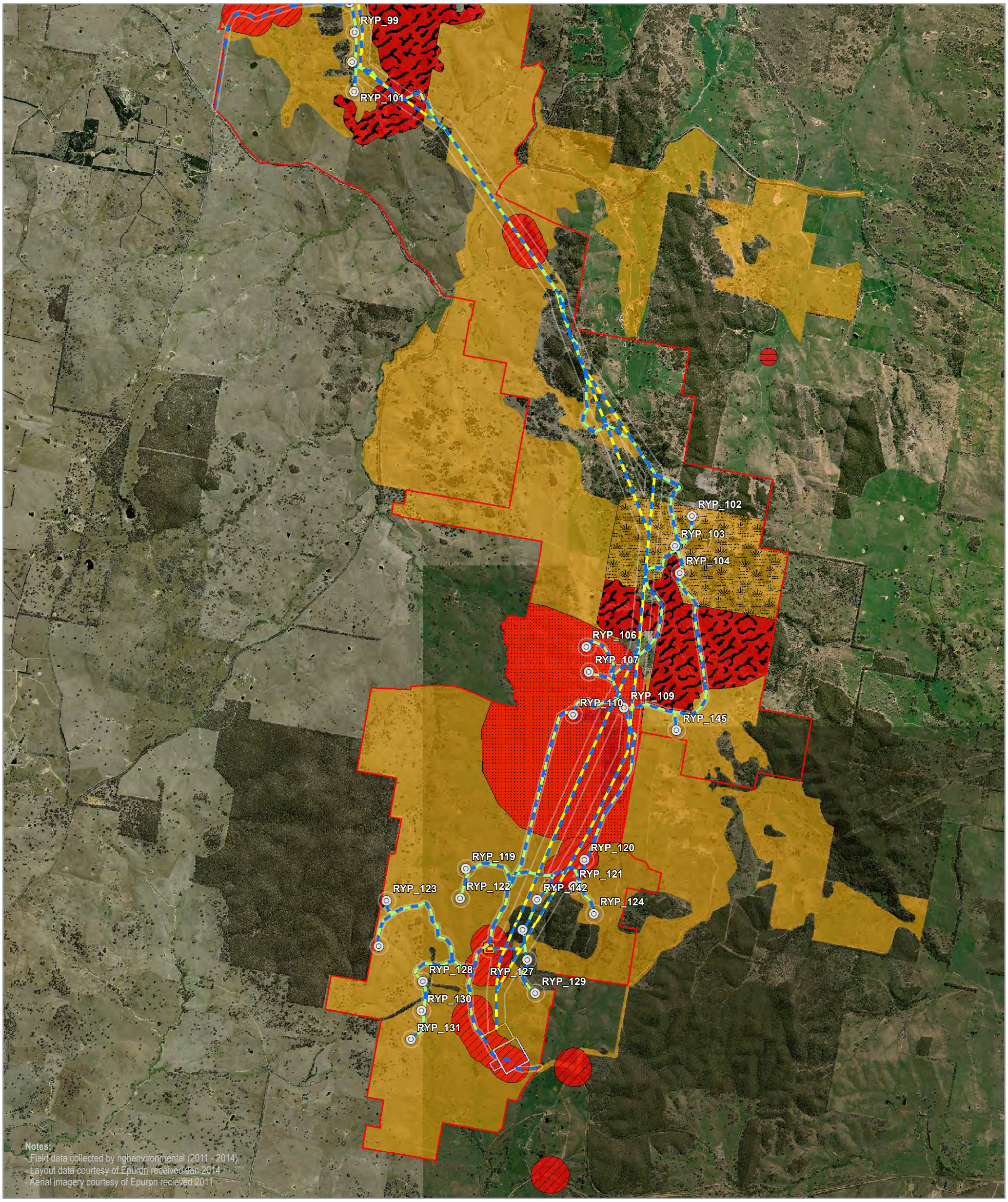

FAUNA CONSTRAINTS MAP 3

Rye Park Wind Farm Biodiversity Assessment

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Rye Park Wind Farm
Aboriginal Cultural Heritage Assessment Report

A report to Epuron

January 2013

Proponent: Rye Park Wind Farm Pty Ltd
Local Government Area: Yass Valley, Boorowa, and Upper Lachlan Shire Councils

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SUMMARY

This summary presents an overview of the Aboriginal heritage study aims, results and recommendations.

New South Wales Archaeology Pty Ltd was commissioned in March 2012 by Epuron to undertake an Aboriginal cultural heritage assessment in relation to the proposed Rye Park Wind Farm. This report documents the proposed impact area, the assessment process, findings, interpretation of results and recommendations.

The assessment has been conducted in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (NSW DEC July 2005), the NSW Office of Environment and Heritage's *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW DECCW 2010a).

A process of Aboriginal community consultation has been undertaken in accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (NSW DEC July 2005) and OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b).

The study has sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the proposal areas, and formulate management recommendations based on the results of the community consultation, background research, field survey and a significance assessment.

The proposed Rye Park Wind Farm is defined as a State Significant Development. This Aboriginal Cultural Heritage Assessment Report (ACHAR) has been prepared to form a component of an Environmental Impact Statement (EIS) which addresses the NSW Planning & Infrastructure, Director General's environmental assessment requirements (DGRs).

Thirteen Aboriginal object locales were recorded during the field survey, 10 of which are single stone artefacts. Undetected or subsurface stone artefacts are predicted to be present in extremely low density. In addition, three quartz outcrops have been recorded which may have been used as stone procurement areas by Aboriginal people. Establishing the artefactual status of these has not been possible based on a visual assessment alone. However, as a precautionary measure it is recommended that they be avoided during construction by implementing a strategy of micro-siting of turbines, roads etc. Three European heritage items have been recorded, and while these do not warrant heritage listing, it is recommended that they also be avoided by micro-siting the relevant components during construction.

The Effective Survey Coverage achieved during the survey is considered to have been sufficient to characterise the nature of artefact distribution. The survey results are therefore assessed to be a relatively accurate reflection of the archaeological status and

artefact density in the proposal area. Accordingly, based on the relevant predictive model of site distribution and the results of the field survey, the proposal area is assessed to be of generally low cultural and archaeological potential and significance. This assessment forms the basis for the formulation of recommendations relating to the proposal.

The Aboriginal object locales comprised of stone artefacts (and any undetected and subsurface artefacts) do not surpass archaeological and cultural significance thresholds which would act to preclude the construction of the proposed wind farm.

Based on a consideration of the predictive model applicable to the environmental context in which impacts are proposed, and the results of the study, it is concluded that the proposed impact areas do not warrant further investigation such as subsurface test excavation.

Given the nature and density of the artefact locales recorded and the low cultural and scientific significance rating they been accorded, unmitigated impacts is considered appropriate. A management strategy of impact avoidance is not warranted, except in respect of the three quartz outcrops. It is recommended also, that the three European heritage items are avoided during construction.

The following recommendations are provided in summary form (see Section 9):

- The proposal area does not warrant further archaeological investigation such as subsurface test excavation. The Effective Survey Coverage achieved during the field survey is considered to have been adequate for the purposes of determining the archaeological status of the proposal area.

- The recorded Aboriginal object locales and the predicted very low density subsurface artefact distribution in the proposal area does not surpass archaeological significance thresholds which would act to preclude the proposed impacts.

- The recorded Aboriginal object locales are assessed to be representative of an extremely low density distribution of stone artefacts. The archaeological and cultural heritage significance of these locales is assessed to be low. Accordingly unmitigated impact is considered to be appropriate.

- There are no identified archaeological and cultural heritage constraints relating to the proposal.

Acknowledgments

Julie Dibden, NSW Archaeology Pty Ltd, acknowledges the assistance in this project provided by:

Brian Hall, Epuron

Bianca Heinze: nghenvironmental

Buru Ngunawal Aboriginal Corporation for assistance with field work

The many property owners who assisted in various ways with information and access

Archaeological evidence confirms that Aboriginal people have had a long and continuous association with the Yass region for thousands of years. We would in particular like to acknowledge and pay our respects to the traditional owners of the country which is encompassed by the proposal.

1. INTRODUCTION

1.1 Introduction

NSW Archaeology Pty Ltd has been commissioned by Epuron to conduct an Aboriginal heritage (archaeological and cultural) assessment in relation to a proposed wind farm near Rye Park (the subject area), north of Yass and east of Boorowa. The area in which impacts are proposed is shown on Figure 1.

The Rye Park Wind Farm proposal would involve the construction and operation of up to 128 wind turbine generators. The turbines would be placed along a series of ridgelines and surrounding crests currently used for farming. The wind farm would produce up to 393 Megawatts (MW) of clean renewable energy.

The project would be assessed under Part 3 of the EP&A Act. It would be classed as State Significant Development (SSD) under State Environmental Planning Policy (State and Regional Development) 2011. This report addresses the Director-General's Requirements (DGRs) relating to archaeology and cultural heritage for the preparation of the Environmental Assessment for the project. The DGRs require:

- An assessment of the potential impact of the projects components on Aboriginal heritage values (archaeological and cultural);
- Effective consultation with Aboriginal stakeholders during the assessment and in development of mitigation options, consistent with the Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC July 2005); *and*
- Consideration of impacts to European heritage values, as relevant.

The project site is located in the Yass Valley, Boorowa, and Upper Lachlan Shire Councils.

The proposal is comprised of the installation and construction, operation and decommissioning of the following infrastructure:

- Up to 128 wind turbine generators (wtg's);
- Electrical connections between wind turbines using a combination of underground cabling and overhead power lines;
- Underground communications cabling;
- Substations and transmission connections linking the wind turbines to an existing transmission system;
- Temporary construction facilities, site compounds, storage areas and batching plants;
- Access roads for installation and maintenance of wind turbines; and
- Onsite control rooms and equipment storage facilities.

The content and format of this report is set out in accordance with the NSW OEH (2011) *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* document. The report aims to document:

- The Aboriginal objects and declared Aboriginal places (as relevant) located within the area of the proposed activity;
- The cultural heritage values, including the significance of the Aboriginal objects and declared Aboriginal places that exist across the whole area that will be affected by the proposed activity, and the significance of these values for the Aboriginal people who have a cultural association with the land;
- How the requirements for consultation with Aboriginal people have been met (as specified in clause 80C of the NPW Regulation);
- The views of those Aboriginal people regarding the likely impact of the proposed activity on their cultural heritage (if any submissions have been received as a part of the consultation requirements, these are included and our response outlined);
- The actual or likely harm posed to the Aboriginal objects or declared Aboriginal places from the proposed activity, with reference to the cultural heritage values identified;
- Any practical measures that may be taken to protect and conserve those Aboriginal objects or declared Aboriginal places; *and*
- Any practical measures that may be taken to avoid or mitigate any actual or likely harm, alternatives to harm, or, if this is not possible, to manage (minimise) harm.

The cultural heritage assessment has been managed by Julie Dibden, NSW Archaeology Pty Ltd. The field work component has been conducted by Julie Dibden and Andrew Pearce, NSW Archaeology Pty Ltd, and members of Buru Ngunawal Aboriginal Corporation, Karen Denny, Wally Bell and Tyrone Bell.

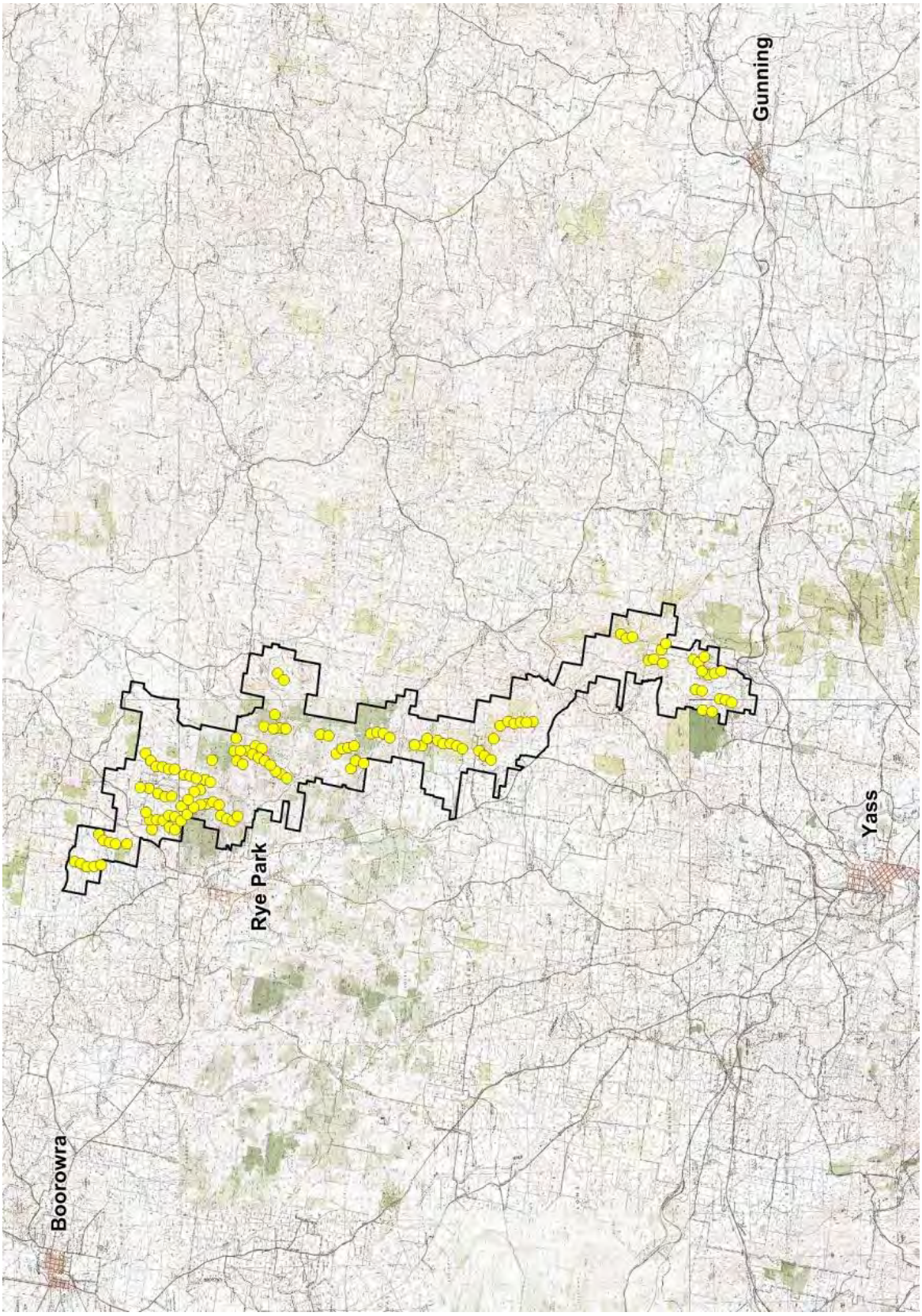

Figure 1 The location of the proposed Wind Farm (map supplied by the proponent).

2. DESCRIPTION OF THE AREA – BACKGROUND INFORMATION

In this section, background and relevant contextual information is complied, analysed and synthesised. The purpose of presenting this material is to gain an initial understanding of the cultural landscape. The following topics are addressed (*cf.* OEH 2011: 5):

- The physical setting or landscape;
- History of peoples living on that land; *and*
- Material evidence of Aboriginal land use.

2.1 The Physical Setting or Landscape

A consideration of landscape is necessary in archaeological work in order to characterise and predict the nature of Aboriginal occupation across the land. In Aboriginal society, landscape could be both the embodiment of Ancestral Beings and the basis of a social geography, and economic and technological endeavour. The various features and elements of the landscape are/were physical places that are known and understood within the context of social and cultural practice.

Given that the natural resources that Aboriginal people harvested and utilised were not evenly distributed across landscapes, Aboriginal occupation and the archaeological manifestations of that occupation will not be uniform across space. Therefore, examination of the environmental context is valuable for predicting the type and nature of archaeological sites which might be expected to occur. Factors which typically inform the archaeological potential of a landform include the presence or absence of water, animal and plant foods, stone and other resources, the nature of the terrain and the cultural meaning associated with a place.

Additionally, geomorphological and humanly activated processes need to be defined as these will influence the degree to which archaeological sites may be visible and/or conserved. Land which is heavily grassed and geomorphologically stable will prevent the detection of archaeological material, while places which have suffered disturbance may no longer retain artefacts or stratified deposits. A consideration of such factors is necessary in assessing site significance and formulating mitigation and management recommendations.

The following information describes the landscape context of the study area.

The proposed Rye Park Wind Farm would be located to the north of Yass and east of Boorowa. The wind farm site extends in a north/south alignment measuring approximately 40 kilometres along a series of contiguous ridgelines and hilltops. The site has been selected for its windy ridges and cleared grazing land (for example, see Plate 1). The proposal would involve approximately 40 properties that are currently used for sheep and cattle grazing.

The area is on the Yass, Binnalong and Boorowa 1:50,000 topographic maps. For mapping purposes it is located in Zone 55.

The proposed wind farm site is situated in the Southern Tablelands of New South Wales and is part of the Eastern Uplands of south-eastern Australia (Jennings and Mabbutt 1977). The Eastern Uplands consists of a wide plateau which extends from the coastal escarpment on the east, to the slopes of its western side. The landscape has low relative relief, lies generally below 600m altitude and possesses slopes generally less that 5° with about 20% of the area containing steeper hills and ranges. The wind farm site is situated within the steeper country. The area has a strongly seasonal thermal climate (Jennings and Mabbutt 1977).

The area is in the Dalton Hills Landscape and this is described as linear ridges and undulating hills of steep dipping, folded Ordovician quartzose, greywackie, slate, chert and phyllite (NSW DECC 2008). The soils derived from this landscape include red soils on the upper slopes, grading to harsh yellow clay subsoils with hard setting A horizons on the lower slopes.

Plate 1 Typical ridge crest (south end of Survey Unit 11) on which wind turbine generators are proposed.

The geology across the majority of the site is Ordovician sedimentary sequences which outcrop variously as shale or slate (Branagan and Packham 2000). The porphyry of the Hawkins volcanics (Early Silurian) outcrops in the south-west near Bango Nature Reserve. The landforms in the wind farm area are very rocky. Low outcrops are common, particularly on crests and hillslopes where, in many cases, bedrock is present at greater than 50 per cent (Plates 2 and 3). The excessively rocky nature of much of the ridge crest

is likely to have made these landforms unfavourable camp locations for Aboriginal people.

Plate 2 Typical rocky ground (north end of Survey Unit 7).

Plate 3 Typical rocky ground close up (SU1).

The dominant soils are red and yellow podzolic lithosols on crests and hillslopes, and red and yellow earths in valleys (Wasson *et al.* 1998). Soils on ridgelines are highly eroded lithosols. Over-grazing and wind is the likely to have been the primary agents of soil removal. Previous erosion has significant ramifications in regard to the stability and integrity, or otherwise, of artefact bearing soil formations, both on crests and within valleys. Plates 3 and 4 exemplify the eroded, skeletal nature of soils on the turbine ridges.

Soils within valleys are both alluvial and colluvial and, while undoubtedly disturbed are, of reasonable depth. In areas adjacent to drainage lines Post Settlement Alluvium is likely to be present above the original land surface.

Land clearance commenced in the region with its occupation by early settlers during the early to mid 1800s. Following clearance, the arable land was utilised for both grazing and various cultivation endeavours including pasture improvement and cropping, while hilly land has been used exclusively for grazing. While the majority of the subject area, including the ridges, hill slopes and valleys, is cleared, there are large areas of regenerating treed country comprised solely of young regrowth (Plate 5).

As a result of the long history of grazing and cultivation, the proposal is located within a highly degraded landscape, where vegetation, soils and geomorphological processes have been dramatically altered by clearing, cropping and grazing (Wasson *et al.* 1998). Tree clearance, the grazing of sheep and cultivation in the Southern Tablelands, has resulted in increased runoff and erosion, both on hill slopes and valley floors, much of which commenced very soon after initial European occupation (Wasson *et al.* 1998). These erosional processes have led to significant changes to landscape processes. More recently dryland salinity has become a problem in the area as a result of earlier vegetation clearance.

