Proposed Development of

Bango Wind Farm

Southern Tablelands, New South Wales

Environmental Impact Statement

Volume 1

September 2016

CWP Renewables

Prepared for Bango Wind Farm Pty Ltd by CWP Renewables Pty Ltd

CERTIFICATION

Submission of Environmental Impact Statement prepared as a State Significant Development under Part 4 of the *Environmental and Planning Assessment Act 1979*.

Application Reference	SSD 6686		
Document Description	Proposed development of Bango Wind Farm - Environmental Impact Statement		
Declaration	I certify that I have prepared the contents of this Environmental Impact Statement in accordance with the Secretary's Environmental Assessment Requirements issued 4th November 2015. The document has also been prepared in accordance with the previously issued Director-General's Requirements dated 31st March 2011 and amendments dated 16th August 2011, 18th April 2012 and to the best of my knowledge, the information contained in the Environmental Impact Statement is not false or misleading. The professional qualifications of the document manager and reviewing manager include Environmental Science and Management and Business.		
	Name	**Signed**	**Date**
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UPDATES TO THIS DOCUMENT

During the preparation of this Environmental Impact Statement, a number of changes occurred.

Please consider these changes while reviewing the document.

- The Assessment Type of the Bango Wind Farm has transitioned from Part 3A, after its repeal, and is now being assessed as a State Significant Development under Part 4 of the EP&A Act. Any reference to a Part 3A assessment in attached technical assessments may be disregarded, and considered as referring to State Significant Development;
- Rugby Wind Farm, a wind farm that was proposed to the north of the Project has been withdrawn. Where references are made to cumulative impacts with the Rugby Wind Farm, please disregard these;
- Slight changes have occurred to the Rye Park Wind Farm layout, a wind farm under development to the east of the Project. The changes made to the layout are not significant and therefore sit within the cumulative impact assessment undertaken for this EIS. The revised layout has been considered in the Environmental Noise Assessment and Cumulative Landscape Visual Impact Assessment. Where further references are made to the Rye Park Wind Farm layout, these will be incorporated into future documentation where required;
- Four turbines at the south east extent of the Project, situated in the Mt Buffalo cluster have been removed through consultation with landowners. This change has been highlighted in maps and a review of all technical assessments has deemed that the removal of the four turbines results in a reduced impact. This change will be incorporated into future documentation. These wind turbines are identified as "removed wind turbines" in the Project maps in Volume 2;
- A number of changes were made to the residence information for the Project as a result of construction of residences and change in occupancy status of existing buildings. These changes have been incorporated into the EIS; and
- Boorowa Council underwent amalgamation, and the LGA is now part of Hilltops Council. References made to the former should be considered to mean the latter.

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CHAPTER 1

Executive Summary

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1. PREFACE

The Environmental Impact Statement (EIS) has been prepared to provide a project description, discuss all potential effects of the Bango Wind Farm on the existing environment and community, and discuss the measures proposed to manage and mitigate any potential adverse effects. The proposed development is for the purpose of generating electricity from wind energy.

The EIS has been prepared in three volumes:

- **Volume 1:** A4 Main text (this volume)
- **Volume 2:** A3 Figures
- **Volume 3:** A4 Appendices

During the Public Exhibition phase of the assessment process the Bango Wind Farm EIS will be available for inspection at the Yass Valley and Boorowa Council offices and online through the New South Wales Department of Planning and Environment website, following the links to the Major Project Assessments page.

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2. INTRODUCTION

Bango Wind Farm Pty Ltd (the Proponent) is proposing to install, operate, maintain and refurbish or decommission up to 122 wind turbines and ancillary structures on an area of the Southern Tablelands, 20 km north of Yass, 7 km south-east of Boorowa and 80 km west of Goulburn, New South Wales (NSW) (see **Figure 2.1**); known as the Bango Wind Farm (the Project). The wind turbines will be erected for the purpose of generating electricity from wind energy.

The Project was publicly announced in March 2011, at the commencement of detailed feasibility studies and early stages of planning. The results of public consultations and feasibility assessments are presented in this EIS, as part of the Development Application (DA) for the Project.

The Project will be assessed with respect to matters of National Environmental Significance under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* as part of this EIS under an accredited process after it was declared a controlled action following referral to the Federal Department of Environment (DoE). Separate Project approval will be granted by the Department of the Environment under the *Environmental and Planning Assessment Act 1979*. This EIS is broad in scope, covering many topic areas. This chapter, being the Executive Summary, provides an overview of the outcomes established by the EIS as a result of the assessments and consultation undertaken.

Bango Wind Farm Pty Ltd

The Project is being developed on behalf of the Proponent by CWP Renewables (CWPR), a wholly owned subsidiary of Continental Wind Partners (CWP) and the Wind Prospect Group (WPG).

CWP were established in 2007 to finance the development of wind farms in Romania and Poland. They have since grown to be a leader in renewable energy development, expanding into the rest of Europe, Australia and New Zealand, with projects totalling over 4,500 MW. Their primary focus remains in wind energy, however they also have interests in solar, hydro, biomass and other renewable technologies.

WPG was founded in the early 1990’s and was responsible for the development of the UK’s second onshore wind farm. WPG works in partnership with local communities and has successfully developed over 3,500 MW of renewable energy projects around the world. The Group’s 200-strong advisory and consultancy team has advised on over 40,000 MW of wind and solar projects globally, with 20 offices in over 10 countries.

Within Australia, the WPG office is located in Melbourne, Victoria. WPG’s Australian subsidiary, Wind Prospect Pty Ltd (WPPL), is one of the most successful developers in Australia, having achieved, alongside its subsidiaries and clients, planning approval for 16 wind farms totalling over 2,160 MW, of which 950 MW is already operating.

Their successful and rapid expansion is based on a proven model of co-operation with local developers. In Australia, CWP’s international expertise in the finance / banking industry and technical aspects of development are combined with WPPL’s own technical expertise and local knowledge. It is this collaborative partnership that ensures accelerated, professional wind development in a mutually successful manner.

3. PROJECT DESCRIPTION

The Project consists of the installation of up to 122 wind turbines, on-site electrical cable network, a collector substation, switching station, operation compound, on-site access roads, crane hardstand areas, up to six permanent and 12 temporary (3-6 months) wind monitoring masts, and appropriate site signs, alongside temporary construction facilities and activities. Subject to technologies of the day, the Project is to have an installed capacity of between 183 MW and 326 MW and is expected to generate approximately 575 to 1,025 GWh per year for the typical 25 year lifespan of the wind farm or until refurbishment / decommissioning is undertaken. Operation of the wind farm is to be carried out by a combination of remote computer control and approximately one local operations / maintenance person for every 10 MW installed.

Final wind turbine selection will occur through a competitive tender process pending Development Approval.

The electricity produced by each wind turbine generator would be transformed from low voltage up to 33 kilovolts (kV) or greater by a transformer located within or adjacent to each wind turbine. Underground electrical cables will be installed at a depth of approximately 0.8 to 1 m below the ground surface to conduct the electricity from the wind turbines to the collector substation. The underground electrical cables will follow on-site access roads where practical.

The collector substation and the switching station sites are expected to require approximately 5.8 hectares (ha) of land and will include standard grid connection infrastructure and buildings. The chosen locations minimise the visual impact of the Project by siting the infrastructure away from frequently used public roads, and will utilise vegetation screening if required. This also allows for the Project's internal electrical infrastructure and grid connection to have a reduced visual impact.

To transmit the energy produced, the Project will connect into a 132 kV TransGrid transmission line running north-south approximately 2.2 km west of the Mt Buffalo Cluster. When it is not generating, the Project will draw a minor amount of electricity from the local transmission network.

Project management will be carried out by the Proponent, unless commercial or other arrangements change. All Project and construction management will comply with the appropriate company's Quality Assurance System and Environmental Management System, or equivalent, ensuring that relevant procedures, statutory requirements and operational standards are met.

4. PROJECT JUSTIFICATION

There has been growing global recognition of the need to mitigate the environmental effects associated with fossil fuel energy generation. Such thoughts have manifested into international, national and state wide commitments supporting the development of clean and sustainable energy projects.

In 2007, the Australian government ratified the Kyoto Protocol and signed up to cut greenhouse gas emissions to 108 % of the levels they were is 1990. This was a watershed decision and an important step in determining Australia's position on climate change in the international arena. In December 2012 Australia agreed to the Doha Amendment to the Kyoto Protocol and signed up to reduce emissions to 98 % of levels they were in 2000 over the eight year period 2013 – 2020 (UNFCCC 2012).

The revised Renewable Energy Target (RET) legislation passed the Federal Parliament in July 2015 and sets a new target of 33,000 GWh of Australia's electricity to be generated from large-scale renewable sources by 2020. Wind energy generation is a low cost, viable renewable energy source and can be readily implemented to meet a substantial percentage of this target.

The Project will play an important role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of Global Warming and Climate Change; contributing up to 3 % (depending on the installed capacity) additional renewable energy generation to meet the legislated Australian target. Moreover the Project site and size has been carefully selected using a number of factors and will displace up to 3.5 million tonnes of CO_2-e by 2020.

5. PLANNING CONTEXT

The development of the Project requires:

- Approval under the State Significant Development (SSD) provisions (Division 4.1) of Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment (EP&A) Act, 1979*; and
- Consideration of the requirements of the Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act, 1999.

The NSW Department of Planning and Environment (DPE) issued the Project with Secretary's Environmental Assessment Requirements (SEARs) on 6 November 2015. The SEARs include key issues for the Proponent to address in the EIS with a focus on impacts, management and mitigation strategies. These SEARs supersede the Director General's Requirements (DGRs) that were previously issued under the previous planning pathway.

On the 7th May 2013, the Federal Minister for the Environment determined that the Project would constitute a Controlled Action pursuant to Section 75F (3) of the *EP&A Act*. The Minister also decided that the proposed action will be assessed by preliminary documentation (PD), including the provision of supplementary information to assess the relevant impacts of the action.

In addition, relevant Federal, State and Local Government legislation, policy and guidelines are considered and addressed throughout the EIS.

6. STAKEHOLDER CONSULTATION

Public consultation for the Project commenced in April 2011 during the early stages of planning and feasibility assessment. Consultation at this time aimed to inform the general public, neighbouring residents, statutory regulators and other stakeholders of the Project in order to identify issues that required addressing during Project planning and design.

Consultation for the Project was conducted by way of letters of notification to stakeholders, face-to-face notification (or letter drop where necessary) with neighbouring residents, a Public Open Day and consultation meetings with various stakeholders as appropriate. The Project website (www.bangowindfarm.com.au) presents an ongoing, active information / consultation portal for people to track the development of the Project and submit questions / comments to the proponent.

A number of consultees have responded over time, providing input or advice to the Project. The Public Open Day, held in August 2012, was attended by almost 40 local and regional residents. Nominations were sought and received for a Community Consultative Committee for the Project. The committee held its first meeting on 8th August 2013, in line with existing Committees and *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines), released on the 23rd December 2011 for public consultation.

7. ASSESSMENT OF KEY ISSUES

The Proponent, along with a number of specialist consultants and stakeholders, has used various methods during the feasibility and planning stages of the Project. Together, the Proponent, specialists and stakeholders have determined the baseline environmental conditions at the Project site, identified potential impacts and developed management strategies to mitigate those impacts where possible. These assessments and consultations have been consolidated into this EIS, to develop a wind farm design that balances environmental, social, economic and cultural needs.

This EIS addresses the requirements of the SEARs in Chapters 8 - 17 and addresses matters outside of those identified in the SEARs in the Chapters 19 and 20, General Environmental Assessment and Social Impact Assessment. These are summarised in the following sections of the Executive Summary with extensive detail found within the main chapters of this **Volume 1** and associated **Volumes 2** and **3**.

8. LANDSCAPE AND VISUAL ASSESSMENT

The Proponent commissioned Green Bean Design Pty Ltd to prepare a Landscape and Visual Impact Assessment (LVIA) and Cumulative Visual Impact Assessment (CLVIA) for the Project. The LVIA and CLVIA were undertaken to include a comprehensive evaluation of the visual character of the landscape in which the Project would be located, and an assessment of the potential landscape and visual impacts that may result from the construction and operation of the Project, taking into account appropriate mitigation measures.

In terms of overall landscape sensitivity, the LVIA determined that each of the five Landscape Character Areas (LCAs) within the Project viewshed had a medium / medium to high sensitivity to accommodate change, and represented a landscape that is reasonably typical of other landscape types found in surrounding areas of the Southern Tablelands. The LVIA determined that nine residences and one approved DA location have a high visual significance rating, two of which are not involved with the Project and that five residences have a medium to high visual significance rating, two of which are not involved with the Project.

The LVIA also determined that the Project is likely to be an acceptable development within the viewshed, which in a broader context also contains built elements such as roads, agricultural industry, aircraft landing strips, communication and transmitter towers and power lines.

There are a number of potential visual effects associated with the Project, including glinting and shadow flicker. Glinting occurs relatively rarely and an assessment of shadow flicker determined that four involved residences and one residence with which the Project has a Neighbour Agreement will experience shadow flicker. The Project will have some degree of visual influence, however it is unlikely that wind farm projects will ever conform, or be acceptable to all points of view.

Overall, the cumulative visual effect of the Project would result in some 'direct', 'indirect' or 'sequential' cumulative impacts when considered against any existing or proposed wind farm developments, including the proposed Rye Park Wind Farm and approved Yass Valley Wind Farm. The CLVIA determined that two residences would experience a Moderate to Low cumulative visual impact, both of which are not involved with the Project.

9. NOISE ASSESSMENT

The Proponent commissioned Sonus Pty Ltd to undertake an Environmental Noise Assessment for the Project in accordance with the SEARs and the South Australian Environmental Protection Authority (SA EPA) *Noise Guidelines for Wind Farms 2009* (SA EPA Guidelines). The SA EPA Guidelines were developed to assess and manage environmental noise impacts from wind farms in South Australia and have been adopted by the DPE.

Wind turbine noise has been predicted and assessed against relevant criteria prescribed by the SA EPA Guidelines for non-involved residences, World Health Organisation (WHO) guidelines for involved residences, and residences with Neighbour Agreements and requirements detailed in the SEARs.

The operation of the wind farm has been considered against the SA EPA Guidelines based use of wind turbine model Senvion MM92 with a hub height of 80 m for Layout Option 1 and the GE 3.4-130 with a hub height of 120 m for Layout Option 2.

Based on predictions, the noise from:

- Layout Option 1 will achieve the environmental noise criteria established in accordance with the SA Guidelines and the WHO Guidelines at all residences.
- Layout Option 2 can achieve the environmental noise criteria set out in the SA EPA Guidelines 2009, and with the WHO Guidelines for one involved landowner with acoustic treatment.

Once the final wind turbine model has been selected, the noise assessment will be re-run to demonstrate compliance with the relevant guidelines and conditions of approval. Any exceedances will be resolved through landowner agreements, reducing wind turbine operational noise, micro-siting wind turbine positions or by the removal of wind turbines, whichever is deemed the most acceptable and appropriate course of action.

Construction noise impact, blasting impact and vibration levels have been assessed and the 'worst case' scenarios modelled and found to be acceptable. Construction traffic noise impact has also been assessed and the 'worst case' construction traffic generation considered. It is predicted that at a distance of 10 m from the road side the criterion can be achieved for 10 passenger vehicle movements and 3 heavy vehicle movements in one hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. Due to the typically large setback of residences from the road network, the resulting noise levels would be considered acceptable under the *NSW Road Noise Policy* (DECCW 2006).

10. ECOLOGICAL ASSESSMENT

Environmental Resource Management Australia Pty Ltd (ERM) was commissioned to undertake an ecological assessment of the Project Study area. The assessment methodology comprised a literature review, site reconnaissance, vegetation mapping and detailed flora and fauna surveys.

Targeted surveys and habitat assessments for threatened species vegetation mapping, flora quadrats and an assessment using the Biobanking methodology were undertaken across the Study area between July 2012 and February 2013.

Four Endangered Ecological Communities (EECs), 12 threatened flora and 41 threatened fauna species and nine migratory species were considered for their potential to occur in the Study area. Targeted surveys and habitat assessments were undertaken to establish the presence of threatened species or suitable habitat for all the threatened species except the Grassland Earless Dragon, for which no potential habitat was present.

A Referral under the EPBC Act was submitted to the DoE in March 2013 addressing the likely impacts of the Project on matters of National Significance. A total of 30 EPBC listed threatened species and ecological communities were assessed for their likelihood of occurrence within the Study area, including the critically endangered Box-Gum Woodland (BGW), the critically endangered Golden Sun Moth (*Synemon plana*) and the vulnerable Superb Parrot (*Polytelis swainsonii*). The Project was designated a Controlled Action under the EPBC Act on the 7th May 2013 due to the residual level of impact which would result from the construction of the wind farm, to be assessed by Preliminary Documentation.

There are a range of potential impacts associated with the Project including direct and indirect impacts. These include:

- Habitat loss –as a direct consequence of earthworks and construction activities;
- Collision-related mortality – direct collision with wind farm infrastructure and alienation of habitat through avoidance of infrastructure;
- Barotrauma – rapid air pressure reduction near moving wind turbine blades which potentially effecting microbats in the study area; and
- Alienation of habitat (displacement) – species may respond to the Project by avoiding breeding or foraging resources and habitat utilisation such as avoidance of areas due to the perceived threat of an unfamiliar object.

The Proponent has made a number of amendments to the proposed layouts to minimise and avoid impacts on the ecological habitat across the site. Information regarding biodiversity and other factors considered during the design process resulted in a significant reduction in the extent of the wind farm and a re-design of the Layout Options to arrive at the two configurations presented in this EIS. Given the presence of Critically Endangered Ecological Communities (CEEC), EEC and threatened flora and fauna species across the Project site, and the requirement for wind turbines to be placed on ridge tops, while extensive micro-siting has been undertaken, the opportunities to avoid all impacts are limited. Nevertheless, wind turbines and associated infrastructure have been generally sited to avoid areas of remnant woodland vegetation and riparian areas. The ecological surveys have been used to inform removal and / or micro-siting of wind turbines and infrastructure to take into account site-specific environmental issues and minimise on-ground ecological impacts.

General avoidance measures that will or have been implemented to minimise impacts on the ecological integrity of the Project site whilst maintaining the engineering and economic feasibility of the Project are summarised below:

- On-site access roads have been designed around existing tracks and roads within the Study area, where practicable, to avoid additional vegetation clearance for access;
- Wind turbines have been placed in cleared, treeless or low tree density areas, where practicable, to minimise the need for additional or excessive tree clearance and loss of hollow-bearing trees;
- Where wind turbines have been placed in woodland areas, they have been situated in areas where ground layer disturbance has previously taken place (e.g. sown areas);
- Construction compounds, operations compounds, collector substations, switching stations and rock crushing facilities have been located outside ecologically sensitive areas, where practicable;
- The Project has been designed to minimise the removal of trees, where possible, and this process will continue into the detailed design phase. Where it is feasible to do so, all wind turbines will be also placed at least 30 m from hollow-bearing trees;
- On-site access roads and transmission line routes have been re-aligned so as to minimise the impact on CEEC / EEC, with disturbance occurring only for the installation of the external transmission line, where only the canopy will be removed, ensuring the understorey remains; and
- The internal reticulation has been placed underground and within the on-site access road footprint where practicable to allow for temporary rather than permanent disturbance. Reticulation will pass overhead across large gullies and waterways to further reduce impacts.

The potential impacts to species from the Project include:

- The removal of up to 83.63 ha of Box Gum Woodland of which 0.26 ha is EPBC Act listed;
- Removal of habitat for up to nine threatened flora species that are likely to or have the potential to occur in the Study Area (none were recorded);
- Removal of up to four fauna habitat types for up to 32 threatened fauna species that are likely to or have the potential to occur in the Study area (15 were recorded);
- Removal of a small number of hollow bearing trees;
- A negligible collision impact to four threatened or locally important birds that have the potential to fly within the rotor swept area; and
- Indirect impacts during construction.

In order to protect the ecological values of the Project site a number of management and mitigation measures have been proposed as outlined in **Chapter 21** Statement of Commitments.

A BioBanking Assessment has been undertaken to calculate the residual impacts of the Project and several properties are being considered as potential environmental offset options. Discussions have commenced with landowners and several potential sites have been highlighted for further investigation as to their suitability in providing the required offsets. Work is ongoing to identify further properties with suitable habitat to ensure the required offset is available prior to the start of construction.

11. CULTURAL HERITAGE ASSESSMENT

New South Wales Archaeology Pty Ltd was commissioned in June 2012 to undertake an archaeological and cultural heritage assessment, comprising of a literature review and field surveys, to collect data.

The assessment identified that the Project region was occupied by Aboriginal speakers of at least two languages - Wiradjuri and Ngunawal. The people of Yass and / or Boorowa district were variously known as the Onerwal [Ngunawal] and the Wallabaloo tribe. The predominant land use by Aboriginal people in the Project site is predicted to have been restricted to a limited range of activities including hunting and gathering forays conducted away from base camps, vantage points and movement through the country. The early 1800's saw changes in the traditional land use of Aboriginal people with the introduction of European settlement.

In accordance with the *Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (NSW DEC 2005) and OEH's *Aboriginal Cultural Heritage Consultation requirements for proponents 2010* (NSW DECCW 2010b), the required field surveys were conducted with the assistance of a number of people from Buru Ngunawal Aboriginal Corporation and Ngunnawal Heritage Aboriginal Corporation. Additionally, Registered Aboriginal Parties (RAPs) were forwarded an outline of the scope of the Project, the proposed cultural heritage assessment process and the heritage assessment methodology for comment. The Ngunawal Heritage Aboriginal Corporation has recommended a salvage program be undertaken to collect and move all stone artefacts. The Proponent indicated that the recommendation for collection would be considered within the context of the development of the Cultural Heritage Management Protocol which would be produced prior to construction of the Project.

A total of 14 Aboriginal object locales with stone artefacts were recorded on-site, all of which were considered to be of negligible to low archaeological significance. Three European heritage items were recorded, all of which were outside the Study area and will not be impacted by the Project.

The proposed impacts from the Project are discrete in nature and will occupy a relatively small footprint within the overall area. Accordingly impacts to the archaeological resource across the landscape can be considered to be partial in nature, rather than comprehensive. However, the construction of the Project will result in substantial physical impacts to any Aboriginal objects which may be located within direct impact areas irrespective of their archaeological significance. That is, any Aboriginal object situated within an area of direct impact will be comprehensively disturbed and / or destroyed during construction.

Given the small development footprint, the nature and density of the artefact locales recorded and the low cultural and scientific significance rating they have been accorded, NSW Archaeology determined that unmitigated impacts is considered appropriate.

12. TRAFFIC AND TRANSPORT ASSESSMENT

Samsa Consulting was commissioned to undertake a Traffic and Transport Assessment for the Project. The study was conducted in accordance with the NSW Roads and Traffic Authority (RTA) *Guide to Traffic Generating Developments* and the SEARs, and provided a technical appraisal of the traffic and safety implications arising from the Project.

The assessment identified two construction period scenarios. A moderate (average) scenario, which is likely to occur for the great majority of the 18 month construction period, and a conservative (high) scenario, which assumes that peak construction periods will occur simultaneously.

It was estimated that the Project has the potential to create a worst case impact of up to an additional 96 vehicles per day (vpd) (moderate impact) or 160 vpd (high impact) on the Lachlan Valley Way. These increases would not create any significant adverse impacts with respect to transport issues such as traffic operations, road capacity on the surrounding road network, site access and road safety. The more significant impacts are expected only during the construction and decommissioning periods, with minor impacts during the operational phase.

A range of management and mitigation strategies have been proposed during the construction, operation and decommissioning phases of the Project to minimise traffic impacts, reduce community disruption and the risk of traffic incidents. In turn this will facilitate minimum disruption to existing traffic conditions.

13. AVIATION ASSESSMENT

Existing aviation activity in the locality of the Project site was identified during planning and design through consultation with the Civil Aviation Safety Authority (CASA), Airservices Australia (AsA), Aerial Agricultural Association of Australia (AAAA), NSW Rural Fire Service (NSW RFS), the Department of Defence, and the local community

One aerodrome certified by CASA and one Airport Landing Area (ALA) are located within 56 km (30 nm) of the Project site. Young Airport near Young NSW, a CASA-registered aerodrome, is located approximately 50 km (27 nm) north west of the nearest wind turbine. Harden ALA is located 32 km (17 nm) south west of the nearest wind turbine. According to the aviation hazard assessment carried out by REHBEIN Airport Consulting (REHBEIN), the Project does not impact on the Obstacle Limitation Surface (OLS) or the Procedures for Air Navigation Services (PANS-OPS) of these airfields.

CASA administers regulations for the intrusion of obstacles into aerodrome OLS and PANS OPS and obstacles 110 m above ground level outside of aerodromes. On 1st March 2011 CASA indicated that a review would be undertaken of safety issues associated with obstacles remote from an aerodrome, which will now be undertaken by Department of Infrastructure and Transport (DIT). As there is no current standard in place, it is CASA's view that the decision of the lighting of obstacles outside the vicinity of aerodromes is the responsibility of the Proponent.

The wind turbines will be greater than 152.4 m (500 ft) above ground level, and are therefore defined as a tall structure. As such CASA has stated that lighting should be considered in accordance with the NASF Guideline D. In this situation, REHBEIN recommends the Proponent consider the provision of obstacle marking and lighting as a duty of care obligation.

An assessment of obstacle lighting and marking visual impacts has also been provided in **Chapter 8** Landscape and Visual Assessment to ensure that a full assessment has been carried out in accordance with the SEARs.

Agricultural aerial spraying activity occurs for pest management and pasture top-dressing. Pest management spraying is unlikely to be affected by the Project. Top-dressing activity will require care by pilots applying the material to properties along the ridgelines.

Some private landing strips are present and of those known, the majority are not impacted by the Project. Those strips which are known to be impacted by the wind turbines have been discussed with the relevant associated landowners.

14. COMMUNICATION ASSESSMENT

Electromagnetic signals (or radio waves) are transmitted throughout the country as part of telecommunication systems by a wide range of operators. Such systems are used for radar, radio broadcast, television, mobile phones and mobile and fixed radio transmitters. Electromagnetic signals generally work best if a clear path exists between the transmitting and receiving locations, known as line of sight (LOS).

There is the potential for interference from any large structure, including wind turbines, which occur within or close to the signal path. Signals can be interfered with or reflected by the rotating blades of a wind turbine, which could degrade the performance of the signal (Bacon 2002). Electromagnetic emissions from generators and other machinery also have the potential to affect signals; however with modern wind turbine generators and strict International Electrotechnical Commission (IEC) regulations for manufacturers, there are now negligible emissions from wind turbines (Auswind 2006).

There are a number of point-to-point links and omni-directional services which occur across and near to the Project. Assessment of these links has predicted that no impacts will occur on communications as a result of the Project. If the Project does cause any interference to any links, the Proponent will conduct an investigation with the afflicted parties and implement a suitable solution to the problem.

15. ELECTROMAGNETIC FIELD ASSESSMENT

Electric and magnetic fields (EMFs) are associated with a wide range of sources and occur both naturally and as a result of human activity. Naturally occurring EMFs are those associated with lightning or the Earth’s magnetic field. Human induced EMFs occur wherever electricity is present, meaning we are constantly exposed to EMFs in our home and work environments.

Wind farms create EMFs from operational electrical equipment, such as transmission lines, substations and the electrical components found within the wind turbines. This equipment has the potential to produce Extremely Low Frequency (ELF) EMFs, which means the current will alternate direction between 30 and 300 times per second, or at 30 to 300 Hertz (Hz).

The measurements of electromagnetic fields can vary within a wind farm, depending on the placement of equipment such as wind turbines, substations and internal electrical cables. The *Interim guidelines on limits of exposure to 50 / 60 Hz electric and magnetic fields* (NHMRC 1989) places guidelines on exposure to both electric and magnetic fields for the public and construction industry.

The typical strategy for reducing electromagnetic fields is distance from the source. Other strategies also include burying cables and placing cables together to cancel the emitted fields. As most of the wind turbine electrical equipment is encased within the wind turbine, in housing at the base of the tower or located up to 120 m above ground level, the distance and shielding from electromagnetic fields decreases the impact from emitting sources.

Electromagnetic fields can have the highest recorded levels at substations; however, appropriate fencing and remote placement of the substation within the landscape can greatly reduce any exposure to electromagnetic fields.

16. FIRE AND BUSHFIRE ASSESSMENT

Fire and bushfire impacts of the Project on human life and property have been assessed by ERM in accordance with the SEARs and the *Rural Fires Act 1997*.

By basing the risk management process on the AS / NZS ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009) and the National Inquiry on Bushfire Mitigation and Management (Council of Australian Governments (COAG) 2004), an analysis and evaluation of bushfire risk and acceptable risk treatments have been undertaken.

The Project occurs in an area of low bushfire risk due to the amount of generally cleared and rural developed land in the area. By reviewing the possible ignition sources from the Project and analysing bushfire risk assessments on life and property, it is possible to create mitigation and management strategies to minimise the Project's impact on fire and bushfire risk. Through implementing these strategies in a Bushfire Emergency Response Plan it is possible to increase the awareness of the procedures of bushfire emergencies, increase the preparedness of construction and maintenance staff, and facilitate orderly and safe evacuation and refuge during times of bushfire.

The consideration of these mitigation and management strategies will allow the Project to decrease its impact on fire and bushfire hazards. The construction of the Project also has potential benefits in tackling bushfires which occur close to and within the Project area, including improved access from new tracks, on-site access roads, fire breaks and reduced lightning strike to vegetation.

17. WATER ASSESSMENT

The Project falls under the Lachlan Unregulated and Alluvial Water Sources (2012) and NSW Murray Darling Basin Fractured Rock Groundwater Sources (2012) Water Sharing Plans. The area is also managed with regard to the Lachlan Catchment Management Authority Catchment Action Plan. Therefore, there are a number of water management targets in place including water sharing, water quality, management of water supply and wastewater, water conservation and efficiency, and river and wetland protection and rehabilitation.

Water required for the Project, as discussed in **Chapter 3** Project Description, will be sourced from on-site water sources, such as bores and dams, where practicable or alternatively brought in from off-site rivers and dams or suppliers. There will be minimal impacts to other surrounding groundwater and surface waters due to limited activities within these areas and effective mitigation and management. Potential impacts are likely to occur mostly from construction activities. However, with an Environmental Management Plan (EMP) in place all potential impacts can be managed, resulting in minimising the extent of remediation efforts being required on-site.

18. GENERAL ENVIRONMENTAL ASSESSMENT

The General Environmental Assessment chapter addresses aspects of the Project covered in and beyond the SEARs. In summary the following aspects are assessed in terms of the existing situation, potential impacts and, where necessary, the management and mitigation measures to be put in place:

- Climate;
- Air quality;
- Soils and landforms;
- Waste;
- Responses to consultation;
- Construction;
- Wind turbine safety standards;
- Wind turbine and microclimate effects; and
- Decommissioning and refurbishment.

19. SOCIO-ECONOMIC ASSESSMENT

The Socio-Economic Assessment chapter addresses a number of Project issues, including those raised in the SEARs, and those beyond the scope of the SEARs. In summary the following aspects are assessed in terms of the existing situation, potential impacts and, where necessary, the management and mitigation measures to be put in place:

- Land value;
- Mineral exploration;
- Tourism;
- Community wellbeing and community fund;
- Local economy; and
- Health.

20. SUMMARY OF ASSESSMENTS: RESIDENCES

Key findings from the visual and noise assessments at residences in the Project locality are summarised in this chapter to facilitate an understanding of the Project impacts at those residences.

21. STATEMENT OF COMMITMENTS

The Statement of Commitments (SoCs) is a summary of all management and mitigation measures collated from chapters of this EIS. The SoCs have been developed to inform Development Consent Conditions of Approval which are to be managed through EMPs as the project is constructed and operated. The two separate EMPs will be created prior to commencement of construction / operation and will be informed by the Conditions of Approval.

The Construction Environmental Management Plan (CEMP) will outline the environmental management practices and procedures that are to be followed during construction. The CEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Community information management;
- Compounds and ancillary facilities management;
- Noise and vibration;
- Traffic and access;
- Soil and water quality and spoil management;
- Air quality and dust management;
- Aboriginal and non-Aboriginal heritage management;
- Soil contamination, hazardous material and waste management;
- Ecological impact management; and
- Hazard and risk management.

The Operational Environmental Management Plan (OEMP) will outline the environmental management practices and procedures that are to be followed during operation. The OEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Community information management;
- Noise management;
- Landscaping;
- Bird and bat management;
- Telecommunication interference; and
- Decommissioning.

22. CONCLUSION

This EIS has assessed the potential environmental impacts that may result from the Project, a proposal incorporating up to 122 wind turbines and capable of generating from 183 to 326 MW of new renewable energy.

The Project has been assessed in accordance with the *Environmental Planning and Assessment Act 1979* and taken into consideration the *Environment Protection and Biodiversity Conservation Act 1999*, along with other Federal, State and Local Government legislation, policy and guidelines.

The Project has incorporated the findings identified through the design phase, including consultation with the local community and associated stakeholders. The potential impacts of the Project have been assessed and appropriate avoidance, mitigation and management measures proposed.

Chapter 21 Statement of Commitments provides a summary of measures to inform the Development Consent Conditions of Approval which the Proponent will implement during the pre-construction, construction, operation / maintenance and decommissioning phases.

Benefits of the proposal have been identified at a global, regional and local scale, including:

- Production of approximately 575 to 1,025 GWh per annum, equivalent to 1.7 to 3 % of the revised 33,000 GWh Large-scale Renewable Energy Target, and sufficient for the average consumption of 78,800 to 140,400 homes (based on **Appendix 3**);
- Displacement of greenhouse gas emissions between approximately 500,000 and 875,000 tonnes of CO_2-e per annum, or 2 to 3.5 million tonnes by 2020 (based on **Appendix 3)**;
- Provision of local jobs, a Community Fund to benefit the local area in the vicinity of the Project and the injection of up to $365 million into the Australian economy; and
- Improved security of electricity supply through diversification.

The Proponent is committed to ensuring the measures proposed in developing the Project are best practice, and that they maintain the high standard set in all regions within which the Proponent operates.

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CHAPTER 2

Introduction

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2. INTRODUCTION

2.1 The Proposal

Bango Wind Farm Pty Ltd (the Proponent) is proposing to install, operate and maintain up to 122 wind turbines and ancillary structures on an area of the Southern Tablelands, 20 km north of Yass, 7 km south-east of Boorowa and 80 km west of Goulburn (see **Figure 2.1**); known as the proposed Bango Wind Farm (the Project). The Project lies within the Yass Valley and Boorowa Council boundaries, in southern NSW. The wind turbines will be erected for the purpose of generating electricity from wind energy.

The Project was publicly announced in March 2011, at the commencement of detailed feasibility studies. The results of public consultation up to the date of this document and feasibility assessments are presented in this Environmental Impact Statement (EIS), as part of the Development Application (DA) for the Project.

The purpose of the EIS is to support the DA associated with the construction and operation of the Project, which will include:

- Construction and operation of up to 122 wind turbines;
- Construction of on-site access roads, hardstand areas and other associated on-site infrastructure; and
- On-site electrical connections and infrastructure.

The EIS may also be used in support of subsequent applications for approval under Section 78A of the *Environmental Planning and Assessment Act 1979 (NSW)* associated with the lease of land for the wind turbine sites and associated infrastructure.

The Project was also assessed by the Federal Department of Environment (DoE) with respect to matters of National Environmental Significance under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*.

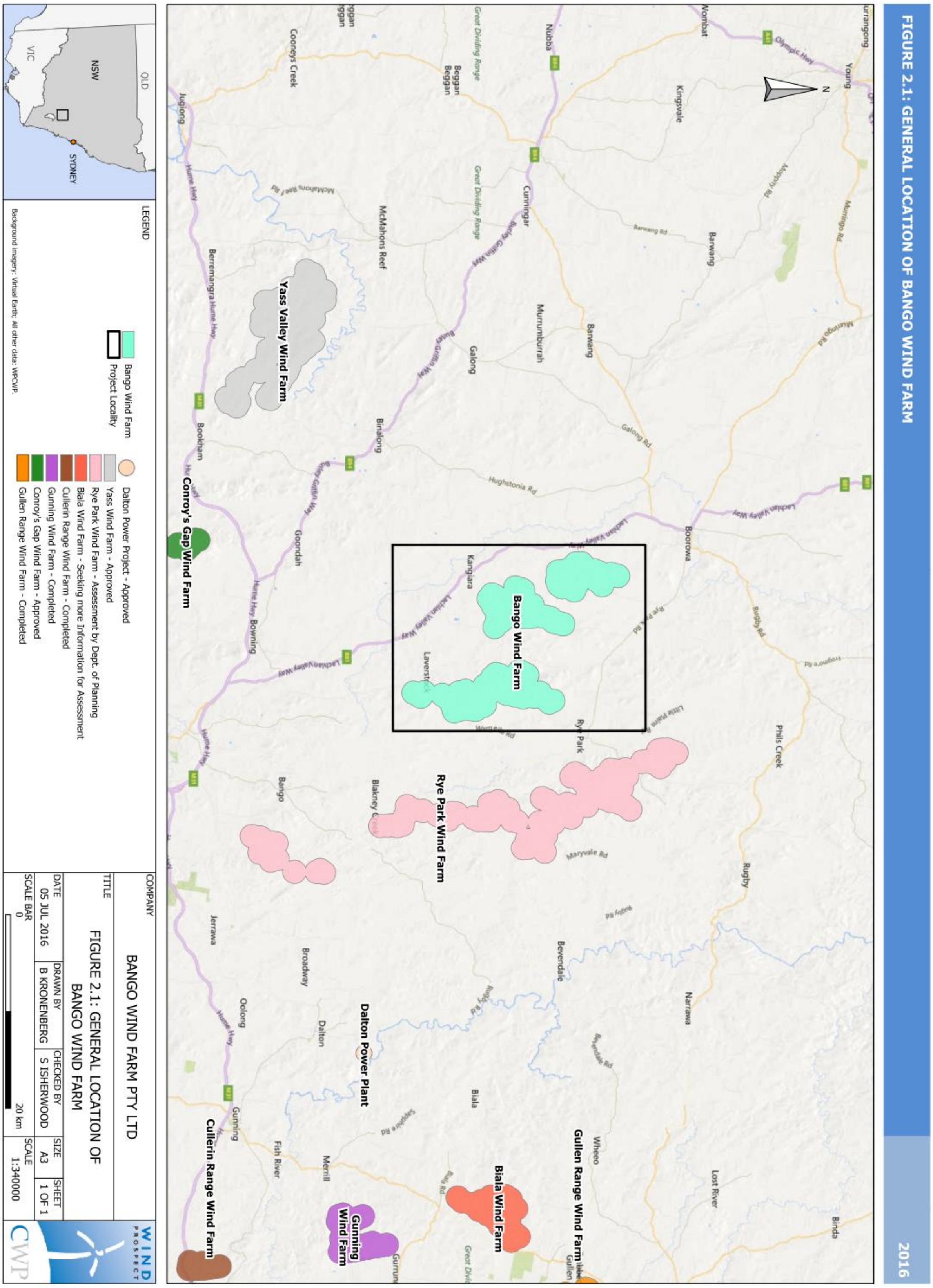

Figure 2.1 General location of Bango Wind Farm

(An A3 size version of this Figure is displayed in Volume 2)

2.2 Bango Wind Farm Pty Ltd

The Project is being developed by the Proponent, a wholly owned subsidiary of CWP Renewables (CWPR), a joint venture partnership between Wind Prospect Group (WPG) and Continental Wind Partners (CWP) to develop wind farm projects in New South Wales.

WPG undertakes all aspects of wind energy development, with offices in Australia, United Kingdom, China, France, Germany, Ireland, Philippines, Poland, South Africa and Turkey. With over 22 years of successful operations within the industry, WPG has been involved in over 34,000 MW of approved wind farms, including onshore and offshore projects, in terms of development, construction, operations and commercial services (see **Table 2.1**). The company's civil, electrical and mechanical engineers alone have been involved in the commissioning of over 126 wind farms around the world.

Table 2.1 WPG track record in wind farm development (May 2015)

Project Type	Projects	MW
Consented	86	3,389
Pre-construction	179	4,528
Constructed	141	2,650
Operating now	63	853
Due diligence	220	28,763

Within Australia, the WPG office is located in Melbourne, Victoria. Wind Prospect Pty Ltd (WPPL) is one of the most successful developers in Australia, having achieved, alongside its subsidiaries and clients, planning approval for 16 wind farms totalling over 2,160 MW, of which 950 MW is already operating.

CWP Renewables have no proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources against them and operate under the following environmental policies:

- Environmental Policy;
- Carbon Neutral Policy; and
- Project-specific Environmental Management Plans.

CWP were established in 2007 to finance the development of wind farms in Romania and Poland. They have since grown to be a leader in renewable energy development, expanding into the rest of Europe, Australia and New Zealand, with projects totalling over 4,500 MW. Their primary focus remains in wind energy, however they also have interests in solar, hydro, biomass and other renewables.

Their successful and rapid expansion is based on a proven model of co-operation with local developers. In Australia, CWP's international expertise in the finance / banking industry and technical aspects of development are combined with WPPL's own technical expertise and local knowledge. It is this collaborative partnership that ensures accelerated, professional wind development in a mutually successful manner.

2.3 Form and Content of the Environmental Impact Statement

This EIS has been prepared to provide a Project description, discuss all potential effects of the Project on the existing environment and community, and describe the measures proposed to mitigate any potential adverse effects.

The EIS has been prepared in three volumes, and comprises:

- **Volume 1:** A4 Main text (this volume)
- **Volume 2:** A3 Figures
- **Volume 3:** A4 Appendices

NOTE: The subject matter of this report involves the use of technical words, units and terms with which the reader may be unfamiliar. A glossary and list of unit conversion factors has been included in **Chapter 23** and reference to this may be of assistance.

An outline of the contents of **Volume 1** (this chapter) is provided below:

Chapters 1 to **6** provide an executive summary and description of the Project. They also outline Project justification, planning context and a summary of the public consultation process.

Chapters 7 to **20** contain the bulk of the EIS for the Project. They describe:

- The existing physical, ecological and social environment of the region;
- Impact assessment information; and
- Impact mitigation measures.

Chapter 21 Statement of Commitments provides an outline of EMP actions relating to the Project which are to inform Development Consent Conditions of Approval.

Chapters 22 and **23** conclude the EIS, contain a glossary, abbreviations and unit conversion factors, and provide a list of publications referenced throughout the document.

CHAPTER 3

Project Description

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3. PROJECT DESCRIPTION

This chapter presents a detailed description of the works associated with the construction, operation and maintenance and decommissioning phases of the proposed Bango Wind Farm development, which is otherwise referred to as 'the Project' throughout this Environmental Impact Statement (EIS).

3.1 Key Terms

For the purposes of this EIS the following terminology has been used when referring to the Project.

Locality: Area encompassing all land within a 10 km radius around the Project site.

Project site: Land within the cadastre boundaries of all properties subject to this proposal, comprising an area of 7,683 hectares (ha).

Study area: 200 metre (m) wide corridor enveloping the proposed infrastructure, comprising an area of 1,888 ha.

Development footprint: The area of impact from all proposed infrastructure comprising an approximate area of 251 ha, of which approximately 135 ha is considered permanent.

Clusters: The Project comprises three 'Clusters' of wind turbines. The Mt Buffalo Cluster incorporates the east of the Project, the Kangiara Cluster incorporates the centre of the Project, with the Langs Creek Cluster incorporating the north west of the Project (refer to **Figures 3.1** to **3.8** and **Table 3.2**). It is possible one or more Clusters may be constructed and commissioned prior to others, or that each Cluster may be partially constructed in stages.

3.2 Location and Site Design

The Project is situated 20 km north of Yass, 7 km south-east of Boorowa and 80 km west of Goulburn, New South Wales (NSW). The ridgeline is of moderate elevation (430 to 760 m above sea level, Australian Height Datum (AHD)). The nearest locality is Rye Park, which is located approximately 4 km to the north-east along Wargeila Road.

When first announced in March 2011 the Project consisted of up to 200 wind turbines and ancillary structures spread over 30 different properties. The 330 kV overhead transmission line 5 km north of Yass was being considered as the power export connection point. Since being announced, the Project has been revised to take into account findings from key assessments and consultation with interested stakeholders. This has resulted in a significant reduction in the extent of the wind farm and a re-design of the wind turbine layout to arrive at the two configurations presented in this EIS.

The Project now comprises a wind farm with two potential Layouts; one consisting of up to 122 wind turbines (Layout Option 1) and the other up to 96 wind turbines (Layout Option 2), together with ancillary structures spread over 15 different properties (the Project site). Details of the land tenure for the Project are contained within **Appendix 1**. Indicative centre point coordinates and ground elevations of each wind turbine layout are detailed in **Appendix 2**. All or some of these wind turbine locations will be used in the construction of the Project, to be determined following final wind turbine selection post-consent. This EIS addresses all wind turbine locations with regard to assessing worst-case impacts associated with the range of wind turbines available in the market.

The Project will consist of the following components:

- The installation of up to 122 wind turbines (Layout Option 1, see **Figure 3.1**) or up to 96 wind turbines (Layout Option 2, see **Figure 3.2**) (refer to **Section 3.8**);
- A collector substation (CS) comprising cable marshalling, switchgear, high voltage transformers and associated protection and communications assets;
- A switching station (SS) comprising switching and protection devices, busbars, circuit breakers, isolators and communication assets;
- Approximately four separate operations compound and lay down areas, including site operations facilities and services buildings;
- Electrical connections and control cables within and between each of the wind turbines and Clusters, connecting to the CS and SS; The electrical connections will consist of a combination of underground transmission lines (up to 132 Kilovolt (kV) double circuit) in single or multiple lines;
- At least four separate on-site access roads from the public road network;
- Crane hardstand areas, turning heads and passing bays for the erection, assembly, commissioning, maintenance, recommissioning and decommissioning of the wind turbines;
- Up to six permanent wind monitoring masts (potentially including the retention of existing temporary monitoring masts);
- Appropriate wind farm signage both during the construction and operational phases of the proposed development; and
- Associated and ancillary facilities (refer to **Section 3.9.5**).

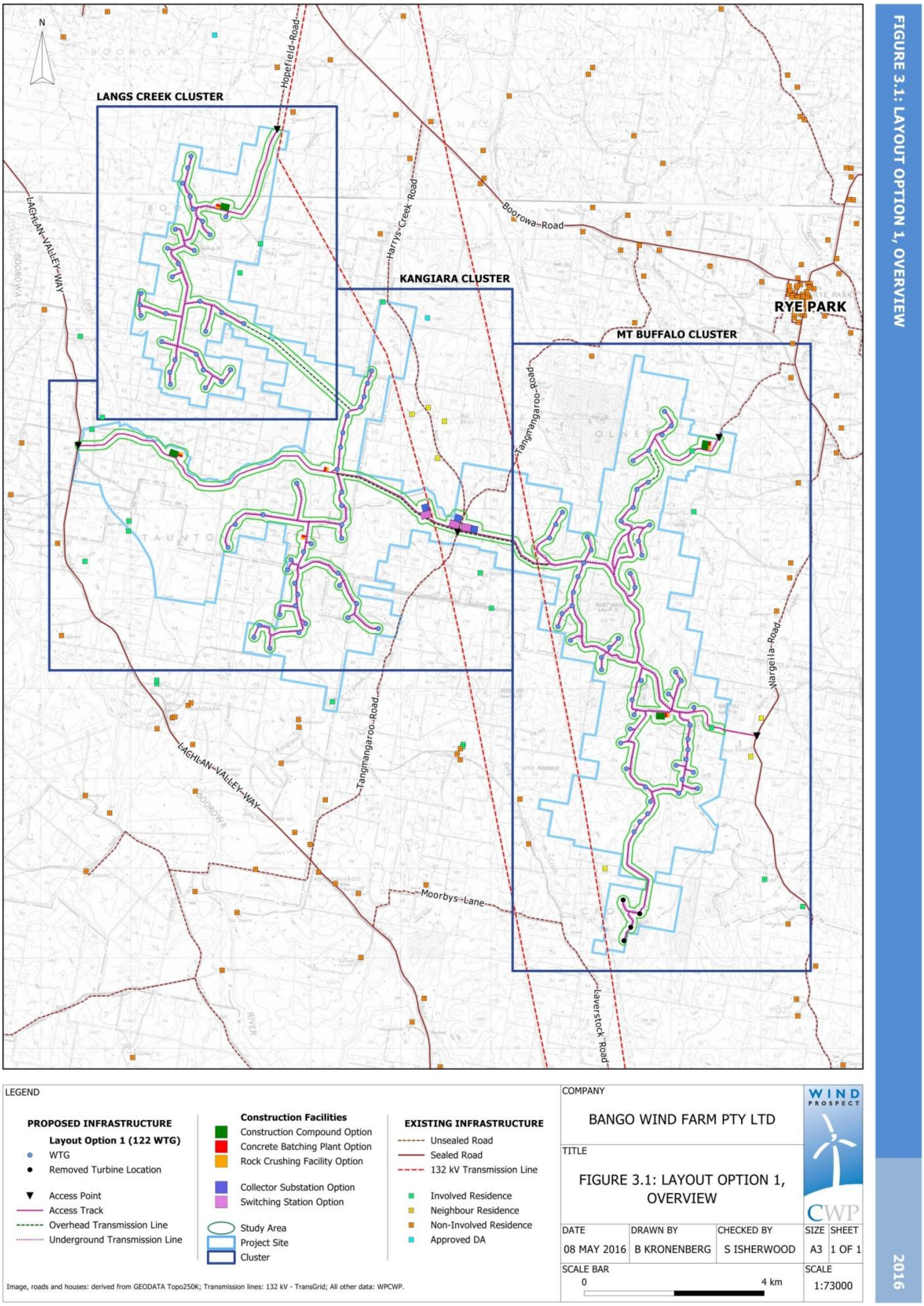

Figure 3.1 Layout Option 1, Overview

(A3 size versions of these Figures are displayed in Volume 2)

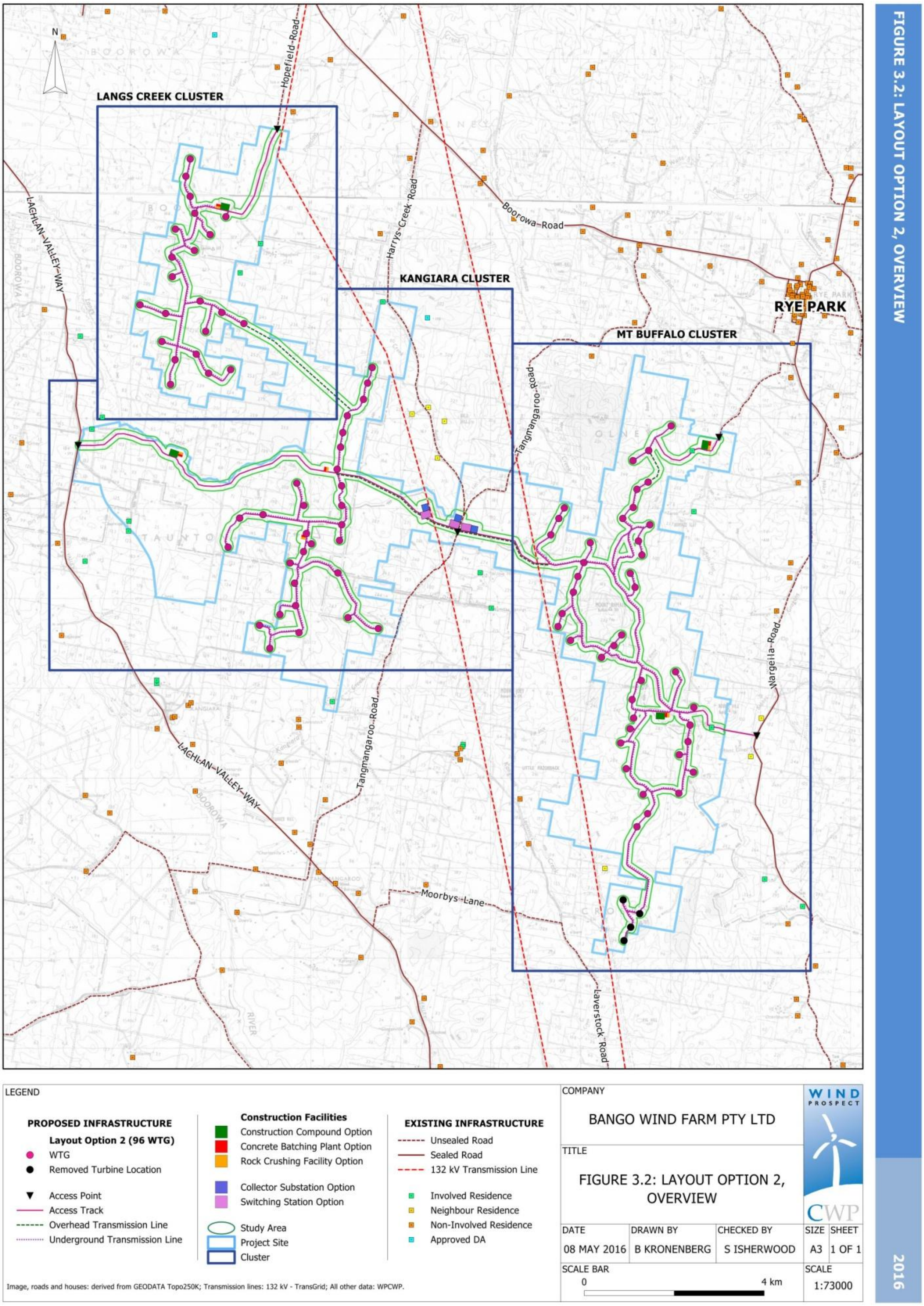

Figure 3.2 Layout Option 2, Overview

(A3 size versions of these Figures are displayed in Volume 2)

Typical dimensions of the components that comprise the Project are presented in **Table 3.1** below.

Table 3.1 Project components and approximate dimensions (based on greatest impact)

Project Component	Approximate Area[1]
Permanent	
Wind turbine footings	25 by 25 m
Wind turbine assembly / Crane hardstand areas	35 by 60 m
Collector substation (CS)	150 by 150 m
Operations compounds *(the extent of permanent section retained within one or more temporary construction compounds)*	75 by 75 m
On-site access: new roads	6 m by 83 km
Overhead transmission lines / easement [2] (Typical pole spacing as per **Table 3.3** of **Section 3.4.4**)	30 m by 0.86 km (1 x 33 kV) 45 m by 7.82 km (2 x 33 kV) 75 m by 0.65 km (2 x 33 kV, 1 x 132 kV)
Switching station (SS)	220 by 160 m
Wind monitoring masts (concrete footing)	1 by 1 m (9 per mast)
Temporary (during construction)	
Earthworks alongside permanent infrastructure (roads / hardstands) [3]	12 m by 83 km (est.)
Underground transmission lines [4]	3 m by 61 km
Concrete /asphalt batching plants	50 by 100 m
Rock crushing facilities	50 by 100 m
Construction compounds	150 by 200 m

[1] *Area stated is subject to detailed design and is provided on a per element basis (for example, the project includes up to 122 wind turbines and the footings of each turbine will cover approximately 25 by 25 m).*

[2] *The final constructed easement width is up to 75 m for the internal overhead transmission lines, depending on their configuration. The maximum easement widths for each transmission line section have been assessed in detail for Ecology and Cultural Heritage and in the calculation of the Development footprint impact area. The actual impact area has been estimated to be 5 % of this total area given the low level of impacts associated with installing the overhead transmission lines and the sparse vegetation cover along the selected routes.*

[3] *Construction of the on-site access road network will require earth works that are beyond the limits of the permanent road impact within the Study area. This is required to level areas of steep gradient to a design suitable for safely transporting Project components into position. Preliminary civil engineering designs have been prepared for both Layout Options based on available contour and geotechnical data, to include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earth works. An assessment of these*

*impacts is included in **Chapter 10** Ecology. The temporary impact areas will be rehabilitated on completion of construction activities in consultation with ecologists and the landowners.*

[4] *Underground transmission lines are considered a temporary impact as no surface impact remains post rehabilitation. Where feasible, underground transmission line will be installed either within or adjacent to on-site access roads and earthworks. The trenches for the cables are backfilled with excavated material and covered with topsoil post installation. The surface above any underground transmission line will be rehabilitation on completion of construction activities in consultation with ecologists and landowners.*

Details of each of the component parts of the Project are described in the following sections and in the accompanying figures. An outline of the construction and operational phases of the development are also provided, along with a timeframe detailing the proposed stages of activity pending project consent.

The Layout Options have been designed with respect to a number of technical, environmental and social factors and more detailed site assessments. Each layout ensures optimum, undisturbed use of the measured and predicted wind resource, after accommodating constraints, for the range of wind turbines currently being considered for the Project.

Given the scale of the Project it is likely that wind turbines within 'Clusters' will be constructed and commissioned in stages, which is discussed in more detail later in **Section 3.8** and **3.9**. Consequently, and for the benefit of stakeholder understanding, the Project has been divided into three main Clusters (see **Table 3.2**, **Figures 3.3** to **3.8**).

Table 3.2 Wind turbine Clusters

Wind Turbine Cluster	Maximum Number of Wind Turbines (Layout Option 1)	Maximum Number of Wind Turbines (Layout Option 2)	General Location
Mt Buffalo Cluster	58	45	East
Kangiara Cluster	34	29	Central
Langs Creek Cluster	30	22	North West

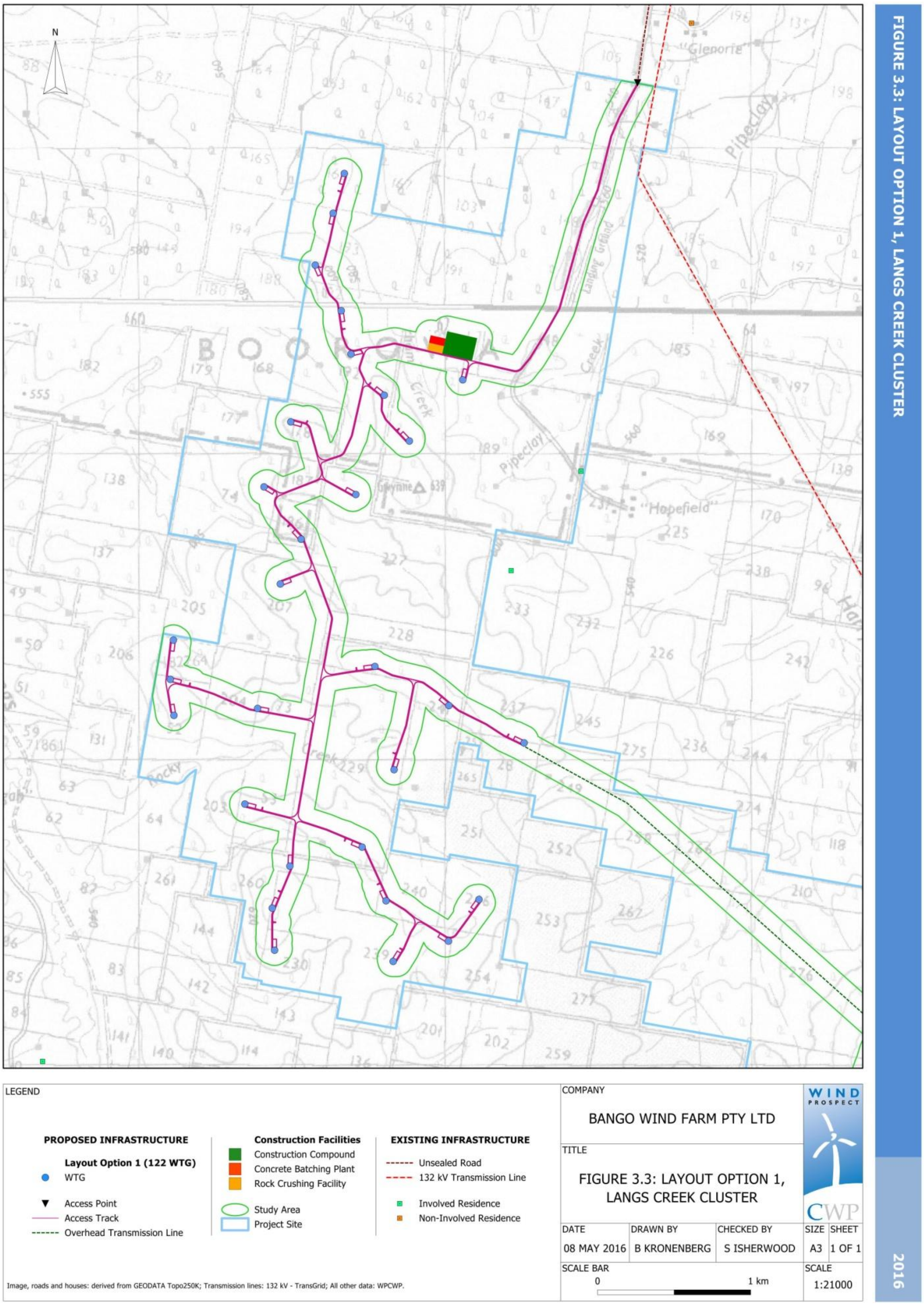

Figure 3.3 - Layout Option 1 – Langs Creek Cluster

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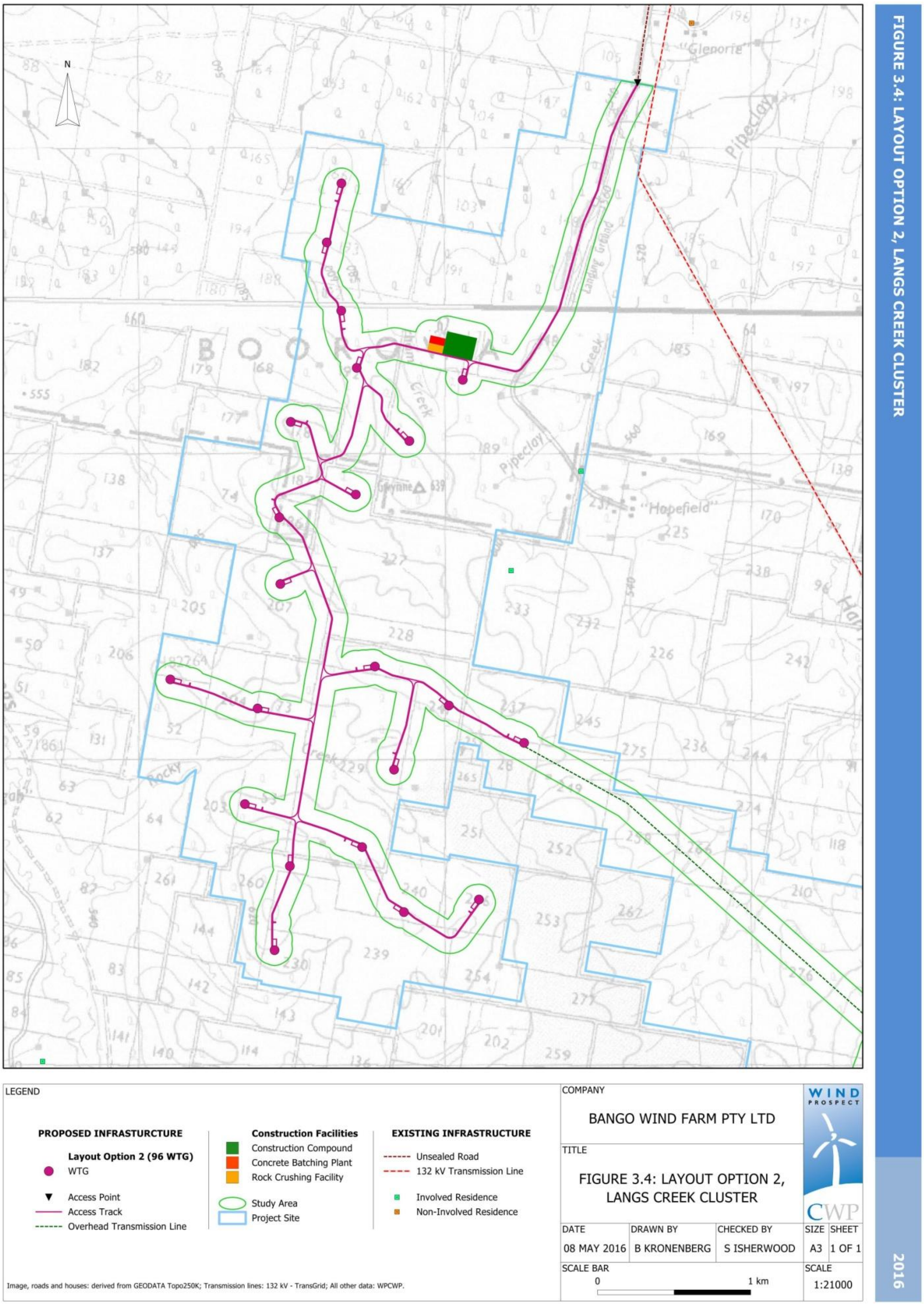

Figure 3.4 - Layout Option 2 – Langs Creek Cluster

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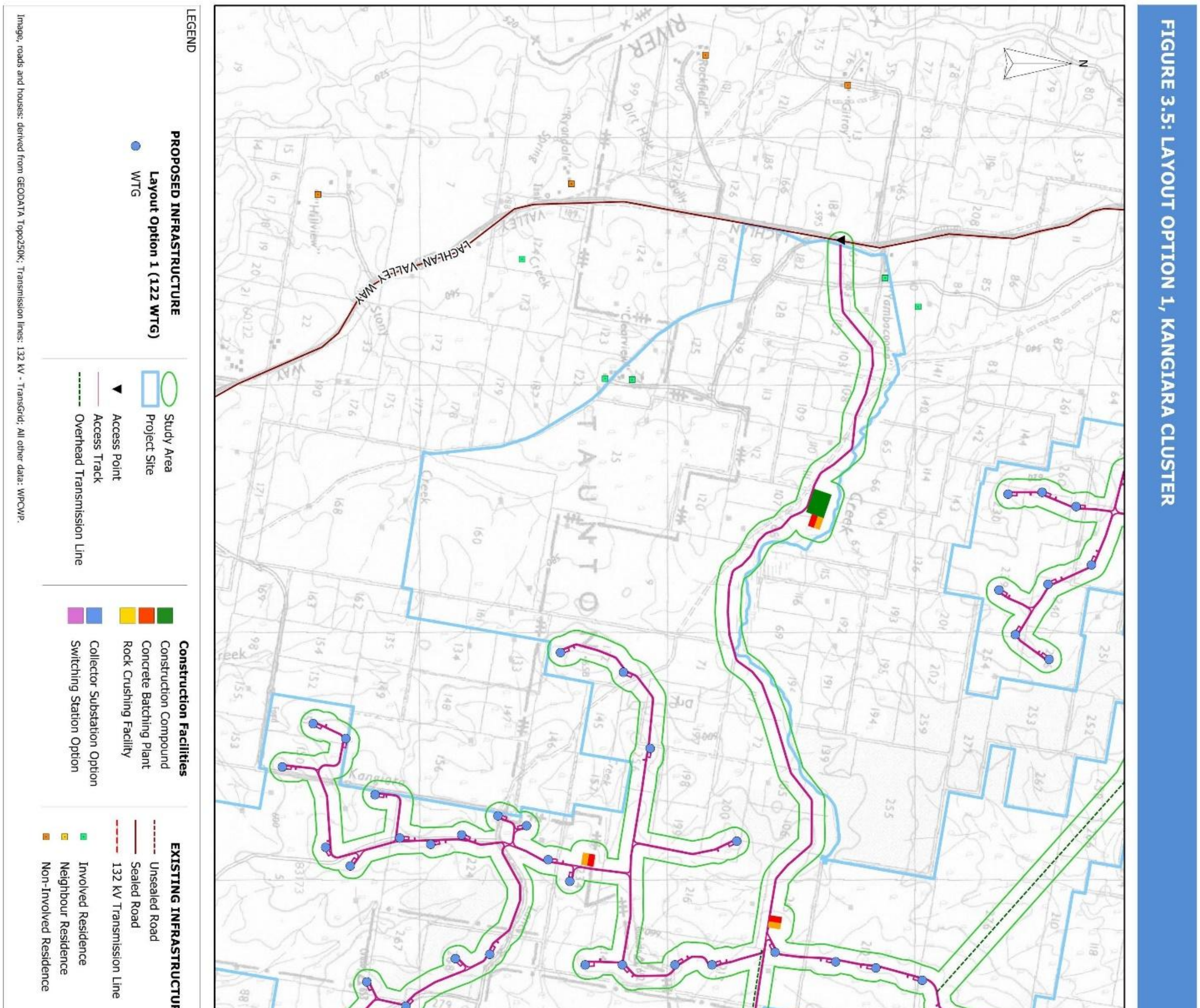

Figure 3.5 - Layout Option 1 – Kangiara Cluster

(***A3 size versions of these Figures are displayed in Volume 2***)

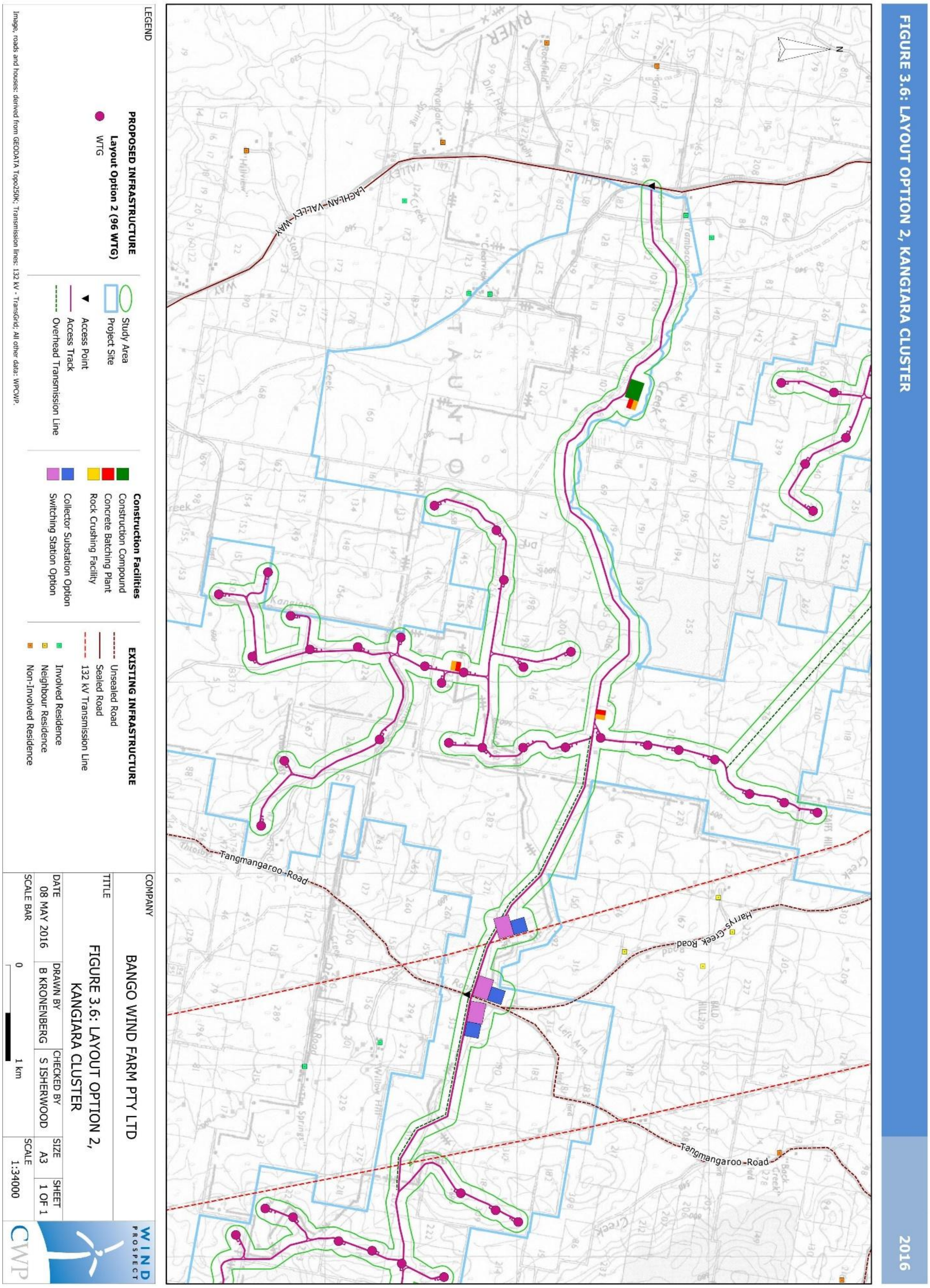

Figure 3.6 - Layout Option 2 – Kangiara Cluster

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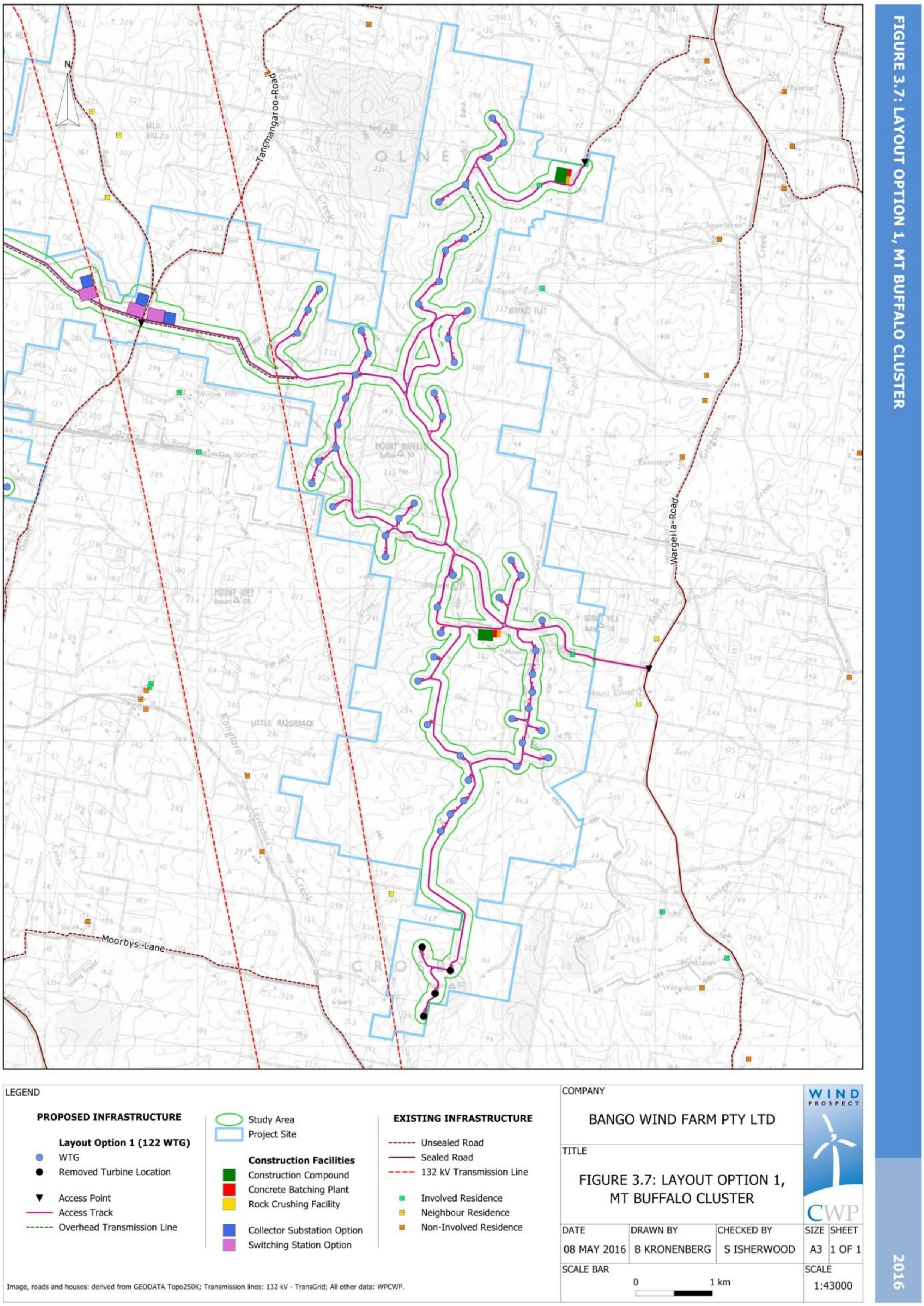

Figure 3.7 - Layout Option 1 – Mt Buffalo Cluster

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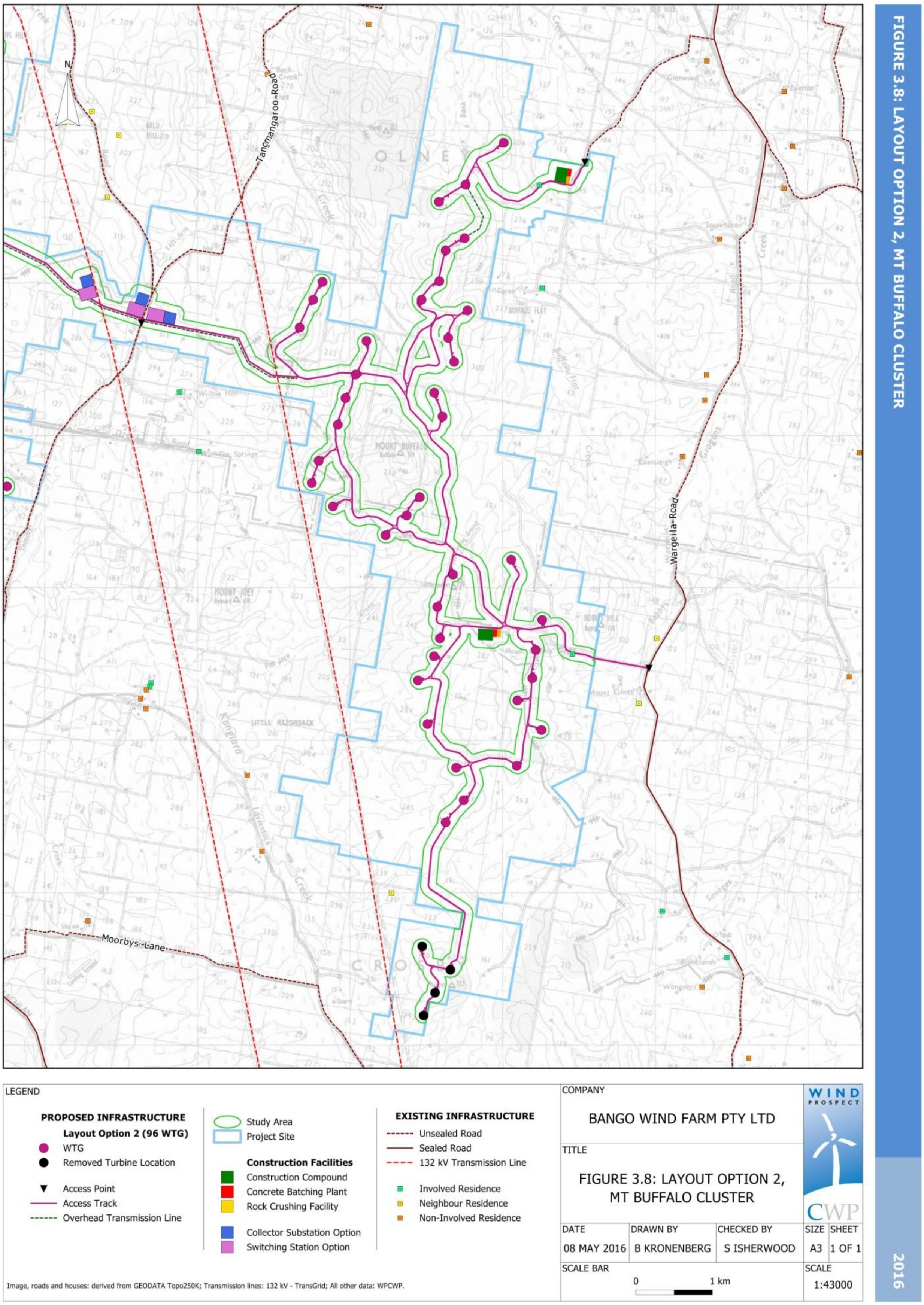

Figure 3.8 - Layout Option 2 – Mt Buffalo Cluster

(A3 size versions of these Figures are displayed in Volume 2)

3.3 Wind Farm Infrastructure

It is not yet known which model of wind turbine will be used for the Project as final wind turbine selection will occur through a competitive tender process after Project approval has been obtained and further detailed design has been undertaken. However, in terms of generation capacity, the wind turbines currently available in the market place which are under consideration for this Project vary in range upwards from approximately 1.5 MW in capacity. By way of example the GE 1.62-100 1.62 MW machine (as installed at the Boco Rock Wind Farm, south of Cooma, NSW) is typical of the type of wind turbine that could be used. **Image 3.1** below displays a picture of a typical wind turbine, detailing the component parts.