Prior to European settlement, the vegetation on hill slopes was open forest dominated by Eucalyptus species; valley floors contained extensive grasslands and swamps (Wasson *et al.* 1998). The botanist and explorer Allan Cunningham visited the region in 1824 and described the vegetation structure and stream character he observed at that time. From descriptions by Cunningham, and others, Wasson *et al.* (1998) have concluded that streams in the region with a catchment of greater than 1000 km^2 possessed a continuous channel, while streams with smaller catchments had less distinct channels often described by early commentators as chains of ponds. The naturalist Lhotsky, in 1834 described the ponds as follows: 'They are commonly round or oval basins of from 20 – 200 feet in diameter or length, excavated or sunk in the superficies of an alluvial soil, which is commonly of a rich kind ...' (cited in Wasson *et al.* 1998). The creeks located within the proposal area would all fall within the smaller catchment category as described above and, accordingly, are likely to have similarly possessed indistinct channels and chains of ponds. Now, however, these features are absent and instead channel incision has created eroded channels (for example, see Plate 7).

Plate 4. Rocky ground (Survey Unit 24).

Plate 5 Turbine ridge with regenerating bush to the right of the track; dead trees on the left exemplify recent attempts to control regrowth (Survey Unit 6).

Plate 6 Turbine ridge (Survey Unit 6); regrowth and dead and fallen timber.

Plate 7 An typical example of gully erosion in drainage lines (south end of Survey Unit 14) .

No major rivers flow through the proposal area, however, there are numerous lower order creeks which are likely to have been discontinuous channels with chains of ponds and possibly minor swamp features prior to European impacts. While not necessarily being places of abundant water, they are likely to have provided Aboriginal land users with a reasonably reliable local water source. Indeed, Malcolm Day, a landowner at the southern end of the wind farm, indicates that even in very dry conditions, springs flow through that country (pers. comm.). However, the elevated hill landforms (crests and slopes), by and large, are unlikely to have provided any potable water.

The proposal area can be characterised as a woodland resource zone. The ridge crests would have possessed limited biodiversity and a general lack of water. Accordingly, they are likely to have been utilised by Aboriginal people for a limited range of activities which may have included hunting and gathering and travel through country (Wally Bell per. comm.). Such activities are likely to have resulted in very low levels of artefact discard. The nature of stone artefacts discarded can be expected to have been correspondingly limited in terms of artefact diversity and complexity.

By comparison the valleys between the ridge lines and hills are likely to have possessed greater levels of biodiversity given the likely presence of chains of ponds and, possibly also, swamp features along drainage lines. In addition, a more reliable source of water is likely to have been present in valleys for much of the year. Such areas are likely to have been utilised more frequently and possibly by greater numbers of individuals at any one time; certainly the valleys are likely to have been the favoured camp locations while people occupied the broader local area. Accordingly, the levels of artefact discard in valleys can be predicted to be correspondingly higher; artefact diversity and complexity is also likely to be greater.

2.2 History of Peoples Living on the Land

Aboriginal people have occupied Australia for at least 40,000 years and possibly as long as 60,000 (Mulvaney and Kamminga 1999: 2). By 35,000 years before present (BP), all major environmental zones in Australia, including periglacial environments of Tasmania, were occupied (Mulvaney and Kamminga 1999: 114). At the time of early occupation, Australia experienced moderate temperatures. However, between 25,000 and 12,000 years BP (the Last Glacial Maximum), dry and either intensely hot or cold temperatures prevailed over the continent (Mulvaney and Kamminga 1999: 114). At this time, the mean monthly temperatures on land were 6 - 10ºC lower; in southern Australia coldness, drought and winds acted to change the vegetation structure from forests to grass and shrublands (Mulvaney and Kamminga 1999: 115-116).

During the Last Glacial Maximum at about 24 - 22,000 years ago, sea levels fell to about 130 metres below present and, accordingly, the continent was correspondingly larger. With the cessation of glacial conditions, temperatures rose with a concomitant rise in sea levels. By c. 6000 BP sea levels had more or less stabilised to their current position. With the changes in climate during the Holocene Aboriginal occupants had to deal not only with reduced landmass, but changing hydrological systems and vegetation; forests again inhabited the grass and shrublands of the Late Glacial Maximum. As Mulvaney and Kamminga (1999: 120) have remarked:

> *When humans arrived on Sahul's[1] shores and dispersed across the continent, they faced a continual series of environmental challenges that persisted throughout the Pleistocene. The adaptability and endurance in colonising Sahul is one of humankinds' inspiring epics.*

In the late Pleistocene much of the land in the region was covered in snow, with glaciers in the mountains and the lower plains being treeless. Over time, the Aboriginal people experienced and adapted to steady and considerable changes in conditions associated with gradual climatic warming, including the alteration of vegetation and variation in the distribution of wildlife (Young 2000).

Human occupation of south-east NSW dates from at least 20,000 years ago as evidenced by dated sites including the Burrill Lake rock shelter (Lampert 1971), Cloggs Cave (Flood 1980) and New Guinea 2 (Ossa *et al.* 1995). The Bulee Brook 2 site in the south coast hinterland ranges, excavated by Boot (1994), provides evidence that occupation of this zone had occurred by at least 18,000 years ago. In the south-eastern highlands, excavation of the Birrigai rock-shelter has provided dates of occupation from 21,000±200 years BP (Flood *et al.* 1987: 16). Pleistocene occupation sites are rare, however, and the majority of recorded sites date from the mid to late Holocene. It is nevertheless reasonable to assume that the Yass/Rye Park area was occupied and utilised by Aboriginal people from the late Pleistocene onwards.

The earliest European reports regarding the Aborigines of the region are provided through the written observations of the first explorers, adventurers and settlers to the district. These sources present only fragmentary and incomplete accounts of the traditional culture of those Aboriginal groups who inhabited the area. Very soon after European contact, with increasing numbers of white settlers after the 1820s, much of the Aboriginal language and lifestyle had changed before it could accurately be recorded. Because of this, reliable information is limited regarding traditional Aboriginal culture and social geography at the time of European arrival.

The primary focus of archaeological research in Australia throughout the 1960s, 1970s and 1980s was the examination of the relationship between Aboriginal people and their environment, and the mechanisms of adaptation in what was apparently a land of harsh conditions and scanty, or at best, seasonal resources. The bulk of archaeological research that has been undertaken in the region has been focused on examining these issues.

However, prior to the 1960s, most archaeological research was aimed at defining change in the archaeological record; this was before direct dating techniques became available and, accordingly, the issue of time was handled by identifying differences in archaeological materials in archaeological deposit – specific artefacts in different layers of deposits were used to define different cultural periods. With the application of direct dating techniques in the 1960s, research shifted away from the use of artefacts for defining different time periods, towards seeking to explain the nature of different artefacts and assemblages of artefacts and food remains in terms of adaptation to the

[1] Sahul is the name given to the single Pleistocene era continent which combined Australia with New Guinea and Tasmania.

environment. The 1960s also saw a shift towards the use of explicit scientific methods of reasoning in archaeological practice. This impetus influenced archaeologists to focus on research topics which were believed to be answerable within a scientific methodology. Topics dealing with site locational models, subsistence, technology and environmental adaptation were addressed. The following section outlines research conducted within the region.

Witter (1980) constructed a model of site distribution for the area situated between Canberra and Dalton. He argued that large lowland camps were found exclusively in river valleys or gently sloping land, while medium sized lowland camps were found mainly on escarpments and saddles. Witter (1980) suggested that mid to late Holocene occupation of the area was focused around both tributary and major stream valleys. He argued that seasonal movement entailed occupation of the tributary valleys and lower slopes during winter in order to be above cold air drainage but below cooler elevations. Additionally, these locations would have provided reliable water and the exploitation of a diversity of resource zones. During summer the larger valley bottoms and higher elevated zones were predicted to have been used.

Witter (1980) constructed two models of Holocene adaptation which he termed Riverine Oriented and Plateau Oriented. The Riverine model was defined as a subsistence regime based on the semi-arid plains which was focused on the exploitation of aquatic plants such as *Typha* and *Triglochia* and animals such as fish and crustacea. This economy was focused on the plains woodlands close to major rivers with seasonal usage of semi-arid and dry temperate uplands. The Plateau subsistence regime was considered to be based on *Acacia* as a vegetable staple. This economy was focused on ridges slopes and flats, however, with camp sites tethered to water.

Pearson (1981) completed a regionally based investigation of Aboriginal and early European settlement patterns in the Upper Macquarie River region. He excavated three rock shelters which revealed Aboriginal occupation of the area dating from 7000 years BP. Pearson characterised Aboriginal site patterning as follows:

- Aboriginal sites were strongly related to water sources. Distance to water varied from 10 to 500 m and generally the average distance to water decreased as site size increased;
- Sites were located on hilly and undulating landforms rather than on river flats or the banks of waterways. However, the regional incidence of landform variation biased this sample;
- Site location was influenced by good drainage and views over water courses and river flats;
- Most sites were located in open woodland contexts with smaller numbers being present in grassland or forest contexts;
- Burial sites and grinding grooves were situated close to habitation areas;
- Ceremonial sites were located away from habitation areas;
- Stone arrangements were located away from campsites in isolated places; they are associated with small hills and knolls or flat land;
- Quarry sites were located where suitable sources were present and reasonably accessible.

Based on an examination of early historical material, Pearson (1981) argued that the region was inhabited by a small number of clan groups each of which were comprised of 80 to 150 people. These groups were divided into smaller 'daily' units of up to 20 people. Pearson (1981) suggests that the 'daily' units made short moves between camp sites which resulted in elongated site formation such as continuous artefact scatters along creeks. Pearson presented ethnographic evidence which suggested that camp sites were not used for longer than three nights and that large sites therefore probably represented accumulations of short term visits.

Pearson (1981) also considered the issue of the reliance upon food staples. He argued that rather than a reliance on a singular food type, a wider based economy was practised with the implication that such a non-specialised economy would probably not have been affected by periodic shortfalls in certain foods and that human movement would have been similarly unaffected.

According to Witter and Hughes (1983), the low hill areas of the Lachlan catchment contained sites which are generally situated on valley flanks. They noted that sites are widely distributed with a higher frequency situated along water courses than in less well drained areas away from creeks and rivers. They posited a model suggesting that the economic focus was within major streams and valleys, with occasional usage of the dryer inland zones. Witter and Hughes (1983) suggested that during dry periods occupation was confined to major stream valleys and that in wetter times people would have moved along temporarily watered headwater streams and onto plateau areas.

White (1986) conducted a general study of the Wiradjuru in which the Witter model (as outlined above) was applied. White (1986) however, explored the basic notions of Riverine and Plateau further, emphasizing the regional division by stressing the comparative importance of less seasonally influenced terrestrial hunting in the east. In the Western Slopes region riverine plains '… interfinger (sic) with the higher land', and White argued that the economy in such country probably consisted of an annual regime which was dependant on the use of both riverine and plateau environments.

The Yass region was occupied by Aboriginal speakers of at least two languages, Wiradjuri and Ngunawal. G.A. Robinson (in Mackaness 1941) noted that the people of Yass were called Onerwal [Ngunawal] (White and Cane 1986). According to Jackson-Nakano (2002), the Aboriginal group who occupied the Yass and Boorowa districts in the early years of European settlement were the Wallabalooa tribe. Jackson-Nakano (2002) also indicates that, according to Bayley (who wrote a brief history of Yass), *Warrambalulah* was the Aboriginal name for the area on which the first township of Yass was settled in 1836.

Following European occupation, Aboriginal society changed from autonomy and economic independence to both economic dependence on, and enforced settlement, by Europeans (White and Cane 1986). It is possibly the latter situation which is now most recalled by Aboriginal people who were either directly affected, or now remembered on behalf of earlier generations; the local camps and reserves in Yass, and elsewhere, are now focal places in the memory of these times.

White and Cane (1986) have defined three phases of this history. When Europeans began to occupy the district, Aboriginal people moved seasonally between an autonomous economic practice based on hunting, fishing and so on, and engagement with the settler society whereby European foodstuffs were obtained. It is probable that during that time, Europeans and Aborigines forged a mutually beneficial relationship, entailing amongst other things, the exchange of labour, foods and protection. Jackson-Nakano (2002) suggests that prominent members of the Wallabalooa group such as Jacky King, Billy the Bull and his brother Andy Lane forged very good relations with the earliest European settlers on their lands, in particular, the Humes, Broughtons, Kennedys, Walkers and Howells. While engaging with settler society, this practice by Aboriginal people, was done so on their own terms. From 1851, reserves of land were set aside for Aboriginal people, however, generally they were avoided and not used. Instead people preferred living on stations located in their own country or the outskirts of towns such as Yass (White and Cane 1986). White and Cane (1986) note that reports in the Yass Courier of 1857 and 1858 refer to the Blacks Camp, which may refer to the same Yass River Camp used later in the 19th century and earlier 20th century.

In the period from the 1830s through until the 1860s, the 'Yass Blacks' were a dominant group and allegedly terrorised and conducted raiding parties on other groups as far a field as Bega and Eden. King Andy frequently went on raids in the Goulburn, Cowra, Molong and Wellington districts (Jackson-Nakano 2002). The territorial expansion conducted by the local Aboriginal people was facilitated, at least in part, by the strong ties which they established with the European settlers and their vast properties.

With the passing of the Robertson Land Acts in 1861, closer settlement by small-scale free selectors reduced the capacity for Aboriginal people to maintain their occupation of country. However, from this time Aboriginal people began to acquire their own parcels of land by purchase or gazettal, and to farm it. Of particular relevance to the current study, several of these properties were located in the Rye Park area at Brickey's Creek, Blakeney Creek and Flakeney Creek (Kaibala 1998). Between 1850s and the 1950s, Aboriginal families lived on farmlets and reserve land and did odd jobs for farmers or seasonal work on stations in the local area (Kaibala 1998).

By the 1880s, the European community at Yass began to demand that Aboriginal people around the town should be controlled. A parcel of land measuring 6 ½ acres at Oak Hill near the water works at Yass was set aside. With timber and iron provided by the Aborigines Protection Board 13 houses were built in 1888. One year later the land area of Oak Hill was reduced to 2 ½ acres (White and Cane 1986). By 1890, 78 people were recorded as living at this site in 12 houses and four bark huts. Similarly to earlier times, the occupation of the Oak Hill site was mutually beneficial to both Aborigines and Europeans. Aboriginal people were able to have ready access to the town economy, continue to live in family groups while being separate from whites, and work within the local economy. On the other hand, Europeans were happy to have Aborigines away from town but close enough to have access to their labour (White and Cane 1986).

However, in 1899 pressure mounted to remove the Aboriginal people from Yass. Inducements to encourage people to move to other reserves failed and by 1909 the Edgerton site, located 20 kilometres from Yass, was selected by the Aborigines

Protection Board. While some people moved to Edgerton, others petitioned to remain at Oak Hill. This request was refused and the North Yass site was revoked. By 1916, however, Edgerton was abandoned with the people having moved back into Yass and camped at Yass Junction with the men working on railway works (White and Cane 1986). People moved back to Oak Hill to a location at the bottom of the hill called The Rocks on the Yass River (White and Cane 1986).

This period until 1930, continued to be one of great difficulty for Aboriginal people, both elsewhere in the state but specifically at Yass (White and Cane 1986). It was during this time that children were removed from their families; between 1900 and 1915 fifteen children were removed from Aboriginal families in Yass. With the proposal to construct water works at Oak Hill at around 1925 Aboriginal people were again asked to leave the site. A new reserve was established in an attempt to remove people. This site known as Hollywood is located south of Yass near the cemetery; in 1934 people were moved to the new site, although one or two families remained at Oak Hill.

The Hollywood site was a failure from many points of view, and by 1940 Aborigines had begun to return to North Yass; this was objected to by whites. However, the situation for the remaining families at Hollywood was becoming untenable also due to the recognition of its inadequate situation (White and Cane 1986). Thereafter a period of resettlement including placing people in a limited number of houses in the town and movement to other reserves located well away from Yass began; Oak Hill also continued to be occupied.

Aboriginal people continue to live in Yass and surroundings areas and maintain strong links and concern for the sites of their ancestors.

2.3 Material Evidence

A search of the NSW OEH Aboriginal Heritage Management Information System (AHIMS) has been conducted for this project on the 11 April 2012 (Client Service ID: 67566). The search area measured 756 km^2 and encompassed the area between eastings 672000 – 690000, and northings 6147000 – 6189000.

Three Aboriginal object sites, none of which are in the proposed impact area, are recorded on AHIMS as present in the search area (see Appendix 1). The AHIMS register only includes sites which have been reported to NSW OEH. Generally, sites are only recorded during targeted surveys undertaken in either development or research contexts. Accordingly, this search cannot be considered to be an actual or exhaustive inventory of Aboriginal objects situated within the local area or indeed within the subject area itself.

The most common Aboriginal object recordings in the region are distributions of stone artefacts. Rare site types include rock shelters, scarred trees, quarry and procurement sites, burials, stone arrangements, contact sites, carved trees and traditional story or other ceremonial places. The distribution of each site type is related, at least in part, to variance in topography and ground surface geology.

One previously recorded Aboriginal sites, AHIMS #51-4-0058 is located along Flakeney Creek Road near to the project boundary (see Figure 3). The original recording indicates artefacts on the road, spread over a distance of 181 metres (x 5m wide). This site was inspected during the current study. Artefacts were found distributed along the edge of the road. No exposures were present off road, however, artefacts would be present across the broader toeslope landform in low density and a relatively undisturbed context. It is possible that this site could sustain impacts if the road were to be upgraded for site access during construction of the wind farm. The current disturbance at the site measures c. 3 metres wide (the road).

Searches have been conducted of the NSW State Heritage Inventory and the Australian Heritage database. No Aboriginal heritage sites are listed on these as being in the proposed activity area.

The following discussion in Section 2.3.1 will present a review of previous archaeological work in the region for the purposes of producing a predictive model of site type and location relevant to the study area.

2.3.1 Previous Environmental Impact Assessment

There have been no previous archaeological studies conducted within the study area itself and few have been undertaken within the immediate local area. However, a number have been undertaken in the broader region in response to statutory requirements for environmental impact assessment. The following discussion includes a review of archaeological work and its results conducted within the regional area.

Clark (1977) excavated three open artefact scatter sites at Waterhole Flat Creek, situated nine kilometres east of Boorowa. A variety of artefact types were recovered including backed blades, scrapers, adze flakes, bipolar flakes and cores. Smaller artefacts were made primarily on quartz, with chert, silcrete and rhyodacite also used. Larger artefacts including hatchets, unifacially and bifacially flaked choppers, anvils, hammerstones and grinding stones were also recovered.

Silcox (1991) recorded five open artefact scatters near the confluence of Castles Creek and Boorowa River, one kilometre upstream from Boorowa. These sites were located in exposures on the surfaces of river terraces. The number of artefacts recorded was low and no distinctive artefact types were present. Raw materials, however, were similar to those noted by Clark (1977).

Witter (1980) surveyed a proposed natural gas pipeline route from Dalton to Canberra. The survey crossed the Yass River and hilly country in the centre of the Upper Yass River catchment. Witter recorded 11 open campsites and 32 isolated finds. The majority of artefacts were comprised of quartz. Witter (1981) subsequently excavated one site and collected a total of 400 artefacts from six others. Backed blades were a prominent element in these collections. Silcrete was the principal raw material. Other materials included felsite, volcanics and quartz. Witter (1981:46) concluded that quartz was probably the predominant stone type utilised in the region.

Koettig and Silcox (1983) surveyed the route of the proposed freeway bypass north and east of Yass. Eight artefact scatters and 50 isolated finds were found within the 14 km x 200 m survey area. Seven of the sites were located on low ridges and slopes and one on creek flats. All of the sites were found within 200 metres of a watercourse.