Consideration will also be given to the use of different wind turbine sizes and types across the Project to better utilise the on-site wind resource profile. Under this circumstance, wind turbine dimensions would remain approximate to the maximum wind turbine sizes envelope assessed in this EIS.

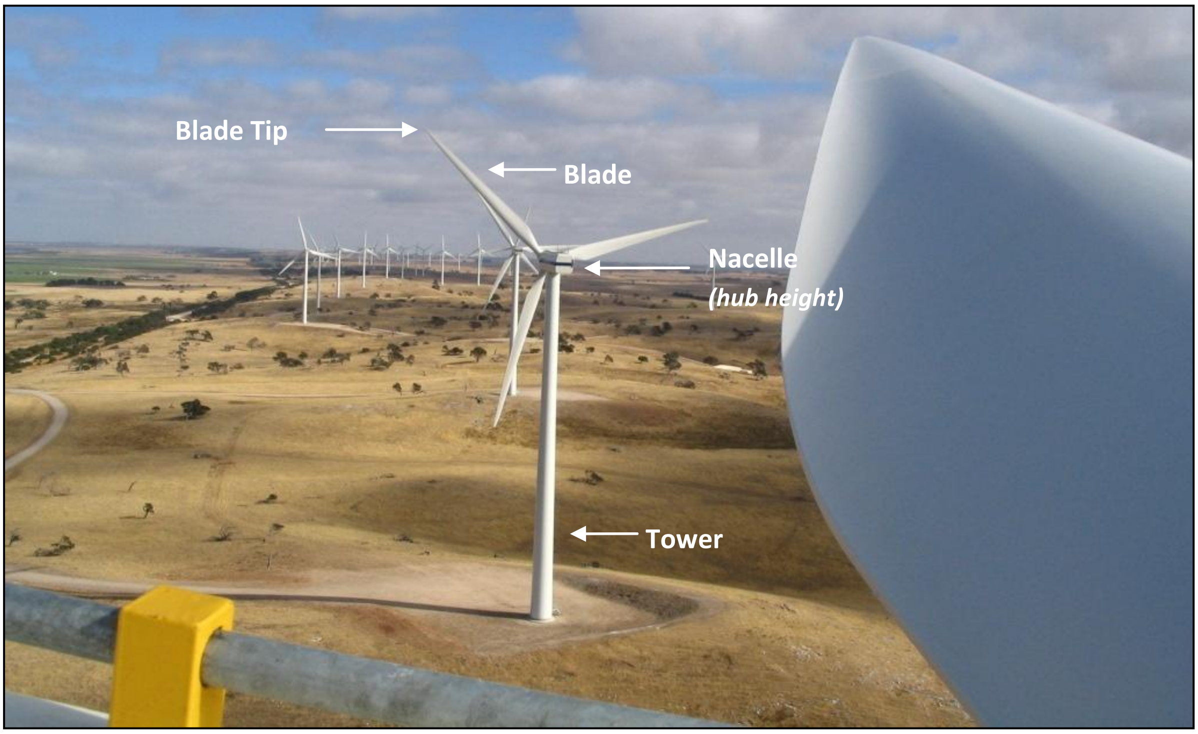

Image 3.1 Components of a wind turbine

3.3.1 *Wind Turbine Rotor*

The wind turbines that will potentially be used for the Project will be three-bladed, semi-variable speed, pitch regulated machines with rotor diameters between 74 and 144 m and a swept area of 4,300 to 16,286 square metres (m^2). Typically, wind turbines of this magnitude begin to generate energy at wind speeds in the order of 3.5 to 4 metres per second (m/s) (13 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 kph). Wind turbine blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub, and include lightning rods for the entire length of the blade. The blades typically rotate at about 12 revolutions per minute (rpm) at low wind speeds and up to 18 rpm at higher wind speeds.

3.3.2 *Towers*

The supporting tower structure of a wind turbine is typically comprised of a reducing cylindrical tower made out of either a welded steel shell or a concrete steel hybrid, fitted with an internal ladder or lift. Alternatives to these conventional specifications are available and comprise, among other solutions, a lattice design shroud in architectural fabric.

A range of tower heights are under consideration with the final selection subject to competitive tender. Typically, towers to accommodate the proposed maximum blade tip height have base diameters of 4.5 to 5.5 m and 3 m at the top. Conventional towers will typically be manufactured and transported to site in three to five sections for on-site assembly, whereas enclosed-lattice structures would be transported to site in standard shipping containers or flatbed trailers for on-site assembly.

For the purpose of the Landscape and Visual Impact Assessment report (see **Chapter 8**) a tower height of 120 m has been used for the visual analysis.

3.3.3 *Blade Tip*

The blade tip will comprise the highest point of the wind turbine when in a vertical position. Recent advances in wind turbine technology have meant that wind turbines with blade tip heights of 200 m are now available in the Australian market. This technology is proposed for use at the Sapphire Wind Farm in northern NSW, and as such can be considered the maximum tip height proposed for the Project.

For the purpose of the LVIA report (see **Chapter 8**) a blade tip height of 192 m was used in the visual analysis. This is 8 m (or 4 %) less in height than the proposed maximum however is considered to be representative of the types of wind turbines available for the Project.

3.3.4 *Nacelle*

The nacelle is the housing constructed of steel and fibreglass that is mounted on top of the tower and is typically 12 m long, 4.5 m high and 4.5 m wide (depending on the turbine model). It encloses the gearbox, generator, transformers (model dependant), motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the wind turbine. If required for safety, aviation obstacle lighting will be fitted to the top of the nacelle.

3.3.5 *Footings*

Two types of foundation for the wind turbines will be considered pending geotechnical investigation of the ground conditions at the Project site. The following examples are based on a typical foundation design, but final wind turbine selection and geological surveys will dictate which is to be used.

Slab (gravity) foundations would involve the excavation of approximately 750 cubic metres (m^3) of ground material to a depth of approximately 2.5 m (based on a 21 m diameter foundation). Approximately 200 m^3 would, if suitable, be used as backfill around the wind turbine base. Remaining excavation material will be used for the on-site road infrastructure, where necessary. A slab foundation would involve installation of shuttering and steel reinforcement, followed by the pouring of concrete (Refer to **Image 3.2** for an example of a conventional gravity footing).

If slab plus rock anchor foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 570 m^3 of ground material to a depth of approximately 2.5 m (based on a 17.5 m diameter foundation). Slab plus rock anchor foundations require shuttering and steel reinforcement, drilling of rock anchor piles up to a maximum depth of 20 m, concrete pour, after which the rock anchors are stressed and secured once the concrete has cured sufficiently (Refer to **Image 3.2** for an example of a conventional rock anchor footing).

Image 3.2 Typical gravity (left) and rock anchor (right) footings

It is necessary for detailed geotechnical surveys to be carried out pre-construction to determine the foundation type per wind turbine. It is feasible that more than one type of wind turbine foundation may be required for the Project, which will be determined during the detailed design phase following the assessment of the individual wind turbine locations. New wind turbines are continually coming on to the market and it is possible that minor variations to these conventional foundation dimensions could occur prior to final wind turbine selection.

The excavation for both types of foundation would be undertaken by mechanical equipment and may require low-level blasting where firm rock is encountered. Blasting would be undertaken by qualified professionals subject to relevant statutory requirements and approvals, and in accordance with relevant guidelines for blasting in proximity to neighbouring dwellings.

Impact assessments undertaken for the Project have assumed the use of the largest foundation footprint for all wind turbines, i.e. slab (gravity) foundations, using the greatest on-ground footprint. A typical foundation size of approximately 25 by 25 m is being considered as worst case for Layout Option 1, which reflects the largest known foundation impact based on currently available wind turbines. It is possible that larger foundations up to approximately 30 by 30 m could be used for Layout Option 2, however the resultant overall impact would be lower due to the fewer number of wind turbines and, therefore, foundations and hardstands required.

3.3.6 *Crane Hardstand and Assembly Areas*

On-site access roads include hardstands (approximately 35 by 60 m) adjacent to each wind turbine for use during component assembly and by cranes during installation. The clearing of native vegetation for the construction of on-site access roads and hardstand areas will be undertaken in accordance with the combined impacts evaluated in this EIS and minimised where practicable. If clearing is found to be unavoidable, this will be appropriately managed and carried out in accordance with Conditions of Approval. The on-site access roads would be surfaced with local stone to required load-bearing specifications. On-site access roads and hardstand areas would be maintained throughout the operational life of the Project and used principally for periodic maintenance of wind turbines. **Image 3.3** below shows a typical hardstand area adjacent to a wind turbine footing. The hardstand areas adjacent to each wind turbine will be retained for use during operation and maintenance in most cases.

Image 3.3 Typical hardstand area adjacent to a rock anchor footing

3.3.7 ***Monitoring Masts***

There are currently two temporary wind monitoring masts installed which are being used to collect data for the Project. A 60 m mast is installed 5.8 km to the south east of the Project site, and a 100 m mast is installed within the Mt Buffalo Cluster. It is expected that additional temporary masts will be installed in stages within the remaining Clusters prior to the start of construction of the Project. The existing temporary 60 m wind monitoring mast does not form part of the Project as it is located outside the current Project site.

Image 3.4 Tubular (left) and lattice (right) wind monitoring masts

Up to six permanent wind monitoring masts, up to 120 m high, are proposed to be installed on-site as part of the Project to provide information for the performance monitoring of the wind turbines. Locations for these masts are yet to be determined and will be influenced by the final wind turbine selection. Up to two temporary wind monitoring masts, up to 120 m high, per permanent mast (a maximum of 12 in total) will be installed for a period of approximately three to six months during the construction period to verify the data collected from the permanent masts. These short-term temporary masts will be located on areas cleared to host wind turbines and therefore will not contribute to an increased permanent impact. The short-term temporary masts will be lowered and removed to accommodate wind turbine construction and operation. The wind monitoring masts would be of a guyed, narrow lattice or tubular steel design. **Image 3.4** above shows both typical tubular and lattice wind monitoring mast designs.

Permanent wind monitoring masts will require a low voltage cable connection for power and a communications cable to be laid. The trench required for this will be much smaller than for the cables between wind turbines. The connection would come directly from the closest wind turbine.

3.3.8 *Viewing Platform*

A viewing platform is not proposed as part of the Project, however a viewing platform or parking bay could be constructed to account for a possible increase in tourism if Council requires, and in which case separate approval would be sought.

3.3.9 *Electrical Infrastructure*

A series of underground and overground transmission lines, a collector substation and switching station are proposed to connect the Project to the national electricity network. Two connection options are assessed as part of this EIS in order to provide a flexible and cost effective option for the Project. Connection to just one or to both of the existing Transmission lines within the Project area are proposed. Both are existing 132 kV lines connecting Yass to Cowra operated by TransGrid. Consultation with TransGrid and Essential Energy has been undertaken to determine the feasibility of these connection options.

The electrical works, including those incorporated in the wind turbine structures, will involve:

- Up to 122 wind turbine transformers (Layout Option 1) or up to 96 wind turbine transformers (Layout Option 2);
- The establishment of a CS approximately 150 by 150 m or 2.25 ha with 33 to 132 kV step up transformers, circuit breakers, isolators and provision for emergency lighting;
- The establishment of a SS approximately 160 by 220 m or 3.52 ha with 132 kV circuit breakers, isolators, metering, protections, communications assets and provision for emergency lighting;
- Approximately 61 km of up to 132 kV entrenched underground transmission lines and control cables;
- Approximately 9 km of up to 132 kV double circuit overhead transmission lines, some sections running in 2 or 3 parallel line configurations (see **Figure 3.1** to **3.2** and **Section 3.4.4**); and
- Establishment of a typical operation facilities building to house control and communications equipment.

3.3.10 ***Generator Transformer***

The wind turbine generators typically produce electricity at 690 V which is stepped up to 33 kV (or greater) by the transformer located either in the nacelle, the base of the tower or adjacent to the base of the tower on a concrete pad. **Image 3.5** shows an example of a transformer located outside of the tower.

Image 3.5 Transformer adjacent to wind turbine

The generator transformer may be oil-filled or a dry type depending on the wind turbine. Where oil-filled transformers are used, appropriate measures will be incorporated to prevent any oil loss and contain any spill within a bunded area. The volume of oil used for generator transformers is in the order of 1,000 litres (L). The output from each of the wind turbines will be directed via 33 kV (or greater) underground and overhead transmission lines that link to the CS.

3.3.11 *Collector Substation*

The potential CS locations have been chosen to minimise access distance and electrical losses, and to reduce their visibility from surrounding public viewpoints (see **Figures 3.1** to **3.8**). Three potential locations have been identified for the CS, only one of which will be constructed, which are at a minimum distance of 0.88 km from any nearby residences. Following construction, and if warranted, raised earthwork perimeters and small areas of native tree planting may be undertaken to screen any parts of the CS that are visible from the surrounding country to reduce noise and visual impact. Emergency backup power for the CS will be supplied by an on-site diesel generator and batteries to maintain network communications and electrical protection capability.

Each proposed CS occupies an area approximately 150 by 150 m or 2.25 ha. The area assessed for each CS includes provision for a 20 m asset protection zone (APZ). The remaining area is to be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The final layout of each CS will be developed in consultation with TransGrid and / or Essential Energy during detailed design. The typical CS arrangement will include step-up transformers, an array of cable marshalling, busbars, switchgear and protection, various voltage and current transformers, operation and facilities building with parking, communication facilities and tower, on-site batteries, diesel generator, lighting, a buried earth grid, lightening masts, power conditioning equipment and a reactive power control systems as agreed with TransGrid and / or Essential Energy. The ground surface within the CS enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. As the transformer(s) may each contain upwards of 50,000 L of oil, provision will be made in the design for primary and secondary containment of any oil that may leak or spill from the transformers or associated components. This would involve constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the CS compound.

3.3.12 *Switching Station*

The potential SS locations have equally been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints (see **Figures 3.1** to **3.8**). Three locations have been identified for the SS, only one of which will be constructed, which are at a minimum distance of 0.93 km from any surrounding residences. Following construction, and if warranted, raised earthwork perimeters and / or small areas of native tree planting may be undertaken to screen any parts of the SS that are visible from the surrounding country to reduce noise and visual impact. The SS will require a standalone power supply from either the local 11 kV distribution network, which is located up to 3.5 km from the proposed SS locations, or an on-site generator.

Each SS will occupy an area approximately 160 by 220 m or 3.52 ha which included provisions for a 20 m APZ. The remaining area is to be surrounded by a 3 m high security fence, surmounted by strands of barbed or razor wire. The SS arrangement will include an array of busbars, circuit breakers, isolators, buried earth grid, various voltage and current transformers as agreed with TransGrid and / or Essential Energy, power conditioning equipment, an operations and facilities building with parking and a secondary distribution supply source. The ground surface within the SS enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs.

The SS will most likely require communication facilities, including a communications tower to provide for communications redundancy which is expected to be up to 45 m in height depending on topographic conditions. Twenty-four hour low-intensity security night lighting or low intensity flood lighting within compounds in accordance with the appropriate Australian (or otherwise) standards will be incorporated into the design. TransGrid and / or Essential Energy requires low-level and high-intensity lighting for operational safety reasons, and the lighting will only be used intermittently for operational and emergency maintenance reasons. The design of the SS will be developed in conjunction with TransGrid and / or Essential Energy and comply with their standards. As the SS will be owned and operated by TransGrid and / or Essential Energy the operational period is likely to be beyond the timeframe of the Project. The SS could potentially increase network reliability and security of supply in the region and therefore TransGrid and / or Essential Energy may wish to retain each SS beyond the operational life of the Project.

3.3.13 *Overhead and Underground Transmission Lines and Control Cables*

The electrical and control cables from the Langs Creek, Kangiara and Mt Buffalo Clusters will comprise a mix of underground and overhead transmission lines and will connect directly into the CS. **Image 3.6** shows a typical overhead transmission line that could be implemented in this Project.

Image 3.6 Double-circuit overhead 33 kV transmission line

Underground Transmission Lines: Underground routes will generally be between the wind turbines and follow the route of the internal on-site access roads (refer to **Image 3.7**). Sections of the proposed overhead transmission line may need to be placed underground subject to local requirements. The final route will minimise vegetation clearing and avoid potential erosion and heritage sites, and will also depend on the ease of excavation, ground stability and cost. Location markers may be placed along the route of the underground transmission lines, if agreed by the participating landowners, for safety reasons. Placement of these transmission lines below ground will result in minimal visual impact once the ground has been rehabilitated, if appropriate.

Image 3.7 Laying underground transmission line within the road network

Control Cables: Computerised controls within and between the wind turbines and the operation facilities building automatically control start-up, speed of rotation and cut-out at high wind speeds and during faults. Recording systems will monitor wind conditions and energy output at each of the wind turbines. Remote 24 hr monitoring and control of the Project will also be employed. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the Clusters of wind turbines.

The installation of buried earthing conductors and electrodes will also be required in the vicinity of the wind turbines, the facilities building and the substations as required.

Overhead Transmission Lines: Approximately 9 km of overhead transmission line will be required to connect the wind turbines to the CS and SS (see **Figure 3.1** to **3.2**). Voltages ranging from 33 kV to 132 kV may be constructed in single or double-circuit configurations depending on the wind turbine selected for the Project and any staging considerations. The overhead transmission lines can be up to 50 m in height, comprising of up to two cross arms with insulators and a typical span length as shown in **Table 3.3**.

Table 3.3 Indicative transmission line specifications

Voltage	Easement Width	Height of Pole	Typical Span Distance (Pole to Pole)
132 kV	45 m	35-50 m	200 – 300 m
66 kV	30 m	30 m	150 – 250 m
33 kV	30 m	20 m	150 m

Note: All easement widths account for a double circuit on a single pole.

The required easement width may vary due to terrain and alignment, such as to accommodate sharp changes in direction.

Depending on the size of wind turbine selected for the Project, it may be necessary to run two or more overhead transmission lines in parallel within the Project site, from each Cluster to the relevant CS and from the relevant SS to the point of connection (see **Figure 3.1** to **3.2**). In this case, two or more overhead transmission lines will follow the same centre line as shown in **Figure 3.1** and **3.2** and their easements will overlap to minimise the impact of the easement corridor. For example, two 33 kV overhead transmission lines (each with a 30 m easement) running in parallel would require a total easement of 45 m (sharing a 15 m overlap). Alternatively, a 132 kV and two 33 kV overhead transmission lines would require a 75 m easement (retaining the greater easement requirements of 45 m for the 132 kV transmission line, plus the two 33 kV easements overlapping).

3.4 Site Access Works

3.4.1 *Site Entry*

The Project site can be reached via the south from the Hume Highway utilising local roads north of Yass, including the Lachlan Valley Way, Boorowa Road, Tangmangaroo Road and Wargeila Road.

Existing access roads are shown in **Figures 3.1** to **3.8** and can be classified into two broad categories:

- Classified Highways: Hume Highways (M31) and the Lachlan Valley Way (MR56), which are maintained by the NSW Transport, Roads and Maritime Service (RMS); and
- Local Roads: The direct access to the Project site is provided by local roads maintained by Yass Valley Council or Boorowa Council. The significant local roads in Boorowa LGA are Rye Park-Dalton Road, Wargeila Road, Tangmangaroo Road, Harry's Creek Road, Hopefield Road and Boorowa Road. The significant local roads in Yass Valley LGA are Lachlan Valley Way, Tangmangaroo Road, Moorbys Lane, Laverstock Road and Wargeila Road.

Yass Valley Council, Boorowa Council and the RMS have ongoing maintenance and improvement programmes for the roads and bridges under their authority. There are no known proposals for major road improvements on the access roads under consideration at the time of writing.

Access routes and points for over-size and over-mass vehicles (primarily those vehicles carrying wind turbine and electrical components) have been investigated from the south. The access route comprises the Hume Highway onto the Lachlan Valley Way, passage south-east of Boorowa and into the Project site via Boorowa Road, Hopefield Lane, Harry's Creek Road, Tangmangaroo Road and Wargeila Road.

Other roads in the locality may also be used both by over-size / over-mass vehicles, but will primarily be used by standard heavy vehicles such as tip-trucks, concrete agitator trucks (if required) and light vehicle transport both during construction and operation.

Note: Approximately 33 km of the arterial road access likely to be used for construction activities are unsealed. This has implications for water usage and dust suppression and is discussed later in this chapter.

All entrances to the Project site from the existing arterial roads will be designed to allow long vehicles to safely exit from or re-enter the road whilst minimising the disruption to traffic. Further consultation will be undertaken with Council and RMS to confirm the final design. Further details relating to safe access considerations and potential road infrastructure upgrades to be considered are discussed in **Chapter 12** Traffic and Transport.

3.4.2 *On-site Access Roads*

Other access consists of new on-site access roads between wind turbines, also comprising hardstand and turning head areas. The on-site access roads have been planned to follow existing farm tracks, where practicable, to minimise impact in traversing the ridgelines and plateaus. All on-site access roads are likely to require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation. The on-site access roads are all located on private land and would not be accessible to the public. Access would be controlled by locked gates.

Construction of the on-site access road network will require earth works in areas of steep gradient to a design suitable for safely transporting Project components into position. Detailed civil engineering designs will be prepared for the final wind turbine layouts, including permanent on-site access roads, hardstand and turning head as well as the extent of required earthworks.

The on-site access roads will be surfaced with compactable, engineered base material with suitable drainage. Some steep sections of on-site access roads may need to be surfaced with asphalt to enable haulage of heavy wind turbine components. Materials will be sourced locally where practicable, including the recycling of aggregate extracted during the construction process, and / or in consultation with the local Councils and landowners (subject to separate approvals being obtained by the contractor for any quarrying operations). Measures will be taken to minimise the risk of the spread of weeds from materials brought in for construction purposes through the CEMP.

On-site access required for the Project site is shown in **Figures 3.1** to **3.8** and described below:

- Mt Buffalo Cluster: Approximately 38 km of new on-site access road;
- Kangiara Cluster: Approximately 29 km of new on-site access road; and
- Langs Creek Cluster: Approximately 16 km of new on-site access road.

3.4.3 *Ancillary Roads and Remediation*

Additional temporary roads, tracks, or even light vehicle movements over farmland areas, may also be required during construction, for instance aspects such as construction of the overhead transmission lines, access to remediate erosion control sites that may occur as a result of the construction process, and laying out tailing ropes to control the rotor lift. The erosion control sites will benefit from the use of excess rock excavated from wind turbine footings and will be chosen based on the availability of excess material, the need for erosion repair, and minimising the distance for material transport.

If the temporary roads are not required for the ongoing operation and maintenance works of the Project they will be removed and rehabilitated on completion of the construction phase, and in accordance with landowner preferences and environmental controls.

3.5 Utility Services

The Project will be connected to TransGrid's 132 kV transmission network and when not generating will draw a minor amount of electricity from the grid. Backup and emergency power at each CS will be supplied by on-site batteries and a standalone diesel generator. Auxiliary power at the SS will be supplied by a local 11 kV distribution line or on-site generator.

Two separate and independent telephone communications facilities (optic fibre and microwave) will be installed between each CS and SS as required by the Australian Electricity Market Operator (AEMO) to enable safe remote monitoring and control of the Project.

Mobile telephone coverage is available on most of the ridgelines and plateaus with limited or no service available on the majority of the valley floor. Although the Project will not rely on this form of communication, it can be assumed that members of the construction, operation and maintenance teams will communicate using both mobile telephones and radios.

Operational water requirements will be provided to the proposed facilities and auxiliary services building from a storage tank designed to collect water from roof drainage and augmented by potable water delivered by tankers. An approved septic system or composting system will be installed to treat minor quantities of waste water. The Proponent will be responsible for the removal of all other wastes from the Project site.

3.6 Resource Requirements

Resource requirements are typical of any new development site, including the provision of cement, gravel, sand, asphalt, water and road base material.

Cement for foundations will be sourced by the civil construction company awarded to undertake the Project. This may be sourced locally or from alternative suppliers.

Gravel and sand will be sourced locally and as close to the Project site where it is practicable to do so, including recycling material excavated from foundations and earthworks where possible. There is one operating quarry for unprocessed construction materials within the Project site located east of Tangmangaroo Road between the Kangiara Cluster and the Mt Buffalo Cluster. Additional operating and disused quarries have been identified within the locality of the Project site which may also be considered during the pre-construction phase, along with quarries outside the Project locality, depending on availability and subject to the contractor obtaining the necessary permits (see **Figure 3.9**). In addition, several landowners have expressed interest in allowing gravel extraction from their properties. If it is decided to pursue the establishment of a local quarry then this will be separately assessed and approved prior to use. Both gravel and sand will be required to prepare the high strength concrete to pour wind turbine foundations. Gravel will also be required to dress the wind turbine sites (see **Image 3.5)** and provide a low resistivity apron around the CS and SS.

Water requirements will be met by sourcing water from within the locality where practicable (subject to the required water licences being obtained). If it is not practicable to source water locally, then it will be brought to the Project site by external water suppliers under contract to the Project. It is estimated that in the order of 15.0 mega litres (ML) of water would be required to produce the quantity of concrete required for gravity footings for Layout Option 1, which can be considered the maximum amount of water required for use in concrete batching. By way of comparison, it is estimated that only approximately 11.0 ML of water would be required if standard rock anchors were used for all footings in Layout Option 1.

In addition, it is estimated that a further 45.9 ML of water would be required for road construction and dust suppression activities. This would provide sufficient volume for all new and upgraded on-site access road construction and dust suppression activities, including those associated with the 33 km of unsealed arterial road. These activities are not embargoed and as such require the Proponent to apply for a permit to the NSW Office of Water (NOW) following Development Consent.

The water volumes provided above are reasonable with regard to the types of activities proposed, however they are estimates and not limits. Prevailing weather conditions during the period of construction, temperature in particular, will affect the volume of water required.

Road base material will be required for construction of on-site access roads to wind turbine sites and the substations. Part of the road base requirement may be sourced from material extracted from wind turbine footings with the remainder sourced on-site (subject to separate assessment and approvals being obtained) or imported to the Project site. Where additional material is required, local supplies of the same geological type could be sourced from the quarries indicated above, local landowner gravel supplies or external aggregate suppliers.

Given the scale of the Project, it is anticipated that there will be minimal waste material exported from the Project site during construction. Top soil cleared during the construction phase will be used for remediation, and rock excavated from wind turbine footing preparations will be used for road base, back fill for foundations and / or erosion control purposes as far as practicable. Ancillary waste, such as packaging associated with component and stock pile deliveries, will be disposed of appropriately in accordance with procedures which will be contained in the CEMP.

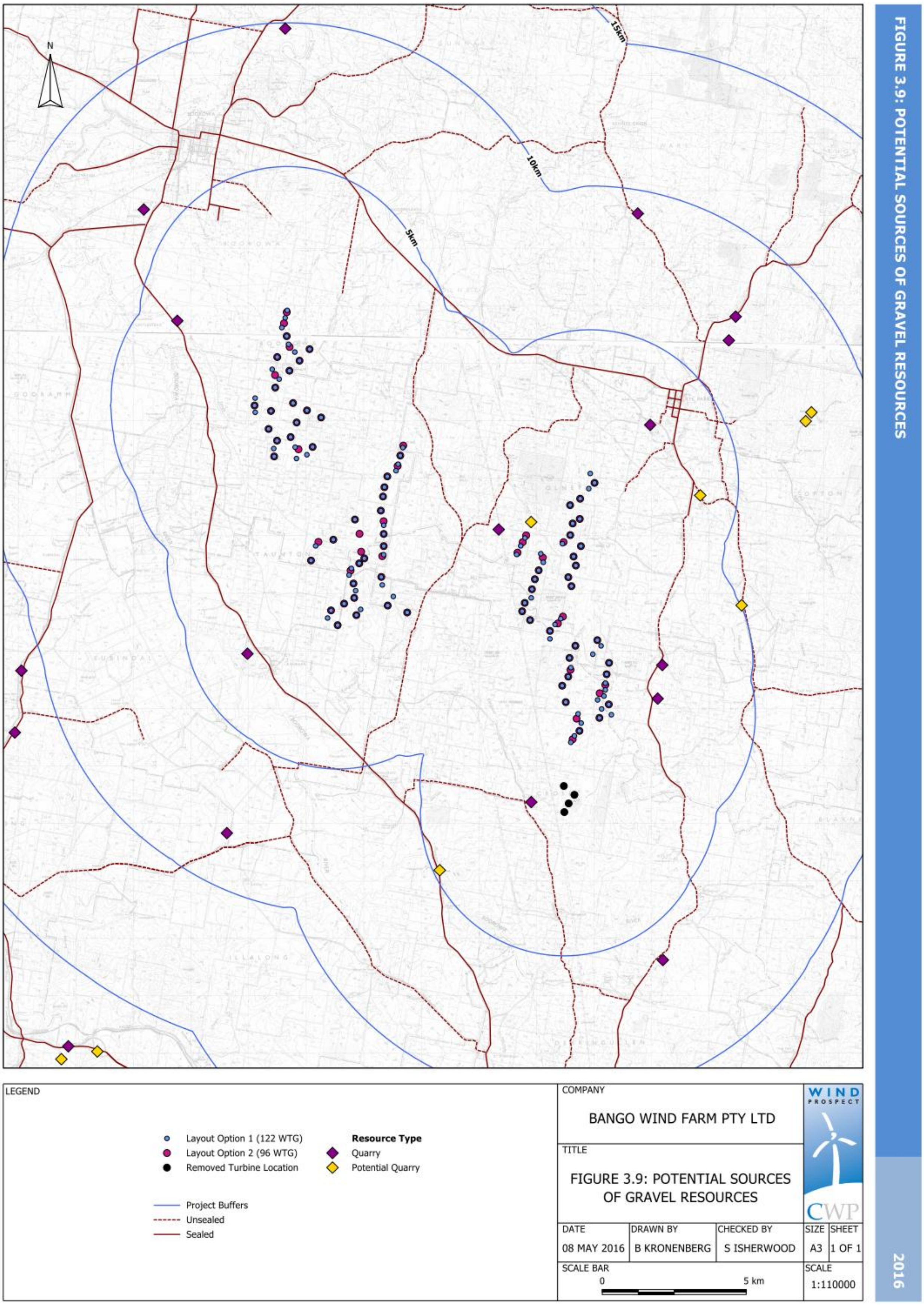

Figure 3.9 - Potential sources of local resources

(An A3 size version of this Figure is displayed in Volume 2)

3.7 Potential Layout Design Variations

The project layout contained in this report is indicative only and is subject to detailed design. The indicative layout has been prepared on the basis of the best knowledge available at this time, and incorporates the avoidance, mitigation and management measures outlined in this report. The Project assessed in this report has assumed the maximum impact of each of the Project components (the on-site access roads, hardstands, cut and fill and turning head areas) to ensure that the worst-case / greatest impact scenario is assessed.

If planning approval is obtained, a preferred wind turbine model will be selected and a construction contractor appointed. Each wind turbine model is uniquely different and requires bespoke turning radii, access and exit gradients and crane requirements. As such, it is not until the construction contractor surveyor traverses the entire Project site and incorporates the requirements of the final Conditions of Approval, that detailed design of the final Project layout, including on-site access roads and hardstands can be submitted to the wind turbine supplier for approval. It is therefore essential for efficient Project delivery that the consent authority provides this necessary flexibility by authorising micro-siting of infrastructure within the Conditions of Approval.

Approval is sought for a micro-siting allowance which will permit some variation in the positioning of up to 122 wind turbines and associated infrastructure within the Project site, where micro-siting impacts are generally in accordance with those presented in this EIS. It is requested that micro-siting is permitted on the basis that:

- No greater impacts to CEECs and EECs occur other than those assessed with the proposed management, mitigation and offset principles to apply;
- Known Wedge-tailed Eagle nests are to be avoided;
- Removal of hollow bearing trees is to be minimised;
- Sites of medium and high Aboriginal significance are to be avoided;
- Impacts to the second Fresnel zone of identified communications links are to be avoided; and
- Standard noise criteria are not to be exceeded unless an agreement exists between the Proponent and affected party.

Where available, those constraints listed above have been mapped across the Project site and are presented in **Figure 3.10**.

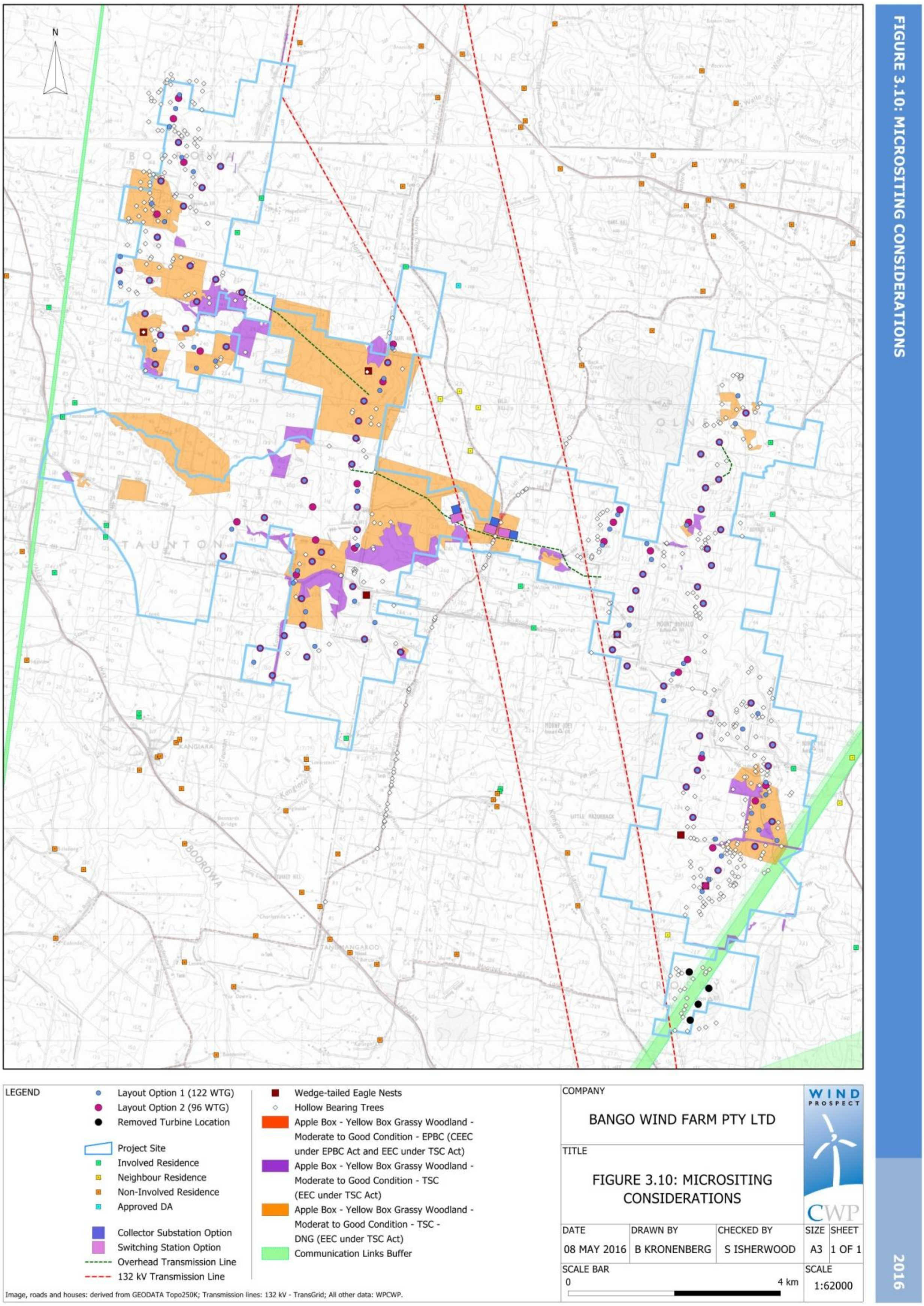

Figure 3.10 – Micro-siting Considerations

(An *A3 size version of this Figure is displayed in Volume 2)*

3.8 Wind Farm Development Phases – Project Approval to Operation

The following section provides a brief description of the detailed design, pre-construction and construction works, operation / maintenance and refurbishment / decommissioning work required at the Project site.

3.8.1 *Anticipated Project Timeline*

The Proponent expects that works will commence within five years of project approval being obtained. The actual timing of construction will principally be driven by the length of time taken to obtain other permits and authorisations, attaining board approval / project financing for commencement and the long lead times for wind farm components. An indicative Project timeline is presented in **Table 3.4** below. Staging of the development is also a consideration and some of those factors which may lead to a staged approach are discussed below in **Section 3.9.2**.

The following provides a guide to the timing of anticipated activities subject to project approval for the Project.

Table 3.4 Anticipated Project timing

Phase	Duration
Detailed design and contract development and Pre-construction works	5 months
Construction works	18-30 months
Commissioning	3 months
Operation	25 years
Maintenance	Periodic and as required
Decommissioning or equipment replacement	At completion of project life

3.8.2 *Construction Staging and Considerations*

The following section provides context into aspects that could have a bearing on a staged construction process and as such the Proponent is seeking flexibility in the Conditions of Approval to allow for a staged development.

Project scale: The Project comprises up to 122 wind turbines and can accommodate a range of wind turbine types and sizes. It is anticipated due to the number of wind turbines proposed that the Project could be constructed in stages. The construction of all 122 wind turbines is subject to commercial considerations and the Conditions of Approval placed on the development.

The Proponent seeks approval to construct and commission the Project either in stages or as a whole wind farm.

3.8.3 *Detailed Design and Contract Development*

Once all required permits and approvals have been obtained and tenders for the design and construction have been awarded, the Project design can be finalised. This stage takes account of updated wind resource monitoring, revised energy modelling and the latest equipment and technology that is available to the Proponent at that time. It is at this stage that final micro-siting of the wind turbines and site infrastructure will occur, subject to the Conditions of Approval placed on the development.

Conditions of Approval and any licensing conditions will be used to prepare the Project EMPs as outlined in **Chapter 21** Statement of Commitments (SoC). The Project EMPs would also be incorporated into the contract specifications for the required construction works and equipment supply to ensure compliance and achieve the Project environmental objectives.

Tenders will be issued using the abovementioned specifications and each tenderer's record of performance will be reviewed as part of the selection process to ensure that they are able to achieve the required specification of works.

The Contractor will also be required to produce / adhere to the CEMP to address its component of the Project works.

3.8.4 ***Pre-construction Works***

Prior to the commencement of construction, a number of enabling works and further site planning would be undertaken by the selected Contractor, including:

- Detailed site investigation including geotechnical investigations involving a series of trial pits and / or boreholes;
- Detailed contour surveys;
- Upgrades to local roads and on-site access roads where required;
- Widening the junctions or corners of local roads, entrance / access points where required;
- Widening the existing gateways, or inserting new gateways as necessary along fence lines;
- Stripping and storage of topsoil from the areas which would be affected by construction activities, including the tower bases, CS and SS locations, on-site access road areas, crane hardstand and assembly areas;
- The establishment of a secure construction compound, with Project owner and subcontractor field offices (portables), parking bays and toilet facilities (temporary). Approximately a 75 by 75 m area will be retained permanently for the lifetime of the Project;
- Erection of appropriate signage on roads;
- Enabling works for the locating of a mobile concrete / asphalt batching plant(s) (temporary, if required);
- Enabling works for the locating of a rock crushing plant(s) (temporary, if required);
- Survey of critical land boundaries and pegging of infrastructure locations;
- Detailed cultural heritage and flora / fauna surveys across the entire Project site (if required);
- Preparation of works procedures and Project Implementation Plan; and
- Engineering design works.

3.8.5 ***Construction Works***

Construction activities include activities that crossover with pre-construction works and comprise site establishment, earth works for on-site access roads, footings and crane hardstand areas, erection of up to 122 wind turbines, approximately six permanent and up to 12 temporary wind monitoring masts (as required), substations, overhead and underground cabling and operations compound. Subject to staging requirements, construction activity is likely to occur over a period of approximately 18 to 30 months with rehabilitation following the completion of works. Daily construction work will occur within recommended working hours where practicable (i.e. 7 am to 6 pm Monday to Friday and 8 am to 1 pm on Saturdays), and outside these hours for low noise construction activities and delivery of materials as required. Certain activities will require work to be conducted outside normal work hours to prevent damage to concrete tower bases and trenches, to reduce the safety risk of open trenches and to reduce the risk of tower self-oscillation. These activities include:

- **Concrete Placing:** Concrete work is to be carried out as a continuous process (once bases are prepared) for some 8-10 hours per base. Weather conditions play a major role; the concrete can only be placed at temperatures between 5 and 35°C (specification) and not during rain periods. Once bases have been prepared it is essential that concrete is poured immediately to prevent any damage that may be caused by rain or prolonged exposure (reinforcement, etc);
- **In-ground Electrical Works:** Once electrical trenches have been excavated it is important that cables are laid and trenches backfilled as soon as practicable so as to avoid damage to the trenches (and surrounding areas) due to exposure to the elements. Safety issues, for people, livestock and native animals, are reduced on early backfill of trenches; and
- **Wind Turbine Installation:** Wind Turbine Installation is intended to fit into the six day working week. However, when erecting the tower, once the top of the tower is attached, the nacelle must go on without delay due to the risk of tower self-oscillation. Unfavourable weather can cause delays in mounting the nacelle. Continuing this work outside of standard construction hours will ensure that there is a risk to people, property and the surrounding environment from tower self-oscillation. The Project area is naturally a high wind area and as such Sunday work may be needed to make up for high wind days during the week.

If concrete laying, in-ground electrical works or wind turbine installation is required to be carried outside of normal construction hours, protocol as described in **Table 3.4** below will be followed.

Table 3.5 Inaudible Works Protocol for concrete placing, in-ground electrical work or wind turbine installation

Step	Responsibility
• Identify the need for works to be carried out outside of standard working hours and discuss the noise implications with the Environmental Advisor. Issues for consideration include: • Timing and duration; • Need and justification; • Site-based noise generation; and • Traffic-noise generation along traffic routes.	Construction Site Manager
• Environmental Advisor to determine whether the works are likely to be inaudible at nearby sensitive receptors and relay this to the Site Manager.	Construction Environmental Advisor
• If the works are likely to be inaudible and are likely to proceed, Environmental Advisor to notify the Environmental Representative and seek endorsement of the works.	Construction Environmental Advisor and Independent Environmental Representative
• If the works are likely to be audible at nearby sensitive receivers, prior to the commencement or continuation of works the	Construction Environmental Advisor

Environmental Advisor will door knock those sensitive receptors to inform them of the likely timeframe associated with the activity.	

All activities not mentioned above or not deemed inaudible will be subject to the normal consultative process with the DPE in accordance with the conditions of approval. Typically, the approved working hours for construction activities can be varied with prior written approval from the Director General. Each request will be considered on a case-by-case basis and will include:

- Details of the nature and need for activities to be conducted during the varied construction hours;
- Proof that the activities undertaken during the varied construction hours will not adversely impact on sensitive receivers in the vicinity of the Project; and
- Consultation with affected landholders including to provide information regarding the timing, duration and location of works undertaken within the varied times and providing a contact point for any inquiries or complaints at least 48 hours before any works commence.

Community construction awareness programme: Prior to the commencement of the Project site construction activities, a programme of community awareness initiatives will be implemented. Information will be disseminated to the local community through the Community Consultative Committee (CCC), local newspapers and direct mail to advise the community of the nature of pending construction activities, their timing and potential impacts. Contact details will be provided for individuals to gain further information or, if desired, to express concerns or complaints.

Updates on the progress of construction works and relevant impacts will be provided during the construction period. The CCC will be available to guide and inform the Proponent on matters of interest to the community, and will provide an additional forum for communication between stakeholders.

Ancillary Facilities: Temporary ancillary facilities will consist of construction compounds and on-site batching and crushing plants, if required. These facilities will include materials storage areas, maintenance workshops, testing laboratories and material stockpile areas.

The location of ancillary facilities will be identified in the CEMP for the Project and will be determined having regard to the following criteria:

- Be located more than 50 m from a waterway;
- Be located within or adjacent to the Project;
- Have ready access to the local road network;
- Be located to minimise the need for heavy vehicles to travel through residential areas;
- Be sited on relatively level land;
- Be separated from nearest residences by at least 200 m (or at least 300 m for a temporary batching plant);
- Not require vegetation clearing beyond that already required by the Project;
- Not impact on heritage sites (including areas of archaeological sensitivity) beyond those assessed to be impacted by the Project;
- Not unreasonably affect the land use of adjacent properties;

- Be above the 20 year Average Recurrence Interval (ARI) flood level unless a contingency plan to manage flooding is prepared and implemented; and
- Provide sufficient area for the storage of raw materials to minimise, to the greatest extent practical, the number of deliveries required outside standard construction hours.

Further details relating to construction noise and vibration are outlined in **Chapter 9** Noise Assessment. Where any of the above criteria cannot be met for any proposed ancillary facility, additional measures will be implemented to minimise any impacts arising from this - details of these measures will either be prepared separately or form part of the CEMP.

All construction ancillary facility sites will be rehabilitated to at least their pre-construction condition and in accordance with the Conditions of Approval, unless otherwise agreed by the affected landowner.

Construction Compounds: Temporary construction compounds will be required for construction, including several demountable buildings used for office, workshop and storage purposes, an amenities block, and portable toilet facilities will be located at the Project site during construction. Arrangements will be made for power and communications at the site office during the construction period. Sufficient car parking will be provided and a cleared flat area to provide for the storage of various items during construction (refer to **Image 3.8**). The temporary construction compounds will be typical of that used at construction sites; noting they will not include accommodation facilities.

Image 3.8 Typical temporary construction compound

Four preferred areas for the construction compounds have been considered, in accordance with the location and connectivity of the wind turbines within each of the Clusters:

- One located off Hopefield Lane within the Langs Creek Cluster;
- One located off Lachlan Valley Way en route to the Kangiara Cluster;
- One located off Rye Park Gunning Road to the north of the Mt Buffalo Cluster; and
- One located off Wargeila Road in the centre of the Mt Buffalo Cluster.

Up to four construction compounds will be constructed at one or more of these locations. The temporary site office facilities will be approximately 40 by 100 m located within the construction compound (approximately 150 by 200 m), a combined area of approximately 3 ha. The area will be fully fenced with sufficient access to allow vehicle movement, stockpiling of materials, and office facilities. An area of approximately 75 by 75 m or 0.56 ha will be retained for permanent use during the life of the Project as an operations compound which will include a site office, workshop, storage, parking and facilities for operational staff. If alternative locations for these facilities are sought then the selection criteria for ancillary facilities will be considered to determine suitable locations and the final locations will be submitted either separately or as part of the CEMP.

On-site Concrete / Asphalt Batching Plant / Rock Crusher: Up to six temporary concrete or asphalt batching plant and rock crushers are proposed to supply concrete, asphalt and aggregate for the wind turbine foundations, CS, SS and on-site access roads during construction. Following detailed geotechnical site investigations and the final wind farm layout, estimates of materials to be processed by these facilities will be calculated. Appropriate Environmental Protection Authority (EPA) licences will be obtained for the operation of rock crushing or concrete batching facilities should the estimated volume of material exceed 30,000 tonnes per annum (or 150 tonnes per day for rock crushing).

Each on-site concrete batching plant facility would occupy an area of approximately 50 by 100 m or 0.5 ha and likely consist of a trailer-mounted concrete mixer, cement bins, sand and aggregate stockpiles and a storage container for various equipment and tools. Sufficient area will be required for the use of front-end loaders, delivery of materials and entry and exit of vehicles. Each concrete batch plant would be powered by a diesel generator and have a production capacity of approximately 40 cubic metres per hour (m^3/h).

Each on-site asphalt batching plant facility, if required, would occupy a similar area of approximately 50 by 100 m or 0.5 ha and likely consist of a plugmill mixing chamber, aggregate dryer, bitumen tanks, aggregate bins and a storage container for various equipment and tools. Each asphalt batch plant would be powered by a diesel generator and have a production capacity of approximately 70 to 90 tonnes of asphalt per hour. Sufficient area for both batching plants would be required for the use of front-end loaders, delivery of materials and entry and exit of vehicles.

Each rock crusher would occupy an area of approximately 50 by 100 m or 0.5 ha and consist of a tracked mobile crushing unit, conveyor belts, feeder and engine. Sufficient area will be required for the use of front-end loaders, delivery of materials and entry and exit of vehicles. **Image 3.9** shows a typical mobile concrete batching plant facility and rock crusher.

Six areas for a crushing / batching plant have been considered (see **Figure 3.1** to **3.2**):

- One located in the Langs Creek Cluster;
- Two located in the Mt Buffalo Cluster; and
- Three located in the Kangiara Cluster.

If alternative locations for these temporary facilities are sought then the selection criteria for ancillary facilities will be considered to determine suitable locations.

Image 3.9 Temporary on-site concrete batching plant and rock crusher

On-site Access Roads and Crane Hardstand / Assembly Areas: On-site access roads and crane hardstand / assembly areas require surfacing in order to cater for construction traffic and machinery. This involves the excavation of the on-site access roads and hardstand areas to an agreed depth, prior to the laying of a compacted quarry rubble base. All of the material retrieved from cuttings and excavations will be either used on-site or disposed of appropriately off-site. Site access points would be gated and secured, and appropriate warning signs erected.

During construction, on-site access roads are constructed at a width of 6 m to allow for passing construction traffic, large mobile cranes, and other long and wide loads. The crane hardstand and assembly areas will be sized at approximately 35 by 60 m.

Dust suppression is a key consideration during the construction and use of on-site access roads. A permit will be sought from NOW for the extraction of the required volume of water to enable the construction and dust suppression of up to 83 km of new and upgraded on-site access roads and up to 33 km of unsealed arterial roads that are likely to be used for on-site access roads. If on-site water cannot be sourced from within the Project site, then water will be brought into the site from appropriate suppliers.

Footing Construction: If gravity foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 750 m^3 of ground material to a depth of approximately 2.5 m. Shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish approximately 0.5 to 1 m below ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete. Given the limited output capacity of the concrete batch plants, foundation designs can incorporate cold joints and construction joints. These can limit foundation pours to around 250 m^3, thereby allowing increased workmanship, less demand on the batching plant and a contingency plan in the event of plant breakdown, delays to material supplies or detrimental weather events (discussed below in more detail).

If rock anchor foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 570 m^3 of ground material to a depth of approximately 2.5 m. The rock anchor cores are drilled into the bedrock prior to concrete pour, and are up to a maximum depth of 20 m. The rock anchor tendons are grouted into place, stressed and secured once the concrete has cured sufficiently. Steel forms shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish at ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete.

Underground Transmission Lines and Control Cables: Either prior to or during wind turbine base construction, the underground transmission lines would be installed. This would involve the cutting or excavation of trenches to a depth of up to 1.2 m for the laying of the underground transmission lines that link the wind turbines. All trenches would be marked with warning tape and backfilled once the cables were in-situ.

The majority of the underground transmission lines will be located adjacent to the on-site access roads, either within the road edge or associated earthworks. The general procedure for the laying of underground transmission lines will be as follows:

- Preparation work, including installation of gates / temporary removal of fences, as required;
- Use of an excavator or rock saw to dig a trench (approximately 0.45 m wide by up to 1.2 m deep depending on the type of soil and quantity of cables);
- Material excavated is stored adjacent to the trench for subsequent back-filling;
- Laying of bundled cables within a bed of protective sand;
- Placement of tape warning of the presence of electrical cables at the required depth; and
- Backfilling and compaction of previously excavated material in layers by use of a vibration plate compactor, all in accordance with Engineering Specifications.

On completion the underground transmission lines may be marked with small marker posts and the surrounding vegetation will be allowed to regrow.

Collector Substation: Three locations for the CS have been proposed (**Figures 3.1** to **3.8**), only one of which will be constructed. The yard will be surfaced with compacted quarry rubble to form a hardstand area. Reinforced concrete footings will then be constructed to support electrical infrastructure and buildings. Infrastructure required within the yard includes transformers, switchgear, power conditioning equipment and operation facilities building. **Image 3.10** shows a typical substation design during construction.

Image 3.10 Electrical substation and switchgear infrastructure

Wind Turbine Erection: The wind turbine components would be delivered to the Project site on semi-trailers. The method of construction would involve the use of a small mobile crane (up to 100 tonne) for the ground assembly operation. A larger 600 to 1,000 tonne crane together with a small mobile crane would be required to erect the wind turbines once ground assembly is complete. Erection is likely to take approximately two to three days per wind turbine. Depending on the configuration, the crane may require up to two days to disassemble and remobilise to a new site. **Image 3.11** shows the sequential stages undertaken during the installation of a wind turbine.

Overhead Transmission Lines: Construction of the proposed overhead transmission lines requires the following works to be undertaken in accordance with an appropriate CEMP:

- Site establishment including the provision of access;
- Centreline surveying and service location;
- Easement preparation, including the lopping and / or removal of trees;
- Excavation and transmission pole erection; and
- Conductor and earth wire installation (including pilot wire).

Image 3.11 A typical wind turbine installation process

Complex line construction methods including helicopter installation and blasting of transmission pole foundations are unlikely to be necessary. Nonetheless, if such methods are proven to be required following detailed design, appropriate measures will be adopted through the CEMP. Equipment to be routinely used during line construction includes:

- Semi-trailer for transportation of transmission poles, wires and other materials;
- 20 tonne crane;
- Pole borer;
- Elevated work platform (EWP); and
- Concrete trucks.

Image 3.12 shows equipment typically used during transmission pole and wire installation.

Image 3.12 Equipment typically used during transmission pole and wire installation

The majority of the proposed overhead transmission line locations can be readily accessed during construction via cleared agricultural land, following negotiations with landholders. In some cases, track creation or enhancement may be required where access cannot be gained or is not considered adequate to support machinery utilised during the construction of the transmission line. A number of creek crossings may also be required to support the required machinery. Crossings not required for future maintenance activities will be decommissioned following the completion of construction works. A protocol for creek crossings on this temporary basis will be included in the CEMP.

Existing access tracks will be utilised where practicable. Where it is not practicable, on-site access roads will preferably be restricted to the proposed overhead transmission line corridor and will connect with existing tracks or public roads at the most convenient locations. Upgrading of the existing access tracks will be necessary to allow access by low-loaders to the CS and SS site and other construction plant and equipment to the remainder of the line route. A protocol will be developed as part of a CEMP, to provide guidelines for minimising environmental impacts during the location and construction of on-site access roads.

Minimal clearing will be required for the construction of overhead transmission lines. Any native vegetation removed will be dealt with in accordance with recommendations outlined in **Chapter 10** Ecology. Shrub and grass understorey species will be maintained where practicable to reduce the risk of soil erosion.

During construction, temporary lay down areas will be positioned along the proposed transmission line route to store hard equipment such as transmission poles and conductors. No fuel, oil or chemicals will be stored at these locations.

The centreline of the proposed overhead transmission line corridor will be surveyed to allow for the correct placement of transmission poles. Existing services, such as water, sewer or telecommunications, will also be identified at this time, will be clearly marked and all staff and subcontractors made aware of their location.

New transmission poles will be predominately of timber, steel or concrete construction with horizontal line posts that would be porcelain or polymer. Steel poles are typically used in areas of difficult terrain as they offer some advantages in steep or rocky areas. The transmission poles will be placed up to 300 m apart, with the final details of pole numbers, spacing and location to be determined during the detailed Project design phase.

Transmission poles will be up to 50 m in height for a double circuit 132 kV transmission line (see **Table 3.3**), with pole diameters of approximately 0.5 to 1 m depending on weight of conductors, span length and height of pole. Poles will be embedded between 2.5 and 9 m into the ground, depending on ground conditions, or alternatively concrete pad and chimney foundations of up to approximately 7 by 7 m may be used. The final height of individual poles will vary depending on the terrain and transmission pole design constraints.

The foundations for the transmission poles will be excavated where practicable using a truck mounted construction vehicle. If it is determined that larger poles and footings are necessary, larger vehicles and construction equipment will be required to access the Study area to excavate the foundations. Earthing plates will be installed within the excavated pole foundations. In instances where large diameter poles are used and the slope of the location for the pole is greater than 4 degrees, a pad approximately 4 by 7 m will be excavated for stabilisation of the bore drilling plant. Once the transmission pole is in place, the hole will be backfilled with concrete. Steel transmission poles are constructed in sections in the field, with concrete transmission poles arriving on location in one piece, delivered to the site in advance of construction. Excavated material would be respread around the transmission pole and stabilised. Vehicle access to each transmission pole would be required during construction and operation.

Conductor and earth wires are strung by initially manually feeding light training lines between poles and then using mechanical equipment to pull the connected conductors from large drums mounted on the rear of specialised vehicles. A number of spans can be strung at once depending on the location and characteristics of the intervening terrain.

Switching Station: The SS will be designed and constructed in line with TransGrid and / or Essential Energy's requirements and any other relevant technical, electrical and planning standards.

The following earthworks would occur during construction of the proposed SS:

- Cut and fill works to create a stable hardstand platform;
- Digging of trenches and footings for the SS infrastructure; and
- Construction of concrete foundations for the control / switch room building and establishment of pads for the installation of electrical infrastructure.

On-site trafficked areas would be limited to areas at the site entrance and surrounding the switch room and control building. The infrastructure compound area would be finished with coarse gravel and pebble material. The remainder of the site would be retained as grassland with landscaped planting as necessary.

Access would be via the Lachlan Valley Way onto Tangmangaroo Road, the latter being unsealed for its entire length.

3.8.6 *Operations Compounds*

One or more operations compounds will be retained for the day to day operation and maintenance of the Project. Each operations compound may include lay down areas, site operations facilities and services buildings; workshop, storage, parking and other facilities for operations staff. The operations compounds will be located within the area utilised for the construction compounds and would take up an area of approximately 75 x 75 m or 0.56 ha. The buildings of the operations compound will house office space, toilet, kitchen, communications equipment and routine maintenance stores. The operations compound buildings will comply with all relevant standards.

Signage: Traffic signage required as part of traffic safety during construction will be installed by the contractor, in compliance with relevant regulations and in accordance with any permits obtained for traffic management.

Signage will be erected at critical locations from the outset of construction, directing all vehicles associated with the construction site to the Project site office. Sightseeing traffic will be directed towards safe, prominent viewpoints where they may view the Project, but not jeopardise the safety of sightseers or impede the progress of construction. Additional signage would be located close to the Project site, providing information about the wind turbines, the companies involved in the Project and essential safety information and telephone numbers.

Negotiations with Yass Valley and Boorowa Councils, NSW RMS and other affected parties will be initiated to determine final signage locations and the works required.

3.8.7 *Commissioning*

Pre-commissioning checks will be carried out on the high voltage electrical equipment prior to connection to the TransGrid transmission network. When the Projects electrical system has been energised, the wind turbines will be commissioned and put into service.

3.8.8 *Operation*

Once operational, the Project would be monitored both by on-site staff and through remote monitoring. Aspects of the Project operation to be dealt with by on-site staff would include safety management, environmental condition monitoring, landowner management, routine servicing, malfunction rectification and site visits. Those functions to be overseen by remote monitoring include wind turbine performance assessment, wind farm reporting, remote resetting and maintenance co-ordination. Pro-active computer control systems monitor the performance of the wind turbines and ensure that any issues are dealt with by on-site staff or contractors, as appropriate.

The SS will be operated by TransGrid or Essential Energy, and therefore separate operational EMPs will be prepared for the SS.

3.8.9 *Servicing and Maintenance*

Maintenance staff are likely to be on-site throughout the year, making routine checks of the wind turbines on an ongoing basis. Major planned servicing would be carried out approximately twice a year on each wind turbine. Each major service visit would potentially involve a number of service vans (two technicians per van) on-site.

Should a problem occur with a wind turbine, then the on-site maintenance staff will attend to the machine to get it operational again. Depending on the situation, a wind turbine could be non-operational for several hours or days. Significant problems which require the replacement of major components, such as wind turbine blades, may require the use of cranes and ancillary equipment. This can result in a wind turbine being offline for several weeks whilst the appropriate equipment and materials are sourced.

Management of regrowth and existing vegetation will be necessary within the overhead transmission line corridors to reduce the threat of fire and physical damage to the transmission line, and to allow access for maintenance vehicles. This will be carried out using mechanical, manual and chemical clearing methods prior to construction activities commencing and as part of ongoing maintenance activities for the duration of the Project.

Following construction of the overhead transmission line, maintenance will most likely be limited to yearly inspections in a 4WD vehicle to check the integrity of the transmission poles and other associated infrastructure. Occasionally, access by medium and heavy vehicles may be required to repair or maintain overhead transmission line components. Access will be gained via dedicated on-site access roads within the overhead transmission line corridor.

Again, the SS will be operated by TransGrid, and therefore separate operational EMPs will be prepared for the SS.

3.8.10 *Refurbishment*

After approximately 20 to 25 years of operation (or sooner if deemed economically viable) the blades, nacelles (top section of the wind turbine) and towers could be removed and replaced. Old blades, nacelles and towers are removed from site for recycling and new components installed on existing or new foundations, as appropriate. Refurbishment would extend the life of the Project for a further 20 to 25 years.

Refurbishment would require the equivalent transportation and installation equipment and facilities used during the initial construction. Further details relating to refurbishment are outlined in **Chapter 18** General Environmental Assessment.

3.8.11 *Decommissioning*

At the end of the operational life of the Project, the wind turbines and all above ground infrastructure will be dismantled and removed from the site. This includes all the interconnection and substation infrastructure, but may exclude the SS. The tower bases would be cut back to below ploughing level or topsoil built up over the footing to achieve a similar result. The land will be returned to prior condition and use. A compressor and rock crusher may be needed to carry out the cutting work.

The on-site access roads, if not required for ongoing farming purposes or fire access, would be removed and the Project site reinstated as close as possible to its original condition and use. Access gates, if not required for farming purposes, would also be removed. Individual landowners will be involved in any discussion regarding the removal or hand-over of infrastructure on their property.

The underground transmission lines are buried below ploughing depth and contain no harmful substances. Further, removing them would involve further unnecessary vegetation disturbance. Accordingly, they would be left in the ground and only recovered if economically and environmentally viable. Terminal connections would be cut back to below ploughing levels.

All decommissioning work would be the responsibility of the Project owner and provision for this has been included in the lease arrangements agreed with the landowners. Further details relating to decommissioning are outlined in **Chapter 18** General Environmental Assessment.

3.8.12 ***Fire Management***

A fire management plan is an important part of both wind farm planning and the community consultation process. All aspects of the Project will adhere to the current guidelines on bushfire protection as outlined in **Chapter 16** Fire and Bushfire.

Despite the low risk that wind farms present, fire management is a major concern within the region, and planning for fire prevention and an effective and informed response is of paramount importance. Planning with regard to fire management not only provides wind farm proponents with assurance that minimum damage would result from a fire incident, it also reassures the landowners / local community and enables the NSW Rural Fire Service (NSW RFS) to confidently plan and execute an effective response.

Wind Farms and Bushfire Operations - Position by the Australasian Fire and Emergency Services Council (AFAC) (AFAC 2014) (see **Appendix 23**), endorsed by NSW RFS states "*Wind farms are an infrastructure development that must be considered in the preparation of Incident Action Plans for the suppression of bushfires in their vicinity. These considerations are routine and wind farms are not expected to present elevated risks to operations compared to other electrical infrastructure.”*

Appropriate fire management actions for all stages of the Project development (i.e. pre-construction, construction, operation and decommissioning) include:

- Monitor weather conditions;
- Maintain fuel reduced zones for all overhead transmission lines and a reduced fuel zone around each wind turbine to ensure adequate defendable space;
- Adherence to all regulations;
- Installation of on-site access roads at least 4 m wide and with appropriate vertical clearance and suitability for all weather conditions;
- Provision of appropriate fire-fighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions;

- Maintaining provision for mobile telephone and UHF radio communications;
- Provision of on-site identification of individual wind turbine locations and access gates for fire-fighting services, and an undertaking to provide local rural fire service groups with access to gates;
- Consideration of total fire ban days in regard to hours within which construction takes place; and
- Providing the RFS with:
- A construction works schedule;
- Maps of the final Layout and identification information for individual wind turbine sites;
- On-site access road plans and locations of access gates;
- Security information such as location of locked gates and restricted access areas;
- Location of any additional water supplies installed for construction activities; and
- Location of potential landing pads for fire-fighting aircraft or helicopters.

The RFS has been notified of the Project and further consultation will continue. Details of the Project site (such as wind turbine, on-site access road and gate locations) will be provided to assist their internal response planning. Specific fire prevention and response measures are outlined in the Project EMP (see **Appendix 19**). Furthermore, an Emergency Response Plan (ERP), as shown in **Appendix 20**, will be developed in consideration of RFS guidelines and further consultation with regional and local rural fire groups, and would include agreed notification protocols, contacts and response actions.

3.9 Summary

The Project will comprise one of two potential design layouts; one consisting of up to 122 wind turbines and the other up to 96 wind turbines and ancillary structures, spread over 15 different properties, with a maximum blade tip height of 200 m. The Project will connect into the 132 kV TransGrid transmission line running north-south approximately 2.2 km west of the Mt Buffalo Cluster.

The Proponent seeks approval for a micro-siting allowance during the detailed design phase.

The Project may be built and commissioned in stages. Construction works involve the grading and surfacing of on-site access roads and wind turbine footprints, and the installation of the Project and connection infrastructure as well as temporary works facilities. Land that is disturbed, but not part of the land-take for the life of the Project, will be reinstated.

Operation of the Project is controlled remotely, with the majority of site visits required being those of maintenance staff. Prior to or at the end of the term of the Project the facility may either be refurbished or decommissioned. Decommissioning will involve the removal of all above-ground infrastructure (excluding access roads, fencing and gates required for the ongoing agricultural use of the land) and the reinstatement of the ground to as near as practicable to its pre-construction condition.

CHAPTER 4

Project Justification

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4. PROJECT JUSTIFICATION

There has been growing global recognition of the need to mitigate the environmental effects associated with fossil fuel energy generation. Such thoughts have manifested into international, national and state-wide commitments supporting the development of clean and sustainable energy projects. Bango Wind Farm (the Project) will play an important role in contributing to both the increasing local and global need for such renewable projects and in tackling the issues of Global Warming and Climate Change.

4.1 Greenhouse Gas Emissions and Climate Change Science

There are naturally occurring greenhouse gases, including water vapour, carbon dioxide, nitrous oxide, methane and ozone in the atmosphere, which reflect and absorb heat from the Earth's surface. These natural greenhouse gases, in particular carbon dioxide, nitrous oxide and methane, in addition to human introduced gases such as halocarbons, chlorine- and bromine- containing substances and sulphur hexafluoride, are increasing in concentration and causing a rise in the normal levels of absorption, leading to the threat of elevated global temperatures.

The consensus of scientific opinion as presented to world governments by the International Panel on Climate Change (IPCC) is that there is a link between humankind's actions and a variety of climate-related issues. Industrialisation and the resultant emissions of greenhouse gases from the burning of fossil fuels have created, and continue to exacerbate, a global environmental problem – Climate Change.

Fossil fuel consumption and industrial processes are the primary drivers behind the rate of carbon dioxide equivalent emissions, which contributed approximately 78 % of the total greenhouse gas emissions increase from 1970 to 2010 (IPCC 2013). Central to this is a heavy reliance on coal for low-cost electricity production, which is also recognised as having the highest output of carbon dioxide equivalent emissions (Garnaut 2008).

Continued and unrestricted emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change will require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks (IPCC 2013). The IPCC notes that there are multiple mitigation pathways that are likely to limit warming to below 2°C relative to pre-industrial levels. These pathways require substantial emissions reductions over the next few decades and near zero emissions of carbon dioxide and other long-lived greenhouse gases by the end of the century (IPCC 2013).

4.2 Global Response

The IPCC, established by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP), was set up in 1988 to provide a comprehensive forum in the fundamental understanding of linkages between greenhouse gas emissions and climate change.

The international consensus was summarised in the Geneva Ministerial Declaration, July 1996. This Conference of the Parties (COP2), addressing the United Nations Framework Convention on Climate Change (UNFCCC), concluded that there was a need for action from all tiers of government to avert the deleterious effects of climate change. This resulted in most participating countries agreeing to encourage renewable energy generation projects through sustainable development initiatives, in addition to complementary actions to develop energy conservation and efficiency measures.

In 1997, the Kyoto Protocol was established, which called for industrialised countries to reduce their collective emissions of greenhouse gases by 5.2 % below 1990 levels over the five year period 2008-2012. The year 2004 saw the Kyoto Protocol made legally binding in the European Union (EU) and ratified by the Russian government. This allowed for the Kyoto Protocol to establish the first binding international commitments to limit greenhouse gas emissions and an international emissions trading system to promote cost-effective reductions in 2005.

In 2007, the Australian government ratified the Kyoto Protocol and signed up to cut greenhouse gas emissions to 108 % of the levels they were in 1990. This was a watershed decision and an important step in determining Australia's position on climate change in the global arena.

The Copenhagen Accord, drafted by the United States, China, India, South Africa and Brazil, was recognised by delegates at the 15th session of the Conference of Parties to the UNFCCC in December 2009. Although countries representing over 80 % of global emissions have engaged with the Accord, unlike the Kyoto Protocol, the Accord is not legally binding and sets no real targets to achieve in emissions reductions. Rather, under the Accord, countries submit pledges for emissions reductions based upon varying baselines, the eventual legal character of which are the subject of current UNFCCC negotiations, including whether they will be binding under international law (Department of Climate Change and Energy Efficiency (DCCEE) 2012a).

The first commitment period for the Kyoto Protocol ended in 2012, however an amendment to extend the Protocol until 2020 was adopted at talks in Doha, Qatar, in December 2012. Known as the Doha Amendment, Australia agreed to reduce emissions to 98 % of levels they were in 2000 over the eight year period 2013 – 2020 under this extension of the Kyoto Protocol (UNFCCC 2012). At present, the Protocol locks in only developed nations, excluding major developing polluters such as China and India, as well as the United States which refuses to ratify it. Nevertheless, the Doha talks cleared the way for the Kyoto Protocol to be replaced by a new treaty binding all developed / developing nations together by 2015 to tackle Climate Change.

4.3 Australian Greenhouse Gas Emissions and Response

Australia is the highest emitter of greenhouse gas emissions in the world at 27.3 tonnes of carbon dioxide equivalent per capita (DCCEE 2012e). The stationary energy sector (electricity generation and direct combustion) has historically been the fastest growing emitter, with a 49 % increase in emissions since 1990 (DCCEE 2012b). Collectively, New South Wales (NSW), Queensland and Victoria account for over 80 % of energy supply greenhouse gas emissions throughout Australia (Department of Climate Change (DCC) 2009).

In 2011, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology (BoM) published *Climate Change: Science and Solutions for Australia*. Based on international climate change research the *Climate Change: Science and Solutions for Australia* report provides the most up-to-date assessment of observed Australian climate changes and causes, and projections for 2030 to 2070. Key projections include:

- Annual temperature increases of approximately 1.0 °C by 2030, with warming as much as 1.2 °C for some inland regions;
- Predicted warming by 2050 ranging from around 0.8 to 1.8 °C for the low assumed emission scenario, and 2.2 to 5.0 °C for the highest assumed emission scenario by 2070;
- Likely to be less rainfall in southern areas of Australia, especially in winter, and in southern and eastern areas in spring. It is also likely that the most intense rainfall events in most locations will become more extreme, driven by a warmer, wetter atmosphere;
- Global seal level rise is currently being observed at 3.2 mm per year and it is projected to be 20 to 60 cm above 1900 levels by 2100, with the possible addition from melted ice sheets of 10 to 20 cm; and
- Storm surges occurring in conditions of higher mean sea levels will enable inundation and damaging waves to penetrate further inland increasing flooding, erosion and the subsequent impacts on built infrastructure and natural ecosystems.

To combat these recorded and potential impacts, the Australian government and other agencies and participants in the climate change and energy sectors have come up with a number of responses in the form of Acts and policies, funds, programs and schemes. Details are provided below.

Emissions Reduction Fund: In July 2014, the Department of the Environment (DoE) established an Emissions Reduction Fund designed to help achieve Australia's 2020 emissions reduction target of five percent below 2000 levels by 2020. The fund will operate alongside exiting programmes working to reduce Australia's emissions growth such as the Renewable Energy Target and energy efficiency standards.

Renewable Energy Target: The Renewable Energy Target (RET) legislation was passed by Federal Parliament in August 2009, providing an expansion on the Mandatory Renewable Energy Target (MRET), aiming to acquire 45,000 GWh of Australia's electricity from renewable sources by 2020. January 2011 saw the RET separated into the Large-scale Renewable Energy Target (LRET) of 41,000 GWh and the Small-scale Renewable Energy Scheme (SRES) of 4,000 GWh. In July 2015 Federal Parliament passed legislation to reduce the LRET to 33,000 GWh by 2020.

GreenPower: A joint initiative of the Australian Capital Territory, NSW, South Australian, Queensland, and Victorian governments, GreenPower was established in 1997 to accredit and audit renewable energy retail products. As of the fourth quarter 2014, 490,000 residential and commercial electricity customers in Australia now purchase accredited renewable energy through the program.

4.4 Need for Renewable Energy Generation in New South Wales

In September 2013, the NSW Government released their *Renewable Energy Action Plan* (REAP) outlining opportunities and actions underway for each of the renewable technologies in NSW. According to the REAP, wind energy will remain the most economical form of large scale renewable energy over the next decade, acknowledging that NSW has excellent wind resources by international standards.

Under the LRET, investors are seeking to utilise this wind resource as the demand for LGCs increases. Compared to other states, NSW has a relatively unexploited wind resource, a large electricity market and an available transmission capacity, which makes it very suitable to accommodate wind power technology.

4.5 Suitability of Wind Power

4.5.1 *Evolution of Wind Technology*

The ability to harness wind power has evolved from research in the 1980s, expansion and consolidation in the 1990s, to a competitive, mature and mainstream energy supply technology in the current market. At the end of 2014, the total international capacity of wind energy was 369,597 MW, with global wind power capacity increasing by 16 % in 2014 (**Figure 4.1**). It is predicted that by 2020 wind power will be supplying 8 % of the global demand for electricity (IEA demand projection – Moderate Scenario, GWEC 2014).

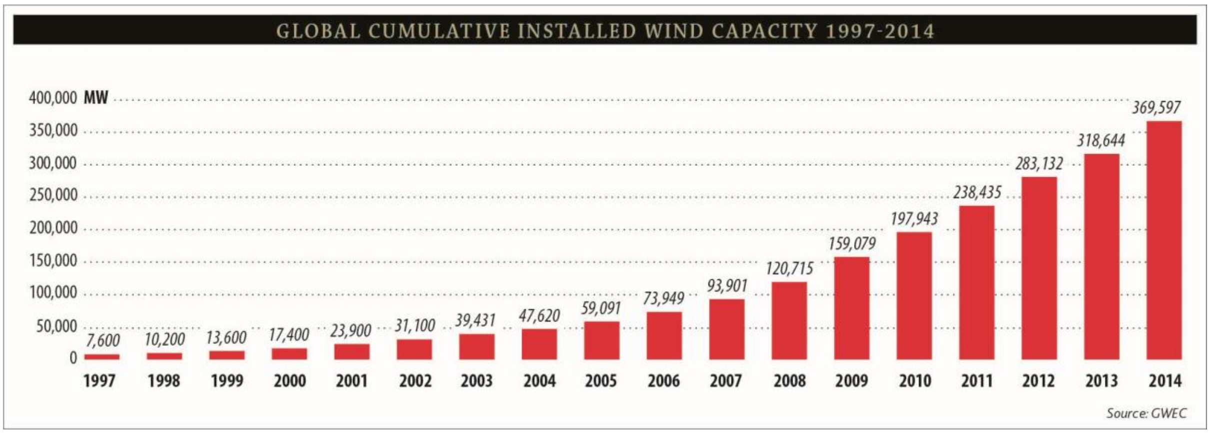


Figure 4.1 Global cumulative installed wind capacity 1996 – 2014

Source: Global Wind Energy Council (GWEC)

One of the advantages of wind technology is its high energy return on the energy invested. As illustrated in **Figure 4.2**, wind technology both on and offshore has a high energy return on energy invested compared to existing conventional energy sources, such as coal, and other renewable technologies. Due to high energy return from wind energy, the requirement to harness the wind more effectively has helped to drive the evolution of wind technology.

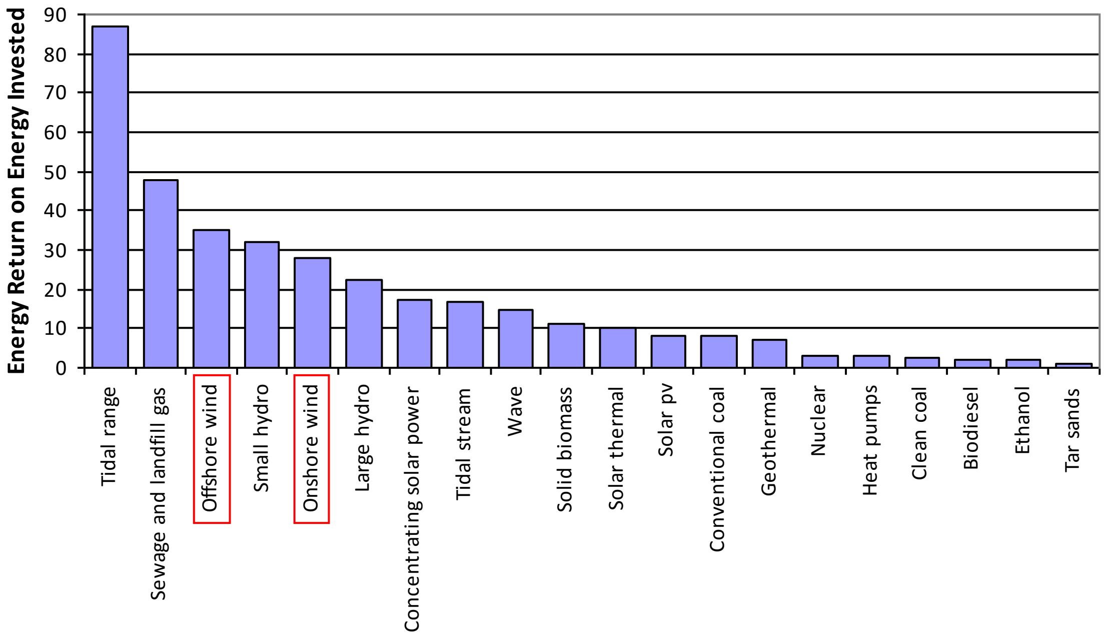


Figure 4.2 Energy return on energy invested – a comparison of power generation technologies

Source: Hughes and Anslow 2007

Wind energy is also well positioned to meet future targets and provide 8 % of the global demand for electricity by 2020, as it possesses one of the lowest production costs, uses no water during electricity production and is a mature technology acceptable to energy utilities in comparison to other renewable energy sources as seen in **Table 4.1**.

Table 4.1 Mainstream renewable energy available in the LRET

Generation Source	Technical Maturity	Water Use (L/MWh)	Cost ($/MWh)
Hydro	Mature	high	27-282
Wind	Mature	nil	75-90
Solid biomass	Research	2000 (wet) / 700 (dry)	47-120
Solar thermal	Emerging	2000 (wet) / 150 (dry)	120-150
Solar PV	Various	nil	111-162
Geothermal	Research	high	large range

Sources: Garnaut 2008; Owen 2009; Epuron 2008

4.5.2 *Community Support*

The Regional Clean Energy Program: There are six Renewable Energy Precincts in NSW: the North East, Hunter and Central Coast, Greater Sydney, North West, South East, and South West. The Regional Clean Energy Program is a community partnership initiative, designed to give local communities a stake in renewable energy development. Resources that have been created to assist the Regional Clean Energy Program include:

- Community Attitudes to Wind Farm in NSW (AMR Interactive 2010);
- Clean Energy Jobs in Regional NSW: (The Climate Institute 2015);
- The Wind Energy Fact Sheet (DECCW 2010);

- Estimating Greenhouse Gas Abatement from Wind Farms in NSW (McLennan Magasanik Associates 2010);
- NSW Wind Farm Greenhouse Gas Savings Tool (OEH 2012); and
- Preliminary Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia. (NSW Department of Lands 2009).