Witter and Hughes (1983) began a survey of transmission lines from Wagga Wagga to Yass which completed by Packard and Hughes (1983). Two 'land systems' were identified in the study area: the plateau consisting of gently rolling hills, largely cleared of timber, and major stream valleys. Archaeological sites were rare in the hills and occurred mainly in areas close to major valleys. Witter and Hughes (1983) argued that this association probably reflects more than simply access to drinking water, noting that the valleys have the greatest vegetation diversity and contain a variety of aquatic food plants in streams. The initial survey located four Aboriginal sites, 13 isolated finds and a possible Aboriginal scarred tree. Packard and Hughes (1983) recorded five small artefact scatters, eight isolated finds and two possible Aboriginal scarred trees. Artefactual material was principally debitage. Quartz was the most common lithic material, with negligible percentages of acid volcanics and chert. Sites were located mainly in ploughed paddocks near creeks.

Packard (1984) conducted an investigation of the association of Aboriginal archaeological sites with modern areas of salinisation and salt scalding in the Yass River Basin. Of the 61 known salting sites, 35 were included in the analysis. Site location was found to range in elevation from 560 m-755 m asl, slope gradient less than 5° and most of the sites had north-west, north or easterly aspects (Packard 1984: 50). A wide range of artefact and stone types was found at most of the sites, suggesting that a range of activities had been carried out (Packard 1984: 54).

In 1985 Silcox and Koettig surveyed the route of the proposed alternate Yass bypass. The survey located three surface and two subsurface artefact scatters and six isolated finds. Eighty per cent of the sites were situated on ridgeline slopes or crests within 200 metres of creeks. This site locational pattern was noted to reflect in part the fact that creek or river valleys were not usually flat and that spurs and slopes usually terminated immediately adjacent to creeks. Surface artefact densities ranged from $1/30m^2$ to $1/40m^2$. Subsurface densities averaged $18/m^2$. Ninety per cent of the artefacts were unmodified flakes and flaked pieces; quartz was the dominant raw material. Silcox and Koettig concluded from the Yass By-pass studies that the pattern of distribution of sites in the Southern Tablelands was a predominance of small sites (less than 50 artefacts and often less than 10) interspersed with occasional medium sites of up to 300 artefacts, and on occasion, very large sites.

Koettig (1986a) investigated a proposed water pipeline route between Bowning and Yass and located two small artefact scatters and two Aboriginal scarred trees near Derringullen Creek, a permanent water course. The two artefact scatters consisted of three artefacts each. Subsequent subsurface testing was carried out at an area identified to be of high potential near Derringullen Creek. The area was relatively flat ground consisting of a series of three main spurs separated by shallow drainage channels and extending c. 700m adjacent to the creek. The testing located a consistent, however, very low density artefact distribution (Koettig 1986b).

Silcox and Koettig (1988) carried out a survey and test excavation within a six kilometre proposed alternative route for the Barton Highway extension at Yass. Five isolated finds and a surface scatter of >150 artefacts were recorded during the survey, with two additional sites located during subsurface testing. Average artefact density of excavated sites was found to vary between very low and low; density varied between 2.3/m² to 12/m². No artefacts were retrieved from one of the test locations, a broad end of a spur overlooking a wide valley of an ephemeral creek. Artefacts comprised flakes, flaked pieces, cores and a backed blade. Fifty seven per cent of the artefacts were of silcrete. Other raw materials recorded were quartz, indurated mudstone, volcanic and chert.

Dean-Jones (1990) conducted an assessment of a proposed hard rock quarry near Gunning. The study area included a crest and upper slopes of a hill north of the Lachlan River. No sites were recorded and this result was seen to be consistent with the predictive model of site location relevant to the area.

During a survey of a proposed fibre optic cable route between Cootamundra and Hall, ACT, Kuskie (1992) located a small artefact scatter on a broad elevated terrace on the southern side of the Yass River. The site comprised a retouched chert flake, a chert flaked piece and a broken acid volcanic flake.

Paton (1993) surveyed a proposed optical fibre cable route from Gunning to Dalton and Dalton to Flacknell Creek Road. The route traversed 21 kilometres of undulating hills in the Upper Lachlan River catchment. No Aboriginal sites were recorded and this result was deemed to be consistent with the predictive model of site location relevant to the area.

Robert Paton Archaeological Studies (1993) conducted a linear survey in relation to a proposed optical fibre cable route between Canberra and Orange. A section of this route extended from Boorowa to Cowra. Four open sites were recorded. Sites were found to be small and in disturbed contexts. All were found in association with permanent or semi permanent water. All artefacts, except one, were made of quartz.

Klaver (1993) recorded seven artefact scatters near Bookham in respect of the proposed Hume Highway Bypass. The sites were all low density artefact scatters consisting of mostly chert and quartzite flakes.

Navin and Officer (1995) conducted a survey of the Bogo Quarry situated on Black Range. The study area consisted of a low hill. One artefact scatter and two isolated finds were recorded. The scatter was found on low gradient basal slopes 400-500 m south of Stony Creek.

Oakley (1995) surveyed a number of proposed Optus towers in the region, one of which was Mt Bowning. No sites were found; the site was highly eroded and found to be of low potential.

Saunders (2000) recorded an Aboriginal open campsite of eight stone artefacts located by Ngunawal ACT and District Aboriginal Council of Elders Association monitors in the Powertel fibre optic cable easement approximately 20m south of the Yass River and

200m north of Yass River Road, northwest of Gundaroo. Saunders also recorded an Aboriginal artefact scatter located by Ngunawal ACT and District Aboriginal Council of Elders Association monitors 50m north of Dalton Open Camp Site (NPWS Site 51-5-003). The monitors collected 50 stone artefacts from the site.

Navin Officer Heritage Consultants (2001) investigated the site of the Yass substation located in an area of low gradient slopes, drainage lines and alluvial flats along the middle reaches of Booroo Ponds Creek. A small low density artefact scatter was found on a spur crest. The scatter comprised three flakes and a flaked piece. Raw materials were volcanic, silcrete and chert. The spur crest in the vicinity of the exposed artefacts was considered to have archaeological potential.

Jo McDonald Cultural Heritage Management Pty Ltd (JMcCHM 2003) undertook a survey of the Gunning Wind Farm, situated on the Cullerin Range. The Gunning Wind Farm proposal area consists of range crest and valley topography elevated at 840 meters (asl). Four sites containing stone artefact scatters and three isolated artefacts were recorded across the proposal area (JMcCHM 2003). One of the scatters was identified as a quartz quarry; blocky quartz was found to outcrop at the site. The majority of recorded artefacts were identified as quartz, however, quartzite, silcrete and red agate was also recorded. Steep hill tops were considered to be of low archaeological potential, while elevated contexts close to water were considered to be of higher sensitivity.

Austral Archaeology Pty Ltd (2005) conducted a program of subsurface test excavation at the proposed Gunning Wind farm site. The works entailed grader scrapes and no artefacts were recovered.

Dibden (2006a) recorded nine locales containing stone artefacts during an assessment of the proposed Conroys Gap Wind Farm. Artefact density calculations based on surface indicators indicate that all artefact locales contain low density artefact distributions. The Survey Units present in the study area were each assessed to be of low or very low archaeological potential based on various factors including nature of the topography, steep gradients and the distance from reliable water.

Dibden (2006b) recorded four locales containing stone artefacts during the study of the proposed Cullerin Wind Farm, situated north of Yass. Four locales containing stone artefacts were recorded. Artefact density calculations based on a consideration of effective survey coverage indicate that all artefact locales, and the Survey Units in which they are situated, contain low density artefact distributions.

OzArk Environmental and Heritage Management (2007) conducted a survey of the Wagga Wagga – Yass 132kV transmission line. The proposal related to pole replacement works in an existing easement. Four Aboriginal artefact scatters only were recorded during the field survey of the entire route.

Austral Archaeology Pty Ltd (2008) surveyed a transmission line associated with the Gunning Wind farm and a number of other small discrete impact proposals. 25 sites were recorded, defined as 13 open artefacts scatters, 9 isolated finds, two areas of PAD and a scarred tree. The majority of finds were located on ridgetops, which Austral Archaeology

Pty Ltd (2008) suggest reflects the use of these landforms for vantage points and movement through country. Austral Archaeology Pty Ltd (2008) argued that the diversity of the raw materials, lack of conjoined artefacts and related materials found in proximity suggested sporadic use over a long time rather than focused activities which might be expected to have taken place in more permanent habitation sites.

Dibden (2008) surveyed the proposed Yass Valley Wind Farm and recorded 116 Aboriginal object sites, most of which were low density stone artefact scatters. Artefact locales were frequently recorded on knolls and saddles of ridge crests and within valley bottom contexts. The majority of locales contained either single or otherwise very few artefacts. The majority of locales on crests are situated on deflated and eroded soil profiles. Given the relatively large areas of exposure encountered (in drought conditions), and the very few artefacts recorded, it was concluded that artefact density, generally was very low. This result was consistent with the relevant predictive model of Aboriginal land use.

Navin Officer Heritage Consultants (2009) conducted a cultural heritage assessment in relation to the proposed Dalton Peaking Power Plant, located some four kilometres north of the township of Dalton. Areas of proposed impact included a 15 hectare power plant site, a three kilometre long (corridor width 25 – 50 metres) gas pipeline, as well as an access road and communications tower. In total the survey area measured some 36 hectares of which 29.88 hectares was surveyed, over basal, upper and simple slopes, as well as spur crests and drainage lines. In the area of the proposed power plant, in conditions of moderate ground surface visibility, ten Aboriginal sites were located and two areas with potential archaeological deposit. The ten sites were comprised of six isolated finds, three low density artefacts scatters and one low density artefact scatter with potential archaeological deposit. Almost all sites were located on slopes, and were comprised of stone artefacts predominantly derived from silcrete, with some quartz and fine grained volcanic.

Thereafter a second survey was conducted in relation to the Dalton Peaking Power Plant (Navin Officer Heritage Consultants 2011) as the result of a rerouting of the proposed pipeline alignment. The survey area was 3.4 kilometres long, covering 15.3 hectares. In this survey three low density artefact scatters were recorded, located on crests and adjoining slopes, and comprised of stone artefacts predominantly derived from silcrete, with some chert, and minor representations of quartz and quartzite. Sites were described as being representative of 'background scatter and/or low density artefact distributions ... a common site type across the South East Highlands'.

Based on the above review and a consideration of the topography, geomorphology and hydrology of the study area the type of sites known to occur in the region and the potential for their presence within the study area are described in Section 2.3.2 below.

2.3.2 Predictive Model of Aboriginal Site Distribution

The type of sites known to occur in the region and the potential for their presence within the study area are listed as follows:

Stone Artefacts

Stone artefacts will be widely distributed across the landscape in a virtual continuum, with significant variations in density in relation to different environmental contexts. Artefact density and site complexity is expected to be greater near reliable water and the confluence of a number of different resource zones.

The detection of artefact scatters depends on ground surface factors and whether or not the potential archaeological bearing soil profile is visible. Prior ground disturbance, vegetation cover and surface wash can act to obscure artefact scatter presence.

Given the environmental context of the proposed wind farm, stone artefacts are predicted to be present in variable density across the landscape. On ridge and hill crests and slopes artefacts are likely to be present in low to very low densities only. In open valleys it is predicted that artefact density is likely to be higher and also, artefacts can be expected to be distributed as continuous occurrence across discrete landforms, especially close to streams.

Grinding Grooves

Grinding grooves are found in rock surfaces and result from the manufacture and maintenance of ground edge tools. Grinding grooves are only found on sedimentary rocks such as sandstone. Given the absence of suitable rock exposures in the study area grinding groove sites are unlikely to be present.

Burials Sites

In the Yass district traditionally Aboriginal people buried their dead in dug graves in rocky soils, usually on the tops of stony hills (White and Cane 1986). Other practices included the disposal of dead in caves (such as that on the Murrumbidgee near Burrinjuck described by Bennett in 1834), hollow trees and in graves dug into antbeds.

White and Cane (1986) note that traditional burial practices continued throughout the early period of European occupation into the 1870s.

The potential for burials to be present is always possible. Given the nature of this site type they are rarely located during field survey. However, given that burials in the local area were reportedly on stony hills it is likely, given the high erosional contexts of these landforms, they are unlikely to have survived.

Rock Shelter Sites

Rock shelters sites are unlikely to be present in the study area given the absence of large vertical stone outcrops.

Scarred and Carved Trees

Scarred and Carved trees result from either domestic or ceremonial bark removal. Carved trees associated with burial grounds and other ceremonial places have been recorded in the wider region. In an Aboriginal land use context this site type would most likely have been situated on flat or low gradient landform units in areas suitable for either habitation and/or ceremonial purposes.

Bark removal by European people through the entire historic period and by natural processes such as fire blistering and branch fall make the identification of scarring from a causal point of view very difficult. Accordingly, given the propensity for trees to bear scarring from natural causes their positive identification is impossible unless culturally specific variables such as stone hatchet cut marks or incised designs are evident and rigorous criteria in regard to tree species/age/size and it specific characteristics in regard to regrowth is adopted.

Nevertheless, the likelihood of trees bearing cultural scarring remaining extant and *in situ* is low given events such as land clearance and bushfires. Generally scarred trees will only survive if they have been carefully protected (such as the trees associated with Yuranigh's grave at Molong where successive generations of European landholders have actively cared for them).

The study area has been extensively cleared and the vast majority of live trees are young. While not impossible this site type is unlikely to have survived and therefore be present.

Stone Quarry and Procurement Sites

A lithic quarry is the location of an exploited stone source (Hiscock & Mitchell 1993:32). Sites will only be located where exposures of a stone type suitable for use in artefact manufacture occur. Quarries are rare site types in the region. One has been recorded near Galong north of the proposal area. This site is an intrusive dike of a dacite-like material which was extracted for flaked stone (Witter and Hughes 1983). A possible quartz quarry was recorded during the survey of the proposed Gunning Wind Farm (JMcCHM 2003). However, caution is required in regard to determining the natural or artefactual status of quartz outcrops which may be fractured by farming practices (*cf.* National Heritage Consultants 2010) or prospecting.

Ceremonial Places and Sacred Geography

Burbung and ceremonial sites are places which were used for ritual and ceremonial purposes. Possibly the most significant ceremonial practices known were those which were concerned with initiation and other rites of passage such as those associated with death. Sites associated with these ceremonies are burbung grounds and burial sites. Additionally, secret rituals were undertaken by individuals such as clever men. These rituals were commonly undertaken in 'natural' locations such as water holes. Pearson (1981) made the following predictions in regard to ceremonial site patterning in the region:

- Burial sites were situated close to habitation areas;
- Ceremonial sites were located away from habitation areas;
- Stone arrangements were located away from campsites in isolated places; they are associated with small hills and knolls or flat land.

In addition to site specific types and locales, Aboriginal people invested the landscape with meaning and significance; this is commonly referred to as a sacred geography. Natural features are those physical places which are intimately associated with spirits or the dwelling/activity places of certain mythical beings (*cf.* Knight 2001; Boot 2002). Boot (2002) refers to the sacred and secular meaning of landscape to Aboriginal people which

has '… legitimated their occupation as the guardians of the places created by their spiritual ancestors'.

Knight's (2001) Masters research conducted in the area of the Weddin Mountains examined the cultural construction and social practice of inhabiting a sacred landscape. This approach is a departure from a consideration of the land and its resources as being a determinant of behaviour, to one in which land is regarded as a *text* – within this conception, land and its individual features, are redolent with meanings and significances which are religiously and ritually centred, rather than economically based.

Knight's (*cf.* 2001:1) work was possible in great measure by the historical record which explicitly defines Weddin as a site of ritual significance. However, the research was additionally driven by a theoretical approach to 'cultural landscapes'. Landscape is redefined away from considerations of its material features which provide a backdrop to human activity, towards a view that a landscape *is rather*, a conceptual entity. According to this view the natural world does not exist outside of its conceptual or cognitive apprehension. The landscape becomes known within a naming process or narrative; thus the landscape is brought into being and understanding – within this process: - '… explanatory parables…' such as legends and mythology are the embodiment of the landscape narrative (Knight 2001: 6).

These narratives are relative to a particular culture, and it is this, which makes an archaeological investigation of the cultural landscape such a thorny one. At distance in time and cultural geography, and especially in the absence of specific ethnographic information, how can the archaeologist attempt to investigate and know these narratives? Knight (2001: 11) employed the concept of the landscape as *mentifact,* whereby archaeological interpretation is concerned with the reconstruction of the landscape as a reflection of prehistoric cosmologies. He argued that this can be reconstructed by exploring the systematic relationships between sites and their topographic setting. This is defined as an *inherent* approach as it is concerned with the role of landscape in both everyday and sacred life. This view is concerned with an integration of the sacred and profane rather than their existence as separate categories of social life: - where "Cult activity may have existed as an inextricably 'embedded' component of daily life, where significant locations and ritual aspects of material culture were thoroughly incorporated into secular ranges and uses" (Knight 2001:13). In this regard Knight (2001: 14) correctly points out that no dichotomy between the material and ideational world existed within Aboriginal life.

Knight (2001: 15) argued that the notion of sacred space is of central concern within an inherent perspective on interpreting cultural landscape. Within human cosmologies locales within the landscape are constructed as being sacred space; this process of the construction of sacred space has been termed *hierophany* by Eliade (1961 in Knight 2001: 15). However, while Knight (2001: 15) suggests that physical entities such as stones, trees, or topographic features such as mountains, caves and rocky outcrops may be subject to such processes of transformation or construction, in reality in Aboriginal society any natural feature of less obvious significance can and should be included within this listing. Aboriginal constructions of heirophany can include the most insignificant landscape feature and objects of less fixed temporal existence such as animals and plants.

While the outside observer readily 'sees' and apprehends mountains and rocky features, more subtle elements of the natural world are easily passed 'unseen'. This point is one which suggests that the personal cultural geography of the archaeologist can severely impact upon the interpretation of the sacred landscape. Knight (2001) does acknowledge this to some extent illustrating the issue by referring to the example of "Jump Up Rock" situated north of Weddin. This place is only understood to have been an important landscape feature by recourse to prior knowledge regarding the meaning of the site name; the hill itself is insignificant and therefore not readily apprehended through an outsiders gaze as being of special significance.

Knight (2001: 16) refers to the issue of peculiarities of form (eg shape, colour, size or texture) and natural distinctiveness (e.g. isolated mountains or rocky features within a plains context) as being an important distinguishing feature of sacred locales. Knight (2001: 16) argues that the construction of sacred space in such a manner is particularly relevant to people for whom the natural domain is the dwelling place of/or the manifestation of their deities. Knight (2001: 16) again draws from Eliade (1964) to suggest that it is at the sacred place that the three fundamental cosmological worlds, the everyday, the upper and underworld may converge; typically the upper world will be associated as a point of 'access' with tall things such as trees while the underworld will be associated with pools and caves. Eliade contends that places where all three worlds can possibly connect, the *axis mundi*, are of a heightened order of sacredness. Hierophanies are therefore natural features which are ascribed sacredness. Additionally, Knight (2001: 17) refers to their ability to provide a landscape based opportunity for people to commune with other worldly deities and associated power because they may constitute spatial access between worlds via ritual.

Guided by these theoretical considerations Knight (2001: 20) engaged with Bradley's (cited in Knight 2001) model of the 'archaeology of natural places' in order to provide guidance for investigating the cultural landscape of the Weddin Mountains and its environs. Bradley (2000) has argued that natural places can be explored archaeologically in order to determine the nature of their role in human cosmologies by attending to four archaeological categories: - Votive offerings, rock art, production sites and monuments. This model was developed within a European context, with its attendant biases of concepts and archaeological categories; clearly not all concepts, some of which are clearly Eurocentric, will be applicable in Australia. Nor will all these data sets be found within the Australian context.

Knight (2001) gives consideration to the types of natural places which might be ascribed sacred significance. These include mountains, woodlands and groves, springs pools and lagoons, rock outcrops and caves and sinkholes. He argues that Aboriginal cosmology is expressed via the natural landscape and sacred places were those which were directly related to the Dreaming. He says that these sacred sites typically are those which are remarkable or important physiographically such as caves, rocks and so on.

Given the potential for natural features to have been important places within an Aboriginal cosmological frame of reference, the survey has sought to identify outstanding natural features present in the study area. It is, however, noted that the landscape of the

entire proposal area is expressed as an abundance of hills and ridges and that, therefore, high places are unlikely to standout as unusual or significant.

Contact Sites

These sites are those which contain evidence of Aboriginal occupation during the period of early European occupation in a local area. Evidence of this period of 'contact' could potentially be Aboriginal flaked glass, burials with historic grave goods or markers, and debris from 'fringe camps' where Aborigines who were employed by, or traded with, the white community may have lived or camped. The most likely location for contact period occupation sites would be camp sites adjacent to permanent water, and located in relative proximity to centres of European occupation such as towns and homesteads. The potential for such sites to be present in the proposal area is possible, however, considered to be unlikely given the location of impacts away from towns or homesteads.

2.3.3 Field Inspection – Methodology

The methodology for the field survey entailed a pedestrian traverse of the proposed activity area. The field survey was aimed at locating Aboriginal objects. An assessment was also made of prior land disturbance, survey coverage variables (ground exposure and archaeological visibility) and the potential archaeological sensitivity of the land.

The approach to recording in the current study has been a 'nonsite' methodology (*cf.* Dunnell 1993; Shott 1995). The density and nature of the artefact distribution will vary across the landscape in accordance with a number of behavioural factors which resulted in artefact discard. While cultural factors will have informed the nature of land use, and the resultant artefact discard, environmental variables are those which can be utilised archaeologically in order to analyse the variability in artefact density and nature across the landscape. Accordingly, in this study, while the artefact is the elementary unit recorded, Survey Units are utilised as a framework of recording, analysis (*cf.* Wandsnider and Camilli 1992) and ultimately, the formulation of recommendations.

The field recording and mapping has been conducted using a mobile GIS system. The location of Aboriginal object locales, European items and Survey Units has been made using ArcGIS software and a Trimble GPS. In order to ensure consistency in data collection all field records were made in Microsoft Access database's formulated specifically for the Rye Park Wind Farm project. Three separate databases were used for recording Survey Unit data, Aboriginal Object data and Historical features data. The data collected forms the basis for the documentation of survey results. The variables recorded are defined below.

Survey Unit Variables

Landscape variables utilised are conventional categories taken from the *Australian Soil and Land Survey Field Handbook* (McDonald *et al.* 1998):

Landforms form the primary basis for defining Survey Unit boundaries. The following landform variables were recorded:

Morphological type:

- Crest: - element that stands above all or almost all points in the adjacent terrain – smoothly convex upwards in downslope profile. The margin is at the limit of observed curvature.
- Simple slope: - element adjacent below crest or flat and adjacent above a flat or depression.
- Flat: - planar element, neither crest or depression and is level or very gently inclined.
- Open depression: - extends at same elevation or lower beyond locality where it is observed.

Slope class and value:

- Level: 0 - 1%.
- Very gentle: 1 - 3%.
- Gentle: 3 - 10%.
- Moderate: 10 - 32%.
- Steep: 32 - 56%.

Geology

The type of geology was recorded and as well the abundance of rock outcrop – *as defined below*. The level of visual interference from background quartz shatter was noted.

- No rock outcrop: - no bedrock exposed.
- Very slightly rocky: - <2% bedrock exposed.
- Slightly rocky: - 2-10% bedrock exposed.
- Rocky : - 10-20 % bedrock exposed.
- Very rocky: - 20-50% bedrock exposed.
- Rockland: - >50% bedrock exposed.

Soil

Soil type and depth was recorded. The potential for soil to contain subsurface archaeological deposit (based on depth) was recorded as Low, Moderate or High. This observation is based solely on the potential for soil to contain artefacts; it does not imply that artefacts will be present or absent.

Geomorphological processes

The following gradational categories were recorded:

- eroded
- eroded or aggraded
- aggraded

Geomorphological agents

The following geomorphological agents were recorded:

- gravity: *collapse or particle fall*

- precipitation: *creep; landslide; sheet flow*
- stream flow: *channelled or unchannelled*
- wind
- biological: *human; nonhuman*

Survey coverage variables were also recorded; these are described further below.

Aboriginal Object Recording

For the purposes of defining the artefact distribution in space it has been labelled as a locale (eg. Survey Unit 1/Locale 1). GPS referenced locational information was captured as WGS84 readings and transformed to GDA coordinates.

The measurable area in which artefacts are observed has been noted and if relevant, a broader area encompassing both visible and predicted subsurface artefacts has been defined. In addition, locale specific assessments of survey coverage variables have been made. The prior disturbance to the locale has been noted. Artefact numbers in each locale have been recorded and a prediction of artefact density noted, based on observed density taking into consideration Effective Survey Coverage, and a consideration of environmental context.

Survey Coverage Variables

Survey Coverage Variables are a measure of ground surveyed during the study and the type of archaeological visibility present within that surveyed area. Survey coverage variables provide a measure with which to assess the effectiveness of the survey so as to provide an informed basis for the formulation of management strategies.

Specifically, an analysis of survey coverage is necessary in order to determine whether or not the opportunity to observe stone artefacts in or on the ground was achieved during the survey. In the event that it is determined that ground exposures provided a minimal opportunity to record stone artefacts, it may be necessary to undertake archaeological test excavation for determining whether or not stone artefacts are present. Conversely, if ground exposures encountered provided an ideal opportunity to record the presence of stone artefacts, the survey results may be considered to be adequate and, accordingly, no further archaeological work may be required.

Two variables were used to measure ground surface visibility during the study; the area of ground exposure encountered, and the quality and type of ground visibility (archaeological visibility) within those exposures. The survey coverage variables estimated during the survey are defined as follows:

Ground Exposure – an estimate of the total area inspected which contained exposures of bare ground; and

Archaeology Visibility – an estimate of the average levels of potential archaeological surface visibility within those exposures of bare ground. Archaeological visibility is generally less than ground exposure as it is dependent on adequate breaching of the bare

ground surface which provides a view of the subsurface soil context. Based on subsurface test excavation results conducted in a range of different soil types across New South Wales it is understood that artefacts are primarily situated within 10 - 30 cm of the ground profile; reasonable archaeological visibility therefore requires breaching of the ground surface to at least a depth of 10 cm.

Based on the two visibility variables as defined above, an estimate (Net Effective Exposure) of the archaeological potential of exposure area within a survey unit has been calculated. The Effective Survey Coverage (ESC) calculation is a percentage estimate of the proportion of the Survey Unit which provided the potential to view archaeological material.

The data collected forms the basis for the documentation of survey results outlined in the section below.

2.3.4 Field Inspection – Results

The survey results are described below. The location of Survey Unit areas and Aboriginal object site recordings are shown on Figures 2, 3, 4 and 5.

Survey Coverage

The area has undergone relatively high levels of prior disturbance associated with agriculture. Original land clearance and subsequent farming practices have impacted the entire proposal area. These impacts include, amongst others, cultivation, fencing, dam construction, and grazing by hard hoofed animals. Previous farming practices are assessed to have caused reasonably high levels of impact to ground surfaces and to any Aboriginal objects which may once have been present.

The trees in the proposal area and its surrounds are predominately regrowth, estimated to be around 50 years old (or less). All trees located within areas of direct impact were inspected during the survey and no evidence of Aboriginal scarring is evident.

Archaeological visibility within many areas of ground exposure was moderate as the result of the ground surface being penetrated by ploughing, vehicle traffic, weathering and stock treadage.

Seventy kilometres of linear impact areas were surveyed during the field work; the area measures c. 352 hectares (Table 1). It is estimated that approximately 105 hectares of that area was subject to physical survey inspection. Ground exposures inspected included bare earth, erosion scalds, animal tracks and roads and measured 12 hectares in area. Of that ground exposure area archaeological visibility inspected (the potential artefact bearing soil profile) is estimated to have been 10 hectares. Effective Survey Coverage is calculated to have been 3.1% of the proposal area.

While an extensive area of land has been surveyed, including the majority of the proposal, not all impact areas were subject to visual inspection. For example, while the majority of turbine ridges have been inspected, some access road and overhead

transmission lines have not. Since undertaking the survey, some minor changes to the layout have been made. Accordingly, some areas remain unsurveyed, while others would now be located outside of the proposal. However, the survey results can be reasonably confidently extrapolated to any unsurveyed areas, and it is concluded that the proposed wind farm area is of low archaeological potential and sensitivity.

Table 1 Survey coverage variables.

SU	Length m	Area sq m	Actually Inspected	Exposure (average) %	Exposure sq m	Visibility (average) %	Visibility sq m	Effective Survey Coverage
SU1	1130	56495	16949	30	5085	80	4068	7.2
SU2	973	48642	14593	1	146	60	88	0.18
SU3	4582	229099	68730	5	3436	90	3093	1.35
SU4	867	43365	13010	1	130	90	117	0.27
SU5	687	34327	10298	1	103	90	93	0.27
SU6	2317	115861	34758	30	10428	80	8342	7.2
SU7	2350	117521	35256	20	7051	80	5641	4.8
SU8	2093	104661	31398	1	314	40	126	0.12
SU9	642	32097	9629	2	193	40	77	0.24
SU10	582	29080	8724	1	87	40	35	0.12
SU11	2544	127207	38162	20	7632	90	6869	5.4
SU12	1283	64138	19241	50	9621	90	8659	13.5
SU13	4726	236285	70886	20	14177	90	12759	5.4
SU14	2050	102509	30753	1	308	90	277	0.27
SU15	2521	126053	37816	1	378	90	340	0.27
SU16	2121	106043	31813	5	1591	90	1432	1.35
SU17	1151	57541	17262	30	5179	90	4661	8.1
SU18	2621	131026	39308	10	3931	90	3538	2.7
SU19	2969	148428	44528	30	13359	90	12023	8.1
SU20	1724	86215	25865	5	1293	90	1164	1.35
SU21	3206	160280	48084	5	2404	90	2164	1.35
SU22	1887	94350	28305	2	566	80	453	0.48
SU23	8347	417370	125211	10	12521	90	11269	2.7
SU24	4319	215936	64781	2	1296	90	1166	0.54
SU25	5524	276212	82864	20	16573	90	14915	5.4
SU26	4418	220920	66276	10	6628	90	5965	2.7
SU27	2890	144494	43348	1	433	60	260	0.18
Total	70523	3526157	1057847		124861		109591	3.1

Table 2 Description of Survey Units

Name	Comments	Proposed impacts
SU1	SU1 is a relatively narrow (c. 20m), gently undulating ridge crest (Plate 8). The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Some areas are treed with regrowth (at south end) and elsewhere given over to pasture. Exposures were primarily bare earth (Plate 3).	Wind turbine generators, access track and underground electrical connections
SU2	SU2 is a wide valley comprised of very gently undulating simple slopes (Plate 9). Quartz gravels are sparse. Exposures were infrequent due to generally thick grass cover.	Access track and possibly underground electrical connections

Name	Comments	Proposed impacts
SU3	SU1 is a generally narrow (c. 20m), gently undulating ridge crest. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse except for near south end where it is moderate to high. It is sparsely treed with scrubby pasture (Plate 10) and a thickly treed area at south end in a very steep gully. Exposures were bare earth, and animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU4	SU4 is a broad, gently undulating ridge crest. The geology is porphyry volcanic and soils are a relatively deep loam. Porphyry cobbles are common across the landform. The landform is sparely treed and is given over to pasture. Exposures were infrequent due to generally thick grass cover.	Wind turbine generators, access track and underground electrical connections
SU5	SU5 is a simple slope with a gentle to moderate gradient with an easterly aspect. The landform is given over to pasture. Exposures were infrequent due to generally thick grass cover.	Access track and possibly underground electrical connections
SU6	SU6 is an undulating ridge crest with gentle to moderate gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is thickly treed with regrowth along most of the SU (Plates 5 & 6). Exposures were bare earth, and animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU7	SU6 is series of ridge crests (some very narrow ie c. 10m) and knolls with gentle to moderate (and occasionally very steep) gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse generally, but high in localised occurrences. It is given over to pasture (Plate 11). Exposures were bare earth, erosion, and animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU8	SU4 is a broad, gently undulating ridge crest. The geology is porphyry volcanic and soils are a relatively deep loam. Porphyry tors (especially on knolls) and cobbles are common across the landform. The landform is sparely treed and is given over to pasture (Plate 12). Exposures were infrequent due to generally thick grass cover.	Wind turbine generators, access track and underground electrical connections
SU9	SU4 is a gently undulating ridge crest. The geology is porphyry volcanic and soils are a relatively deep loam. Porphyry cobbles are common across the landform. The landform is sparely treed and is given over to pasture. Exposures were infrequent due to generally thick grass cover.	Wind turbine generators, access track and underground electrical connections
SU10	SU10 is a low rise in a valley. It has a very gentle gradient and south-westerly aspect. It is covered with thick grass and effective survey coverage was low.	Substation
SU11	SU11 is an undulating narrow (20-30 m) ridge crest with gentle to moderate gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is sparsely treed with scrubby pasture (Plate 1). Exposures were bare earth, and animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU12	A series of grassed, generally very steep (up to 38°), simple slopes (Plate 15). The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Exposures were bare earth and animal tracks.	Access track and possibly underground electrical connections
SU13	SU11 is an undulating broad ridge crest with gentle to moderate gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is thickly treed with regrowth along most of the SU (Plate 16). Exposures were bare earth, and animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU14	A series of grassed, gentle to moderate gradient, simple slopes and spur crests (Plate 17). The geology is shale and soils are thin	Wind turbine generators, access track

Name	Comments	Proposed impacts
	and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Minimal exposures were bare earth and animal tracks.	and underground electrical connections
SU15	A series of grassed, gentle to moderate gradient undulating lower slopes, drainage depressions and spur crests (Plate 18). The geology is shale and soils are thin and rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Minimal exposures were bare earth and animal tracks.	Transmission line
SU16	A series of grassed, moderate gradient, simple slopes, drainage depressions and spur crests. The geology is shale and soils are thin and rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Exposures were bare earth and animal.	Transmission line
SU17	SU17 is an undulating narrow (30 m) ridge crest with gentle to moderate gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse, except within areas in which quartz bedrock outcrops and near south end. The landform is grassed and with sparse trees (Plate 19). Exposures were bare earth and animal tracks.	Wind turbine generators, access track and underground electrical connections
SU18	SU18 is a series of gently to moderately undulating ridge crests. The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Some areas are treed with regrowth (at south end) and elsewhere given over to pasture. Exposures were primarily bare earth.	Wind turbine generators, access track and underground electrical connections
SU19	SU19 is an undulating narrow ridge crest with gentle to moderate gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is sparsely treed with scrubby pasture (Plate 20). Exposures were bare earth, and animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU20	SU20 is a series of gently to moderately (occasionally steep) undulating ridge crests. The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. Some areas are treed with regrowth and elsewhere contains thick Sifton bush (Plate 21). Exposures were primarily bare earth.	Wind turbine generators, access track and underground electrical connections
SU21	SU21 is an undulating narrow ridge crest with gentle to moderate gradient slopes. The geology is shale and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is sparsely treed with thick Sifton bush (Plate 22). Exposures were bare earth, and animal and tracks.	Wind turbine generators, access track and underground electrical connections
SU22	SU22 is a series of moderately (occasionally steep) undulating ridge crests. The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is mostly treed with regrowth and elsewhere with thick Sifton bush. Exposures were primarily bare earth.	Wind turbine generators, access track and underground electrical connections
SU23	SU23 is a series of gently and moderately (occasionally steep) undulating ridge crests. The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is grassed at the northern and southern ends and treed with regrowth and thick Sifton bush in the mid area (Plate 23). Exposures were primarily bare earth, with some animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU24	SU24 is a series of gently and moderately (occasionally steep) undulating ridge crests. The geology is shale/slate and soils are thin and very rocky. Quartz gravels are sparse. It is grassed at the northern end and treed with regrowth scrub and thick Sifton bush in the south (Plate 24). Exposures were primarily bare earth, with some animal tracks.	Wind turbine generators, access track and underground electrical connections
SU25	SU25 is a narrow gently and moderately (occasionally steep)	Wind turbine

Name	Comments	Proposed impacts
	undulating ridge crest. The geology is shale/slate and soils are thin and very rocky. Quartz gravels are sparse. It is grassed in the mid area (Plate 25) and treed with regrowth scrub and Sifton bush in the north and south. Exposures were primarily bare earth, with some animal and vehicle tracks.	generators, access track and underground electrical connections
SU26	SU26 is a relatively narrow gently and moderately (occasionally steep) undulating ridge crest. At the south end knolls are very rocky. The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is grassed at the northern end (Plate 26) and treed with regrowth scrub in the south. Exposures were primarily bare earth, with some animal and vehicle tracks.	Wind turbine generators, access track and underground electrical connections
SU27	SU27 is a relatively narrow gently and moderately undulating ridge crest. The geology is shale/slate and soils are thin and very rocky (shale shatter, cobbles and bedrock). Quartz gravels are sparse. It is grassed (Plate 27). Exposures were primarily bare earth, with some animal tracks.	Wind turbine generators, access track and underground electrical connections

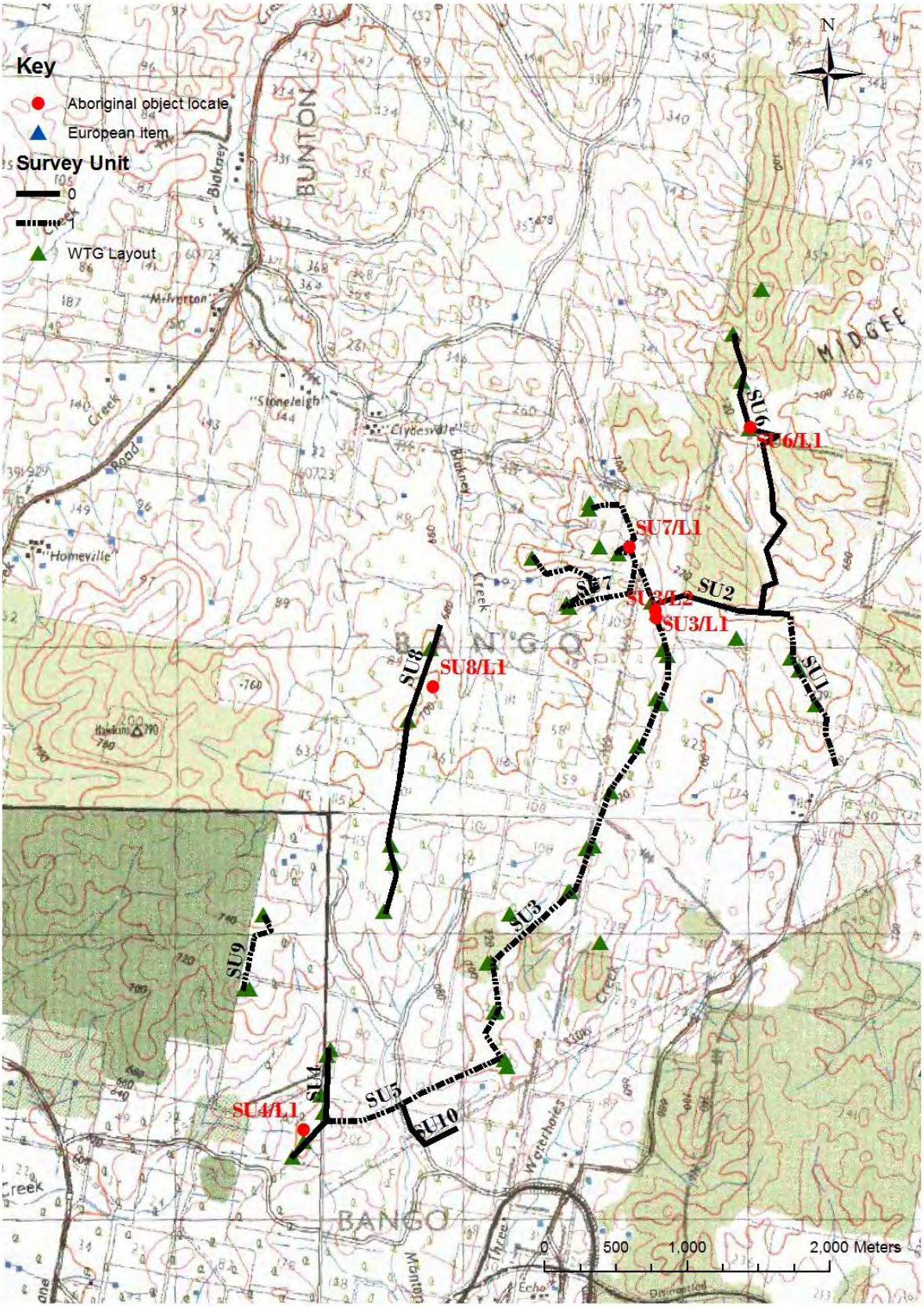

Figure 2 Location of Survey Units and Aboriginal object locales in respect of proposed wind turbine generator layout; south end of proposal area.