Community Attitudes to Wind Farms in NSW: DECCW commissioned AMR Interactive (2010), a specialist research organisation, to undertake telephone interviews to study the attitude of communities to wind farms and renewable energy across the six renewable energy precincts over May and June 2010. A total of 2,022 residences and 300 businesses were interviewed with the following key results:

- Familiarity with wind power found 59 % spontaneously named wind power as a clean energy source, with 81 % of residents regarding wind power as an acceptable source for power generation when asked specifically. 68 % of residents knew about wind farms currently operating in NSW, however only 28 % knew of planned or under construction wind farms;
- Perceptions about wind power and its benefits and impacts found 32 % of residents believed wind farms would contribute to an increase in tourism, 69 % of residents did not perceive any health concerns, and 62 % did not perceive a negative impact on the environment;
- Level of support for wind farms found 85 % of residents supported wind farms being built in NSW with 80 % supporting wind farms in their local region. 79 % supported wind farms being built 10 km from their residence and 60 % at 1 to 2 km. 68 % of the residents which opposed a wind farm at 1 to 2 km saw an overall benefit for wind farms to the local region;
- Key drivers for support of a wind farm at 1 to 2 km included benefits to the local community and economic benefits. Key drivers for opposition of a wind farm at 1 to 2 km included perceived visual and noise impacts, concerns about health, safety and heritage values and perceptions of wind power relating to clean energy and its potential in NSW; and
- 61 % of non-farming businesses in the Renewable Energy Precincts believed there would be no impact from a wind farm and 30 % anticipated positive effects on their businesses. Farming businesses were more likely to spontaneously express concern about the location of a wind farm; nevertheless, 57 % would consider a wind farm on their property.

National Telephone Survey: The Australian Wind Energy Association (now known as the Clean Energy Council) commissioned the Australian Research Group Pty Ltd (ARG) to conduct a telephone survey on renewable energy, in particular wind farms in August 2003 (ARG 2003). A total of 1,027 participants were surveyed with the following results:

- 94 % thought that a target to increase the contribution of clean energy from renewable resources was a good (32 %) or very good idea (62 %). Less than 3 % considered the current target to be too high or much too high;
- A substantial majority (76 %) said that they were prepared to pay 5 % more on electricity bills for 10 % more clean energy when faced with the option of having cheap electricity at any cost;
- 88 % said they wanted the government to increase support to the renewable energy sector, compared to 26 % wanting an increase in support for the fossil fuel sector;
- For 71 %, reducing greenhouse pollution outweighed protecting industries that rely on reserves of fossil fuel; and

- 95 % supported (27 %) or strongly supported (68 %) building wind farms to meet Australia's rapidly increasing demand for electricity and 91 % agreed it was more important to build wind farms for electricity than avoid building them in rural Australia.

The survey indicated that the majority of respondents supported clean energy from renewable resources, even with a potential increase in price. It also highlighted that the general consensus is that it is more important to reduce greenhouse pollution rather than support the fossil fuel sector, and instead place wind farms in rural areas.

NSW Southern Tablelands Survey: Wind farm developer Epuron Pty Ltd commissioned REARK Research to conduct a random phone survey on 300 residents in the Goulburn, Crookwell and Yass region to determine community perception of wind farm developments in the Southern Tablelands, July 2007 (ERM 2008). The survey concluded that:

- 80 % were concerned right now with the threat of global warming and its impact on the environment, while 16 % were unconcerned;
- 89 % were in favour of wind farm projects being developed in the Southern Tablelands, while 5 % were opposed;
- 71 % accept a wind farm within 1 km of their home and 83 % accept a wind farm within 10km; and
- 9 in 10 have seen a wind turbine and more than 8 in 10 have seen the Crookwell Wind Farm.

The survey indicated that the majority of respondents were concerned about global warming and have had the opportunity to view wind turbines, such as the wind farm at Crookwell. As a result the majority of respondents were willing to have a wind farm within 1 km of their residence.

CSIRO report 2012: CSIRO Science into Society Group released a report in 2012 detailing research into nine wind projects representing states with the greatest wind resources (including NSW), and wind projects at various stages of development (operational, under construction, proposed and rejected) (Hall et al. 2012). The report found that there is strong community support for wind farms, including from rural residents who do not necessarily publicly express their views. However, against this background, the CSIRO also performed a review of media coverage of wind farms. Their review found more citations rejecting wind farms (32 reasons) than supporting wind farms (19 reasons); a finding that suggests a media bias which does not correlate with the general public's view (Hall et al. 2012). The existing planning process and regulatory approach was found to be an appropriate mechanism for development approval, however, this could be improved by a stronger framework for community engagement.

4.5.3 *"Taralga Wind Farm" Judgement*

The 2007 Land and Environment Court hearing of the Taralga Landscape Guardians Inc. v Minister for Planning and RES Southern Cross Pty Ltd reviewed a number of key issues relating to wind farms in rural NSW. In particular, issues relating to visual impacts on the landscape from surrounding residences and the village of Taralga were scrutinised.

The judgement stated that wind turbines were acceptable in the landscape at Taralga, and set out steps for determining how many wind turbines would be acceptable. Based on the economic viability, visual impact on the village and the broader public interest, it was decided that the original design of 69 wind turbines of the Taralga Wind Farm was acceptable. As for any residential visual or other associated impacts with the Taralga project, it was decided that any suggested mitigation measures need to be settled by RES Southern Cross Pty Ltd and the potentially affected residence.

By comparison, the LVIA has determined that the Project would have an overall medium visual significance on the majority of non-involved and involved residences within the projects 10 km viewshed. The Project would have a slightly lower visual significance on views from surrounding road corridors and public spaces. However, there have been concerns raised by individual property holders on potential visual impacts as discussed in **Chapter 6** Stakeholder Consultation and, similar to the Taralga judgement, any mitigation measures will be discussed between the Proponent and any affected landowners.

4.5.4 *Interaction with the Electricity Network*

The National Electricity Market (NEM) commenced in 2008 to provide a single marketplace for the wholesale trading of electricity across all Australian states and territories, with the exception of Western Australia and the Northern Territory. On 1st July 2009, the Australian Energy Market Operator (AEMO) adopted the role of the market and system operator of the NEM, and manages the supply and demand of the electricity market by ensuring power generation is available at each instant in time to meet the required consumption. The NEM is supported by baseload power stations, generally coal, to provide 100 % capacity 100 % of the time. However, this is not always possible due to maintenance and intermittent failures of coal fired power stations which, in NSW, result in on average 28 days of planned maintenance per annum (Power System Planning and Development (PSPD) 2009). This requires AEMO to source power from multiple energy generators to provide a secure baseload.

Despite common misconceptions that wind farms are inefficient and unreliable, they are in fact an efficient and reliable energy supplier in the NEM and can support baseload in the market. This is due to the fact that (PSPD 2009):

- Both wind farms and modern coal fired power stations are efficient, in the order of 35 - 45 %;
- The NEM is strong enough to cope with the output fluctuations of a wind farm;
- Wind turbines are reliable, with an availability of greater than 97 % which means that wind farms are able to operate for the majority of the year;
- Wind farms are in fact similar to hydro power and coal fired generators, which also do not operate at 100 % capacity 100 % of the time;
- Wind is a free energy source and therefore mitigates risks to the existing electricity supply infrastructure from acts of terrorism and price risks from fossil fuels which are tied strongly to the international market; and
- Existing wind farms in NSW and elsewhere in Australia are demonstrating that wind energy production is clean, reliable and cost effective in meeting current market energy demands.

It is likely the Project will not result in the direct closure of any baseload or coal fired power stations, instead wind energy will become an increasing and important part of the energy mix as Australia transitions into a carbon constrained economy.

4.5.5 *Finite Resource Market*

As previously mentioned in **Section 4.4**, the dominant fuel consumption in Australia is fossil fuel combustion, through the long term usage of oil, natural gas and coal. Post-2000 fossil fuel prices have reached record highs compared to the price of coal in the 1970s and oil in the 1980s. Therefore, not only are these forms of energy emitting large concentrations of carbon dioxide, they are prone to substantial price swings and can result in additional costs of protecting customers from the volatility of fuel prices. New, renewable energy technologies are required to extend the limited amount of oil and natural gas reserves and to help minimise the impact of mining in remote and sensitive areas. A continued annual increase in market share combined with increasing support from international communities and decreasing component costs, make wind power one such technology that can assist in reducing dependence on fossil fuels.

4.5.6 *Life Cycle Assessment*

Wind turbines require energy to be spent during the manufacturing stage of component production (blades, towers, generators, etc) and therefore a certain amount of carbon dioxide equivalents will be produced as a result. In comparison to other forms of energy, such as coal and nuclear, onshore wind farms have relatively low carbon intensities, as seen in **Figure 4.3**.

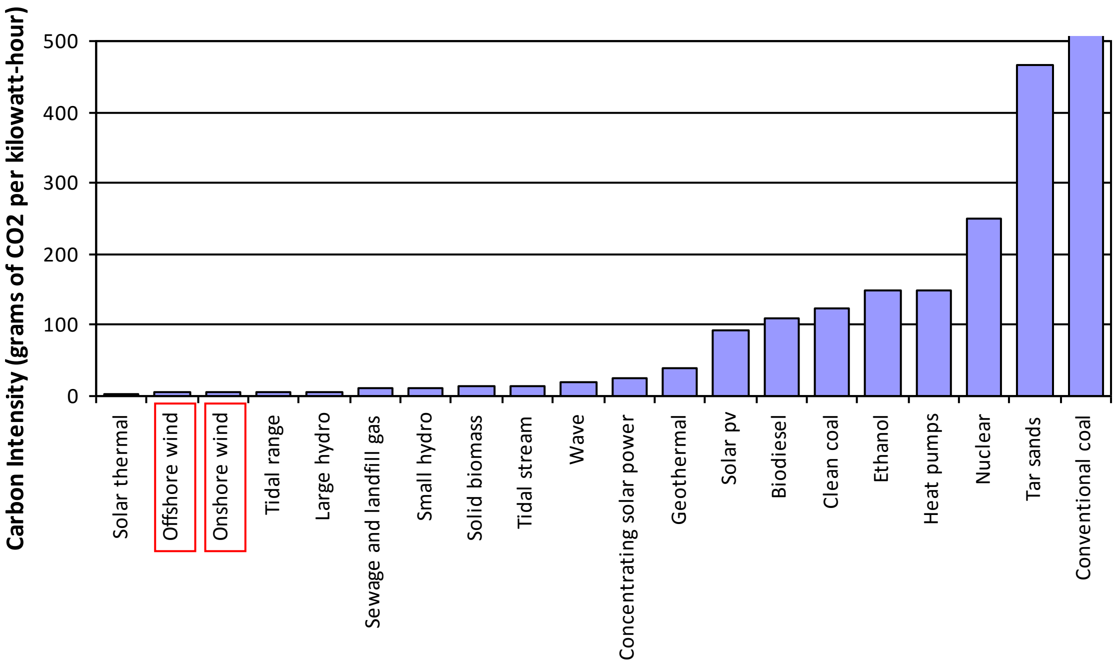
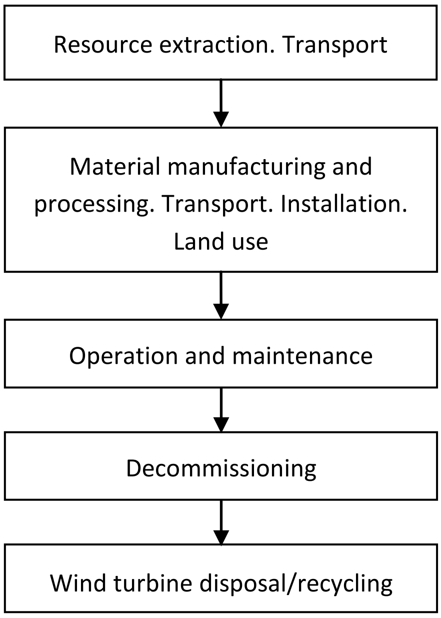


Figure 4.3 Typical industrial carbon footprints

Source: Hughes and Anslow 2007

To further analyse the carbon footprint of a wind turbine a Life Cycle Assessment (LCA) can be undertaken which identifies areas in the manufacturing and construction of the wind turbine where carbon dioxide emissions can be reduced. The main steps of the LCA for a wind turbine are displayed in **Figure 4.4**.



Note: 10 % loss in material when recycling occurs at the wind turbine disposal stage

Source: Adapted from Martinez et al. 2009

Figure 4.4 Life Cycle Assessment model of a wind turbine

In general, the time for a wind turbine to repay the energy used in construction ranges from five to eight months (Martinez et al. 2009; Tremeac and Meunier 2009; Elsam 2004; DECCW 2008). Of the processes involved, manufacturing has the largest impact in producing carbon emissions. However, energy consumed during manufacture is balanced by energy saved by the recycling of components following decommissioning (Martinez et al. 2009; Tremeac and Meunier 2009).

4.6 Contribution of Bango Wind Farm

4.6.1 ***Land Suitability***

The Project is consistent with the *State Environmental Planning Policy 15 – Rural Landsharing Communities (SEPP 15)* as it is a development which can occur in unison with the continuing use of the land for rural purposes.

Although the Project temporarily reduces the land available for agriculture during construction, the long term use of the land for agricultural purposes will not be compromised during operation of the Project. The land within the Project Site is not deemed to be of high agricultural value, and thus the impact to affected landowners will be minimal. In addition, the potential diversity of income gained by landowners would assist in ensuring traditional rural communities can remain on the land and continue managing their properties during times of drought or other hardship. In response to the *Draft NSW Planning Guidelines: Wind Farms* (DP&E 2011), NSW Primary Industries (DPI) provided a submission regarding the siting of wind farms in regional areas and consultation with the Agriculture NSW Division. In their submission, DPI clarifies that the Agriculture NSW Division recognises that wind farms comfortably co-exist with agriculture; they therefore do not require consultation for this type of development (DPI 2012).

The Project is currently subject to two Local Environmental Plans (LEPs); the Boorowa LEP 2012 and the Yass Valley LEP 2013. The Project Site and adjacent land is zoned as RU1 Primary Production for agricultural purposes. Other than minor disruption during construction, the Project would not significantly affect the strategic land use objectives of agricultural farming. Only a very small percentage (1-2 %) of land would be lost to the Project.

One of the functions of LEPs is to identify minimum lot sizes for subdivisions. Under the Boorowa LEP, lots resulting from subdivisions must be a minimum size of 40 ha (Clause 2.6[2]). Under the Yass Valley LEP, lots resulting from subdivisions must be a minimum size of 80 ha (Clause 4.1[3]). No pending or approved subdivisions by non-involved landowners in the vicinity of the Project were identified through discussions with Boorowa Council and Yass Valley Council. However, there are a number of lots owned by non-involved Landowners surrounding the Project area that could potentially be subdivided. Potential impacts were assessed with respect to these lots, including noise and visual assessment in **Chapter 8** Landscape and Visual and **Chapter 9** Noise.

Visual and noise impacts were also assessed with respect to current and future dwelling entitlements (DE) on lots surrounding the Project in **Chapter 8** Landscape and Visual and **Chapter 9** Noise. Yass Valley Council and Boorowa Council have advised that they do not maintain a register of land that could be approved for a DE, with approval being established through a development application process. As such, the Proponent identified lots in the vicinity of the Project that have DEs or could potentially have DEs in the future (see **Figure 4.5**).

Having DE rights does not mean that a dwelling will be constructed on the land. Future impacts to neighbouring lots have therefore been considered in this light and mitigation measures have been discussed between the Proponent and any affected landowners where a DE is known to be actively progressed. Two approved Development Applications have been identified within the vicinity of the Project, and impacts at these locations have been assessed within this EIS.

There are two Nature Reserves and one Water Supply Reserve in a 30 km radius of the Project (**Table 4.2** and **Figure 4.6**).

Table 4.2 Reserves within a 30 km radius of the Project

Reserve Type	Reserve Name and Location in Relation to the Project
Nature Reserve	Young (north-west) Mundoonen (south-east)
Water Supply Reserve	Name not specified (south)

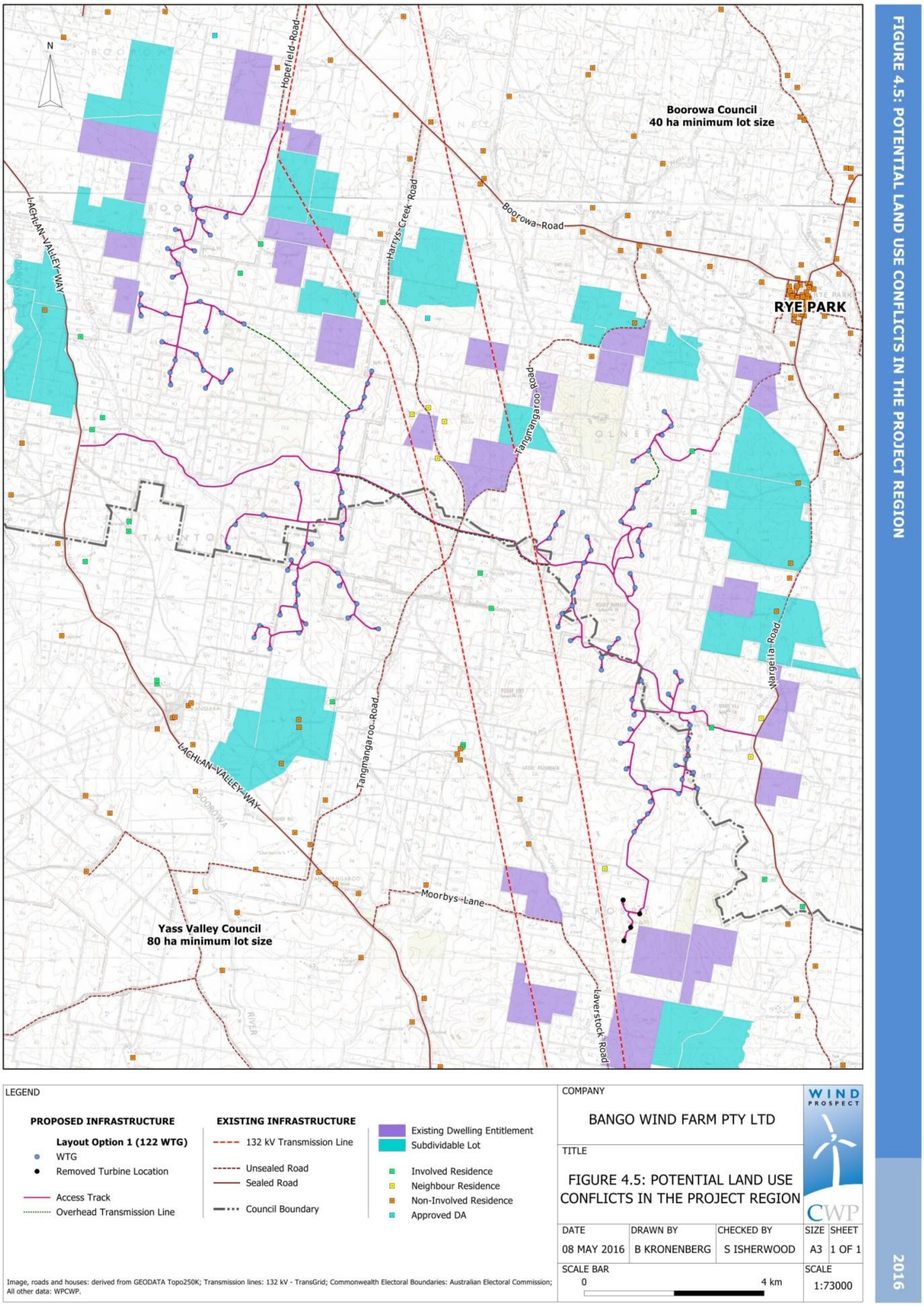


Figure 4.5 Potential land use conflicts in the Project region

(An A3 size version of this Figure is displayed in Volume 2)

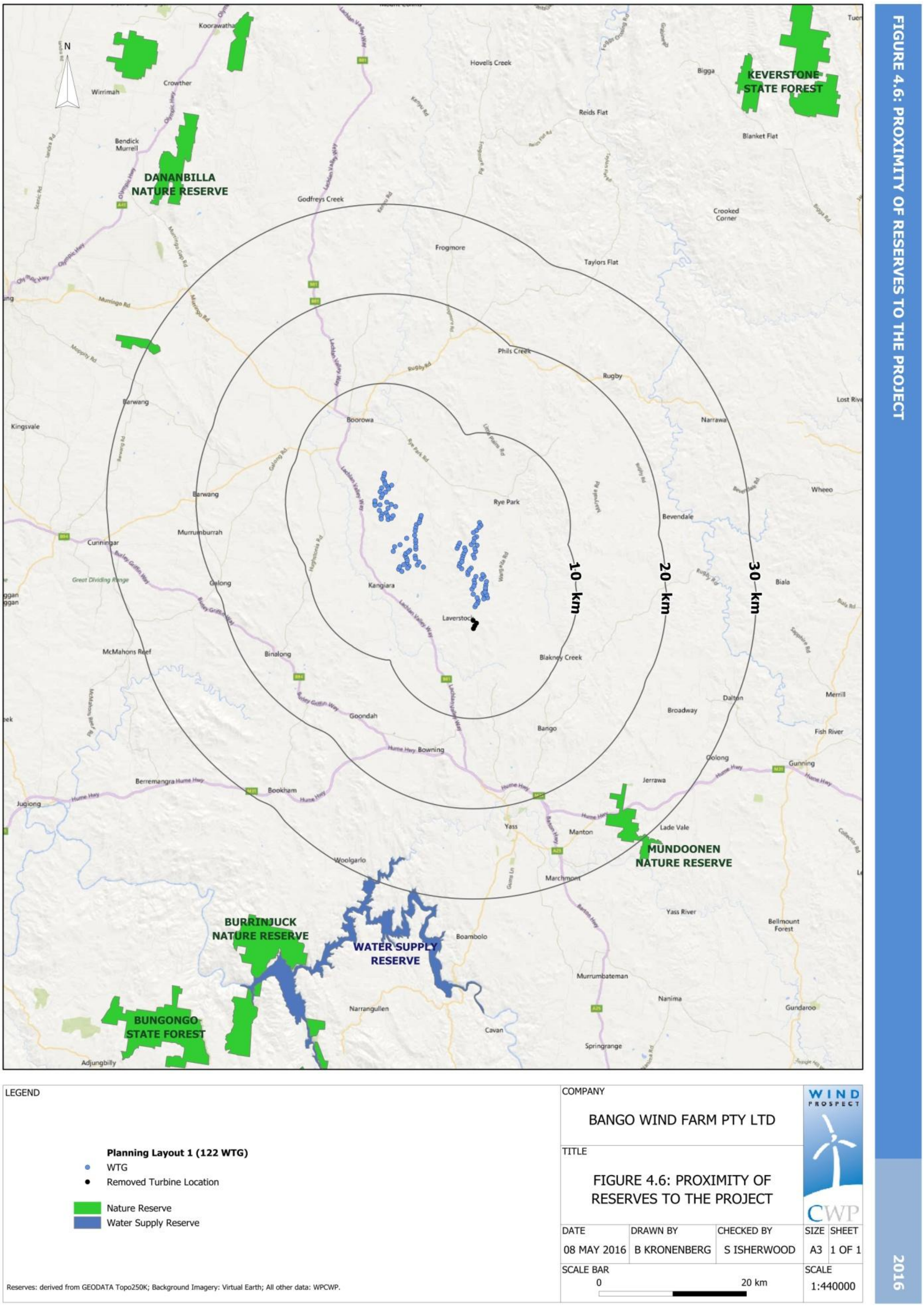


Figure 4.6 Proximity of reserves to the Project

(An A3 size version of this Figure is displayed in Volume 2)

The water supply reserve to the south of the Project forms part of a discontinuous linkage south to the Australian Alps national parks including Kosciuszko and Namadgi National Parks. Gazetted in 1944, Kosciuszko National Park is the largest national park in NSW and one of the most complex conservation reserves in Australia (DEC 2006). The Park contains the highest mountains on the Australian continent, unique glacial landscapes, unusual assemblages of plants and animals, a number of which are found nowhere else and extensive tracts of forest and woodland (DEC 2006). Namadgi National Park was gazetted in 1984 and is the largest conservation reserve in the ACT, covering 46 % of the territory. The park contains the water storages of the Cotter Catchment, and a diversity of habitats, flora and fauna, and aboriginal and European heritage sites (DTaMS 2010).

Numerous vegetation types occur within the Park, ranging from dense mountain gum forests in the high north of the Park to the lower and more open forests of scribbly gum and stringybark in the south. There are four campsites and numerous four-wheel drive tracks and bushwalking tracks. All Nature Reserves are managed to control widespread invasive flora and fauna species. Due to distance, vegetation and topography, it is unlikely the Project would be visible from walking tracks or picnic areas within either of the reserves.

The Project site overlaps with one current mineral exploration licence and one current mineral exploration licence application (see **Table 4.3**). It is unlikely that the placement of wind turbines within or adjacent to mining operations (should mining be economical, environmentally acceptable and approved) would result in conflict, based on the type of mining activity (elemental minerals) currently being investigated. Wind farms currently co-exist with mining areas in NSW, including the approved Woodlawn Wind Farm, adjacent to Veolia’s Woodlawn Bioreactor near Tarago, NSW (a disused open cut mineral mine). Ochre Resources Pty Ltd have been contacted about the Project; see **Chapter 19** Socio-Economic Assessment for more detail.

Table 4.3 Exploration and Mining Licences overlapping the Project site

Company	Title(s)	Status
Ochre Resources Pty Ltd	EL8313	Expiry: 14th October 2017
Ochre Resources Pty Ltd	ELA5167	Application Date: 10th April 2015

4.6.2 *Layout and alternatives*

A range of factors are considered during the ‘site selection’ phase, which affect the suitability of an area for a wind farm, and which can potentially shape a development. These include:

- Suitable wind resource;
- Ease of connecting to and capacity of the local electricity transmission network;
- Site access and general ground conditions, including slope and geology;
- Proximity to residential properties and the nature of surrounding land uses;
- Availability of wind turbine sites based on a range of constraints;
- Presence (or absence) of nationally and locally significant areas with regard to environment, landscape, nature conservation, archaeology and cultural heritage; and
- Interest within the community and local socio-economic impacts.

Wind Resource: Numerous investigations into the wind resource potential at several locations across NSW have revealed some general principles which can be applied to assess the merit of an individual site's wind resource. Wind speeds are likely to be adequate in areas that are:

- Exposed to open water or large areas of open grassland without intervening obstructions. These areas receive a very smooth airflow with a high-energy content; and
- On significantly elevated locations, surrounded by a smooth and gently rounded landscape, thus promoting wind speed-up. The ranges that make up the Project area offer excellent speed-up due to topographical detail, with elevated hills in the east and exposed, open agricultural plains in the west of the Project site.

The Proponent has installed wind monitoring equipment to record on-site wind data which, when modelled with long term BoM data from local area, shows wind speeds that are high and consistent making the Project viable in the selected location.

Land Use: The Project is located in an agricultural area with low surrounding population density. Wind turbines are placed further from non-associated landowners than associated landowners, in order to minimise impacts, as discussed in **Chapter 6** Stakeholder Consultation, **Chapter 8** Landscape and Visual and **Chapter 9** Noise.

Electricity Transmission Network: Ease of connection to and capacity within the grid can be difficult to assess, given the commercially confidential nature of certain information concerning the electricity distribution and transmission networks, coupled with the complexity and variety of connection options that may be available. However, on a broad scale, areas remote from high voltage overhead transmission lines or from existing population centres are unlikely to offer many feasible opportunities for grid connection. Together with grid connection factors, actual grid capacity and the ability for the electricity grid to absorb wind generated electricity seem to be the principal limiting factors for wind farm development in NSW.

The high voltage transmission network that the Project will connect into is the TransGrid 132 kV single circuit overhead transmission line running north-south through the centre of the Project. The capacity of this line was determined during the feasibility stage of development. Should the line capacity not be sufficient, options are available to upgrade the transmission line to remove constraints. A single or double circuit 33 kV to 132 kV external transmission line will be constructed for energy export to the grid. The exact voltage required will depend on the wind turbine chosen and any staging considerations.

Site Access and Condition: There is good road access to the Project site as discussed in **Chapter 12** Traffic and Transport. Several sealed minor roads and numerous unsealed, graded minor roads intersect the Project site. These roads connect to sealed secondary roads, with access to State and Federal Highways.

Community Interest and local socio-economic impacts: Landowner interests are also important in determining the location of wind turbines, as a wind farm cannot be placed on land where the landowners do not consent to the project. Neighbouring landowners are not always receptive to the placement of wind turbines and appropriate consultation was carried out during the assessment of this Project, as discussed in **Chapter 6** Stakeholder Consultation. In response to neighbouring landowner concerns, the Proponent has made a number of modifications to the Project. These modifications seek to respond by reducing the visual and noise impacts at nearby properties whilst maintaining the positive outcomes of the development (see **Chapter 6** Stakeholder Consultation). Wind farms typically have an overall positive impact on the socio-economic situation of surrounding communities. The Project will provide local construction and operational jobs and local business stimulus through construction and operation. A community fund will be established to provide annual funding to support local projects and initiatives. The fund is intended to build strong relations between the community and the Project and also to offset any residual impacts (see **Chapter 19** Socio-economic Assessment).

4.6.3 ***Scale***

In 2001, five wind farms were operational in NSW, each consisting of 1 to 15 wind turbines and each with a capacity up to 10 MW (TSEDA NSW 2002). Recently, larger wind farm projects have been proposed, approved and constructed as listed in **Table 4.4**. This increase in size is a response to the LRET and the target emission reductions for NSW, as discussed in **Chapter 5** Planning Context. Therefore the Project, with up to 122 wind turbines, is comparable in scale to more recently proposed wind farms and is of a suitable size to contribute to Australia’s target of emissions reductions.

Table 4.4 NSW Wind Farms

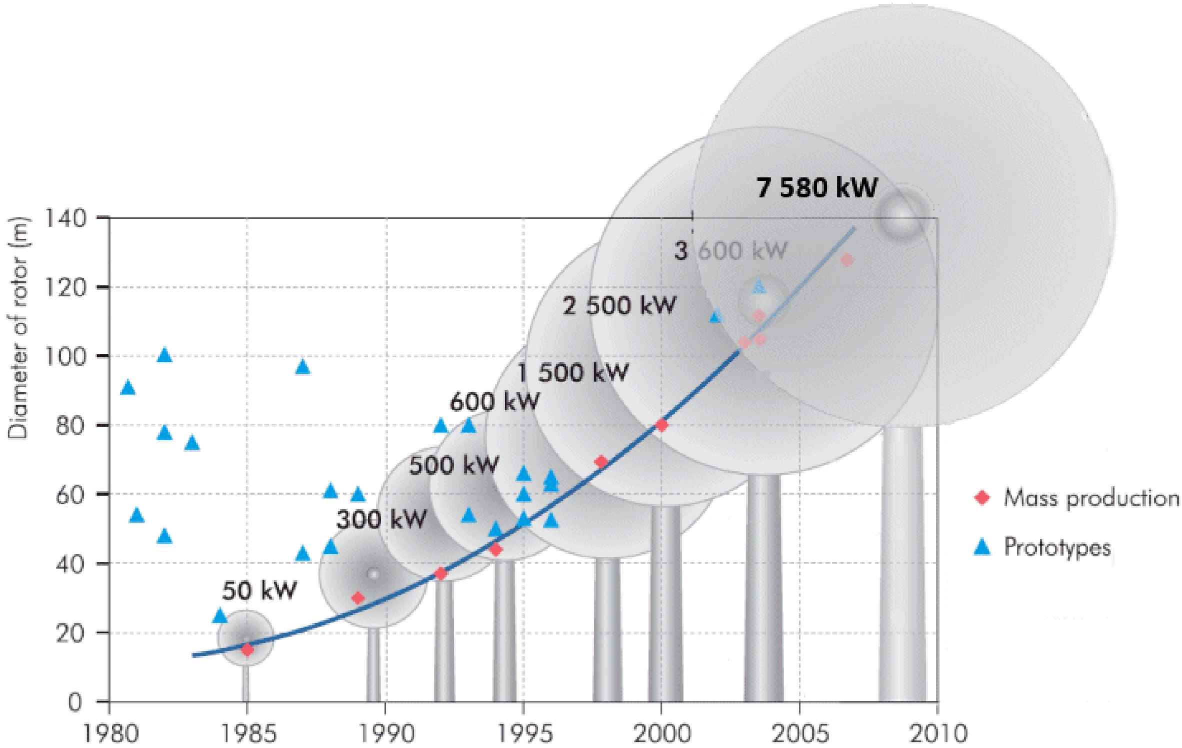
Wind Farm	State of Development	Number of Wind Turbines
Capital 1	Operating	67
Cullerin	Operating	15
Crookwell	Operating	8
Blayney	Operating	15
Gullen Range	Operating	73
Woodlawn	Operating	23
Boco Rock	Operating	67
Taralga	Operating	51
Conroy's Gap	Approved	15
Black Springs	Approved	9
Silverton	Approved	282
Crookwell 2	Approved	46
Glen Innes	Approved	27
White Rock	Under Construction	119
Kyoto Energy Park	Approved	42
Capital 2	Approved	41
Sapphire	Approved. Modification under assessment.	109
Flyers Creek	Approved	42
Collector	Approved	55
Bodangora	Approved	33
Crudine Ridge	Approved	77
Crookwell 3	Recommended for Approval	28
Yass Valley	Approved	79
Paling Yards	Under Assessment	55
Rye Park	Under Assessment	109
Liverpool Range	Under Assessment	288
Uungula	Under Assessment	249
Adjungbilly	Lapsed Application	26
Golspie	Lapsed Application	100

Source: DP&E (2015), Major Project Register, Accessed 6/5/2015

Generally, having a larger scale wind farm will result in higher energy production, leading to reduced capital costs and therefore lowering the cost per unit of energy generated.

4.6.4 *Size of Proposed Wind Turbines*

Wind turbines come in various sizes depending on use and location. **Figure 4.7** provides a timeline of the different styles of wind turbines from the 1970s to the present. It is important to note that new wind turbine models are constantly being developed and this chart is only representative of the increasing scale of machines over time.



Source: International Energy Agency (IEA)

Figure 4.7 Evolution of wind turbine generators

Source: Center for Climate and Energy Solutions, Accessed 23/10/2012

The Great California Wind Rush in the early eighties saw the introduction of 1,000 x 55 kW wind turbines in Palm Springs, California. In 1995, 39 x 600 kW wind turbines were installed in Denmark at the Rejsby Hede Wind Farm, representing the largest wind farm in Denmark at the time. With increasing generator and wind turbine size, the demand for wind turbines for larger projects grew, creating momentum towards a mature world market. Offshore wind farms increasingly became of interest to countries with high population densities and restricted onshore sites. Today, with an ever-increasing demand for renewable energy sources, wind turbines continue to increase in generator size and height for both onshore and offshore installations to maximise the capacity of wind farms, and significantly improve the provision of renewable energy on a global scale.

Bango Wind Farm is a part of today's increasing trend towards the use of larger wind turbines that have the capacity to capture greater portions of the wind resource in NSW and deliver realistic baseload electricity generation. The Proponent will be reviewing a number of wind turbine models as discussed in **Chapter 3** Project Description, which will ultimately determine the number of wind turbines installed and the capacity of the Project.

4.6.5 *The NSW Wind Farm Greenhouse Gas Savings Tool*

As part of the Renewable Energy Precincts initiative the NSW Government has developed the NSW Wind Farm Greenhouse Gas Savings Tool, allowing communities and industry to easily calculate the projected greenhouse gas savings from new wind farms in different Renewable Precincts across NSW.

The NSW Wind Farm Greenhouse Gas Savings Tool estimates savings by multiplying the output from a wind farm with the emissions intensity of the electricity supplied in the NEM. The emissions intensity of electricity supplied in the NEM varies according to the location and size of a new wind farm, so site specific emissions intensities must be used for different size developments within each Renewable Precinct.

The Project will have an installed capacity range of approximately 183 MW (based on a 1.5 MW wind turbine on Layout Option 1) to 326 MW (based on a 3.4 MW wind turbine on Layout Option 2), which is dependent on the final wind turbine model and layout selection, as outlined in **Chapter 3** Project Description. The NSW Wind Farm Greenhouse Gas Savings Tool, therefore, has been used to estimate the greenhouse gas savings at 183 MW and 326 MW using the NSW / ACT Border West Renewable Precinct emission savings (results in **Appendix 3**).

The estimated annual greenhouse gas savings from an installed capacity of 183 MW is 500,000 tonnes of CO_2-e. At this capacity, the Project would generate 575 GWh of electricity annually, enough to power 78,800 homes each year (**Appendix 3**). This would contribute 1.7 % of the 33,000 GWh LRET by 2020.

The estimated annual greenhouse gas saving from an installed capacity of 326 MW is 875,000 tonnes of CO_2-e. At this capacity, the Project would generate 1,025 GWh of electricity annually, enough to power 140,400 homes each year (**Appendix 3**). This would contribute 3.0 % of the 33,000 GWh LRET by 2020.

The Project and creation of wind farms are part of an upstream solution. It is part of the solution for not only reducing the generation of carbon dioxide equivalents from coal fired power stations, but also providing alternate electricity to users in NSW for at least 78,800 homes, reducing the pressure on the finite resources of fossil fuels.

With respect to the above calculations, higher capacity factors and therefore increased renewable generation can be achieved through:

- Increasing the hub height to capture higher wind speeds;
- Selecting a wind turbine most suited to producing the greatest yield with respect to the wind resource across the Project site; and
- Allowing flexibility in the size and range of machines which can be installed at each Cluster within the Project site.

Optimising the Project site in this manner would displace more of the energy that would otherwise be generated from incumbent coal fired power stations and thereby reduce carbon dioxide equivalent emissions.

4.6.6 *Consequence of not proceeding with the Project*

Australia has made significant progress towards establishing guidelines and targets that will reduce carbon emissions and promote both renewable energy and energy efficiency. With regards to a prominent target, the NSW Government has stated it will seek to attract a large portion of the investment that will result from the Renewable Energy Target (NSW Trade and Investment 2012). Without this Project, other projects will need to be developed to meet the RET, and there is potential for the NSW Government to miss out on the significant investment, estimated at an injection of between $205 and $365 million into the Australian economy, that the Project is expected to deliver.

Similarly, on an international scale, Australia is currently on track to fulfil its Kyoto Protocol target on emission reductions (DCCEE 2012c). As electricity demand increases, it will be vital for an increasing proportion of Australia's energy mix to be renewable energy, to remain on track to meet the target. Large-scale wind energy production, and importantly this Project, will contribute to ongoing reductions in carbon emissions. Without this Project, and others like it, coal will continue to play a dominant role in meeting energy demand, and Australia's carbon emissions will continue to increase, making it harder to meet the Kyoto Protocol, and other such national and international targets.

Finally, coal mining, and coal fired power generation, is placing increasing pressure on limited natural resources in Australia, including land and water (McAlpine 2012). For example, coal fired power stations use large volumes of water for cooling purposes during operation. The National Water Commission has identified that power stations often obtain their water at sub-commercial rates, so no economic incentives exist to encourage investment in more efficient technologies (Smart and Aspinall 2009). Equally, coal mining is generally not able to co-exist with farming activities, and often requires substantial areas of, often agricultural, land (McAlpine 2012). Wind farms, by contrast, use very little water during operation, and comfortably co-exist with agriculture. Investment in low impact technology such as this Project will alleviate some of the concerning resource impacts associated with conventional energy sources. Without such projects, dwindling natural resources will continue to be depleted at an unsustainable rate.

4.7 Summary

Increased greenhouse gases absorbing warmth from the earth are causing deleterious effects on the Earth's climate. Through ongoing research and a better understanding of carbon emissions International, National and State Governments are realising the benefits of clean, renewable energy generation. Policy implementation is now encouraging energy generation from renewable sources in order to both reduce harmful atmospheric emissions and meet future energy demand with diverse and secure supplies.

In 2007, the Australian government ratified the Kyoto Protocol and signed up to cut greenhouse gas emissions to 108 % of the levels they were in 1990; a watershed decision and an important step in determining Australia's position on climate change in the international arena. In December 2012 Australia agreed to the Doha Amendment to the Kyoto Protocol and signed up to reduce emissions to 98 % of levels they were in 2000 over the eight year period 2013 to 2020 (UNFCCC 2012).

The RET legislation was passed in Federal Parliament in August 2009 and set an initial target of 41,000 GWh, which was subsequently revised in July 2015 to 33,000 GWh, of Australia's electricity to be generated from large-scale renewable sources by 2020. Wind energy generation is a low cost, viable renewable energy source and can be readily implemented to meet a substantial percentage of this target.

The Project will play an important role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of Global Warming and Climate Change; contributing up to 3.0 % (dependent on the installed capacity) additional renewable energy generation to meet the legislated Australian target. Moreover the Project site and size has been carefully selected using a number of factors and will displace up to 3.5 million tonnes of CO_2-e by 2020.

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CHAPTER 5

Planning Context

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5. PLANNING CONTEXT

This chapter of the Environmental Impact Statement (EIS) addresses any relevant statutory provisions in relation to the Bango Wind Farm (the Project).

The development of the Project requires:

- Approval under the State Significant Development (SSD) provisions (Division 4.1) of Part 4 of the New South Wales (NSW) *Environmental Planning and Assessment (EP&A) Act, 1979*; and
- Consideration of the requirements of the Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act, 1999.

In addition, relevant Federal, State and Local Government legislation, policy and guidelines are considered and described in the following sections.

5.1 Federal Government Legislation and Policy

5.1.1 *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*

The *EPBC Act* is the central piece of environmental legislation for the Australian government. It provides the legal framework to protect and manage matters of national environmental significance, while also considering cultural values and society's economic and social needs.

Under the Act, the Proponent must conduct a Protected Matters Report to assemble technical information depending on the level of assessment. Environmental Resources Management Australia (ERM), on behalf of the Proponent, prepared a Protected Matters Report using the protected matters search tool addressing the identified Matters of National Environmental Significance (MNES).

The Project was declared a 'Controlled Action' pursuant to Section 75F(3) of the *EP&A Act* on 7th May 2013 following referral to the Commonwealth Department of the Environment (DoE). The Minister decided that the proposed action will be assessed by preliminary documentation (PD), including the provision of supplementary information (see **Appendix 4**) to assess the relevant impacts of the action.

The DoE will be assessing the Project using:

- The information contained in the original referral;
- A response to the further information requested on the impacts of the action and the strategies to mitigate and / or offset that impact; and
- Any other relevant information on the matters protected by the *EPBC Act*.

Once DoE has received satisfactory information in response to the PD request, the report will be put on exhibition for public comment. Any comments will be addressed either through revision of the original PD or providing a supplementary document. This final report triggers a 40 business day assessment period, at the end of which a decision on the action will be made.

Matters relating to threatened species and communities are addressed in **Chapter 10** Ecology and in **Appendix 12**. The full list of additional requirements from the DoE is included in **Appendix 4** and listed in **Table 5.2**.

5.1.2 *National Airports Safeguarding Framework 2012*

To address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers, the National Airports Safeguarding Advisory Group (NASAG) in May 2012 released *Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation* as part of their The National Airports Safeguarding Framework.

The guideline encourages consultation with aviation stakeholders and the preparation of a risk assessment using a suitably qualified aviation consultant. Accordingly Civil Aviation Safety Authority (CASA), Airservices Australia (AsA), Aerial Agricultural Association of Australia (AAAA), Department of Defence (DoD) and the Royal Australian Air Force (RAAF) have been informed as discussed in **Chapter 6** Stakeholder Consultation. The recommendations from CASA and results of the risk assessment are discussed in **Chapter 13** Aviation.

5.1.3 *Radiocommunications Act 1992*

Part 4.1 'Standards and other technical regulation' of the *Radiocommunications Act 1992* is designed to make the introduction of infrastructure such as wind turbines efficient, flexible and responsive with regard to the interference of radio emissions. The standards also require an adequate level of immunity from electromagnetic disturbances.

As wind turbines and associated ancillary structures produce electromagnetic fields, the Project has the potential to interfere with radiocommunications as discussed in **Chapter 14** Communication Assessment.

5.1.4 *Directory of Important Wetlands in Australia*

The Directory of Important Wetlands is a database of Ramsar defined wetlands in Australia, developed by the Australian government and State and Territory nature conservation agencies.

There are no recorded Ramsar wetlands in the vicinity of the Project, as discussed in **Chapter 17** Water and **Appendix 21**.

5.1.5 *Civil Aviation Safety Regulations 1998*

The *Civil Aviation Safety Regulations 1998* require the Civil Aviation Safety Authority (CASA) must be informed of proposals to build a structure greater than 110 meters above Australia Datum. This is to determine whether the structure is a potential hazard to aircraft, and to provide any associated mitigation measures including marking or lighting. Aviation impacts are considered in more detail in **Chapter 13** Aviation Assessment.

5.2 State Government Legislation, Policy and Guidelines

5.2.1 *Environmental Planning and Assessment Act 1979*

In NSW, wind farm developments are subject to the *EP&A Act* and relevant instruments that are created under it. In 2011 the NSW Government repealed Part 3A of the *EP&A Act* and announced that it will stop accepting any new projects in the Part 3A assessment system. This system was replaced by the Part 4 State Significant Development (SSD) assessment system which commenced on 1st October 2011.

The Project entered the planning system as a Part 3A project in March 2011 and was transitioned to Part 4 SSD in March 2014. The relevant instruments that now apply to the Project under SSD are thus Part 4 Development Assessment and Part 1 Section 5. With regard to the provisions of Part 1 Section 5, the Project takes into consideration the following as listed in **Table 5.1**.

Table 5.1 Part 1, Section 5 and where addressed within the EIS

Section 5	Chapter of EIS
to encourage:	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,	This EIS provides a comprehensive assessment of all relevant issues to the Project through **Chapters 3** to **19**. Mitigation, management and monitoring measures have been developed by the Proponent and consultants reports for a range of environmental issues. The Project has minimized the impact on the natural environment and sought to provide suitable environmental offsets where mitigation was not possible. The Project provides income to the landowners and a benefits fund for the wider community, increasing the economic benefits.
(ii) the promotion and co-ordination of the orderly and economic use and development of land,	The Project will not significantly affect the existing use of the land for grazing and cropping purposes within the site. Further, the Project will result in economic benefits for involved land owners and the local community through direct (i.e. property owners) and indirect opportunities (i.e. employment and contract opportunities), including a community benefits fund. **Chapters 4**, **18** and **19** address this matter in more detail.
(iii) the protection, provision and co-ordination of communication and utility services,	The Project will generate clean energy into the electricity network providing additional generation capacity in the local and regional network with no significant impact on existing utility services. **Chapter 14** of this EIS has assessed the impact of the Project on existing communication services. No impacts are predicted to occur on communications as a result of the Project.
(iv) the provision of land for public purposes,	The development is located entirely on private land and as such will not impact on the usability of public land.
(v) the provision and co-ordination of community services and facilities, and	The Project is anticipated to have an overall positive influence on the socio-economic situation in the local, regional and state levels. Additionally a community fund and necessary road upgrades will deliver additional services and facilities to the local community for the lifetime of the project.

	Chapter 19 addresses this in more detail.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and	A comprehensive ecological assessment of the area proposed to be affected by the Project has been undertaken and presented in **Chapter 10**. As well as responding to identified issues during the design phase, a number of management and mitigation measures have been proposed in order to protect the ecological values of the Project site. In the wider context, the Project helps reduce the impact of Climate Change which is perhaps the biggest threat to ecosystems globally.
ecologically sustainable development, and	The Project will generate clean and sustainable energy and thus contribute to both the increasing local and global need for renewable energy projects and in tackling the issues of Global Warming and Climate Change. **Chapters 4**, **5**, **10** and **19** cover this in more detail.
the provision and maintenance of affordable housing, and	The provision of affordable housing is not applicable to this Project.
to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and	The development is being assessed under Part 4 SSD of the NSW EP&A Act, with the NSW Department of Planning and Environment and the Commonwealth Department of Environment as the approval authorities. Local councils as well as relevant state and federal agencies and departments, have been identified and consulted as part of the assessment process for this proposal as outlined in **Chapter 5** and **6** of this EIS.
to provide increased opportunity for public involvement and participation in environmental planning and assessment.	Consultation for the Project was conducted by way of letters of notification to stakeholders, face-to-face contact with neighbouring residents, Public Open Days and consultation meetings with various stakeholders. The full consultation effort is outlined in **Chapter 6**.

The DPE is responsible for ensuring that the requirements of the *EP&A Act* and its regulations are addressed for developments where the Minister for Planning has the Approval Authority.

5.2.2 *Secretary's Environmental Assessment Requirements*

After the submission of the Preliminary Environmental Assessment (PEA) on 1st March 2011, the Director-General of the DPE provided Project specific assessment requirements, the DGRs, on 31st March.

In line with the Project transitioning from Part 3A to a State Significant Development, Secretary's Environmental Assessment Requirements (SEARs) were issued for the Project on 6th November 2015. This EIS complies with both the DGRs and SEARs. The SEARs, as listed in **Appendix 4**, include key issues for the Proponent to address in the EIS with a focus on impacts, management and mitigation strategies. **Table 5.2** summarises the requirements and where each issue is addressed within the EIS.

Table 5.2 Outline of SEARs as issued by the DPE and where addressed within the EIS

Secretary's Environmental Assessment Requirements	Chapter of EIS
General Requirements	
Executive summary	**Chapter 1**

Secretary's Environmental Assessment Requirements	Chapter of EIS
Detailed description of the Project	**Chapter 3**
Relevant Codes	**Chapter 3**
Relevant statutory provisions	**Chapter 5**
Assessment of issues (outlined below)	**Chapters 7** to **20**
Statement of Commitments	**Chapter 21**
Conclusion justifying the Project	**Chapter 22**
Certification of the authors of the EIS	**Cover Page**
Assessment Requirements	
Project Justification	**Chapter 4**
Assessment of key issues	**Chapter 7**
Visual	**Chapter 8**
Noise	**Chapter 9**
Ecology	**Chapter 10**
Cultural heritage	**Chapter 11**
Traffic and transport	**Chapter 12**
Aviation hazard	**Chapter 13**
Communication	**Chapter 14**
Electromagnetic fields	**Chapter 15**
Fire and bushfire hazard	**Chapter 16**
Water	**Chapter 17**
General environmental	**Chapter 18**
Waste	**Chapter 18**
Socio-Economic	**Chapter 19**
Consultation Requirements	
Appropriate and justified level of consultation with agencies and community	**Chapter 6**

Resources considered in this EIS
Best Practice Guidelines for Implementation of Wind Energy Projects in Australia (Auswind, 2006)
Wind Farms and Landscape Values: National Assessment Framework (Australian Wind Energy Association and Australian Council of National Trust, June 2007)
Visual Representation of Wind Farms - Good Practice Guidance (Scottish Natural Heritage, 2006)
Best Practice Guidelines for Wind Energy Development (British National Wind Energy Association, 1994)
Exploring Community Acceptance of Rural Wind Farms in Australia (CSIRO, 2012)
Draft National Wind Farm Development Guidelines (Environment Protection and Heritage Council, 2010)
Cumulative Risk for Threatened and Migratory Species (Commonwealth Department of Environment and Heritage, March 2006)
Wind Farms and Birds: Interim Standards for Risk Assessment (Auswind, July 2005)
Assessing the Impacts on Birds - protocols and Data Set Standards (Australian Wind Energy Association)

Resources considered in this EIS
Threatened Biodiversity Survey and Assessment - Guidelines for Developments and Activities (Working Document) (DEC, 2004a)
Advisory Circular 139-18(0) Obstacle Marking and Lighting of Wind Farms (Civil Aviation Safety Authority, July, 2007). Note: this advisory is currently withdrawn; however a replacement has not been issued to date. Currently, the National Airports Safeguarding Framework (NASF) *Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation* provides guidance to State / Territory and local government decision makers to address the risk to civil aviation, including outlining mitigation measures such as marking and lighting.
Manual of Standards (MOS), Part 139 – Aerodromes (CASA, 2012)
The NSW State Groundwater Quality Protection Policy (DLWC, 1998)
The NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2002)
Department of Water and Energy's Guidelines for Controlled Activities (February 2008)
Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005)
Draft Guidelines for Threatened Species Assessment (DEC, 2005)
Wind Farms - Environmental Noise Guidelines (South Australian Environment Protection Authority, 2003)
NSW Industrial Noise Policy (EPA, 2000)
Environmental Criteria for Road Traffic Noise (NSW EPA, 1999)
Environmental Noise Control Manual (EPA, 2004)
Assessing Vibration: A Technical Guideline (DECC, 2006)
Wind Farm Greenhouse Gas Savings Tool (DECCW)
Planning for Bushfire Protection 2006 (NSW RFS) (PBP 2006)
Soil Conservation Act 1938

5.2.3 *State Environmental Planning Policy (State and Regional Development) 2011*

Clause 8 of the *State Environmental Planning Policy (State and Regional Development) (SEPP SRD) 2011* states that the development is SSD if:

- The development on the land concerned is, by the operation of an environmental planning instrument, not permissible without development consent under Part 4 of the Act; and
- The development is specified in Schedule 1 or 2.

Schedule 1, Clause 20 of the SEPP SRD identifies facilities for the generation of electricity and heat development with a capital investment value (CIV) of more than $20 million as being a SSD. The estimated CIV of the Project is greater than $20 million, therefore the SEPP SRD is applicable and the project is to be assessed as SSD under Part 4 of the *EP&A Act*.

5.2.4 *State Environmental Planning Policy (Infrastructure) 2007*

The *State Environmental Planning Policy (SEPP) (Infrastructure) 2007* was developed to improve the efficiency of the existing planning system in delivering essential public infrastructure and services, by repealing 20 existing environmental planning instruments.

The *SEPP Infrastructure* outlines the planning processes for infrastructure projects under Part 4, Part 5 and exempt development. It also outlines the circumstances for the exempt development of temporary (less than 30 months) wind monitoring masts in Clause 39(2). Up to six permanent wind monitoring masts will be applied for in the Project as they are required for the duration of the Project's operation, which is discussed in **Chapter 3** Project Description.

5.2.5 *State Environmental Planning Policy (Rural Lands) 2008*

The *State Environmental Planning Policy (SEPP) (Rural Lands) 2008* specifically applies to development applications under Part 4 of the EP&A Act. The primary aims are relevant the Project with the following principles and objectives being addressed in this EIS, namely:

- Facilitate the orderly and economic use and development of rural lands for rural and related purposes;
- Identify the Rural Planning Principles and the Rural Subdivision Principles so as to assist in the proper management, development and protection of rural lands for the purpose of promoting the social, economic and environmental welfare of the State;
- Implement measures designed to reduce land use conflicts;
- Identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations; and
- Amend provisions of other environmental planning instruments relating to concessional lots in rural subdivisions.

The *Rural Lands SEPP* does not directly impact the land use suitability of the proposed development, rather the aims of the *Rural Lands SEPP* are to ensure agricultural lands are not compromised by the pressure for other land uses, especially more intensive uses. The Project is consistent with the *Rural Lands SEPP* as it is a development which can occur in unison with the continuing use of the land for rural purposes.

The *Rural Lands SEPP* has also been used as a vehicle to restrict subdivision of rural lands where conflicts occur. It does not require councils to review their minimum lot size(s) or change those lot sizes in an existing Local Environment Plan (LEP). Councils have the option to transfer the existing minimum lot size(s) currently applying in its Local Government Area (LGA) into a new LEP. The *Rural Land SEPP* does not enforce change in the local controls, with the exception of concessional lot provisions.

Table 5.3: Outline of Rural Lands SEPP principles and where addressed in EIS

State Environmental Planning Policy (Rural Lands) 2008	**Chapter of EIS**
Clause 7: Rural Planning Principles	
The promotion and protection of opportunities for current and potential productive and sustainable economic activities in rural areas;	The Project assists local landowners by providing a fixed, annual income. This income can be used to expand their farming activities or protect their farm during times of hardship. See **Chapters 4** and **19** for more information.
Recognition of the importance of rural lands and	The Project is proposed for rural land, but has a very small

agriculture and the changing nature of agriculture and of trends, demands and issues in agriculture in the area, region or State;	development footprint. The wind farm lease payments will help landowners through the provision of a fixed, annual income to assist with any economic downturn. See **Chapters 4** and **19** for more information.
Recognition of the significance of rural land uses to the State and rural communities, including the social and economic benefits of rural land use and development;	The Project has minimal impact on rural land use and provides landowner and wider community benefits. See **Chapter 19** for more information.
In planning for rural lands, to balance the social, economic and environmental interests of the community;	Wind farms assist with the economic development of the local area, including financial benefits to landowners and the wider community. There is potential for increased employment and service sector growth in nearby towns. This is detailed in **Chapters 10** and **19**.
The identification and protection of natural resources, having regard to maintaining biodiversity, the protection of native vegetation, the importance of water resources and avoiding constrained land;	The Project has been designed to minimise the impact on the local environment or otherwise mitigate for the impacts. See **Chapter 10** for more information.
The provision of opportunities for rural lifestyle, settlement and housing that contribute to the social and economic welfare of rural communities;	The potential for long-term growth industries centered on wind farm development such as the Project can boost the social and economic welfare of local communities. See **Chapter 19** for more information.
The consideration of impacts on services and infrastructure and appropriate location when providing for rural housing; and	The provision of rural housing is not applicable.
Ensuring consistency with any applicable regional strategy of the Department of Planning or any applicable local strategy endorsed by the Director-General.	The Project has considered and is consistent with all relevant legislation, policies and frameworks applicable to the locality. This is detailed in **Chapter 5**.
Clause 12: Objects of Part	
To identify State significant agricultural land and to provide for the carrying out of development on that land; and	The Project does not impact on State significant agricultural land and only affects a small proportion of other agricultural land. See **Chapter 4** for more information.
To provide for the protection of agricultural land: • that is of State or regional agricultural significance, and • that may be subject to demand for uses that are not compatible with agriculture, and • if the protection will result in a public benefit.	The Project is not required to provide for the protection of rural land. See **Chapters 4** and **5** for more information.

5.2.6 *State Environmental Planning Policy 44 (Koala Habitat)*

State Environmental Planning Policy (SEPP) 44 (Koala Habitat) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

Koala habitat has been assessed as part of the Project impacts in **Chapter 10** Ecology and **Appendix 12,** recognising that the species was listed as vulnerable under the Act in 2012.

Table 5.4: Outline of SEPP 44 and where addressed in EIS

State Environmental Planning Policy 44 (Koala Habitat)	**Chapter of EIS**
Clause 3: Aims and objectives	
Encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline: • By requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and • By encouraging the identification of areas of core koala habitat, and • By encouraging the inclusion of areas of core koala habitat in environment protection zones.	The ecological impact of the Project has been considered in **Chapter 10**. Although habitat has been found in the area, no koalas were recorded and so the area is not considered core koala habitat.

5.2.7 *National Parks and Wildlife Act 1974*

The *National Parks and Wildlife (NPW) Act 1974* outlines matters relating to flora and fauna and Aboriginal heritage. To ensure accordance with the relevant parts of the *NPW Act*, ERM has conducted an assessment of flora and fauna in **Appendix 12** with an overview provided in **Chapter 10** Ecology.

As the Project has the potential to impact on Aboriginal objects or declared Aboriginal Places, the *Aboriginal cultural heritage consultation requirements for proponents 2010* has been implemented with this Project to engage interested parties for Aboriginal Assessment and Advisory Services along with NSW Archaeological Pty Ltd (NSW Archaeology). The completed assessment on Aboriginal heritage is attached in **Appendix 13**, with an overview provided in **Chapter 11** Cultural Heritage.

5.2.8 *Protection of the Environment Operations Act 1997*

The *Protection of the Environment Operations (POEO) Act 1997* is administered by the Office of Environment and Heritage (OEH), Environmental Protection Authority (EPA), local councils and other public authorities. The EPA issues licences to control the air, noise, water and waste impacts of a scheduled activity. The EPA is now the appropriate regulatory authority (ARA) for large-scale wind farms, specifically:

- Schedule 1, Clause 17 (1) of the *POEO Act* lists large-scale wind farms, approved under SSD, as a scheduled activity requiring an environment protection licence.
- Schedule 1 of the *Protection of the Environment Operations (General) Regulation 2009* sets out applicable licence administrative fees for large-scale wind farms.

The Project will therefore require an environmental protection licence to operate, with the noise limits prescribed in the licence being substantially consistent with the planning consent. In addition, during the construction phase a licence is expected to be necessary for:

- Mobile concrete batch plants if the total of pre-mixed concrete and / or concrete products exceeds 30,000 tonnes per year; and
- Crushing, grinding or separating if the activity has the capacity to process more than 150 tonnes of materials per day or 30,000 tonnes of materials per year.

5.2.9 ***Threatened Species Conservation Act 1995***

The purpose of the *Threatened Species Conservation (TSC) Act 1995* is to prevent impacts, conserve and protect biological diversity and ensure ecologically sustainable development. The *Threatened Species Amendment Act 2004* further enhanced the purpose of the original Act by integrating conservation with main-stream decision making, under the *EP&A Act,* on land usage and structure of the economy.

ERM has undertaken a flora and fauna assessment to determine the significance for threatened species, presented in **Appendix 12** and summarised in **Chapter 10** Ecology.

5.2.10 ***Threatened Species Conservation (Biodiversity Banking) Regulation 2008***

Biodiversity Banking (BioBanking) provides the means to address the loss of biodiversity in NSW. Landowners have the ability to establish Biobanking sites, which can be 'bought' by developers to secure the conservation of biodiversity in perpetuity.

BioBanking provides the means to address the loss of biodiversity from particular developments which impact upon the environment in NSW. It is a market-based scheme that provides a streamlined biodiversity assessment process for development, a rigorous and credible offsetting scheme, as well as an opportunity for rural landowners to generate income by managing land for conservation.

The Proponent undertook a preliminary Biobanking assessment across the Project site to ensure the principles in the SEARs are maintained and suitable sites are located for offsetting threatened areas as discussed in **Chapter 10** Ecology and **Appendix 12**.

5.2.11 ***NSW Catchment Management Authority Act 2003***

The *NSW Catchment Management Authority (CMA) Act 2003* aims to establish authorities for decision-making and provide natural resource planning at a catchment level. This is done through applying scientific and local community knowledge to achieve a fully functioning and productive landscape. Under the *CMA Act*, Catchment Management Authorities are required to prepare a Catchment Action Plan (CAP).

Chapter 17 Water and **Appendix 21** discuss how the Lachlan Catchment Management Authority CAP is applicable to the Project.

5.2.12 ***Native Vegetation Act 2003***

The main objective of the *Native Vegetation (NV) Act 2003* is to promote ecologically sustainable development, prevent broad scale clearing and protect and improve native vegetation. The Project requires approval under the *NV Act* as a result of the Project requiring the clearing of native vegetation.

ERM conducted vegetation surveys to identify species potentially affected and the total area of disturbance. The results are in **Appendix 12** and findings are summarised in **Chapter 10** Ecology.

5.2.13 *Noxious Weeds Act 1993*

The *Noxious Weeds Act 1993* defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The Act sets up categorisation and control actions for the various noxious weeds according to their potential to cause harm to the local environment.

Any weeds found on-site, as discussed in **Chapter 10** Ecology, will be managed in accordance with assigned Control Categories determined by the Act.

5.2.14 *Fisheries Management Act 1994*

The *Fisheries Management (FM) Act 1994* provides for the conservation, protection and management of fisheries, aquatic systems and habitats in NSW. The Project will require permits under section 219 of the *FM Act,* regarding the passage of fish not to be blocked, as the development will have some impact on causeways and other water crossings.

ERM has undertaken an assessment of aquatic habitats, presented in **Appendix 12** and summarised in **Chapter 10** Ecology.

5.2.15 *Contaminated Land Management Amendment Act 2008*

The *Contaminated Land Management Amendment Act 2008* stipulates the management of contaminated land, where contamination is significant enough to warrant regulation. The amendment to this Act allows contaminated sites to be cleaned more efficiently.

As discussed in **Chapter 17** General Environmental Assessment and **Chapter 21** Statement of Commitments, if any contaminated sites are found during construction, the appropriate authorities will be notified and actions taken in accordance with the Act.

5.2.16 *NSW Rural Fire Act 1997*

The *NSW Rural Fire Act 1997* imposes obligations on land managers to take all reasonable measures to prevent the occurrence and spread of wildfire to adjoining lands from lands under care and management. Fire management is implemented under an EMP sub-plan (see **Appendix 19**). **Chapter 16** Fire and Bushfire discusses further impacts and possible mitigation methods.

5.2.17 *Roads Act 1993*

The *Roads Act 1993* addresses authorities, functions and regulation of activities relating to the use and type of roads. Consultation with the Roads and Maritime Services, Yass Valley Council and Boorowa Council, as outlined in **Chapter 6** Stakeholder Consultation, is required to determine access and necessary upgrading of access points.

Under section 138 of the *Roads* Act, actions that impact on public road would require a permit from the Local Council and / or RMS, as appropriate. Further detail is provided in **Appendix 14**, with a summary in **Chapter 12** Traffic and Transport.

5.2.18 *Crown Lands Act 1989*

The *Crown Lands Act 1989* provides for the administration and management of crown lands relevant to the Project area.

The Project design has specifically avoided crown lands for the purpose of siting wind turbines. Where it is necessary to impact crown roads, those areas affected will either be sought to be closed and transferred to the relevant landholder or crossing licences sought. Further detail is provided in **Chapter 18** General Environmental Assessment.

5.2.19 *Surveying Act 2002 No. 83*

Clause 24 (1) of the *Surveying Act 2002 No. 83* states that "A person must not remove, damage, destroy, displace, obliterate or deface any survey mark unless authorised to do so by the Surveyor-General". The Department of Lands has been consulted, as discussed in **Chapter 6** Stakeholder Consultation, in regards to the close proximity of wind turbines to any Trigonometrical Stations (TS). While the Project does not directly impact on any TS, full results of that discussion are presented in **Chapter 17** General Environmental Assessment.

5.2.20 *The Heritage Act 1977*

The purpose of the Heritage Act 1977 is to promote understanding and encourage conservation and protection of the State's Heritage. *The Heritage Act* does this through the identification and registration of items of State Heritage significance and Interim Heritage Orders. The Project has avoided impacting any identified heritage items, but may require permits should construction uncover items relevant under *The Heritage Act.*

The cultural heritage impacts of the Project have been assessed and are discussed in **Chapter 11** Cultural Heritage Assessment and **Appendix 12.**

5.2.21 *Water Management Act 2000*

The *Water Management Act 2000* governs for the sustainable and integrated management of water resources in NSW, including for the protection of water resources, ecology, managing water sharing and water use, drainage, floodplain management and controlled activities.

The Project will require a water use approval under Section 89, a water management work approval under Section 90, and an activity approval under Section 91 of the *Water Management Act 2000*.

5.2.22 *Water Act 1912*

The *Water Act 1912* governs the issue of new water licenses and the trade of water licenses and allocations. Water licenses are required for the extraction of water from a water body via a pump, the capture of surface water (i.e. damming), and for the extraction of groundwater. Local governments facilitate the necessary licensing required under the *Water Act*.

5.2.23 ***Other Water Policies and Plans***

The Project, under the SEARs, must consider the following additional policies and plans with regard to water usage and quality during construction / dust suppression activities and the use of concrete batching plant(s) facilities:

- Fisheries Management Act 1994;
- NSW State Rivers and Estuaries Policy (1991);
- NSW Sand and Gravel Extraction Policy for Non-Tidal Rivers (1992);
- NSW Groundwater Quantity Management Policy (undated);
- NSW Weir Policy (1997);
- NSW State Groundwater Policy Framework Document (1997);
- NSW Groundwater Quality Protection Policy (1998);
- Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (1999);
- NSW State Groundwater Dependant Ecosystem Policy (2002);
- NSW Water Quality and River Flow Objectives for the Lachlan River Catchment (2006);
- NSW Wetlands Policy (2010);
- NSW Policy for Managing Access to Buried Groundwater Sources (2011);
- Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources (2012);
- Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources (2012);
- NSW Office of Water Guidelines for Controlled Activities on Waterfront Land (2012); and
- NSW Aquifer Interference Policy (2012).

This EIS addresses how the Project will consider each of these policies and plans in **Chapter 17** Water and **Appendix 21**.

5.2.24 ***Noise Regulations and Guidelines***

The SA Environment Protection Authority's *Noise Guidelines for Wind Farms 2009* provides guidelines for the predicted equivalent noise levels from wind turbines. In accordance with NSW's adoption of these guidelines, recorded noise levels at relevant non-involved receivers should not exceed 35 dBA or 5 dBA above background noise levels, whichever is the greater. These guidelines are formally applied in NSW and as advised in the SEARs have been used in the assessment of the Project as discussed in **Chapter 9** Noise and **Appendix 10**. During construction the Project will be regulated by the *Interim Construction Noise Guideline* (Department of Environment and Climate Change (DECC) 2009).

During construction the Project will also be regulated by Traffic Noise – *NSW Road Noise Policy* (Department of Environment Climate Change and Water (DECCW), 2011); and Vibration – *Assessing Vibration: A Technical Guideline* (DECC, 2006) (construction vibration).

5.2.25 ***Road Authority Approvals and Permits***

Prior to construction, a licensed and experienced transport contractor specialising in the transport of over-size and over-mass loads will arrange all required approvals and permits. These contractors operate closely with road authorities and will consider the following acts and regulations:

- Operating Conditions: Specific permits for over-size and over-mass vehicles and loads (RTA 2008);
- Road Transport (General) Act 2005: General Class 1 Oversize (Load-Carrying Vehicle) Notice 2007 under Division 3 of Part 2 of the Road Transport (Mass, Loading and Access) Regulation 2005 (RTA); and
- Road Transport (General) Act 2005: General Class 1 Oversize (Special Purpose Vehicle) Notice 2007 under Division 3 of Part 2 of the Road Transport (Mass, Loading and Access) Regulation 2005 (RTA).

5.2.26 ***NSW 2021: A Plan to Make NSW Number One***

NSW 2021 aims to drive economic growth in regional NSW and strengthen local environments and communities. To meet these aims the Plan has a number of priority actions including promoting energy security through a more diverse energy mix, reducing coal dependence, increasing energy efficiency and moving to lower emission energy sources.

The Project aligns with these priority actions by supplying NSW with new renewable energy generations and displacing output of greenhouse gas emissions from alternative power generation sources as discussed in **Chapter 3** Project Description and **Chapter 4** Project Justification.

5.2.27 ***Best Practice Guidelines for Implementation of Wind Energy Projects in Australia***

These *Best Practice Guidelines* (BP Guidelines) were originally developed by Auswind in 2006 and updated by the Clean Energy Council (CEC) in 2013. The BP Guidelines have been produced by a broad range of both industry and regulatory organisations and provide an outline of and background to best practice processes for all stages of wind farm site selection, development, construction, operation and decommissioning. These processes ensure that Australia's wind industry provides safe, reliable, economically and environmentally sustainable energy to Australia.

The Project has followed the BP Guidelines where appropriate to do so and without conflict to existing legislation, policy and / or regulations.

5.2.28 ***Draft NSW Planning Guidelines: Wind Farms 2011***

The *Draft NSW Planning Guidelines: Wind Farms* 2011 (Draft Guidelines) were released on 23rd December 2011. The purpose of the Draft Guidelines is to:

- Provide clear and consistent regulatory framework for the assessment and determination of wind farm proposals across the state;
- Outline clear processes for community consultation for wind farm developments; and
- Provide guidance on how to measure and assess potential environmental noise impacts from wind farms.

Those aspects summarised in **Table 5.5** have been explicitly considered in this chapter and subsequent chapters of this EIS.

Table 5.5 Aspects of the Draft Guidelines considered within the EIS

Aspect of the Draft Guidelines	Section of EIS
Local council planning controls	**Chapter 5** (this chapter)
Proximity of wind turbines to existing residences (2 km Gateway)	**Chapter 6**, **8** and **9**
Consultation	**Chapter 6**
Landscape and visual amenity	**Chapter 8** and **Volume 2**
Noise	**Chapter 9** and **Appendix 9**
Health	**Chapter 19**
Ecology	**Chapter 10** and **Appendix 11**
Aviation safety	**Chapter 13** and **Appendix 14**
Bushfire hazard	**Chapter 16** and **Appendix 18**
Blade throw	**Chapter 18**
Economic issues	**Chapter 6** and **19**
Decommissioning	**Chapter 18**
Monitoring and Compliance	**Chapter 20**

5.3 Regional and Local Government Legislation / Policy

5.3.1 *Regional Policies*

The Project lies in the Lachlan Catchment Management Authority (CMA), within the Lachlan catchment. Under the SEARs, the Project must consider the Lachlan CMA Catchment Action Plan (CAP) to conform to the principles of an ecologically sustainable landscape. Further information is provided in **Chapter 17** Water and **Chapter 10** Ecology and **Appendix 21** Soil and Water Assessment.

5.3.2 *Local Environmental Plans*

The Project site is located within the Boorowa and Yass Valley Local Government Areas, and as such is subject to two Local Environmental Plans (LEPs); the Boorowa LEP (2012) and the Yass Valley LEP (2013). The LEPs are an established framework for development within local government areas. For the Project to be eligible for assessment under Part 4 of the *EP&A Act*, the proposed activity is required to be permissible under the relevant LEP. The Project occurs on land zoned RU1 Primary Production, which does not prohibit the erection of wind turbines on farms, as land can still be predominantly used for pastoral purposes. Wind turbines also provide additional income, allowing maintenance of rural properties without having to use alternative methods such as subdivision. The requirements for each LEP and how the proposal is addressing them are listed below in **Table 5.6**.

The SEARs also require the EIS to address the suitability of the Project with respect to potential land use conflicts and future surrounding land use taking into account local and strategic land use objectives. Further detail is provided in **Chapter 4** Project Justification about mitigation methods for future potential land use conflicts.

Table 5.6 Local Environmental Plan requirements

Boorowa LEP 2012	Yass Valley LEP 2013	Relevance to the Project
Planning		
To minimise conflict between land uses within Zone RU1 Primary Production and land uses within adjoining zones.	To establish planning controls that promote sustainable development.	Addressed under the EP&A Act, Part 3A as Critical Infrastructure (s.75C) which excludes all environmental planning instruments (s.75R) except for SEPPs that specifically relate to the Project and council orders under Division 2A of Part 6 (related to enforcement).
	To minimise land use conflicts.	In preparing the Environmental Impact Statement requirements, the Director-General is to consult relevant public authorities and have regard to the need for the requirements to assess any key issues raised by those public authorities (s.75F(4)). Yass Valley and Boorowa Councils have been consulted and provided input into the DGRs (s.75F(4)).
Agriculture		
To encourage diversity in primary industry enterprises and systems appropriate for the area.	To encourage the use of rural land for agriculture and other forms of development which are associated with rural industry or which require an isolated or rural location.	The Project temporarily reduces the available land for grazing (during construction). However in the long term agricultural use would not be significantly impacted due to the limited amount of land-take required for the Project. The Project would provide off-farm income to landowners assisting agricultural enterprises during times of drought or other hardship (discussed in **Chapter 19** Socio-Economic Assessment).
To encourage the retention of productive rural land for agriculture.		
To encourage sustainable primary industry production.	To encourage sustainable primary industry production by maintaining and enhancing the natural resource base.	The Project is consistent with the *Rural Lands SEPP* as it is a development which can occur in unison with the continuing use of the land for rural purposes.
Environmental Protection		
To identify, protect, conserve and enhance Boorowa's natural assets.	To protect, manage and restore areas of high ecological, scientific, cultural or aesthetic values.	This EIS addresses the DGRs with regard to minimising environmental impacts and risks (see **Chapter 21** Statement of Commitments). Results demonstrate the Project will develop in a manner which minimises risks to the natural and physical environment.
	To provide for a limited range of development that does not have an adverse impact on those values.	
Cultural Values		
To conserve the heritage significance of heritage	To conserve the environmental heritage of	Aboriginal Cultural Heritage surveys and Non-Indigenous surveys have been conducted in

Boorowa LEP 2012	Yass Valley LEP 2013	Relevance to the Project
items and heritage conservation areas, including associated fabrics, settings and views.	Yass Valley.	accordance with the DGRs (full detail **Chapter 11** Cultural Heritage). This will protect and conserve the cultural heritage in the area. The community was contacted via a number of means as discussed in **Chapter 6** Stakeholder Consultation, including a Public Open Day, Public Opinion Surveys, website, media releases, door to door and newsletters, to ensure that the opinions of the rural community were heard.
To conserve Aboriginal objects and Aboriginal places of heritage significance.	To conserve archaeological sites.	
To conserve archaeological sites.	To protect and conserve the cultural heritage and history of the Yass Valley.	
Residential		
To encourage and provide opportunities for population growth in rural villages.	To encourage employment opportunities in accessible locations.	The proposed development is located 20km north of Yass and 7km south-east of Boorowa. There is limited rural residential development in the vicinity of the Project (full detail **Chapter 4** Project Justification, **Chapter 18** General Environmental Assessment and **Chapter 19** Socio-Economic Assessment).
Financial		
To encourage employment opportunities in accessible locations.	To encourage employment opportunities and to support the viability of centres.	The community will be provided with a Community Fund for the life of the Project, and there will be added benefits to the community with increased jobs and economic activity as discussed in **Chapter 19** Socio-Economic Assessment. Ratepayers will not incur any financial burdens as the Proponent will be responsible for any road upgrades and building of infrastructure required for the Project.
To reinforce the role of the Boorowa township as the main commercial centre.	To encourage employment opportunities.	
Industry		
To encourage diversity in primary industry enterprises and systems appropriate for the area.	To provide for infrastructure and related uses.	Increased road traffic may be generated by the development on local roads to view the Project. A viewing platform or parking bay could be constructed to account for a possible increase in tourism if Council requires it (discussed **Chapter 19** Socio-Economic Assessment). The proposal promotes an industry that would benefit the local community and wider population into the future. Due to the careful planning and proposed management of the Project there would be minimal nuisance caused by the proposed development (discussed **Chapter 4** Project Justification).
To encourage diversity in primary industry enterprises and systems appropriate for the area.		

The Yass Valley LEP 2013 (YVLEP) does not reference wind farms within the Land Use: Zone RU1 Primary Production classification. By way of that absence, in accordance with the wording in the YVLEP, wind farm developments are prohibited in accordance with Part 4 of that Land Use Title. Yass Valley Council were consulted regarding their position regarding wind farms, and the follow response was received.

"In preparing the Yass Valley LEP 2013, Yass Valley Council was advised by the then Department of Planning & Infrastructure that 'electricity generating works' was not to be included within the land use table for the RU1, RU2, RU3, RU4, IN1 and IN3 zones given this use was permitted with consent in these zones under the provisions of State Environmental Planning Policy (Infrastructure) 2007. Given the proposed site area within the Yass Valley LGA is wholly within the RU1 Primary Production Zone, Yass Valley Council understands that electricity generating works is permitted with consent under SEPP (Infrastructure) 2007 regardless of the provisions of the YVLEP."

5.3.3 ***Development Control Plans***

The *EP&A Act* Division 6 specifies how local Council Development Control Plans (DCPs) are to be considered for projects assessed under the *EP&A Act*. Section 74BA (1) of the *EP&A Act* states the principle purpose of DCPs is to provide 'guidance' to development proponents and consent authorities and to assist 'facilitating development that is permissible'. As such, DCP provisions are not 'statutory requirements'.

Section 79C (3A) of the *EP&A* outlines the requirements for a consent authority if a DCP contains provisions that relate to the development that is the subject of a development application. Where a development proposal complies with the standards of a DCP, a consent authority will not be allowed to require more onerous standards. If a proposed development does not comply with the standards of a DCP, a consent authority will be obliged to 'be flexible in applying those provisions' and to 'allow reasonable alternative solutions' that achieve the objectives of those standards. A consent authority may only consider DCP provisions in connection with the assessment of the pending development application i.e. not other development applications that may have been lodged or maybe lodged in the future. The intended effect of this is to prevent councils arguing that an approval will set a 'precedent'.

The Project is subject to the Boorowa Council DCP, adopted November 2013 and the relevant Yass Valley Council DCPs. These documents were created to supplement the relevant LEPs and to provide further detailed provisions to guide development; however, they contain no objectives or regulations specific to wind farm developments.

5.3.4 ***South West Slopes Bush Fire Risk Management Plan and Southern Tablelands Bush Fire Management Plan***

The Project will be subject to the South West Slopes Bush Fire Risk Management Plan and the Southern Tablelands Bush Fire Risk Management Plan and will comply with provisions contained in these. Issues associated with the Project will be incorporated into the EMP sub-plan to ensure any concerns arising are addressed.

CHAPTER 6

Stakeholder Consultation

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6. STAKEHOLDER CONSULTATION

6.1 Preliminary Consultation

The Proponent submitted a draft Preliminary Environmental Assessment (PEA) for the Project to the New South Wales (NSW) Department of Planning and Environment (DPE) on the 25th February 2011. In response, the DPE issued Director-General's Requirements (DGRs) on 31st March 2011 and supplemented them on 16th August 2011 with additional consultation requirements. Secretary's Environmental Assessment Requirements (SEARs) were subsequently issued on 6th November 2015 following the Project's transition to Part 4 State Significant Development.

In addition, further governmental assessment advice was provided by the following agencies:

- Airservices Australia (AsA);
- Aerial Agricultural Association of Australia (AAAA);
- Boorowa Council;
- Upper Lachlan Shire Council;
- Civil Aviation Safety Authority (CASA);
- Trade and Investment NSW (T&I NSW);
- Mineral Resources, T&I NSW;
- Office of Environment and Heritage (OEH, formerly DECCW);
- Department of Defence (DoD); and
- NSW Office of Water (NOW).

6.1.1 *Commonwealth Supplement to the Director-General's Requirements*

The Proponent submitted a Referral of the Proposed Action under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* on 27th March 2013.

On 7th May 2013, the Federal Minister for the Environment determined that the Project would constitute a Controlled Action pursuant to Section 75F (3) of the *EP&A Act*. The Minister also decided that the proposed action will be assessed by preliminary documentation (PD), including the provision of supplementary information (see **Appendix 4**) to assess the relevant impacts of the action.

The DoE will be assessing the Project using:

- The information contained in the original referral;
- A response to the further information requested on the impacts of the action and the strategies to mitigate and / or offset that impact; and
- Any other relevant information on the matters protected by the *EPBC Act*.

Once the DoE has received satisfactory information in response to the PD request, the report will be put on exhibition for public comment. Any comments will be addressed either through revision of the original PD or providing a supplementary document. This final report triggers a 40 business day assessment period, at the end of which a decision on the action will be made.

6.2 Approach to Consultation

Public consultation for the Project began in mid April 2011 during the commencement of Project planning. Consultations at this time was intended to inform the general public, neighbouring residents, statutory regulators and other stakeholders of the Project in order to identify issues that may require addressing during Project planning and design. Extensive public consultation has taken place since the early stages of the Project and has targeted all interested and potentially affected parties. Consultation took the form of:

- Establishment of a Project website (www.bangowindfarm.com.au) for general information dissemination, announcements, feedback requests and document distribution;
- Letters of notification to various stakeholders, including local, state and national groups and agencies;
- Face-to-face notification (or letter drop where necessary) of neighbouring residents within approximately 3 km of the Project;
- Project newsletters distributed during development to the local community (x2),
- A Public Opinion Survey (POS), A Landscape Values survey, advertisements, media releases and press / radio interviews;
- A Public Open Day held at Boorowa Bowling Club, Boorowa;
- The Project Community Consultative Committee;
- Doorknocking in the Project locality; and
- Ongoing consultation and meetings with various stakeholders throughout the Project planning and design stages.

The Proponent has maintained the Project website since the Project's inception and has continued to maintain an 'open door' policy for consultation. The provision of the Project Manager's contact details on the website ensures that stakeholders can find out information about the Project at any stage of the development.

6.3 Stakeholder Identification and Consultation

The stakeholders listed below in **Tables 6.1**, **6.2** and **6.3** were provided with information regarding the proposed development. They were invited to provide any comment, information or guidance in the course of the Project's design and in the preparation of this EIS. Copies of the responses (where given in writing) are included in **Appendix 5** and **17** and summarised in **Section 6.4**.

6.3.1 *Key Interest Groups*

Table 6.1 List of all individual and group stakeholders directly consulted

Group	Stakeholder
Key Interest Groups	
Immediate Community	• Participating landowners • Neighbouring residents
Local Aboriginal Groups	• Yukkumbruk • Peter Falk Consultancy • Pejar Local Aboriginal Land Council • Gundungurra Aboriginal Heritage Association Inc

	• Yass Valley Indigenous Consultative Committee Community Development • Ngunawal Heritage Aboriginal Corporation • 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 • Onerwal Local Aboriginal Land Council
Local Community and Businesses	• Locally elected members • Title holders of mineral exploration leases and mining licences within the Study area # • Interested people in the broader community • Local Businesses • Local Schools and Education Centres • Boorowa Rotary • Boorowa Business Association • Boorowa District Landscape Guardians • Apex (Boorowa) • Boorowa Education Foundation • Lions Club (Yass) • Rotary Club (Yass) • Industry Capability Network • Beyond Zero Emissions • Landcare (Boorowa) • Country Women's Association (Boorowa) • Lachlan Catchment Management Authority (LCMA) • NSW Farmer's Association (Yass) • Probus (Yass) • Regional Development Australia • Boorowa Historical Society • Tablelands Livestock Health and Pests Authority • Yass Valley Men's Shed • Yass Toastmasters • St Joseph's Boorowa • Boorowa Central School • Rye Park Public School • Yass High School

Indicates those stakeholder groups that were identified by the DPE as key consultees and provided input into the DGRs.

Website Launch: In March 2011, to coincide with initial consultation, the Project website (www.bangowindfarm.com.au) was launched as a means of providing ongoing, up-to-date information to interested stakeholders. The website provides copies of newsletters, community consultation documentation and regular information updates on the Project as a whole. The website also provides a mechanism for people to provide feedback via an online survey, as well as contact details for the Proponent should they wish to discuss specific issues directly.

Initial Consultation: Face-to-face contact was made with neighbouring residents during the week commencing 30th July 2012 within approximately 3 km of the Project site. Upwards of 50 neighbouring residences were visited. These residents were provided with information on key points of the Project proposal and Newsletter #1 (see **Appendix 7**), office contact details including the contact details of the Development Manager for the Project, a Public Opinion Survey to complete and a Frequently Asked Questions (FAQ) brochure on generic wind farm facts. In the event of the resident being absent or access was prohibited (i.e. 'Private Property' or 'No Trespassing' signs on gates), a package containing the aforementioned material was left at the main door, letterbox or gate.

In August 2012, letters were sent to over 50 groups, individuals, community leaders, Government organisations and MPs introducing and describing the Project and providing access to all publicly available information about the Project. Contact details and a link to the website were provided to ensure further information could be sought if desired.

Public Open Day: A Public Open Day was held for the Project at Boorowa Bowling Club, Boorowa on 16th August 2012. Residents within the district were advised of the Public Open Day by way of a unaddressed mail out of Newsletter #1 as well as advertisements in the local newspapers (Yass Tribune and Boorowa News) for the two weeks leading up to the event. A press release was also issued to local media outlets, including the aforementioned newspapers, as well as the Canberra Times, ABC Central West and Prime Television, inviting people to participate.

The Public Open Day, attended by almost 40 people, presented details of the Project and associated electrical infrastructure. Display panels were used to present a wide range of information including maps of Layout options and photomontages of the likely appearance of the Project. Also displayed was information collected during the preparation of the EIS and general wind farm facts and figures. Sonus were engaged for the day to present a noise demonstration for attendees. They demonstrated the typical audibility of a wind farm. A DVD presentation from the British Wind Energy Association (BWEA) was shown, outlining the key features of wind farms during planning, construction and operation.

Copies of the first Bango Wind Farm newsletter, FAQ brochure and company information relating to CWP Renewables (CWPR) were also made available. Six members of the CWPR team were on-hand to answer questions and explain the details of the Project.

Residents in proximity to the Project: There has been a particular consultation focus on the residents in close proximity to the Project. Neighbouring residents within 2 km of proposed turbines have been actively engaged to respond to the Draft Guidelines as described in **6.5.2 Neighbour Agreements**. Additional direct consultation effort has also been made for residents and landholders within approximately 5 km of the Project. These efforts have sought to ensure that landholders with greater potential impact from the Project have not only been informed about the development but could provide important feedback to inform design changes and mitigation measures. Residents have been engaged through the Public Opinion Survey, discussing the details directly with CWPR staff on the phone, in private meetings, at the Public Open Day, and were also able to keep up to date through the Project website.

Project Refinement: A number of modifications have been made to the Project site since the original project envelope was presented in the PEA in March 2011, significantly reducing the size of the development (see **Figure 6.1**). These modifications were made as a direct result of lengthy community consultation and input and desktop studies. An update was provided to the community in Newsletter #1 (see **Appendix 7**) describing the extent of the removed and newly identified wind turbine investigation areas.

Modifications were made to the Project based on a number of factors, including:

- Stakeholder feedback regarding land use and land use changes in the areas surrounding Yass;
- Updated wind modelling across the Project site;
- Availability of new wind turbine models in the market;
- Consideration of the Draft Planning Guidelines for Wind Farms;
- Ongoing stakeholder consultation; and
- Findings from ecological assessments which commenced in 2012.

This development approach resulted in the robust Project Layouts which are proposed and assessed in this EIS.

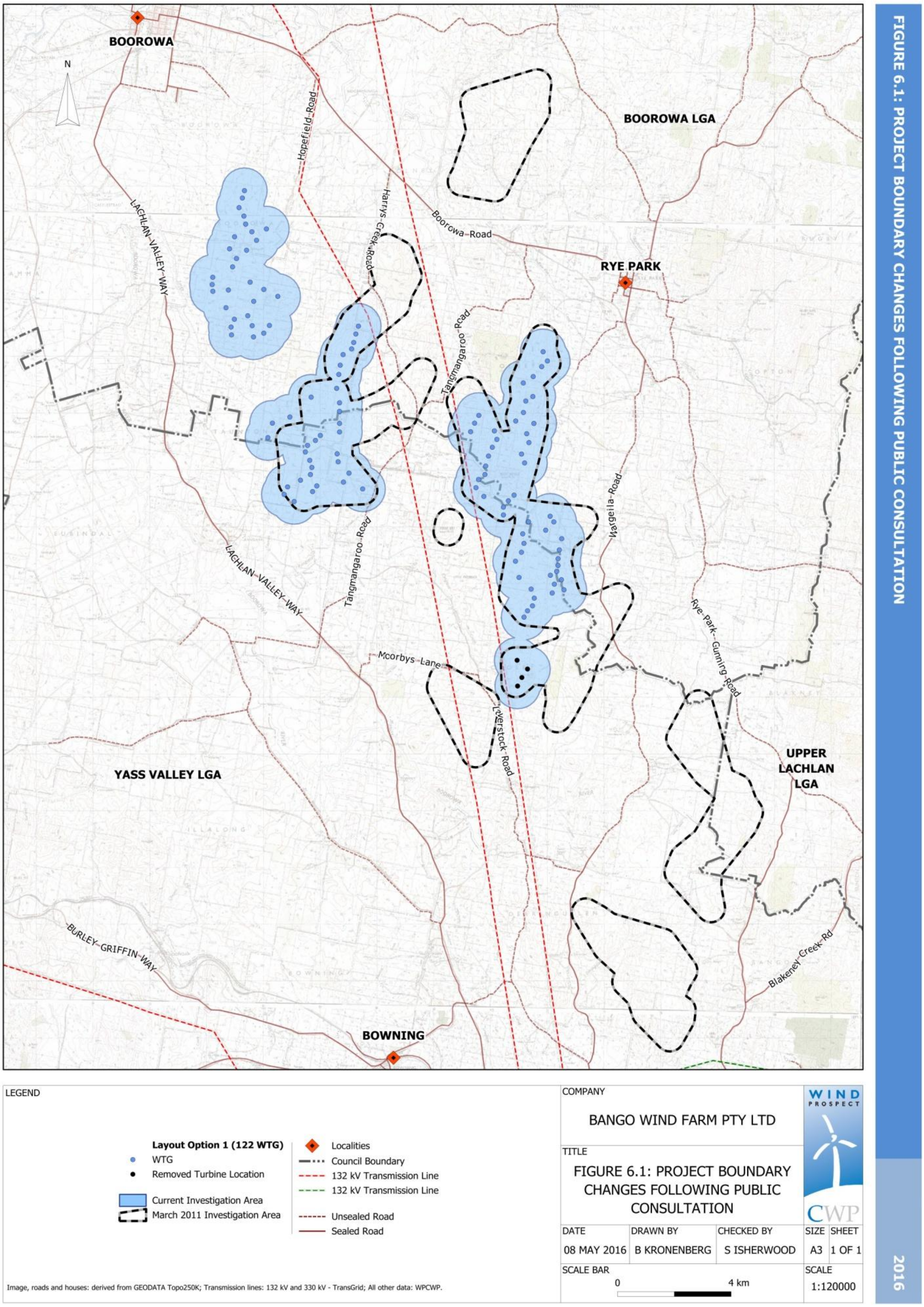

Figure 6.1 Project boundary changes following Public Consultation

(*An A3 size version of this Figure is displayed in Volume 2*)

6.3.2 *Key Government Consultees*

Table 6.2 List of all Key Government Consultees

Group	Stakeholder
Key Government Consultees	
Local Councils	• Yass Valley Council # • Boorowa Council # • Upper Lachlan Shire Council #
NSW Government Departments	• NSW Aboriginal Land Council (NSW ALC) • NSW Office of Environment and Heritage (OEH) # • NSW Department of Primary Industries (DPI) # • NSW Department of Trade and Investment, Regional Infrastructure and Services (now NSW Trade & Investment (NSW T&I)) • NSW Office of Water (NOW) # • NSW Department of Lands (DoL) - Crown Lands / Native Title • NSW DoL - Surveyor General • NSW Roads and Maritime Services (RMS) # • NSW Rural Fire Service (RFS) #
Federal Government Agencies	• Department of Environment (DoE) • Department of Climate Change and Energy Efficiency (DCCEE) • Department of Defence (DoD) # • Civil Aviation Services Australia (CASA) # • Airservices Australia (AsA) #
Service Providers	• TransGrid # • Essential Energy

Indicates those stakeholder groups that were identified by the DPE as key consultees and provided input into the DGRs.

6.3.3 *Other Government and Non-Government Consultees*

Table 6.3 List of all Other Government and Non Government Organisation Consultees

Group	Stakeholder
Other Government and Non Government Organisations	
Other Government and Non Government Organisations	• Australian Conservation Foundation • Greenpeace • Beyond Zero Emissions • Friends of the Earth • Planet Ark • Nature Conservation Council NSW • Conservation Volunteers Canberra • Greening Australia • World Wide Fund for Nature Australia (Threatened Species Network) • Office of the Clean Energy Regulator • Aerial Agricultural Association Australia # • Bureau of Meteorology (BoM) • Goldenfields Water County Council • Harden Council • Australian Rail Track Corporation(ARTC) • Australian Communications and Media Authority (ACMA) • NSW Government Network Radio Service • NSW Police Service • NSW Ambulance Service • NSW State Emergency Service • NSW Farmers Association • Broadcast Australia (incl. ABC) • Optus • Telstra • SBS Corporation • PRIME • NBN • Channel Ten • Channel Seven • WIN (Channel 9) Television

Indicates those stakeholder groups that were identified by the DPE as key consultees and provided input into the DGRs.

A Stakeholder Consultation Plan created from the outset of the Project is summarised in **Table 6.4**. The plan details the timeline of dissemination of information and consultation with all three stakeholder categories. Throughout this period, consultation continued with all stakeholders that expressed an ongoing interest in the Project.

Table 6.4 Key stages in the consultation process

Approximate Timing	Category / Group / Stakeholder	Nature of Consultation
General Activity		
2008 - ongoing	Participating landowners	Initial approach, licence negotiation, ongoing development liaison.
	TransGrid	Initial approach, ongoing grid connection studies, consultation on connection options.
February 2011	DPE	In consultation with the DPE the Project was declared a Major Project under Part 3A of the *EP&A Act.*
February / March 2011	DPE OEH NOW DPI Yass Valley Council Boorowa Council Upper Lachlan Shire Council DoD CASA AsA	A Project Application and PEA were submitted, and initial DGRs were issued. It was determined that a Planning Focus Meeting was not required.
March 2011	Participating landowners RTA DoL	Notification of all landowners upon whom the proposed development may occur or impact, of the Major Project Application in accordance with Clause 8F of the *Environmental Planning and Assessment Regulation 2000.*
April 2011	All	Public consultation commenced for the Project. Bango Wind Farm website was launched and a media release was issued.
April 2011	All	Direct consultation with local stakeholders and local Councils regarding the Project continued and is ongoing.
July 2011	All	Participation in a carbon reduction feature in the Yass Tribune, with contact details for the Project supplied.
August 2011	DPE	Additional DGRs were issued.
November 2011	All	Project update and contacts included in the Southern Tableland Wind News produced by the Clean Energy Council, and distributed to 20,000 homes in the Southern Tablelands.
March 2012 onwards #	Neighbouring residents (within 2 km of a wind turbine)	Neighbour Agreement discussions with neighbours who have residences within 2 km of a proposed wind turbine location.
July 2012	Local Aboriginal Groups	Advertisments were published regarding proposed archaeological and cultural heritage surveys, seeking input into the process.
August 2012	All	Project Layout changed and reduced in response to community feedback over the previous 12 months. Wind Turbines were removed from the southern-most extent of the

Approximate Timing	Category / Group / Stakeholder	Nature of Consultation
		Project, and total number of Wind Turbines reduced.
August 2012 onwards #	Neighbouring residents	Newsletter #1 distributed and information disseminated via door-knocking within approximately 3 km of the Project site and feedback sought directly and through Public Opinion Survey.
August 2012	Neighbouring residents Key Interest Groups Yass Valley Council Boorowa Council	Public Open Day held in Boorowa incorporating maps, facts and figures, Newsletter #1 and finding from key assessments undertaken to date.
August 2012	Local Community Groups	Information disseminated via emails, accompanied by Newsletter #1.
	NSW Government Departments Yass Valley Council Boorowa Council	Information disseminated via email accompanied by Newsletter #1.
	Federal Government Departments	Information disseminated via email accompanied by Newsletter #1.
	Other Government and Non-Government Organisations	Information disseminated via email accompanied by Newsletter #1.
November 2012	All	Renewable Energy Feature in Yass Tribune
November / December 2012	Local Aboriginal Groups	Archaeological and cultural heritage survey participation.
February 2013	All	Newsletter #2 Mailed to all residents surrounding the Project, and distributed to interested stakeholders. The Newsletter included information about the CCC and technical assessments being undertaken for the Project.
March / April 2013	CASA AsA AAAA DoD	Provision of Project information, and request for input into the Project Aviation Impact Statement (Rehbein Consulting).
April 2013	TransGrid	Connection Enquiry was submitted.
May 2013	DPE and Proponent	Submission of EA to DPE for Adequacy Review.
October 2013	Involved Landowners Project Neighbours CCC members	A site visit to Gullen Range Wind Farm was run for those interested in seeing a wind farm up close.
December 2013	Australian Government	RET Review process begins.
March 2014	DPE	Project transitioned to Part 4 State Significant Development following repeal of Part 3A.
April 2014	Key Interest Groups	Project Update and contact details were provided by email. Input into Project development was sought.
May 2014	Key Interest Groups	A presentation was made to the Yass Rotary Club regarding the Project.

Approximate Timing	Category / Group / Stakeholder	Nature of Consultation
May 2015	Australian Government	RET Review completed with negotiated agreement of a reduced RET.
June 2015	DPE, DoE and Proponent	Formal adequacy response provided.
October 2015	DPE and Proponent	Response provided from DPE to Proponent regarding the EIS adequacy review.
November 2015	Local stakeholders Yass Valley Council Boorowa Council	Project update provided to key Project stakeholders.
February / March 2016	Neighbouring residents	Door knocking and mailout of Project update in Project area.
Community Consultation Committee #		
July 2012	Neighbouring residents, Key Interest Groups and Local Councils	First call for participation in Community Consultation Committee undertaken with media release, website, door-knocking, newsletter, Open Day notices and local paper adverts. Closing Date: 21st September 2012 (One response)
September 2012	Neighbouring residents, Key Interest Groups and Local Councils	Second call for participation in Community Consultation Committee undertaken with media release, website and local paper adverts. Closing Date: 31st October 2012 (Two responses)
February 2013	Neighbouring residents	Third call for participation in Community Consultation Committee undertaken with website, direct mail drop, newsletter. Closing Date: 31st March 2013 (One response)
August 2013	CCC members	Appointment of Chairperson and inaugural meeting of the CCC.
May 2014	CCC Members	Second meeting of the CCC held at Boorowa
November 2015	CCC Members	Third meeting of the CCC held at the Community Centre in Yass. This was attended by DPE representatives.
EPBC Referral		
March 2012	DoE	Referral submitted to DoE for assessment.
May 2013	DoE	Determination of 'Controlled Action' status under the EPBC Act.
May 2013	DoE	Request for additional information as Project will be assessed by preliminary documentation.
March / April 2016	All	Update community about upcoming public exhibition of the EIS and timeframes for submission through newsletter, website and

Approximate Timing	Category / Group / Stakeholder	Nature of Consultation
		mail drops.
Future		
May 2016	All	Public Exhibition of the EIS during which submissions can be made.
May 2016	CCC members	CCC meeting during public exhibition period.
May / June 2016	All	Ongoing notification of Project stakeholders regarding public exhibition and provision of information regarding the Project.
Q3 2016	Proponent	Prepare and submit a Response to Submissions Report in response to exhibition submissions.
Q1 / Q2 2017	DPE, PAC and DoE	Recommendation from DPE and if recommended for approval, review by the Planning Assessment Commission and final Development Consent decision.
Post Approval	Proponent	If approved, ongoing consultation about Project progression including regarding construction and operation, and complaints management throughout these stages.

 # Specific reference to the requirements of the Draft Guidelines.

6.4 Stakeholder Response

6.4.1 *Key Interest Groups*

A number of Key Interest Group stakeholders have provided input into the Project, highlighting a broad range of issues for consideration. Such input from local groups and individuals is important during the development of the Project in order to mitigate adverse impacts to the local community as far as practicable.

Issues raised by Key Interest Groups concerned broader aspects of the development that are considered throughout this EIS, summarised below in **Table 6.5**.

The issues raised have been addressed by the Proponent in a number of ways such as;

- Project modifications as shown in **Figure 6.1**;
- Expanding the scope of assessment studies; and
- Proposing reasonable and feasible mitigation measures and commitments.

Table 6.5 identifies the relevant chapter which contains the detailed response to each of the issues raised.

Table 6.5 Summary of the broader Key Interest Group issues and where addressed within the EIS

Key Interest Group	Issue Raised	Detailed Response
Neighbouring Residents and Local Community and	Visual impact including: • Scale of the proposed wind turbines; • How they fit within the existing landscape;	**Chapter 8**

Key Interest Group	Issue Raised	Detailed Response
Businesses	• Impact on local public viewpoints and residences; and • Night lighting.	
	Roads and maintenance including: • Dust impact; • Impact on level of service; • Deterioration of local roads; and • Risk of accidents.	**Chapters 12** and **18**
	Noise impact including: • Operational wind turbine noise; • Concerns about non-compliance with noise guidelines; and • Low frequency noise.	**Chapter 9**
	Economic value including local investment.	**Chapters 4** and **19**
	Community fund including: • Fund amount; • Types of projects and initiatives funded; and • Administration of the fund.	**Chapter 19**
	Bushfire risk including: • Impact on aviation support; and • Increased fire risk from the Project.	**Chapter 16**
	Health including impact on the health of local residents from the noise and / or infrasound of the operating turbines.	**Chapter 19**
	Decommissioning including: • Responsibility for removing infrastructure after the Project life; • Extent of removal; and • Likelihood of refurbishment.	**Chapter 18**
	Greenhouse emissions reductions including: • Energy repayment period; and • Emissions reduction compared to gas fired generation.	**Chapter 4**
	Dissemination of information including: • How project information has been distributed; and • Efforts undertaken to ensure residents and landholders knew about the project.	**Chapter 6** (this chapter)
	Communication impacts including impacts on mobile and TV reception.	**Chapter 14**
	Aviation impacts including impact on ability to fertilize and spray land within and near wind turbines.	**Chapter 13**
Local Aboriginal Groups	Archaeological and cultural heritage survey participation	Registered groups were invited to be involved in the cultural heritage surveys More information in **Chapter 11**

6.4.2 *Key Government Consultees*

Various environmental stakeholders have provided advice on flora and fauna species of potential significance in the area. Such stakeholders include OEH, DPE, Boorowa Council, NOW and DoE. Consultation with these agencies will be ongoing, with their input into the development process being critical for the appropriate environmental management of the Project site.

In addition to receiving the DGRs for the Project, the DPE also provided broader agency input that was used in defining assessment requirements. These are summarised in **Table 6.6** with respect to the relevant chapter of the EIS in which the issue is addressed. There are a number of additional Key Government Consultees that did not have the opportunity to provide input from the outset.

However, through identification and subsequent consultation, their opinions have been sought and considered in this EIS.

Consultation has been undertaken with Key Government Consultees by means of reviewing additional agency feedback provided with the DGRs on 31st March 2011, follow-up emails, phone calls and meetings relative to the interest/concern raised by each consultee. Feedback was sought relevant to the design of the Project, and to determine appropriate measures to mitigate and reduce the environmental impact of the Project.

Generally the requirements of the Key Government Consultees are more prescribed in their nature. **Table 6.6** below provides a summary of the categories of issues that were raised with reference to the chapters in which the details of the issues are considered.

Table 6.6 Summary of the broader Key Government Consultee issues and where responded to in detail within the EIS

Key Government Consultee	Issue Raised	Detailed Response
Boorowa Council	Human Health	**Chapter 19**
	Bushfire risk	**Chapter 16**
	Communication impact	**Chapter 14**
	Roads and maintenance	**Chapters 12** and **18**
	Socio-economic impacts	**Chapter 19**
	Waste management	**Chapter 18**
	Cumulative impact	Relevant chapters
	Decommissioning	**Chapter 18**
Upper Lachlan Shire Council	Roads and maintenance	**Chapters 12** and **18**
	Noise impact	**Chapter 9**
OEH	Biodiversity	**Chapter 10**
	Threatened species	**Chapter 10**
	Vegetation clearing	**Chapter 10**

Key Government Consultee	Issue Raised	Detailed Response
	Noise and Vibration	**Chapter 9**
	Waste	**Chapter 18**
	Water and Soils	**Chapter 17**
	Air quality	**Chapter 18**
	Cultural heritage	**Chapter 11**
DP&E	Cumulative impact	Relevant chapters
	Community consultation	**Chapter 6** (this chapter)
NOW	Water supply	**Chapter 3** and **17**
	Water courses, riparian corridors and Groundwater Dependant Ecosystems	**Chapter 17**
DoL (No response)	Trigonometrical stations	**Chapter 17**
T&I	Minerals	**Chapter 6** (this chapter)
LPMA	Crown Land / Native Title	**Chapter 18**
RMS (No response)	Roads and maintenance	**Chapter 12**
RFS (No response)	Fire and bushfire risk	**Chapter 16**
DoD	Aviation hazard	**Chapter 13**
	Communication impact	**Chapter 14**
CASA	Aviation hazard	**Chapter 13**
AsA	Aviation hazard	**Chapter 13**
AAAA	Aviation hazard	**Chapter 13**
DoE	*EPBC Act*	**Chapters 3** and **10**
TransGrid	Grid connection	**Chapter 6** (this chapter, see below)

The Proponent has submitted a 'Connection Enquiry' to TransGrid in order to progress the connection of the Project to the transmission network. This process is a preliminary formal arrangement that involves TransGrid and the Australian Electricity Market Operator (AEMO) in determining the Project's electrical connection requirements.

6.4.3 *Other Government and Non-Government Organisations*

Consultation also occurred with a range of Other Government and Non-Government Organisations, and a full list of these stakeholders is provided in **Table 6.3**, in **Section 6.3**.

A thorough assessment of aviation related hazards in conjunction with the responses received from DoD, CASA, AAAA and AsA can been seen in **Chapter 13** Aviation.

Some users or managers of various radio communications, telecommunication and television services have provided advice on the likely effect of the proposed wind turbines on their transmission signals. All advice received has been used in conjunction with results of electromagnetic interference studies (see **Chapter 14** Communication) to develop a compliant Layout or to propose mitigation measures in the event of concerns over interference from the Project.

6.5 Stakeholder Consultation under the Draft NSW Planning Guidelines: Wind Farms

6.5.1 *Extent to which the Guidelines apply to the Project*

The Draft Guidelines were issued by the DPE on 23rd December 2011, and a letter and Policy Statement was issued by the Director-General on 18th April 2012 asked all wind farm proponents to develop projects in accordance with the Draft Guidelines (see **Appendix 4**). A checklist was provided to highlight a project's requirements to follow the Draft Guidelines depending on how advanced they were through the planning process.

Bango Wind Farm is considered under the following category and subsequent requirements, as outlined in the checklist (as shown in **Appendix 4**):

> ***2. Applications for which DGRs have been issues but are yet to be exhibited.***
>
> *The guidelines will apply to the maximum extent possible to all wind farm applications for which the DGRs have been issues, but an environmental assessment has not yet been exhibited.*

6.5.2 *Community Consultation Committee*

The Proponent has established a Community Consultation Committee (CCC) following the release of the Draft Guidelines. Calls for nominations for the Bango Wind Farm CCC were made using a double-sided A4 Expressions of Interest (EoI) form. The form contained a summary of the requirements for CCC participation, in addition to general selection criteria questions for interested local stakeholders to complete and return (see **Appendix 6**).

There were three rounds of calls for participation, due to the low number of EoI forms returned at each stage in the process. **Table 6.7** summarises the key dates, responses received and the approach taken to promote the Bango Wind Farm CCC to the wider community.

Table 6.7 Community consultation key dates

Approximate Timing	Category / Group / Stakeholder	Nature of Consultation
Community Consultation Committee		
July 2012	Neighbouring Residents, Key Interest Groups and Local Councils	First call for participation in Community Consultation Committee undertaken with a media release 16th July 2012, website, door-knocking in the general area around the Project, Newsletter #1 by unaddressed mail delivery to localities of Boorowa, Kangiara, Laverstock and Rye Park between the 6th and 10th August 2012, Open Day notices and local paper adverts published in the Boorowa News on 2nd and 9th of August and in

Approximate Timing	Category / Group / Stakeholder	Nature of Consultation
		the Yass Tribune on 1st, 3rd,8th and 10th of August. Closing Date: 21st September 2012 (1 response)
September 2012	Neighbouring Residents, Key Interest Groups and Local Councils	Second call for participation in Community Consultation Committee undertaken with a media release titled Bango Wind Farm's Community Consultation Committee Deadline Extended issued on 15th October 2012, website and local paper adverts published in the Boorowa News on 18th and 25th of October and Yass Tribune on 17th, 19th, 24th and 26th October. Closing Date: 31st October 2012 (2 responses)
February 2013	Neighbouring Residents	Third call for participation in Community Consultation Committee undertaken with website, unaddressed mail drop to localities of Boorowa, Kangiara, Laverstock and Rye Park between the 25th February and 1st March 2013 which included Newsletter #2 and the EoI. Closing Date: 31st March 2013 (1 response)
8th August 2013	CCC members	Appointment of Chairperson and inaugural meeting of the CCC.

Due to the low rate of return after the second call for expressions of interest, advice was sought from the DPE in November 2012, informing them of the response rate and requesting further advice. DPE suggested a further targeted mail drop in the area around the wind farm, which was duly undertaken in February 2013. Newsletter # 2 plus the EoI were circulated to all mailboxes by Australia Post mail drop in the Project's local area. As a result of this third call for participation, one additional response was received.

The Proponent engaged an independent chair and set up an interim CCC with meetings held on 8th August 2013 and 6th May 2014. The Bango CCC is made up of:

- One independent chair;
- Two landowners within approximately 5 km from wind turbines in the Project;
- One landowner outside 5 km from wind turbines in the Project who also represents the local landscape guardian group;
- One involved landowner;
- A representative from each of Yass Valley and Boorowa Councils; and
- One representative from the Proponent.

A number of issues have been raised and discussed during the initial meetings of the CCC. These are summarised below in **Table 6.8** with respect to the relevant chapter of the EIS in which the issue is addressed in detail. The minutes of the CCC meetings are available to all stakeholders through the Project website at www.bangowindfarm.com.au and are included in **Appendix 6**.

Table 6.8 Summary of the issues raised by the CCC and where addressed within the EIS

Issue Raised	Addressed in Detail
Land Values	**Chapter 19**
Setback from residences	**Chapters 4, 6, 8**, **9** and **18**
Community fund	**Chapter 19**
Soil and landscape characteristics	**Chapter 18**
Bushfire risk	**Chapter 16**
Benefits to local business	**Chapter 4** and **19**
Draft NSW Planning Guidelines – Wind Farms	**Chapter 5**
Impact on endangered species	**Chapter 10**
Project timeframe	**Chapter 3**
Controlled Action under EPBC Act	**Chapter 5** and **10**

6.5.3 *Mineral Exploration and Mining Licence Holders*

Consultation letters and maps showing the layout of the Project were sent to all mineral exploration licence and mining lease holders identified by T&I and by searching in the Minview database, (DPI 2011a). The details of these licences and the status of communications are outlined in **Table 6.9**.

Table 6.9 Exploration Licences overlapping the Project site

Company	Titles	Status	Response
Oakland Resources Ltd	EL 7412 EL 7408	Expired Expired	Oakland Resources Ltd stated the Project would have had a significant impact on exploration activities.
Tungsten NSW PL	EL 6274	Expired	No response received
Ochre Resources Pty Ltd	ELA 5005	Application Date: 31st March 2013	No response received
Ochre Resources Pty Ltd	EL8313	Expiry: 14th October 2017	No response received
Ochre Resources Pty Ltd	ELA 5167	Application Date: 10th April 2015	No response received

Where achievable, the Project has avoided direct impact with any mining lease holders within the Project site. As exploration licences can be considerable in their geographic extent, however, it has not been possible to completely avoid direct impacts on such licences over the Project site. Given there is no active mining taking place in those areas until a mining lease is granted, the development of the Project is not restricted in any way at this time. Under the *NSW Mining Act 1992*, Division 2, should the Project be built prior to the granting of a mining licence, it would constitute a ‘significant improvement’ over the land (Clause 23A, Schedule 1) and would therefore limit the amount of mining activity which could take place in the vicinity of the Project.

6.6 Summary

Community engagement for Bango Wind Farm was undertaken extensively, and by way of numerous methods, including letters / emails of notification to stakeholders, face-to-face contact with neighbouring residents, a Public Open Day, consultation meetings with various stakeholders and the Community Consultative Committee. The Project website presents an ongoing, active consultation and information dissemination resource for people to track the development of the Project and provide comment (www.bangowindfarm.com.au).

Stakeholders include statutory bodies, local interest groups and regional residents. A number of consultees responded, including local community groups concerned about the Project, and provided input or advice. The Proponent maintains an ongoing consultation process, including periodic meetings of the Community Consultative Committee.

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CHAPTER 7

Assessment of Key Issues

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7. ASSESSMENT OF KEY ISSUES

A number of issues require assessment in the development of a wind farm. Each issue has varying importance depending on the type and scale of the project. The classification of an issue determines the level of assessment required.

Issues are identified in a number of ways, including:

- Relevance to guidelines, strategic plans or policies produced by the New South Wales government or other governing bodies;
- Reference to other projects, especially those in similar locations;
- Association to research and reference material on wind farms; and
- Outcomes from consultations with stakeholders.

The Secretary's Environmental Assessment Requirements (SEARs), issued under the *Environmental Planning and Assessment Act (EP&A Act) 1979*, requires key or additional issues be identified as these issues have the potential to create environmental or human impacts. This Environmental Impact Statement is structured to address the requested key issues and **Table 7.1** summarises each key issue and the investigation strategies employed. **Chapters 8** to **17** provide greater detail including the methodologies, results and mitigation measures recommended by these investigations for each key issue individually. Additional issues not directly required by the DGRs are identified in **Chapter 18** General Environmental Assessment and **Chapter 19** Socio-Economic Assessment.

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing developments and future developments to ensure that any potential environmental impacts are not considered in isolation.

Table 7.1 Key assessment areas related to the Project and methods of investigation

Key Issue	Addressed	Investigation Strategy
Landscape and Visual	**Chapter 8**	Assessment by Green Bean Design Pty Ltd, and broader stakeholder engagement
Noise	**Chapter 9**	Assessment by Sonus Pty Ltd, and broader stakeholder engagement
Ecology	**Chapter 10**	Assessment by Environmental Resources Management (ERM) Australia Pty Ltd, and broader stakeholder engagement
Cultural Heritage	**Chapter 11**	Assessment by New South Wales Archaeological Pty Ltd, and broader stakeholder engagement
Traffic and Transport	**Chapter 12**	Assessment by Samsa Consulting Pty Ltd and engagement with key agencies
Aviation	**Chapter 13**	Assessment by REHBEIN Airport Consulting and engagement with with key government agencies and broader stakeholders
Communication	**Chapter 14**	Assessment by Lawrence Derrick and Associates, and broader stakeholder engagement
Electromagnetic Fields	**Chapter 15**	Desktop review
Fire and Bushfire	**Chapter 16**	Assessment by Environmental Resources Management (ERM) Australia Pty Ltd and broader stakeholder engagement
Water	**Chapter 17**	Consultation with key government agencies and associated landowners
General Environmental Assessment	**Chapter 18**	Consultation with associated parties and desktop review
Socio-Economic Assessment	**Chapter 19**	Consultation with associated parties and desktop review

CHAPTER 8

Landscape and Visual Impact Assessment

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8. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

The Proponent commissioned Green Bean Design Pty Ltd (GBD) to prepare a Landscape and Visual Impact Assessment (LVIA) and supplementary Cumulative Landscape and Visual Impact Assessment (CLVIA) for the Project. The LVIA involved a comprehensive evaluation of the visual character of the landscape in which the Project would be located, and an assessment of the potential landscape and visual impacts that may result from the construction and operation of the Project, taking into account appropriate mitigation measures. The CLVIA assessed the Project in the context of other approved and proposed wind farm developments in the Project locality.

This chapter presents a summary of the LVIA methodology as well as the key results and findings from the assessment. The detailed results of the LVIA are included in **Appendix 8**.

The LVIA addresses the Secretary's Environmental Assessment Requirements (SEARs) for the Project, as well as feedback received as a result of consultation with local stakeholders and residents. Neither Yass Valley Council nor Boorowa Council have relevant policies or guidelines regarding landscape or scenic quality that may apply to developments of this nature.

The Australian Wind Energy Association and Australian Council of National Trust's publication *Wind Farms and Landscape Values National Assessment Framework* (June 2007), was utilised to form the methodology of the LVIA, which also encompasses the general assessment framework outlined in the National Assessment Framework. In addition to the National Assessment Framework, the LVIA has also included a review of the *National Wind Farm Development Guidelines* (Public Consultation Draft V2.4 2010).

The National Assessment Framework outlines four steps as follows:

- Step 1: Assess the Landscape Value:
  - Preliminary Landscape Assessment; and
  - Full Landscapes Assessment.
- Step 2: Describe and model the wind farm in the landscape;
- Step 3: Assess the impacts of the wind farm on landscape values; and
- Step 4: Respond to impacts.

For the purposes of the LVIA and CLVIA a blade tip height of 192 m was used. This height is 8 m (or 4 %) lower in height than the proposed maximum of 200 m. However, the turbine used is considered to be representative of the technology currently available on the market, and a review addressing the consistency of the assessment has been undertaken (see **Appendix 8**). The review found that no additional impacts would occur as a result of the 8 m difference in blade tip height.

8.1 Method

The LVIA methodology adopted by GBD has been applied to a number of similar LVIA State Significant projects assessed and approved by the New South Wales (NSW) Department of Planning and Environment (DPE), including wind farms in rural NSW.

The LVIA methodology included the following activities and assessments:

- Desktop study addressing visual character and identification of new locations within the surrounding area;
- Fieldwork and photography;
- Preparation of ZVI diagrams;
- Assessment and determination of landscape sensitivity;
- Assessment of significance of visual impact; and
- Preparation of photomontages and illustrative figures.

8.1.1 *Viewshed, Zone of Visual Influence and Visibility*

A core component of the LVIA is defined by the description, assessment and determination of the viewshed, zone of visual influence and visibility associated with the Project.

Viewshed: For the purpose of the LVIA, viewshed was defined as the area of land surrounding and beyond the Project which may be potentially affected by the Project. In essence, the viewshed defines the LVIA study area. The viewshed for the Project has been divided into a series of concentric bands (at 2 km, 5 km and 10 km distance offsets) extending across the landscape from the wind turbines. The viewshed extent can vary between wind farm projects, and be influenced or informed by a number of criteria including the height of the wind turbines together with the nature, location and height of landform that could limit visibility.

It is important to note that the wind turbines would be visible from some areas of the landscape beyond the 10 km viewshed; however, within the general parameters of normal human vision, a wind turbine at up to 200 m to the tip of the rotor blade would occupy a relatively small proportion of a person's field of view from distances in excess of 10 km.

The viewshed is used as a framework and guide for visibility assessment, as the degree of visual significance would tend to be gradated with distance although there are unlikely to be any distinct or abrupt noticeable changes between the nominated distances.

Table 8.1 Viewshed descriptors

Distance from Wind Turbine	Potential Viewshed Descriptors
>20 km	Wind turbines become indistinct with increasing distance. Rotor movement may be visible, but rotor structures are usually not discernible. Wind turbines may be potentially discernible but generally indistinct within the viewshed resulting in a Low level visibility and Nil level visibility where influenced or screened by surrounding topography and vegetation.
10 to 20 km	Wind turbines are noticeable but tending to become less distinct with increasing distance. Blade movement may be visible but becomes less discernible with increasing distance. Wind turbines are potentially discernible but generally indistinct within viewshed resulting in Low level visibility.
5 to 10 km	Wind turbines are visible but tending to become less distinct depending on the overall extent of view available from the potential receptor location. Movement of blades may be discernible where visible against the skyline. Wind turbines potentially noticeable resulting in Low to Moderate level visibility.
3 to 5 km	Wind turbines are clearly visible in the landscape but tending to become less

Distance from Wind Turbine	Potential Viewshed Descriptors
	dominant with increasing distance. Movement of blades discernible. Wind turbines are potentially noticeable but less dominant within the viewshed resulting in Moderate level visibility.
1 to 3 km	Wind turbines would generally dominate the landscape in which the wind turbine is situated. Potential for high visibility depending on the category of receptor, their location, sensitivity and subject to other visibility factors. Wind turbines are potentially dominant within the viewshed resulting in Moderate to High level visibility.
<1 km	Wind turbines would dominate the landscape in which they are situated due to large scale, movement and proximity. Wind turbines would be potentially dominant and significant within viewshed resulting in High level visibility.

Zone of Visual Influence (ZVI): The ZVI diagrams are used to identify theoretical areas of the landscape from which a defined number of wind turbines, or portions of wind turbines, may be visible within the viewshed. They are useful for providing an overview as to the extent to which the Project could be visible from surrounding areas.

ZVI diagrams have been prepared using Layout Option 1, which represents the maximum number of wind turbines and thus worst case, to show:

- Layout Option 1 to the tip of blade;
- Layout Option 1 to the hub height; and
- Layout Option 1 toward the whole wind turbine.

The ZVI diagrams are illustrated in **Figures 8.1** to **8.4** in **Volume 2**, and **Appendix 8**. The ZVI methodology is assumed to be conservative as the screening effects of any structures and vegetation above ground level are not considered in any way. Therefore the Project may not be visible at many of the locations indicated on the ZVI diagrams due to the presence of trees or other screening elements. A summary of the ZVI analysis is included in **Appendix 8**.

Visibility: The level of wind turbine visibility within the 10 km viewshed can result from a number of factors including the distance between a receptor and the Project, static or dynamic receptor locations (e.g. residents or motorists) or the relative position of the receptor to the wind turbines. Whilst the distance between a receptor and wind turbines is a primary factor to consider when determining potential visibility, there are other factors, for example the level of tree cover and weather conditions, which may also affect the degree of visibility.

In order to facilitate objective assessment of visibility, a set of key criteria was developed. The key criteria against which the visibility of the Project was assessed from each viewpoint include the distance of the viewpoint from the Project, the potential visual prominence of the Project, the number of visible wind turbines and the context in which the wind turbines are viewed. A number of factors existing at a local level can influence the visibility of the Project, including the visual backdrop of the proposal, local influences and visual desensitisation.

8.1.2 *Visual Absorption Capability and View Catchment*

Visual Absorption Capability (VAC) is a classification system used to describe the relative ability of the landscape to accept modifications and alterations without the loss of landscape character or deterioration of visual amenity. The VAC classification system is suitable to use on smaller ancillary structures where their scale and form is more readily absorbed by elements within the surrounding landscape. The VAC classification system, as described in **Table 8.2**, is used to determine the capability of the landscape to absorb the proposed collector and switching substation and transmission lines.

Table 8.2 Visual Absorption Capability descriptors

VAC Rating	VAC Description
High	Electrical infrastructure components would be extensively screened by surrounding vegetation and undulating landform.
Medium	Electrical infrastructure components would be visible but existing vegetation and surrounding landform would provide some screening or background to reduce visual contrast.
Low	Electrical infrastructure components would be highly visible either due to lack of screening by existing vegetation or surrounding landform (e.g. open flat farmland, cleared vegetation, or steep hillside crossing ridgeline).

8.2 Existing Situation

The landscape character of a site refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how this is perceived by people. It reflects a particular combination of geology, landform, soils, vegetation, land use and human settlement and creates a particular sense of place for different areas within the landscape (Horner and MacLennan & Envision 2006).

The existing landscape context of the site and its surrounding environment are classified into distinct and relatively homogenous areas of landscape character. As the landscape encompassing the Study area varies greatly, five landscape character areas (LCA) were defined using a combination of aerial, topographic and soil landscape maps and site photographs:

- LCA 1 – Undulating pastoral / agricultural landscape;
- LCA 2 – Drainage Lines;
- LCA 3 – Hills and Ridgelines;
- LCA 4 – Timbered areas; and
- LCA 5 – Rural residences.

The landscape sensitivity of the five LCAs were rated on a number of factors including; landform and scale, land cover, settlement and human influence, movement, rarity and inter-visibility with adjacent landscapes. Settlement and human influence and intervisibility have medium landscape sensitivity ratings across all of the LCAs while land cover and rarity have low to medium ratings across the LCAs.

The LVIA determined that the Project is likely to be an acceptable development within the viewshed, which in a broader context also contains built elements such as roads, agricultural industry, aircraft landing strips, communication and transmitter towers and transmission lines.

8.2.1 *Perception and Public Consultation*

Individual perception is an important issue to consider in any visual impact assessment, as the attitude or opinion of an individual receptor adds significant weight to the level of potential visual impact. These attitudes or opinions of individual receptors toward wind farms can be shaped and formed through a multitude of complex social and cultural values.

It is unlikely that wind farm projects will ever conform or be acceptable to all points of view. Some receptors accept and support wind farms in response to global or local environmental issues, others support the environmental ideals of wind farm development as part of a broader renewable energy strategy, but do not consider them appropriate for their regional or local area, whereas others find the whole concept of wind farms unacceptable.

Throughout the Project development phase Public Opinion Surveys (POS) were distributed to Key Interest Group stakeholders. In addition, a "*Have Your Say*" feature of the Project website provided the same functionality via an online form to capture stakeholder views, comments and concerns. The following table summarises the responses received.

Do you approve of wind being used to generate renewable electricity?		
No Answer	0	0 %
Yes	15	45 %
No	13	39 %
No view	5	15 %
Respondents	33	
On hearing of our proposal, what was your initial view?		
No Answer	0	0 %
I support it	7	21 %
I don't support it	19	58 %
Undecided	7	21 %
Respondents	33	
How close do you live to the proposed wind farm?		
No Answer	1	3 %
<15km	25	76 %
>15km	7	21 %
Respondents	33	
Does the website provide adequate information?		
Yes	5	28 %
No	13	72 %
Respondents	18	

Note: Respondents did not always answer each question posed, resulting in a range of respondent sample groups as evident above.

As discussed in **Chapter 6** Stakeholder Consultation, these results are statistically too small to determine an overall trend, however they do provide a snapshot of local community attitudes.

Whilst published research into the potential landscape and visual impacts of wind farms is limited in Australia, there are general corresponding results between those that have been carried out when compared to those carried out overseas.

In 2010, AMR Interactive on behalf of NSW Department of Environment & Climate Change (DECCW) survey polled 2,022 residents across the six Renewable Energy Precincts, including the Central Tablelands. The key findings of the survey indicated that:

- 85 % of people supported the construction of wind farms in NSW and 80 % within their local region; and
- 79 % supported wind farms being built within 10 km of residences and 60 % of people surveyed supported the construction of wind turbines within 1 to 2 km from their residences.

These results are reflected in other surveys including the community perception survey toward wind farms undertaken by Epuron for the Gullen Range Wind Farm Environmental Assessment in 2008. The results of the survey, which targeted a number of local populations within the Southern Tablelands, suggested that around 89 % of respondents were in favour of wind farms being developed in the Southern Tablelands, with around 71 % of respondents accepting the development of a wind farm within 1 km from their residence.

In 2012, CSIRO Science into Society Group released a report detailing research into nine wind projects representing states with the greatest wind resources (including NSW), and wind projects at various stages of development (operational, under construction, proposed and rejected) (Hall et al. 2012). The report found that there is strong community support for wind farms, including from rural residents who do not necessarily publicly express their views. However, against this background, the CSIRO also performed a review of media coverage of wind farms. Their review found more citations rejecting wind farms (32 reasons) than supporting wind farms (19 reasons); a finding that suggests a media bias which does not correlate with the general public's view (Hall et al. 2012). The existing planning process and regulatory approach was found to be an appropriate mechanism for project approval, however, this could be improved by a stronger framework for community engagement.

Whilst individual perception and local community attitudes toward project development are an important issue, and need to be considered in terms of potential landscape and visual impacts, there is also the issue of the greater potential societal benefit provided by renewable energy projects, as discussed in **Chapter 4** Project Justification.

8.3 Potential Impacts

The potential significance of visual impact resulting from the construction and operation of the Project would result primarily from a combination of the following factors:

- The visibility or extent to which the Project structures would be visible from surrounding areas;
- The degree of visual contrast between the Project structures and capability of the surrounding landscape to visually accommodate the Project;

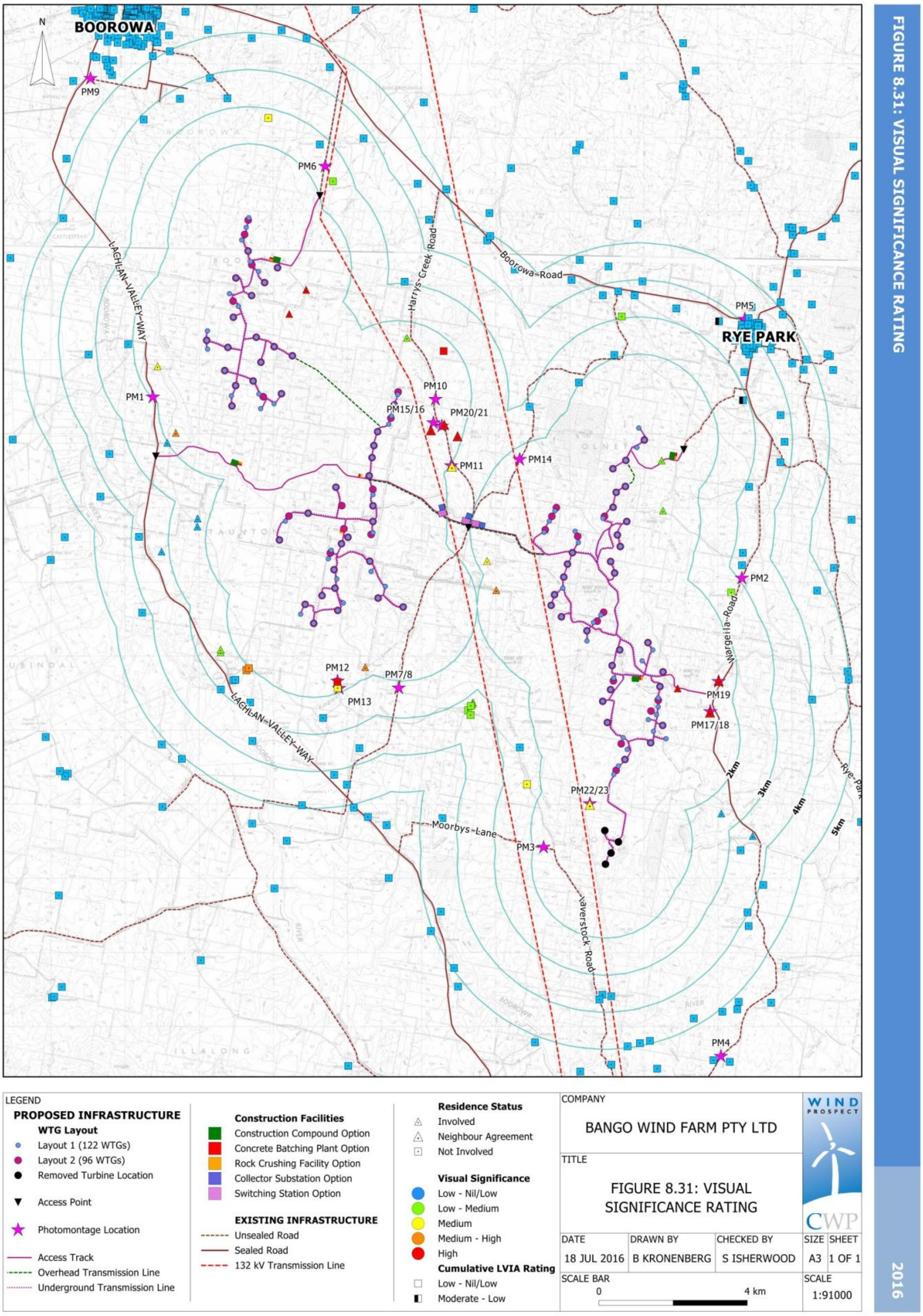
- The category and type of situation from which receptors may view the Project;
- The distance between receptor and wind turbines;
- The duration of time a receptor may view the Project from any static or dynamic view location;
- The visual sensitivity of receptors surrounding the Project; and
- The visual backdrop of the Project.

The criteria used to establish visibility and the significance of visual impact, and viewpoint locations are detailed in **Appendix 8**. The LVIA assessed the visual sensitivity and visual effect of residence viewpoints resulting in an overall visual significance rating ranging from Nil through to High. The Significance Ratings for residence viewpoints within 5km of the Project site are presented in **Figure 8.31** below and in **Appendix 8**. Each residence viewpoint has local influences (such as vegetation and topography) which may potentially screen the Project from view. These screening factors are described in **Appendix 8.** The following table lists those residences that were assessed as having a Medium Visual Significance or higher.

Table 8.3 Visual Significance rating of Medium or higher at residences in the Project locality

Residence ID	Status	Visual Significance Rating	Distance to Nearest Wind Turbine
100	Involved	High	0.5 km
119	Involved	High	1.0 km
225	Involved	High	1.0 km
101	Neighbour Agreement	High	1.1 km
115	Neighbour Agreement	High	1.3 km
136	Neighbour Agreement	High	1.5 km
154	Neighbour Agreement	High	1.9 km
155	Neighbour Agreement	High	1.4 km
235*	**Non-involved**	High	1.7 km
282	**Non-involved, Approved DA**	High	1.7 km
087	Involved	Medium to High	1.5 km
117	Involved	Medium to High	1.7 km
160	Involved	Medium to High	1.7 km
062	**Non-involved**	Medium to High	2.1 km
260	**Non-involved**	Medium to High	2.0 km
009	Involved	Medium	1.4 km
021	Involved	Medium	1.7 km
158	Neighbour Agreement	Medium	2.1 km
238	Neighbour Agreement Under Negotiation	Medium	1.0 km
076*	**Non-involved**	Medium	1.9 km
060*	**Non-involved**	Medium	2.4 km
283	**Non-involved, Approved DA**	Medium	2.7 km

*Denotes those residences where a Neighbour Agreement was offered and declined.



Image, roads and houses: derived from GEODATA Topo250K; Transmission lines: 132 kV - TransGrid; All other data: WPCWP.

Figure 8.31 Visual Significance Rating

(An A3 version of this Figure is displayed in Volume 2)

View locations beyond 5 km of the Project have a greater potential to be screened by topography, as well as tree cover to the east of the Project site. It is unlikely that residence viewpoints beyond 5 km of the Project would experience any high or moderate to high visual significance.

A local road network extends roughly parallel to the main ridgelines and hills within the Project area and provides a variety of direct and indirect view opportunities toward the Project. Tree planting alongside road corridors surrounding the Project site tends to restrict views to partial and glimpsed opportunities (including views from the Lachlan Valley Way and the Wargeila Road).

It is unlikely that the Project will have any significant visual impact on the Boorowa Township and smaller rural localities, including the Rye Park Village, which are located in the landscape surrounding the Project site. This is primarily due to the screening influence of undulating landform and the distance between the Project and potential view locations within the population centres.

Overall the LVIA has determined that the Project would have a medium visual significance on the majority of involved, neighbouring and non-involved residences located within the 10 km viewshed.

It should be noted that the term ‘visual impact’ may not necessarily always imply or represent an individual’s negative response toward the wind turbines, and that an individual’s perception of wind farms can be positive, negative or neutral.

8.3.1 *Shadow Flicker*

Residential: Wind turbines can cast shadows on surrounding areas at a distance from the base of the tower due to their height. When viewed from a stationary position, the moving shadows can appear as a flicker giving rise to the phenomenon of ‘shadow flicker’.

A shadow flicker assessment was prepared for Layout Option 1 to determine and illustrate the potential impact of shadow flicker on surrounding receptor locations. As there are no guidelines published in NSW by which to assess the impact of shadow flicker, the assessment adopted the Victorian Planning Guidelines that state:

“The shadow flicker experienced at any dwelling in the surrounding area must not exceed 30 hours per year as a result of the operation of the wind energy facility”.

The results of the shadow flicker assessment for the Project determined that nine dwellings may be subject to some levels of shadow flicker. The results of the shadow flicker assessment are outlined in **Table 8.4**, which determine that one neighbouring residence (subject to a negotiated agreement) and four involved residences surrounding the Project would experience shadow flicker in excess of 30 hours per year, as detailed in **Appendix 8**.

Table 8.4 Shadow Flicker Assessment

Residence ID	Status	Cluster	Shadow Flicker Hours / Year
009	Involved	Langs Creek	10.5
032	Involved	Mt Buffalo	75.03
041	Involved	Mt Buffalo	95.59
100	Involved	Mt Buffalo	136.19

101	Neighbour	Kangiara	73.34
115	Neighbour	Mt Buffalo	26.43
119	Involved	Langs Creek	60.4
225	Involved	Langs Creek	28.5

Motorists: There are no specific guidelines to address the potential impact of wind turbine shadow flicker across roads, although there are lighting standards that address the need to minimise the adverse effects of shadow flicker caused by some roadside or overhead objects. The standards suggest that the flicker effect will be noticeable and possibly cause annoyance for motorists between 2.5 and 15 Hz (2.5 to 15 flickers per second), and that a flicker effect between 4 and 11 Hz should be avoided for longer than 20 seconds. As the potential flicker frequency for the Project is likely to be around 1 Hz, it is unlikely that the flicker effect will cause annoyance or impact on a driver's ability to operate a motor vehicle safely whilst travelling along local roads surrounding the Project.

8.3.2 *Photosensitive Epilepsy*

The Canadian Epilepsy Alliance (2008) defines photosensitivity as '*a sensitivity to flashing or flickering lights, usually of high intensity, which are pulsating in a regular pattern – and people with photosensitive epilepsy can be triggered into seizures by them*'. Both the Canadian Epilepsy Alliance (2008) and Epilepsy Action Australia (2008) estimate that less than 5 % of people with epilepsy are photosensitive.

Epilepsy Action Australia (2008) suggest that the frequency of flashing or flickering light most likely to trigger seizures occurs between 8 to 30 Hz (or flashes / flickers per second), although this may vary between individuals. It also suggests that 96 % of people with photosensitive epilepsy are sensitive to flicker between 15 to 20 Hz.

Given the low flicker frequency associated with the Project (around 1 Hz), which falls below the range suggested by Epilepsy Action Australia as a potential trigger for photosensitive epileptic seizures, it is unlikely that the Project would present a risk to people with photosensitive epilepsy.

8.3.3 *Blade Glint and Reflectivity*

Blade glint refers to the reflection of sun from one or more rotating wind turbine blades. The occurrence of blade glint depends on a number of conditions, including the orientation of the nacelle, angle of the blade and angle of the sun. The reflectivity of the blades surface is influenced to some extent by the colour and age of the blade.

Blade glint can be mitigated through the use of matt coatings which, if applied correctly, will generally reduce potential visual impacts.

8.3.4 *Electrical works*

The Project would include electrical infrastructure to collect and distribute electricity generated by the wind turbines to the existing electricity network. The proposed electrical works are discussed in more detail in **Chapter 3** Project Description.

The three potential collector substation (CS) and switching station (SS) sites (only one of each will be constructed) will require the installation of low-level security lighting and emergency lighting for occasional use during the night. Both types of lighting will be directed downwards to minimise the level of visibility in the surrounding area. The substation sites would not be significantly visible from beyond their immediate location, and would be largely screened by landform and scattered trees within the north and central sections of the Project. Views from individual residential dwellings towards these locations would also be partially screened by localised landform and vegetation, therefore would not be subject to significant visual impacts from the electrical infrastructure.

While some of the electrical connections between the wind turbines and on-site CS will be via underground cabling, there will be some overhead transmission lines associated with the Project. The overhead transmission line will be used to export power from the wind farm to the TransGrid 132 kV transmission line running between the Kangiara and Mt Buffalo Clusters.

An assessment of the visual significance for the proposed overhead transmission line, CS and SS determined that 5 of 10 residences would have no visual significance and 5 of 10 residences would have a low visual significance. The LVIA determined that the electrical works (including the overhead transmission line, SS and CS) would be unlikely to have a significant visual impact on surrounding involved, neighbouring and non involved dwelling locations within 2 km of the proposed electrical works.

8.3.5 ***Night Lighting***

The Proponent commissioned REHBEIN Airport Consulting, an independent aviation safety expert, to conduct an Aeronautical Impact Assessment and Obstacle Lighting Review to determine the risks posed to aviation activities by the Project. The REHBEIN Aviation report, as discussed in **Chapter 13** Aviation Assessment, recommended that the Project may require lighting as duty of care, or other applicable mitigation measures, if a blade tip height of 150 m is exceeded. The outcomes of the aviation assessment (see **Appendix 15**) will be submitted to CASA and DIT for their consideration.

The withdrawn CASA Advisory Circular required two red medium intensity obstacle lights on top of the nacelle of specified turbines at a distance not exceeding 900 m and all lights were to flash synchronously. To minimise visual impact some shielding of the obstacle lights below the horizontal plane was permitted.

Further discussion on the assessment process and requirement for wind turbine lighting is included within **Chapter 13** Aviation Assessment.

Epuron (2008) conducted studies in Victoria on night time lighting mounted on wind turbines and discovered that lights could be visible for a number of kilometres. The actual intensity of the night time lighting was considered to be no greater than other sources of night time lighting, including vehicle head and tail lights. **Appendix 8** provides an illustration of the visual effect of night time lighting mounted on wind turbines at the Cullerin Wind Farm, New South Wales.

Existing night lighting in the area is present, associated with homesteads dispersed around the Project site. Headlights and brake lights from vehicles travelling along local roads would also create an intermittent source of illumination. Potential night time light sources generated by the Project could result from:

- Control and auxiliary buildings;
- Collector substation and switching station;
- Wind turbines and wind monitoring masts; and
- Scheduled or emergency maintenance.

Night time lighting associated with the wind farm is unlikely to have a significant visual impact on the majority of public view locations. Whilst obstacle lighting of the wind turbines would be visible to motorists travelling along the local roads, the duration of visibility would tend to be very short and partially screened by undulating landform and vegetation along some sections of local road corridors, as well as influenced by the direction of travel.

Night time obstacle lighting associated with the wind farm would be visible from a number of the residential view locations surrounding the Project; however, topography and screening by vegetation around residential dwellings would prevent or partially obscure views toward night time obstacle lighting.

8.3.6 *Cumulative Impacts*

A Cumulative LVIA (CLVIA) was undertaken to consider and assess the visual significance of the Project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation (see **Table 8.5**).

Table 8.5 Other wind farm developments within the 10 km Project viewshed

Wind Farm	Proponent / Owner	Status	Number of Wind Turbines	Direction from the Project
Rye Park Wind Farm	Trustpower	More information required to finalise assessment	109	East

Cumulative visual impacts can be combined or sequential, and are typically influenced by a range of factors including the distance between individual wind farms, the distance over which they are visible, the overall character of the landscape and its sensitivity, siting and design if the wind farms and the way in which the landscape is experienced.

The CLVIA study area was identified by overlapping the 10 km viewsheds for the Project and Rye Park Wind Farm, and used methodology and baseline visual significance results from the Project LVIA and the Rye Park Wind Farm LVIA. Within that study area, four areas were subsequently defined as a product of their distance from both wind farms:

- **Area A:** Residences are located within 5 km of both wind farms
- **Area B:** Residences are located within 5 km of the Project, but beyond 5km of Rye Park Wind Farm
- **Area C:** Residences are located within 5 km of Rye Park Wind Farm, but beyond 5 km of the Project
- **Area D:** Residences are located beyond 5 km of both the Project and Rye Park Wind Farm

Of the 18 residences assessed in Area A, eight were determined to have a Nil to Low cumulative visual impact, eight were determined to have a Low cumulative visual impact and two were determined to have a Moderate to Low cumulative visual impact. Residences within Rye Park village are located in Area A, however it was concluded that the Project would be largely screened by undulating landform, vegetation within and surrounding the village and distance from the village. **Table 8.6** below details those residences with a Moderate to Low cumulative visual impact.

Table 8.6 Cumulative visual impact rating of Moderate to Low at residences in the Project locality

Residence ID	Status	Cumulative Visual Impact Rating	Distance to Nearest Wind Turbine
051	Non-involved	Moderate to Low	3.6 km
048	Non-involved	Moderate to Low	2.9 km

For Areas B, C and D, the mitigating factors associated with residences, including local topography, vegetation and distance were considered. It was determined that the Rye Park Wind Farm would not be expected to increase the determination of visual impacts beyond their assessment within the LVIA.

A series of 'sequential' views would occur from local roads, although the journey between the wind farms would include a range of views extending toward and beyond wind turbines. The extent and overall visibility of wind turbines would be influenced by the direction of travel relative to the alignment of the wind farms, landform, the temporary nature of views from moving vehicles and reasonably extensive roadside vegetation.

The Rye Park Wind Farm is proposing to run a power line north-south through the project to the 330 kV transmission line. Given the distance these power lines will be away from the Project, the visual impact will be minimal in comparison to the wind turbines themselves.

8.4 Photomontages

Photomontages have been prepared to illustrate the general likely appearance of the Project following construction (see **Table 8.7**). Twenty three locations were selected to represent both residence and public viewpoints with views towards the Project. Photomontages PM 1 to PM 10 illustrate the proposed wind turbines from public view locations (such as road corridors), depicting a range of views including outlooks from Boorowa and Rye Park. Photomontages PM 11 to PM 23 were taken from non-involved and neighbouring residences within 2 km of the Project, in accordance with the requirements of the NSW Draft Guidelines.

The photomontages represent Layout Option 1 as it comprises the greater number of wind turbines and would present a worst case visual impact.

Table 8.7 Photomontage locations across the Project locality

Photomontage	Photo Location	Photomontage	Photo Location
PM1	Lachlan Valley Way – sealed road	PM13	235 Laverstock Cottage
PM2	Wargeila Road – unsealed road	PM14	158 Undurba Park

Photomontage	Photo Location
PM3	Moorbys Lane – unsealed road
PM4	Wargeila Road – unsealed road
PM5	Cook Street – Rye Park
PM6	Hopefield Lane – unsealed road
PM7	Tangmangaroo Road – unsealed road
PM8	Tangmangaroo Road – unsealed road
PM9	Meads Lane – sealed road
PM10	Harrys Lane – unsealed road
PM11	185 Klondyke
PM12	076 Laverstock

Photomontage	Photo Location
PM15	101 Valrosa
PM16	101 Valrosa
PM17	115 Banksia Downs
PM18	115 Banksia Downs
PM19	136 Bobby's Hill
PM20	155 Rocky Springs / Reve Nikia
PM21	155 Rocky Springs / Reve Nikia
PM22	172 Brookdale
PM23	172 Brookdale

The process used to generate the photomontages is detailed in **Appendix 8**. Whilst a professional photomontage provides an image that illustrates a reasonably accurate representation of a wind turbine, both in relation to its proposed location and its scale relative to the surrounding landscape, the LVIA acknowledges that large scale objects in the landscape can appear smaller in photomontages than in real life, partly due to the fact that a flat image does not allow the viewer to perceive any information relating to depth or distance.

8.5 Management and Mitigation

It is inevitable that wind turbines of the size proposed for the Project will have some degree of visual impact. However, a number of mitigation measures have been incorporated into the design of the Project, or form Project commitments, with the aim of minimising visual impact. These include:

Mitigation through design

- Location of the collector substation, switching station and other ancillary infrastructure have been sited sympathetically with the nature of the locality and away from major roads and residences to reduce visual impact;
- Tracks have been designed to follow contour lines, where possible, to ensure cut and fill in track construction is minimised; and
- The majority of electrical connections within the Project site (i.e. cables between the wind turbines) have been designed to be located underground, where possible, in order to reduce the need for overhead power lines and further reduce potential visual impacts; and
- Project layout design changes undertaken in response to community feedback through early engagement. See **Chapter 6** Consultation for more information.

Project Commitments

- Use of a matt and / or off-white finish on the structures to reduce visual contrast between wind turbine structures and the viewing background (this is subject to final wind turbine selection and aviation safety requirements);
- Limit amount of advertising, signs or logos mounted on wind turbine structures, except those required for safety purposes;
- Undertake landscape planting where screening is deemed appropriate and in accordance with the outcomes of the assessment process;
- Where feasible select materials and colours for ancillary structures with consideration of reflective properties;
- Reinstate disturbed soil areas immediately after completion of construction and decommissioning, where practicable, which would include re-contouring and re-seeding with appropriate plant species and local materials where feasible;
- Where practicable local materials will be used to reconstitute disturbed areas to minimise colour contrast;
- Enforce safeguards to control and minimise dust emissions during construction and decommissioning;
- Limit the height of stockpiles to minimise visibility from outside the Project;
- Except for emergencies, minimise activities that may require night time lighting and, if necessary, use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the Project site to minimise glare; and
- Where shadow flicker presents a problem at surrounding involved or non-involved dwellings, appropriate mitigation options will be adopted. These may include direct responses such as the installation of screening structures or planting of trees and / or the use of wind turbine control strategies, or an indirect response through negotiated agreement between the Proponent and dwelling owner.

In preparing the appropriate construction EMP sub-plan, consideration will be given to the suitability of the above and general mitigation measures outlined in **Appendix 8** with regard to the parameters of the Project.

Any residual impacts resulting from the Project after successful implementation of mitigation measures implemented through the EMP sub-plan and compliance with relevant codes and standards will be below acceptable levels.

8.6 Summary

The LVIA and CLVIA reports detail the current landscape values, predicted visual influence of the Project and other potential visual effects. A variety of methods were used in the visual assessment of the Project, including public consultation, on-ground surveys, ZVI assessments, photomontage production and assessment of shadow flicker effects.

In terms of overall landscape sensitivity, the LVIA determined that each of the five LCAs within the Project viewshed had a medium / medium to high sensitivity to accommodate change, and represented a landscape that is reasonably typical of other landscape types found in surrounding areas of the Southern Tablelands. Therefore, some characteristics of the landscape are likely to be altered by the wind farm; however, the landscape will have some capability to accommodate this adjustment. This capability is largely derived from the presence of predominantly large scale and open landscape across portions of the wind farm, together with the relatively low settlement density within the Project 10 km viewshed.

The LVIA determined that nine residences and one approved DA location have a high visual significance rating, two of which are not involved with the Project.

The LVIA has also determined that five residences have a medium to high visual significance rating, two of which are not involved with the Project.

The CLVIA determined that two residences would experience a Moderate to Low cumulative visual impact, both of which are not involved with the Project.

The LVIA determined that the Project is likely to be an acceptable development within the viewshed, which in a broader context also contains built elements such as roads, agricultural buildings and facilities, aircraft landing strips, communication and transmitter towers and overhead transmission lines.

There are a number of potential visual effects associated with the Project. The likely incidence of glinting is impossible to predict, but experience suggests that this occurs relatively rarely. Shadow flicker effects are likely to be experienced in excess of 30 hours per year by one residence with which the Project has a Neighbour Agreement and four involved residences. Night time lighting has the potential to be visible from surrounding receptors, however the level of visual impact would diminish over distance and when screened by landform or vegetation. The Project will have some degree of visual influence, however it is unlikely that wind farm projects will ever conform, or be acceptable to all points of view.

The collector substation and switching station locations and overhead transmission line options are unlikely to result in a significant visual impact for the majority of surrounding residential or public view receptors due to a combination of distance, undulating landform and tree cover.

CHAPTER 9

Noise Assessment

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9. NOISE ASSESSMENT

The Proponent commissioned Sonus Pty Ltd (Sonus) to conduct an Environmental Noise Assessment of the Project (see **Appendix 10**). The assessment addresses the Secretary's Environmental Assessment Requirements (SEARs) for the Project which require the operational noise to be assessed against:

- The South Australian Environmental Protection Authority (SA EPA) *Noise Guidelines for Wind Farms 2009* (SA EPA Guidelines, **Appendix 9**) with a base level of 35 dB(A) (operational noise);
- The NSW *Industrial Noise Policy* (EPA 2000) (operational noise);
- *Interim Construction Noise Guideline* (DECC 2009) (construction noise);
- The NSW *Road Noise Policy* (DECCW 2011) (traffic noise); and
- *Assessing Vibration: A Technical Guideline* (DECC 2006) (construction vibration).

This chapter summarises noise fundamentals, describes the phenomena of wind turbine noise, and presents the results of the Environmental Noise Assessment of the Project. The methodology for predicting wind turbine noise levels at nearby residences is discussed and the predicted results are presented. Noise associated with wind farm construction activities is also discussed and potential mitigation measures are outlined.

9.1 Noise Fundamentals

Hearing is a fundamental human sense and is used constantly for communication and awareness of the environment. Noise is generally described as being 'unwanted' or 'unfavourable' sound and, to some extent, is an individual or subjective response because what may be 'sound' to one person, may be regarded as 'noise' by another.

The measurement and assessment of noise has been developed steadily over the last century, taking into account human response measures such as hearing damage and other potential health effects such as stress. Complex noise measurement and analytical devices have also been developed to facilitate the assessment process.

A-weighting and 'dB(A)': The overall level of a sound is usually expressed in terms of dB(A) (decibels), which is measured using the 'A-weighting' filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. A person's hearing is most sensitive to sounds at mid frequencies (typically 500 to 4,000 Hertz (Hz)) and less sensitive at lower and higher frequencies. The level of a sound in dB(A) is considered a good measure of the loudness of that sound. Different sources having the same dB(A) level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (e.g. the loudness of human speech and a distant motorbike may be perceived differently, although they can be of the same dB(A) level).

A change of up to 1 dB(A) in the level of a sound is difficult for most people to detect, whilst a 1 to 5 dB(A) change corresponds to a small but noticeable change in loudness. A 10 dB(A) change corresponds to an approximate doubling or halving in loudness. **Table 9.1** below presents examples of typical noise levels.

Table 9.1 Typical noise levels

Sound Pressure Level (dB(A))	Typical Sources	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Source: SLR, 2011

9.1.1 ***Wind Turbine Noise***

There are two main sources of noise emissions from wind turbines. The first is aerodynamic noise from the rotation of the blades. Noise is generated by the blades passing through the air and passing the tower creating a ‘swishing’ sound, with the noise primarily arising at the tip and back edge of the rotor blade. The noise level increases with increasing wind speed, and thus rotation speed, until the rotation of the wind turbine blades is controlled (e.g. by feathering the blades) at a fixed speed.

The second source of noise is mechanical noise from the operating components of the wind turbine located in the nacelle. Mechanical noise has virtually disappeared from modern wind turbines, due to improved engineering. Technical improvements include elastically dampened fastenings and couplings of the major components in the nacelle, and a certain amount of sound insulation. The basic components themselves, including gearboxes, have developed considerably, with modern wind turbine gearboxes using ’soft’ gearwheels; that is, toothed wheels with hardened surfaces and relatively ductile root material.

The noise emitted from wind turbines is a function of the wind speed, with higher wind speeds producing higher wind turbine noise levels until the rotation is modulated. However, in a similar way, background noise levels also increase with increasing wind speed, with background noise generally increasing at a greater rate than wind turbine noise at high wind speeds.

9.1.2 ***Background Noise***

Background noise is a feature of the ambient acoustic environment and in rural areas it is generated primarily by wind action on vegetation. The level of background noise will vary across a project and with wind speed, depending on the surrounding topography, presence of vegetation and other sources of noise present in an agricultural environment. The ambient background noise of a project forms part of the noise assessment process for a wind farm.

9.1.3 *Substation Noise*

Transformer substations form an integral part of the Project, converting the incoming low voltage power generated by each of the wind turbines to higher voltages suitable for export to the neighbouring electricity network. The Collector Substation (CS) components are discussed in detail in **Chapter 3** Project Description. Transformers that are located with a CS emit a characteristic 'hum' which has been assessed in the context of their proposed location options for the purposes of this EIS. Switching Stations (SS) do not incorporate large capacity transformers and therefore are not assessed for operational noise.

9.1.4 *Overhead Transmission Lines*

Overhead transmission lines are typically silent in operation and are not normally a source of noise complaint. A slight crackling noise may be heard close to a transmission line (within 50 to 100 m) during some climatic conditions due to the corona effect, however these are considered negligible and temporary. In addition, there is the potential for wind-induced Aeolian noise to occur under specific conditions, although this is rare and only at times when there are high wind speeds and high background noise levels. There are mitigation measures available to reduce Aeolian noise if necessary.

9.1.5 *Construction and Decommissioning*

There will be some noise emissions from the construction and decommissioning of the Project, however such emissions will be localised and temporary. Examples of emission sources during construction include road and civil works, excavation and foundation construction, electrical infrastructure works and turbine erection, heavy vehicle movements, crushing and screening, concrete batching and possibly blasting.

9.2 Noise Guidelines

The SEARs issued for the Project in November 2015 required operational wind farm noise to be assessed against the SA EPA Guidelines 2009 with a base level of 35 dB(A) (see **Appendix 9)**. The guidelines were developed to assess and manage environmental noise impacts from wind farms in South Australia and have been adopted by DPE.

9.2.1 *Scope of SA EPA Guidelines*

The core objective of the SA EPA Guidelines is to balance the advantage of developing wind energy projects in South Australia (and adopting States) with protecting the amenity of the surrounding community from adverse noise impacts when taking into account the acoustic environment of that community. The SA EPA Guidelines were also developed to provide guidance for acceptable levels of noise generation from wind turbines on those residents at a relevant residence that do not have an agreement with the Proponent; that is, non-involved landowners. However, this does not exempt the Proponent from responsibilities regarding noise amenity for participating landowners or neighbours with whom agreements have been reached who may be affected.

The SA EPA Guidelines do not provide an assessment of the potential for low frequency noise or infrasound, but they do state that after an extensive literature search, the SA EPA is not aware of any infrasound being reported at modern wind farm sites (as opposed to projects containing earlier, downwind wind turbine models for which infrasound was a characteristic).