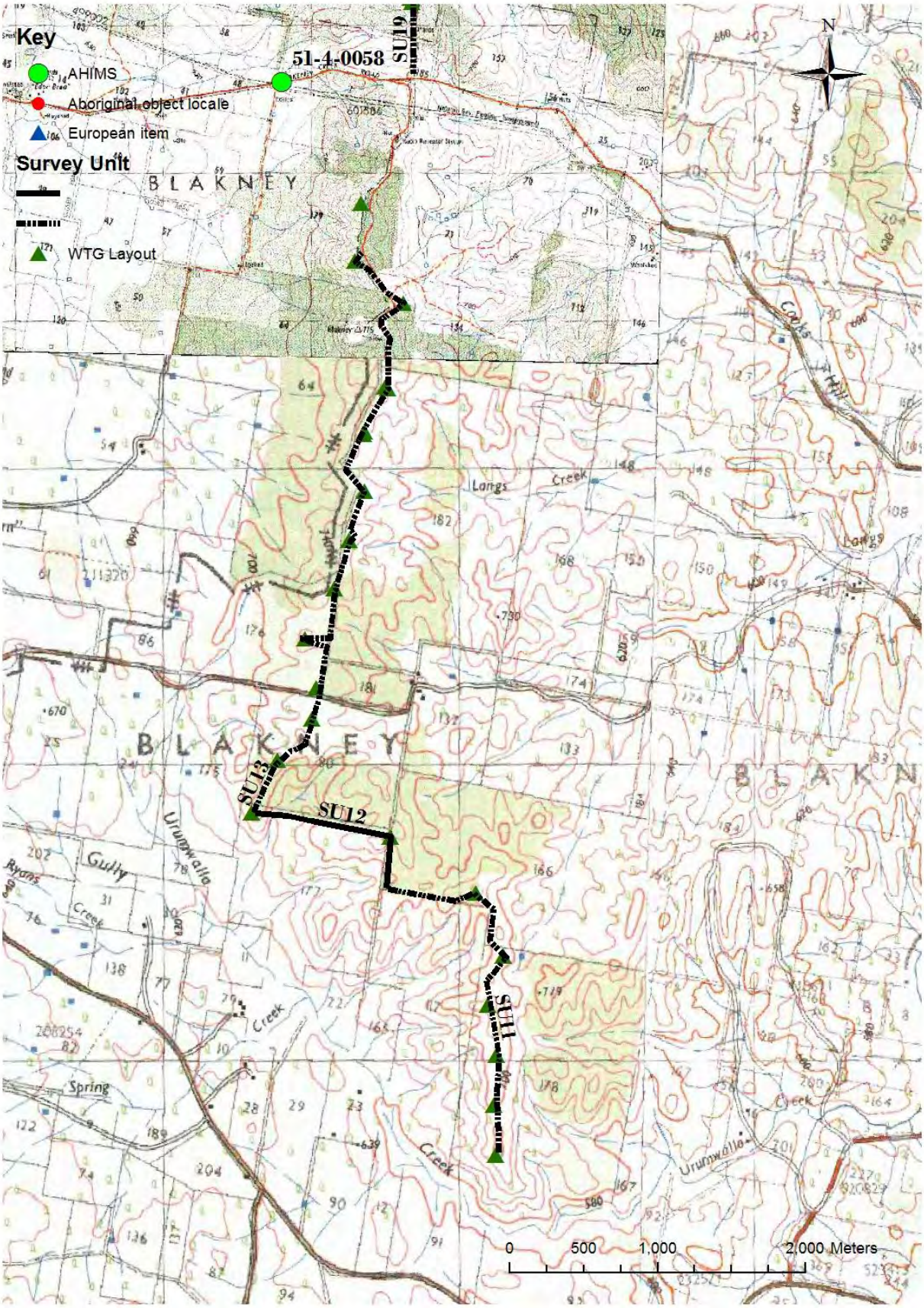

Figure 3 Location of Survey Units and Aboriginal object locales in respect of proposed wind turbine generator layout; south-mid end of proposal area.

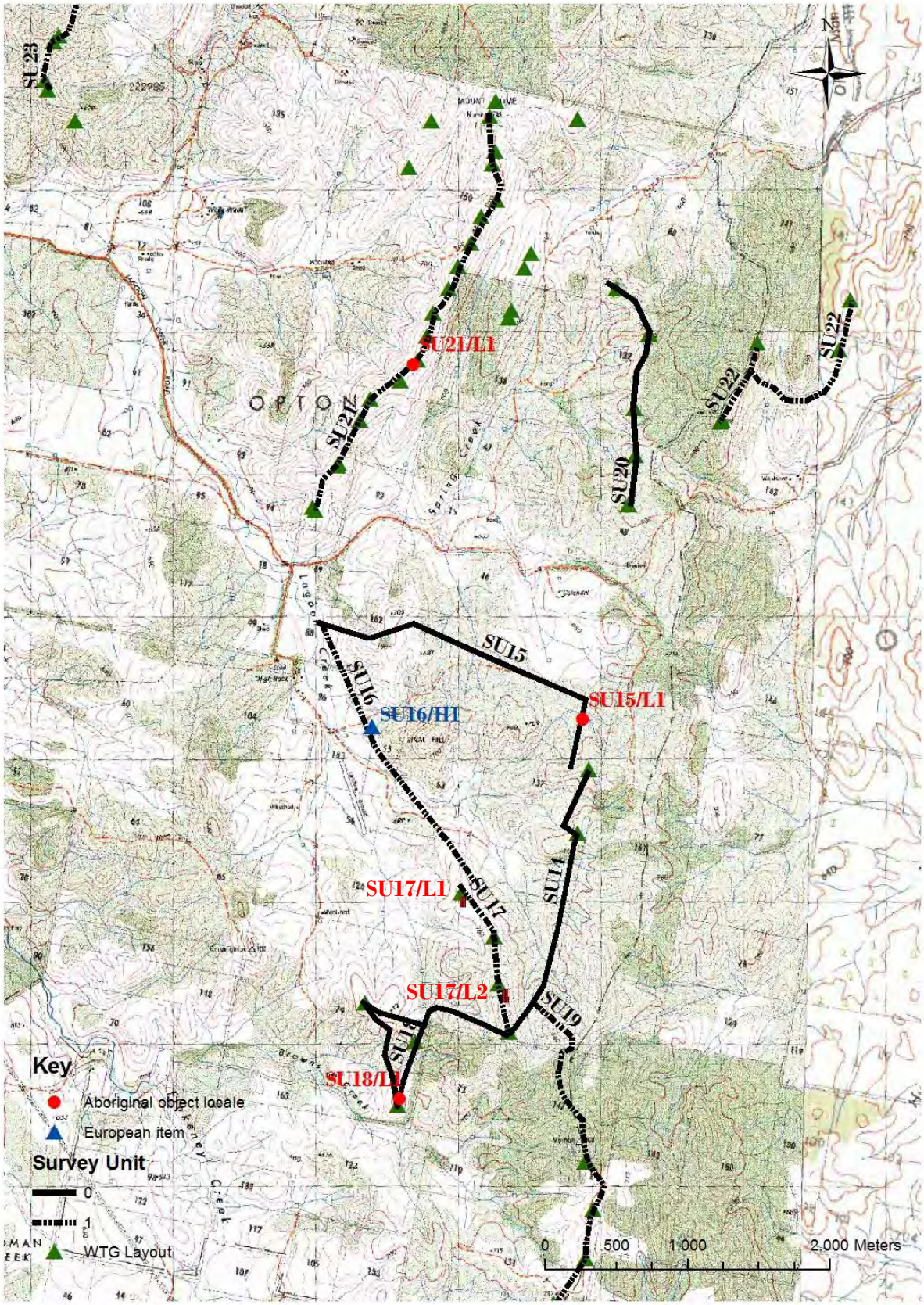

Figure 4 Location of Survey Units and Aboriginal object locales in respect of proposed wind turbine generator layout; north-mid end of proposal area.

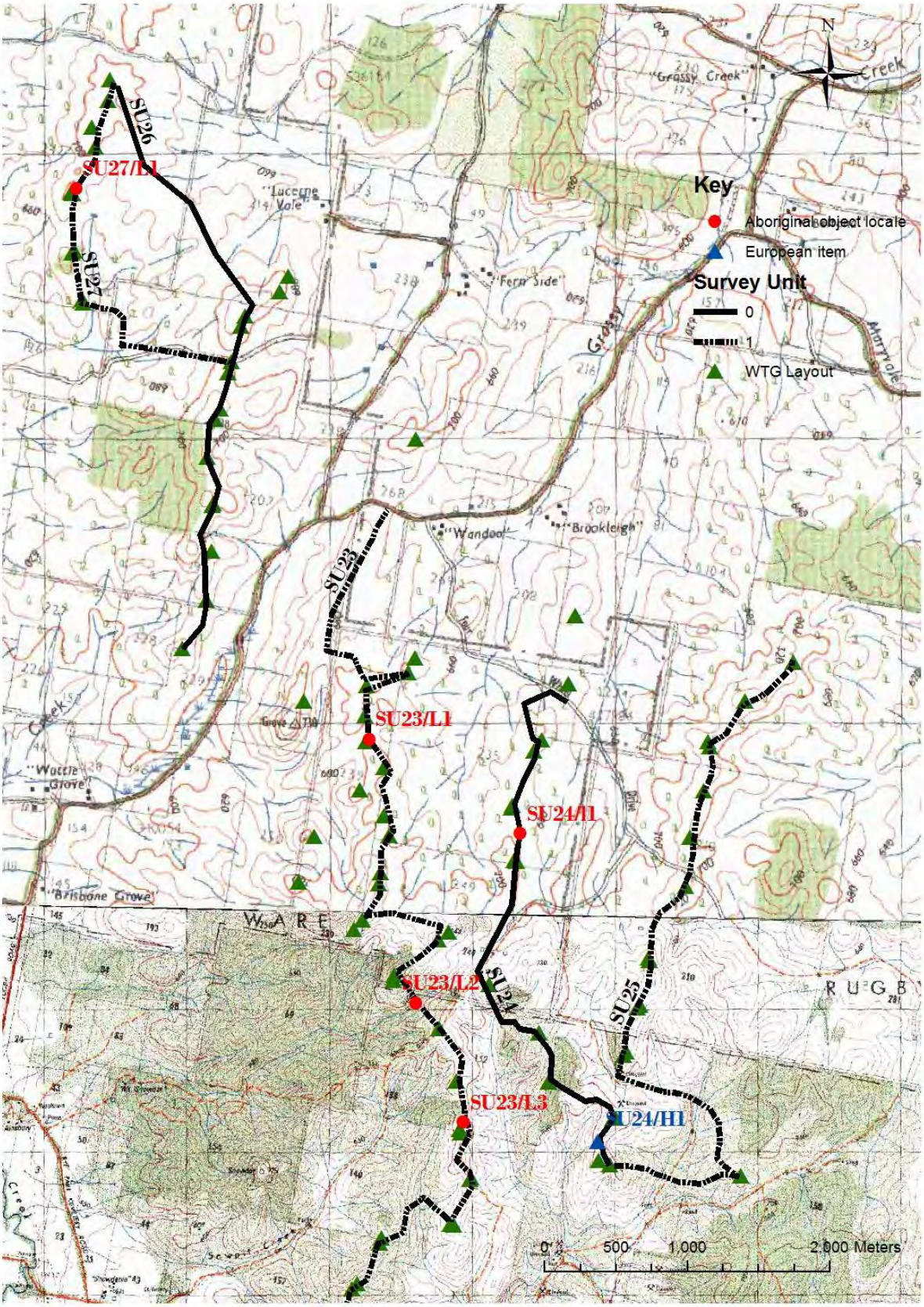

Figure 5 Location of Survey Units and Aboriginal object locales in respect of proposed wind turbine generator layout; north end of proposal area.

Plate 8 Proposed turbine location on Survey Unit 1; looking 140°.

Plate 9 The valley of Survey Unit 2 looking 250°.

Plate 10 Midway along Survey Unit 3 looking 190°, note wind monitoring mast in distance.

Plate 11 A turbine ridge in Survey Unit 7 looking 130°.

Plate 12 Survey Unit 8 in middle distance; photo taken from SU7 and looking south-west.

Plate 13 Survey Unit 9 looking south.

Plate 14 Survey Unit 10 looking 50°.

Plate 15 Survey Unit 12 looking east.

Plate 16 Midway along SU13 looking south.

Plate 17 Survey Unit 14 looking south.

Plate 18 Survey Unit 15 looking 285°.

Plate 19 Survey Unit 17 looking 155. Note narrow crest, rocky outcrops and fallen timber.

Plate 20 Survey Unit 19 looking 180° at a proposed turbine site. Note rocky ground and high exposure.

Plate 21 Survey Unit 20; north end looking 100°.

Plate 22 Survey Unit 21 near north end looking south. Note rocky ground and Sifton bush, as far as the eye can see.

Plate 23 Survey Unit 23, north end looking south.

Plate 24 Survey Unit 24, south end. Note Mt Hume (north end SU21) in distance.

Plate 25 Survey Unit 25 looking 10°.

Plate 26 North end of Survey Unit 26 looking north.

Plate 27 Survey Unit 27 looking south; note, SU27/L1 in distance.

Aboriginal Object Recordings

The Aboriginal object locales recorded during the survey are summarised in Table 3 and described in further detail below.

Table 3 Summary of Aboriginal object locales recorded during the field survey.

Name	Comments	Easting	Northing
SU3/L1	1 artefact on an existing farm track in SU3	685473	6154461
SU3/L2	2 artefacts on an existing farm track in SU3	685479	6154403
SU4/L1	1 artefact on ridge in SU4	683008	6150815
SU6/L1	1 artefact on ridge adjacent to track in SU6	686132	6155741
SU7/L1	1 artefact in large erosion scour on ridge in SU7	685287	6154897
SU8/L1	1 artefact in a sheep track	683916	6153919
SU15/L1	2 artefacts in an erosion scour in SU15	681986	6173467
SU17/L1	Possible quartz stone procurement area (spa)	681143	6172183
SU17/L2	Possible quartz stone procurement area (spa)	681444	6171527
SU18/L1	1 artefact on a moderate gradient simple slope	680701	6170806
SU21/L1	1 artefact on a ridge crest in SU21	680799	6175957
SU23/L1	1 artefact on a farm track in SU23	678390	6182077
SU23/L2	2 artefacts adjacent to a drainage line in SU23	678717	6180230
SU23/L3	1 artefact on a farm track in SU23	679052	6179394
SU24/L1	5 artefacts on a farm track in SU24	679451	6181416
SU27/L1	Possible quartz stone procurement area (spa)	676340	6185935

Survey Unit 3/Locale 1 685473e 6154461n Trimble GPS (GDA)

One stone artefact was recorded on a farm track in Survey Unit 3 (Plate 28). The landform is a narrow ridge crest with a northerly aspect and gentle gradient. The broad area of erosion measures >50 x 3 m, of which 90% was ground exposure, possessing 95% archaeological visibility. The effective survey coverage is relatively high, and given that one artefact only was recorded, artefact density is assessed to be very low.

The recorded artefact is a fine grained, grey silcrete broken flake (longitudinal fracture) measuring 41 x 32 x 14 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional.

Plate 28 The location of SU3/L1 looking 160°.

Survey Unit 3/Locale 2 685479e 6154403n Trimble GPS (GDA)

Two stone artefacts were recorded over a distance of 5 metres on a farm track in Survey Unit 3 (Plate 29). The landform is a narrow ridge crest with an open aspect and very gentle gradient. The broad area of erosion measures >50 x 3 m, of which 90% was ground exposure, possessing 95% archaeological visibility. The effective survey coverage is relatively high, and given that one artefact only was recorded, artefact density is assessed to be very low.

The recorded artefacts are:

- grey silcrete broken flake (longitudinal fracture) measuring 46 x 18 x 8 mm (distal end missing);
- light brown silcrete flake (medial portion) measuring 24 x 15 x 4 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional.

Plate 29 The location of SU3/L2 looking 140°.

Survey Unit 4/Locale 1 683008e 6150815n Trimble GPS (GDA)

One stone artefact was on a ridge crest in Survey Unit 4 (Plate 30). The artefact was found in a bare earth exposure. In the area, ground exposure was estimated to be c. 1% (very low) with 90% archaeological visibility. The effective survey coverage is low.

The recorded artefact is a tuff broken flake (proximal end) measuring 7 x 6 x 2 mm.

The locale may contain additional artefacts but these would be present in very low density. The site has subsurface potential given some depth to the soils, but artefact density is predicted to be very low. The geomorphological context is nevertheless erosional.

Plate 30 SU4/L1 looking east.

Survey Unit 6/Locale 1 686132e 6155741n Trimble GPS (GDA)

One stone artefact was on a ridge crest in Survey Unit 6 (Plate 31). The artefact was found in a bare earth exposure adjacent to a fire trail. In the area, ground exposure was estimated to be c. 85% with 70% archaeological visibility. The effective survey coverage is high.

The recorded artefact is a black chert flake measuring 32 x 23 x 5 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional.

Plate 31 Location of SU6/L1 looking north.

Survey Unit 7/Locale 1 685287e 6154897n Trimble GPS (GDA)

One stone artefact was on a saddle of a ridge crest in Survey Unit 7 (Plate 32). The artefact was found on the edge of a large erosion scour. In the area, ground exposure was estimated to be c. 95% with 70% archaeological visibility. The effective survey coverage is high.

The recorded artefact is a weathered, fine grained silcrete flake measuring 15 x 24 x 7 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the eroded nature of the soil, the site has no subsurface potential. The geomorphological context is erosional.

Plate 32 Location of SU7/L1 looking 75°.

Survey Unit 8/Locale 1 683916e 6153919n Trimble GPS (GDA)

One stone artefact was recorded in a sheep track in Survey Unit 8 (Plate 33). The landform is a broad ridge crest with a northerly aspect and very gentle gradient. The area is well grassed and effective survey coverage is low.

The recorded artefact is a fine grained volcanic broken flake (medial) measuring 36 x 22 x 10 mm.

The site has subsurface potential given some depth to the soils, but artefact density is predicted to be very low. The geomorphological context is erosional.

Plate 33 Location of SU8/L1 looking south.

Survey Unit 15/Locale 1 681986e 6173467n Trimble GPS (GDA)

Two stone artefacts were recorded in a bare earth exposure (10 x 3 m) in Survey Unit 15 adjacent to a minor drainage line (Plate 34). The landform is a simple slope with a north-westerly aspect and very gentle gradient. The area of erosion measures 30 sq m, of which 50% was ground exposure, possessing 90% archaeological visibility. The effective survey coverage is relatively high, and given that two artefacts only were recorded, artefact density is assessed to be very low.

The recorded artefacts are probably a part of a single knapping event:

- Fine grained, grey silcrete broken flake (proximal portion) measuring 22 x 14 x 4 mm;
- Fine grained, grey silcrete core (3 rotations and 9 scars) measuring 33 x 24 x 19 mm.

The site has subsurface potential given some depth to the soils in the lower valley context, but artefact density is predicted to be low. The geomorphological context is nevertheless erosional.

Plate 34 Location of SU15/L1 looking 245°.

Survey Unit 17/Locale 1 681143e 6172183n Trimble GPS (GDA)

A quartz outcrop in Survey Unit 17 possesses evidence of having been struck by means of *hard hammer percussion* (Plates 35 & 36). This locale, SU17/L1, is defined for the purposes of this assessment as a possible Aboriginal stone procurement area (SPA); the status of this site cannot be determined by a visual assessment alone. While it appears unambiguous that the quartz outcrop has been struck by human agency, the actual identity of that agent is uncertain; there is some possibility that the features have resulted from animals (with hard Hooves), machinery (bikes, tractors, dozers) or prospectors. To attempt to resolve this question, archaeological excavation would be required.

The quartz seam is exposed as discontinuous small bedrock outcrops (which are up to 40cm x 1.5 m in size) and numerous cobbles that cover an area measuring approximately 30 – 30 square metres. The seam is oriented north-south. It measures c. 70m long, by 10 wide and c. 40 cm high above the ground. The quartz is reasonable quality (from the view point of a stone knapper) milky quartz.

The outcrop possesses crushed and battered areas and bifacially flakes edges with negative flake scars. A small amount of blocky quartz shatter is visible in the immediate vicinity of the seam. Ground exposure at the site is low, and it is possible that flaked debris is present in a subsurface context.

Plate 35 Location of SU17/L1 looking south.

Plate 36 SU17/L1 Close up of cobble with bifacial flake scar along edge.

Survey Unit 17/Locale 2 681444e 6171527n Trimble GPS (GDA)

A second, albeit minor quartz outcrop in Survey Unit 17 also possesses evidence of having been struck by means of *hard hammer percussion* (Plates 37). This locale is a possible SPA.

The quartz seam is exposed as discontinuous small bedrock outcrops (which are up to 40cm x 40 cm in size) and numerous cobbles that cover an area measuring approximately 30 – 30 square metres. The seam is oriented north-south. It measures c. 100m long, by 10 wide and c. 30 cm high above the ground. The quartz is reasonable quality milky quartz.

The outcrop possesses sparse crushed and battered areas and bifacially flakes edges with negative flake scars. A small amount of blocky quartz shatter is visible in the immediate vicinity of the seam. Ground exposure at the site is low, and it is possible that flaked debris is present in a subsurface context.

Plate 37 Location of SU17/L2

Survey Unit 18/Locale 1 680701e 6170806n Trimble GPS (GDA)

One stone artefact was on a moderate gradient simple slope in Survey Unit 18 (Plate 38). The artefact was found in a bare earth exposure. In the area, ground exposure was estimated to be c. 15% with 90% archaeological visibility. The effective survey coverage is high.

The recorded artefact is a grey tuff flake measuring 28 x 29 x 9 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential.

Plate 38 Location of SU18/L1 looking 245°.

Survey Unit 21/Locale 1 680799e 6175957n Trimble GPS (GDA)

One stone artefact was recorded on a ridge crest Survey Unit 21 (Plate 39). The landform is a narrow ridge crest with an open aspect and very gentle gradient. The area is covered in Sifton bush and effective survey coverage is low. Given the nature of the landform, it is assumed that the artefact is out of context, and likely to have eroded from the ridge crest above.

The recorded artefact is a milky quartz blade flake measuring 32 x 10 x 6 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional.

Plate 39 Location of SU21/L1 looking south.

Survey Unit 23/Locale 1 678390e 6182077n Trimble GPS (GDA)

One stone artefact was recorded on a track on a ridge crest in Survey Unit 23 (Plate 40). The landform is a broad ridge crest with a northerly aspect and very gentle gradient. The area is grassed with recently slashed Sifton bush; effective survey coverage is high.

The recorded artefact is a milky quartz broken flake (proximal portion) measuring 14 x 11 x 6 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional and the ground surface is highly disturbed.

Plate 40 Location of SU23/L1 looking 135°.

Survey Unit 23/Locale 2 678717e 6180230n Trimble GPS (GDA)

Two stone artefacts were recorded in a bare earth exposure (5 x 2 m) in Survey Unit 23 adjacent to a minor, highly eroded drainage line (Plate 41). The area of erosion measures 10 sq m, of which 80% was ground exposure, possessing 90% archaeological visibility. The effective survey coverage is relatively high, and given that two artefacts only were recorded, artefact density is assessed to be very low.

The recorded artefacts are:

- Milky quartz flake measuring 20 x 11 x 5 mm;
- Milky quartz flake measuring 26 x 14 x 6 mm.

The site has subsurface potential given some depth to the soils in the lower valley context, but artefact density is predicted to be low. The geomorphological context is erosional.

Plate 41 Location of SU23/L2 looking south-west.

Survey Unit 23/Locale 3 679052e 6179394n Trimble GPS (GDA)

One stone artefact was recorded on a track in Survey Unit 23 (Plate 42). The landform is a ridge crest with a easterly aspect and gentle gradient. The area is covered in regrowth scrub and Sifton bush; effective survey coverage is relatively high.

The recorded artefact is a grey tuff flake measuring 29 x 40 x 12 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional. The ground surface is highly disturbed.

Plate 42 Location of SU23/L3 looking south-west.

Survey Unit 24/Locale 1 679451e 6181416n Trimble GPS (GDA)

Five stone artefacts were recorded in a vehicle track on a crest in Survey Unit 24 (Plate 43). The area measures > 50 m x c. 2m of which 40% was ground exposure, possessing 90% archaeological visibility. The effective survey coverage is relatively high, and given that five artefacts only were recorded, artefact density is assessed to be very low.

The recorded artefacts are:

- Fine grained grey silcrete broken flake (distal) measuring 19 x 19 x 9 mm;
- Fine grained brown silcrete flake measuring 24 x 16 x 6 mm;
- Fine grained brown silcrete flake piece measuring 14 x 13 x 5 mm;
- Fine grained brown silcrete flake measuring 12 x 22 x 6 mm;
- Fine grained brown silcrete flake piece measuring 15 x 21 x 8 mm.

The locale may contain additional artefacts but these would be present in very low density. Because of the skeletal nature of the soil, the site has no subsurface potential. The geomorphological context is erosional. The ground surface is highly disturbed.

Plate 43 Location of SU24/L1 looking south.

Survey Unit 27/Locale 1 676340e 6185935n Trimble GPS (GDA)

A large quartz outcrop in Survey Unit 27 possesses evidence of having been struck by means of *hard hammer percussion* (Plate 44). This locale is a possible SPA; the status of this site cannot be determined by a visual assessment alone. As with the previously described spas, while it appears unambiguous that the quartz outcrop has been struck by human agency, the actual identity of that agent is uncertain.

The quartz seam is exposed as relatively large bedrock outcrop and cobbles. The seam is oriented north-south. It measures c. 30m long, by 10 wide and c. 50 cm high above the ground. The quartz is reasonable quality milky quartz. At the south end, the outcrop is massive exposed shale.

The outcrop possesses crushed and battered areas and bifacially flakes edges with negative flake scars and cobbles with negative scars. A small amount of blocky quartz shatter is visible in the immediate vicinity of the seam. Ground exposure at the site is low, and it is possible that flaked debris is present in a subsurface context.

Plate 44 Location of SU27/L1 looking south.

3. CONSULTATION PROCESS

A process of Aboriginal community consultation has been undertaken as a component of this assessment, and has been conducted in accordance with the guidelines as set out in the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (NSW DEC July 2005) and OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b).

It is noted that there were two late registrations of interest, being Onerwal Local Aboriginal Land Council and Gunjeewong Cultural Heritage Aboriginal Corporation, and that these two groups have been accommodated within the process of consultation. The Onerwal Local Aboriginal Land Council is the relevant LALC for the proposal area, and although consulted the Land Council was unable to supply a representative to participate in the field survey.

3.1 Consultation

In order to identify, notify and register Aboriginal people who may hold cultural knowledge relevant to determining the cultural significant of Aboriginal objects and/or places in the area of the proposed project, the following procedure was implemented (Copies of all documentation relating to this process have been submitted to OEH [Queanbeyan] in separate correspondence dated 8 August 2012).

Correspondence dated 10 April 2012 was sent to:

- OEH Queanbeyan office
- Onerwal Local Aboriginal Land Council
- the Registrar, Aboriginal Land Rights Act 1983
- the National Native Title Tribunal, requesting a list of registered native title claimants, native title holders and registered Indigenous Land Use Agreements
- Native Title Services Corporation Limited (NTSCORP Limited)
- Yass Valley Shire Council
- Upper Lachlan Shire Council
- Boorowa Shire Council
- the Lachlan Catchment Management Authority, requesting contact details for any established Aboriginal reference group

In addition an advertisement was placed in the 11 April 2012 edition of the Yass Tribune newspaper (closing date for registration of interest was noted as 25 April 2012).

Following advice received from NSW OEH (16 April 2012) and the National Native Title Tribunal (19 July 2012), further correspondence was sent to:

- Yukkumbruk
- Peter Falk Consultancy
- Pejar Local Aboriginal Land Council
- Gundungurra Aboriginal Heritage Association Inc

- Yass Valley Indigenous Consultative Committee Community Development
- Ngunnawal Heritage Aboriginal Corporation
- Arnold Williams - Ngunnawal Elders Corporation
- Yurwang Gundana Consultancy Cultural Heritage Services
- Buru Ngunawal Aboriginal Corporation
- Carl and Tina Brown
- Gunjeewong Cultural Heritage Aboriginal Corporation
- Gundungurra Tribal Council Aboriginal Corporation

The registered Aboriginal parties for this project are:

- Buru Ngunawal Aboriginal Corporation
- Gundungurra Aboriginal Heritage Association Inc
- Carl and Tina Brown
- Gunjeewong Cultural Heritage Aboriginal Corporation
- Onerwal Local Aboriginal Land Council

An outline of the scope of the project, the proposed cultural heritage assessment process and the heritage assessment methodology was forwarded to the registered parties on varying dates, immediately following receipt of their registration of interest. No responses were received from registered parties in regard to the consultation process and methodology. However, Wally Bell, Buru Ngunawal Aboriginal Corporation provided valuable information in regard to the archaeological sensitivity and potential of the study area. Sharyn Halls, Gundungurra Aboriginal Heritage Association discussed her ancestors connections to Blakney Creek, located in the local area.

For review and comment, a copy of this report has been forwarded to the registered parties; no responses have been received.

4. SUMMARY AND ANALYSIS OF BACKGROUND INFORMATION

In the previous section of this report, the results of the background research and the field survey have been outlined. The purpose of this section of the Aboriginal cultural heritage assessment report is to explain the results. In summary, the turbine ridges are predicted to be of low archaeological potential. No previously recorded Aboriginal places, areas or objects are known to be present in the proposal area, however, 13 object locales (most of which are single artefacts) and three possible SPAs were recorded during fieldwork.

Given the extensive survey coverage (see Table 1) and adequate Effective Survey Coverage (see Table 1), the paucity of stone artefacts is believed to be an accurate reflection of the artefactual status of the proposal area. That is, the proposed impact areas are assessed to contain very low density artefact distribution. Accordingly, undetected or subsurface stone artefacts are predicted to be present in extremely low density.

The archaeological results are also in keeping with the information kindly provided to us by the Buru Ngunawal Aboriginal Corporation people. Given the location of the wind turbine ridges well away from water, Wally Bell indicates that the area would have been used '… for travel through country, *if that*'.

From an archaeological perspective, the results can be compared and contrasted to previous studies. Packard and Hughes (1983) also found that sites were rarely present on the elevated topographies of the region. The predominance of quartz in assemblages found by many other researchers (for example, Clark 1977; Witter 1981; Packard & Hughes 1983; Silcox & Koettig 1985; JMcCHM Pty Ltd 2003) is however, not entirely comparable to the results at Rye Park where a much greater range of other materials were recorded.

It is concluded that there are no information gaps which are of a significant magnitude to warrant any further consideration at this time.

5. CULTURAL HERITAGE VALUES AND STATEMENT OF SIGNIFICANCE

The following significance assessment criteria is derived from the relevant aspects of ICOMOS Burra Charter (Australian ICOMOS 1999).

Aboriginal cultural heritage sites are assessed under the following categories of significance:

- Social or cultural value to contemporary Aboriginal people;
- Historical value;
- Scientific/archaeological value;
- Aesthetic value.

Aboriginal cultural significance
The Aboriginal community will value a place in accordance with a variety of factors including contemporary associations and beliefs and historical relationships. Most heritage evidence is highly valued by Aboriginal people given its symbolic embodiment and physical relationship with their ancestral past.

Archaeological value
The assessment of archaeological value involves determining the potential of a place to provide information which is of value in scientific analysis and the resolution of potential archaeological research questions. Relevant research topics may be defined and addressed within the academy, the context of cultural heritage management or Aboriginal communities. Increasingly, research issues are being constructed with reference to the broader landscape rather than focusing specifically on individual site locales. In order to assess scientific value sites are evaluated in terms of nature of the evidence, whether or not they contain undisturbed artefactual material, occur within a context which enables the testing of certain propositions, are very old or contain significant time depth, contain large artefactual assemblages or material diversity, have unusual characteristics, are of good preservation, or are a part of a larger site complex. Increasingly, a range of site types, including low density artefact distributions, are regarded to be just as important as high density sites for providing research opportunities.

Aesthetic value
Aesthetic value relates to aspects of sensory perception. This value is culturally contingent.

5.1 Statement of Significance

The 13 Aboriginal sites identified in the subject area are assessed to be representative of extremely low density artefact distribution. Their cultural and archaeological heritage value is low. The AHIMS site #51-4-0058 is likewise assessed to be of low archaeological heritage significance. The archaeological status of the three SPAs is uncertain, and accordingly, their cultural and archaeological values are unknown.

6. THE PROPOSED ACTIVITY

In this section the nature and extent of the proposed activity and any potential harm to Aboriginal areas, objects and/or places is identified.

A full description of the proposal and its potential impact on the landscape and heritage resource is described. A summary of the impact history of the study area has been described in Section 2 and is not repeated here. However, it is emphasised that prior and existing land uses have caused significant changes to geomorphological processes in the area with an associated effect on the archaeological resource.

Potential impacts to archaeology and heritage during the construction phase of the wind farm proposal relate to site preparation, operation of vehicles and machinery and the installation of infrastructure. This may involve earthworks and excavations and vegetation clearing.

6.1 Proposed Impacts

The proposal would involve the construction, operation, and decommissioning of the wind farm. The proposed impact areas are shown in Figures 2, 3, 4 and 5. Up to 128 wind turbine generators are proposed. Each turbine would have three blades likely to be up to 112m diameter mounted on a tubular steel tower up to 100 metres high, with capacity between 1.5 and 3.6 MW.

The proposal would involve the following construction:

- Electrical connections between wind turbines and on-site substations, which would be a combination of underground cable and overhead power lines;
- Onsite control buildings and equipment storage facilities for each precinct;
- A temporary concrete batching plant at each precinct;
- Access roads within the precincts in addition to minor upgrades to access on local roads, as required, for the installation and maintenance of wind turbines;
- A number of freestanding permanent monitoring masts for wind speed verification and monitoring.

A description of the individual components and their related impacts are outlined as follows:

Turbines

The ground disturbance associated with each turbine will include the construction of reinforced concrete footings excavated to a maximum size of 15 x 15 metres. A hardstand area adjacent to the turbine footings which could measure up to 40 x 20 metres is required for a crane. A delivery area for the various components is also necessary. In most cases it is anticipated that the turbine access track could be used as a delivery area. Each tower will have a transformer which will be housed either within the base of the tower, in the nacelle (located on the tower), or adjacent to the tower as a small pod mount transformer.

Electrical Connections

The onsite electrical works will include on-site power reticulation cabling (underground and overhead) linking the turbines to a Substation. Underground cabling is proposed between the turbines, with overhead cabling proposed in some locations to connect the turbines to the substation and/or the existing transmission system. Underground cabling would be laid out in trenches measuring 1 - 1.5 metres deep and 0.5 - 1 metres wide and where possible the trench routes will follow access tracks, with short spur connections to each turbine. Overhead cabling would require an easement of c. 40 - 60 metres wide and would be erected on 30 - 40 metres high single steel or concrete poles spaced 150 - 300 metres apart, with spans avoiding all wet areas. Postholes would be 3 - 5 metres deep and c. 3 - 5 metres in diameter.

Substation

A substation is required to convert power from onsite reticulation voltage to a transmission voltage of 132kV suitable to connect to the existing 330 kV transmission system. The substation would occupy an area measuring c. 250 x 250 metres. The substation would be fenced and the ground covered with crushed rock and partly by concrete pads for equipment, walkways and cable covers.

On-site Control and Facilities Building

An on-site Control and Facilities Building which will house instrumentation, control and communications equipment is proposed. The building would measure up to 25 x 15 metres and would be built on a concrete slab. Control and communications cabling is also required to extend from the Control and Facilities Building to each turbine and to the site Substation. The control cabling will be installed using the same method and route as the power cabling.

6.2 Type of Harm

The proposed works would entail ground disturbance and, accordingly, the construction of the wind farm has the potential to cause impacts to any Aboriginal areas, places or objects which may be present within the zones of direct impact.

Impacts will be located on land currently utilised for sheep grazing. Previous land use has resulted in relatively significant environmental impacts and a generally degraded landscape. European activated geomorphological processes and other natural processes associated with land degradation, will have caused significant prior impacts to Aboriginal objects within the proposal area.

However, irrespective of prior impacts the proposed works entail ground disturbance and accordingly the project has the potential to cause additional impacts to any Aboriginal objects which may be present within the individual components of the proposal. The nature of impacts relating to each Aboriginal object locale is set out below in Table 4. At this time it is uncertain whether or not impacts would occur to AHIMS site 51-4-0058 on Flakeney Creek Road. If they were however, to upgrade the road for access, impacts would be direct and partial in nature; there would be partial loss of value only.

Table 4 Impact Assessment.

Survey Unit and Aboriginal object locale	Type of harm	Degree of harm	Consequence of harm
SU1	Nil	n/a	n/a
SU2	Nil	n/a	n/a
SU3 including: SU3/L1 SU3/L2	Direct	Partial	Partial loss of value
SU4 including: SU4/L1	Direct	Partial	Partial loss of value
SU5	Nil	n/a	n/a
SU6 including: SU6/L1	Direct	Partial	Partial loss of value
SU7 including: SU7/L1	Direct	Partial	Partial loss of value
SU8 including: SU8/L1	Direct	Partial	Partial loss of value
SU9	Nil	n/a	n/a
SU10	Nil	n/a	n/a
SU11	Nil	n/a	n/a
SU12	Nil	n/a	n/a
SU13	Nil	n/a	n/a
SU14	Nil	n/a	n/a
SU15 including: SU15/L1	Direct	Partial	Partial loss of value
SU16	Nil	n/a	n/a
SU17 See section 7 re. SPAs	Nil	n/a	n/a
SU18 including: SU18/L1	Direct	Partial	Partial loss of value
SU19	Nil	n/a	n/a
SU20	Nil	n/a	n/a
SU21 including: SU21/L1	Direct	Partial	Partial loss of value
SU22	Nil	n/a	n/a
SU23 including: SU23/L1 SU23/L2 SU23/L3	Direct	Partial	Partial loss of value
SU24 including: SU24/L1	Direct	Partial	Partial loss of value
SU25	Nil	n/a	n/a
SU26	Nil	n/a	n/a
SU27 See Section 7 re. SPA	Nil	n/a	n/a

7. AVOIDING AND/OR MINIMISING HARM

The principles of ecologically sustainable development and the matter of cumulative harm have been considered for this project. The area is in a vast rural region and hence existing and future impacts are low, despite the construction of numerous wind farms in the region. The majority of cultural values, including archaeological, which attach to the landform and the broader landscape remain intact across the region.

Avoidance or the mitigation of harm has been considered as an option in relation to the proposed activities. However, the cultural and archaeological heritage significance of the proposal area has not been assessed to be of sufficient significance to warrant the implementation of avoidance or impact mitigation strategies (the exception to this is in regard to the 3 SPAs – see below). However, a number of management strategies are possible and these are each given consideration below.

7.1 Management and Mitigation Strategies

Further Investigation

The field survey has been focused on recording artefactual material present on visible ground surfaces. Further archaeological investigation would entail subsurface excavation undertaken as test pits for the purposes of identifying the presence of artefact bearing soil deposits and their nature, extent, integrity and significance.

Further archaeological investigation in the form of subsurface test excavation can be appropriate in certain situations. These generally arise when a proposed development is expected to involve ground disturbance in areas which are assessed to have potential to contain high density artefactual material and when the Effective Survey Coverage achieved during a survey of a project area is low due to ground cover, vegetation etc.