The SA EPA Guidelines require that non-involved residences are part of an acoustic assessment of wind turbine noise. Whilst nearby residences (i.e., typically those within around 1 to 2 km of a wind farm) may perceive some level of wind turbine noise at particular wind speeds and directions, careful project design and appropriate mitigation measures can ensure noise levels do not exceed guideline criteria.

9.2.2 *SA EPA Noise Guidelines for Wind Farms 2009 (NSW adoption)*

NSW have adopted the SA EPA Guidelines with the inclusion that:

> *"The predicted equivalent noise level ($L_{Aeq,\ 10min}$), adjusted for tonality in accordance with these guidelines should not exceed:*
>
> - *35 dB(A); or*
> - *the background noise level by more than 5 dB(A); or*
> - *whichever is the greater, at all relevant receivers for each integer wind speed from cut-in to rated power of the WTG."*

The SA EPA Guidelines explicitly state that the "swish" or modulation noise from wind turbines is a fundamental characteristic. However, it specifies that tonal or annoying characteristics of wind turbine noise should be penalised. If characteristics such as tonality are identified, the predicted noise level is penalised by the addition of 5 dB(A).

9.2.3 *World Health Organisation Guidelines*

The SA EPA Guideline criteria have been developed to minimise the impact on the amenity of those not involved with the Project. It is recognised however, that where financial agreements exist, the Proponent cannot absolve themselves of the responsibility of ensuring that an adverse effect on an area's amenity does not occur as a result of the operation of the Project. In light of the aforementioned requirement, the Proponent has referred to the World Health Organisation (WHO) criteria (for protection of amenity and avoidance of sleep disturbance) as published in the document *Guidelines for Community Noise (1999)*.

The criterion for Project involved residences within this assessment recognises the changed attitudinal response to noise from the Project for those financially involved with the Project. Furthermore, the implications of wind turbine noise have been discussed with each of the involved landowners in relation to their property. Therefore the assessment of the adopted external criteria of 45 dB(A) or the level provided by the SA EPA Guideline criteria, where higher, will be adopted. Effectively this becomes 45 dB(A) or background plus 5 dB(A), whichever is the higher.

9.2.4 *Other Relevant Guidelines*

Other relevant guidelines that address noise impacts relevant to the Project include the:

- NSW EPA *Industrial Noise Policy 2000* (INP) for the assessment of substation noise;

- NSW Department of Environment & Climate Change (DECCW) *Interim Construction Noise Guideline 2009* for the assessment of construction noise;
- DECCW *Assessing Vibration: A Technical Guideline 2006* for the assessment of construction vibration;
- DECCW *NSW Road Noise Policy* for the assessment of traffic noise associated with construction.

Further guidance on noise measurement and prediction is contained within Australian Standard AS4959-2010 *Acoustics - Measurement, prediction and assessment of noise from wind turbine generators*.

9.3 Methods

In general, the wind turbine noise assessment procedure contains the following steps:

1. Predict and plot the L_{Aeq} 35 dB(A) noise level contour from the Project under reference conditions. Receptors (residences) outside the contour are considered to be within acceptable wind farm noise levels.
2. Establish the pre-existing background noise level at each relevant receptor (residence) within the L_{Aeq} 35 dB(A) noise level contour through background noise monitoring.
3. Predict wind farm noise levels at all relevant assessment residences for the wind speed range from cut-in to 14 m/s.
4. Assess the compliance of wind farm noise at each relevant receptor (residence) with the relevant criteria.

Noise predictions were conducted by Sonus using the CONCAWE noise propagation model and SoundPLAN noise modelling software. The CONCAWE model considers the influence of sound power levels and locations of noise sources, separation distances between noise sources and receivers, topography, absorption of the ground, air absorption and meteorological conditions.

The predicted noise levels are made to an external location on the wind farm side of the residence and do not account for the influence of local structures or the residence itself. The façade of the residence will provide a reduction in noise such that the noise levels inside a residence will be significantly lower than the predicted external noise levels, even when the windows are open.

It should be also noted that the predicted noise levels are based on a downwind model that assumes the wind is blowing directly from each wind turbine generator to the receiver location. This is a conservative (higher noise level) assumption as it is not possible for a receiver location to be downwind from all wind turbines at any one time.

9.3.1 *Wind Turbine Noise*

Noise from both Project layouts, excluding the removed wind turbines has been assessed (see **Volume 2** – Layout maps). The coordinates of wind turbines for each layout are provided in **Appendix 2.** The noise assessment considered the following wind turbine models for each layout:

- Layout Option 1 – Senvion MM92 2.05 MW with a hub height of 80 m; and
- Layout Option 2 – GE 3.4-100 3.4 MW wind turbines with a hub height of 120 m.

These wind turbines were chosen based on the likely “worst case” (highest sound power level) wind turbine selection available to the Proponent at the time of the assessment.

Table 9.2 Wind Turbine Dimensions

Layout	Model	Hub Height (m)	Blade Length (m)	Blade Diameter (m)	Tip Height (m)
Layout Option 1	Senvion MM92 2.05 MW	80	45.2	92.5	126
Layout Option 2	GE 3.4-130 3.4 MW	120	63.7	130	185

9.3.2 *Background Noise*

In order to establish the intrusive noise limit, background noise monitoring is required to establish the pre-existing ambient noise environment as a function of wind speed. As wind speed increases the ambient noise level at most residences generally also increases as natural sources such as wind in trees, etc. begin to dominate. The variation in background noise with wind speed is usually quite site specific and related to various physical characteristics such as topographic shielding and the extent and height of exposed vegetation.

Background noise levels were measured at 14 locations in the vicinity of the Project between 16th August and 5th December 2012. The measurements were conducted in accordance with the SA EPA Guidelines. Separation of noise data collected at night was considered, but correlation over 24 hours was implemented.

The 14 monitoring locations, summarised in **Table 9.3**, were selected based on initial predictions of the Project’s noise. Preference was given to residences with the highest predicted noise levels and without commercial agreements, subject to access permission.

Table 9.3 Monitoring locations and periods

Residence ID	Residence Name	Monitoring Periods	
BAN0009	Noongah	16/08/2012 to 10/09/2012	08/11/2012 to 05/12/2012
BAN0032	Taree	17/08/2012 to 30/08/2012	08/11/2012 to 05/12/2012
BAN0034	Dovers Flat	16/08/2012 to 28/08/2012	07/11/2012 to 05/12/2012
BAN0048	Glenwood	16/08/2012 to 25/08/2012	08/11/2012 to 05/12/2012
BAN0060	Montalta	16/08/2012 to 01/09/2012	08/11/2012 to 05/12/2012
BAN0076	Laverstock	16/08/2012 to 11/09/2012	07/11/2012 to 03/12/2012
BAN0115	Banksia Downs	16/08/2012 to 09/09/2012	08/11/2012 to 05/12/2012
BAN0136	Bobbys Hill	16/08/2012 to 11/09/2012	08/11/2012 to 05/12/2012
BAN0144	Letona	16/08/2012 to 01/09/2012	08/11/2012 to 05/12/2012
BAN0152	Eversleigh	16/08/2012 to 11/09/2012	08/11/2012 to 05/12/2012
BAN0155	Rocky Springs	16/08/2012 to 01/09/2012	07/11/2012 to 05/12/2012
BAN0158	Uundurba Park	16/08/2012 to 31/08/2012	07/11/2012 to 05/12/2012
BAN0159	Danebank	16/08/2012 to 03/09/2012	07/11/2012 to 04/12/2012

BAN0170	Back Creek	16/08/2012 to 06/09/2012	07/11/2012 to 05/12/2012

Each noise logger was located in accordance with the SA EPA Guidelines (e.g., at an equivalent distance from the façade of the residence and any significant trees whilst minimising the influence of fixed noise sources such as air conditioning units) and placed on the Project side of the residence.

The background noise level was measured in 10 minute intervals at each of the monitoring locations. Photographs of the noise monitoring equipment at each location are provided in **Appendix 10**.

During the background noise monitoring regime, the Proponent measured the wind speed at a wind monitoring mast located locally within close proximity to the Project site. The wind speed was measured in 10 minute intervals at various measurement heights on each wind mast.

Local weather loggers were also concurrently deployed at residences BAN0158 and BAN0155 which measured rainfall and wind speed at the microphone height (approximately 1.5 m above ground level). The rainfall and wind speed data were collected to determine the periods when weather directly on the microphone may have influenced the measured background noise levels in the vicinity.

The noise data corresponding to any periods of measured rainfall and / or measured wind speed exceeding 5 m/s at the microphone height for more than 90 % of the measurement period were discarded.

Table 9.4 summarises the number of data points at each monitoring location, following the removal of wind data which may have been influenced by weather. Data below the cut-in wind speed of the wind turbine models considered (i.e., 3 m/s at 10 m AGL) have also been removed in accordance with the SA EPA Guidelines. It is noted that the resultant number of useable data points achieves the SA EPA Guidelines minimum requirement of 2,000 data points.

Table 9.4 Useable data points

Residence ID	No. of Usable Data Points
BAN0009	4832
BAN0032	3969
BAN0034	3952
BAN0048	3511
BAN0060	4295
BAN0076	4759
BAN0115	4751
BAN0136	4838
BAN0144	4135
BAN0152	4847
BAN0155	4290
BAN0158	4142
BAN0159	4331
BAN0170	4515

Following data removal, the background noise data were correlated with the wind speed data measured at the closest wind monitoring mast. A least squares regression analysis of the data was undertaken to determine the line of best fit for the correlations in accordance with the SA EPA Guidelines. Based on the regression analysis, the background noise level (LA90,10) at a range of wind speeds within the operating range of the wind turbines is provided in **Table 9.5**. The background noise levels in **Table 9.5** have been used to established noise criteria for each residence, in accordance with the SA EPA Guidelines. Where background noise monitoring has not occurred at a residence, the measured background levels at the closest monitoring location, located on the same side of the Project as the residence, have been used to derive the criteria.

Table 9.5 Background noise levels (dB(A))

ID	Background Noise Levels (dB(A)) at integer wind speeds at hub height (120 m AGL) (m/s)											
	3	4	5	6	7	8	9	10	11	12	13	14
BAN0009	29	30	31	32	32	32	32	32	32	33	35	38
BAN0032	27	28	29	29	29	29	29	29	30	31	33	35
BAN0034	31	32	33	33	33	33	34	34	35	36	37	40
BAN0048	28	30	32	33	34	35	36	36	37	38	39	40
BAN0060	28	28	29	29	29	29	30	31	32	33	36	39
BAN0076	31	31	31	32	32	32	32	33	33	34	36	39
BAN0115	31	31	31	32	32	33	34	35	36	37	38	39
BAN0136	26	27	27	28	28	29	30	31	32	34	36	38
BAN0144	25	26	27	27	28	29	30	31	32	35	37	40
BAN0152	29	30	31	31	32	32	33	34	35	37	39	41
BAN0155	23	23	24	25	25	26	27	29	30	32	34	37
BAN0158	25	26	28	29	30	30	31	33	34	37	40	43
BAN0159	25	26	27	28	29	30	32	33	35	37	39	41
BAN0170	25	26	27	28	28	28	29	30	31	32	34	37

9.3.3 *Substation Noise*

The noise from the proposed CS locations at the Project has been considered against the NSW EPA INP. Three location options are being considered for the CS. It is proposed that up to two transformers with capacities up to 100 MVA, or a single transformer up to 200 MVA will be installed. For a description on the potential locations, refer to **Chapter 3** Project Description.

The sound power levels of transformers have been derived from the Australian / New Zealand Standard AS/NS60076.10:2009. The worst-case (i.e., highest predicted noise level) transformer selections associated with the potential CS arrangement have been used (see **Appendix 10**).

9.3.4 *Site Establishment, Construction and Decommissioning*

The site establishment and construction of a project comprise activities such as road construction, civil works, excavation and foundation construction, electrical infrastructure works and wind turbine erection requiring processes such as heavy vehicle movements, crushing and screening, concrete batching, loaders, excavators, generators, cranes and, subject to local conditions, possibly blasting.

To assess construction noise in accordance with the SEARs, DECCW's *Interim Construction Noise Guideline 2009* (the ICN Guideline) has been considered.

The ICN Guideline provides an emphasis on implementing "feasible" and "reasonable" noise reduction measures and does not set mandatory objective criteria. However, the ICN Guideline does establish a quantitative approach, whereby "management levels" are defined based on the existing Rating Background Level (RBL). The management levels as defined by the ICN Guideline are provided in **Appendix 10**.

Construction: The equipment and activities on-site will vary throughout Project construction, depending on the various stages of construction. The predicted noise from construction activity is presented as a worst case (highest noise level) scenario, where it is assumed all equipment is present and operating simultaneously on-site for each stage of construction.

The weather conditions used for the predictions are the most conducive for the propagation of noise, comprising of an overcast day with a breeze from the construction activity to the residence. Other weather conditions would result in lower noise levels than those predicted for daytime construction.

Construction Vibration: To assess construction vibration levels in accordance with the DGRs, the DECC document "*Assessing Vibration: A Technical Guideline*", February 2006 (the Technical Guideline) is referenced.

The Technical Guideline provides an emphasis on construction activity implementing feasible and practicable vibration reduction measures and does not set mandatory standards or objective criteria.

Traffic Noise: Traffic generated by the Project during its construction phase has been evaluated in **Chapter 12** Traffic and Transport and **Appendix 14**. Traffic generated by the Project during its operational phase will be insignificant in the context of existing road use in the region.

In accordance with the SEARs, traffic noise associated with the construction of the Project was assessed against the *NSW Road Noise Policy* (DECCW 2011).

Traffic noise criteria are provided for a range of scenarios. The most appropriate classification for the Project construction site and its associated traffic is considered to be "land use developments with the potential to create additional traffic on local roads". However, it should be noted that this criteria applies to an ongoing operation, as distinct to a temporary construction process and as such provides a conservative (more stringent) approach.

The criteria are equivalent ($L_{Aeq,\ 1\ hour}$) noise levels of no greater than 55 dB(A) during the daytime (7 am to 10 pm) and 50 dB(A) during the night-time (10 pm to 7 am). This noise level is to be achieved outside, at a distance of 1.5 m from the façade of a residence.

9.4 Potential Impacts

9.4.1 *Impacts from Wind Turbine Noise*

Figures contained within the Environmental Noise Assessment report (**Appendix 10)** and **Figures 9.1** and **9.2** (see **Volume 2**), depict the predicted wind turbine noise level curves, residences and statistical results for each Layout Option and wind turbine model.

SA EPA Guidelines and WHO Guidelines: The operation of the Project has been considered against the stringent SA EPA Guidelines based on the Senvion MM92 wind turbine with a hub height of 80 m for Layout Option 1 and the GE 3.4-130 wind turbine with a hub height of 120 m for Layout Option 2.

The wind turbine noise predictions have been conducted on the basis that the sound power level data would be warranted. No penalty was a pplied during the assessment for the presence of tonal characteristics as the Proponent will seek a guarantee on tonality from the manufacturer as part of the procurement process.

Table 9.6 and **Table 9.7** show the predicted noise levels at residences where the SA EPA Guidelines and/or WHO Guidelines were shown to be exceeded for each of the Layout Options.

Table 9.6 Layout Option 1 Predicted Noise Level at Residences Where Exceedences Occur

Residence ID	Representative Logging Location	Criterion (dB(A)) for integer wind speeds					Predicted Noise Level (dB(A)) for integer wind speeds				
		8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
BAN100	BAN158	45	45	45	45	45	46	47	47	47	47

Table 9.7 Layout Option 2 Predicted Noise Level at Residences Where Exceedences Occur

Residence ID	Representative Logging Location	Criterion (dB(A)) for integer wind speeds					Predicted Noise Level (dB(A)) for integer wind speeds				
		8 m/s	9 m/s	10 m/s	11 m/s	12 m/s	8 m/s	9 m/s	10 m/s	11 m/s	12 m/s
BAN100	BAN158	45	45	45	45	48	46	48	48	48	48

Based on predictions, the noise from:

- Layout Option 1 will achieve the environmental noise criteria established in accordance with the SA Guidelines and the WHO Guidelines at all residences; and
- Layout Option 2 can achieve the environmental noise criteria established in accordance with the SA Guidelines at all non-involved residences. The WHO Guideline criteria will be met for all residences with the exception of BAN100.

In addition, to achieve the WHO Guidelines at BAN100 the acoustic performance of the façade would be assessed and potential acoustic treatment considered. This treatment might take the form of mechanical ventilation to allow windows to be closed and/or sealing any gaps around doors and windows.

Based on the above, for any wind turbine model with sound power levels and hub heights that are equal to or less than those assessed for the Senvion MM92 and GE 3.4-130, the respective Layout Options can achieve the stringent requirements of the SA EPA Guidelines.

If a wind turbine model with higher sound power levels or an alternative wind turbine hub height is later considered, the Proponent is committed to demonstrating compliance with the SA EPA Guidelines prior to construction, in a form similar to this assessment.

Compliance: Once the final wind turbine model has been selected, the noise assessment will be re-run to demonstrate compliance with the SA EPA Guidelines. Should there prove to be any exceedances at this stage, they will be resolved through micro-siting wind turbine locations, the removal of wind turbines, landowner agreements, or the reduction of wind turbine operational noise, whichever is deemed the most acceptable and appropriate solution to achieve compliance.

9.4.2 *Cumulative Impacts*

A Cumulative Environmental Noise Assessment was undertaken to consider the cumulative noise impacts of the Project and the proposed Rye Park Wind Farm, located to the east of the Project. Whilst Rye Park Wind Farm is still under consideration by DPE, it has been considered in this circumstance to provide an indication of any potential cumulative impacts should it be approved. The predicted noise levels indicate that the cumulative noise levels from the Project and the Rye Park Wind Farm can achieve SA EPA Guideline environmental noise criteria and WHO Guidelines for both Layout Options where a noise management strategy is implemented. For further detail refer to **Appendix 10**.

9.4.3 *Tonality*

As indicated above, the predictions have been conducted without a penalty for the presence of tonal characteristics. To provide certainty, the Proponent will seek a guarantee from the manufacturer as part of the procurement process. The general form of the guarantee should be that a penalty for tonality is not applicable at any residence when tested in accordance with an accepted methodology.

9.4.4 *Modulation*

Amplitude modulation, or “swish”, is an inherent noise character associated with wind farms. The SA EPA Guidelines explicitly account for “swish” as a fundamental characteristic of noise from a wind farm regardless of its depth, provided that it is generated by a properly maintained and operated wind turbine or wind farm. This is a key reason for the stringency of the SA EPA Guidelines.

9.4.5 *Van Den Berg Effect*

The Van Den Berg effect is a term that is used to describe “excessive” amplitude modulation as discussed above. The term has also been applied to a meteorological condition that produces a high wind shear whereby low wind speeds are experienced at ground level at a wind farm site with high wind speeds at hub height. Where the noise criteria is derived from background noise levels correlated with wind speeds measured close to ground level, there is the potential that the noise criteria could be exceeded in such a meteorological condition. The potential is reduced in this assessment by using the wind shear for each data point derived from two measurement heights that are well above ground level.

Notwithstanding this, the meteorological conditions required for the Van Den Berg effect typically occur during nights where there is little to no cloud cover and low wind speeds. The Van Den Berg effect has been observed on a flat site in Europe under these specific conditions.

In two matters before the NSW Land and Environment Court (Gullen Range Wind Farm NSW LEC 41288 of 2008 and Taralga Wind Farm NSW LEC 11216 of 2007), it has been determined by the relevant meteorological experts that the required meteorological conditions to trigger the effect were not a feature of the environment. In Gullen Range (NSW LEC 41288 of 2008), the meteorological analysis prepared by Dr Chris Purton concluded that suitable conditions for this effect were not a feature because of the elevated ridgeline location of the project (Purton, evidence NSW LEC 41288 of 2008).

A specific assessment of the meteorological conditions of the Project with respect to the Van Den Berg effect has not been made. Notwithstanding, if suitable conditions did exist to regularly generate high levels of “swish”, then there is no scientific research to indicate that the stringent SA EPA Guidelines do not adequately account for it. Indeed, given the conditions are more likely to occur at night, then sleep disturbance would be the main issue to address, and the noise standards applied by the SA EPA Guidelines to wind farms are significantly more stringent than limits established for the potential onset of sleep disturbance.

9.4.6 ***Low Frequency Noise***

Low frequency noise is not clearly defined but is generally regarded to mean noise in the range of 10 to 200 Hz. Noise occurring at frequencies below 20 Hz is often referred to as infrasound (see **Section 9.5.7**). The topic of low frequency noise is discussed in further detail in **Appendix 10** and in the British Wind Energy Association Technical Annex *Low Frequency Noise and Wind Turbines, 2005* (**Appendix 11**).

Low frequency noise is almost always present in an ambient quiet background, produced, for example, by machinery, transport, structure-borne noise and natural sources such as wind, waves and thunder. Low frequency sound produced by wind farms is not unique in overall level or content. Low frequency sound can be easily measured and heard at a range of locations at levels well in excess than in the vicinity of a project. Compliance with the SA EPA Guidelines will therefore inherently provide an adequate level of protection of amenity in the surrounding area from low frequency noise impacts.

Notwithstanding, predictions of the C-weighted noise level (the C-weighting is used to indicate the low frequency content) at residences have been made based on the worst-case (highest noise level) sound power level spectra for the models assessed for Layout Options 1 and 2 in this assessment. The predictions have considered the available sound power level data for frequencies down to 20 Hz.

Based on the predictions, the low frequency noise from the Project will be no greater than 60 dB(C) at all residences. These levels are below low frequency noise limits considered by the NSW authorities for recent developments and within the Draft Guidelines.

9.4.7 *Infrasound*

Infrasound is generally defined as noise at frequencies less than 20 Hz. The generation of infrasound was detected on early wind turbine designs, which incorporated the blades 'downwind' of the tower structure. The mechanism for the generation was that the blade passed through the wake caused by the presence of the tower. Modern wind turbines locate the blades upwind of the tower and it is found that wind turbines of contemporary design produce much lower levels of infrasound.

Whilst the aerodynamic noise from rotating wind turbine blades do produce low levels of infrasound, a large range of measurements of infrasound noise emissions from modern upwind wind turbines indicates that at distances of 200 m, infrasound is in the order of 25 dB below the recognised perception threshold of 85 dB(G) (see **Appendix 10**). The level of infrasound will further reduce at greater distances from the wind turbines, therefore the infrasound at residences is expected to be even lower as the separation distances between the Project and residences are well in excess of 200 m.

It is noted that there are natural sources of infrasound including wind and breaking waves, and of human-made sources such as industrial processes, vehicle movements, air conditioning and ventilation systems that produce infrasound at a similar or greater level than what has been measured at distances of 200 m of a modern wind turbine.

A recent study by the SA EPA into infrasound provided findings for both G and un-weighted measurement data at very low frequencies that were consistent with a wide range of national and international peer reviewed studies, including:

- Measured levels of infrasound from wind farms are well below the threshold of perception;
- Measured infrasound levels around wind farms are no higher than levels measured at other locations where people live, work and sleep; and
- Characteristics of noise produced by wind farms are not unique and are common in everyday life.

It is for the above reasons that infrasound from wind farms is not required to be assessed in contemporary standards and guidelines used by Australian and International authorities.

9.4.8 *Operational Vibration*

Operational vibration associated with the operation of wind turbines is expected to produce negligible impacts as non-audible perception of infrasound through felt vibrations in various parts of the body only occurs at levels well above the threshold of hearing. At distances of 200 m, infrasound is in the order of 25 dB below the recognised perception threshold of 85 dB(G) (see **Appendix 9**). The nearest residence is well in excess of the conservative distance of 200 m.

9.4.9 *Substation Noise Impacts*

Noise from the CS has been predicted and summarised in **Appendix 10**. The highest noise level predicted is 26 dB(A) at BAN0021 and 23 dB(A) at BAN0158, both of which have commercial agreements with the Proponent. The noise level at all other locations is predicted to be 20 dB(A) or less. Based on this analysis, the conservative criterion of 30 dB(A) will be achieved at all locations and as such will not adversely impact on the amenity of residences in the locality of the CS.

9.4.10 *Overhead Transmission Lines*

Operational noise associated with the proposed overhead transmission lines is expected to be negligible as transmission lines are typically silent in operation and are not normally a source of noise complaint. Electrically induced Corona noise can occur during rain or high humidity but is infrequent and rarely a problem at distances greater than 50 to 100 m. There is also the potential for wind induced Aeolian noise although this is also rare and occurs when there are high wind speeds and high background noise levels. There are mitigation measures available to reduce Aeolian noise if necessary.

For the maintenance of any overhead transmission line there would be a small number of vehicular movements and the potential for occasional helicopter patrols during inspections along the easement. These practices are generally considered acceptable across other transmission lines. In the unlikely event that complaints are received in relation to noise generation from maintenance activity, appropriate action would be taken by the Proponent to reduce any excessive noise impact.

9.4.11 *Impacts from Construction and Decommissioning*

Construction: The closest non-involved residence is approximately 1.7 km from the nearest proposed wind turbine. Distances greater than 1.7 km will result in lower noise levels than those presented in **Table 9.8.** The required separation distance in order to achieve 10 dB(A) above the RBL (i.e., a limit of 40 dB(A)) is provided in **Table 9.8**.

Based on the predicted noise levels, it is expected that construction noise will potentially be greater than 40 dB(A) for some activities at a distance of 1.7 km. The predicted noise levels are significantly less than the 75 dB(A) upper limit provided in the ICN Guideline. It is possible that a residence located between 1.7 km and 2.4 km from construction activity may be noise affected but not highly noise affected. Therefore, the Proponent will apply all feasible and reasonable work practices to meet the noise affected level, and will inform any impacted residences of the proposed construction work. Feasible and reasonable noise control strategies to minimise noise during construction are detailed in **Appendix 10**.

Construction Vibration: It is expected that the main sources of vibration will be the drilling rigs, where required, rock trenching equipment and roller operation during the road and hard stand construction. The level of vibration at a distance will be subject to the energy input of the equipment and the local ground conditions. Typically, the distances required to achieve the construction vibration criteria provided in the Technical Guideline for continuous, impulsive and intermittent vibration are in the order of 20 to 100 m. The 100 m distance is a conservative estimate, with vibration from these activities unlikely to be detectable to humans at such a distance.

Based on the separation distances between the construction activities and the nearest residences being well in excess of the conservative distance of 100 m, vibration levels are expected to easily achieve the criteria.

If construction activities do occur within 100 m of a residence, it is recommended that a monitoring regime is implemented during these times to ensure compliance with the Technical Guideline.

Blasting: The separation distances between the potential blasting activities and the nearest dwellings are in the order of magnitude for which ground vibration and airblast levels have been adequately controlled at other sites. Monitoring should occur around sites where blasting occurs to monitor and ensure compliance with the Blasting Guidelines.

Table 9.8 Predicted construction noise levels

Phase	Main Plant and Equipment	Predicted Noise Level at 1,700 m (dB(A))	Separation to Achieve 40 dB(A) Criterion (km)
Site set-up and civil works	Generator Transport truck Excavator Low loader	40	1.65
Road and hardstand construction	Mobile rock crushing plant Dozer Roller Low loader Tipper truck Excavator Scraper Transport truck	46	2.4
Excavation and foundation construction	Excavator Front end loader Concrete batching plant Mobile rock crushing plant Truck-mounted concrete pump Concrete mixer truck Mobile crane Transport truck Tipper truck	46	2.4
Electrical installation	Rock trencher Concrete mixer truck Low loader Tipper truck Mobile crane	46	2.4
Wind turbine delivery and installation	Extendable trailer truck Low loader Mobile crane	41	1.8

Traffic Noise: Construction activity will incorporate passenger vehicle and heavy vehicle movements to and from the Project site along local roads in the vicinity of the Project. These vehicles will include semi-trailers, low loaders, haulage trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles.

The daytime criterion provided by the ECRTN is an equivalent ($L_{Aeq,\ 1\ hour}$) noise level of 55 dB(A) during any given hour. It is predicted that at a distance of 10 m from the road side the criterion can be achieved for ten passenger vehicle movements and three heavy vehicle movements in one hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. That is, the noise level of 20 passenger vehicles and six heavy vehicle movements could be accommodated in an hour at a residence that is 20 m from the roadside. It is noted that care should be taken to avoid the acceleration of trucks and the use of truck engine brakes in close proximity to residences.

9.5 Management and Mitigation

The following section lists mitigation measures relating to operational and construction noise of the Project.

9.5.1 *Wind Turbine Noise*

After final wind turbine selection and Project refinement, additional noise modelling will be carried out during pre-construction to ensure that the predicted noise levels are within required criteria based on the chosen wind turbine. Any variation in the predicted noise levels against the Conditions of Approval will be considered and appropriate mitigation measures implemented, where necessary, to ensure compliance.

If, during operation, wind turbine noise impacts are identified as having the potential to exceed the applicable limit due to temperature inversion, atmospheric stability or other reasons, then an 'adaptive management' approach can be implemented as a contingency strategy to mitigate or remove the impact. This process could include:

- Investigating the nature of the reported impact;
- Identifying exactly what conditions or times lead to undue impacts;
- Consideration of operating wind turbines in a reduced 'noise optimised' mode during offending wind directions and at night-time (sector management);
- Providing acoustic upgrades (glazing, façade, masking noise etc) to affected residences; and
- Turning off or operating in a noise reduced mode those wind turbines that are identified as causing the undue impact.

To achieve the WHO Guidelines at BAN0100 acoustic treatment will be investigated and implemented in consultation with the landowner as required.

Neighbour agreements have been put in place with a number of neighbouring properties. The NAs allow for noise impacts consistent with host residences (WHO Guidelines). As such, these residences have been considered as involved residences. For those residences without NAs, the wind farm will be designed that predicted noise levels are within the required criteria.

9.5.2 *Substation Noise*

If the preferred substation location is non-compliant with NSW INP the following mitigation measures would be applied as a contingency strategy where appropriate:

- The use of transformer(s) with a lower sound power level output;
- Landscaping, comprising where appropriate raised embankments and / or screening, around the substation; and
- Providing acoustic upgrades (glazing, façade, masking noise etc) to affected residences.

9.5.3 *Construction and Decommissioning*

Noise emissions from construction, major maintenance or decommissioning / refurbishment work can be minimised by continued adequate maintenance of construction vehicles, erection of temporary acoustic barriers and propriety enclosures around machines, and by ensuring work activities occur within recommended working hours, according to the SA EPA Guidelines, where practicable (i.e., 7 am to 6 pm Monday to Friday and 8 am to 1 pm Saturdays) and outside these hours for low noise construction activities and delivery of materials as required. Certain activities will require work to be conducted outside normal working hours to prevent damage to concrete tower bases and trenches, to reduce the safety risk of having open trenches and to reduce the risk of tower self-oscillation. These activities are detailed in **Chapter 3 Project Description**. Any work undertaken outside these hours will be subject to the normal consultative process with DPE in accordance with the conditions of approval. Any noise emissions from construction activity will be localised and temporary.

To minimise potential noise impacts associated with night-time deliveries, there will be prior notification to the affected public and restricted use of exhaust / engine brakes in built-up areas.

In preparation of the appropriate construction EMP sub-plan, consideration will be given to the suitability of the general mitigation measures related to construction outlined in **Appendix 10** with regard to the parameters of the Project. Any residual impacts resulting from the Project after successful implementation of mitigation measures implemented through the EMP sub-plan and compliance with relevant codes and standards will be below acceptable levels.

9.6 Summary

Wind turbine noise has been predicted and assessed against relevant criteria prescribed by the SEARs, SA EPA Guidelines, WHO guidelines and the Draft Guidelines where appropriate.

When assessed against the SA EPA Guidelines, Layout Option 1, equipped with the Senvion MM92 wind turbine, was predicted to comply with all relevant noise criteria and WHO guidelines at all neighbouring and involved residences. Layout Option 2, equipped with the GE 3.4-130 wind turbine, was predicted to comply with all relevant noise criteria and WHO guidelines at all neighbouring residences, and at all involved residences, where a noise management strategy is implemented.

Once the final wind turbine model has been selected, the noise assessment will be re-run to demonstrate compliance with the SA EPA Guidelines and SEARs. Any exceedances will be resolved through landowner agreements, reducing wind turbine operational noise, micro-siting wind turbine positions or by the removal of wind turbines, whichever is deemed the most acceptable and appropriate course of action.

Construction activity has been assessed and the ‘worst case’ scenarios modelled were found to be generally acceptable given the temporary and limited duration of the works.

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CHAPTER 10

Ecological Assessment

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10. ECOLOGICAL ASSESSMENT

Environmental Resources Management Pty Ltd (ERM) was commissioned to undertake an Ecological Impact Assessment (EIA) of the Project. The full report is available in **Appendix 12.**

This chapter draws from that report and summarises aspects of the methods used to capture data and the nature of the existing ecological features of the Project site. More pertinently an assessment of potential impacts, proposed avoidance, mitigation and management measures and an offset strategy with respect to those impacts are also presented.

For the purposes of the EIA, a blade tip height of 192 m was used. This height is 8 m (or 4 %) lower in height than the proposed maximum. However, the turbine used is considered to be representative of the technology currently available on the market, and a review addressing the consistency of the assessment has been undertaken (see **Appendix 12**).

In particular, a consideration of any change to impacts on avifauna flight paths was undertaken, and it was concluded that the blade tip height increase did not change the findings for the impact assessment for bird and bat species as reported in the EIA.

10.1 Legislative Framework

10.1.1 *Commonwealth Environment Protection and Biodiversity Conservation Act 1999*

A Referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*) was submitted to DoE in March 2013 addressing the likely impacts of the Project on Matters of National Environmental Significance (NES). A total of 30 EPBC listed threatened species and ecological communities were assessed for their likelihood of occurrence within the Study area, including the critically endangered Box-Gum Woodland (BGW), the critically endangered Golden Sun Moth (*Synemon plana*) and the vulnerable Superb Parrot (*Polytelis swainsonii*). Prior to submitting the referral, discussions were undertaken between the Proponent and ERM and subsequent re-design work carried out with the view to minimise impacts on listed threatened species and BGW wherever practicable.

The Project was designated a Controlled Action under the *EPBC Act* on 7th May 2013 due to the residual level of impact which would result from the construction of the Project. The Minister also decided that the Project will be assessed by preliminary documentation (PD), including the provision of supplementary information (see **Appendix 4**) to assess the relevant impacts of the action.

10.1.2 *NSW Legislation and Policy*

The Project is assessed under the following New South Wales (NSW) environmental acts and plans:

- Environmental Planning and Assessment Act 1979 (EP&A Act);
- Threatened Species Conservation Act 1995 (TSC Act);
- Native Vegetation Act 2003;
- National Parks and Wildlife Act 1974;
- Fisheries Management Act 1994;
- Noxious Weeds Act 1993;

- Threatened Species Conservation (Biodiversity Banking) Regulation 2008;
- State Environmental Planning Policy 44 (Koala Habitat);
- State Environmental Planning Policy (Major Development) 2005;
- Boorowa and Yass Valley Council's Local Environmental Plans (LEPs); and
- NSW Draft Planning Guidelines: Wind Farms 2011.

10.2 Methods

To understand the existing environment and any potential impacts, ERM conducted a literature review, vegetation mapping, flora and fauna surveys and a BioBanking Assessment of the Study area.

10.2.1 *Literature Review*

A review of all readily available literature, database records, imagery and maps pertaining to the ecology of the Study area and surrounding locality provided important background information which formed the basis for the assessment. A full list of all data sources is available in **Appendix 12**.

10.2.2 *Vegetation Mapping*

Vegetation mapping was undertaken throughout spring and summer 2012 – 2013. Approximate areas of woodland, grassland and cropping in the Study area were obtained from the aerial photography. These areas were refined via analysis of previous vegetation mapping datasets. Ground truthing during field visits allowed the stratification of vegetation types to be further refined, to produce a final and complete vegetation map of the Study area.

10.2.3 *Flora and Fauna Surveys*

Detailed flora and fauna surveys commenced in July 2012 and continued to February 2013 in accordance with Department of Environment and Conservation (DEC) *Threatened Biodiversity Survey and Assessment Guidelines Working draft* (DEC 2004a). Targeted flora and fauna surveys were undertaken for subject species identified by the Office of Environment and Heritage (OEH), species listed in the DGRs and any other threatened flora species considered to have the potential to occur in the Study area identified by database searches and the BioBanking Credit Calculator. For a full species list refer to **Appendix 12**.

10.2.4 *BioBanking*

The BioBanking Assessment was undertaken in accordance with the *BioBanking Assessment Methodology and Credit Calculator Operational Manual* (NSW DECC 2009). The Biobanking Credit Calculator required targeted surveys for four Endangered Ecological Communities (EEC), 12 threatened flora species, 41 threatened fauna species and nine migratory species. Targeted surveys were not undertaken for one of the species listed (Grassland Earless Dragon), as habitat assessments recorded no potential habitat in the form of native temperate grassland within the Study area.

10.3 Existing Situation

10.3.1 *Vegetation Types*

Two Lachlan Catchment Management Authority (CMA) Biometric Vegetation Types (BVTs) were recorded in the Study area, as shown in **Figures 10.1** to **10.3**:

- LA103: Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands; and
- LA182: Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion.

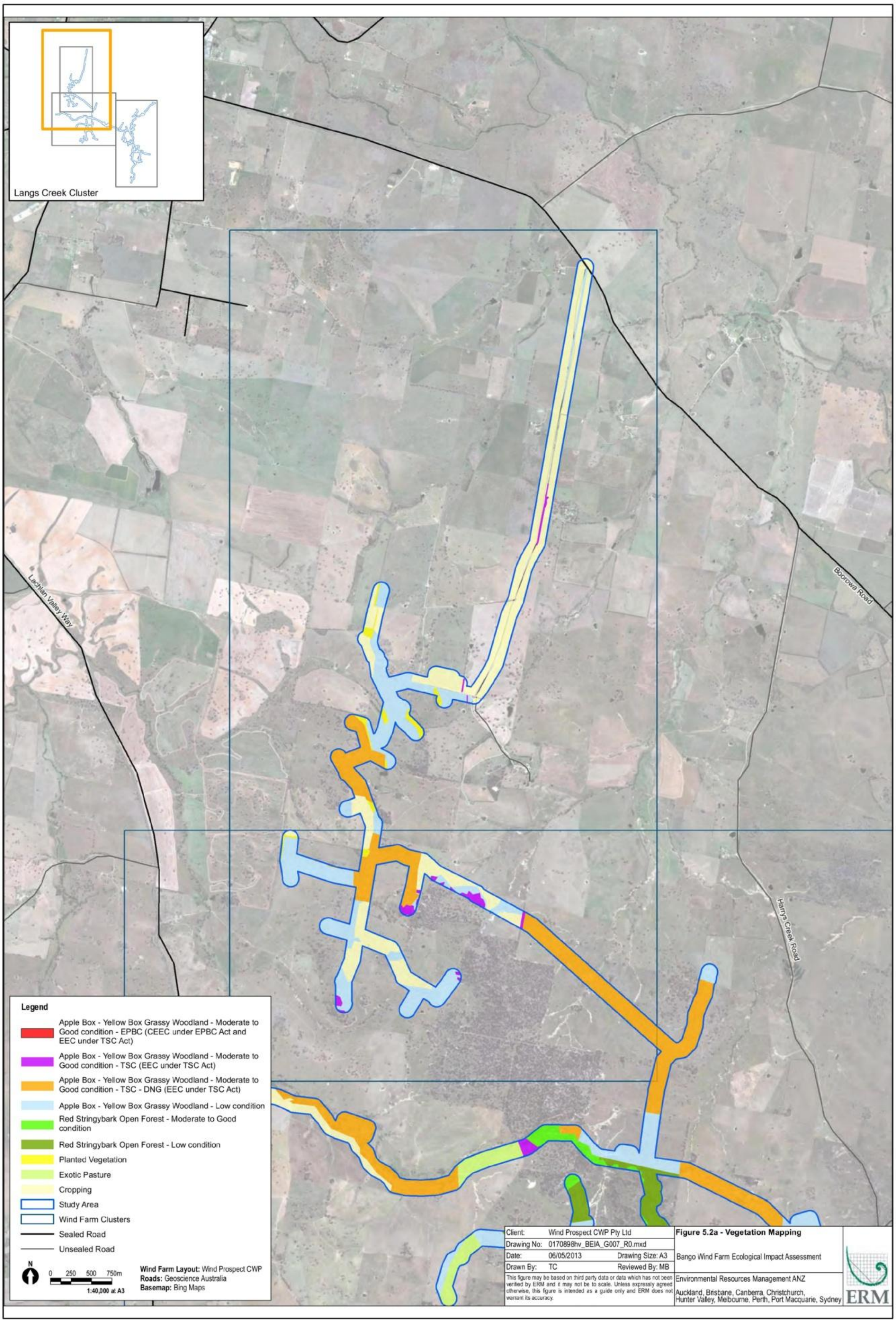


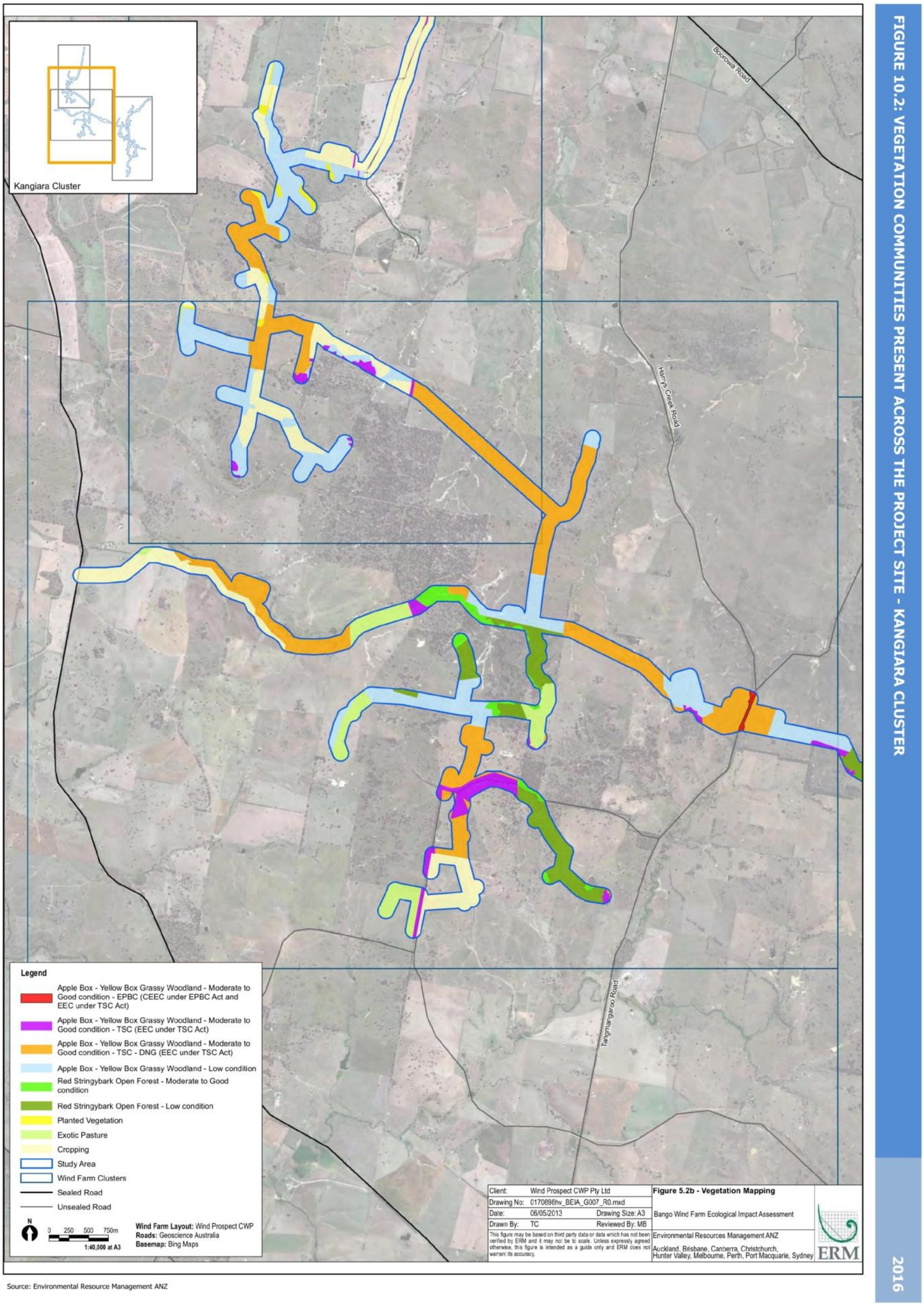
FIGURE 10.1: VEGETATION COMMUNITIES PRESENT ACROSS THE PROJECT SITE - LANGS CREEK CLUSTER

2016

Source: Environmental Resource Management ANZ

Figure 10.1 Vegetation communities present across the Project site – Langs Creek Cluster

(A3 versions of these Figures are displayed in Volume 2)

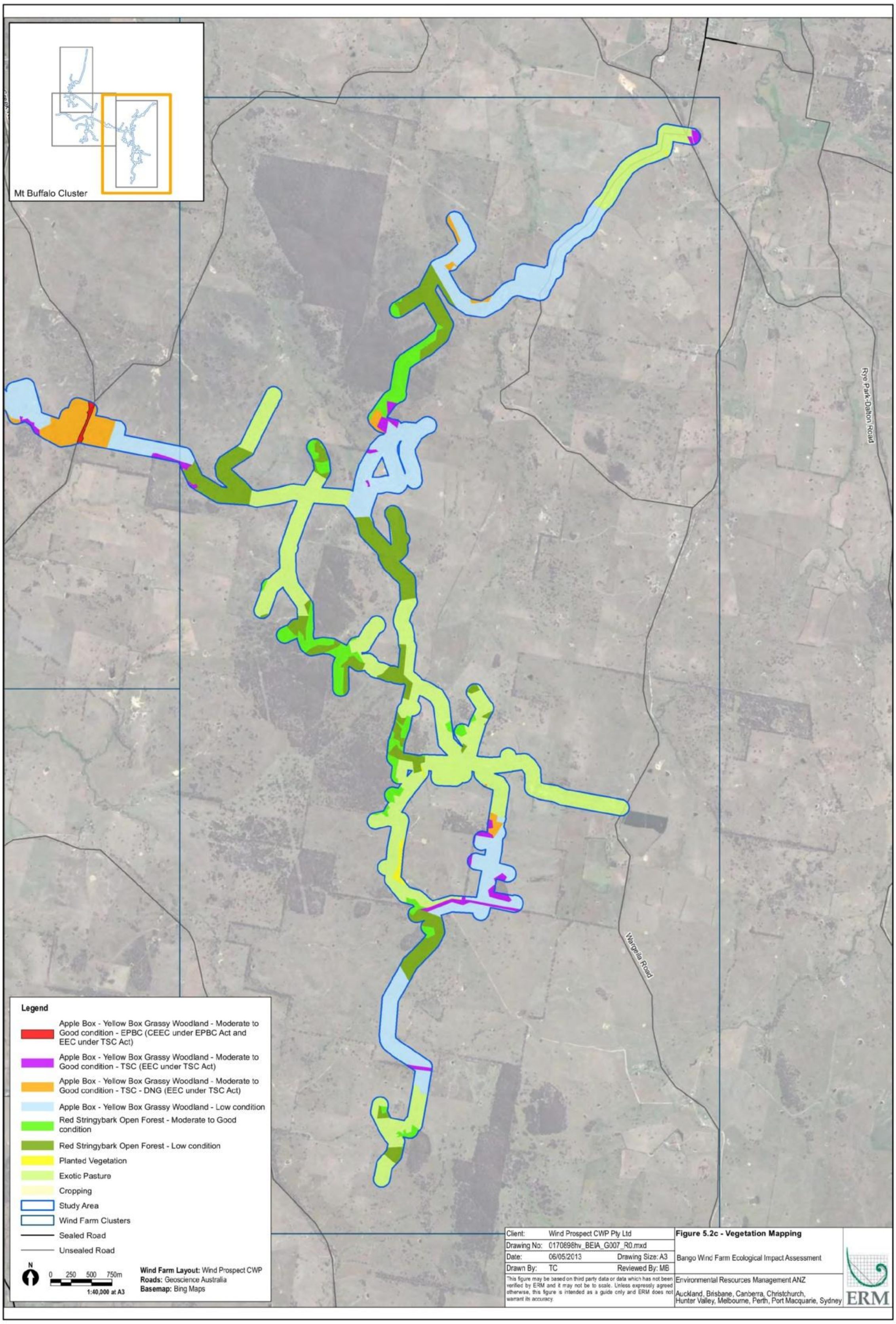


Source: Environmental Resource Management ANZ

Figure 10.2 Vegetation communities present across the Project site – Kangiara Cluster

(A3 versions of these Figures are displayed in Volume 2)

FIGURE 10.3: VEGETATION COMMUNITIES PRESENT ACROSS THE PROJECT SITE - MT BUFFALO CLUSTER



Source: Environmental Resource Management ANZ

2016

Figure 10.3 Vegetation communities present across the Project site – Mt Buffalo Cluster

(A3 versions of these Figures are displayed in Volume 2)

Endangered Ecological Communities (EECs): Within the list of BVTs, only one EEC was identified within the Study area. LA103 Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands is listed as an EEC under the TSC Act. A small proportion also meets the criteria for listing as a Critically Endangered Ecological Community (CEEC) under the *EPBC Act*. OEH (2012c) estimates that Box-Gum Woodland has been cleared significantly (65 to 95 % depending on specific vegetation type) within the Lachlan CMA.

As a general rule, the condition of vegetation types across the Project site will vary according to a range of human-induced, geological and climactic conditions. Given the Project site is primarily used for agricultural purposes, vegetation types are impacted by weed invasion, grazing intensity and soil disturbance to varying degrees, depending on the land use practices implemented on each property.

Within the Project site, the vegetation corridors are fragmented, with denser native vegetation typically occurring on the steeper slopes of the ranges, and in distinct areas largely avoided in the design of infrastructure for the Project. Spurs and gentle slopes support lightly wooded areas. The Box Gum Woodlands tend to prefer the more fertile areas which have largely been previously cleared for agriculture. Grasslands occur over a majority of the Project site, within which the majority of the Project infrastructure has been sited. Further description of the vegetation types and dominant species can be found in **Appendix 12**.

10.3.2 *Flora*

A variety of threatened species have also been previously recorded within the locality. Those species previously recorded (OEH 2013b, ALA 2013) or considered to have the potential to occur (DoE 2013) are listed in **Appendix 12** together with their conservation status.

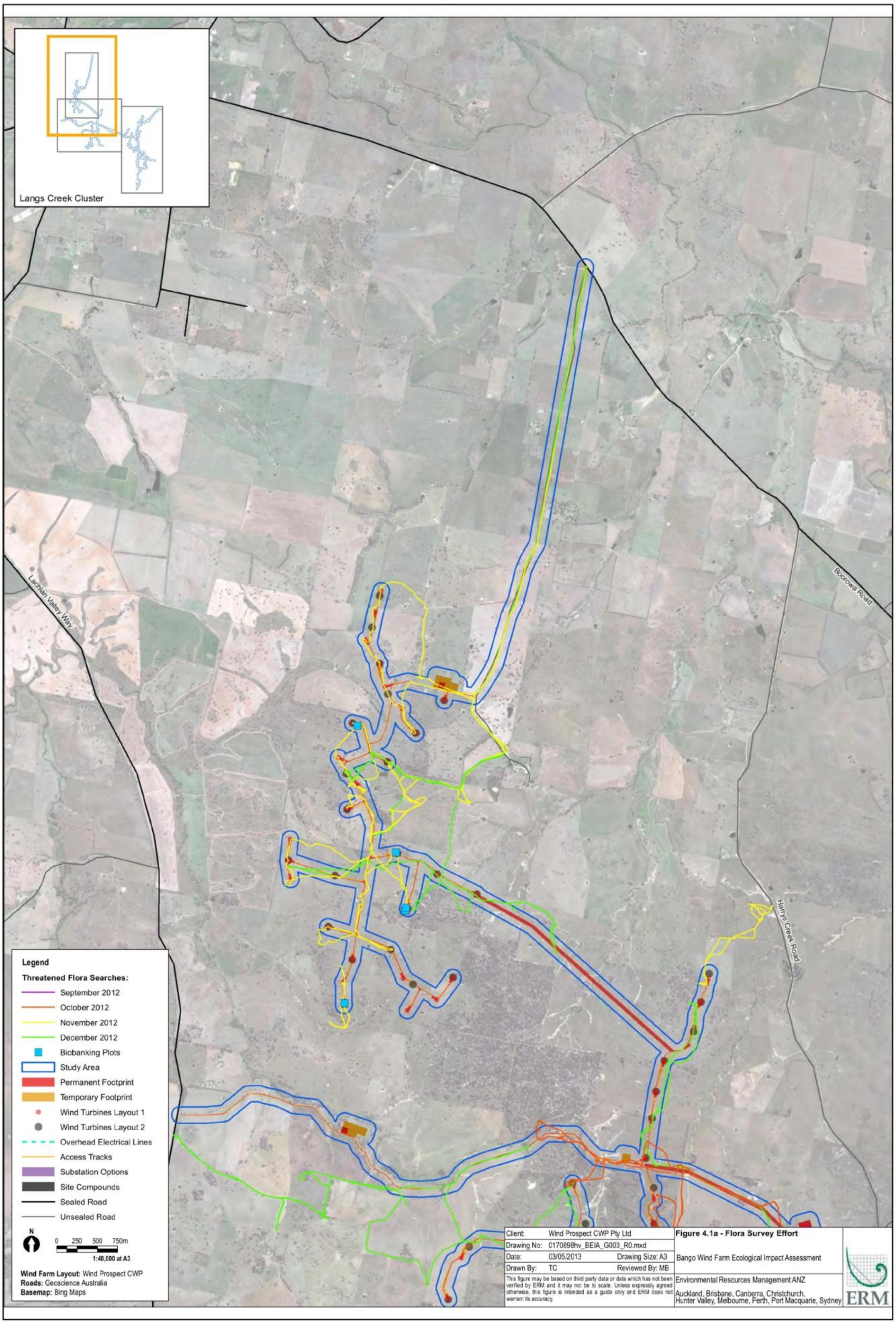
A total of 127 flora taxa, 97 (76 %) native and 30 (24 %) exotic species, were recorded across the Study area during field surveys. Potential habitat exists for ten threatened species (see **Appendix 12**), however only one species, Yass Daisy (*Ammobium craspedioides*), was recorded on-site 750 m to the west of the Study area in the Mt Buffalo Cluster. **Figures 10.4** to **10.6** illustrate the locations of each flora survey point. The recorded locations of threatened flora species are depicted in **Figures 10.11 to 10.13**.

Exotic Species: Two weed species listed as declared noxious weeds (NW) under the NSW *Noxious Weeds Act 1993* for the Boorowa and Yass Valley LGAs were recorded within the Study area.

Exotic species accounted for approximately 22 % of all species recorded across the Study area and often occurred in localised patches in paddocks, such as in sheep camps. Noxious Weeds recorded throughout the Study area are provided in **Table 10.1**.

Table 10.1 Noxious weed species present within the Study area

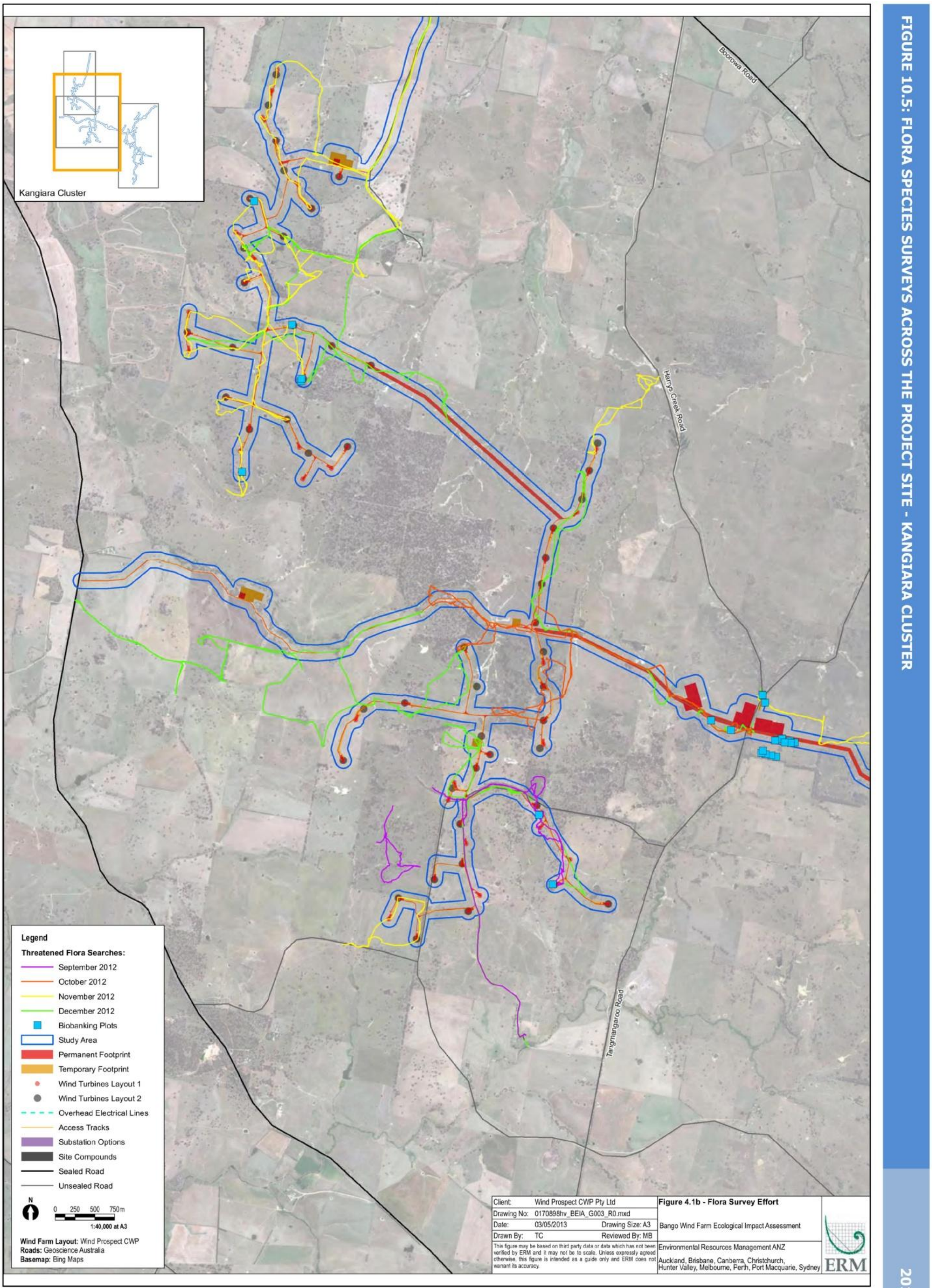
Category	Species	
Noxious Weeds	*Echium plantagineum*	Paterson's Curse
	Onopordum acanthium	Scotch Thistle



Source: Environmental Resource Management ANZ

Figure 10.4 Flora species surveys across the Project site – Langs Creek Cluster

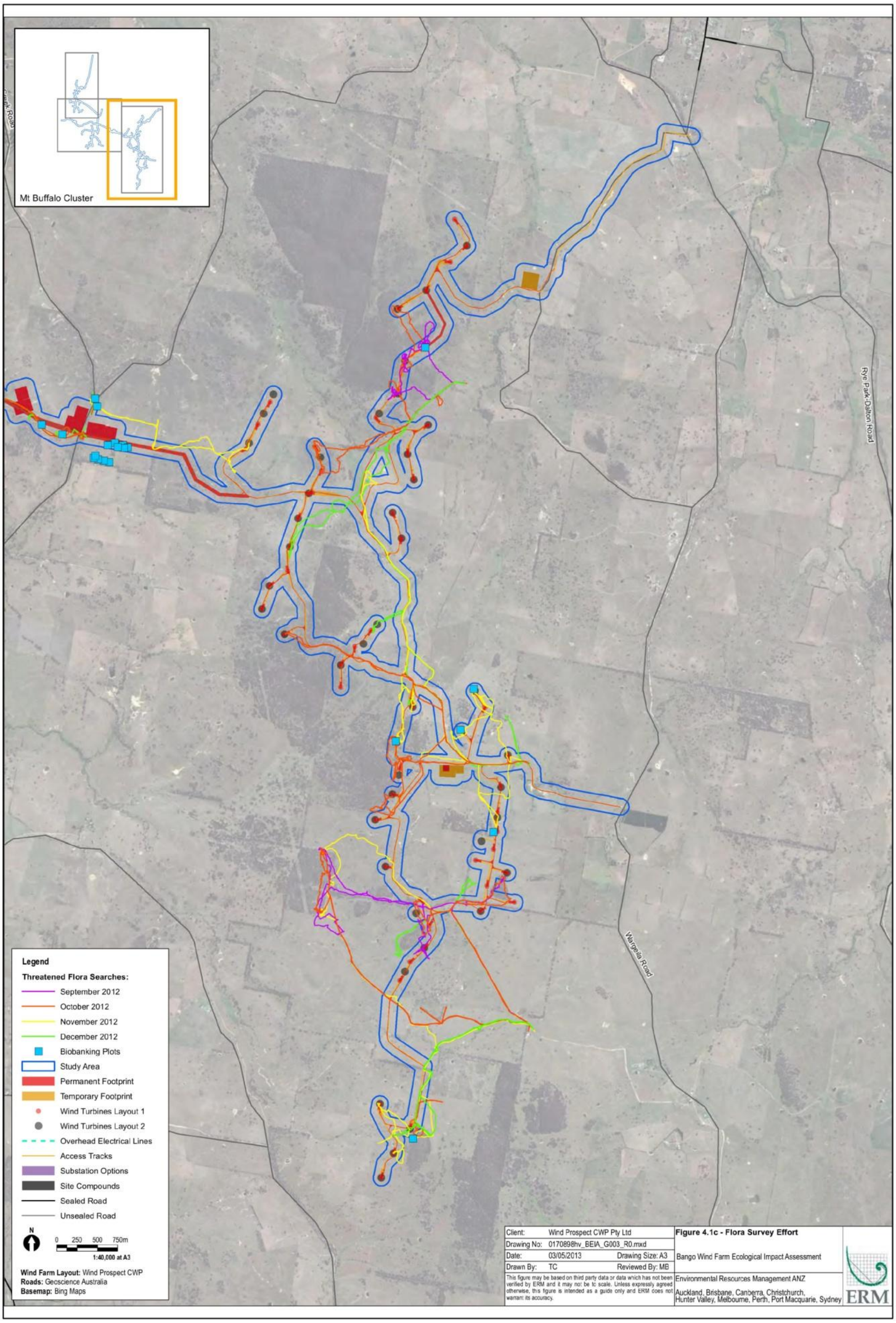
(A3 versions of these Figures are displayed in Volume 2)



Source: Environmental Resource Management ANZ

Figure 10.5 Flora species surveys across the Project site – Kangiara Cluster

(A3 versions of these Figures are displayed in volume 2)



Source: Environmental Resource Management ANZ

Figure 10.6 Flora species surveys across the Project site – Mt Buffalo Cluster

(A3 versions of these Figures are displayed in volume 2)

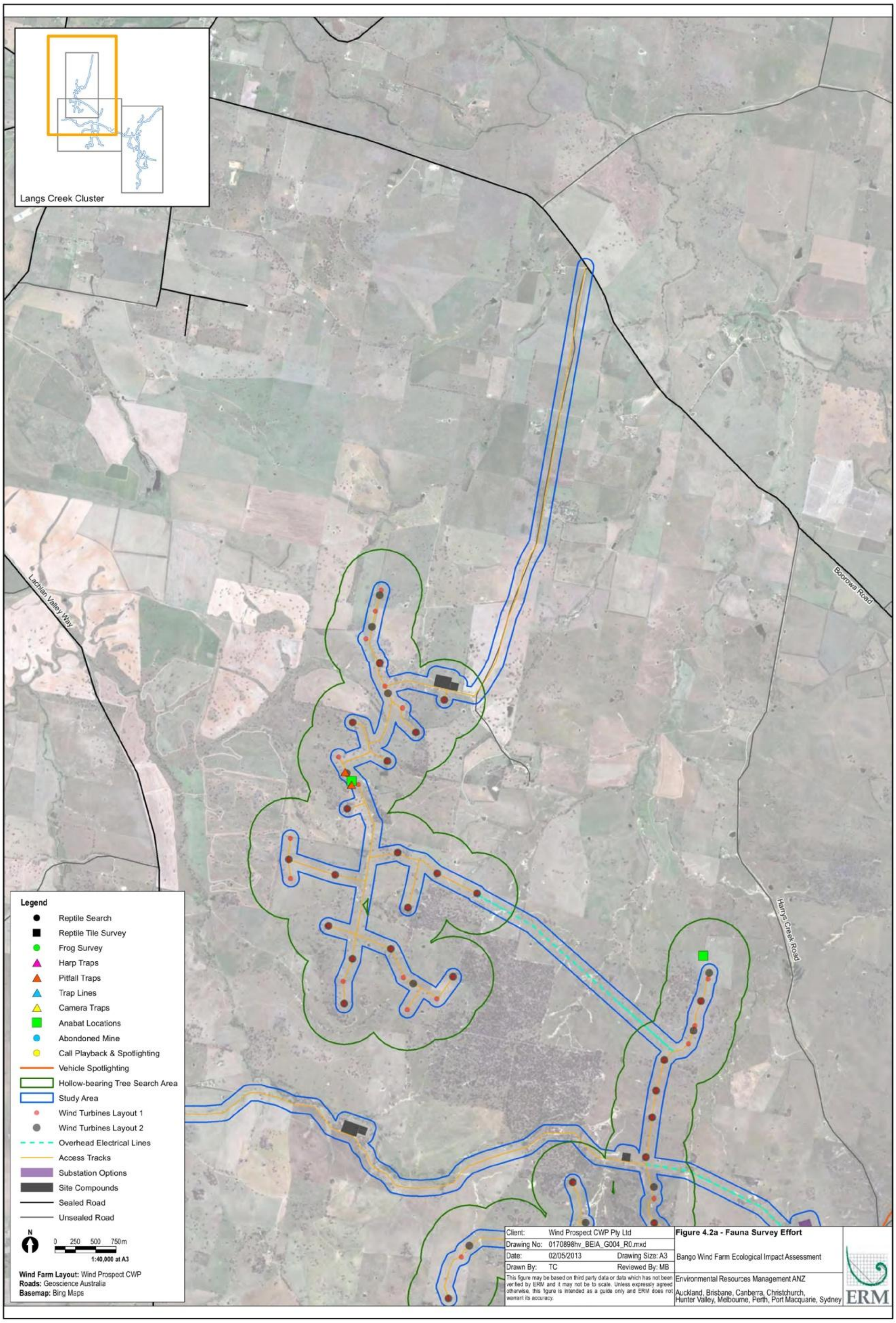
10.3.3 *Fauna Habitat*

The Project site supports a diversity of habitat types including native woodlands, native grasslands, exotic grasslands and aquatic habitats. Within these habitat types, a variety of fauna habitat resources exist, including hollow-bearing trees, paddock trees, tussock grasslands, disused mines, farms dams and creek lines. A summary of key habitats present is discussed in **Appendix 12**.

10.3.4 *Fauna Groups*

A total of 152 fauna species (144 native, 8 introduced) were recorded across the Study area (see **Appendix 12** for full list):

- 106 bird species, including four introduced;
- 12 reptile species;
- 7 frog species;
- 1 insect species;
- 13 terrestrial / arboreal mammal species (including 4 introduced); and
- 13 microbat species (5 additional species were identified to genus only, or with low certainty).



Source: Environmental Resource Management ANZ

Figure 10.7 Fauna survey effort across the Study area – Langs Creek Cluster

(A3 versions of these Figures are displayed in Volume 2)

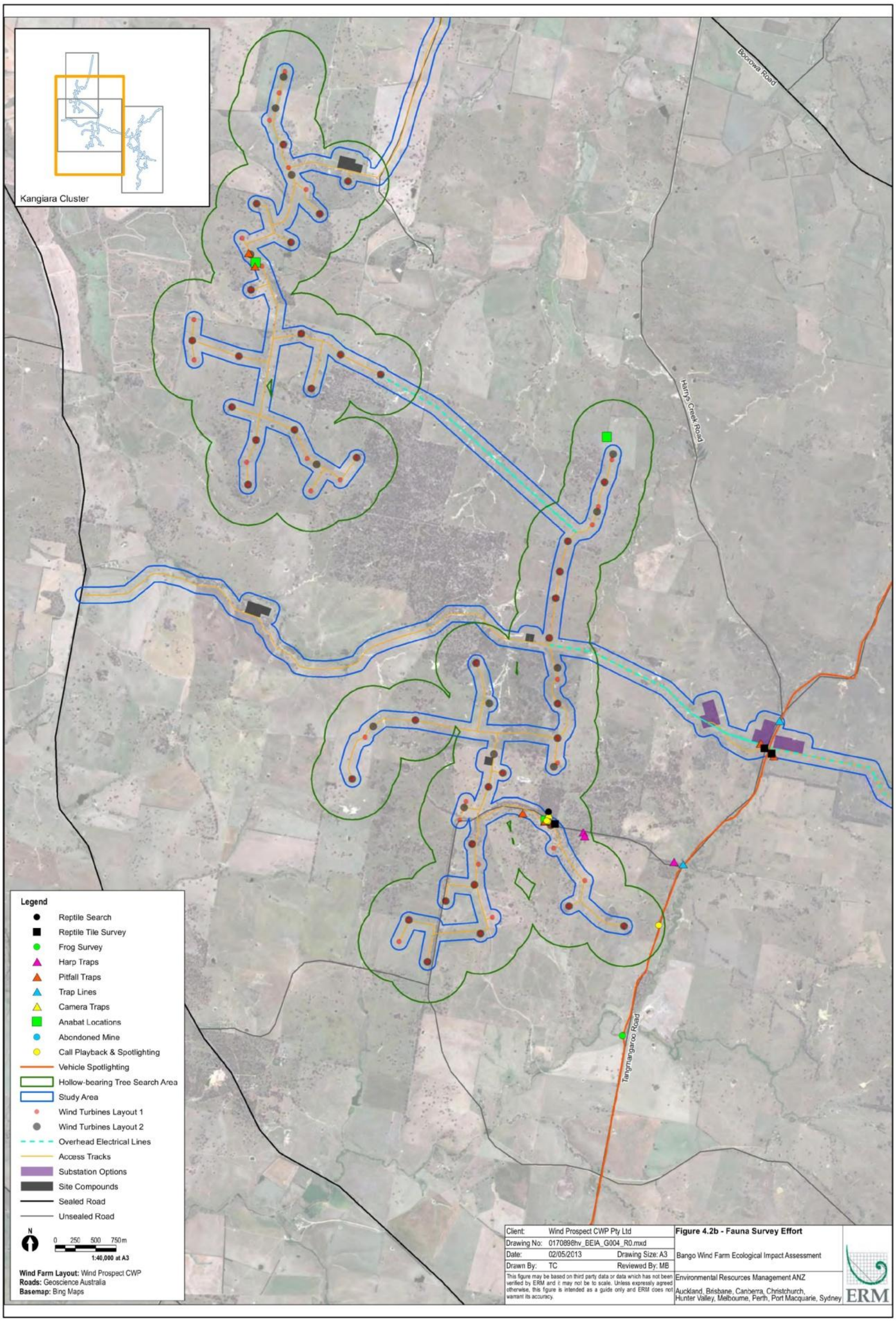


FIGURE 10.8: FAUNA SURVEY EFFORT ACROSS THE STUDY AREA - KANGIARA CLUSTER

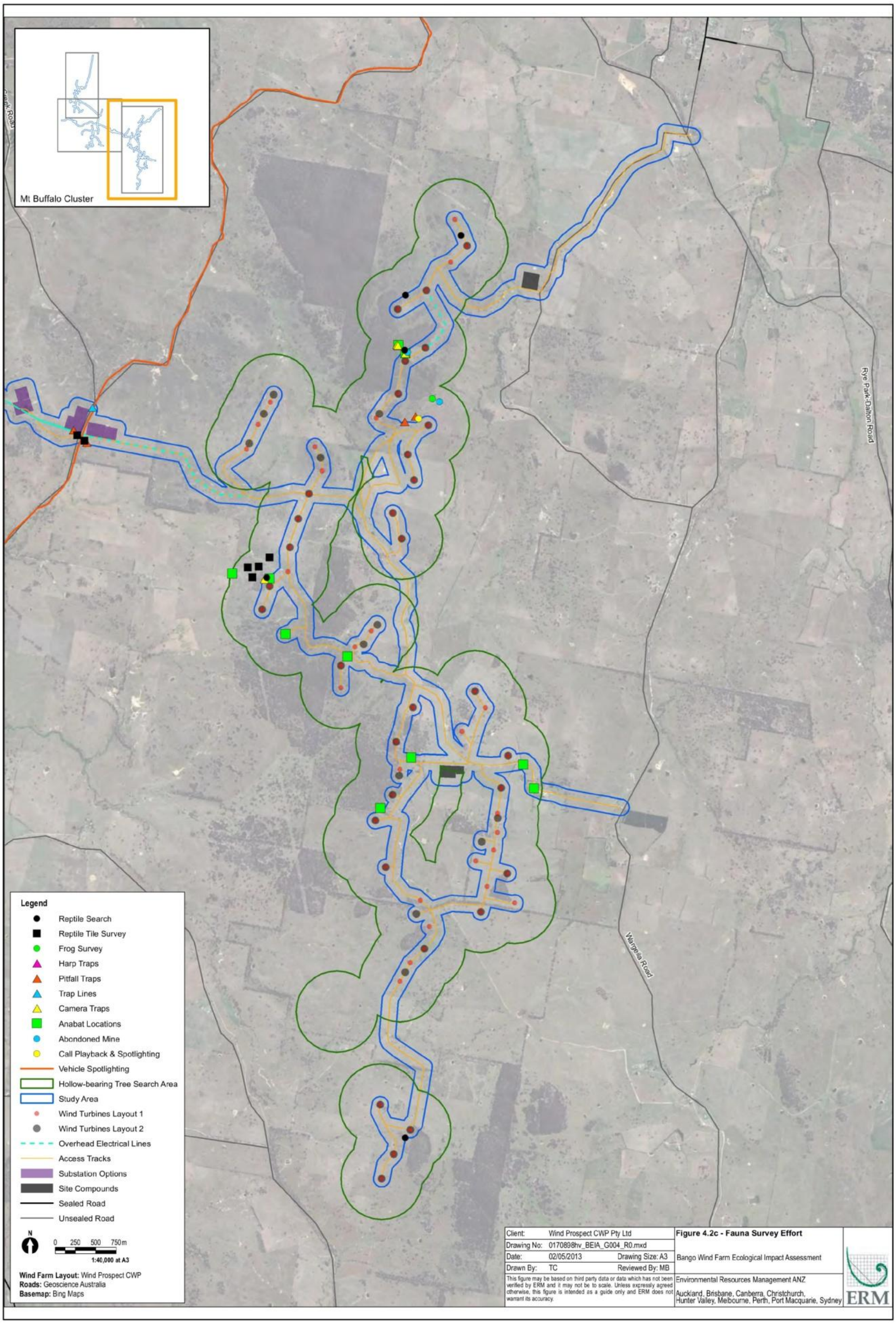
2016

Source: Environmental Resource Management ANZ

Figure 10.8 Fauna survey effort across the Study area – Kangiara Cluster

(A3 versions of these Figures are displayed in Volume 2)

FIGURE 10.9: FAUNA SURVEY EFFORT ACROSS THE STUDY AREA - MT BUFFALO CLUSTER

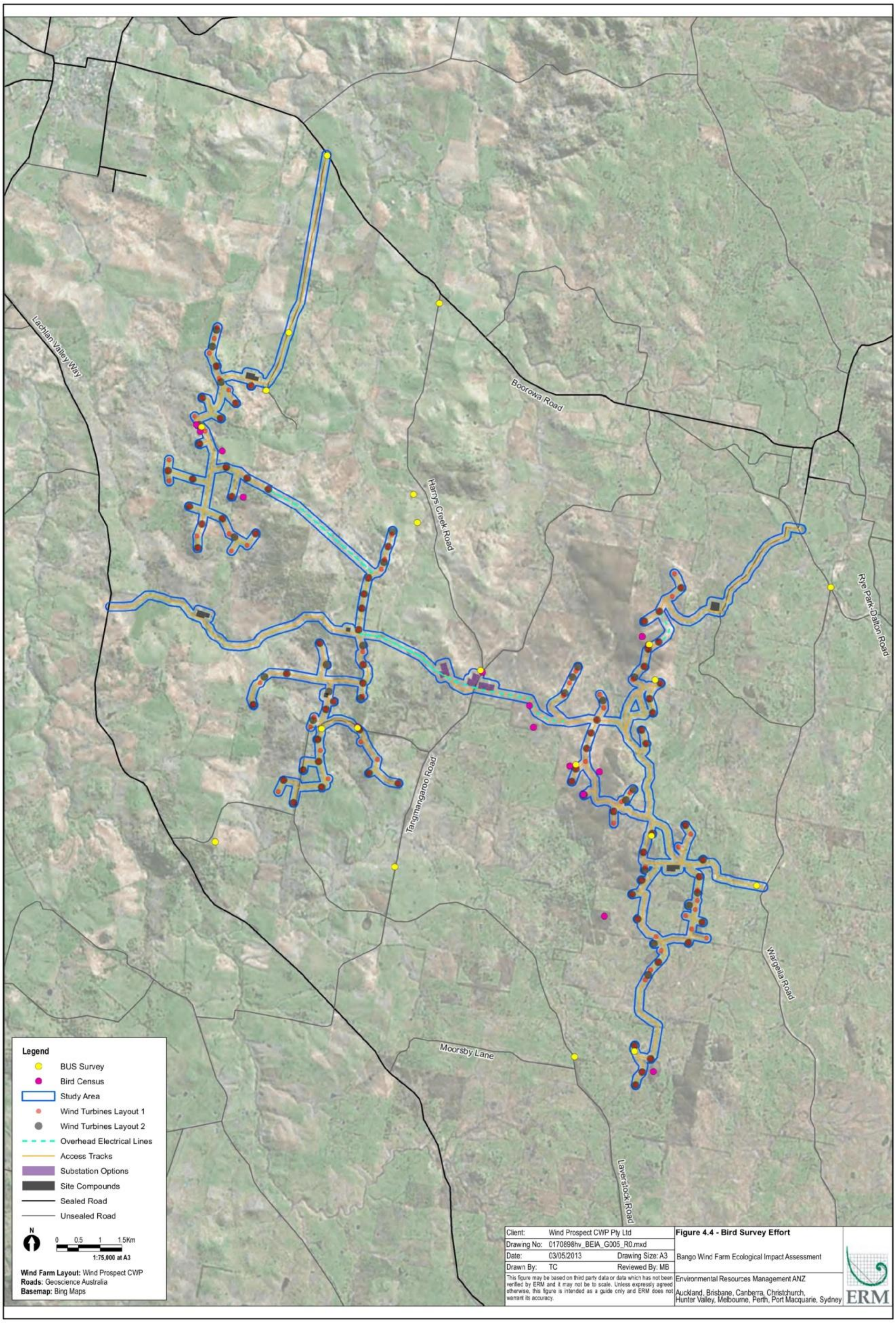


Source: Environmental Resource Management ANZ

2016

Figure 10.9 Fauna survey effort across the Study area – Mt Buffalo Cluster

(A3 versions of these Figures are displayed in Volume 2)



Source: Environmental Resource Management ANZ

Figure 10.10 Fauna survey effort across the Study area – Bird Survey

(A3 versions of these Figures are displayed in Volume 2)

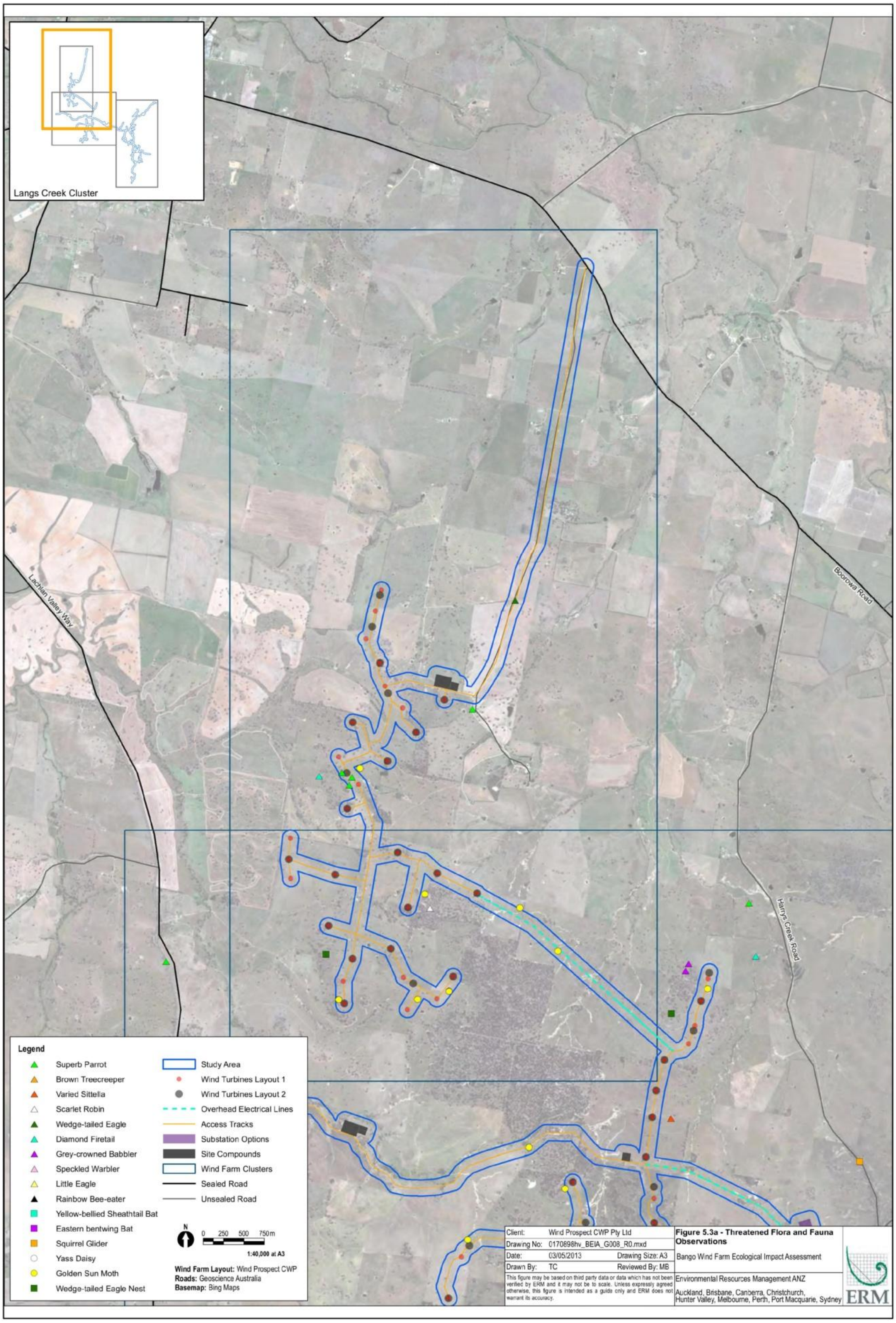


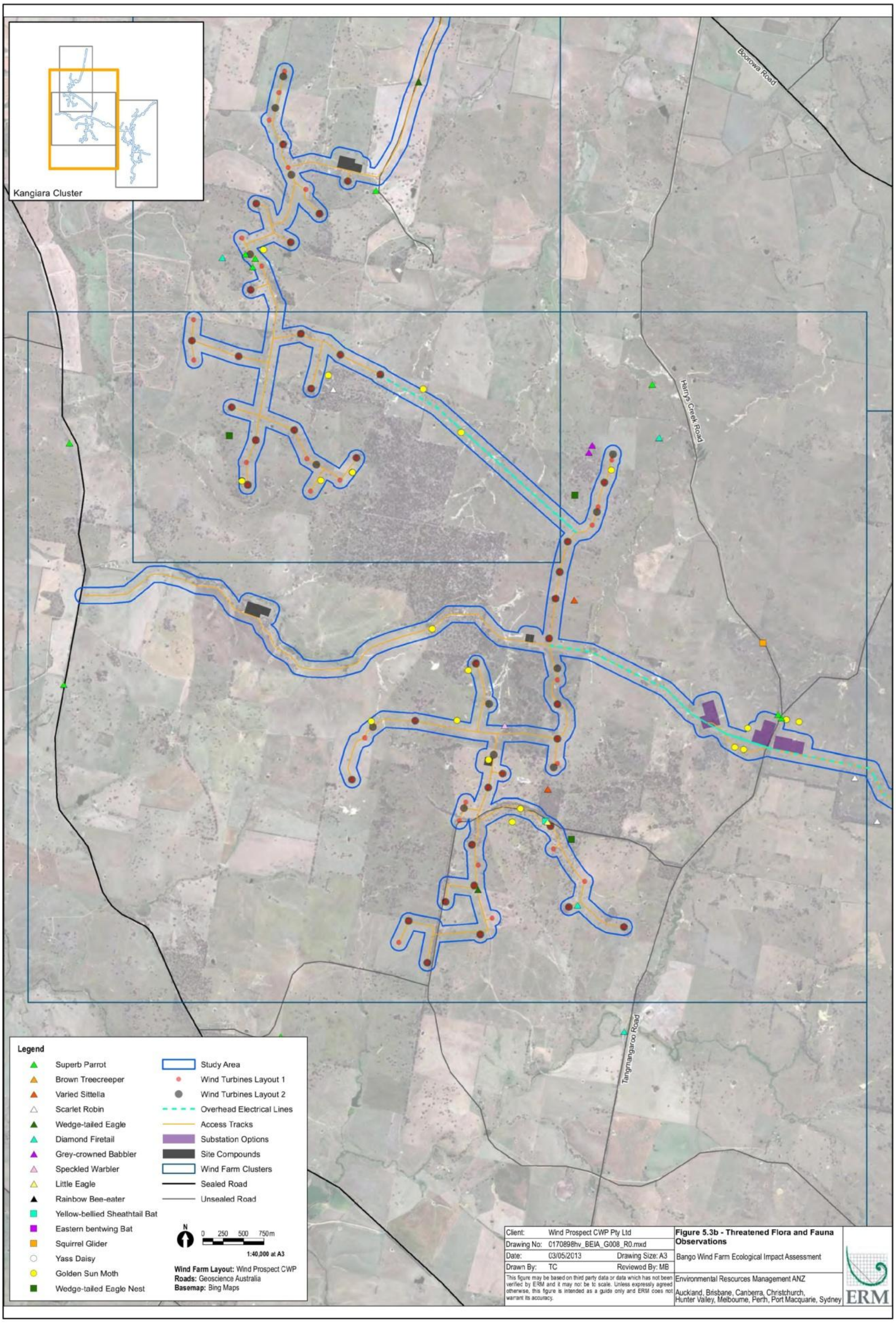
FIGURE 10.11: THREATENED SPECIES RECORDED ACROSS THE STUDY AREA - LANGS CREEK CLUSTER

2016

Source: Environmental Resource Management ANZ

Figure 10.11 Threatened species recorded across the Study area – Langs Creek Cluster

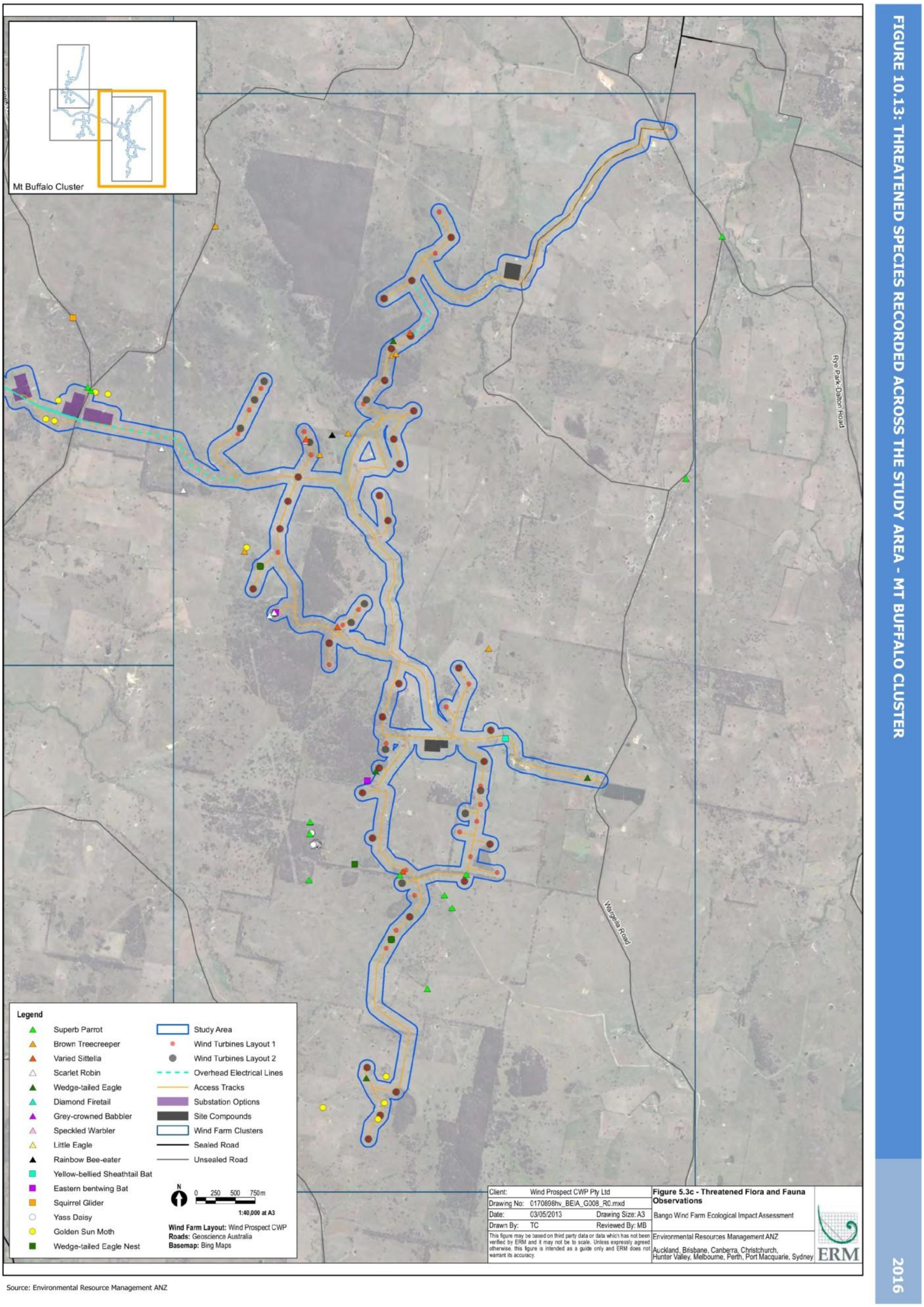
(A3 versions of these Figures are displayed in Volume 2)



Source: Environmental Resource Management ANZ

Figure 10.12 Threatened species recorded across the Study area – Kangiara Cluster

(A3 versions of these Figures are displayed in Volume 2)



Source: Environmental Resource Management ANZ

Figure 10.13 Threatened species recorded across the Study area – Mt Buffalo Cluster

(A3 versions of these Figures are displayed in Volume 2)

A variety of threatened species have been previously recorded within the locality. Those species previously recorded (BirdLife Australia 2013; OEH 2013b, ALA 2013) or considered to have the potential to occur (DoE 2013) are listed in **Appendix 12** together with their conservation status. **Figures 10.7** to **10.10** illustrate fauna survey locations and **Figures 10.11** to **10.13** illustrate the locations of threatened species recorded within the Project site.