No areas of the proposal area have been identified which warrant further archaeological investigation in order to formulate appropriate management and mitigation strategies. Based on a consideration of the predictive model of site type applicable to the environmental context in which impacts are proposed, the archaeological potential of the proposed impact areas is assessed not to warrant further investigation. It has not been demonstrated that Aboriginal objects with potential conservation value have a high probability of being present in the subject area. Accordingly, test excavation conducted under OEH's *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010: 24) is not necessary.

Furthermore, the environmental context in which impacts are proposed contain highly eroded landforms, most of which are weathered to bedrock. Accordingly, subsurface excavation is impractical.

Conservation

Conservation is a suitable management option in any situation, however, it is not always feasible to achieve. Such a strategy is generally adopted in relation to sites which are

assessed to be of high cultural and scientific significance, but can be adopted in relation to any site type.

In the case at hand, avoidance of impacts (or minimisation of impacts) in regard to the recorded artefacts locales is not considered to be warranted. Such a strategy, would in any case, likely result in impacts to other Aboriginal objects (as predicted) which may not have been recorded because of subsurface incidence or lack of obtrusiveness.

However, in respect of the three possible SPAs, it is recommended, that given the possibility that they are stone procurement areas which would have elevated archaeological and cultural significance, these should be avoided during construction. An active strategy of impact avoidance would need to be implemented in order to ensure their conservation, and this is considered to be warranted. The alternative would be to conduct further investigation which would entail excavation and specialised analysis to determine their actual artefactual status or otherwise.

Mitigated Impacts

Mitigated impact usually takes the form of partial impacts only (i.e. conservation of part of an Aboriginal artefact locale or Survey Unit) and/or salvage in the form of further research and archaeological analysis prior to impacts. Such a management strategy is generally appropriate when Aboriginal objects are assessed to be of moderate or high significance to the scientific and/or Aboriginal community and when avoidance of impacts and hence full conservation is not feasible. Salvage can include the surface collection or subsurface excavation of Aboriginal objects and subsequent research and analysis.

It is assessed that the archaeological resource in the proposal area does not surpass significance thresholds which warrant any form of impact mitigation in this regard. However, note recommendations above under heading *Conservation* in regard to the three SPAs.

Unmitigated Impacts

Unmitigated impact to Aboriginal objects can be given consideration when they are assessed to be of low archaeological and cultural significance and otherwise in situations where conservation is simply not feasible.

The Aboriginal object locales identified have been assessed to be of low cultural and archaeological heritage significance. The AHIMS site #51-4-0058 is likewise assessed to be of low archaeological heritage significance. In addition, any undetected or subsurface artefacts are likewise assessed to be of low archaeological sensitivity. Given the nature and artefact density in the proposal area, and the low scientific significance rating they been accorded, unmitigated impacts are appropriate.

8. STATUTORY INFORMATION

The NPW Act provides statutory protection for all Aboriginal objects and Aboriginal Places.

An 'Aboriginal object' is defined as

> 'any deposit, object or material evidence (not being a handicraft for sale) relating to Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains'.

An Aboriginal place is an area declared by the Minister to be an Aboriginal place for the purposes of the Act (s84), being a place that in the opinion of the Minister *is or was of special significance with respect to Aboriginal culture*.

Under s90 of the NPW Act a person must not destroy, damage or deface or knowingly cause or permit the destruction, damage or defacement of an Aboriginal object or Aboriginal Place without first obtaining the s90 consent Aboriginal Heritage Impact Permit (AHIP). Consents which enable a person to impact an Aboriginal object are issued by the OEH upon review of a s90 Aboriginal Heritage Impact Permit application.

Under Section 89J of the Environmental Planning and Assessment Act 1979, the following authorisations are not required for State significant development that is authorised by a development consent granted after the commencement of this Division (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

- an Aboriginal heritage impact permit under section 90 of the National Parks and Wildlife Act 1974.

9. RECOMMENDATIONS

The following recommendations are made on the basis of:

- A consideration of the relevant section of the Environmental Planning and Assessment Act (see Section 8 Statutory Information).
- The results of the investigation as documented in this report.
- Consideration of the type of development proposed and the nature of proposed impacts.
- The discussion is Section 7 regarding impact mitigation and management.

The following recommendations are provided:

- The proposal area does not warrant further archaeological investigation such as subsurface test excavation.
- The 13 recorded Aboriginal object locales and the predicted very low density subsurface artefact distribution in the proposal area does not surpass archaeological significance thresholds which would act to preclude the proposed impacts.
- The 13 recorded Aboriginal object locales are assessed to be representative of a very low density distribution of stone artefacts. The cultural and archaeological heritage significance of these locales is assessed to be low. Accordingly, unmitigated impact is considered to be appropriate. A management strategy of impact avoidance is not warranted, except in respect of the three quartz outcrops. It is recommended also, that the three European heritage items are avoided during construction.
- There are no identified Aboriginal archaeological and cultural constraints relating to the proposal.
- It is recommended that additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. It is predicted that significant Aboriginal objects can occur anywhere in the landscape and, accordingly, they need to be identified and impact mitigation strategies implemented prior to impacts.
- The proponent should, in consultation with an archaeologist, develop a Cultural Heritage Management Plan. The development of an appropriate Cultural Heritage Management Plan should be undertaken in consultation with an archaeologist, the registered Aboriginal parties and the NSW Office of Environment and Heritage.

The Cultural Heritage Management Plan would set out procedures relating to the conduct of additional archaeological assessment, if required, and the management of any Aboriginal cultural heritage values which may be identified.

- Personnel involved in the construction and management phases of the project should be trained in procedures to implement recommendations relating to cultural heritage, as necessary.

- Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development.

10. REFERENCES

Alcorn, G. 1976 *A History of Rye Park Public School 1876-1976*. Rye Park Public School Centenary Committee, Rye Park, N.S.W.

Austral Archaeology Pty Ltd 2005 *Archaeological Test Excavation at Proposed Gunning Wind Farm NSW, Test Excavation Report*. Prepared for Connell Wagner PPI.

Austral Archaeology Pty Ltd 2008 *Aboriginal Archaeological and Cultural heritage Assessment Gunning Wind Farm NSW Additional Assessment Report*. Prepared for ACCIONA Energy.

Bayley, W. A. 1973 *Yass Municipal Centenary History*, Yass Municipal Council, Yass.

Boot, P. 1994 Recent Research into the Prehistory of the Hinterland of the South Coast of New South Wales. In Sullivan, M, Brockwell, S. and Webb, A. (eds) *Archaeology in the North: Proceedings of the 1993 Australian Archaeological Association Conference*. NARU: Darwin.

Boot, P. personal communication February 2009.

Branagan, D. and G. Packham 2000 *Field Geology of New South Wales*. NSW Department of Mineral Resources: Sydney.

Carlos, G. 2008 A short history of Yass Tramway, *Yass Tribune* http://yass.yourguide.com.au/news/local/news/general/a-short-history-of-yass-tramway/1335550.aspx?storypage=0 (accessed 27th November 2008)

Carter, C. 1994 *The Archaeology of the Robertson Land Acts*. Unpublished BA Honours Thesis, Australian National University.

Clark, P. 1977. *Aboriginal campsites along Waterhole Flat Creek*. Unpublished BA Honours Thesis, Department of Prehistory and Anthropology: Australian National University.

DPWS Heritage Design Services 2001, *Greater Burrinjuck Dam Precinct Heritage Assessment*, report for State Water.

Dean-Jones, P. 1990 *Report of an archaeological survey of a proposed hard rock quarry near Gunning*.

Department of Mineral Resources 1994 *Gold in New South Wales*, Sydney.

Dibden, J. 2005a *Proposed Residential Subdivision at the Bermagui Country Club. Archaeological Subsurface Test Excavation. S87 Permit # 2144*. Report to Paynter Dixon Golf Pty Ltd.

Dibden, J. 2005b *Proposed Wind Farm – Snowy Plains Subsurface Test Excavation s87 Permit # 2199*. A report to Taurus Energy.

Dibden, J. 2005c *Proposed Residential Subdivision Moruya Subsurface Test Excavation*. A report to Patent Developments.

Dibden, J. 2006a *Taurus Energy Proposed Wind Farm – Cullerin, via Goulburn Aboriginal Archaeological Assessment*. A report to nghenvironmental.

Dibden, J. 2006b *Taurus Energy Proposed Wind Farm –Conroys Gap, via Yass Aboriginal Archaeological Assessment*. A report to nghenvironmental.

Dibden, J 2006c Proposed Re-Development at Kalorama Caravan Park, Millingandi, near Merimbula, NSW. Subsurface Test Excavation. Preliminary Research Permit #2402. Report to Driftwood Village.

Dibden, J. 2006d *Proposed Commercial, Residential and Industrial Subdivision Lot 4 DP1077434, Lot 1510 DP 1977898 & Lot 2432 DP 793758 South Bega NSW Subsurface Test Excavation*. A report to Planning Initiatives.

Dorrough, J., A Yen, V. Turner, S. Clark, J. Crosthwaite and J. Hirth 2004 Livestock grazing management and biodiversity conservation in Australian temperate grassy landscapes. *Australian Journal of Agricultural Research*. Vol 55; pp 279 – 295.

Dunnell, R. 1993 The Notion Site in J. Rossignol and L. Wandsnider eds *Space, Time and Archaeological Landscapes*. New York: Plenum, pgs 21-41.

Eades, D. 1976 *The Dharawal and Dhurga Languages of the New South Wales South Coast*. Canberra: Australian Institute of Aboriginal Studies.

Flood, J. 1980 *The Moth Hunters*. Australian Institute of Aboriginal Studies: Canberra.

Flood, J. 1995 *Archaeology of the Dreamtime* (Revised ed.) Angus and Robertson, Sydney.

Flood, J., David, B., Magee, J. & English, B. 1987 Birrigai: A Pleistocene Site in south-eastern highlands. *Archaeology in Oceania*. 22: 9-26.

Harden Murrumburrah District Historical Association, n.d. *Brief history of the Harden Murrumburrah district*, Harden.

Heritage Council of New South Wales 2008 *Levels of Heritage Significance* Heritage Office, NSW Department of Planning, Sydney.

Heritage Office and Department of Urban Affairs and Planning 1996 *Regional histories: regional histories of New South Wales* Department of Urban Affairs and Planning, Sydney.

Hiscock, P. & Mitchell, S. 1993 *Stone Artefact Quarries and Reduction Sites in Australia: Towards a Type Profile*. AGPS: Canberra.

Irving, R. 1982 *Reader's Digest book of historic Australian towns,* Reader's Digest, Surry Hills.

Jackson-Nakano, A. 2002 *Pajong and Wallaballooa; A History from the Records of Aboriginal Farming Families at Blakney and Pudman Creeks*. Aboriginal History Monograph 9. Aboriginal History Inc. Canberra.

Jeans, D. N. 1966 *A Historical Geography of New South Wales*. Reed Education: Sydney.

Jennings, J. and J. Mabbutt 1977 Physiographic outlines and regions. In: Jeans, D. (ed): *Australia: a Geography*. Sydney University Press; Sydney: PP 38 – 52.

Jo McDonald Cultural Heritage Management Pty Ltd 2003 *Archaeological Survey for an Aboriginal Heritage Assessment Gunning Wind Farm, Gunning, NSW*. Report prepared for Connell Wagner PPI.

Kabaila, P. 1998 *Wiradjuri Places. The Murrimbidgee River Basin with a section on Ngunawal Country*. ACT: Black Mountain Projects.

Kearns, R. H. B. 1973 *Broken Hill, volume 1 1883-1893: Discovery and Development*, Broken Hill: Broken Hill Historical Society.

Klaver, J. 1993 *Duplication of Hume Highway Carriageway and Bypass of Bookham, NSW. Archaeological Survey for Aboriginal Sites*. Report to Mitchell McCotter.

Koettig, M. 1986a *Survey for Aboriginal Sites Along the Proposed Water Pipeline Between Bowning and Yass*. Report to Public Works Department, New South Wales.

Koettig, M. 1986b *Test Excavations at Derringullen Creek Near Yass*. Report to Public Works Department, New South Wales.

Koettig, M. and R. Silcox 1983 *Survey for Archaeological Sites along the Proposed Yass By-Pass Route*. Report to NSW Department of Main Roads.

Knight, T. 2001 *Stepping Stones to the Sky Archaeological Perspectives on the Cultural Significance of the Weddin Mountains in Recent Prehistory*. Unpublished Master of Arts by Research Thesis. School of Archaeology and Anthropology Australian National University, Canberra.

Kuskie, P. 1992 *An Archaeological Assessment of the Proposed Route of Optus Commission's Fibre Optic Cable Between Cootamundra, NSW, and Hall, ACT*. Report to Landscan Pty Ltd.

Kuskie, P. 2000 *An Aboriginal Archaeological Assessment of the Proposed Mount Arthur North Coal Mine, Near Muswellbrook, Hunter Valley, New South Wales*. Unpublished report to Dames and Moore.

Lampert, R. 1971 *Burrill Lake and Currarong: Coastal Sites in Southern New South Wales*. Terra Australia 1 Department of Prehistory. ANU: Canberra.

Lloyd, H. 1990 *Boorowa: Over 160 Years of White Settlement* Toveloam Pty Ltd, Panania, NSW.

Lunt, I., D. Eldridge, J. Morgan and G. Witt 2007 A framework to predict the effects of livestock grazing and grazing exclusion on conservation values in natural ecosystems in Australia. *Australian Journal of Botany*. Vol 55; No 4; pp 401 - 415.

Maher, B. 2003 *Binalong: beyond the limits*. Rev. Brian Maher, Canberra.

McDonald, R. Isbell, R, Speight, J. Walker, J. and M. Hopkins 1998 *Australian Soil and Land Survey Field Handbook*. CSIRO Australia.

Mission Australia 2000 *History in the Making: Yass, picture and memories*. Mission Australia, Canberra.

Mulvaney, J. and J. Kamminga 1999 *Prehistory of Australia*. Allen and Unwin: St Leonards.

Navin, K. and K. Officer 1995 *Archaeological survey proposed extension to Bogo Quarry, South of Yass, NSW*. Report to David Hogg Pty Ltd.

Navin Officer Heritage Consultants 2001 *Yass 330/132kV Substation Reconstruction Project Archaeological Assessment*. Report to Pacific Power.

Navin Officer Heritage Consultants 2009 Dalton Peaking Power Plant Cultural Heritage Assessment. A Report to URS for AGL.

Navin Officer Heritage Consultants 2011 Dalton Peaking Power Plant – Gas Pipeline. Archaeological Assessment. A Report to URS for AGL.

NSW Department of Environment and Conservation 2005 *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*.

NSW Department of Environment, Climate Change and Water 2007 Data Audit and overview of the Aboriginal Cultural Heritage in the Lachlan Catchment. Report to the Lachlan CMA Regional Aboriginal Reference Group.

New South Wales Department of Environment, Climate Change and Water 2010a *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales 2010*.

New South Wales Department of Environment, Climate Change and Water 2010b *Aboriginal cultural heritage consultation requirements for proponents 2010*.

New South Wales Office of Environment and Heritage 2011 *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW*.

New South Wales Heritage Office and Department of Urban Affairs 1996, *Heritage Assessments, NSW Heritage Manual*, HO/DUAP, Sydney.

New South Wales Heritage Office 2001 *Assessing Heritage Significance*, HO/DUAP, Sydney.

Oakley, B. 1995 *Archaeological investigation Optus Communications*. Report to Optus Communications.

Olley, J. and R. Wasson 2003 Changes in the flux of sediment in the Upper Murrumbidgee catchment, Southeastern Australia, since European settlement. *Hydrological Processes*. Vol 17; pp 3307 – 3320.

Ossa, P., Marshall, B. & Webb, C. 1995 New Guinea 2 cave: A Pleistocene site on the Snowy River, Victoria. *Archaeology in Oceania* 30(1):22-35.

OzArk Environment & Heritage Management P/L 2007 *Ecology and Heritage Assessment: Wagga Wagga – Yass Line 990 132 kV Transmission Line*. Report to International Environmental Consultants PL on behalf of TransGrid.

Rob Paton Archaeological Studies Pty Ltd 1993 *An archaeological survey of the Proposed Optical Fibre Cable Route Mitchell, ACT to Orange, NSW*. A report to Telecom Australia.

Pearson, M. 1981 Seen Through Different Eyes: Changing Land Use and Settlement Patterns in the Upper Macquarie River Region of NSW from Prehistoric Times to 1860. Ph.D. Thesis, Department of Prehistory and Anthropology, Australian National University, Canberra.

Perry, T. M. 1965 *Australia's first frontier*. Melbourne University Press: Melbourne.

Register of the National Estate Database Records http://www.environment.gov.au/cgi-bin/ahdb/search.pl Accessed 13/6/ 2012

Seddon, J., A. Zerger, S Doyle and S Briggs 2007 The extent of dryland salinity in remnant woodland and forest within an agricultural landscape. *Australian Journal of Botany*. Vol. 55; No. 5; pp 533- 540.

Saunders, P. 2000 *Investigation of Dalton Open Campsite North and Yass River Open Campsite*. Report to Energy Australia.

Shaw, A. G. L. 1970 *The Economic Development of Australia*. Longman: London.

Shott, M. 1995 Reliability of Archaeological Records on Cultivated Surfaces: A Michigan Case Study. *Journal of Archaeological Field Archaeology*. Vol 22; pp. 475 – 490.

Silcox, R. 1991 *Boorowa Dam: Archaeological survey of inundation area*. Report to Public Works Department, NSW.

Silcox, R. and M. Koettig 1985 *Survey for Aboriginal and Historic Sites along the Proposed Alternative Yass By-Pass Route, N.S.W*. Report to DMR.

Silcox, R. and M. Koettig 1988 *Barton Highway Extension at Yass: Survey and Test Excavations on the Proposed Alternative Route*. Report to Kinhill Stearns Pty Ltd.

Southern Tablelands of NSW 2008 *Towns and villages: Yass* http://www.argylecounty.com.au/towns/yass.html (accessed 27th November 2008)

Stewart, J. and Hassall, D. 1998 *The Hassall Family. Celebrating 200 years of Australia 1798-1998*. The Hassall Family Bicentenary Association Inc.

Thistleton, J. 2012 *Exploring the Hume Heritage* The Canberra Times 3 March 2012 http://www.canberratimes.com.au/act-news/exploring-the-hume-heritage-20120302-1u92t.html#ixzz23Td6vrDC Accessed 15/7/2012

Tindale, N. 1974 *Aboriginal Tribes of Australia*. ANU Press, Canberra.

Wandsnider, L and E. Camilli 1992 The Character of Surface Archaeological Deposits and Its Influence on Survey Accuracy. *Journal of Field Archaeology*. Vol. 19 pp 169 - 188.

White, I. 1986 *Dimensions of Wiradjuri An Ethnohistoric Study*. B. Litt thesis, The Australian National University, Canberra.

White, I. and S. Cane 1986 *An Investigation of Aboriginal Settlements and Burial Patterns in the Vicinity of Yass*. Report to the NSW NPWS, Queanbeyan.

Witter, D. 1980 *An Archaeological Pipeline Survey between Dalton and Canberra. Aboriginal and Historical* Resources Section, National Parks and Wildlife Service, Sydney, NSW.

Witter, D. 1981 *Archaeological Salvage Investigations on the Dalton to Canberra Pipeline*. Aboriginal and Historical Resources Section, National Parks and Wildlife Service, Sydney, NSW.

Witter, D. and P. Hughes 1983 *Stage 1 of an Archaeological Survey of the Murrumburrah-Yass and Murrumburrah-Wagga Wagga Electricity Transmission Lines*. Anutech report to NPWS.

Wasson, R., R. Mazari, B Starr and G. Clifton 1998 The recent history of erosion and sedimentation on the Southern Tablelands of southeastern Australia: sediment flux dominated by channel incision. *Geomorphology* Vol: 24; pp 291 – 308.

Yass and District Historical Society 2008 *History and Timeline*. http://www.yasshistory.org.au/history.htm (accessed 27th November 2008).

Yass Valley Council 2008 *Historic Yass* Valley http://www.yass.nsw.gov.au/about/1573/1582.html (accessed 27th November 2008).