Avifauna: A total of 106 (102 native) bird species, including 8 threatened species and 1 migratory species, were recorded within the Project site during surveys.

Vegetation types on-site support foraging, nesting and roosting habitat with numerous hollow-bearing trees and an abundance of native flora providing extensive resources throughout all seasons. **Table 10.2** provides an overview of the threatened and migratory species surveyed on-site. Details on the occurrence of threatened bird species are discussed in **Appendix 12** and shown in **Figures 10.11** to **10.13**.

Table 10.2 Threatened and migratory avifauna species present within the Study area

Category	Species			
Threatened bird species	*Chthonicola sagittata*	Speckled Warbler	*Polytelis swainsonii*	Superb Parrot
	Circus assimilis	Spotted Harrier	*Pomatostomus temporalis temporalis*	Grey-crowed Babbler
	Climacteris picumnus victoriae	Brown Tree-creeper	*Stagonopleura guttata*	Diamond Firetail
	Daphoenositta chrysoptera	Varied Sitella	*Petroica boodang*	Scarlet Robin
Migratory species	*Merops ornatus*	Rainbow Bee-eater		

Habitat for wetland birds across the Project site is largely limited to farm dams and the ephemeral drainage lines across the Study area. Most farm dams had water during the survey period due, although their habitat value for waterbirds is limited due to their small size and lack of / limited amount of fringing vegetation.

The habitat on-site also has the potential to accommodate other threatened species, including the Gang-gang Cockatoo (*Callocephalon fimbriatum),* Glossy Black-cockatoo (*Calyptorhynchus lathami*), White-fronted Chat (*Epthianura albifrons*), Little Lorikeet (*Glossopsitta pusilla*), Painted Honeyeater (*Grantiella picta*), Swift Parrot (*Lathamus discolor*), Square-tailed Kite (*Lophoictinia isura*), Hooded Robin (*Melanodryas cucullata cucullatta*), Black-chinned Honeyeater (*Melithreptus gularis gularis*), Turquoise Parrot (*Neophema pulchella*), Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*) and Flame Robin (*Petroica phoenicea*). Recent survey efforts did not record these species within the Study area.

For a full description of avifauna within the Study area, refer to **Appendix 12**.

Ground-dwelling and Arboreal Mammals: The Study area has limited habitat for ground-dwelling mammals due to grazing and limited shrub layer, although areas with woodland or tussock grasses and fallen timber provide suitable habitat for species such as the Eastern Grey Kangaroo (*Macropus giganteus*), the Short-beaked Echidna (*Tachyglossus aculeatus*), the Swamp Wallaby (*Wallabia bicolour*), the Red-necked Wallaby (*Macropus rufogriseus*), the Yellow-footed Antechinus

(*Antechinus flavipes*) and the Common Wallaroo (*Macropus robustus*) all of which were recorded within the Study area. An additional five exotic mammal species were also observed.

Trees on-site provide habitat for arboreal mammals. One threatened arboreal mammal species, the vulnerable Squirrel Glider (*Petaurus norfolcensis*), was recorded during surveys. Two other arboreal species, the Common Ringtail Possum (*Pseudocheirus peregrines*) and the Common Brushtail Possum (*Trichosurus vulpecular*) were also recorded on-site. Potential habitat exists for the Koala (*Phascolarctos cinereus*), though they have not previously been recorded in the locality and, despite targeted surveys, no individuals were recorded in the Study area.

Bats: Of the 13 species of microbat recorded on-site, two are listed as Vulnerable under the *TSC Act*: the Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and the Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*). The hollow-bearing trees and vegetation types across the Study area provide potential roosting habitat and foraging habitat for both the common species recorded on-site and the threatened Yellow-bellied Sheathtail Bat. As the Eastern Bentwing Bat roosts in caves, the Study area only provides foraging habitat for this species.

There were no threatened bat species records within a 10 km radius of the Study area prior to ERM survey efforts (OEH 2013b). **Table 10.3** lists the threatened bat species recorded on-site.

Table 10.3 Threatened bat species present within the Study area

Category	Species			
Common bat species	*Austronomus australis (syn. Tadarida australis)*	White-striped Freetail Bat	*Nyctophilus geoffroyii*	Lesser Long-eared Bat
	Chalinolobus gouldii	Gould's Wattled Bat	*Nyctophilus sp*	Long Eared Bat
	Chalinolobus morio	Chocolate Wattled Bat	*Vespadelus darlingtoni*	Large Forest Bat
	Mormopterus sp	Freetail Bat	*Vespadelus regulus*	Southern Forest Bat
	Mormopterus sp 2	Eastern Freetail Bat	*Vespadelus vulturnus*	Little Forest Bat
	Mormopterus sp 4	Southern Freetail Bat		
Threatened bat species	*Miniopterus schreibersii oceanensis*	Eastern bentwing Bat	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail Bat

Amphibians: Creeklines and drainage lines within the Study area are predominantly ephemeral in nature, with more permanent pools in lower areas, which may provide habitat for amphibian species. Seven species were identified during surveys, none of which were threatened species.

Database searches indicated that the *EPBC Act* listed Booroolong Frog (*Litoria booroolongensis*) and Growling Grass Frog (*Litoria raniformis*) had the potential to occur on-site (DoE 2013). Due to the limited amount of habitat remaining to support these species, targeted surveys were not undertaken by ERM for these two threatened species.

Reptiles: Habitat for reptiles includes woodland, grassland, drainage lines and scattered rocky outcrops with woody debris and limited leaf litter present across the site. Twelve common reptile species were recorded, none of which were threatened.

Two threatened species, the Pink-tailed Worm-lizard (*Aprasia parapulchella*) and the Striped Legless Lizard (*Delma impar*) were listed as having the potential to occur within the Study area (DoE 2013). Habitat for the Pink-tailed Worm-lizard is limited due to the quality of the habitat which has been impacted by historical land use.

The Striped Legless Lizard is found mainly in Natural Temperate Grassland (NTG) and also in secondary grassland near NTG, and occasionally in open Box-Gum Woodland. The habitats identified within the Study area are predominantly derived native grasslands from woodland areas, much of which has undergone grazing, pasture improvement and fragmentation of woodland areas. Thus, the areas surveyed comprise sub optimal habitat for this species.

Migratory Birds: Ten migratory species were identified from the *EPBC Act* Protected Matter Search Tool (DoE 2013), as listed in **Appendix 12**. One migratory bird species, Rainbow Bee-eater (*Merops ornatus*) was recorded within the Study area.

10.4 Potential Impacts

10.4.1 *Construction*

Vegetation Clearance: Although construction of the Project involves the removal of vegetation across a large area, impacts are primarily restricted to a narrow, linear pathway with clearance occurring in narrow bands throughout an open woodland and grassland landscape (see **Figures 10.1** to **10.3**). The Project is comprised of both permanent and temporary vegetation removal, with areas such as underground reticulation requiring trenching for installation which can then be filled and revegetated to prevent weed invasion and erosion once installed.

As detailed in **Chapter 3** Project Description, two on-site access road layouts (Layout Option 1 and 2) are being investigated in order to reduce the likely vegetation clearance required for the Project. These layouts have been designed according to civil engineering requirements and with respect to minimising all unavoidable native vegetation clearance, particularly in areas containing threatened ecological communities or species. All remaining impacts have been quantified through the use of the BioBanking Credit Calculator (see **Section 10.4**) and in accordance with 'improve or maintain' principles. **Table 10.4** summarises the total area of permanent and temporary vegetation loss for each vegetation type and condition.

Threatened Ecological Communities: Under a worst-case scenario (Layout Option 1), the Project would involve the permanent removal of up to 83.63 ha of Box-Gum Woodland, in various conditions, from the Study area. This vegetation type is recognised as an EEC and occurs across the Study area as shown in **Figure 10.1** to **10.3**. Only a relatively small proportion of LA103 present within the Study area will be permanently cleared by the Project; i.e. 10 %. A further 17.81 ha will be temporarily cleared for roads, reticulation and construction facilities.

Table 10.4 Estimated clearance of each vegetation type under Layout Option 1

Biometric Vegetation Type (BVT)	BVT Code	Area in Study Area (ha)	Total Area in Development Footprint (ha)	Permanent Impact Area (ha)	Temporary Impact Area (ha)
Box Gum Woodland (Mod/Good EPBC)	LA103	2.27	0.26	0.26	-
Box Gum Woodland (Mod/Good TSC)	LA103	65.27	3.08	2.57	0.51
Box Gum Woodland (Mod/Good TSC-DNG)	LA103	313.00	49.16	42.69	6.47
Box Gum Woodland (Low)	LA103	469.57	48.94	38.11	10.83
Red Stringybark Open Forest (Mod/Good)	LA182	99.24	5.28	3.75	1.53
Red Stringybark Open Forest (Low)	LA182	238.72	21.98	17.39	4.59
Total		**1,188.07**	**128.7**	**104.77**	**23.93**

Threatened Flora - Yass Daisy: A population of Yass Daisy comprising over 200 individuals occurs outside the Study area and will not be affected by the Project. Although it is possible that areas of potentially suitable grassland habitat will be affected, an assessment against significant impact criteria concluded that the Project would not result in a significant impact to an important population of the Yass Daisy.

Loss of Riparian Vegetation: The Project involves the establishment of a small number of informal creek crossings across small creeks and drainage lines. An assessment of the impacts of these crossing is included in **Chapter 17** Water. Given the landscape is highly modified and riparian vegetation primarily consists of a grassy ground layer with no over-storey, the impacts are likely to be minimal.

Fauna Habitat Removal: Habitat for a variety of threatened fauna species is present across the Study area, and a worst-case scenario would involve permanent removal of up to 104.77 ha (8.8 % of the Study area) of potential habitat for a variety of species. Given the Project design is linear in structure, no large consolidated areas of clearing will occur and the proposed clearance will not isolate areas of potential habitat. **Table 10.5** quantifies the impacts to fauna species. Impacts to certain threatened species are discussed in more detail in the following paragraphs.

Golden Sun Moth (GSM): Infrastructure associated with the Project is proposed in areas where GSM were recorded and in areas of suitable habitat for the species. This includes wind turbines, on-site access roads, overhead transmission lines and a substation. Through the iterative design process, areas of known and potential habitat have been avoided as much as possible. A total of 810.2 ha of suitable habitat exists in the Study area, of which 100.87 ha (12 %) is in the Development Footprint, 82.48 ha (10 %) of which will be permanently impacted.

Woodland Birds: The Project would not significantly impact on the Brown Treecreeper, Diamond Firetail, Varied Sittella Flame Robin, Scarlet Robin, Grey-crowned Babbler, Speckled Warbler or Hooded Robin.

Table 10.5 Fauna habitat impacts

Species	Impact	Habitat Type	Total in Study Area (ha)	Total Impacted Area (ha)
Superb Parrot	Habitat removal	Box Gum Woodland, Stringybark Woodland, Hollow-Bearing Trees	166.78 - 449 (HBT)	6.58 – 15 (HBT)
Powerful Owl, Barking Owl	Habitat removal	Box Gum Woodland, Red Stringybark Open Forest, Hollow-Bearing Trees	166.78 – 449 (HBT)	6.58 – 15 (HBT)
Woodland Birds	Habitat removal	Box Gum Woodland, Red Stringybark Open Forest, Hollow-Bearing Trees	166.78 – 449 (HBT)	6.58 – 15 (HBT)
Regent Honeyeater, Swift Parrot	Habitat removal (Foraging only)	Box Gum Woodland, Red Stringybark Open Forest	166.78	6.58
Turquoise Parrot, Gang-gang Cockatoo	Habitat removal Hollow -Bearing trees	Box Gum Woodland, Red Stringybark Open Forest	166.78 - 449 (HBT)	6.58 - 15 (HBT)
White-fronted Chat	Habitat removal	Natural Temperate Grassland and grassland derived from Box-Gum Woodland	313	42.69
Squirrel Glider	Habitat removal, Fragmentation	Box Gum Woodland, Hollow-Bearing Trees	2.26	0.26
Spotted Harrier, Little Eagle, Square-tail Kite	Habitat removal, Blade strike	Woodland Habitats including Box Gum Woodland, Red Stringybark Open Forest.	166.78	6.58
Koala	Habitat removal, Fragmentation	Box Gum Woodland, Red Stringybark Open Forest	166.78	6.58
Striped Legless Lizard	Habitat removal, disturbance	Open Box Gum Woodland, Native grassland	313	42.69
Pink-tailed Worm lizard	Habitat removal, disturbance	Open Box Gum Woodland, Native grassland	313	42.69
Rosenberg's Goanna	Habitat removal, disturbance	Woodland Habitats including Box Gum Woodland, Red Stringybark Open Forest.	166.78	6.58
Golden Sun Moth	Habitat removal	DNG, Low condition Box Gum Woodland	810.2	82.48
Bats	Habitat removal, Blade Strike	Hollow-Bearing Trees	166.78 - 449 (HBT)	6.58 – 15 (HBT)

HBT = Hollow-Bearing tree

Superb Parrot: The primary impact associated with the Project is that of injury or death of individual Superb Parrots due to collision with wind turbines and potential loss of breeding habitat through the removal of hollow-bearing trees. Of the 449 mapped hollow-bearing trees it is likely 15 will be removed during Project construction. This constitutes approximately 3.4 % of the total number of hollow-bearing trees available to the Superb Parrot within 500 m of a proposed wind turbine location. Thus it is unlikely the proposed action will have a significant impact on the species, affect foraging or breeding habitat to the extent that the species would decline. The results of the Significant Impact Assessment indicated that the proposed action would not significantly impact on the Superb Parrot.

Swift Parrot and Regent Honeyeater: No preferred foraging habitat has been identified within the Study area for either species. It has been concluded from the Significant Impact Assessment that the Project is unlikely to have a significant impact on the Swift Parrot or Regent Honeyeater.

Little Lorikeet, Black-chinned Honeyeater, Turquoise Parrot, Gang-Gang Cockatoo: The Project would not significantly impact on the Little Lorikeet, Black-chinned Honeyeater, Turquoise Parrot or Gang-gang Cockatoo.

White-fronted Chat: The Project is unlikely to have a significant impact on the White-fronted Chat.

Threatened raptors: Whilst the Project would reduce vegetated habitat for nesting by 8.62 ha for the Spotted Harrier, Little Eagle and Square-tailed Kite it is unlikely that the Project would significantly impact on the Little Eagle. However, this species is considered to be a key species and would be monitored as part of the bird and bat monitoring program.

Owls: The Project would not significantly impact on the Powerful Owl or the Barking Owl provided mitigation measures are implemented.

Threatened bats: Whilst the Project would reduce potential roosting habitat for the Yellow Bellied Sheathtail bat and foraging habitat for both of these bat species, the loss of habitat would be very small in comparison to the resources available in the Project locality. It is unlikely that the Project would significantly impact on the Eastern Bentwing Bat, however, this species is considered to be a key species and would be monitored as part of the bird and bat monitoring program.

Koala: The Koala has not been recorded within the Study area, however secondary and supplementary habitat for this species does exist. It has been concluded from the Significant Impact Assessment that the proposed action is unlikely to have a significant impact on the Koala.

Squirrel Glider: The Squirrel Glider was recorded during the field surveys. The greatest impact to this species would be habitat fragmentation. The hollow-bearing trees to be removed would not constitute optimal breeding habitat for this species so it is unlikely there would be a significant impact on the lifecycle of this species. The removal of a portion of habitat within the road corridor may increase the level of habitat fragmentation on this species by impeding movement along and across the road corridor. If mitigation measures are implemented, it is unlikely that the proposal would have a significant impact on the Squirrel Glider.

Rosenberg's Goanna: This species was not recorded during field surveys; however a portion of woodland habitat that is preferred habitat for Rosenberg's Goanna would be removed as part of the Project. This is unlikely to increases the levels of fragmentation within the Study area as it is already highly fragmented.

Pink-tailed Worm-lizard: The species was not recorded during targeted surveys where optimal or sub-optimal habitat was identified, however the construction of the Project would result in the loss or modification of a small portion of habitat suitable for this species. It has been concluded from the Significant Impact Assessment that the Project is unlikely to have a significant impact on the Pink-tailed Worm-lizard.

Striped Legless lizard: Approximately 313 ha ha of secondary or sub-optimal habitat for this species has been identified within the Study area. The Project would result in the removal of approximately 52.5 ha or 13 % of what would be considered secondary habitat for this species. Surveys were undertaken in areas of the most suitable habitat and this species was not recorded during the field surveys.

Migratory Species: One migratory species, the Rainbow Bee-eater was recorded on-site during surveys. The species is likely to use the Study area as a stopover point, using shelter resources in the woodland areas and foraging resources across the entire Study area. Although potential habitat occurs, it is unlikely that the Study area provides an area of 'important habitat' for any migratory species, as described in the *Matters of National Environmental Significance Significant Impact Guidelines 1.1*. Therefore the Project is not expected to substantially modify, destroy or isolate an area of important habitat for a migratory species.

Indirect Impacts: Indirect impacts relate to matters during the construction phase that are created as a consequence of the primary impact. A summary of the anticipated indirect impacts is provided below with further information contained within **Appendix 12** and, where indicated, the respective chapters of the Environmental Impact Statement (EIS).

- Runoff, sedimentation and erosion (**Chapter 17** Water and **Chapter 18** General Environmental Assessment);
- Hydrological changes (**Chapter 17** Water and **Chapter 18** General Environmental Assessment);
- Edge effects / increased weed invasion (this chapter);
- Wildfire (**Chapter 16** Fire and Bushfire); and
- Noise (**Chapter 9** Noise).

The Construction Environmental Management Plan (CEMP) will include erosion and sediment control measures to limit runoff to adjacent habitat areas and watercourses such as devices to be installed, monitoring requirements and corrective actions. Due to the position of the Project on ridge tops, it is expected that there will be nil to negligible impact on groundwater hydrology.

The spread of weeds is a high risk with any large scale development that extends over a large geographic area. Stringent weed management measures will be implemented during and post construction to combat edge effects and ensure that the degree and extent of current weed infestation is not aggravated by the Project. Such measures will include the control of runoff that may contain seeds, the washing down of vehicles to prevent the transportation of weeds between areas when a significant weed risk has been identified and the recovery of top-soils that have a high percentage of native seeds in the seedbank.

Fire prevention measures, outlined in a Fire and Bushfire Management Plan, will include the availability of basic fire-fighting equipment at each active construction location, the construction of intermittent passing bays on all on-site access roads to facilitate emergency access and access to communications (either mobile telephone or UHF radio) at all times.

Construction activities will generate noise that may disturb some fauna. The response of fauna to such noise is inconsistent between and within species, making it difficult to predict likely impacts.

While noise may displace some fauna, the impacts are expected to be localised to the current area of noise-generating construction activity, temporary and short term.

10.4.2 *Operation*

Direct Impacts: Impacts on bird and bat species may occur during the operational phase. Impacts include the potential for birds and bats to accidentally collide with towers and moving wind turbine blades. Many studies have investigated the potential impacts of wind farms on birds and bats, most undertaken outside Australia. Reviewing the evidence, the impacts appear to be dependent on a number of factors including:

- Proximity of wind turbines to bird concentrations and migratory pathways (Brett Lane & Associates 2005);
- Wind farm layout, spacing between wind turbines and type of wind turbine used (Brett Lane & Associates 2005; Australian Greenhouse Office 2006);
- Location in the landscape, type of habitat and surrounding area, in particular proximity of wind turbines to forested areas and wetlands (Kevin Mills & Associates 2005; Australian Greenhouse Office 2006);
- Lighting used on wind turbines (Brett Lane & Associates 2005) (see **Chapters 8** Landscape and Visual and **Chapter 13** Aviation for further assessment of wind turbine lighting); and
- Location of wind turbines on forested ridges (Arnett 2005).

Further discussion specific to the species affected by this Project is contained within **Appendix 12**.

Bats: Direct impacts on bat species relate predominantly to wind turbine collision and blade strike. There may also be some potential for barotrauma. Based on the results of literature reviews and an understanding of bat behaviour, those species considered most likely to come into contact with blades or otherwise be impacted by wind turbines include those which forage above the canopy, are migratory or have large foraging areas and may roost in hollows. Further discussion on pertinent bat behaviour and interaction with wind turbines is contained in **Appendix 12**.

Due to the open nature of the Project site, identification of potential flyways is difficult. The open woodland environment means that bats may forage relatively unobstructed across the majority of the site. During the development phase of the Project, wind turbines have been placed as far as practicable away from large stands of trees to minimise the impact on foraging bat species.

Of the species recorded across the Study area, the Yellow-bellied Sheathtail-bat and the Eastern Bent-wing Bat were the only species considered to have a high potential for strike due to their migratory nature, foraging behaviour above the canopy and, in the case of the Yellow-bellied Sheathtail-bat, its habit of roosting in tree hollows.

Measures to prevent bat strike wherever possible will be implemented, including (where practicable) ensuring wind turbines are located no closer than 30 m from hollow-bearing trees. During operation, monitoring to measure collision rate and death from barotrauma will be undertaken in accordance with the relevant monitoring guidelines provided by the Australian Wind Energy Association. However, based on the findings of past studies, it is likely that some collisions will be unavoidable even with appropriate mitigation measures (see **Appendix 12**).

Aviation lighting did not appear to affect the incidence of foraging bats around wind turbines and there was no difference between numbers of bat passes at lit and unlit wind turbines. Preliminary evidence also suggests that bats are not attracted to the lighting attached to wind turbines (Arnett 2005; Kerlinger et al. 2006; Kunz et al. 2007).

Birds: Direct impacts on bird species relate predominantly to wind turbine collision, blade strike and avoidance of areas where wind turbines are present. Few studies have been conducted in Australia or have investigated agricultural landscapes such as those within the Study area. However, it has been suggested that the vulnerability of a species to collision is species and habitat-specific (Erickson et al. 2001). Factors such as the flight character, distribution across the Project site, size and manoeuvrability of individuals, time of day / night and whether the species is migratory determine the likely collision risk. It considered unlikely that many of the species common to the Study area would be likely to collide with wind turbines. Passerine species, due to their fast flight patterns and sometimes high flight, may be at risk of collision.

Of the 17 bird species recorded flying within the rotor swept area (RSA), collision risk was estimated for the threatened species (Superb Parrot, Little Eagle, Spotted Harrier) using a Collision Risk Model (CRM) developed for Scottish National Heritage. Collision risk was also calculated for the non-threatened Wedge-tail Eagle. Collision mortalities based on data collected during field surveys and calculated using 95 % and 99 % avoidance rates vary between species. For the Superb Parrot, the number of collisions predicted is 0.027 birds per month, however with the more realistic avoidance rate of 99 % this fell to 0.0055 birds per month. For the Little Eagle, the number of collisions predicted is 0.028 and 0.0057 birds per month using the 95 % and 99 % avoidance factors respectively. Similarly for the Spotted Harrier, the number of collisions predicted is 0.024 and 0.0049 birds per month using the 95 % and 99 % avoidance factors respectively. Collision predictions for the Wedge-tailed Eagle suggest the number of collisions is 0.046 birds in November, 0.012 in December, 0.22 in January and 0.14 in February. With the more realistic avoidance rate of 99 % this fell to 0.0093 birds for the month of November, 0.0024 in December, and 0.044 in January and 0.028 in February based on the data collected. Two threatened raptor species were recorded at RSA height.

Raptors have large home ranges and low reproductive rates and, therefore, loss of these individuals is likely to have a greater effect on population numbers than it may on other species. Research to date has identified a range of potential impact rates. Some studies have shown that, in general, mortality rates for birds at wind farm sites is between 1 and 2 individuals per wind turbine per year (Illinois Department of Natural Resources 2007; Smales 2005). Alternative studies, however, conducted in the home range of one species found that likely impacts would result in a 0.001 % increase in mortality rate, which is not significantly different from that obtained in the absence of the wind farms (Smales & Muir 2005).

Migratory birds have been listed amongst the species most commonly impacted by wind turbines. Whilst wind turbines are likely to be below the flight altitude of most migratory species, weather and other factors have been suggested as potential causes of reduced flight height and therefore may result in migratory birds colliding with wind turbines (Erickson et al. 2001). While the Project is not located within any known key migratory bird pathways, the Rainbow Bee-eater was recorded within the Study area. During the operational phase of the Project, Rainbow Bee-eaters may collide with wind turbines or change their migratory path to avoid wind turbines.

Lighting Impacts: There has been suggestion that the use of lighting on wind turbines increases the potential for avian and microbat collisions as some species are attracted to the lighting for navigation purposes or for feeding on the insects that often centre on the light source. Results from studies are relatively inconclusive, with some studies identifying a relationship between lighting and avian collisions (US Department of Interior Fish and Wildlife Service 1993) and others identifying no significant difference between wind turbines lit with L-864 obstruction lights and those without (Jain et al. 2007).

With regard to lighting impacts on bat species, limited data is available on wind farm impacts on bats in Australia and as yet there is no clear proof of a link between wind turbine lighting, insect activity and bat mortality.

Indirect Impacts: Indirect impacts relate to matters during the operation phase that are created as a consequence of the primary impact. A summary of the anticipated indirect impacts, with further information contained in **Appendix 12**, includes:

- Habitat avoidance;
- Predation by feral animals; and
- Bushfire (**Chapter 16** Fire and Bushfire and **Appendix 19**).

Overseas studies, such as Devereux et al. (2008), on wintering farmland birds in Europe may be used to estimate patterns and degrees of habitat alienation on similar species, such as seed-eaters and corvids, in Australia. Studies of White-bellied Sea-eagles (as a representative raptor species) at wind farm sites conducted by Smales (2005) indicate that White-bellied Sea-eagles have been known to continue to occupy operational wind farm sites in southern Australia, including the Bluff Point Wind Farm in Tasmania (Smales 2005). In another study, post-construction monitoring of the Klondike Wind Farm in Oregon, USW (Johnson et al. 2003) found that avian and bat fatality rates were minimal, and that the wind farm did not appear to have resulted in displacement of breeding raptors.

Careful planning to avoid the placement of wind turbine clusters in or near areas of high habitat values will minimise the risk of the alienation of habitat to key threatened woodland species such as the Brown Treecreeper, and Scarlet Robin. The potential impacts to the Superb Parrot are not yet known and hard to predict as this species' movement patterns and use of the Study area are not fully understood.

10.4.3 ***Decommissioning***

Direct and indirect impacts anticipated from decommissioning works at the end of the life of the wind farm, as discussed in **Chapter 3** Project Description and **Chapter 18** General Environmental Assessment, are likely to include:

- Disturbance of vegetation adjacent to wind turbines from machinery during deconstruction, cutting back of tower bases, and storing of wind turbine components prior to removal from site;
- Soils disturbance resulting in sedimentation and erosion;
- Spread of weeds through site disturbance;
- Accidental fire during cutting back; and

- Disturbance of fauna habitat from machinery and storing of wind turbine components prior to removal from site.

Further impact assessments will be conducted prior to decommissioning works to ensure impact assessment and management actions are up-to-date and respond to the environmental values present on-site at the time.

10.4.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of the Project in the context of future wind farm developments to ensure that any potential environmental impacts are not considered in isolation.

There are no existing wind farms in the vicinity of the Study area, however, three are proposed in the vicinity of the Project: Rye Park Wind Farm (approximately 7 km to the east of the Project), Conroy's Gap Wind Farm (approximately 22 km to the south of the Project) and Yass Valley (approximately 18 km to the south west of the Project). Cumulative impacts associated with multiple wind farms include on ground impacts, such as clearing of vegetation and habitat, and impacts to the airspace used by birds and bats.

Cumulative impacts related to the loss of native vegetation communities apply to both BVTs recorded in the Study area. As Apple Box – Yellow Box Grassy Woodland, and other grassy woods that meet the definition of Box-Gum Woodland, are highly cleared vegetation types in the Lachlan CMA, the cumulative impact of their clearing would result in further reduction and possible fragmentation the EEC / CEEC. However, due to the fact that previous extensive clearing has been undertaken in the Study area for agricultural purposes, the majority of wind turbines and other infrastructure can be sited, where practicable, in areas that do not comprise intact Box Gum Woodland or intact vegetation types.

The operation of a number of wind farms in the area is likely to increase the chance of blade strike for birds and bats and has the potential to increase habitat alienation. Of particular concern is the Wedge-tailed Eagle which is considered to be a species that is particularly susceptible to the impacts of wind farms due to the loss of large trees used as breeding habitat and death or injury from rotor collisions. Although significant cumulative impacts on the common non-threatened mainland form of the Wedge-tailed Eagle could occur, evidence indicates that it is unlikely, particularly given the species' abundance throughout NSW.

As a consequence, due to careful design, the cumulative impacts associated with the establishment of up to four wind farms within the region (including the Project) has been assessed as low to negligible. Impacts are likely to be restricted to highly mobile species and potentially the cumulative loss of vegetation communities across numerous wind farms.

10.5 Avoidance, Management and Mitigation

10.5.1 *Avoidance Measures*

The Proponent has made a number of amendments to the Project to minimise and avoid impacts on the ecological habitat across the site. Information regarding biodiversity and other factors considered during the design process resulted in a significant reduction in the extent of the Project and a re-design of the Layout to arrive at the two configurations presented in this EIS. Given the presence of CEEC, EEC and threatened flora and fauna species across the Project site, and the requirement for wind turbines to be placed on ridge tops, the opportunities to avoid all impacts are limited. Nevertheless, wind turbines and associated infrastructure have been generally sited to avoid areas of remnant woodland vegetation and riparian areas. The ecological surveys have been used to inform removal and / or micro-siting of wind turbines and infrastructure to take into account site-specific environmental issues and minimise on-ground ecological impacts.

Whilst it is not practicable to completely avoid placing wind turbines in any areas supporting woodland, thereby impacting Project feasibility, a number of amendments have been made to minimise impacts in these areas. The linear layout of wind turbines along ridgelines, required for the wind farm to function at maximum capacity and be economically feasible, in some cases limits the areas to which wind turbines can be moved to avoid impacts, but on the other hand ensures no consolidated areas of clearing occur.

General avoidance measures that will or have been implemented to minimise impacts on the ecological integrity of the Project whilst maintaining the engineering and economic feasibility are summarised below:

- On-site access roads have been designed around existing tracks and roads within the Study area, where practicable, to avoid additional vegetation clearance for access;
- Waterway crossings will be designed in accordance with NOW guidelines including NOW's Guidelines for controlled activities (2012) and in consultation with NOW to consider how to avoid, minimise and manage impacts on in-stream and riparian ecology from works close to waterways and / or waterway crossings;
- Wind turbines have been placed in cleared, treeless or low tree density areas, where practicable, to minimise the need for additional or excessive tree clearance and loss of hollow-bearing trees;
- Where wind turbines have been placed in woodland areas, they have been situated in areas where ground layer disturbance has previously taken place (e.g. sown areas);
- Construction compounds, CS, SS and rock crushing facilities have been located outside ecologically sensitive areas, where practicable;
- The Project has been designed such that tree removal has been minimised and will be further minimised during the detailed design phase, including placing wind turbines at least 30 m from hollow-bearing trees, where practicable;
- On-site access roads and transmission line routes have been re-aligned so as to minimise the impact on the CEEC / EEC, with disturbance occurring only for the installation of the overhead transmission line, where only the canopy will be removed, ensuring the understorey remains; and
- The underground transmission line cables have been placed within the earthworks of the on-site access road footprint where practicable to allow for temporary rather than permanent disturbance. Reticulation will pass overhead across large gullies and waterways to further reduce impacts.

Specific avoidance measures were adopted into the Project design to account for biodiversity values. The key adjustments are outlined in **Table 10.6**.

Table 10.6 Avoidance measures adopted into the Project Design

Project Feature	Original Location	Adjusted Location	Reason
Main access road to the Kangiara Cluster	Tangmangaroo Road, starting at the intersection with the Lachlan Valley Way and continuing to the intersection with Harrys Creek Rd	Removed. Access is now proposed directly off the Lachlan Valley Way.	To avoid removal or modification of intact roadside stands of Box-Gum Woodland along Tangmangaroo Road. The stands provide habitat for threatened species, including the Squirrel Glider, which was recorded in this area.
Substations	Within Box Gum Woodland DNG in the Kangiara Cluster	Moved to nearby grassland with a lower percent coverage of native species	To avoid removal of Box Gum Woodland DNG and potential GSM habitat.
Six wind turbines and associated access tracks	Within the Environmental Stewardship Block on 'Glanmire'	Removed	To avoid removal or modification of an area of Box Gum Woodland that is being managed under the Environmental Stewardship Program.
One wind turbine	Adjacent to a stand of Box-Gum Woodland in the Kangiara Cluster	Removed	To avoid areas adjacent to Box Gum Woodland that have a high potential of being within the flight path of the Superb Parrot.
Turbines and access tracks	Within a remnant of Red Stringybark Open Forest in the Mt Buffalo cluster	Moved to the edge of remnant woodland and nearby grassland	To avoid removal and fragmentation of remnant native woodland.

10.5.2 *Mitigation / Recommendations*

In order to protect the ecological values of the Project site a number of management and mitigation measures have been proposed. Given their extent, and to avoid duplication, these are generally outlined in **Chapter 21** Statement of Commitments together with the Project stage during which each would be implemented, as well as **Appendix 12**.

10.5.3 *Offset Strategy*

A detailed offset strategy will be developed in the detail design phase prior to construction commencing as the area of impact to the various vegetation types across the Project is determined. For the purpose of this report a 'worst case' assessment and offset requirement of the Project is presented.

A BioBanking Assessment has been undertaken to calculate the residual impacts of the Project. The quickest and simplest method of meeting the offset requirements is to purchase the correct number and type of biodiversity credits from the credit register. However such credits may not be available through the credit register, thus ERM has conducted desktop investigations to locate potential suitable offset locations. In order to do this, the credit requirement for each BVT was converted to hectares (see **Table 10.7**), using the credit to hectare converter developed by OEH and the area generated for each BVT was then matched with equivalent vegetation types within the Locality, based on CMA scale vegetation mapping (see **Tables 10.8** and **10.9**). **Figure 10.14** to **10.15** illustrates the distribution of suitable vegetation types at local and regional scales.

Table 10.7 Ecosystem credit requirements and their equivalent in hectares

BVT Code	BVT name	Area in Study Area (ha)	Permanent Impact Area in Development Footprint (ha)	Required Credits	Equivalent Hectares Required
LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	850.11	83.63	1,428	153.5
LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	337.96	21.14	399	42.9

NB: Data is based on the Credit Report provided in Annex H of Appendix 12 and the BioBanking Credit Converter

The results of the desktop investigations conducted by ERM have assisted the Proponent to identify potential properties that may be suitable. Discussions have commenced with involved and non-involved landowners and several potential sites have been highlighted for further investigation as to their suitability in providing the required offsets. Work is ongoing to identify further properties with suitable habitat to ensure the required offset is available prior to the start of construction. These sites may either be managed by the landowner themselves, purchased to be managed for conservation by the Proponent (or contractors acting on their behalf) through an appropriate covenant or transferred to the Minister for the Environment and gazetted as Conservation Reserves (subject to agreement with the Minister for the Environment).

Table 10.8 Impacted and matched vegetation types for offsetting analysis

Impacted Vegetation Types			Matched Vegetation Types		
ID	Veg Type	Required Ha	ID	Veg Type	ArcGIS (VIS Map Unit)
LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	153.5	LA103	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	44
			LA113	Black Sallee - Tussock Grass open woodland of the South Eastern Highlands	25
			LA120	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion (Benson 277)	46
			LA121	Blakely's Red Gum moist sedgey woodland	Un-

Impacted Vegetation Types			Matched Vegetation Types		
				on flats and drainage lines of the South Eastern Highlands and South Western Slopes	mapped
			LA145	Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)	69
			LA194	Riverine Inland Grey Box grassy woodland of the semi-arid (warm) climate zone (Benson 237)	74
			LA205	Snow Gum - Candle Bark grassland / woodland of the South Eastern Highlands	Un-mapped
			LA219	White Box grassy woodland on well drained podsolic clay soils on hills in the NSW South Western Slopes Bioregion (Benson 266)	78
			CW102	Apple Box - Yellow Box dry grassy woodland of the South Eastern Highlands	CW102
			CW138	Fuzzy Box - Inland Grey Box on alluvial brown loam soils of the NSW South Western Slopes Bioregion and southern BBS Bioregion (Benson 201)	CW138
			CW215	White Box grassy woodland of the Nandewar and Brigalow Belt South Bioregions	CW215
LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion	42.9	LA182	Red Stringybark - Scribbly Gum - Red Box - Long-leaved Box shrub - tussock grass open forest the NSW South Western Slopes Bioregion (Benson 290)	41
			LA183	Red Stringybark - White Box grassy open forest of the South Western Slopes	Un-mapped
			LA223	White Cypress Pine woodland on sandy loam soils on the plains of central NSW (wheatbelt) (Benson 70)	19

NB: CW vegetation types are included because, in this circumstance, they can be used as an offset .

Table 10.9 Species credit requirements and their equivalent in hectares

Species Name	Common Name	TSC Act Status	Extent of Impact	Tg* Value	Number of Credits Required	Equivalent Hectares Required
Hieraaetus morphnoides	Little Eagle	V	6.58	0.74	89	15
Circus assimilis	Spotted Harrier	V	6.58	0.74	89	15
Synemon plana	Golden Sun Moth	E	82.48	0.40	2,062	344

*NB: *Tg value relates to the species' response to environmental gain, as defined in the BioBanking Credit Calculator.*

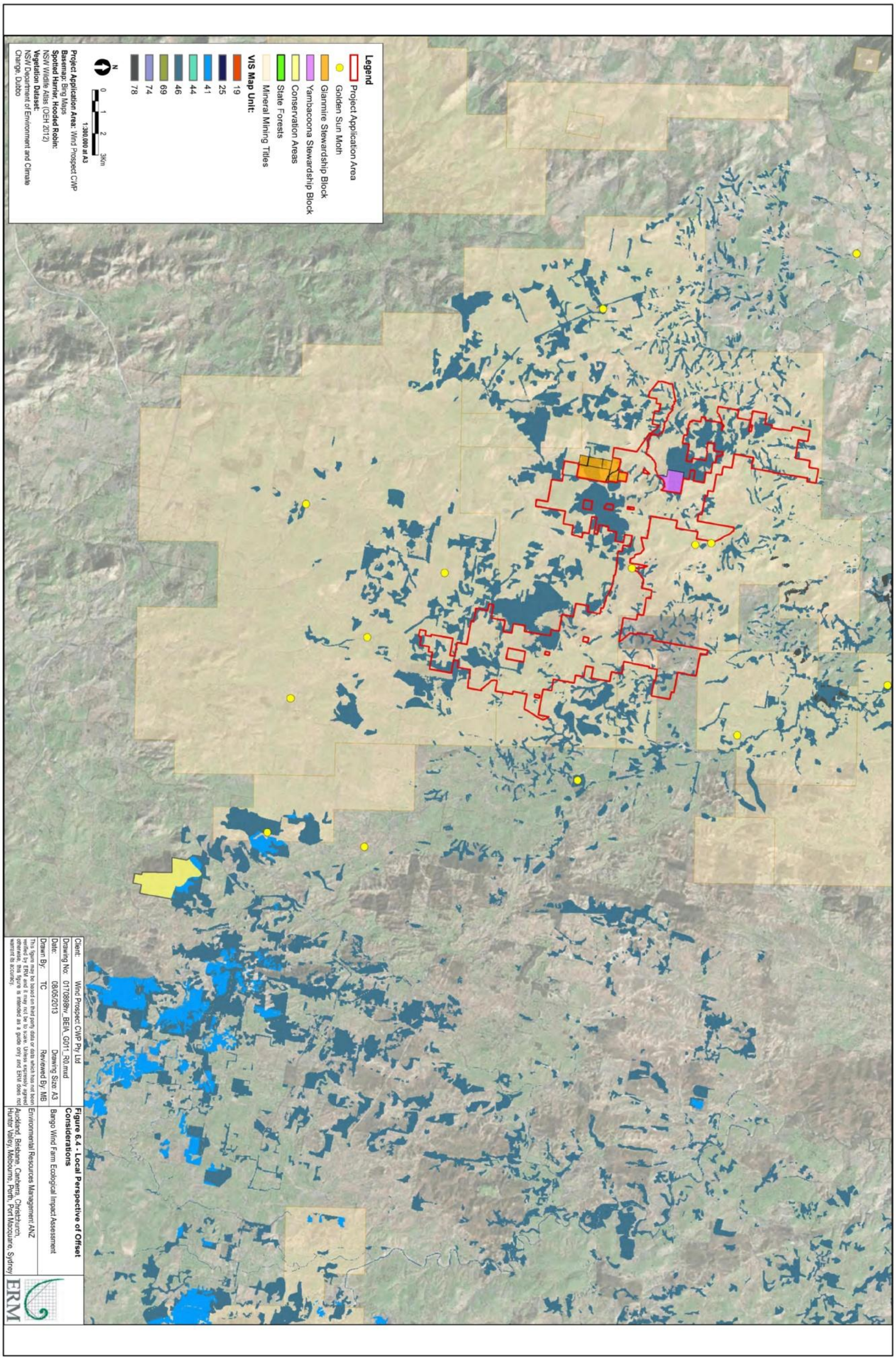


Figure 10.14 Local offset considerations perspectives

(An A3 version of this Figure is displayed in Volume 2)

FIGURE 10.15: REGIONAL OFFSET CONSIDERATIONS PERSPECTIVES

2016

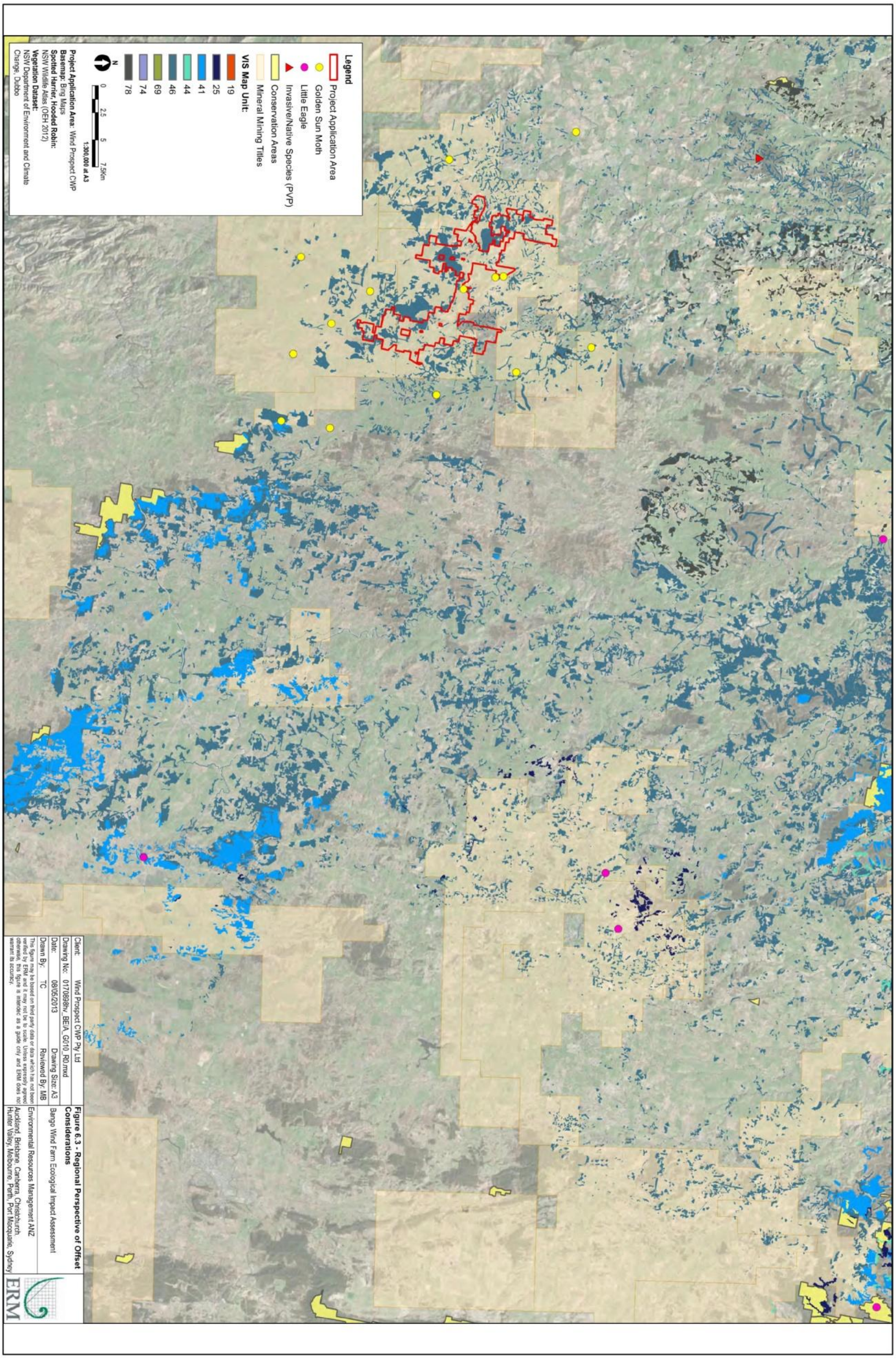


Figure 10.15 Regional offset considerations perspectives

(An A3 version of this Figure is displayed in Volume 2)

10.6 Summary

Under Part 4 of the *EP&A Act*, the Project is required to meet the principles of the 'maintain and improve' test. Whilst complete avoidance of all impacts on threatened species, their habitat and areas of native vegetation is not practicable, a number of avoidance and impact minimisation measures, including the modification of the Layouts to avoid areas containing threatened species and communities, have been implemented. Furthermore, mitigation measures will be implemented as part of Project construction and operation which will further reduce the potential impacts from the Project.

For those impacts that cannot be mitigated or avoided, offset options are being investigated that will make a substantial contribution to the protection of the CEEC / EEC and threatened species and their habitat in the Lachlan CMA through in-perpetuity protection of large, viable offset areas.

Through the suite of avoidance, mitigation and offset measures outlined in this chapter, with further detail in **Chapter 21** Statement of Commitments and **Appendix 12**, the principles of the 'maintain and improve test' are upheld.

CHAPTER 11

Cultural Heritage Assessment

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11. CULTURAL HERITAGE ASSESSMENT

New South Wales Archaeology Pty Ltd (NSW Archaeology) was commissioned in June 2012 to undertake an Aboriginal archaeological and cultural heritage assessment of the proposed Project in accordance with the Secretary's Environmental Assessment Requirements (SEARs). The full report is attached in **Appendix 13**.

The Cultural Heritage Assessment was conducted and written in accordance with the *Draft guidelines for Aboriginal cultural heritage impact assessment and community consultation* (NSW DEC 2005), the OEH *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (*NSW OEH 2011b) and the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (NSW DECCW 2010b) and OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b).

Both Aboriginal and European heritage is present throughout Australia's rural landscape, and is protected in accordance with Part 6 of the *National Parks and Wildlife Act 1974*, which provides protection for Aboriginal Objects and Aboriginal Places. The construction of a wind farm project has the potential to cause direct impacts to any Aboriginal objects (predominantly stone artefacts) or European items which may be present within the Study area. As such, a heritage assessment has been undertaken to identify those Aboriginal groups with a heritage interest in the Project site, and to determine any heritage objects or places present within the Project site in order to avoid them where necessary.

11.1 Partnership with Aboriginal Communities

In accordance with the *Draft guidelines for Aboriginal cultural heritage impact assessment and community consultation* (NSW DEC 2005) and OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (NSW DECCW 2010b), as discussed in **Chapter 5** Planning Context, the Proponent and NSW Archaeology actively sought to identify stakeholder groups or people wishing to be consulted about the Project. Written notification about the Project, dated 9th July 2012, was sent to the following groups:

- OEH, Queanbeyan Office;
- Onerwal Local Aboriginal Land Council;
- Office of the Registrar, Aboriginal land Rights Act 1983;
- The National Native Title Tribunal;
- Native Title Services Corporation Limited (NTSCORP Limited);
- Yass Valley Council;
- Upper Lachlan Shire Council;
- Boorowa Council; and
- Lachlan Catchment Management Authority.

In addition, an advertisement was placed in 11th July 2012 edition of the Yass Tribune and 12th July 2012 edition of the Boorowa News local newspapers.

Following advice received from OEH and the National Native Title Tribunal, further written notification was supplied to the following:

- Yukkumbruk;
- Peter Falk Consultancy;
- Pejar Local 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; and
- Gundungurra Tribal Council Aboriginal Corporation.

11.2 Methods

The heritage assessment was conducted using:

- A desktop study, search of relevant databases and literature review;
- Detailed field survey;
- Analysis and discussion of results; and
- Recommendations.

For the purposes of the field survey the Project was divided into 43 Survey Units defined according to landform morphological type and accounting for approximately 466 ha of the Project site. The field work occurred in December 2012 and involved a pedestrian traverse of 93.4 kilometres of linear impact areas. The survey was lead by NSW Archaeology with the assistance of representatives of the local Aboriginal community including Tyrone Bell (Buru Ngunawal Aboriginal Corporation) and Graeme Dobson (Ngunnawal Heritage Aboriginal Corporation).

Aboriginal: The Study area was surveyed to identify any Aboriginal sites or objects present, described as artefact locales, and to determine the potential impacts upon them. A predictive model was also used to determine the nature of Aboriginal occupation across the land. The degree of Aboriginal occupation is based on a number of factors and, as a result, occupation may not have been uniform across the Project site. By studying these factors, the predictive model can determine the type and nature of archaeological sites which might be expected to occur across the Study area.

Non-Aboriginal: The European component of this assessment included searches 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. Searches of the Australian Heritage Database, the State Heritage Database and the National Trust of Australia (NSW) Register have revealed no items listed in this area.

Heritage items recorded were assessed against heritage listing criteria by NSW Archaeology.

11.3 Existing Situation

11.3.1 *Aboriginal Heritage*

The assessment identified that the region was occupied by Aboriginal speakers of at least two languages - Wiradjuri and Ngunawal. The people of Yass and / or Boorowa district were variously known as the Onerwal [Ngunawal] (White and Cane 1986) and the Wallabalooa tribe (Jackson-Nakano 2002). 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. These studies concluded that stream valleys or areas within 200 metres of stream valleys were most frequently occupied as they provided access to drinking water and had the greatest vegetation diversity, including a variety of aquatic food plants in streams. The predominant land use by Aboriginal people in the Project site is predicted to have been restricted to a limited range of activities including hunting and gathering forays conducted away from base camps, vantage points and movement through the country. Such short-term activities are likely to have resulted in low to very low levels of object discard, diversity and complexity.

The early 1800s saw changes in the traditional land use of Aboriginal people with the introduction of European settlement. Further detail on the impact of European settlement in the local area is provided in **Appendix 13.**

11.3.2 *Non-Aboriginal Heritage*

Three European heritage items were recorded during the study, none of which satisfy heritage listing criteria. All are located outside the Study area and will not be impacted by the Project.

11.4 Survey Results and Potential Impacts

A total of 43 Survey Units encompassing 466 ha, were created prior to the field survey of the Study area. Ground exposures inspected included bare earth, erosion scalds, animal tracks and roads and measured approximately 6.8 ha. Of this area, archaeological visibility (the potential artefact-bearing soil profile) was estimated to have been 4.9 ha. Effective Survey Coverage (ESC) has therefore been calculated at less than 1 % of the Study area. While low, the ESC result is normal for grassed country.

A total of 14 Aboriginal object locales with stone artefacts were recorded within the assessed Survey Units, as listed in **Table 3** in **Appendix 13**. Artefacts have been calculated as having predominantly very low density artefact distributions, and assessed as being significantly disturbed and without archaeological deposit (due to a lack of adequate soil cover). As such, the archaeological resource can be considered to be of correspondingly low significance. All Survey Units were assessed to be of negligible to low archaeological sensitivity.

Given the nature and density of the artefact locales recorded in the Study area and the low scientific significance rating they have been accorded, a strategy of impact avoidance is not warranted in regard to these locales. However, in correspondence dated 22 April 2013, the Ngunawal Heritage Aboriginal Corporation has requested a programme of salvage in respect of the 57 artefacts found during the field survey. This matter will be considered further prior to the construction of the wind farm during the development of the Cultural Heritage Management Protocol.

11.4.1 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. Given that the impact of the Project on aspects of cultural heritage are both isolated and minimal in nature, it is anticipated that there will be no cumulative effect on cultural heritage from the introduction of the Project into the area.

11.5 Management and Mitigation

Desktop and on-site survey results identified 14 Aboriginal locales. Impacts are predicted to be discrete in nature due to the relatively small development footprint within the overall Project site. The archaeological heritage significance of the locales has been assessed to be low. Accordingly, unmitigated impact, where this would occur, is considered to be acceptable.

A full list of mitigation and management strategies is contained in **Sections 7 and 9** of the consultant report of **Appendix 13**. In preparation of the appropriate construction EMP sub-plan, consideration will be given to the suitability of the mitigation measures outlined in the technical report with regard to the parameters of the Project.

Such strategies include:

- The Proponent, in consultation with an archaeologist, relevant Aboriginal communities and OEH, will develop a Cultural Heritage Management Protocol which provides procedures to be followed for impact avoidance and unexpected finds;
- Consideration of a salvage protocol will be given prior to the construction of the wind farm during the development of the Cultural Heritage Management Protocol.
- Personnel involved in the construction and management phases of the Project trained in procedures to implement recommendations relating to cultural heritage, where necessary, to decrease impact; and
- Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development.

The Project can continue as the Survey Units and Aboriginal object locales recorded do not surpass scientific significance thresholds. Also, no Survey Units have been identified to warrant further archaeological investigation, such as a subsurface test excavation.

The following mitigation and management strategies are suggested to minimise the impact on Aboriginal objects and places:

- Ground disturbance impacts associated with the Project be kept to a minimum and to defined areas, to ensure minimum impact on Aboriginal objects, which can be expected to extend in a relatively continuous, albeit very low to low density distribution, across the broader landscape encompassed by the Project;
- It is recommended that additional archaeological assessments are to be carried out if any new impacts are to occur outside the Study area. If a significant Aboriginal object is identified, prior

to impact, mitigation strategies will be implemented. It may be culturally appropriate to salvage artefacts from certain sites; and

- Aboriginal Site Impact Recording Forms are to be completed (and submitted to the OEH) for each Aboriginal object / locale harmed during construction of the Project.

Mitigation measures to account for these recommendations are presented in **Chapter 21** Statement of Commitments.

Any residual impacts resulting from the Project after successful implementation of mitigation measures implemented through the EMP sub-plan and compliance with relevant codes and standards will be below acceptable levels.

11.6 Summary

The proposed impacts from the Project are discrete in nature and will occupy a relatively small footprint within the overall area. Accordingly impacts to the archaeological resource across the landscape can be considered to be partial in nature, rather than comprehensive.

Fourteen Aboriginal object locales were recorded during the field survey. Undetected or subsurface stone artefacts are predicted to be present in extremely low density. The Study area is assessed to be of generally low cultural and archaeological potential and significance. Three European heritage items have been recorded, all of which are outside the Study area and will not be impacted by the Project.

Given the small development footprint, the nature and density of the artefact locales recorded and the low cultural and scientific significance rating they have been accorded, unmitigated impacts is considered appropriate.

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CHAPTER 12

Traffic and Transport Assessment

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12. TRAFFIC AND TRANSPORT ASSESSMENT

Samsa Consulting was commissioned to undertake a traffic and transport assessment for the Project (see **Appendix 14** for full report). The study was conducted in accordance with the NSW Roads and Traffic Authority (RTA) *Guide to Traffic Generating Developments* and the Secretary's Environmental Assessment Requirements (SEARs), and provides a technical appraisal of the traffic and safety implications arising from the Project. Detail relating to on-site road infrastructure is provided in **Chapter 3** Project Description and preliminary designs can be seen in **Figures 3.1** to **3.8**.

12.1 Methods

The traffic and transport assessment undertaken comprised of a desktop study, consultation and fieldwork. The desktop study involved reviewing maps of the Project area to identify features and revision of Roads and Maritime Services (RMS) data to establish existing traffic volumes. Consultation was undertaken by Samsa Consulting with the Proponent, RMS, Yass Valley and Boorowa Councils, and heavy vehicle operators experienced in handling wind turbine components. The feedback provided base Project information, advice on existing traffic conditions and possible routes for heavy vehicles during construction. There were no relevant Council traffic/road policies identified at the time of the assessment. Fieldwork by Samsa Consulting involved inspection of the roads along the potential transport routes and a traffic count was undertaken during November 2012 to establish existing traffic volumes and road conditions.

The assessment developed strategies and recommendations to minimise traffic impacts throughout the life of the Project. The main focus of the assessment, however, is the construction phase, as this is likely to generate greater traffic impacts on the existing public road network and on-site access roads, compared to other phases.

12.2 Existing Situation

To establish existing traffic conditions within the locality of the Project, Samsa Consulting reviewed traffic volume data and undertook spot counts.

Lachlan Valley Way, west of the Project, has the largest volume of traffic with 3,400 vehicles per day (vpd). Rye Park Road, north of the Project, has less than 500 vpd. Tangmangaroo Road, running through the Project, and Hopefield Lane, connecting to the Langs Creek Cluster, both have less than 50 vpd.

Yass Valley Way, south of the Project, has 2,961 vpd, Rye Park-Dalton Road, east of the Project, has less than 500 vpd and Wargeila Road, east of the Project, has 353 vpd at the southern end and less than 50 vpd along unsealed sections to the north (see **Appendix 14**).

In order to assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the Project, Samsa Consulting also assessed the potential impact of additional traffic on traffic flow. Road capacity was expressed and qualified along a section of the rural road network as its 'Level of Service' (LoS) (refer to **Appendix 14**). LoS is typically expressed in total vpd and / or vehicles per hour (vph).

The LoS descriptions are:

LOS A: Free flow conditions, high degree of freedom for drivers to select desired speed and manoeuvre within traffic stream. Individual drivers are virtually unaffected by the presence of others in the traffic stream.

LOS B: Zone of stable flow, reasonable freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS C: Zone of stable flow, but restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.

LOS D: Approaching unstable flow, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream. Small increases in flow generally cause operational problems.

LOS E: Traffic volumes close to capacity, virtually no freedom to select desired speed or manoeuvre within traffic stream. Unstable flow and minor disturbances and / or small increases in flow would cause operational break-downs.

LOS F: Forced flow conditions where the amount of traffic approaching a point exceeds that which can pass it. Flow break-down occurs resulting in queuing and delays.

The existing levels of service range from LoS A on Lachlan Valley Way, Rye Park Road, Wargeila Road and Rye Park-Dalton Road to LoS B on Yass Valley Way (see **Table 12.4**). For Tangmangaroo Road, Hopefield Lane and the northern section of Wargeila Road, which are all minor unsealed roads, service flow rates are not applicable as the roads do not have formed lanes and carriageways. However, these sections of road are operating at a high level of service with significant spare capacity due to their very low existing traffic volumes (less than 50 vpd).

12.3 Potential Impacts

The transport of materials and equipment to the Project Site during the construction phase would involve a temporary increase in the local traffic volume and, potentially short term road closures, some delays to local traffic, local road upgrades and repairs to accommodate the transport of oversize loads. During the operational phase the volume of traffic relative to the construction phase would decrease significantly, resulting in a small number of operations and maintenance vehicles along with infrequent use of larger vehicles such as heavy haulage and cranes.

12.3.1 *Transport Routes*

A number of main and secondary roads, as discussed in **Chapter 3** Project Description and **Appendix 14**, have been assessed to access the Project site for construction, maintenance, refurbishment, decommissioning and visiting purposes.

The assessment has taken into account not only the site access locations but also potential road transport options from all travel directions. The technical report in **Appendix 14** includes an assessment of several route options considering factors such as;

- Standard of road infrastructure, including pavement type and condition, width of carriageway and road formations, pavement line marking, controlled access to side roads, and bridge and culvert crossings;

- Speed limits and school zones;
- Restrictions on vehicle access as prescribed by road authorities and physical obstructions such as overhead powerlines, overpasses, crests, dips and tight radius curves;
- Road user conflicts such as traffic volumes and local, regional and school bus routes;
- Distance from major road networks to the Project Site access points;
- Clearing or pruning of roadside vegetation; and
- Obstacles such as roadside furniture that may need to be temporarily removed.

The preferred routes proposed have been assessed to result in the lowest practicable impact.

Major Road Network Route Options

Effectively, transport from the various directions would travel along the following major State Road or highway routes before travelling along the necessary local road network:

- East, north-east, south and west – via Hume Highway, Lachlan Valley Way and Yass Valley Way (these routes would include over-size vehicle transport); and
- North – via Cowra and Lachlan Valley Way (standard vehicle transport only)

Figure 12.1 shows the regional major road network and transport routes. The major road network provides a relatively high standard of road infrastructure, generally suitable for transport by the heavy and over-size vehicles used in delivery of components and materials for the construction of the Project.

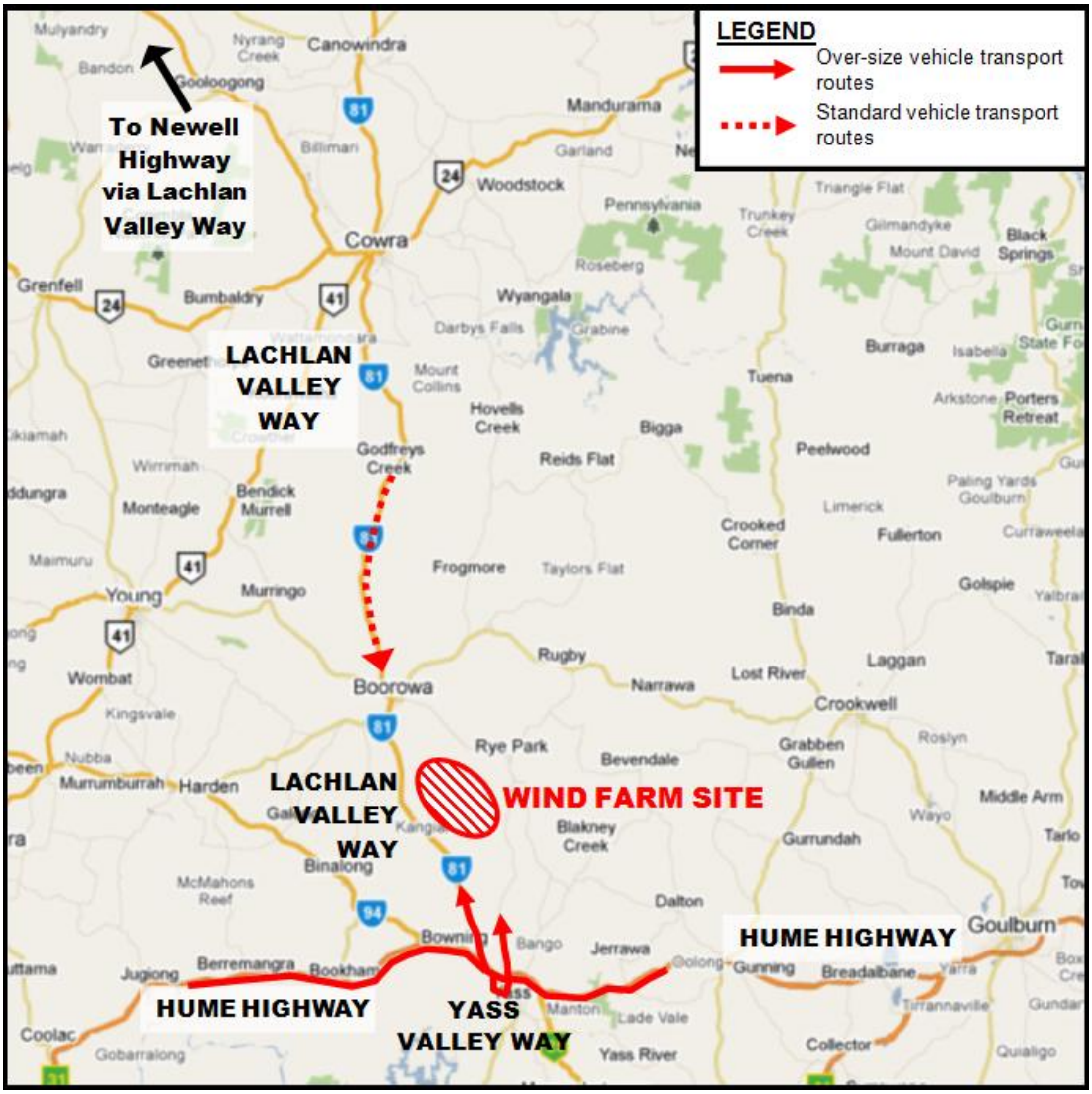

Figure 12.1 Regional major road network and Project transport routes

Project Site Access Locations

Five site access points are proposed off the public road network. Four of which provide access to wind turbine clusters with the other providing access for the substation construction only – refer to **Table 12.1** and **Figure 12.2** and **Chapter 3** Project Description.

Table 12.1 Access routes to Project Clusters

Cluster	Site Access Name	Main access route
Kangiara	Lachlan Valley Way Access	Yass Valley Way and Lachlan Valley Way
Langs Creek	Hopefield Lane Access	Lachlan Valley Way, east of Boorowa Town (via Meads Lane and Long Street), Rye Park Road and Hopefield Lane
Mt Buffalo	Wargeila Road Access	Yass Valley Way, Wargeila Road
Mt Buffalo	Rye Park – Dalton Road Access	Yass Valley Way, Wargeila Road and Rye Park Dalton Road
Collector / Switching Substation	Tangmangaroo Road Access	Lachlan Valley Way and Tangmangaroo Road

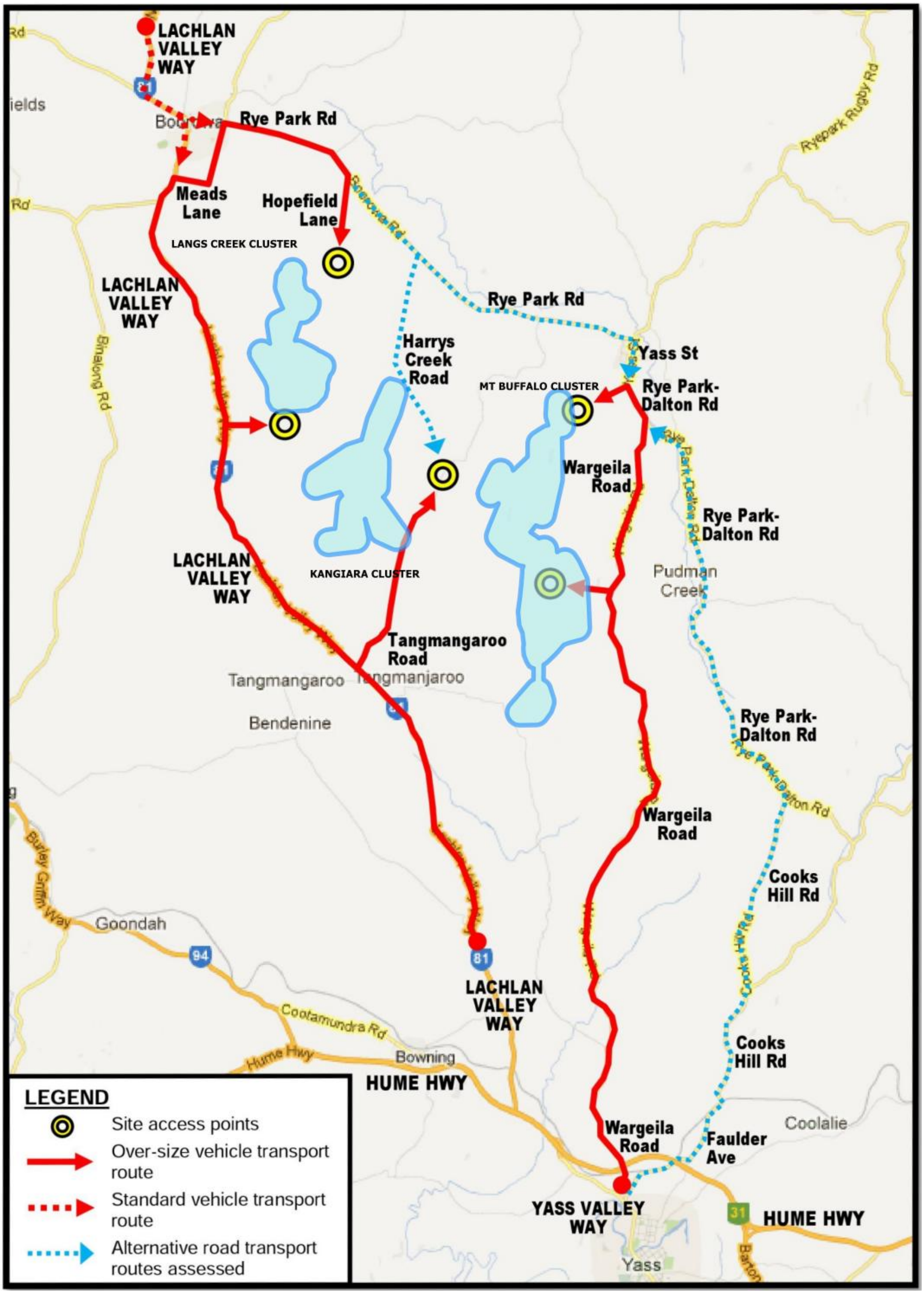

Figure 12.2 Transportation routes to Project site access points

Specific consideration has been given to minimising impacts to the town of Boorowa and the village of Rye Park.

Transport Route around Boorowa

Transport to the Hopefield Lane access off Rye Park Road is to be diverted around Boorowa's urban area. The preferred route is to turn east off Lachlan Valley Way into Meads Lane and continue to Long Street (also known as Cemetery Road at the southern end) where the route turns north. The route then continues north along Long Street where it turns into Rugby Road at the eastern edge of Boorowa town, and continues north-east along Rugby Road. **Appendix 14** provides further detail about this transport route and **Figure 12.3** shows how transport will be diverted around Boorowa.

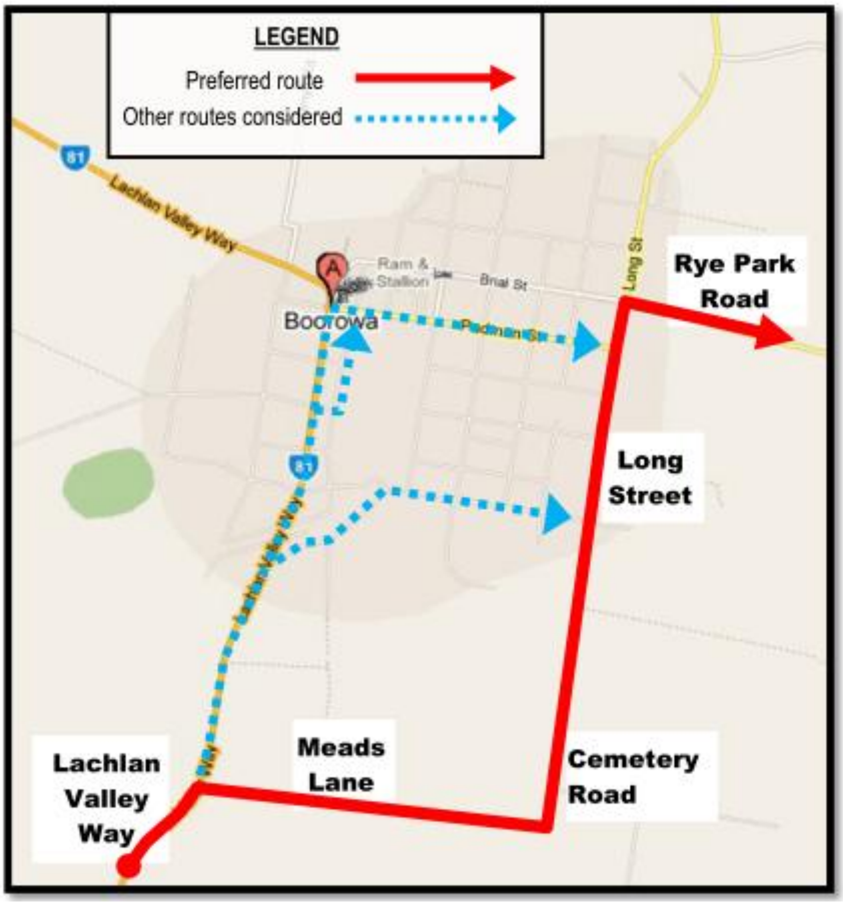

Figure 12.3 Oversize vehicle transportation route around Boorowa

Transport Route through Rye Park

Transport via the Rye Park village area was considered initially and assessed. The route along Rye Park Road (east from Hopefield Lane) is considered to be generally conducive to over-size vehicle transport. However, a transport route via Rye Park village has been disregarded from further assessment due to there being no viable bypass route of the village and Yass Street (main street of Rye Park) has numerous overhead powerlines, several public land uses along the main street, and overhanging foliage (details as listed in **Appendix 14**).

12.3.2 *Construction*

Construction traffic for the installation of the Project would be present over a period of approximately 18 months to two years. The traffic would consist of:

- Articulated semi-trailers (extendible and regular trailer sizes), heavy duty low loaders, dolly / jinker arrangements and a variety of high power prime movers – for transporting initial establishment equipment, materials and wind turbine components;
- Tipper trucks – to bring stone for the on-site access roads and to remove soil;
- Bulldozers – for road works on-site;
- Concrete agitators – to transport concrete from the batching plant for use on-site;
- Cranes – four cranes (two main cranes and two tailing cranes) moving between wind turbine sites; and
- Conventional 4WD vehicles and sedans – use by on-site personnel.

During the construction period the largest number of vehicle movements is likely to occur during the delivery of the wind turbine components. Each of the wind turbines will require up to six escorted, extendible trailers for the tower, three for the blades and one for the nacelle. Additional loads will consist of concrete, steel reinforcement, base tower sections, road stone and other construction materials being delivered to the Project site.

Load weights and lengths of equipment and components will vary. The heaviest loads are expected to be the nacelles weighing up to around 125 tonnes. Over-mass loads will be carried on trailers, or combinations of trailers, with sufficient axle groups to ensure compliance with point load and overall load limits for the road surface. As such, over-mass vehicles will incur less loading stress on the road surface, especially when run under escort with limited speed, than normal heavy vehicle traffic. The longest loads will be for the blades, which will have trailer lengths up to 72 m long.

Table 12.2 Project component transportation

Wind Farm Components	Characteristics	Traffic Generation
Nacelle	Weight is up to 125 tonnes, one per wind turbine: single load with installed drive trains.	Traffic generation for 1 wind turbine: 1 over-size (mass) vehicle Traffic generation for 122 wind turbines: 122 over-size vehicles
Blades	Three blades per wind turbine: up to 72 m long, single blade per vehicle.	Traffic generation for 1 wind turbine: 3 over-size (length) vehicles Traffic generation for 122 wind turbines: 366 over-size vehicles
Hub	Typical weight is approximately 40 tonnes, one per wind turbine in single load. Sometimes the hub 'capping', which is a lightweight fibreglass piece, is stacked into groups of 3 and sent in a single load to site.	Traffic generation for 1 wind turbine: 1 low-loader vehicle Traffic generation for 122 wind turbines: 122 low-loader vehicles
Tower	Typically three to five sections, each weighing between 20 and 65 tonnes depending on the section and measuring between approximately 20 m to 25 m long. An additional section for insert into the foundation weighs 10 tonnes and is typically 4 m in diameter and 5 m long. Typically 3 to 4 sections per tower, plus the foundation ring. Tower sections range from 15 m (lower sections) up to 30 m (top section).	Traffic generation for 1 wind turbine: 5 low-loader (over-mass) vehicles + 1 semi-trailer truck Traffic generation for 122 wind turbines: 610 low-loader (over-mass) vehicles + 122 semi-trailer trucks
Additional Materials	Typically for each wind turbine, additional miscellaneous equipment to be delivered to the site would require approximately one container (semi-trailer) truck.	Traffic generation for 1 wind turbine: 1 semi-trailer truck Traffic generation for 122 wind turbines: 122 semi-trailer trucks
Sub-station Transformers	The collector substation transformers would have a typical weight of up to 90 tonnes. Transportation of up to five transformers would be by road and would involve direct loading onto a platform trailer.	Traffic generation: 5 over-size (mass) vehicle + 10 semi-trailers of support equipment.
Switching Station	Semi-trailer for transportation of switching station components at the point of connection.	Traffic generation: 10 semi-trailers of components and associated equipment.
Overhead Transmission Lines	Semi-trailer for transportation of power poles, conductors, wires and other materials.	Traffic generation: dependant on final details of pole numbers, spacing and location but assume a minimum 20 semi-trailers of poles and associated transmission line equipment.
Site Cranes	Assume four cranes (2 main cranes and 2 tailing cranes) moving between wind turbine sites. These would travel to the preferred site access point at the start of construction and then leave at the end.	Traffic generation: 4 over-size (mass) vehicle + 12 semi-trailers of support equipment.

On-site movement during the construction period will mainly consist of concrete mixers moving from the batching plants to the wind turbine bases, to pour tower footings. Each footing may contain up to 640 m^3 of concrete to be poured over an eight hour period, which would result in some 107 concrete mixer truck trips per day. Water carts for dust suppression may also be required, the number of trips dependant on the site conditions at the time of construction.

Traffic generation predictions used by Samsa Consulting for this assessment include both a moderate or average scenario and a conservative or high (in brackets) scenario (see **Table 12.3**).

The moderate scenario is likely to apply for the great majority of the 18 month construction period. The conservative scenario assumes that peak construction staff numbers would coincide with other peak traffic generating activities (such as concrete pours, access road construction and wind turbine component delivery). In certain instances, such as the delivery of wind turbine components, the conservative scenario may only occur for a discrete period and accordingly the moderate scenario is estimated at low or zero. It is important to note that it is more likely that peak access road construction activities would be undertaken during the earlier stages of the construction program, and would not necessarily coincide with peak construction staff numbers or other peak construction activities such as concrete foundation pours. Nonetheless, this conservative overlap of activities was adopted to present the 'worst case' conservative scenario.

Traffic generation was classified into daily movement trips (i.e. two-way trips, generally involving vehicles travelling to site in the morning, and returning at the end of the day) shown as vehicles per day (vpd) and peak hour trips (where applicable) shown as vehicles per hour (vph). Traffic generation for both the moderate and conservative scenarios is shown in **Table 12.3** and, in more detail, in **Appendix 14**.

Table 12.3 Estimated Project-related traffic generation

Vehicle Type		**Total Estimated Vehicles**				
		Lachlan Valley Way	**Tangmangaroo Road**	**Rye Park Rd / Hopefield Lane**	**Yass Valley Way / Wargeila Road**	**Rye Park-Dalton Road**
Light vehicles [Construction staff]	vpd	48 (80)	20 (30)	48 (80)	48 (80)	48 (80)
	vph	24 (40)	10 (15)	24 (40)	24 (40)	24 (40)
Standard heavy vehicles [Miscellaneous construction]	vpd	48 (66)	14 (20)	40 (46)	48 (64)	12 (18)
	vph	13 (15)	9 (9)	13 (15)	13 (15)	9 (9)
Over-size vehicles * [Wind turbine components]	vpd	0 (14)	0 (10)	0 (14)	0 (14)	0 (14)
	vph	0 (4)	0 (4)	0 (4)	0 (4)	0 (4)
Total Vehicles	**vpd**	**96 (160)**	**34 (60)**	**88 (140)**	**96 (158)**	**60 (112)**
	vph	**37 (59)**	**19 (28)**	**37 (59)**	**37 (59)**	**33 (53)**

vpd – vehicles per day (i.e. two way trips) **vph – vehicles per hour (peak hour)**

*Source: **Appendix 14** (conservative estimates in brackets).*

**Delivery of the wind turbine components occurs for approximately 4 months and appears only in the conservative scenario estimate.*

Road Capacity: These traffic estimates indicate that the operating conditions (LoS) along the rural road network will change negligibly from existing conditions after the addition of Project related construction traffic (see **Table 12.4**). The majority of the relevant rural road network has significant spare capacity and is operating at a high LoS. The addition of heavy vehicles and construction staff traffic during peak construction periods is able to be absorbed by the both the rural and urban networks with appropriate road infrastructure upgrades and construction traffic management.

Table 12.4 Rural road network capacity – existing and future LoS

Road Section	Existing LoS	Future LoS
Lachlan Valley Way	A	A/B
Rye Park Road	A	A/B
Yass Valley Way	B	B
Wargeila Road	A	A/B
Rye Park-Dalton Road	A	A

Source: ***Appendix 14****.*

Heavy and Over-Sized Haulage: All Project component deliveries, including all over-sized vehicles, will be transported via the Hume Highway from the south, east and north and potentially the Newell Highway and Lachlan Valley Way from the west and far north (as listed in **Appendix 14**). There are some locations along the over-size transport routes (for example, Wargeila Road access route) where road alignments and / or narrow carriageway widths would require over-size vehicles to use the full carriageway width. This would require temporary, short-term full road closures ('rolling' road closures as vehicles pass critical locations) aided by pilot and escort vehicles.

To minimise potential impacts, the final route will take into consideration the shortest route to the Project site with appropriate carriageway and clearance and the routes that cause the least disruption to local transport and commercial activities. Final routes will be decided prior to construction between the Proponent, haulage contractor and road authorities and any required road modifications or upgrades designed and assessed at the time, as necessary.

Any required road modifications and upgrades are likely to involve temporary road closures. The identified potential locations are included under **12.4.2** Potential Road Infrastructure Upgrades. The locations are mostly on minor rural roads with low volumes of traffic which is expected to produce short term delays without significant traffic impact.

Public Visits: Experience gained from operational wind farms at Hallett and Starfish Hill in South Australia, Albany and Esperance in Western Australia, Ravenshoe in Queensland, Crookwell and Blayney in New South Wales and Codrington in Victoria suggests that there will be a great deal of public interest generated during the construction and operational phases. There have been several local wind farms constructed and now operating in the region around the Project. Some additional local traffic may result but is unlikely to materially impact the LoS.

12.3.3 *Operation and Maintenance*

Operational traffic would involve maintenance and inspection vehicles, or other traffic use (e.g. visitors), which would make periodic visits to the Project Site, as discussed in **Chapter 3** Project

Description. Vehicles used would be standard 4WD vehicles, sedans or vans. Bulldozers / graders would be needed on an infrequent basis for maintenance of on-site access roads during the life of the Project to allow for continued maintenance and inspection.

If a significant component of a wind turbine needs replacement, larger vehicles such as cranes and / or semi-trailers could be required, similar to that used during construction.

12.3.4 *On-site Access Roads*

The construction and maintenance of the Project requires the construction of an on-site access road network to reach each of the wind turbine locations and the substation. In some cases the access road network works would involve upgrading existing farm tracks and in others constructing new ones. The on-site access road design has considered topography, drainage and potential erosion impacts (see **Chapter 3** Project Description).

The on-site access road network would consist of private roads and not be accessible to the public. Access would be controlled by locked gates. The on-site access roads would generally be 6 m wide with regular passing bays and turning heads to accommodate construction vehicles and the crane required to assemble the wind turbines. Ongoing operational maintenance of on-site access roads would be undertaken by the Project operator.

12.3.5 *Decommissioning*

The traffic and potential impacts would be similar to the construction phase of the Project. The key difference being less traffic volume as there will be no requirement for concrete mixer trucks, which in turn reduces the potential impacts during decommissioning.

12.3.6 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a Project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. The main source of traffic within and around the Project is currently generated by agricultural activities and a small number of residences.

At present there is one major project that may result in cumulative impacts when combined with the Project. Rye Park Wind Farm is at a different stage of the design and development process and thus its timing for construction and operation is unclear at this stage.

Rye Park Wind Farm proposes to use the major and minor roads networks in the surrounding area, some of which is similar to the transport routes proposed for the Project, e.g. Lachlan Valley Way and / or Rye Park-Dalton Road. This has the potential to exacerbate any traffic and transport impacts.

Once progression of this project is confirmed and other potential major development in the surrounding area is determined, and when the construction dates / timetables are finalised for the Project, the cumulative impact of these would need to be considered with respect to transport and traffic considerations.

12.4 Management and Mitigation

To ensure adequate road safety is maintained, a comprehensive management plan will be prepared in conjunction with the chosen transport contractor and relevant road authorities (including local Councils). These would detail appropriate construction traffic controls and management measures and all aspects would be implemented in co-ordination with the Councils and RMS. It is acknowledged that on occasions local traffic will be inconvenienced. However, the management measures within the EMP sub-plan would endeavour to mitigate any impacts.

The following mitigation measures address all Project impacts, from construction through operation to decommissioning.

12.4.1 *Construction*

- Contract a licensed transport contractor with experience in transporting heavy and over-size loads. The contractor would be responsible for obtaining all required approvals and permits from the RMS and Councils (see **Appendix 14**) and for complying with any conditions specified in the aforementioned approvals, including complying with the relevant traffic and transport policies and guidelines;
- Develop an EMP sub-plan in conjunction with the transport contractor and road authorities to include, but not be limited to, the following:
- Scheduling of deliveries, timing of transport, limiting the number of trips per day, and reducing traffic during school bus route hours, i.e., 7:00 to 9:00 am and 3:00 to 4:30 pm;
- Undertaking community consultation before and during all haulage activities and providing a dedicated telephone contact list to enable any issues to be rapidly identified and addressed;
- Letterbox drop along affected routes;
- Minimising disruption to local vehicles by ensuring average and maximum wait times due to Project related traffic along local roads are kept to a minimum;
- Managing transport operations including provision of warning and guidance signage, traffic control devices, temporary construction speed zones and other temporary traffic control measures;
- Designing and implementing temporary modifications to intersections and roadside furniture as appropriate;
- Assessing, designing and implementing potential alignment changes to the existing road and culverts;
- Producing a Transport Code of Conduct which would be made available to all contractors and staff detailing traffic routes, behavioural requirements and speed limits;
- Establishing procedures to monitor traffic impacts on public and on-site access roads during construction, including noise, erosion and sediment, dust nuisance and travel times, and to implement modified work methods to reduce such impacts where practicable;
- Where reconstruction or provision of a temporary crossing is required over a creek or drainage structure, the design of this structure will be discussed with the relevant authority; and
- Reinstating pre-existing conditions after temporary modifications to the roads and pavements along the route where applicable, in consultation with the relevant authorities.
- Implement all aspects of the EMP sub-plan in co-ordination with the RMS, local Councils and property managers;

- Prepare road dilapidation reports covering pavement, drainage and bridge structures in consultation with RMS and the local Councils for all of the proposed transport routes before and after construction. Regular inspection regimes undertaken in consultation between local Councils and the proponent would be developed. Any damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired at the Proponent's cost. Alternatively, the Proponent may negotiate other forms of compensation for road damage with the relevant roads authorities as appropriate; and
- Consideration for establishing a transport pool for employees from nearby towns to minimise traffic volumes.

12.4.2 ***Route Upgrades***

Full structural upgrades are not normally required for wind farm access routes. Exceptions include where access is via an under-rated bridge, or where there are obstructions that overhang the road or limit the width of the vehicle / load that can pass. Mitigation strategies could comprise works to the road surface, road width, overhead obstacles, and bridges and culverts. Selection of these measures will be dependent on a full technical assessment by a qualified structural engineer which will typically occur during the detailed design phase of the Project, once dimensions and loads are known.

The potential road infrastructure upgrades that may be required and / or would need to be considered by the chosen transport contractor have been detailed in **Appendix 14**.

Road Surface: Generally clearances as low as 300 mm should be considered for over-mass trailers. Mitigation measures may include:

- Review of road camber, rise, fall and undulations;
- Placement of speed limits on roads to minimise stresses on road surfaces; and
- Use of temporary surfaces of crushed rock or similar material for on-site roads. Vehicles are designed to and capable of travelling on unsealed surfaces, and this measure is normally adequate to prevent loaded vehicles becoming bogged.

Road Width: Larger wind turbine loads require a road width of up to 5 m, which may be larger than the width of minor roads that service remote wind farm sites. Mitigation measures may include:

- Where road width is restricted (sealed or unsealed), clear sufficient vegetation from sides of the road to allow shoulders of crushed rock to be laid;
- Match the level of the surface preparation to that of the existing road to prevent tyre damage (and in the case of sealed roads, the break-up of the edge of the sealed section);
- Undertake a swept path analysis once the wind turbine model has been determined, to ensure that obstacles such as ditches or traffic furniture can be identified and remedied ahead of time; and
- Regular maintenance of temporary or crushed rock road surfaces to be undertaken when over-size / over mass vehicles are travelling to / from the Project site.

Overhead Obstacles: Over-size vehicles can travel with a combined total height of 5.2 m without the need for an overhead pilot. Mitigation measures for overhead obstacles may include:

- Identification of any obstructions or height risks, such as low bridges, overhead transmission lines, hanging wires or tree branches;
- Where a bridge risk occurs, detailed calculations to be undertaken to ensure loads do not present any risk of bridge strike;
- Where overhanging wires occur, additional temporary support to be provided if required; and
- Overhanging tree branches to be cut back or restrained away from the path of the vehicle.

Bridges and Culverts: Where bridges and / or culverts are deemed not strong or wide enough (typically less than 5 m travel path width) to support wind turbine transport equipment, mitigation measures may include:

- Utilising a temporary diversion with a structure that will provide necessary support, while leaving the original structure in place;
- Reinforcing the existing structure by means of steel plates / girders as required, providing necessary support. Reinforcement can be provided either below the structure, or as additional support on top of the existing road surface; and
- As a last resort, where other options are not feasible or practicable, consideration may be given to the replacement of the bridge / culvert with a structurally suitable permanent upgrade to support the projected component loads.

12.4.3 *Operation and Maintenance*

- Establish a procedure to ensure the ongoing maintenance of the on-site access roads during the operation phase. This maintenance would include sedimentation and erosion control structures, where necessary.

12.4.4 *Decommissioning*

- Prepare and implement a revised EMP sub-plan reflecting the changes in traffic volumes, during time of decommissioning.

12.5 Summary

Samsa Consulting have estimated that the Project has the potential to create a worst case of up to an additional 96 vpd (moderate impact) or 160 vpd (high impact) on the Lachlan Valley Way (see **Table 12.3**). These increases would not create any significant adverse impacts with respect to transport issues such as traffic operations, road capacity on the surrounding road network, site access and road safety. Additionally, these impacts are expected only during the construction and decommissioning periods, with only minor increases to traffic volumes during the operational phase.

The temporary increase in traffic volumes due to construction-related activities is able to be readily absorbed by the subject road network with appropriate road infrastructure upgrades and construction traffic management. Adoption of the strategies for minimising traffic impacts outlined in this section should reduce community disruption and the risk of traffic incidents, thus facilitating the least amount of disruption.

CHAPTER 13

Aviation Assessment

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13. AVIATION ASSESSMENT

Existing aviation activity in the locality of the Project site was identified during planning and design through assessing the likely impact of the Project on various aviation facilities and / or activities. Consultation was sought with the Department of Defence (DoD), Civil Aviation Safety Authority (CASA), Airservices Australia (AsA), Aerial Agricultural Association of Australia (AAAA), the Royal Flying Doctor Service (RFDS), the NSW Rural Fire Service (NSW RFS), local agricultural operators, recreational aviation operators and the local community. This chapter presents an assessment of the aviation activity in the Project locality, potential impacts from the Project and appropriate mitigation measures. This assessment includes the results of an independent Aviation Impact Statement, **Appendix 15**, prepared by REHBEIN Airport Consulting (REHBEIN).

For the purposes of the Aviation Assessment, a blade tip height of 192 m was used. This height is 8 m (or 4 %) lower in height than the proposed maximum of 200 m. However, the turbine used is considered to be representative of the technology currently available on the market, and a review addressing the consistency of the assessment has been undertaken (see **Appendix 15**). The review found no change in impact associated with the additional 8 m blade tip height.

13.1 Methods

The methodology REHBEIN used for conducting the Aviation Impact Statement was based on the framework proposed by CASA Advisory Circular AC 71-1(0), *Guidelines for Airspace Risk Management and Associated Aeronautical Study Methodology*. This is a systematic means of analysing potentially complex risk issues and to provide the decision maker with the information necessary to make a decision with confidence. The three key issues considered by REHBEIN were:

- The consequence of risk;
- The frequency of occurrence of risk; and
- The perception of risk.

The following relevant standards and guidelines were also considered by REHBEIN when developing the Aviation Impact Assessment:

- CASA Civil Aviation Regulations (CARs);
- CASA Manual of Standards Part 139 – Aerodromes (MOS Part 139);
- International Civil Aviation Organisation (ICAO) Procedures for Air Navigation Services – Aircraft Operations;
- Draft NSW Planning Guidelines: Wind Farms;
- National Airports Safeguarding Framework Guidelines D – Managing the Risk to Aviation Safety of Wind Turbine Installations (wind farms) and Wind Monitoring Towers;
- Wind Farm Aviation Impact Studies – Requirements for AsA Assessment; and
- EUROCONTROL Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors.

Consequences and frequency may be assessed by statistical analysis, however perception needs to be addressed by consultation with stakeholders to identify needs, issues and concerns.

13.2 Existing Situation

13.2.1 *Military Low Level Flying*

Low level flying exercises are carried out by military aircraft from a number of defence airfields. Routes at or below 1,524 m (5,000 feet) above ground level used by military jet aircraft for low level, high speed navigation or terrain following exercises are designated as Military Low Jet Routes (MLJRs). Although some MLJRs are permanently activated, the majority exist only for a short duration. Hence, MLJRs can be considered flexible and can be designed to accommodate the existence of a wind farm. The DoD will consider the presence of wind farms when planning low level flights.

Advice received from the DoD indicates that the Project will be outside any areas affected by the Defence (Areas Control) Regulations (see **Appendix 15**). Nevertheless, there is an ongoing need to obtain and maintain accurate information about tall structures so that risks associated with inadvertent collision by low flying aircraft can be reduced. In Australia, tall structures are defined in Civil Aviation Safety Regulations 1998 (CASR) 139.365 as "*a building or structure the top of which will be 110 metre or more above ground level*". In April 2005 CASA released advisory circular AC 139-08(0) *Reporting of tall structures*, providing guidance on how tall structures were to be reported to CASA. The Royal Australian Air Force (RAAF) who are responsible for recording the location and height of tall structures, stipulate in the advisory circular that a tall structure is one which "*the top measurement of which is 30 metres or more above ground level – within 30km of an aerodrome, or 45 metres or more above the ground elsewhere*".

The Project wind turbines and associated wind monitoring masts will meet the above definition of a tall structure. DoD requests that the Proponent provide RAAF with "as constructed" details so that the structures can be appropriately shown on aviation charts.

13.2.2 *Airspace around Aerodromes*

Airspace associated with an aerodrome may comprise of Obstacle Limitation Surfaces (OLS) or Procedures for Air Navigation Services (PANS-OPS) surfaces. In areas covered by an OLS, wind turbines may be acceptable, but need to be assessed in relation to critical manoeuvres, such as those associated with landing and take-off. PANS-OPS surfaces cannot be infringed in any circumstances by wind turbines so that the aircraft is safeguarded from collision with obstacles when the pilot is flying by reference to instruments rather than a purely visual approach.

One aerodrome certified by CASA and one Airport Landing Area (ALA) are located within 56 km (30 nm) of the Project site. Young Airport near Young NSW, a CASA-registered aerodrome, is located approximately 50 km (27 nautical miles (nm)) north west of the nearest wind turbine. Harden ALA is located 32 km (17 nm) south west of the nearest wind turbine.

To address the issue of wind turbine height, CASA's *Manual of Standards Part 139 – Aerodromes*, states that, in general, an obstacle would require obstacle lighting unless an aeronautical study assesses it as being shielded by another object or that it is of no operational significance. For wind turbines occurring outside of an aerodrome, CASA formerly provided guidance material in *Advisory Circular AC 139-18(0) Obstacle Marking and Lighting of Wind Farms*, which has subsequently been withdrawn. The current guidance regarding mitigation measures such as marking and lighting is provided by the National Airports Safeguarding Framework (NASF) *Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation*. Due to the withdrawal of *Advisory Circular AC 139-18(0),* CASA's statutory power to require obstacle marking and lighting only applies within the vicinity of an aerodrome (30 km). Therefore, it is CASA's view that the decision of the lighting of obstacles outside the vicinity of aerodromes is the responsibility of the Proponent, in consideration of their duty of care. It is recommended that as the wind turbines will be greater than 152.4 m (500 ft) above ground level, and are hence defined as a tall structure, they should be lit in accordance with the NASF Guideline D.

Notwithstanding the withdrawal of the CASA Advisory Circular, in response to specific queries as to lighting standards to apply to wind farms that are remote from an aerodrome, CASA has previously advised:

- Even though a CASA assessment is not required it is important to point out the Proponent may have a duty of care to local aviators, such as aerial spraying and private flight operators, whose aeroplane landing area may be located in the vicinity of the wind farm, and who may want the wind turbines made conspicuous for night flying and during periods of low visibility;
- If the Proponent wishes to provide additional visibility, this may be achieved by installing obstacle lighting which meets the standards set out in the CASA Manual of Standards (MOS) Part 139 Aerodromes, Chapter 9, Section 9.4 – Obstacle lighting; and
- The Advisory Circular information (AC 139-18 (0)) is still valid as a recommendation if the Proponent wishes to do so as a risk mitigator.

The Proponent had RHEBEIN Airport Consulting prepare an independent Aviation Impact Statement (see **Appendix 15)** to determine whether the Project had an operational significance and would require obstacle lighting for the wind turbines. As stated above, it is recommended that the wind turbines be lit in accordance with the NASF Guideline D.

13.2.3 ***Transiting Civil Air Routes***

Aircraft may operate under either Instrument Flight Rules (IFR) or Visual Flight Rules (VFR). The former rules relate to aircraft navigated using flight instruments which process data from aircraft systems, ground-based navaids or satellites. Conversely, aircraft operating under VFR only operate in visual meteorological conditions (VMC) and are most likely to operate outside of controlled airspace, though they may also enter controlled airspace if safe and necessary. Regular public transport jet aircraft operating into or between major Australian cities operate only in controlled airspace and under IFR. Charter and business aircraft may operate in controlled airspace under either IFR or VFR or outside controlled airspace under VFR. General aviation training aircraft are most likely to operate under VFR. Military aircraft may operate anywhere and may be flying at very low levels.

Since IFR pilots may be relying solely on flight instruments and have no outside visual reference, a lowest safe altitude (LSALT) is published for each air route. This is determined by adding 300 m (984 ft) minimum vertical clearance to the highest terrain or known structure en route. For VFR flight, the minimum statutory height is 152 m (500 ft) above ground level in non-populous areas – approximately the same height as a wind turbine. VFR traffic in daylight hours is not confined to air routes and may operate anywhere provided they do so in VMC. During these conditions wind farms would be visible and have no impact on flying activity. Night VFR pilots must fly at or above the IFR

LSALT for that route. It is conceivable that a new wind farm, if located on prominent terrain, may require an increase in LSALT for a particular IFR route.

13.2.4 ***Designated Airspace***

Special use airspace is defined either as Prohibited, Restricted or Danger areas. Wind turbines are not allowed within Prohibited or Restricted areas as these are usually set aside for military training and weapons firing and often extend upwards from ground level. Danger areas relate to mining or quarrying sites, chimneys or stacks with high velocity or high temperature discharges or special aviation activities such as aerobatic training, etc. Wind turbines may not be compatible with some activities conducted within a Danger area. CASA may also elect to designate a Danger area around a wind farm. There is no restriction on the entry of Danger areas by aircraft.

13.2.5 ***Radar***

Two types of radar are used for air traffic control, Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR). A specific type of SSR, known as Route Surveillance Radar (RSR) is strategically located along busier air corridors. Tall structures, such as wind turbines may interfere with electromagnetic transmission as discussed in **Chapter 15** Electromagnetic Fields. Steel towers and rotating wind turbine blades can cause reflection and / or deflection of radiated signals and as a consequence interfere with aviation communication, navigation and surveillance (CNS) systems established for air traffic management. Since the PSR does not provide height information, the air traffic controller may be forced to divert aircraft which may be in the vicinity of the wind farm within PSR coverage regardless of their flight level. In addition, turning blades may also reflect or deflect PSR signals and prevent aircraft flying in their “shadow” from being detected. In this case the co-located SSR would also detect the aircraft. Radar coverage, which depends on the line of sight of each radar, must be guaranteed within controlled airspace which extends from ground level in airport control zones (CTR) and from 2,591 m (8,500 ft) in en route airspace.

AsA, a government-owned corporation, provide safe and environmentally sound air traffic control management and related airside services to the aviation industry, with a network of 19 radars. To determine if further assessment of the impact of the Project on AsA radar facilities is required, AsA require the Eurocontrol Guidelines on *How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors* to be considered. With respect to these guidelines it has been determined that the Project will be greater than 16 km (9 nm) from the closed RSR located at Mt Bobbara, NSW and the closes SSR located at Mt Majura, NSW, hence no further assessment is required with respect to SSR. With regard to PSR, the Project will be located within the 111 km (60 nm) operational range of the closest PSR at Mt Majura, ACT and parts of all the proposed wind turbines would be within line of sight. AsA have confirmed that the Project would have no adverse impact on air navigation and safety instrumentation or radar.

13.2.6 ***Radio Navigation Aids***

Radio navigation aids, such as non-directional beacons (NDB), are ground-based navigation aids that rely primarily on the transmission / reception of radio signals to determine the location of an aircraft. Similar to SSR, a wind turbine may interfere with the radio signal as discussed in further detail in **Chapter 15** Electromagnetic Fields. The closest radio navigation aid to the Project site is the

Rugby NDB which is located approximately 19 km (10 nm) north east of the nearest wind turbine. The Project will not have an impact on the performance of the Rugby NDB.

13.2.7 *Electromagnetic Interference*

Large scale power generation, including wind farms, may cause electromagnetic interference (EMI) with the on-board radio communication equipment of aircraft overflying or flying in the vicinity. However, according to the available literature this effect is considered negligible due to the standards which apply to wind turbine construction. Further detail on EMI is presented in **Chapter 15** Electromagnetic Fields.

13.2.8 *Other Aviation Activities*

It is possible that aircraft may intermittently fly over the Project site to undertake agricultural aerial spraying or bushfire control. In relation to the former, pest management is likely to occur annually, while top-dressing (nutrient application) may occur every five years or so. Fixed wing agricultural aircraft, light and medium helicopters, AirCranes, medical aircraft and transport aircraft are regularly used by the NSW RFS in both initial attack and in ongoing fire operations in the South West Slopes region

Eight private airstrips are known of within the locality of the Project site (see **Figure 13.1**), with the nearest non-involved airstrip being 3.2 km south of the nearest wind turbine in the Mt Buffalo Cluster. These were identified through a desktop study of the Project locality and notification of aviation bodies, including the AAAA. The Project is not expected to have any impact on operations conducted from this airstrip, and all other non-involved airstrips are potentially less affected. Furthermore, the distances between wind turbines and cultivated areas of land on adjacent properties outside the Project site are sufficient to assume minimal impact on agricultural aerial operations during the periods of low wind speeds at which these aircraft operate. The airstrips located within the Project site are located on involved land, and have been discussed with the relevant landowners. The Project layout was designed to avoid and reduce impacts on the nearest airstrip.

AAAA's position is that the organisation opposes all wind farm developments and overhead transmission lines unless the developer has:

- Consulted in detail with local operators;
- Received independent expert advice on safety and economic impacts; and
- Considered the impacts on the aerial application industry.

The RFDS and NSW RFS were consulted about the Project and had no issues. There is no known recreational or miscellaneous aviation activity in the vicinity of the Project which could be adversely impacted.

13.3 Potential Impacts

13.3.1 *Military Low Flying*

The Project is not located within any areas designated for low-level military flying exercises. Nevertheless the importance of the requirement to notify the DoD of the Tall Structure with as constructed details. It is possible to plan any low-level military activity to avoid the Project site once it is operational.

13.3.2 *Airspace around Aerodromes*

Tall structures have the potential to obstruct or present a safety hazard for aircraft, if sited in an OLS or in areas with high levels of air traffic. The maximum wind turbine height proposed for the Project is up to 200 m (656 ft). Final wind turbine height will depend on the model of wind turbine deemed to be appropriate for installation and may fall below this maximum. The Project does not impact on the OLS of any airport or the PANS-OPS protection surfaces for Young Airport. Nor will it have an impact on civil air traffic operating under either IFR or VFR, but rather will provide a prominent topographical feature which may assist visual navigation (see **Appendix 15**). As a consequence, the Project is not likely to be assessed as an “obstacle” or a hazard to the safety of aircraft and airport operations. However, the International Civil Aviation Organization (ICAO) which sets international standards and recommended practices, of which Australia is a member state, considers wind turbines in excess of 150 m an obstacle and as such, lighting is recommended. Although it should be noted that ICAO Standards and Recommended Practices (SARPS) do not necessarily apply to domestic aviation activities, which is the primary concern with wind farms in Australia. The outcomes of the Aviation Impact Assessment will be submitted to CASA for their comment pending Development Approval.

Lighting facilities on wind turbines or around wind farms have the potential to have two primary impacts. The first is the visual amenity of the Project area at night (see **Chapter 8** Visual), both for local residences and visitors. The second impact relates to local bird and bat populations (see **Chapter 10** Ecology). Some bird and bat species are known to be attracted to some types of lights, for either navigational purposes or for feeding activity. This attraction may increase the probability of interaction with the wind turbine blades.

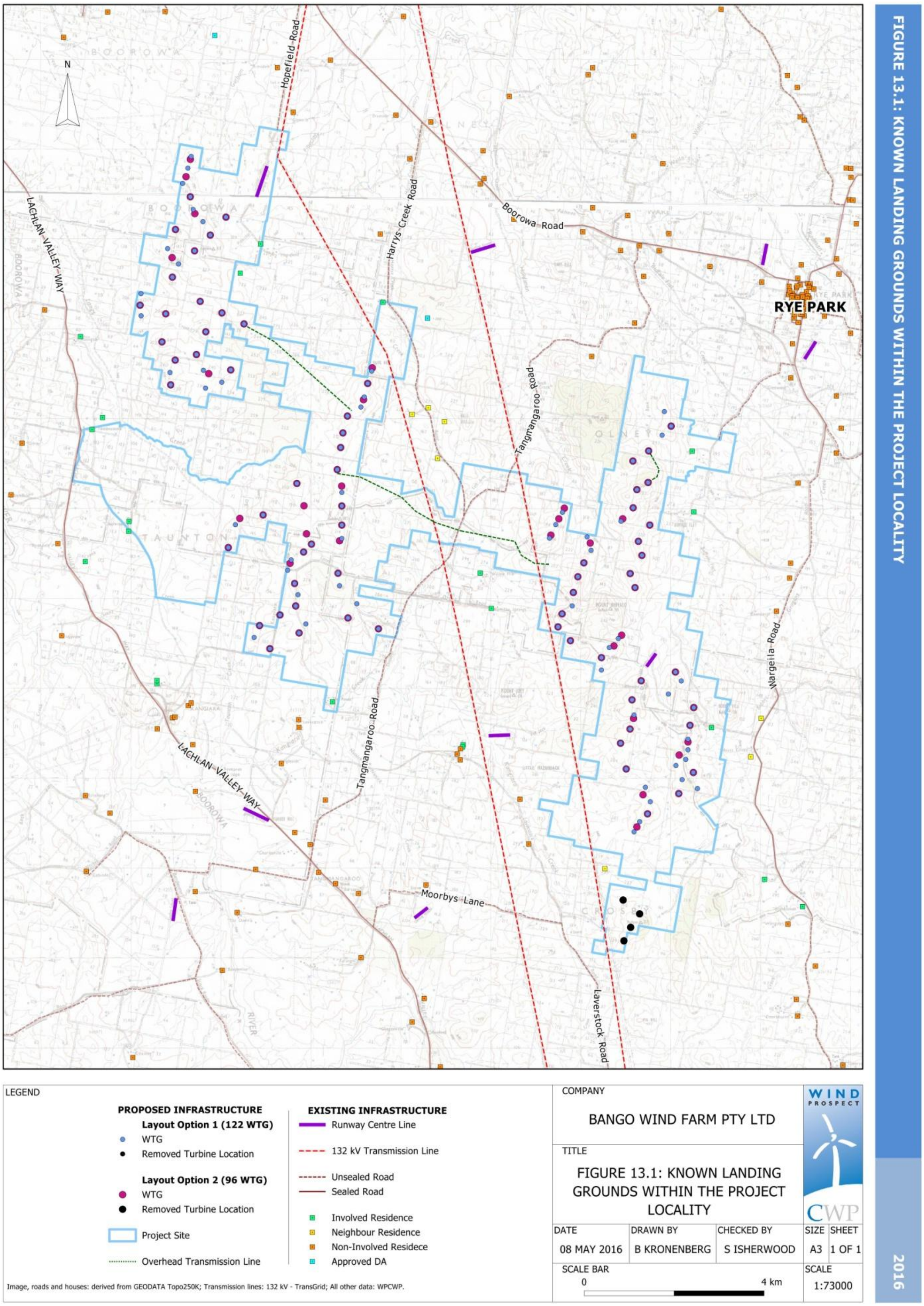

Figure 13.1 Known landing grounds within the Project locality

(An A3 size version of this Figure is displayed in Volume 2)

13.3.3 *Transiting Civil Air Routes*

AsA has informed the Proponent that at the calculated maximum height of the highest wind turbine at 944 m (3,098 ft) AHD, the Project will not adversely impact the performance of AsA's Precision / Non-Precision Nav Aids, HF / VHF Comms, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite / Links. They have also advised that the Project will not affect any LSALT or any sector or circling altitude, nor any instrument approach or departure procedure at any aerodrome.

13.3.4 *Other Aviation Activities*

The Project has the potential to impact on agricultural aerial spraying activities and operations conducted by the NSW RFS. Wind turbines may potentially present physical obstacles that need to be negotiated when carrying out aerial spraying or fire fighting. For agricultural aviation activities, top-dressing of pastures, which can occur atop the ranges in the area, is most likely to be affected. There is very little evidence of crop farming in the area, suggesting the use of aerial pest management would be limited, however, if present, it would be more likely to occur along the lower slopes of the ranges.

As such, REHBEIN Airport Consulting considers that, given the distances from wind turbines to cultivated areas of land on adjacent properties outside the Project site, there will be minimal impact on agricultural aerial operations during the periods of low wind speeds at which the aircraft operate.

AAAA has previously provided guidance on this matter with respect to the Civil Aviation Authority CAAP 92:1(1), *Guidelines for Aeroplane Landing Areas* (1992) (see **Appendix 16**), with particular regard to runway splay or "clearway" distances for agricultural runways (CWP Renewables, 2009). A "clearway" is defined as an area in which there are no obstacles penetrating a slope of 2.5 % rising from the end of the runway over a width of 45 m, see **Figures 13.2** and **13.3** below.

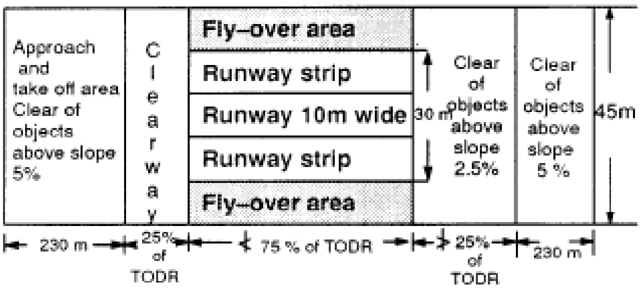

Figure 13.2 Landing ground dimensions – agricultural day operations

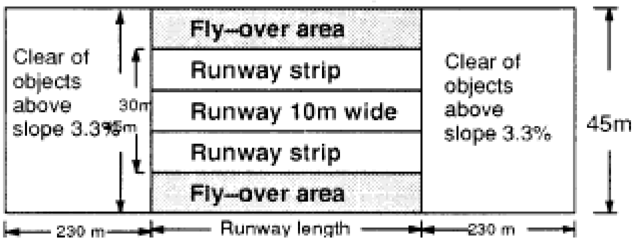

Figure 13.3 Landing ground dimensions – agricultural night operations

Source: Civil Aviation Authority CAAP 92:1(1), Guidelines for Aeroplane Landing Areas (1992) ***(Appendix 16)***

Agricultural and fire fighting operations that involve low level flying can only occur in good conditions (high visibility) in accordance with the aviation regulations, during which wind turbines can be considered to be highly visible structures. Presently, aerial operators engaged in low level flying are required to undertake a risk assessment for each flight. This assessment identifies specific obstacle hazards such as trees and transmission lines and would include wind turbines. The REHBEIN assessment of the impact of wind turbines on aerial fire fighting operations is supported by *Wind Farms and Bushfire Operations - Position* (October 2014) by the Australasian Fire and Emergency Services Council (AFAC) (see **Appendix 23)**. The position statement is endorsed by NSW RFS which states "*Aerial fire fighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.*"

13.3.5 ***Cumulative Impacts***

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation.

There is one other wind farm proposed in the Project locality which has not yet been constructed. The Rye Park Wind Farm is approximately 7 km east of the Project with a proposed size in excess of 100 wind turbines. The developers of Rye Park Wind Farm will also be required to prepare an AIS as part of their Environmental Impact Statement.

As wind turbines are large metallic structures with rotating carbon fibre blades, the impact on radar coverage and performance is subject to potential cumulative effect. Preliminary assessment suggests that the Rye Park Wind Farm would be well beyond 16 km from the nearest SSR, as is the Project and therefore would have no impact upon it. However, the Rye Park Wind Farm may also be within the 60 nm instrumented range of the nearest PSR and within line radar line of sight. AsA is aware of the Rye Park Wind Farm proposal but confirmed that the wind farm will not have an unacceptable impact on radar. This suggests that the cumulative effect of both wind farms on radar has been reviewed and it is not considered an issue for the Project.

Other aviation activities, such as aerial agricultural operations and recreational aviation, are typically subject to the cumulative effect of obstructions as the available area of operation becomes more restricted as the number of obstructions increases.

It is conceivable that the DoD may consider designating MLJRs in the Bango and Rye Park Wind Farm region. However, any MLJR which DoD may require in the area can be designed to avoid the wind farms with minimal impact on military operations.

13.4 Management and Mitigation

13.4.1 ***Department of Defence***

The Proponent will provide the RAAF with 'as constructed' details for entry on the Tall Structures Database and aviation charts.

13.4.2 *CASA Requirements*

The Proponent will provide CASA with wind turbine location and height details once final design positions are known and before construction commences. During construction, additional and separate notification will be required for the use of cranes (temporary obstacles) that exceed 110 m above ground level. After construction is complete, the Proponent will provide CASA with as constructed details of the wind turbines and monitoring masts.

On receipt of Development Approval for the Project, and with particular regard to the Aviation Impact Statement, the Proponent will consult with CASA and DIT on the issue of obstacle lighting. The Proponent will seek a solution which, if appropriate to do so, will consider the provision of obstacle marking and lighting. If CASA insist on full compliance with the requirements of the now withdrawn CASA Circulatory AC 139-18(0), the Proponent will commit to shielding provisions allowed under existing CASA guidelines. The shielding restricts the downward component of light to 5 % of nominal intensity emitted 5° below horizontal and zero light emission 10° below horizontal. The visual impact of outfitting the wind turbines with obstacle lighting has been assessed within this EIS (see **Chapter 8** Visual).

13.4.3 *Airservices Australia*

The Proponent will provide AsA with the location and height details of wind turbines with as constructed details.

13.4.4 *NSW Rural Fire Service*

The Proponent will provide NSW RFS with the location and height details of wind turbines once final wind turbine locations are known and before construction commences. After construction is complete, the Proponent will provide NSW RFS with as constructed details. The Proponent will also liaise with the NSW RFS in preparation of the Bushfire Emergency and Evacuation Plan.

13.4.5 *Aerial Agricultural Association of Australia and Other Activities*

The Proponent will provide AAAA with the location and height details once final wind turbine locations are known and before construction commences. After construction is complete, the Proponent will provide AAAA with as constructed details.

Given the distances from wind turbines to cultivated areas of land on adjacent properties outside the Project site, there will be minimal impact on agricultural aerial operations during the periods of wind speeds at which the aircraft operate. Appropriate information regarding the wind turbine layout and dimensions will be supplied to individual operators if required.

13.5 Summary

Wind farms have the potential to impact on aviation activity and aerodrome operations by introducing obstacles to aerial operations and interfering with aerial communication and navigation aids.

One aerodrome certified by CASA and one Airport Landing Area (ALA) are located within 56 km (30 nm) of the Project site. Young Airport near Young NSW, a CASA-registered aerodrome, is located 50 km (27 nm) north-west of the nearest wind turbine. Harden ALA is located 32 km (17 nm) south west of the nearest wind turbine. The Project does not impact on the OLS of any airport or the PANS-OPS protection surfaces for Young Airport. Nor will it have an impact on civil air traffic operating under either IFR or VFR, but rather will provide a prominent topographical feature which may assist visual navigation.

Where a wind turbine 150 m or taller in height is proposed away from an aerodrome the Proponent should conduct an aeronautical risk assessment and may require lighting on wind turbines in accordance with NASF Guideline D. There is no requirement for CASA to be notified if a proposed wind turbine or wind monitoring tower is less than 150 m in height and does not infringe the OLS of an aerodrome. However, they should still be reported for inclusion in the national database of tall structures maintained by the RAAF.

REHBEIN Airport Consulting recommends the Proponent consider the provision of lighting as a duty of care obligation. On receipt of Development Approval for the Project, the Proponent will consult with CASA on the issue of obstacle lighting. The Proponent will be seeking a solution, which if appropriate to do so will consider the provision of obstacle lighting. If CASA insist on full compliance with the requirements of the now withdrawn CASA Circulatory AC 139-18(0), the Proponent will commit to shielding provisions allowed under existing CASA guidelines.

Agricultural aerial spraying activity for pest management and pasture top-dressing is not considered to be a common activity across the Project site. Pest management spraying is unlikely to be affected by the Project. Top-dressing activity will require care by pilots applying the material to properties along the ridgelines.

Despite the presence of another wind farm in the vicinity of the Project, no cumulative impact on air activity in and around the Project is expected.

Some private landing strips are present in the locality and these are not impacted by the Project.

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CHAPTER 14

Communications Assessment

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14. COMMUNICATIONS ASSESSMENT

Electromagnetic signals (or radio waves) are transmitted throughout the country as part of telecommunication systems by a wide range of operators. Such systems are used for radar, radio broadcast, television, mobile phones and mobile and fixed radio transmitters. Electromagnetic signals generally work best if a clear path exists between the transmitting and receiving locations, known as line of sight (LOS).

There is the potential for interference from any large structures, including wind turbines, which occur within or close to the signal path. Signals can be interfered with or be reflected by the rotating blades of a wind turbine, which could degrade the performance of the signal (Bacon 2002). Electromagnetic emissions from generators and other machinery also have the potential to affect signals; however with modern wind turbine generators and strict International Electrotechnical Commission (IEC) regulations for manufacturers, there are now negligible emissions from wind turbines (Auswind 2006).

This section describes the existing radio and communication systems that operate within the vicinity of the Project, as well as general television broadcast services. It also provides an assessment of potential interference effects caused by the Project and suggested mitigation measures.

14.1 Methods

Experts have been consulted to assess the potential interference to radio-communications and TV signals in the area of the Project from electromagnetic signals. Lawrence Derrick & Associates (LDA) conducted an assessment of the potential impacts of radio-communication services (see **Appendix 17**), while Broadcasting Australia and commercial television (TV) stations were consulted regarding potential TV interference and relevant operators were consulted regarding point to multipoint (PMP) communication links (see **Appendix 18**). The following sections outline the approaches taken in measuring such interference.

14.1.1 *Radio-communication Investigations*

The Australian Communications and Media Authority (ACMA) Register of Licensed Radio-communications was reviewed by LDA to determine the location of any radio-communications links and towers within or close to the Project site. Once this was done, a corridor was created around each of the links or towers to ensure that the First Fresnel Zone (refer to **Appendix 17** for description) was not affected by any of the proposed wind turbines or blades.

14.1.2 *Television Investigations*

Broadcast Australia (managers of the National Transmission Network transmitting both ABC and SBS channels), Prime Television, Australian Capital Television and WIN Television were approached to determine what effects the Project, and in particular wind turbines, would have on any of their transmission towers or television services.

14.2 Existing Situation

14.2.1 *Radio-communications*

There are two point-to-point (PtP) links in the UHF band over two paths which nominally traverse the Project. Both are operated by the Office of Environment and Heritage.

There are an additional six PMP services in the Project region (see **Appendix 17**) which were considered by LDA. Given the distance of the base station locations from the Project site, it is unlikely that any related path would cross the Project. The PMP operators have been notified of the Project and its indicative wind turbine locations, and any appropriate impacts will be mitigated if required. There are no low power FM broadcasting stations within the locality of the Project site or Study area.

14.2.2 *Television*

Residences in the vicinity of the Project receive television reception primarily from the Canberra, Central Tablelands and the South-West Slopes / East Riverina. The off-air main television signals are broadcast from Black Mountain (Canberra, 73 km south of the Project), Mt Canobolas (Central Tablelands, 125 km north of the Project) or Mt Ulandra (South-west Slopes / East Riverina, 90 km west of the Project). The operators of these stations are ABC, SBS, CBN, CTC and WIN Television NSW Pty Ltd. The Project is located just outside the tertiary coverage areas at the extremities of the three main station service areas, an adequate distance to negate any disturbance to the signal.

14.2.3 *Air Services Radar*

There are two registered Airservices Australia (AsA) Radar facilities, located approximately 18 km from the nearest wind turbine. Both may possibly be within LOS of the wind turbines. Non Directional Beacons (NDBs) and / or other VHF services are also located at one of the facilities. Potential impacts that the wind turbines may have on the performance of the air services radar facilities have been considered in **Chapter 13** Aviation. AsA have been notified about the Project. It is considered that there will be no impact on the VHF services due to separation distance from the Project to these sites.

14.2.4 *Mobile Phones*

Vodafone currently has very limited 2G and 3G coverage with no mobile internet coverage across the Project locality as seen in **Figure 14.1**. Using the Next G Network, Telstra provides coverage for mobiles across the Project via Telstra Mobile where an external antenna is used. Telstra also provides some broadband access, as seen in **Figure 14.2.** Optus 3G dual band and 4G coverage services the majority of the Project site, as seen in **Figure 14.3.**

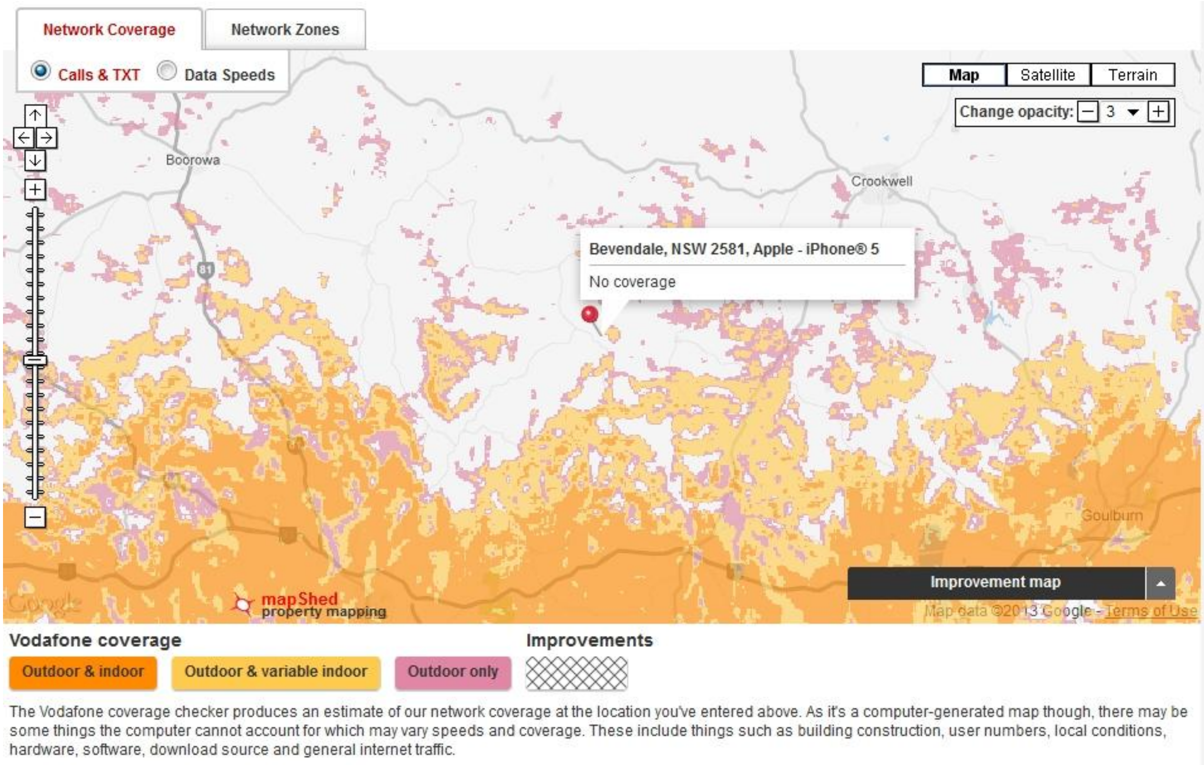


Figure 14.1 Vodafone coverage across the Project site

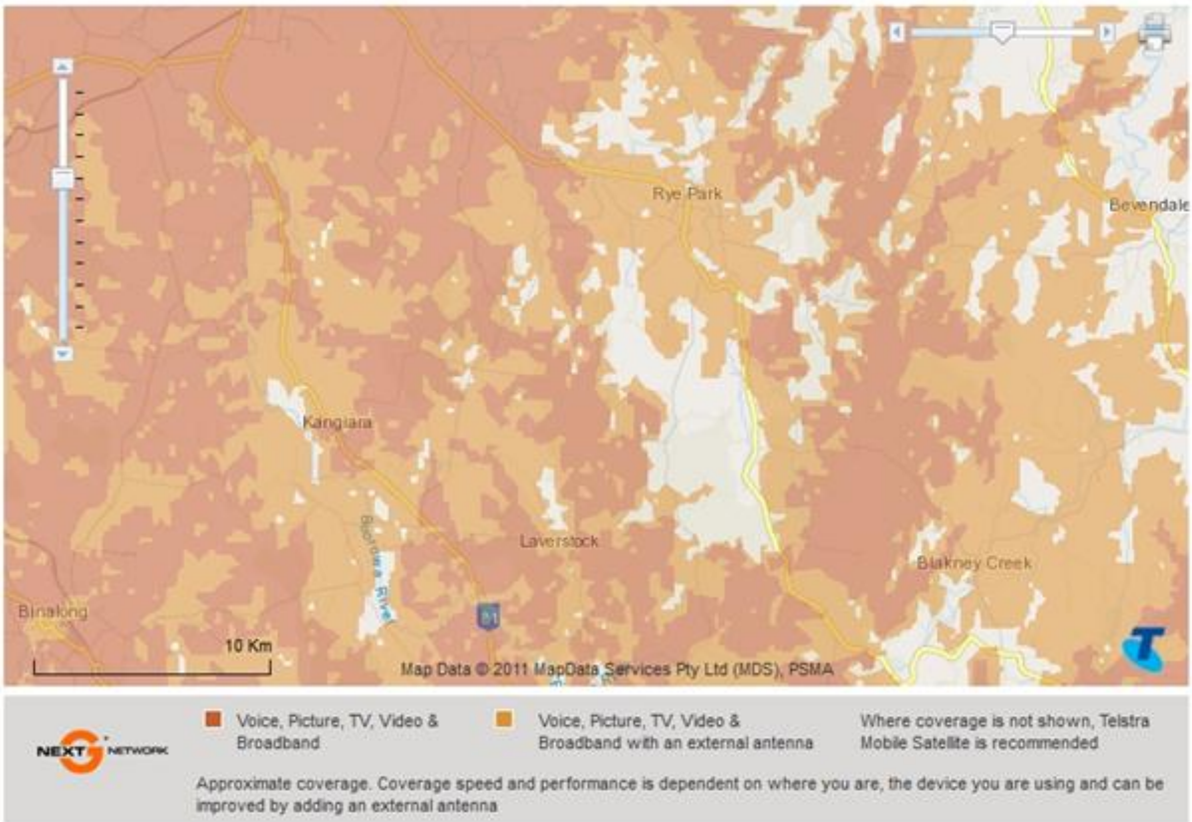
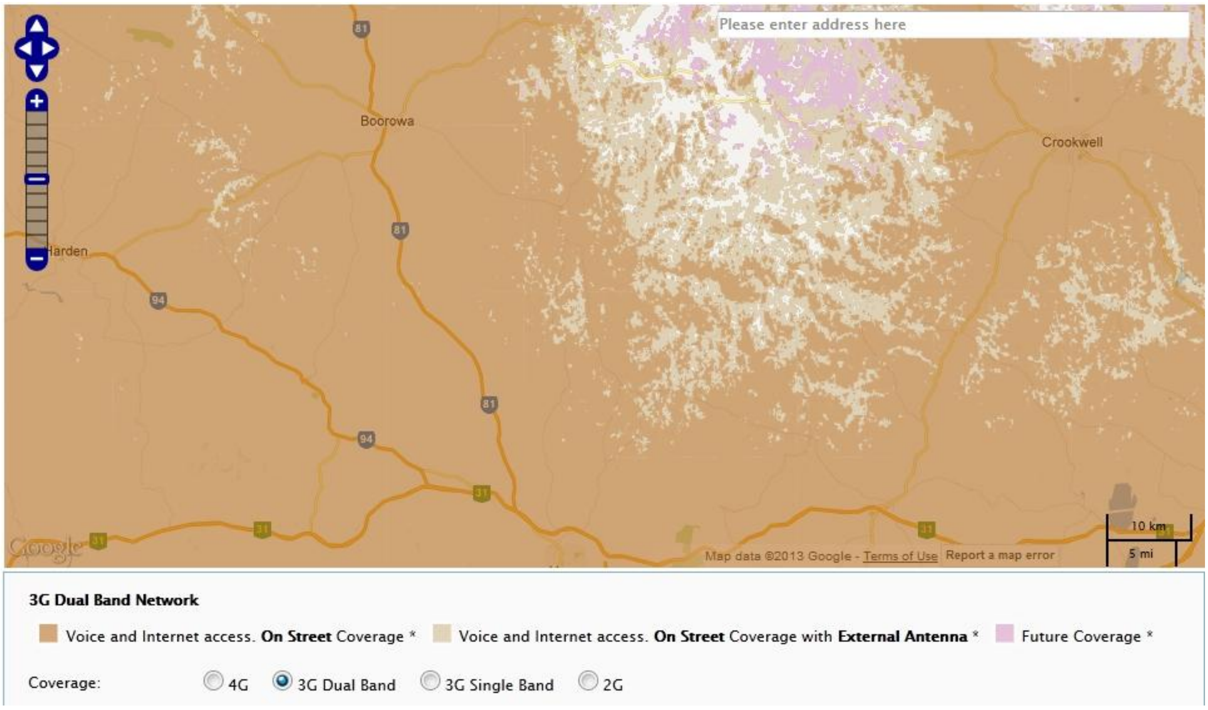


Figure 14.2 Telstra coverage across the Project site



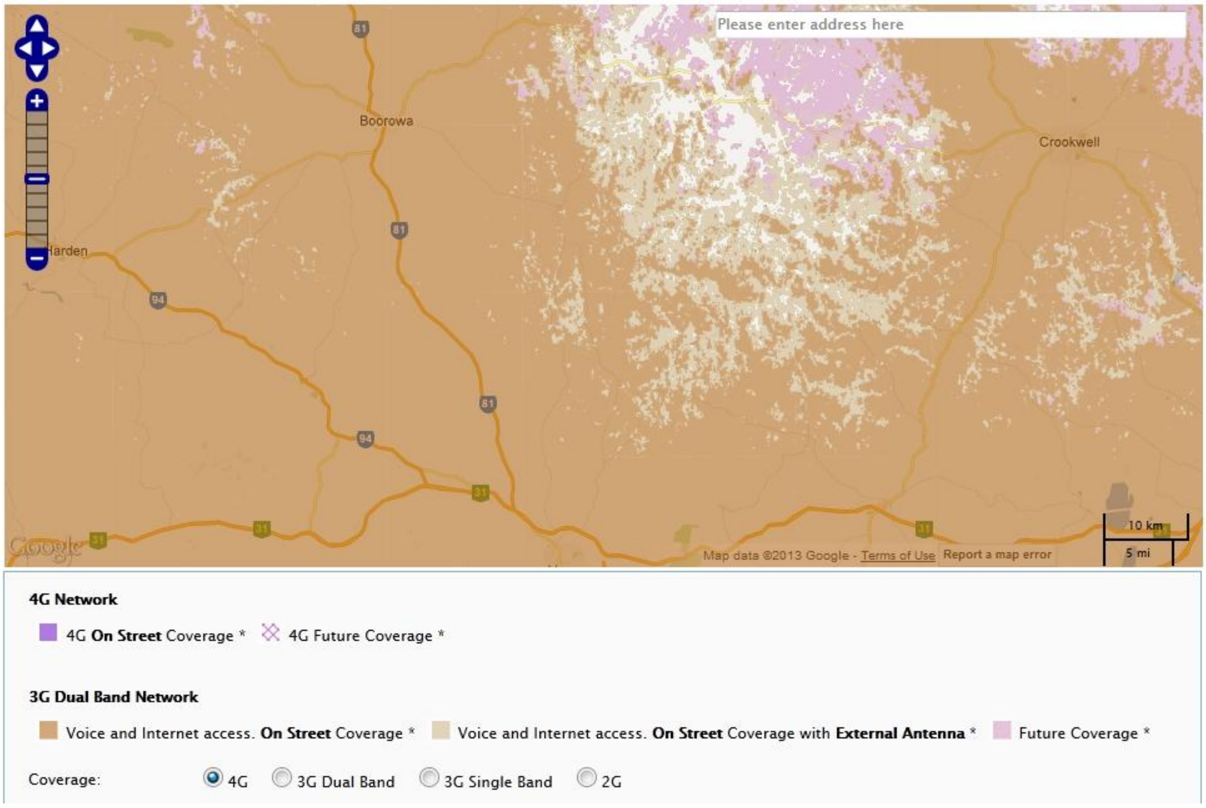


Figure 14.3 3G (dual band) and 4G Optus coverage across the Project site

14.3 Potential Impacts

Potential impacts on the communications services in the area vary depending on the type of signal link used and the proximity of the Project components to those links.

14.3.1 *Radiocommunications*

PtP and PMP services require a clear LOS, and therefore can be easily affected by structures within the LOS pathway. As a general rule of thumb, if objects are placed outside of the First Fresnel zone (or zone of electromagnetic interference) then impacts can be avoided. The First Fresnel clearance zones of PtP radio-communication links that cross through or near the Project will not be impacted upon as seen in **Figure 14.4**. Also, no wind turbines are located within a disruptive distance of a transmitting or communication tower, which means the Project is not expected to have any negative impacts on existing PtP links using such towers.

For PMP services, usually only the base station is registered, so the remote end is not known, making it harder to determine wind turbine obstruction. Given that most base station locations are remote from the Project site there is a low probability that any path would cross the Project. PMP operators have been contacted for comment with no issues highlighted to date.

Radio Frequency broadband noise generated by transmission lines could be received by the radio receivers at radio repeaters or terminal sites if sites are close to the lines and if the links were operating at low frequencies. However, generally this is not an issue as transmission lines today are each built to standard specifications that reduce potential impact. Poles, towers and wires that are part of the transmission line could also physically obstruct the radio signal. However, due to the low height and limited dimension of the wires, there is minimal impact from such structures.

Amplitude Modulated (AM) and Frequency Modulated (FM) radio transmission systems are considered to be subject to negligible impacts from wind farm projects and effects only occur at very small distances from wind turbines (i.e. within tens of metres) (National Research Council 2007). This will be no different at the Project site.

Mobile radio services do not necessarily require a totally clear LOS and so are less susceptible to interference by structures.

14.3.2 *Television*

Wind turbines can interfere with analogue television signals by causing the picture to flicker or ‘ghost’ in time with the rotation of the blades, also known as scattering or reflection.

Broadcast Australia does not envisage any significant issues for ABC or SBS TV services due to the location of their sites in relation to the viewing audience and the Project site (see **Appendix 18**). No other responses to correspondence were received, however, 2.4 km distance to the nearest wind turbine is considered sufficient to have minimal impact on station coverage.

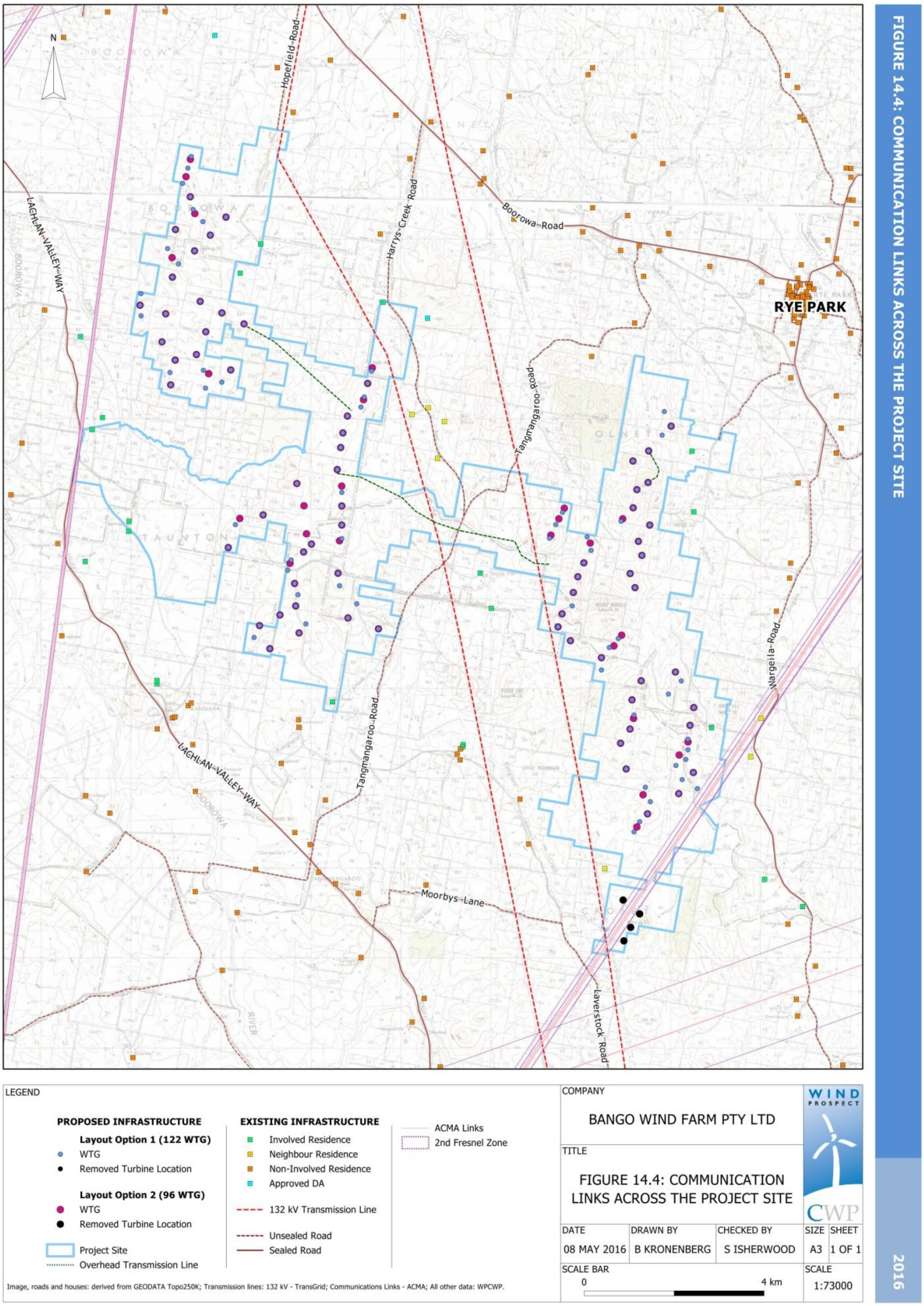


Figure 14.4 Communication links across the Project site

(***An A3 size version of this Figure is displayed in Volume 2***)

14.3.3 *Mobile Phones*

Mobile phone reception is mainly dependent on the position of the receiver. The position of the receiver is able to move around both natural and unnatural obstacles in the landscape and therefore wind turbines will have minimal impacts on signal quality.

Telstra's response to consultation indicated that results of Radio rayline analyses revealed that there is no potential for undue interference from the Project. It was also indicated that Telstra will require protection or relocation of fixed telecommunications infrastructure should any be impacted by the Project (see **Appendix 18**). Optus' response to consultation indicated that no impacts from the Project were expected on existing or planned Optus sites. Communication from Vodafone has not yet been received, though no additional impacts are expected from the Project.

14.3.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. As each wind farm project has to assess its potential impact on communication links in the area and provide mitigation measures if any impact is to occur, it is anticipated that any potential cumulative effect on communications links from proposed or existing wind farms will be covered by appropriate mitigation measures highlighted in the respective project's Environmental Impact Statement.

14.4 Management and Mitigation

Typical general mitigation requirements include:

- Amend planned wind turbine positions if necessary and feasible within the Conditions of Approval, to create corridors to ensure minimal interference on links;
- A system for recording any complaints on interference, to allow for further investigations with the affected party, to reach an amicable solution;
- Use of primarily non-metallic wind turbine blades, to minimise disruption; and
- Where practicable use equipment complying with the Electromagnetic Emission Standard AS/NZS 4251.2:1999.

Although no impacts on radio and communications are expected, typical mitigation requirements for radio-communication, if impacts occur, could include:

- Modifications to or relocation of existing antennae;
- Installation of a directional antennae; and
- Installation of an amplifier to boost the signal.

If television interference is experienced and reported by an existing receiver in the vicinity of the Project, the source and nature of the interference would be investigated by the Proponent. Should the cause of interference be attributed to the Project, then the Proponent will put suitable mitigation measures in place after consultation and agreement with the affected landowner or television broadcaster. These could include:

- Re-orientation of existing aerials to an alternative transmitter;
- Provision of a land line between the affected receiver and an antenna located in a suitable reception area;
- Provision of satellite or digital TV where available; or
- Installation of a new repeater station in a location where interference can be avoided (this is more complex for digital transmissions but also less likely due to the structure of the digital signal).

14.5 Summary

There are a number of PtP and PMP links, and omni-directional services which occur across and near to the Project. Assessment of these links has predicted that no impacts on communications will occur as a result of the Project. If the Project does cause any interference to any links, the Proponent will conduct an investigation with the afflicted parties and implement a suitable solution to the problem.

CHAPTER 15

Electromagnetic Fields

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15. ELECTROMAGNETIC FIELDS

Electric and magnetic fields (EMF) are associated with a wide range of sources and occur naturally and as a result of human activity. Naturally occurring EMFs are those associated with lightning or the Earth's magnetic field. Human caused EMFs occur wherever electricity is present, meaning we are constantly exposed to EMFs in our home and work environments.

Wind farms create EMFs from operational electrical equipment such as transmission lines, substations and the electrical components found within the wind turbines. This equipment has the potential to produce Extremely Low Frequency (ELF) EMFs, that is, the current will alternate direction between 30 and 300 times per second, or at 30 to 300 Hertz (Hz).

This chapter focuses on the theoretical health impacts and suitable mitigation strategies for ELF EMFs generated by the operation of a wind farm.

15.1 Existing Situation

There are currently no Australian standards regulating exposure to ELF EMFs. The National Health and Medical Research Council (NHMRC) issued interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields (NHMRC 1989) which are currently the responsibility of and subject to a review by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). These guidelines are aimed at preventing immediate health effects resulting from exposure to these fields.

The NHMRC recommended exposure limit for members of the public (24 hour exposure) is 1,000 milligauss (mG) for magnetic fields and 5 kilovolts per metre (kV/m) for electric fields. For exposure up to a few hours a day, the guidelines recommend exposure to be limited to 10,000 mG for magnetic fields, and 10 kV/m for electric fields (ARPANSA 2011).

Table 15.1 EMF sources and magnetic field strength

Source	Typical Measurement (mG)	Range of Measurement (mG)
Television	1	0.2 to 2
Refrigerator	2	2 to 5
Kettle	3	2 to 10
Personal computer	5	2 to 20
Electric blanket	20	5 to 30
Hair dryer	25	10 to 70
Distribution transmission line (under the line)	10	2 to 20
Transmission line (under the line)	20	10 to 200
Edge of easement	10	2 to 50

Note: Owing to variations in the design of electrical appliances and the loadings on transmission lines, the EMF levels may vary. The table above is based on a consistent set of measurements undertaken by power authorities in Australia using similar techniques and protocols to overseas measurements. *Source: Electricity Networks Association (2006)*

Table 15.1 provides typical magnetic field measurements and ranges associated with various EMF sources. Electric fields around most equipment / appliances are close to zero due to the shielding that is provided by the equipment itself. According to ARPANSA (2011) exposure levels to magnetic fields around the home are in the range of 0.1 to 2.5 mG. For homes near transmission lines, these levels may be as high as 5 to 10 mG.

15.2 Potential Impacts

ELF EMFs will be generated once the wind turbines and electrical infrastructure are energised (commissioned) and during the operation of the Project. The final configuration of the Project will determine the profile and intensity of electric and magnetic fields across the Project site.

15.2.1 ***Electrical Cables***

Chapter 3 Project Description details the electrical infrastructure associated with the Project. Below are examples of ELF EMFs from high voltage transmission lines, provided to illustrate existing knowledge. The field strength from an electrical cable is dependent on load current(s), distance from the emitting source, relative phasing of circuits and spacing of conductors. Known measurements on the strength of both magnetic and electric fields are provided below:

- Measurements using a gaussmeter from underneath a 220 kV transmission line resulted in a maximum recorded limit of 7.8 microTesla (µT) (or 78 mG) (Transpower 2009). Typical levels of magnetic field under a 330 kV high voltage transmission line range from 5 to 50 mG at a distance of 30 m from the centre of the easement (NGH Environmental 2008). Both of these measurements are in line with the range expected and presented in **Table 15.1**; and
- Similarly, electric field measurements from underneath a 220 kV transmission line, resulted in a maximum recorded limit of 3.2 kV/m (Transpower 2009) with levels of 0.07 kV/m and 0.01 kV/m recorded at 30 m and 60 m from a 115 kV transmission line (Hafemeister 1996).

These figures are far less than the NHMRC recommended limits for exposure of 1,000 mG and 5 kV/m.

The strength of magnetic and electric fields can also change along a transmission line if there is an unbalanced load of energy within the line or there is line sagging due to excessive heat on the cables. Both of these effects could cause increased recordings directly underneath the transmission line, however, the effects are temporary and would not exceed the 24 hour exposure limit from the NHMRC.

15.2.2 ***Substation***

Due to the function of a substation and the required components, substations have the highest variation in magnetic fields from 1 to 66 mG (0.1 to 6.6 µT) (recorded at the security fence around the substation) (Health Protection Agency 2004). Note that the recorded magnetic fields are still below the NHMRC limit of 1,000 mG.

15.2.3 ***Wind Turbines***

An EMF is created in the generator and electrical equipment of a wind turbine whilst operational. The impact of electromagnetic fields on the surrounding environment is limited by the shielding of the electrical equipment in the wind turbine structure or small housing unit at the base of the tower and by the height of the generator which is encased up to 120 m above the ground. The test results from a 1.65 MW wind turbine in Canada show a measured magnetic field at the front door of the wind turbine of 0.4 mG with typical values at a distance of 10 feet (ft) (3 m) from the wind turbine base of 0.04 mG (Windrush Energy 2004). Furthermore, at a distance of 25 ft (7.5 m) from a wind turbine, no measurable magnetic field is expected (Windrush Energy 2004). It is anticipated that an increase in generator capacity of up to 3.3 MW would still result in magnetic field measurements below the NHMRC limit of 1,000 mG for the Project.

15.2.4 *Receptors*

There is limited chance of the public being exposed to electric and magnetic fields from the Project, since the Project site is wholly located on freehold land. Overhead transmission lines may run parallel to or cross over some local roads within the Project locality but will typically be separated from them by at least 10 m when running adjacent to them. The nearest residence to a proposed substation location is approximately 880 m away for an involved landowner and 1.05 km for a non-involved landowner. All electrical components will therefore be a suitable distance away from residences and fall within acceptable levels of exposure.

15.2.5 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation.

Cumulative impacts need to consider the presence of existing electrical infrastructure, such as under and over ground transmission lines, substations, and transformers (pole-mounted or otherwise). The Project is of sufficient distance from other existing and proposed wind farms, and EMF impacts are sufficiently localised, that no cumulative impact is anticipated.

EMF impacts will also be created from the cumulative operation of the proposed Project components within the Project site. However as detailed above, in **Sections 15.1** and **15.2**, and the Management and Mitigation measures outlined below it is anticipated that the introduction of the Project will not have a significant cumulative impact.