Young, M. (ed.), 2000 *The Aboriginal People of the Monaro*, NSW NPWS.

GLOSSARY

Aboriginal object - A statutory term, meaning: '… any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains' (s.5 NPW Act).

Declared Aboriginal place - A statutory term, meaning any place declared to be an Aboriginal place (under s.84 of the NPW Act) by the Minister administering the NPW Act, by order published in the NSW Government Gazette, because the Minister is of the opinion that the place is or was of special significance with respect to Aboriginal culture. It may or may not contain Aboriginal objects.

Development area - Area proposed to be impacted as part of a specified activity or development proposal.

Harm - A statutory term meaning '… any act or omission that destroys, defaces, damages an object or place or, in relation to an object – moves the object from the land on which it had been situated' (s.5 NPW Act).

Place - An area of cultural value to Aboriginal people in the area (whether or not it is an Aboriginal place declared under s.84 of the Act).

Proponent - A person proposing an activity that may harm Aboriginal objects or declared Aboriginal places and who may apply for an AHIP under the NPW Act.

Proposed activity - The activity or works being proposed.

Subject area - The area that is the subject of archaeological investigation. Ordinarily this would include the area that is being considered for development approval, inclusive of the proposed development footprint and all associated land parcels. To avoid doubt, the subject area should be determined and presented on a project-by-project basis.

APPENDIX 1 OEH AHIMS RESULTS

Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : Rye Park WF

Client Service ID : 67566

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
51-6-0099	Rye Park Pioneer Cemetery	AGD	55	676900	6178000	Open site	Valid	Burial : -	Burial/s	
	Contact	Recorders	Ms.Adrienne Howe-Piening					Permits		
51-4-0058	Flakeney Creek	AGD	55	680880	6168786	Open site	Valid	Artefact : -		
	Contact	Recorders	Mr.Giles Hamm					Permits		
51-4-0053	Flakeney Creek 1	AGD	55	677180	6171760	Open site	Valid	Modified Tree (Carved or Scarred) : -		
	Contact	Recorders	Petra Schell					Permits		

Report generated by AHIMS Web Service on 11/04/2012 for Julie Dibden for the following area at Datum :GDA, Zone : 55, Eastings : 672000 - 690000, Northings : 6147000 - 6189000 with a Buffer of 50 meters.Additional Info : Archaeological assessment. Number of Aboriginal sites and Aboriginal objects found is 3

APPENDIX 2 EUROPEAN HERITAGE

Local Historical Context

European Exploration and Settlement

A party led by Hamilton Hume is attributed as being the first Europeans to arrive in the Yass district. From the early age of 17, Hume had taken to exploring and over the course of several expeditions, setting out from his home at Appin, he had travelled to the regions of Bong Bong, Moss Vale, the Shoalhaven River, and the western side of the Blue Mountains. In 1821, at the age of 24, Hume and his accompanying party ventured to areas north-west of Lake George. Travelling across the Cullerin Range they headed towards the headwaters of the Lachlan River, camping overnight near present day Gunning, before then heading south-west and encountering the Yass plains which, near the junction of the Yass River and Murrumbateman Creek, had been 'freshly burnt by blacks'. Hamilton Hume, along with his brother John Kennedy Hume, his brother-in-law George Barber, and William Henry Broughton, subsequently staked out substantial land claims in the region. Hume established his first station 'Wollawardella' on good land at Lerida Creek in the Gunning district and it was from here, just three years later in 1824, that Hume set out with Captain William Hovell on their celebrated expedition to explore an overland route from Sydney to Port Philip (Jackson-Nakano 2002). Meanwhile, William Henry Broughton took up one of the first landholdings on the Boorowa River which by 1849 had been expanded to encompass squattings totalling some 5,400 hectares in area.

Following Hume's first expedition, Henry O'Brien made one of the first applications to graze cattle in the Yass area. This was soon followed by his brother Cornelius. Henry was also one of the first settlers in the region, settling at Douro. Early stations in the district were "Henry O'Brien's, Barber's, Belle Vale, Terry's Kenilworth, Dr Harris at Underaligo, Hume's at Gunning and Broughton's at Burrowa (Boorowa)" (Bayley 1973: 17). During these early years the area around Yass and beyond also began to be squatted, with crude huts of these first European settlers beginning to dot the landscape, erected by landowners to house their workers and 'Government servants' (convicts) (Jackson-Nakano 2002). By 1830, Ned Ryan had settled at Galong, James Roberts at Currawong and Dr John Harris at Callangan (HMDHA n.d.). Hume received various land grants for his efforts in exploration and in 1829 he selected land on the Yass River at Borroo Springs (Bayley 1973; Irving 1982; Mission Australia 2000). He later bought Cooma Cottage and 100 acres of Cornelius Brown's original 960 acre grant. Hume and his descendants lived at Cooma Cottage until at least the late 1870s.

The nineteen counties, which corresponded to the areas of permissible settlement in New South Wales, were defined by Governor Sir Ralph Darling in 1829. In the south-west, the limits were marked by a plough line across the Port Philip track at Bowning Hill, just to the west of Yass; this point was known as the Limits of Location. Yass was located just inside these limits. However, there was nothing to physically stop settlement expanding beyond Yass. The lands beyond were squatted on for grazing cattle and were effectively outside the jurisdiction of the Empire. This situation was changed in 1837, however,

when squatting licences were introduced (Maher 2003). On an expedition outside the 19 counties in 1836, Major Mitchell noted:

1836, Oct. 27 … we had arrived on the Murrumbidgee River, 75 miles below where the river quitted the settled districts … I found the upper portion of this fine stream fully occupied as cattle stations …

Between 1836 and 1840, a small number of European settlers started occupying land in the region of present day Rye Park. John James Howell is said to have been one of the first people to arrive in the Boorowa district at some time between 1825 and 1827. Thereafter, heading south-east following the course of Pudman Creek, he occupied a portion of land, described as a huge property, which he named 'Arkstone Forest' (at a later date the name was changed to 'Springfield'). John James Howell married Lucy Hassall following the death of her first husband, and together they resided at the Arkstone house, described as a two-storey brick building with numerous associated sheds and outbuildings. John James Howell died in 1847 but his wife Lucy continued to running the property for a further six years with the aid of her son James Mileham Hassall. Later, the minister Robert Cartwright resided at 'Arkstone Forest' for a period of some 18 years before relocating to Collector (Alcorn 1976; Stewart and Hassall 1998, Lloyd 1990).

When John James Howell's nephew, William P. Howell, arrived in the colony from England in 1837, he took up residence with his uncle at 'Arkstone Forest'. Not long after, William Howell married Elizabeth Hassall, the daughter of Lucy and stepdaughter of his uncle John James Howell. In 1840 William also took up additional land at Pudman Creek, which he called 'Llangrove'. William, an ambitious young man, thereafter controlled the squatting rights of both the Hassall and Howell families in the Rye Park area and proceeded to develop the property. In 1843 he and Elizabeth built the substantial 'Llangrove' house, which still stands. They obtained freehold over the property in 1851, at which time it was comprised of 1,200 acres, and lived out their retirement together on the estate, both passing away in 1860 (Alcorn 1976; Stewart and Hassall 1998).

In 1861, Sir John Robertson, the Minister of Lands, introduced legislation (Crown Lands Occupation Act 1861 and Crown Lands Alienation Act 1861) to allow selection of land by any person under certain conditions, at a set price of one pound per acre. One quarter of the purchase price was required with the balance deferred as long as certain conditions were met. This legislation set minimum and maximum sizes for portions as well as orientation and boundary proportions. Selection could also take place prior to survey. The intention of this legislation was to allow access to land on fair and easy terms and promote closer settlement throughout the colony (Carter 1994: 21). Prior to 1860, apart from the notable Howell and Hassall families, only another two or so Europeans had settled in the Rye Park district. However, with the passing of the Robertson Land Act in 1861 allowing settlers to select land at reasonable prices, combined with an influx of dissolutioned goldminers, particularly from the Young goldfields, vacant land was suddenly being taken up with fervour. By 1867, most of the better land throughout the district had been selected (Alcorn 1976).

After the death of William and Elizabeth, 'Llangrove' was subsequently purchased by the Hume family and run by Andrew Hamilton Hume, the nephew of Hamilton Hume, who changed the name of the property to 'Everton'.

Mining and other developments

The search for minerals in Australia began soon after the arrival of the First Fleet. Initial reports of gold were, however, suppressed due to fears of effects the news might have on the convicts (Kearns 1980). The first official report of gold in New South Wales was at Fish River between Rydal and Bathurst in 1823 by James McBrien, a Land Department Surveyor. At that time mining was still not a priority for the colony, however, following the emigration of settlers to the gold rush in California in 1849 the government realised the need to identify substantial gold deposits at home to reverse the migration. A reward was offered for the discovery of payable gold and in April 1851, John Lister and William Tom made the first report of payable gold at the junction of Lewis Ponds and Summer Hill Creeks, Ophir near Bathurst. Thus began the Australian gold rush which provided the first impetus for substantial growth in the country. Within the next ten years, population grew in New South Wales from 197,265 to 350,860. The gold rush also affected demography, with a substantial increase in non-Anglo immigrants such as those from Germany, France, America, and China. Initial finds were alluvial deposits, although with time reef gold was also identified and mined. From 1851 to 1948, New South Wales contributed 8.5% of Australia's gold production (Department of Mineral Resources 1994: 3-4).

With the onset of the gold rush and attention suddenly focused on that pursuit, reports of discoveries of gold from all over the countryside became frequent. In response, a large proportion of the population took to the road, making their way from one reported goldfield to another. The Goulburn Herald of 1 May 1851 noted that '... everybody in Yass has left for the diggings, only five adults are left, and three of them are going prospecting next week'. As a result of this frenzy, in 1852 the roads through Boorowa were described as being abuzz with a myriad of miners moving from one field to another. In that same year a few specks of gold were reportedly found near Anns Vale, east of Boorowa, and a small nugget in Pudman Creek (Lloyd 1990: 247).

It nevertheless soon became apparent, however, that despite numerous finds in other regions, there were no rich goldfields to be exploited in the Boorowa and Rye Park district. Instead, copper and the accompanying minerals, lead and silver, formed the basis of the local mining industry in the area. The Walla Walla Copper Mines, located six kilometres north-west of Rye Park, is indicated to have actually begun operation prior to the 1951 gold rushes, some seven months earlier in 1850. As such, it is one of the oldest mining sites in New South Wales. The initial owners purchased the land and commenced mining the copper ore with significant success, but when gold fever took hold in the colony it rendered the cost of labour so prohibitive that the owners had no choice but to cease working the mine (Register of the National Estate database records). This mine appears to have reopened by 1872, during a period of what Lloyd (1990) calls 'copper mania' which apparently struck the Rye Park region at this time. Lloyd (1990) indicates that it was a Mr. H Wilson who was the first person to discover copper at the Walla Walla mine, and that soon after the Walla Walla Copper Joint Stock Company was formed over 60 acres of purchased land comprised of 200 mineral leases situated at

'Bidgemuninga' on Pudman Creek. This mining area showed good returns before eventually drying up and the company becoming insolvent in 1903.

The similarly named Wallah Wallah Silver and Lead Mine and Smelter is located about 4.5 kilometres to the east of the Rye Park township. To date it is the only example of a lead and silver smelter found in the region. Today the Wallah Wallah Silver and Lead Mine consists of several deep shafts, and an extensive body of mullock, slag and ore waste, and the smelter site (Register of the National Estate database records).

Lloyd (1990) describes other mines in the district, including one located on the 'Everton' property, which is indicated from 1881 to have produced silver as well as a small amount of gold. Given its location there is some possibility that this refers to the Wallah Wallah Silver and Lead Mine. Later, in 1926, deposits of tungsten, wolfram, molybdenum and bismuth were also discovered in the Rye Park area. These rare metals were mined extensively in the district up until 1957, at which time this mining activity ceased (Lloyd 1990).

Agricultural Industry

Agriculture, and particularly the wool industry, has had a central role in the European history of the Rye Park district. Since the early 1800s, superfine merinos have been produced in the broader district, including Goulburn, Gunning and Yass (DPWS HDS 2001). Hume himself bred merinos, and others such as George Merriman at the Ravensworth Stud were instrumental in the development of the wool industry. With the introduction of the Robertson Land Acts in the 1860s, there was fierce competition for land between the original squatters and the new selectors trying to establish themselves in the region. By the late 1870s, most of the big runs had been replaced to some extent by smaller freehold properties, although many of the squatter families continued to be very influential in the agricultural industry. At 'Everton', the nephew of Hamilton Hume, Andrew Hamilton Hume, had set about expanding the property through a series of land purchases and over time he had increased the size of the property to 12,000 acres. Andrew Hamilton Hume established at 'Everton', a stud herd of merino sheep bred from 2,500 ewes he obtained from Hamilton Hume's 'Humewood' property in 1865. Under the stewardship of Andrew Hamilton Hume and his eldest son Hamilton Rawdon Hume, the 'Everton' stud amassed more than 218 national and international awards (Thistleton 2012). Even today, the descendants of the early pioneers are still producing much of the wool that continues to gain international awards (DPWS HDS 2001).

Historical Register Searches

Searches have been conducted for previous heritage listings in and around the study area; these searches have included all of the relevant heritage registers for items of local through to world significance. Details of these searches are provided below.

Australian Heritage Database

This database contains information about more than 20 000 natural, historic and Indigenous places.

A search of this database (13 June 2012) revealed that there is 2 items listed on the Register of the National Estate (RNE) as being in or near the proposed Rye Park area; a summary of the search results is provided below in Table 1. Neither of these items are in the Rye Park Wind Farm study area, although the Wallah Wallah Silver and Lead Mine and Smelter is in reasonably close proximity.

Table 1 Australian Heritage Database Search Results.

Heritage Item	Location	Register and Status
Walla Walla Copper Mines	Rye Park, NSW, Australia	Register of the National Estate (Non statutory archive)
Wallah Wallah Silver and Lead Mine and Smelter	Rye Park, NSW, Australia	Register of the National Estate (Non statutory archive)

Of itself listing on the Register of the National Estate does not afford legal protection for a heritage item. None of the abovementioned identified items listed on the Register of the National Estate are included in another Commonwealth statutory heritage list and as such are not afforded protection under the EPBC Act.

State Heritage Inventory

The NSW heritage database contain over 20,000 statutorily-listed heritage items in New South Wales. This includes items protected by heritage schedules to local environmental plans (LEPs), regional environmental plans (REPs) or by the State Heritage Register.

The information is supplied by local councils and State agencies and includes basic identification details and listing information. Consequently listings should be confirmed with the responsible agency.

The Rye Park Wind Farm falls within the boundaries of three local council areas, they being Boorowa Council, Upper Lachlan Shire Council and Yass Valley Council. A search of this database in relation to all three council areas (13 June 2012) revealed no listings that were in the vicinity of the proposed Rye Park Wind Farm study area.

National Trust of Australia (NSW) Register

The National Trust of Australia (NSW) is a non-government Community Organisation which promotes the conservation of both the built and natural heritage (for example, buildings, bushland, cemeteries, scenic landscapes, rare and endangered flora and fauna, and steam engines may all have heritage value). The Trust has approximately 30,000 members in New South Wales.

A search of the National Trust of Australia (NSW) Register (13 August 2012) revealed that there is only one item in the vicinity of the Rye Park Wind Farm proposal area that is currently listed with the National Trust (Table 2). The item in question is the property 'Everton', formerly 'Llangrove', which is outside the Wind Farm study area.

Table 2 National Trust of Australia (NSW) Register search results.

Item name	Address	LGA
Everton formerly Llangrove	Rye Park	Boorowa

Historical Themes

A historical theme is a way of describing a major historical event or process that has contributed to the history of NSW. Historical themes provide the background context within which the heritage significance of an item can be understood. Themes have been developed at National and State levels, but corresponding regional and local themes can also be developed to reflect a more relevant historical context for particular areas or items.

The table below (Table 3) summaries the historical themes that are applicable to the Rye Park study area.

Table 3 National, state and local historical themes applicable to the study area and surrounds.

Australian Theme	NSW Theme	Local Theme
Peopling Australia	Aboriginal cultures and interactions with other cultures	Day-to-day life
		Mythological and ceremonial
		Natural resources
		Contact period
Developing local, regional and national economies	Agriculture	Fencing
		Sheds
		Pasture
		Water provision
		Farmsteads
		Shearing
		Machinery
	Commerce	Banking
		Trade routes
		Shops
		Inns
	Communication	Postal services
		Telephone and telegraph services
		Newspapers
		Transport networks
	Environment – cultural landscape	Tree plantings
		Picnic areas
	Events	Floods
	Exploration	Camp sites
		Exploration routes
		Water sources
	Industry	Mills

Australian Theme	NSW Theme	Local Theme
		Shearing sheds
		Workshops
		Transport network
	Mining	Prospecting
		Mine claims
		Extraction of ores
		Processing plants
		Transport of supplies and ore
		Mining settlements
		Mining equipment/machinery
		Mining landscapes
	Pastoralism	Pastoral homesteads
		Sheds and yards
		Travelling stock reserves
		Fencing and boundaries
		Pastoral workers' camps
		Water sources
	Technology	Communication networks
		Processing of ores
	Transport	Railways
		Early roads
		Private tracks
		Coaches and teamsters
		Bridges
Building settlements, towns and cities	Towns, suburbs and villages	Town plan
		Neighbourhoods
	Land tenure	Fencing and other boundary markers
		Mining lease markers
		Trig stations
	Utilities	Water distribution
		Garbage disposal
		Sewage/septic systems
		Provision of electricity
		Bridges
		Culverts
	Accommodation	Inns and hostels
		Domestic residences
		Temporary encampments
		Homesteads
		Humpies
Developing Australia's cultural life	Domestic life	Domestic artefact scatters
		Residences

Australian Theme	NSW Theme	Local Theme
		Food preparation
		Gardens
		Domesticated animals
	Leisure	Show grounds
		Picnic/camping areas
		Racecourse
		Scenic lookouts
		Town halls
		Tourism
	Religion	Churches
	Social institutions	Public hall
		Social groups/associations
	Sport	Sports grounds
		Sports teams
Marking the phases of life	Birth and death	Graves
	Persons	Individual monuments
		Significant individuals/families
		Place names

Predictive Statements

As the above table indicates, there is an array of themes and hence potential site types that might occur in and around the Rye Park Wind Farm study area, although many of these correspond to heritage items in urban contexts. Given that there are no known historical villages or towns within the proposal area it is unlikely that most of these themes will be represented within the proposed turbine envelopes and other areas of direct impacts. There is, however, potential for sites associated with agriculture, such as fences, stockyards, sheep folds, sheds, ploughfields and water tanks. More generally there is the potential for roads, tracks and paths. There is also some potential for evidence of small mining ventures, including shafts, mullock heaps and costeans. However, given that the majority of impacts associated with the proposed wind farm are located on exposed ridge tops, the potential for evidence of early settlement, such as homesteads and huts, is relatively low.

Results

Three European heritage items have been recorded in the vicinity of proposed impacts, as listed in Table 5 and described below.

Table 5 List of European Heritage Items

Name	Comments	Easting	Northing
SU16/H1	Harvester	680511	6173417
SU24/H1	Costean	679992	6179258
See below	Mine	680190	6179520

SU16/H1

The harvester is located under a tree on the High Rock property (see Plate 1). It is in good condition. The significance of this item is not sufficient to warrant heritage listing. While in the general vicinity of a proposed transmission line, the harvester is unlikely to be impacted, however, measures should be undertaken to ensure that it is not.

Plate 1 Harvester – SU16/H1.

SU24/H1

This costean, or exploratory digging, is located on the crest of a ridge (SU24) – see Plate 2. It measures c. 16 x 7 m in total area, including the trench and mullock on either side. The trench is 0.7 – 1 m deep. The significance of this item is not sufficient to warrant heritage listing. It is in the area of a proposed track and could be impacted. Measures should be undertaken to ensure that it is not.

It is noted also that a mine site, not inspected during the survey, is present near to the costean (350 m to the north-east). Its location has been determined via the topographic map. Its grid coordinate is 680190.6179520.

Plate 2 SU24/H1 Costean