15.3 Management and Mitigation

To ensure there is no unnecessary exposure to EMFs the following mitigation and management measures could include:

- Burying underground transmission lines where feasible to shield electrical fields;
- Placing overhead transmission lines in isolated locations where practicable;
- Placing underground cables together so that the magnetic fields caused by the current in each cable cancel each other out due to the alternating current in each cable being out of phase;
- Placing appropriate security around emitting structures (e.g. collector and switching substations); and
- Ensuring the public, including tourists, that need to go near emitting structures are accompanied by a trained and qualified staff member.

15.4 Summary

ELF EMFs are generated from operational machinery. The measurements of EMFs can vary within a wind farm, depending on the placement of equipment such as wind turbines, substations and internal electrical cables.

The *Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields* (NHMRC 1989) places guidelines on exposure to both electric and magnetic fields for the public and construction industry.

The typical strategy for reducing electromagnetic fields is to provide an adequate separation distance between the source and potential receptors. Other strategies include burying cables and placing underground cables together to cancel the fields they emit.

As most of the wind turbine electrical equipment is encased within the wind turbine, either in housing at the base of the tower or located up to 120 m above ground level, both the elevation (distance from the ground) and the shield provided by the housing reduces the levels of electromagnetic fields.

The highest levels of electromagnetic fields are often recorded at substations. Appropriate fencing and remote placement of the substation within the landscape can greatly reduce exposure.

CHAPTER 16

Fire and Bushfire Assessment

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16. FIRE AND BUSHFIRE ASSESSMENT

Fire and bushfire impacts of the Project on human life and property have been assessed in accordance with the Secretary's Environmental Assessment Requirements (SEARs) and the *Rural Fires Act 1997*.

In basing the risk management process on the AS/NZS ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009) and the National Inquiry on Bushfire Mitigation and Management (Council of Australian Governments (COAG) 2004), an analysis and evaluation of bushfire risk and acceptable risk treatments have been undertaken. The complete Bushfire Hazard and Risk Assessment conducted by Environmental Resources Management Australia (ERM) is included in **Appendix 19**.

16.1 Methods

The following steps were undertaken in the assessment process:

- Determine whether the Project area has been mapped as bushfire prone land under *NSW Rural Fire Service (RFS) Planning for Bushfire Prone Areas 2006* (PBP 2006);
- Identify the assets within and surrounding the Study area requiring protection;
- Identify the bushfire risk factors such as bushfire history and known bushfire behaviour in the Study area and within the surrounding lands;
- Map the bushfire hazard at a site specific scale following the relevant guidelines and compare with bushfire prone area mapping;
- Assess likelihood and consequence and evaluate bushfire risk to and from the Project following Standards Australia (2009). Link findings from Step 1 with this process; and
- Produce risk mitigation and management treatments and satisfy PBP 2006 requirements.

Vegetation associations mapped by ERM as part of the Ecological Assessment (see **Chapter 10** Ecology) were simplified to fall in line with a methodology devised by the Southern Regional Fire Association (1994). The methodology grouped vegetation associations into similar fire fuel characteristics based on the frequency that the vegetation community provides 'available fire fuel', the structure of the vegetation and the ability of ground level fuels to carry fire into higher vegetation levels, arrangement of the fuel within the vegetation type, and the amount of fuel that accumulates after a long period without fire. Bushfire hazard classes were then identified across the landscape by applying relative weightings to the varying fuel groups and combining them with available slope classes (i.e. <5, 5-10, 10-15, 15-20, >20 degrees) within a Geographic Information System (GIS).

A bushfire risk analysis was undertaken for the Study area that involved consideration of the causes and sources of risk, their positive and negative consequences, and the likelihood that those consequences can occur. The risk classification scheme was developed through qualitative scales of likelihood and of consequences in methodology adopted from AS/NZ ISO 31000:2009 *Risk Management – Principles and guidelines* (Standards Australia 2009) and NSW RFS (2008). The terminology for describing risk factors is also consistent with the bushfire risk management planning process adopted by the NSW RFS for 'rural fire districts' of NSW. See **Appendix 19** for an example of the qualitative scales of likelihood and consequences.

16.2 Existing Situation

Yass Valley Council Bushfire Prone Land Map identifies the Study Area as supporting bushfire prone land. The map triggers the need to assess the proposed development against the bushfire protection provisions under *Planning for Bushfire Prone Areas 2006*, NSW Rural Fire Service (RFS) (PBP 2006).

The area in and around the Project site consists predominantly of cleared plains, native pasture and areas of both open forest and grassy woodlands in various conditions. The Project site is surrounded by grazing and cropping farms extending for many kilometres. For more information on vegetation communities and distribution refer to **Chapter 10** Ecology.

There have been no significant fires recorded for the Project site within the last five years, although relatively large fires were recorded within the district and to the east of Rye Park during the 2012 / 13 fire season. Some small bushfires occurred on several involved landowner properties over the same period, but were localised and limited in their extent. Small bushfires also occurred on several involved landowner properties in the 2015 / 16 fire season.

Days with a higher fire index rating occur from October to April, although persistent dry conditions have extended the season into May. The days with a higher fire index rating are generally associated with strong gusty north-westerly to south-westerly winds accompanied by high daytime temperatures and low humidity. Afternoon wind changes often hamper fire fighting efforts.

The main sources of ignition in the South West Slopes and Southern Tablelands regions are harvest and farm machinery, lightning strikes, escapes from legal and illegal burning, accidents (arcing of high voltage electrical transmission lines in high winds), slashing and arson.

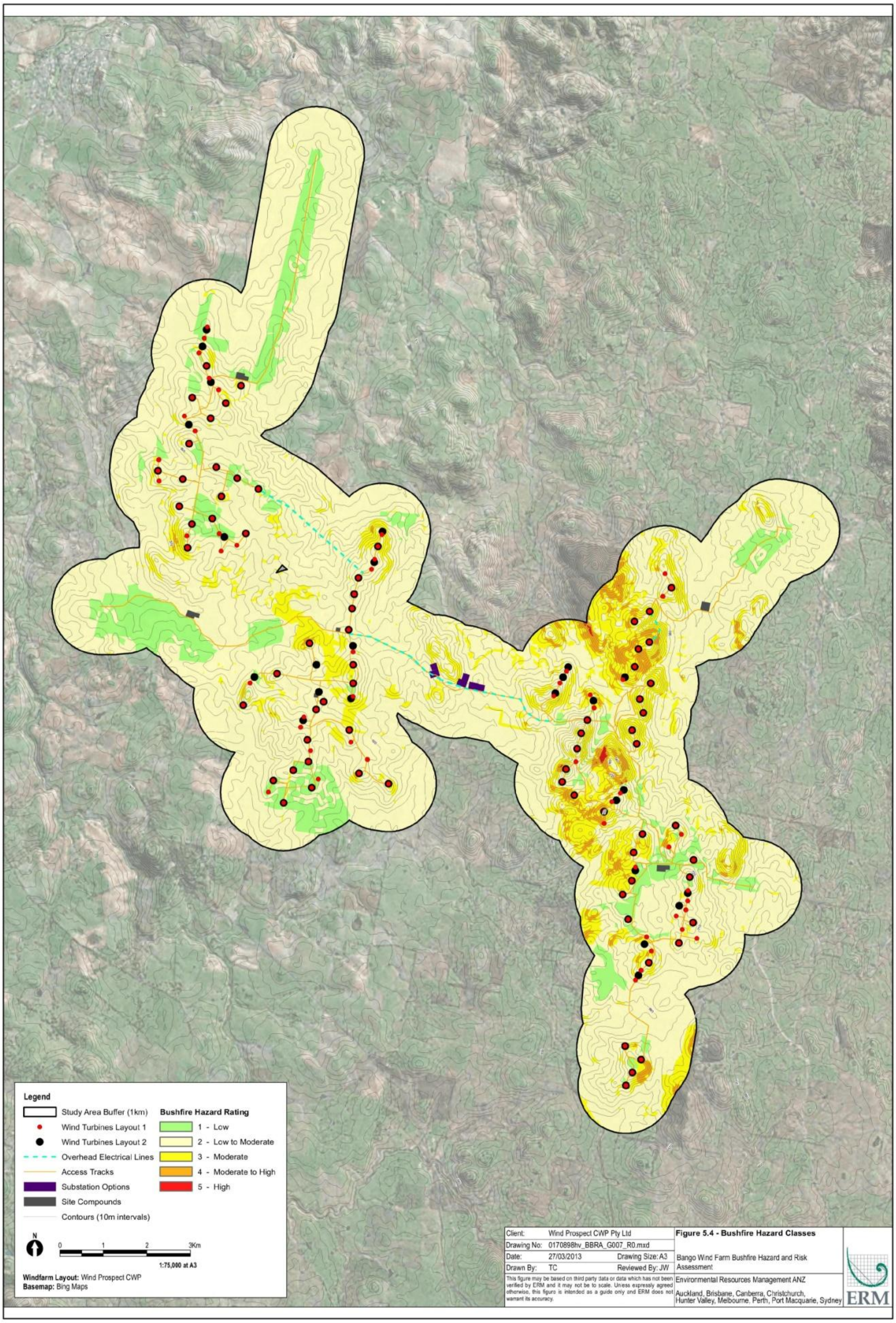
The existing level of bushfire protection for life and property in the surrounding Project site is relatively good. This is due to the extensive areas of cleared grazing land combined with the compartmentalisation of the landscape by roads, both of which act as fire breaks.

16.3 Potential Impacts

16.3.1 *Bushfire Impacts*

Using methodology adapted from the Southern Regional Fire Association (1994), fuel groups in the Project site have been classified with a relative weighting from minimal to high. Fuel group ratings were combined with slope classes to produce **Figure 16.1**, a bushfire hazard map. The steeper areas in the eastern section of the Study area have a high bushfire hazard, and areas of woodland and open forest across the site generally have a medium fire hazard. The rest of the Project site, dominated by pasture grass and poor condition woodland and native grassland is a low to moderate or low fire hazard.

FIGURE 16.1: BUSHFIRE HAZARD ACROSS THE PROJECT SITE



2016

Source: Environmental Resource Management ANZ

Figure 16.1 Bushfire hazard across the Project site

(An A3 size version of this Figure is displayed in Volume 2)

Applying the NSW RFS (2008) risk matrix, the risk rating to life (human), Project infrastructure, surrounding properties (residences, stock and crops) and ecological values / assets risk categories were determined as either medium to low or medium. The former risk rating was assigned to loss of life in a populated area, injury to workers or visitors, extensive and widespread loss of infrastructure within the Study area, and extensive and widespread loss of infrastructure and or property to surrounding properties. The remaining risk factors were assigned a risk rating of low. For full results see **Appendix 19**.

16.3.2 *Construction and Decommissioning*

During construction and decommissioning, the use of flammable materials and ignition sources on-site increases the risk of fire (AusWEA 2001).

16.3.3 *Operation*

Substations, ancillary infrastructure, wind turbines and transmission lines all have the potential to start or influence the spread of fire on-site due to the presence of electrical equipment and associated petrochemicals. Wind turbines in particular can start or influence fires from malfunctioning wind turbine bearings, inadequate crankcase lubrication, cable damage during rotation and electrical shorting or arching which occurs in transmission or distribution facilities (AusWEA 2001).

Fire in modern wind turbines is rare and dedicated monitoring systems (e.g. SCADA) enable wind turbines to be automatically shut down if ambient temperatures exceed the safe operating range, or if components overheat. Other remote alarming and maintenance procedures are required for electrical faults, which can still occur within the tower or nacelle and start a fire.

A wind turbine can influence its surrounding wind and temperature, which can ultimately impact on bushfires. However the amount of increase is approximately 0.7 °C in temperature and 0.6 m/s in wind speed at ground level (Baidya et al. 2004) which is negligible, considering existing vegetation is predominantly cleared pasture and grassland with low and minimal fuel loads.

Lightning strikes have the potential to occur at any wind farm location with the frequency of strikes dependent on the local climate and weather systems. Each wind turbine is built with lightning arresters to protect the blades, nacelle and tower assembly. If the lightning is not grounded correctly, then minor damage can occur to the wind turbine, and potentially the surrounding area, starting a fire.

Underground transmission lines will be used where practicable, as discussed in **Chapter 3** Project Description, which will reduce the risk of electrical fires. Where underground placement is not suitable, overhead transmission lines will be used, which will have an increased risk of an electrical fire. The transmission lines will be built, however, to appropriate specifications and routed to avoid trees and forest fragments where practicable. This will reduce the maintenance required for Asset Protection Zones (APZs), which in turn will minimise the start / spread of a fire.

The transformers are located in the substation facility which will contain oil for the purpose of cooling and insulation. The substation will be built with sufficient bunding to ensure all oil is contained if a leak occurs, reducing the risk of oil spreading and potentially catching fire. The substation itself will be surrounded by gravel and concrete to minimise the spread of fire and improve the APZ.

16.3.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. Each wind farm development has to be assessed for potential impact on fires and bushfires in the area and mitigation measures must be provided, including a Bushfire Emergency and Evacuation Plan. As such, it is anticipated that any potential cumulative effect to fire and bushfire from the Project or other proposed or existing wind farms in the area will be covered by appropriate mitigation measures highlighted in the respective project's Environmental Impact Statement (EIS).

16.4 Management and Mitigation

For appropriate management and mitigation strategies to be adapted to the Project, the risk analysis provided in **Appendix 19** should be applied when assembling an EMP sub-plan. This will then create a final Bushfire Emergency and Evacuation Plan, a draft of which is shown in **Appendix 20**. The Bushfire Emergency and Evacuation Plan will become a sub-plan under the Emergency Evacuation Plan which aims to increase the awareness of the procedures during bushfire emergencies, increase the preparedness of construction and maintenance staff, and facilitate orderly and safe evacuation and refuge during times of bushfire impact. The NSW RFS will be consulted with during the development of the final Bushfire Emergency and Evacuation Plan.

Six broad groups of risk treatment options are described by AS/NZS ISO 31000:2009 and the NSW Bushfire Co-ordinating Committee Guidelines (2008):

- **Avoid the Risk**: Fire weather to be monitored daily, ignition creating activities should not be undertaken outside on days of total fire ban, locate electricity services to limit the possibility of ignition of surrounding bushland or the fabric of buildings and undertake regular inspections of overhead transmission lines to ensure they are not fouled by branches;
- **Reduce the Likelihood:** Maintain fuel reduced zones for all overhead transmission lines and a reduced fuel zone around each wind turbine to ensure adequate defendable space, safe working procedures and emergency response procedures should be developed and strictly implemented for all work tasks, construction and maintenance staff should be trained in the basic first response fire fighting techniques, maintain a 10 m wide fuel reduced zones around construction activities that may result in ignition, maintain roads to 6 m wide with a 4 m vertical clearance to provide all weather access for heavy fire fighting vehicles, locate water access points appropriately and use diesel vehicles during the construction phase;
- **Accept the Risk:** Provide and maintain fire fighting equipment capable of controlling and suppressing small initial outbreaks of fire, provide and maintain public and property access roads as per the performance criteria and acceptable solutions of (Planning for Bushfire Protection 2006), provide the RFS with necessary information to assist with internal response planning;
- **Transfer the Risk**: Take out appropriate insurance and Public Liability Insurance Policies; and

- **Retain the Risk:** Prepare an Emergency Response Plan in accordance with the 'Guide to Developing a Bushfire Evacuation Plan' (RFS 2004) and the AS 3745:2010 'Planning for Emergencies in Facilities'.

A detailed list of risk treatment options is provided in **Appendix 19.**

The Project will also provide added benefit for any fire fighting operations due to the presence of new on-site access roads over terrain which previously had only unmade tracks or no formed access whatsoever. This will allow fire fighters to reduce fire response times and provide an opportunity to more easily access fires on properties within and neighbouring the Project. The height of the wind turbines also increases the likelihood that they will attract and discharge lightning strikes safely due to their internal lightning protection, strikes which could otherwise have started a fire when hitting a tree. The Community Fund could be used to purchase additional fire fighting equipment for the region, such as new or additional fire trucks, should it be deemed appropriate. The creation of cleared areas on ridge lines also acts as potential fire breaks.

Wind turbines have the potential to present a hazard to fire fighting helicopters and planes, as with any tall structures. Victorian Country Fire Authority (2012) notes that fire suppression aircraft operate under "Visual Flight Rules". As such, fire suppression aircraft only operate in areas where there is no smoke and during daylight hours. Aerial fire fighting activities can be carried out in and around the Project provided proper pre-planning is undertaken. The wind turbines will be shut down during any significant bushfires within the Project area, either entirely or by cluster as deemed appropriate in consultation with the RFS.

16.5 Summary

The Project occurs in an area of low bushfire risk due to the amount of generally cleared and rural developed land in the area. By reviewing the possible ignition sources from the Project and analysing bushfire risk assessments on life and property it is possible to create mitigation and management strategies to minimise the Project's impact on fire and bushfire risk. Through implementing these strategies in an Emergency Response Plan it is possible to increase the awareness of the procedures of bushfire emergencies, increase the preparedness of construction and maintenance staff, and facilitate orderly and safe evacuation and refuge during times of bushfire.

The consideration of these mitigation and management strategies will allow the Project to decrease its impact on fire and bushfire hazards. The construction of a wind farm also has potential benefits in tackling bushfires which occur close to and within the Project site, including improved access from new on-site access roads, fire breaks and reduced lightning strike to vegetation.

CHAPTER 17

Water Assessment

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17. WATER ASSESSMENT

This chapter reviews existing water conditions in accordance with relevant legislation and policies from the Secretary's Environmental Assessment Requirements (SEARs) as listed in **Chapter 5** Planning Context. The Project is subject to the following water related policies and plans, which have been considered as part of this assessment (see **Appendix 21** Water and Soil Assessment).

- *Water Management Act 2000; Water Management Act 2000* Note*:* Under Section 75U of the EP&A Act, separate approvals for a water use approval under Section 89, a water management work approval under Section 90, or an activity approval under Section 91 of the Water Management Act 2000 are not required for the Project;
- Water Act 1912;
- Fisheries Management Act 1994;
- NSW State Rivers and Estuaries Policy (1991);
- NSW Sand and Gravel Extraction Policy for Non-Tidal Rivers (1992);
- NSW Groundwater Quantity Management Policy (undated);
- NSW Weir Policy (1997);
- NSW State Groundwater Policy Framework Document (1997);
- NSW Groundwater Quality Protection Policy (1998);
- Policy and Guidelines for Aquatic Habitat Management and Fish Conservation (1999);
- NSW State Groundwater Dependant Ecosystem Policy (2002);
- NSW Water Quality and River Flow Objectives for the Lachlan River Catchment (2006);
- NSW Wetlands Policy (2010);
- NSW Policy for Managing Access to Buried Groundwater Sources (2011);
- Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources (2012);
- Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources (2012);
- NSW Office of Water Guidelines for Controlled Activities on Waterfront Land (2012); and
- NSW Aquifer Interference Policy (2012).

These regulations provide for a number of water management targets including water sharing, water quality, management of water supply and wastewater, water conservation and efficiency, and river and wetland protection and rehabilitation. Water required for the Project, as discussed in **Chapter 3** Project Description, will be sourced from on-site water sources, such as bores and dams, where practicable or alternatively brought in from off-site rivers and dams or suppliers as required.

17.1 Existing Situation

The Project site lies within the upland reaches of the Lachlan Catchment. A number of small ephemeral creeks and gullies drain off the ridgelines of the Project site including Dirt Hole Creek, Dry Creek, Langs Creek, Kangiara Creek and Harry's Creek. These streams then either flow west and south into the Boorowa River or north into Pudman Creek. The Boorowa River is a tributary of the Lachlan River, the only river in NSW to have significant wetlands along both its length and at its end.

17.1.1 *Groundwater Source*

The Project site is located over the Lachlan Fold Belt Ground Water Management Area (GWMA). The average depth to the watertable for the Lachlan Fold Belt GWMA is 40 metres (ABARES 2012) and typically bore yields are small and sufficient for stock and domestic supplies only, due to the limited permeability of the rock sequences (NOW 2010).

The average upper limit of the water bearing zone (WBZ) of boreholes in the vicinity of the Study area is approximately 14.6 m (NSW OEH 2013a). As no groundwater dependant ecosystems were recorded within the Study area (ERM 2013), groundwater is unlikely to have a significant influence on terrestrial ecosystems and is unlikely to be encountered during construction activities (see **Appendix 21** Water and Soil Report). Pending geotechnical investigations, footings will be either slab (gravity) foundations or slab plus rock anchor foundations. Both footing types require surface excavation to a depth of approximately 2.5 m for the main foundation, whilst rock anchors will also require drilling up to a depth of 20 m for each anchor. Groundwater surveys will be undertaken prior to footing design and construction, particularly any that requires drilling at depth, to ensure no groundwater issues or contamination would result.

17.1.2 *Riparian / Watercourse Zone*

Most of the drainage lines in the Study area are ephemeral, flow only for a short time post rainfall events and are minor tributaries draining off the ridgelines. Using the Strahler System the streams on-site were generally categorised as shown in **Table 17.1** and are shown in **Figure 7.2** of **Appendix 21**.

Table 17.1 Streams that intersect the Study area

Strahler Number	Streams
1st Order	Gorham Creek, ephemeral drainage lines with limited vegetation near the ridges
2nd Order	Bobby's Creek, Hardiman Creek, Rocky Creek
3rd Order	Dry Creek, Harrys Creek, Kangiara Creek
4th Order	Dirt Hole Creek, Langs Creek

There are two zones to be considered within riparian corridors:

- A Vegetated Riparian Zone (VRZ) is the land contained within and adjacent to the channel including a vegetated buffer as specified by NOW (2012); and
- An Asset Protection Zone (APZ) is a requirement of the NSW Rural Fire Service and is designed to protect assets (houses, buildings, etc.) from potential bushfire damage.

Due to the Study area being surrounded by rural land, the APZ component of the riparian corridor has not been considered. **Table 17.2** provides the different VRZ widths for different stream orders and are shown in **Figure 7.1** of **Appendix 21**.

Table 17.2 *Water Management Act 2000* VRZ widths

Watercourse Type (Strahler Number)	VRZ Width (m) (Each Side of Watercourse)	Total Riparian Corridor Width (m) (Plus Channel Width)
1st Order	10	20
2nd Order	20	40
3rd Order	30	60
4th Order and greater *	40	80

**Includes estuaries, wetlands and any parts of rivers influenced by tidal waters*

17.2 Wetlands

Numerous small features mapped in the database of NSW wetlands (OEH 1987) occur within the immediate vicinity of the Study area, the closest being a reservoir 3 km to the south. Lake Burrinjuck is located approximately 27 km south of the Study area. No wetlands listed under the Ramsar Convention or under the Directory of Important Wetlands occur within 60 km of the Study area, nor were any recorded in the Study area during ecological surveys by ERM (2013).

17.3 Aquatic

Most of these streams surrounding the Study area are considered to be first order streams, with three second order streams, three third order streams and two fourth order streams (see above). No significant aquatic species are present within the Study area (see also **Chapter 10** Ecology for consideration of the presence of the Booroolong Frog (*Litoria booroolongensis*) and the Growling Grass Frog (*Litoria raniformis*) in the Study area).

17.4 Potential Impacts

17.4.1 *Groundwater Source*

Two types of foundations will be considered for the Project:

- Slab (gravity) foundation - involves the excavation of approximately 750 cubic metres (m^3) of ground material to a depth of approximately 2.5 m ; and / or
- Slab plus rock anchor foundation - involves the excavation of approximately 570 m^3 of ground material to a depth of approximately 2.5 m and the drilling of rock anchor piles up to a maximum depth of 20 m.

Any modification / pollution of groundwater flows may impact upon groundwater dependant ecosystems outside the Study area and upon the quality and quantity of water available in bores used as a rural water supply. The average upper limit of the water bearing zone of boreholes in the vicinity of the Study area is approximately 14.6 m (NSW OEH 2013). Due to the shallow excavation depth, the probability of groundwater contact occurring is expected to be low due the location of the turbines on hill crests. However, the drilling of rock anchors has the potential to intersect with the Water Bearing Zone due to their potential depth below ground level, particularly for wind turbines located at lower elevations.

It is unlikely that earthworks for roads, hardstand areas and underground cabling will interfere with groundwater flows due to their shallow construction depths. If water is extracted from bores within the Project Site for use during construction, there may be a localised and temporary impact on the groundwater regime.

As the final foundation design is yet to be confirmed, the requirement for any further assessment of groundwater impacts will be undertaken at the detailed foundation design stage and included in the CEMP.

Should the Project require bore water to supplement that available through existing licences and allocations, detailed geotechnical studies will be undertaken at the relevant sites and at that time an assessment of predicted dewatering volumes, zone of drawdown and associated impact, water quality and disposal methods, impact on licensed users and basic landholder rights will be made. This will be undertaken in combination with the necessary licensing requirements from NOW and permissive occupancy rights of the affected landowners.

River Red Gum forest mapped along the Boorowa River and Pudman Creek is not likely to be affected by the Project, due to distance from the Study Area. No groundwater dependant ecosystems were recorded in the Study area (ERM 2013), hence impacts on terrestrial ecosystems from any alteration to groundwater flow is expected to be negligible.

17.4.2 ***Riparian / Watercourse***

The construction phase of the Project will have the highest potential for impact on the areas surrounding the Project Site. For a full description of construction works on-site see **Chapter 3** Project Description, however a brief overview of potential impacts on riparian / watercourses is outlined below.

There are potentially 173 stream crossings associated with the Project. Of these the vast majority (93) are located on first order streams which are best described as drainage lines, 48 on second order streams, 24 on third order streams and eight on fourth order streams. Of these, 53 are access track crossings – 33 over first order streams, and the remaining 20 over second order and higher streams. Refer to **Figure 7.1** of **Appendix 21** for a map showing the riparian zones and **Figure 7.2** of **Appendix 21** for a map showing the stream orders and crossings relative to the Study Area of the Project.

General construction activities could include excavation, trenching, concrete batching, and other earthworks. These activities can impact on surface waters by:

- Modifying surface drainage characteristics;
- Siltation from erosion and runoff;
- Siltation effects from catchment runoff; and
- Contamination of water resources.

It is not anticipated that the Project will alter the magnitude or direction of surface water flows. Mitigation measures are expected to minimise and avoid potential impacts from general construction activities and drainage line crossings.

17.4.3 *Wetlands*

The Project is not likely to influence the hydrology of surface water systems and / or ground water systems upon which any of the features mapped in the database of NSW wetlands depend.

The groundwater level data from surrounding bore holes suggests that the ridgelines are unlikely to support an ecosystem which is reliant on groundwater present at such depths. Therefore the potential impact on aquatic species is expected to be minimal, both within and external to the Study area.

17.4.4 *Cumulative Impacts*

An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. The proximity of the proposed Rye Park Wind Farm (7 km east) increases the potential for cumulative impacts on water resources, particularly on Pudman Creek which drains into the Boorowa River. Consequently particular care will be taken to minimise the movement of soil off-site by both wind farm developments. Any impacts on groundwater sources are expected to be confined to the immediate area of each project due to the nature of fractured rock providing limited channels for groundwater flow. The Project is of sufficient distance from the approved Dalton Power Plant (30 km south-east) and approved Yass Valley Wind Farm (25 km south-west), that it is anticipated that there will be no cumulative effect on groundwater, riparian and watercourse corridors and wetlands from the introduction of the proposed development into the area.

17.5 Water Requirements and Sourcing

Water requirements will be either met by sourcing groundwater from within the Project site as long as a zero share licence can be obtained under the current water sharing plan, or from surface water sources such as Lake Burrinjuck. All groundwater and surface water sources are licensed and regulated within the Project site under the *Water Sharing Plan for the Lachlan Unregulated and Alluvial Water Sources (2012* and the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources (2012).*

Where available, groundwater may be purchased from involved or adjacent landowner properties who hold groundwater licences and have unused allocations. This will be undertaken in combination with the necessary licensing requirements from NOW and permissive occupancy rights of the affected landowners. If water cannot be sourced locally, then it will be brought to site by external water suppliers under contract to the Project. The use of regulated surface water allocations from Lake Burrinjuck may also be an option. In which case a water access licence for a specific purpose will be obtained or it will be bought from an existing licence holder such as Yass Valley Council with the water trucked to storage tanks on-site. NOW will be consulted in the detailed designed phase to progress the necessary arrangement to formalise the use of water during construction.

It is estimated that in the order of 15 ML of water would be required to produce the quantity of concrete required for gravity footings for Layout Option 1, and as such can be considered the maximum amount of water required for use in concrete batching. By way of comparison, it is estimated that only 11 ML of water would be required if standard rock anchors were used for all footings in Layout Option 1.

In addition, approximately a further 45.9 ML of water would be required for road construction and dust suppression activities. This would provide sufficient volume for all new and upgraded on-site road construction and dust suppression activities, including those associated with the 33 km of unsealed arterial road. These activities are not embargoed and as such require the Proponent to apply for a permit to NOW.

A water balance showing the total water use for the Project is shown in **Table 17.3** below.

Table 17.3 Water Balance for the Project

Water Source	Water Sourced / Disposal	Water Quantity (ML)
On-site groundwater/Lake Burrinjuck	Sourced	60
On-site rainwater collection	Sourced	1
Concrete for footings and general construction	Disposal	-15
Water for dust suppression	Disposal	-45.9
Potable water consumption and firefighting	Disposal	-1
Total Water Balance		**0**

Based on the current regulatory provisions, if a company wishes to utilise water for dust suppression and concrete batching (both commercial / industrial purposes) from a bore licensed for stock and domestic purposes, a Purchase and Trade Entitlement option is available as follows:

- The Proponent will apply to NOW under the *Water Act 1912* to authorise an additional purpose of industrial / commercial with a zero entitlement. This will require proof of occupancy and involve the associated landowner(s);
- The Proponent will identify the volumes of water required within an annual period and purchase this from an existing licence holder with the necessary volumes and purpose. The purchase can be temporary or permanent. There are agents available which facilitate water trading who could assist. Following completion of the Project, the entitlement could be traded once it is no longer required;
- An application for a transfer under the *Water Act 1912 / Water Management Act 2000* will need to be approved by NOW to enable the trade to occur. This will require an assessment of the impact of the trade in accordance with relevant policy; and
- Under a Water Sharing Plan additional volumes may be able to be licensed for commercial activities in line with a controlled allocation policy.

Identification of appropriate water sources to enact this process will be determined post-consent, during the pre-construction phase of the Project. Should this approach not prove feasible, then water will be sourced from commercial suppliers within the vicinity of the Project at the expense of the Proponent or contractor.

Potable Water: Potable water will be required for the consumption of the construction workforce. The estimated potable water requirement during construction is estimated to reach a maximum of

2,300 litres per day. Water storage tanks will be provided within the construction compound (during construction) and operations compound (during operation) for bulk potable water storage. Provisions will also be made to allow collection and storage of rainwater from the roof of site buildings. Water will be made available in site storage tanks for fire emergency response.

17.6 Management and Mitigation

A management plan, also discussed in **Chapter 18** General Environmental Assessment, will be prepared in line with the '*Blue Book'* (Landcom 2004) as part of the Construction Environmental Management Plan (CEMP) for the Project site, given the extent of the proposed on-site access roads and the nature of the soil on-site (see **Chapter 21** Statement of Commitments). The main objectives of the CEMP sub-plan will be:

- To minimise soil disturbance;
- To minimise erosion events from increased surface runoff; and
- To minimise disturbance of water resources in the area.

Specific soil and water management measures that will be considered for inclusion in the CEMP sub-plan include:

- Adequate investigation of where soil disturbance is likely to expose and / or exacerbate pre-existing problems;
- Planning for erosion and sediment control concurrently with engineering design (including undertaking necessary further investigations), prior to any works commencing, and integrate other landscape components (e.g. riparian, ecological);
- Avoid wherever possible clearing areas of highly erodible soils and steep slopes which are prone to water and wind erosion;
- Install the necessary control measures prior to works commencing;
- Minimise the area of soil disturbed and exposed to erosion (include appropriate vehicle management to restrict traffic to nominated access roads);
- Install water slowing and diversion devices around construction areas including measures to manage surface run-off from hardstand areas and surfaced on-site access roads;
- Conserve topsoil for later site rehabilitation / revegetation;
- Divert clean run-on water around disturbed areas;
- Control water flow from the top of, and through the Project Site;
- Progressively rehabilitate disturbed lands as soon as practicable; and
- Inspect and maintain soil and water management measures appropriately during the construction and operation phase, with regular inspections and maintenance scheduled.

Specific groundwater management that will be considered for inclusion in the CEMP sub-plan include:

- Measures for activities identified as possibly impacting upon groundwater resources such as water extraction, compaction of ground or deep excavations (e.g. footings);
- Undertake detailed geotechnical investigations to ascertain the type and extent of footings so to determine the potential for interception of groundwater and zone of drawdown and associated

impact on groundwater and potential effect on water quality, with disposal methods developed for any dewatering required; and

- Monitoring of low- and high- flow conditions is to be regularly undertaken prior to the commencement of works to determine baseline water quality parameters. The EMP sub-plan may also include relevant detail about which parameters would be measured and the frequency of monitoring and also list out corrective measures that would be applicable to employ. Surface water monitoring locations should include:
  - Junction of Langs Creek and Rocky Creek;
  - Junction of Dry Creek and Langs Creek;
  - Upper reaches of Fat Jack Creek;
  - Upper reaches of Gorham Creek;
  - Upper reaches of Hardiman Creek;
  - Upper reaches of Kangiara Creek; and
  - Upper reaches of Thorsby Creek.

Specific measures in the EMP sub-plan in relation to the design of on-site access roads and trenching would include:

- On-site access roads located to reduce the risk of sediment entering drainage lines, avoid perched water tables, maintain effective vegetative buffers and to be kept above flood levels;
- On-site access roads will have a slight grade to allow free surface drainage and to avoid ponding in wheel tracks;
- Bitumen or gravel surfacing may be required where grades are required to exceed 15 ° on soils of low erodibility or 12 ° on soils of moderate erodibility;
- Runoff to be minimised from concentrating and reaching erosive speeds;
- Drain and channel linings may be required if flow velocities exceed erosive levels for the in-situ soil material;
- Upslope clean water should be diverted away from disturbed areas through the use of catch drains and berm drains;
- Outfall and / or infall drainage will be used for cross bank construction and located such that flow is not directed back onto the access road;
- Disturbance of soil and vegetation to be minimised as much as practicable, both on and adjacent to tracks and will follow land contours to minimise the amount of cut and fill;
- Drainage line crossing:
  - Drainage lines will be crossed with culverts and will not obstruct flows or create turbulent flows that will cause erosion;
  - Crossing approaches should be perpendicular (or nearly so) to the drainage line, unless using an angled approach for further reduced disturbance;
  - Culvert inlets and outlets to be adequately protected;
  - Maintenance of existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse; and
  - Stabilise and rehabilitate all disturbed areas in order to restore the integrity of the riparian corridor;

- Revegetation to be undertaken as soon as practicable following works and locally native species used as a base mix to stabilise soils to minimise erosion. In circumstances where 'Type D' soils are present and ecological values are low, a cover crop may be required using sterile seed sources; and
- Inspection of all access roads regularly and following heavy traffic use or heavy rainfall to be undertaken as part of both the CEMP and OEMP.

All work within and across the VRZ of the riparian corridors has been designed to be in line with NOW and DPE guidelines for watercourse crossings, through the use of causeways or bed level crossings on first order streams and box culverts on second order streams and above. Hardstands areas for the operations compound, concrete batching plants, rock crusher, collector substations (CS), switching station (SS) and construction compounds will be located, where practicable, outside of the VRZ to minimise construction and operational impacts on watercourse and riparian corridors.

Specific measures in the CEMP sub-plan in relation to riparian zones include:

- Where cables are to be installed across watercourses, cable installation should be in accordance with the NSW Office of Water Controlled Activities: Guidelines for Laying Pipes and Cables in Watercourses Guideline, where:
- cables should be situated on the downstream side of channel bedrock outcrops, or across a straight section of the watercourse (ie avoiding bends);
- backfilling needs to restore the channel shape and bed level to preconstruction condition;
- the trench is to be open for minimal length of time only;
- water flows should be continuous both during and after construction (ie avoiding or minimising 'stopping' the flow); and
- measures taken to prevent potential water quality issues (turbidity, spills)
- All waterway crossings are to undergo detailed design post-approval, and are to be constructed in consultation with NOW and DPI (Fisheries) and in line with the NOW *Guidelines for Controlled Activities* and DPI (Fisheries) guidelines: *Policy and Guidelines for Fish Friendly Waterway Crossings* (2004) and *Why do Fish Need to Cross the Road* (2004);
- Drainage line crossings to not obstruct flows or create turbulent flows that will cause excessive erosion;
- Drainage line crossings will maintain existing or natural hydraulic, geomorphic and ecological functions of the watercourse;
- The approach of drainage line crossings should be approximately perpendicular to the drainage line to reduce the disturbance distance;
- Culvert inlets and outlets must be adequately protected;
- Any stormwater outlets to aim to be 'natural', yet provide a stable transition from a constructed drainage system to a natural flow regime;
- All ancillary drainage infrastructure, e.g. sediment and littler traps, should, where practicable, be located outside the riparian corridor. Runoff should be of an appropriate water quality and quantity before discharge into a riparian corridor or watercourse;
- All stockpiles are to be located away from drainage lines and natural watercourses and, where necessary, should be appropriately protected to contain sediment and runoff (e.g. sediment fencing); and

- Regular inspection, maintenance and cleaning of water quality and sedimentation control devices.

Specific measures in the EMP sub-plan in relation to the hydrology of the site would include:

- The establishment and operation of the concrete batching plants is to be in accordance with the Environment Protection Authority's (EPA) Environmental Guidelines for the Concrete Batching Industry and Environment Protection Licence issued by OEH;
- Design measures to be implemented for concrete batching plant sites to contain spills and minimise loss of sediment and other contaminated material;
- Design measures to be implemented for primary and secondary containment of any oil that may leak or spill from transformers or associated components, such as constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the CS compound;
- Concrete and cement carrying vehicles are to be washed out in appropriate wash-down facilities off-site;
- Management of hazardous materials, waste and sewage will ensure no undue contamination of water resources occurs;
- Dewatering procedure to allow for discharge of water from deep excavations or trenches;
- Wastewater produced during construction from temporary on-site toilets to be stored before being trucked off-site or disposed of via a septic or composting toilet system which complies with Council requirements and meets necessary health regulations;
- Any hazardous products are to be stored and transported appropriately in accordance with relevant OEH and Workcover guidelines and regulations, to avoid release to the environment;
- All hazardous materials are to be properly classified, stored away from flood prone areas and drainage lines. Appropriate spill kits and fire protection are to be provided on-site during construction; and
- Any on-site refuelling must occur in an area greater than 100 m from the nearest drainage line and ensure correct practices are in place, including:
  - Refuelling to be carried out in a specified bunded area, according to regulatory requirements;
  - Use of drip trays and spill mats; and
  - No refuelling to be carried out in the vicinity of a waterway.

17.7 Summary

The Project is not expected to significantly affect the watercourses or riparian vegetation within the site, the general locality or downstream. Groundwater impacts are expected to be limited to a low likelihood of dewatering for excavation of footings and sourcing water for the construction phase by existing groundwater extraction licences, however further detailed groundwater assessment may be required prior to the start of construction and pending detailed wind turbine foundation design. No impacts on wetlands or groundwater dependent ecosystems are expected. An EMP sub-plan will be prepared which will address all potential impacts, with the aim of minimising the risk of remediation efforts being required on-site.

The sourcing of water for construction activities will be undertaken using appropriate regulatory licences to access bore or surface water, as outlined previously. Should it not prove practicable to obtain water from within the Project site or from Burrinjuck Dam, then water will be purchased from existing licence holders locally and brought to site at the Proponent's expense.

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CHAPTER 18

General Environmental Assessment

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18. GENERAL ENVIRONMENTAL ASSESSMENT

This chapter, in addition to **Chapter 19** Socio-Economic Assessment, addresses aspects of the proposed Project beyond the key issues identified in the Secretary's Environmental Assessment Requirements (SEARs). In summary the following chapter contains sections on climate, air quality, soils and landforms, waste, responses to consultation and aspects relating to construction, blade throw, refurbishment and decommissioning.

18.1 Climate

The Project is located on the boundary of the South Western Slopes and South Eastern Highlands bioregions of NSW. The local climate is characteristic of the South Eastern Highlands bioregion: temperate with warm summers and no dry season (OEH 2011a). Rainfall is reasonably evenly distributed throughout the year, with slightly less rainfall recorded between February and May (Bureau of Meteorology (BoM) 2013).

A summary of climate data from Kangiara (Laverstock) (Station No 73023, elevation 560 m), Boorowa Post Office (Station No 70220, elevation 488 m) and Yass (Linton Hostel) (Station No 70091, elevation 520 m) from BoM (2013) is presented in **Table 18.1**.

Table 18.1 Annual weather conditions

Weather Conditions	Measurements	
	Kangiara (Laverstock)	**Boorowa Post Office**
Annual mean rainfall	689.5 mm	612.6 mm
Highest mean monthly rainfall	66.4 mm (July)	57.9 mm (October)
Lowest mean monthly rainfall	43.7 mm (February)	42.7 mm (February)
	Yass (Linton Hostel)	**Boorowa Post Office**
Annual mean minimum / maximum temperature	7.2 °C / 20.7 °C	5.1 °C / 19.3 °C
Highest mean monthly maximum temperature	29.5 °C (January)	26.1 °C (January)
Lowest mean monthly minimum temperature	1.1 °C (July)	-3.2 °C (June)

Source: BoM 2012

The Yass (Linton Hostel) Station is the closest station with records for the annual number of clear, cloudy and rainy days. Data recorded at this station indicates an annual average of 92.2 clear days, 109 cloudy days and 74.3 days with rainfall greater than or equal to 1 mm (BoM 2013).

18.2 Air Quality

18.2.1 *Existing Situation*

Air quality in the Boorowa and Yass Local Government Areas (LGA), is generally considered to be acceptable (OCSE 2009a; OCSE 2009b). Impacts in the region tend to be limited to smoke and ash from wood heaters during winter when temperature inversions trap air pollution close to the ground, and dust during dry and windy conditions. Drought, hazard reduction burning, bushfires and stubble burning are seasonal occurrences that also impact on air quality (OCSE 2009a; OCSE 2009b). The impact of vehicle emissions is unlikely to be noticeable in either LGA. As there is no routine air quality monitoring in the area there is no way to assess whether there has been any change in air quality over time (OCSE 2009a; OCSE 2009b).

The Project site would not be expected to experience air quality issues from industry as it is located in a rural / agricultural setting. Low residential density means particulate emissions from wood heaters is not a significant issue. However, air quality could be affected by occasional bushfires, fuel reduction burns and dust particle generation from agricultural activity, development sites and unsealed roads during dry conditions.

18.2.2 *Potential Impacts*

The majority of potential impacts to air quality from the Project will occur during the construction phase. Dust particles and other emissions can be released from a range of activities, including:

- Clearing of vegetation;
- Open exposed areas;
- Stockpiles;
- Excavation works;
- Mobile concrete batching plants;
- Rock crushing;
- Processing and handling of material;
- Construction activities;
- Transfer points;
- Loading and unloading of material; and
- Haulage activities along unsealed roads.

The expected quantities of dust produced as a result of construction can be appropriately managed in accordance with an air quality and dust management plan. This plan will be implemented to control potential air pollution, including the primary sources of emissions; dust, plant and vehicle emissions and odour. Under this plan, dust deposition gauges will be installed near Mobile Resource sites to monitor dust emissions and ensure emissions do not exceed 4 grams per metre squared per month, in accordance with NSW OEH guidelines.

Similarly, the EMP sub-plan will outline measures to conserve energy and reduce greenhouse gas emissions that will result from construction activities. Reports to the Clean Energy Regulator within the Commonwealth Government will consolidate and capture emissions and energy usage data annually.

Cumulative Impacts: An assessment of cumulative environmental impacts considers the potential impact of a project in the context of existing and future developments to ensure that any potential environmental impacts are not considered in isolation. There is one proposed wind farm in the immediate vicinity of the Project, Rye Park Wind Farm (7 km to the east). Potential impacts will be limited to the construction period, therefore it is anticipated there will be no long-term cumulative effect of dust generation, or impact to air quality from the introduction of the Project into the area. Should the construction of one or more wind farms happen concurrently, there is the possibility of a short-term increase in dust emissions in a localised area, but given the distances between the wind farms the potential for cumulative impact is considered very low.

18.2.3 *Management and Mitigation*

The majority of work will not occur near residential areas. However, to ensure appropriate mitigation measures are utilised for dust and other emissions, an EMP sub-plan will be included in the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP). Mitigation methods may include:

- During excavation topsoil will be stockpiled. After excavation, topsoil will be replaced for seeding / fertilising and excess subsoil will be disposed of in an appropriate manner. If any excavation occurs on steep slopes the topsoil will need to be stabilised;
- Where practicable, loads will be covered to prevent windblown dust or other materials escaping;
- Any stockpiled material will be covered with plastic sheeting or otherwise bound to reduce dust where practicable. Dust levels at stockpile sites would be visually monitored. Dust suppression (e.g. water sprays) would be implemented if required;
- During dry and windy conditions a water cart or alternative non-chemical dust suppression would be available and applied to work areas;
- Progressive revegetation and stabilisation will be undertaken where practicable; and
- If blasting is required, Australia and New Zealand Environment and Conservation Council (ANZECC) guidelines for control of blasting impacts will be followed.

18.3 Soils and Landforms

18.3.1 *Existing Situation*

A Water and Soil Assessment has been prepared for the Project (see **Appendix 21**). The Project area overlies one geological formation, namely the Hawkins Volcanics Unit of the Douro Group. The geology is Silurian to early Devonian and consists of biotite-cordierite-garnet rhyolitic to dacitic ignimbrite with flow-banded, vesicular rhyodacitic to dacitic lava, volcanic sandstone, minor rhyodacitic agglomerate and rhyolitic lapilli tuff (Colquhoun et al. 2008; Johnson et al. 2002). In some areas a surface layer of alluvial or colluvial gravel, sand, silt and clay or residual-eluvial-saprolite deposits exists (Colquhoun et al. 2008; Johnson et al. 2002). The characteristic terrain includes undulating low hills and rocky rises. Soils are typically Yellow Earths, Yellow Podzolic Soils and Shallow Soils; rock outcrops are common in the latter soil type (Hird 1991). Slopes are susceptible to sheet, rill and gully erosion with drainage lines also prone to gullying.

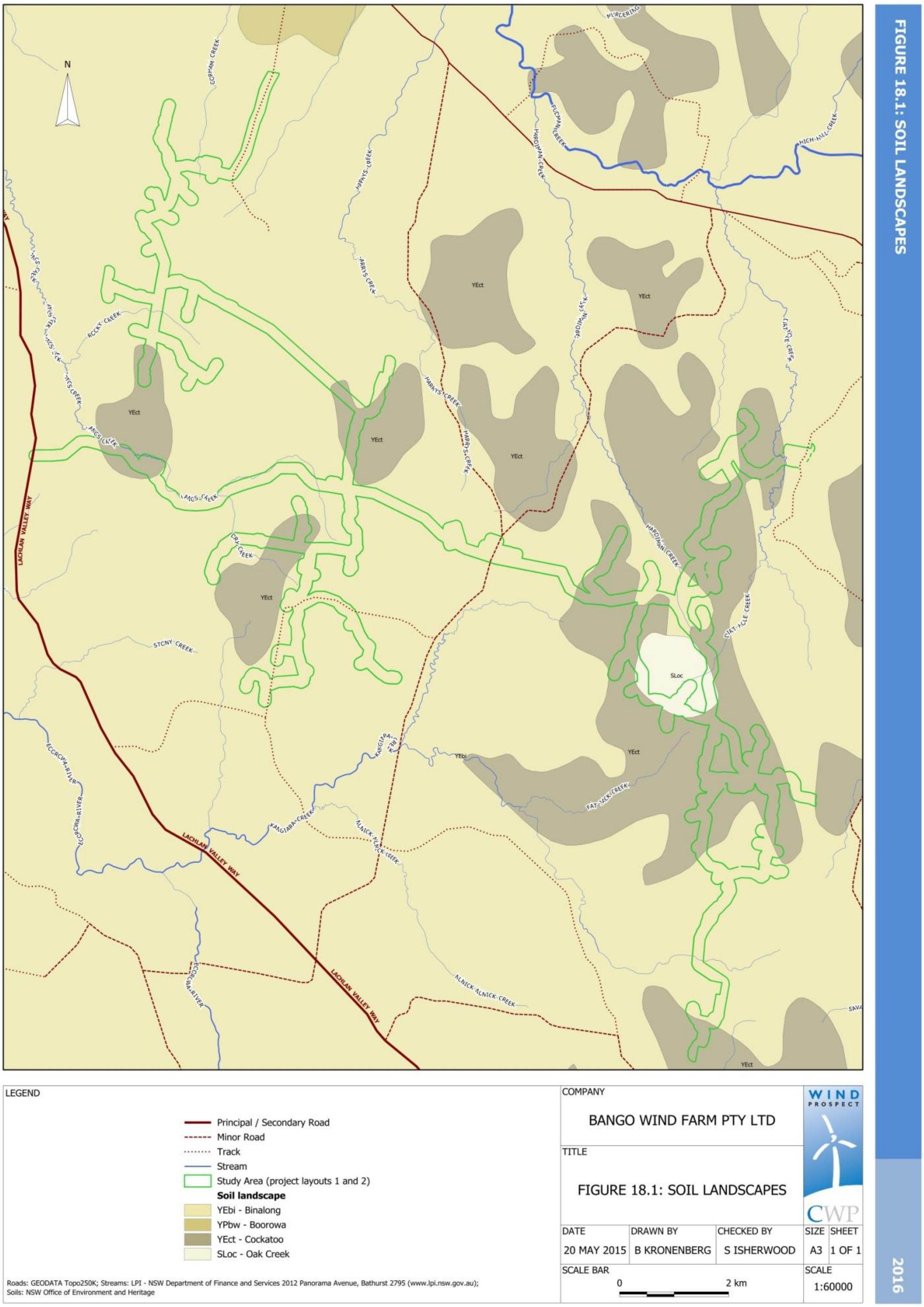

Figure 18.1 Soil landscapes

(An A3 size version of this Figure is displayed in Volume 2)

Soil characteristics for the Project site are based on soil mapping descriptions by Hird (1991). The main soil landscapes in the Project locality are the Binalong, Boorowa, Cockatoo and Oak Creek units (see **Figure 18.1**).

Associated landowners were also consulted to determine if there were any known contamination sites on their land. A few landowners have indicated that whilst potentially contaminating activities (e.g. sheep dips, fuel storage, and herbicide spraying) occur or have occurred on-site, these activities have not taken place near wind turbine or associated infrastructure locations that will be disturbed by the Project.

Based on the Australian Soil Classification, the erosion hazards of the soil landscapes across the Project site were identified and are listed in **Table 18.2**.

Table 18.2 Soil landscape erosion hazards across the Project site

Unit	Erosion Hazard	Soil Types
Binalong	Extreme / very high	Lithosols / Stony Earths / Colluvial Podzolic soils
Boorowa	Low to moderate	Yellow Podzolic Soils
Cockatoo	High	Red Earths / Yellow Earths
Oak Creek	Extreme / very high / high	Siliceous Sands / Sandy Earths / Podzolic Soils

18.3.2 *Potential Impacts*

The majority of potential impacts will occur during construction and will therefore be limited to the timeframe of construction activity on the Project site including through:

- Vegetation clearing;
- Excavation and heavy machinery works;
- Grading/levelling;
- Access road upgrades;
- Possible trenching for powerlines;
- Vehicle traffic and heavy machinery traffic;
- Excavation for turbine foundation breakdown and site building removal;
- Re-contouring the surface; and
- Revegetation and rehabilitation works.

The impacts could include increasing the potential for:

- Erosion and weathering processes;
- Introducing and or spreading of weed species;
- Changing hydrology and drainage paths, which can potentially increase the area’s chance of dry land salinity; and
- Impact on the ground stability.

The extent these impacts may occur will be determined by the characteristics of the soil (see **Appendix 21**) found across the Project site.

Using the R-factor (rainfall erosivity) value for the region, the erosion hazard for the various soil landscapes ranges from low (for slopes less than 17 %) to high (for slopes greater than 17 %). When combined with other factors such as structural degradation hazard, sodicity, permeability and a lack of vegetation cover, there may be minimal to significant impacts from water erosion. All four soil types have a moderate to high structural degradation hazard, thus when exposed are likely to have higher susceptibility to water or wind erosion and this will need to be considered appropriately during the construction phase.

Cumulative Impacts: Other existing and proposed wind farms in the region are a sufficient distance from the Project site to ensure cumulative impacts to soil and landforms will not occur. Construction activity is localised to specific clusters and wind turbine locations over the construction timeframe, therefore the likelihood of cumulative impacts is considered to be low. As such, it is anticipated that there will be no cumulative effect to soil and landforms from the introduction of the Project into the area.

18.3.3 *Management and Mitigation*

A number of management actions will be implemented to manage surface runoff, exposed soil surfaces and contamination to surrounding soil. These methods will be included in the EMP sub-plan and will include:

- Procedures for personnel to manage suspected contaminated soils during earthwork construction;
- Planning for erosion and sediment control concurrently with engineering design, prior to any works commencing;
- Stabilisation of disturbed soil surfaces as soon as practicable after works have ceased in the area;
- All stockpiles covered, where practicable, to prevent the loss of material during wind and rain events. Where practicable stockpiles will be placed in areas sheltered from the wind; and
- Progressive rehabilitation of disturbed lands as soon as practicable.

The EMP sub-plan will consider *Guidelines for planning, construction and maintenance of tracks* (NSW Department of Land and Water Conservation 1994) and *Managing Urban Stormwater: Soils and Construction, 4th Edition* (Landcom 2004) when designing, constructing and maintaining the Project. The EMP sub-plan will require detailed geotechnical investigations, which will take place post consent.

Also to minimise soil compaction at the Project site, the EMP sub-plan will have specific measures for stock management, including:

- Management of stock access during periods of vegetation and soil disturbances; and
- Removal of stock access from construction areas for entire construction periods to allow for regeneration, subject to landowner participation.

18.4 Waste

It is anticipated that the Project construction phase will generate the following waste and waste types in varying quantities:

- Excavated material – generated by earthworks. In general the excavated material will be reused within the Project. Any disposal of unsuitable excavated material will require development consent from the appropriate authorities, procedures for which will be outlined in the CEMP or sub-plan.
- Vegetation – generated from clearing and trimming. Vegetation will be mulched and used on-site where feasible, with the remaining to be burnt on-site with permission from Council, provided as firewood to landowners or taken to the Boorowa Garbage Depot operated by Boorowa Council or Murrumbateman Transfer Station / Landfill operated by Yass Valley Council.
- Scrap metal – generated from surplus steel reinforcements or off-cuts. Scrap metal could be collected and recycled;
- Timber – generated from formwork, off-cuts and packaging. This would be segregated for possible reuse but otherwise would be disposed of offsite;
- Excess concrete – normally generated in minor quantities from concrete deliveries. This could be collected and disposed of offsite;
- Waste oil, grease and lubricants – generated in minor quantities from repair and maintenance of plant and equipment. All chemicals and oils will be treated as contaminated waste at the Boorowa Garbage Depot, Murrumbateman Transfer Station / Landfill or via programs such as the ChemClear program;
- Office waste – generated from the construction compound. This would be sorted at source for recycling, with the rest disposed of offsite;
- General rubbish – generated by the construction workforce. This would be sorted at source for recycling, with the rest disposed of offsite; and
- Sanitary systems waste – generated from the construction compound and various worksites. This will be collected and disposed of offsite by licensed contractors.

During operation, the main waste streams anticipated would be the following:

- Waste oil, grease and lubricants – generated in minor quantities from repair and maintenance of equipment, including transformers, and from the clean out of oil-water separators where installed. All chemicals and oils will be treated as contaminated waste at the Boorowa Garbage Depot, Murrumbateman Transfer Station / Landfill or via programs such as the ChemClear program;
- Office waste – generated from the site office. This would be sorted at source for recycling, with the rest disposed of through an arranged Council or private collection service;
- General rubbish – generated by the on-site workforce and visitors. This would be sorted at source for recycling, with the rest disposed of offsite; and
- Sanitary systems waste – generated from the site office and various worksites. On-site toilets will either be drained by a septic tank or be an enclosed unit. This can also be collected and disposed of offsite by licensed contractors.

Waste will be managed according to a Waste Management Plan based on the hierarchy principles of resource management of the Waste Avoidance and Resource Recovery (WARR) Act 2001, ensuring that resource management options are considered against a hierarchy of the following order:

- Avoidance of unnecessary resource consumption;
- Resource recovery (including reuse, reprocessing, recycling and energy recovery); and
- Disposal.

Under the OEH Waste Classification Guidelines (2012a) there will be liquid waste and general solid waste (non-putrescibles) produced. All waste will be disposed of in line with Council and OEH guidelines.

Cumulative Impacts: Other existing and proposed wind farms in the region will have mitigation and management measures in place to minimise and dispose of waste correctly. Also, post construction, the Project will produce minimal waste materials, similar to other wind farms, and it is therefore anticipated that there will be no cumulative waste production impacts from the introduction of the Project into the area.

18.5 Responses to Consultation

18.5.1 *Trigonometrical Stations*

The Land and Property Information Division (LPI) of the Department of Finance and Services were asked to provide advice on development conditions with regard to proximity of wind turbines to Trigonometrical Stations (TS) within a wind farm site. General guidelines were provided by LPI (see **Appendix 22**) that wind turbines are to be located to:

- Avoid sight lines to nearby population centres and to neighbouring TS, particularly to closer ones;
- Make every effort to position the structures as far as reasonably possible from the TS;
- Position the structures generally to the south of the TS to provide for an unobstructed view to GPS satellites;
- Avoid disturbing the TS and its eccentric marks during construction; and
- Avoid sloping roofs of associated buildings towards the TS.

A list of TS located in the vicinity of the Project infrastructure is shown in **Table 18.3**.

Table 18.3 Trigonometrical Stations across the Project site

TS Name	Cluster	Closest Infrastructure	Distance
Buffalo	Mt Buffalo	On-site access road	440 m
Crosby	Kangiara	Wind Turbine	27 m
Gododo	Kangiara	On-site access road	123 m
Gwynne	Langs Creek	Wind Turbine	288 m
Leatherjacket	Mt Buffalo	On-site access road	125 m
Mallyon	Mt Buffalo	On-site access road	175 m

During the construction phase, care will be taken not to disturb or damage the TS or adjacent witness marks. Fines apply under current legislation should the TS locations be disturbed, damaged or destroyed and the Proponent would be required to reinstate them. The Proponent has therefore committed to maintaining a distance of at least 20 m to the south of any TS and 100 m to the north of any TS, to avoid disturbing or damaging the TS and adjacent witness marks, and to micro-siting wind turbines to maintain line of sight to nearby population centres and neighbouring TSs.

18.5.2 *Crown Roads and Crown Land*

Pending Development Approval, and where applicable, a licence will be sought with the Crown Lands to impact on Crown Land or Crown roads.

18.5.3 *Native Title*

In consultations with the LPI advice was sought as to whether Native Title existed across any of the landholdings affected by the Project. The LPI have confirmed that Native Title is extinguished over all lands affected by the Project.

18.6 Construction

Construction Environmental Management Plan: The CEMP will be developed prior to pre-construction and used to address environmental impacts identified by the risk analysis process in both the pre-construction and construction stages. The CEMP will consist of and address the following:

- A description of activities to be undertaken during construction of the Development (including staging and scheduling);
- Statutory and other obligations that the Applicant is required to fulfil during construction, including meeting the Building Code of Australia provisions, approval / consents, consultation and agreements required from authorities and other stakeholders under key legislation and policies;
- A description of the roles and responsibilities for relevant employees involved in the construction of the Project, including relevant training and induction provisions for ensuring that employees, including contractors and sub-contractors, are aware of their environmental and compliance obligations under the Conditions of Approval;
- An environmental risk analysis to identify the key environmental performance issues associated with the construction phase; and
- Details of how environmental performance would be managed and monitored to meet acceptable outcomes, including what actions will be taken to address identified potential adverse environmental impacts (including any impacts arising from the staging of the construction of the Project). In particular, the following environmental performance issues shall be addressed in the Plan:
    - Compounds and ancillary facilities management;
    - Noise and vibration;
    - Traffic and access;
    - Soil and water quality and spoil management;
    - Air quality and dust management;

- Aboriginal and non-Aboriginal heritage management;
- Soil contamination, hazardous material and waste management;
- Ecological impact management; and
- Hazard and risk management.

Operational Environmental Management Plan: An OEMP will be developed prior to the completion of construction activities in order to address the broad range of the environmental impacts identified in the risk analysis.

18.7 Wind Turbine Safety Standards

18.7.1 *Existing Situation*

Wind turbines are designed to meet international engineering design and manufacturing safety standards. This includes tower, blade and generator design. There is an international quality control assurance program for wind turbines, and a number of relevant safety and design standards. The lead organisation for development of international standards for wind turbine generating systems is the International Electrotechnical Commission (IEC), and the most broadly applied standard covering machinery and structures is IEC 61400-1: '*Wind turbine Systems - Part 1: Safety Requirements*'.

Independent agencies are retained by wind turbine manufacturers to certify that the design and construction of a given wind turbine / tower assembly conform to accepted standards in terms of design load assumptions, construction materials and methods, control systems and safety measures. This is a generalised type of certification provided at manufacturers' expense. Once a specific system make and model are selected, the user then customarily funds a second independent certification attesting to the applicability of the system design and construction to the site-specific conditions. In addition, foundation design and commissioning checks address potential failure due to extreme events such as extreme wind loadings, as well as frequency tuning of the different parts of the structure to avoid failure due to dynamic resonance.

International experience to date has indicated very low risks associated with tower collapse, components falling from towers, ice throw and blade throw. Risks have been continually reduced as wind turbine technology has improved.

18.7.2 *Potential Impacts*

Wind Turbine Tower Collapse: Wind turbines and towers are designed to strict standards in order to withstand extreme weather events. Collapse of a tower which has been constructed in accordance with international standards and local building codes is an extremely remote possibility. In the unlikely event of a tower collapse, the potential worst case risk to the public is calculated from failure of the tower at its base, or of its anchorage to the foundation (EDP Renewables 2005). This creates a hemispherical hazard zone with a radius approximately equal to wind turbine tip height as illustrated in **Figure 18.2**. (Tubular steel towers could buckle at some point along their length. This failure mode would result in a smaller hazard zone due to the reduced radius).

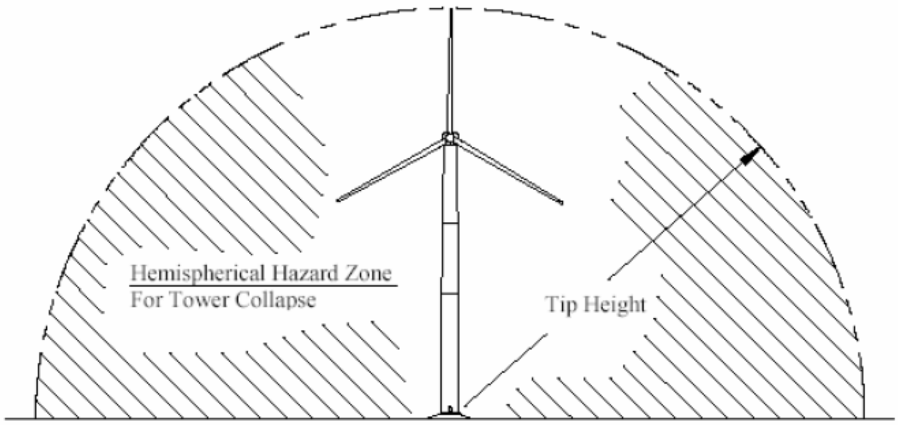

Figure 18.2 Wind turbine tower collapse - potential hazard zone

Source: EDP Renewables 2005

Blade Throw: Extensive literature reviews on blade throw indicate that there are many approaches to modelling blade throw potentials, whether theoretical or experience based. This is likely due to the complexity of the analysis, coupled with the extremely low incidence of blade throw reports. Despite this there is a strong similarity in results from both predictive and incidence based studies, providing a robust and reliable framework within which to estimate blade throw and safety risk.

Modelling conducted for the Wild Horse Wind Power project (EDP Renewables 2005) presents a simplified worst case scenario, where loss of a whole blade would occur with the blade rotating at maximum speed, when oriented at 45 ° from the horizontal axis and rising. This is the classic maximum trajectory case from standard physics texts as illustrated in **Figure 18.3**. Review of this data indicates that for the maximum wind turbine envelope (the worst case scenario), blade throw distance is approximately one wind turbine tip-height.

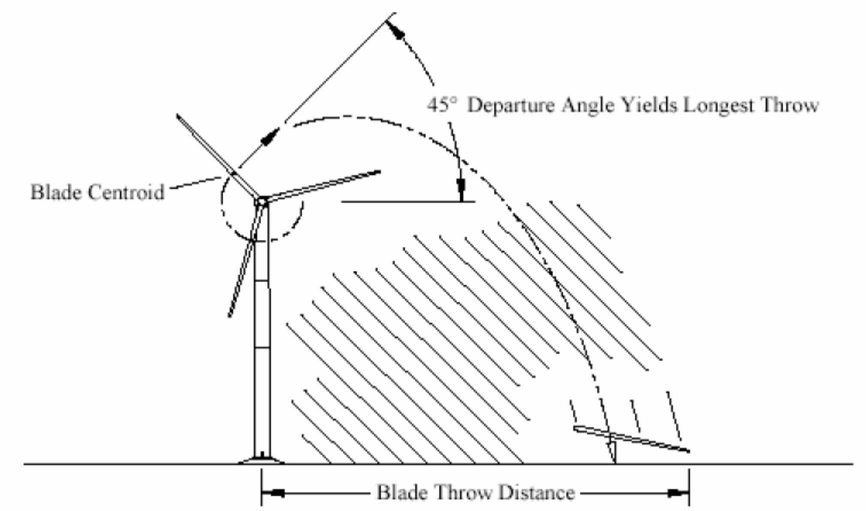

Figure 18.3 Blade throw distance

Source: EDP Renewables 2005

Blade fragment throw, where the blade is damaged (such as by lightning strike) and breaks apart, has also been estimated through use of a dynamic model of blade failure and Monte Carlo simulation techniques (Rogers et al. 2011). Using three wind turbine models, this study found that release velocity is an important factor in estimating blade fragment throw distance. Using an equation based on release velocity, wind turbine dimensions and acceptable risk, the study found theoretical blade fragment throws of up to 526 m for a 3.0 MW wind turbine (Rogers et al. 2011).

Cotton (2007) estimated impact probabilities at a wind farm site by comparing two methodologies based upon mathematical modelling techniques and risk contours. Whole blade throw was found to range between distances of 155 and 203 m from the tower. In one situation, in order to model worst case impact, wind speeds equivalent to one-in-fifty year events were used and very small blade fragments were considered (10 % blade fragments). Under these conditions, there was a 1 % chance of throw distances up to 1,462 m.

Risks of wind turbine blade failure and throw reported in a Dutch incidence handbook have also been researched (Kammen 2003). The maximum reported throw distance documented was found to be 150 m for an entire blade and 500 m for a blade fragment (Chief Medical Officer of Health 2010). These distances correlate with other modelled and predicted blade throw distances. According to Braam et al (2005) in the Chief Medical Officer of Health's Report (2010), risks of blade failure (including non-throw events) range from one in 2,400 to one in 20,000 wind turbines per year.

With regard to the Project, the closest non-involved and occupied residence (as detailed in **Chapter 9** Noise and **Chapter 8** LVIA) is 1.7 km south of the nearest wind turbine in the Kangiara Cluster. The closest involved and occupied residence is 0.73 km east of the nearest wind turbine in the Mt Buffalo Cluster. The closest neighbouring property boundary is approximately 44 m from the nearest wind turbine location and micro-siting will ensure blades do not over sail the boundary once the final wind turbine model is known.

Probability Assessments: Probability of occurrence is critical to blade throw analysis. The probability associated with the Hazard Zone Distance scenarios modelled for the Wild Horse Wind Power project (EDP Renewables 2005), as detailed above, provide a rational basis for assessing the risks of wind turbines within their surrounding environment. **Table 18.4** provides a uniform approach to determining the frequencies of occurrence of each of the described events, representing incidents reported in German, Danish and Dutch databases.

Table 18.4 Blade throw probabilities – frequencies of occurrence

Scenario	Recommended Value (1 / year)
Collapse of entire tower from base	3.2×10^{-4}
Loss of entire blade	8.4×10^{-4}
Loss of blade fragment	2.6×10^{-4}

Source: Braam & Rademakers 2004

A risk assessment of the Kittitas Valley Wind Power project was conducted using available research on risks of tower collapse, blade throw and ice throw, including published studies and guidance documents from the US and Europe. The highest probability of a blade or other object being thrown was found to be less than one in one billion (Kammen 2003). For comparative purposes, this was described as being lower than the risk associated with riding a bicycle 16 km or having a single chest x-ray at a modern hospital (Kammen 2003). The risk assessment summarised the public health and safety risks posed by the project as insignificant and less than the risks posed by other common energy generating technologies and countless other common activities (Kammen 2003).

Blade Icing and Ice Throw: The potential for ice throw poses similar concerns to that of blade fragment throw. While ice build-up on blades is an occasional problem for wind turbines, in terms of lost energy production, flying ice is considered less of a risk. When ice builds up on the blades, the blades turn very slowly (at only several revolutions per minute) until the ice is shed. This is because the airfoil has been compromised by the ice, and the blades are unable to pick up any speed.

As noted by EDP Renewables (2005), while more than 55,000 wind turbine have been installed world-wide, there has been no reported injury caused by ice thrown from wind turbines. Reported data on ice throws indicates that ice fragments were found on the ground between 15 and 100 m from wind turbines and were in the range of 0.1 to 1 kg in mass (EDP Renewables 2005).

Under certain conditions ice can form on towers and rotor blades in a variety of ways. It has been observed that moving rotor blades are subject to heavier build ups of ice than stationary structures through the mechanism of rime icing. Rime icing occurs when a sub-freezing structure is exposed to moisture-laden air with significant velocity (Sagebrush Power Partners 2007). If the ice then becomes detached while the blades are rotating, there is the possibility of ‘ice throw’ over a considerable distance from the wind turbine.

Because of the large number of variables and the need for established guidelines in risk assessment, the ‘Wind Energy Production in Cold Climates’ study (WECO 1996-1998) commissioned by the European Union Commission’s Environment Directorate-General has supplemented this modelling effort with continuation of an information outreach program originally initiated by the German Wind Energy Institute (DEWI) and the Finnish Meteorological Institute (FMI). This effort consists of gathering experiential data from a large number of wind turbine operators regarding occurrence of icing, and details of any ice throw events. Findings from this effort were presented by WECO team members at the BOREAS IV wind energy symposium in 1998. Significant findings included that the risk of being struck by ice becomes very small at distances greater than 100 metres from each tower at the proposed facility (EDP Renewables 2005; Chief Medical Officer of Health 2010).

The ice throw hazard area extends in a direction normal to the prevailing wind direction and downwind from the wind turbine and there is essentially zero ice throw hazard as little as 25 metres upwind from the plane of the rotor as illustrated in **Figure 18.4** (EDP Renewables 2005). Persons, animals and facilities within the ice throw hazard zone of approximately 100 metres could theoretically be at risk of being struck by an ice fragment.

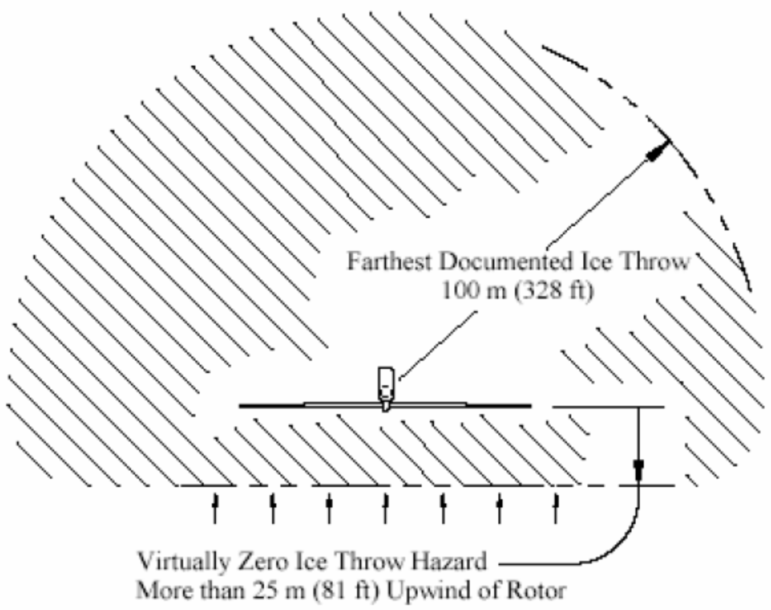

Figure 18.4 Blade ice throw and blade fragment throw hazard zone

Source: EDP Renewables 2005

18.7.3 *Management and Mitigation*

Failure of Machinery and / or Structures: Wind turbines are equipped with multiple safety systems as standard equipment. As examples: rotor speed is controlled by a redundant pitch control system and a backup disk brake system; critical components have multiple temperature sensors and a control system to shut the system down and take it off-line if an overheating condition is detected.

Tower Collapse: The selected wind turbines / tower combination will be subjected to an engineering review to ensure that the design and construction standards are appropriate. This review will include consideration of code requirements under various loading conditions and give a high degree of confidence of structural adequacy of the towers.

Blade Throw: Certification of the wind turbine to the manufacturers' requirements will ensure that the static, dynamic and defined-life fatigue stresses in the blade will not be exceeded under the combined load cases expected for a specific site. The standard includes safety factors for normal, abnormal, fatigue and construction loads. This certification, together with regular periodic inspections, will give a high level of assurance against blade failure in operation.

Blade Icing and Ice Throw: If, subject to site conditions, it is deemed necessary to mitigate the risk of ice throw then the implementation of special wind turbine features can prevent ice accretion or wind turbine operation during such periods. These include:

- To keep the control system of the wind turbine in operation in icy weather conditions two heated wind vanes and two heated anemometers can be installed;
- Rime ice build up on the blades has a significant influence on the lift force and therefore on the power curve of the wind turbine. If average power is continuously out of synchronisation with the power curve for 2 minutes it is an indication that rime ice has accreted on the blades and the wind turbine will be stopped;

- Additional loads created by ice accretion cause vibrations on the blades which are monitored by the control system. When the vibrations exceed the adjusted limits the wind turbine will be stopped; and
- An ice sensor can be installed on the roof of the nacelle. It measures the temperature and the relative air humidity of the environment. If certain values are reached, the wind turbine will be stopped automatically by the control system. The meteorological values are determined by local conditions.

In the event of one of these control systems stopping the operation of the wind turbine, the wind turbine will remain switched off until it is reset manually by service staff. The secure function of all these measurements are checked by certified bodies and are confirmed in a certificate.

18.8 Wind Turbines and Microclimate Effects

A number of studies have investigated the potential microclimate effects of wind turbines. That is, the effect that wind turbines may have on the air and land immediately downwind of a wind turbine, or wind farm.

These studies have identified that wind turbines can generate additional downwind turbulence, that is, a mixing of air at high altitudes with air at low altitudes (Beyers and Roth 2012). It is thought that this turbulence can lead to enhanced vertical mixing when there is a contrast in temperature, having a warming effect during the night and a cooling effect during the day (Baidya Roy and Traiteur 2010). What has not yet been determined is whether this phenomenon has a detrimental, beneficial or harmless effect.

In Ontario, the organisation Grape Growers of Ontario engaged a consultant to investigate the effect of a wind farm on local grape production on the Niagara Peninsula. It was found that at night the wind turbines replicated the beneficial impacts of wind machines that are used to counter cold injury to grapes (Beyers and Roth, 2012). However, the same mixing could produce colder surface condition during the day. This study also found that seasonal and wind speed and direction conditions determined to what extent, if any, air temperature mixing persisted. Other studies into microclimate effects include long term modelling in Texas, USA, in a region with over 2,000 wind turbines that found a marked localised warming effect on night-time temperatures and another study in Iowa, USA that found that air turbulence from wind turbines could possibly “ward off early fall frosts and extend the growing season” for crops such as soybeans and corn (Zhou et al. 2012; Takle and Lundquist 2010).

There is a likelihood that wind turbines interact with the climate in which they are sited, influencing local conditions, including surface air temperatures. These potential impacts, however, must be considered in the context of other microclimate influences. Microclimate conditions are influenced by numerous factors, including the slope of the land, shade, exposure and bodies of water, changes in precipitation and clouds (Zhou et al. 2012). Further, human-induced changes within an environment such as introduction of hedges, tree-lines, irrigation, dams, land cover and use also strongly influence the microclimate of an agricultural region (Liu and Kang 2006).

18.9 Decommissioning and Refurbishment

On 23rd December 2011 the NSW Government released *Draft NSW Planning Guidelines: Wind Farms* (Draft Guidelines) for public consultation. Proposed within the Draft Guidelines are specific requirements relating to decommissioning, which are detailed below.

Section 1.3(f) of the Draft Guidelines sets out two specific requirements:

- The Proponent / wind farm owner, rather than the host landowner, must retain the responsibility for decommissioning; and
- Applicants are to include a Decommissioning and Rehabilitation Plan (DRP) in their EIS.

As detailed in **Chapter 3** Project Description, Project refurbishment and decommissioning have been considered within this EIS. The DRP is proposed to be finalised at the pre-decommissioning phase, to ensure the relevant regulations of the day are incorporated into the DRP and to ensure the DRP specifically addresses the as-built specifications of the Project, which may be subject to micro-siting or other design modifications prior to construction. The decommissioning and refurbishment commitments presented in this section and those in the **Chapter 21** Statement of Commitments will be used to inform a draft DRP which will be created prior to commencement of construction in order to address the key specific design characteristics, including turbine model, of the Project.

The following additional detail provides a framework for the DRP.

Responsibility: All decommissioning work will be the responsibility of the Project owner which is a provision within the lease arrangements with the landowners. In line with previous Conditions of Approval, the Proponent can provide a copy of the decommissioning clause in the lease documentation to the satisfaction of the DPE prior to commencement of construction, if required.

Community Construction Awareness Programme: Similar to the construction phase of the Project, prior to the commencement of decommissioning activities, a programme of community awareness initiatives will be implemented. Information will be disseminated to the local community through local newspapers and direct mail to advise them of the nature of the activities, their timing and potential impacts. Contact details will be provided for individuals to gain further information or if required to express concerns or complaints.

Updates on the progress of refurbishment or decommissioning works and relevant impacts will be provided during the period through various media and through the Community Consultative Committee (CCC). The CCC will be available to guide and inform the Project owner on matters of interest to the community, and will provide an additional forum for communication between stakeholders.

Key considerations that will frame the DRP include:

- Timing and phasing of the works to minimise impacts on agricultural activities;
- Management of traffic along the preferred access routes; and
- Coordination of employment and contractor involvement to ensure local area participation is maximised.

A DRP will be prepared and updated every five years following the practical operation date of the Project. As mentioned previously, this is to ensure the DRP is representative of the as-built Project site, which may be subject to micro-siting and modification prior to the commencement of and ongoing operation. The DRP created in year five will be the detailed analysis of the decommissioning steps, based on data collected during the construction of the Project. The DRP will, at this stage, contain estimated decommissioning costs based on the as-constructed design, including the chosen wind turbine model. From year 15 onwards, detailed assessment of decommissioning costs will be collated based on the current resale market for wind turbines and generic decommissioning costs.

Decommissioning: At the end of the operational life of the Project, the wind turbines and all above-ground infrastructure will be dismantled and removed from the site. This includes all the interconnection and substation infrastructure, but may exclude the switching station which may form an integral part of the TransGrid network. The tower bases would be cut back to below ploughing level or topsoil built up over the footing to achieve a similar result. The land will be returned to prior condition and use as far as practicable. A compressor and rock crusher may be needed to carry out the cutting work.

The on-site access roads, where not required for farming purposes or fire access, would be removed and the Project site reinstated as close as practicable to its original condition and use. Access gates, where not required for farming purposes, would also be removed. Individual landowners will be involved in any discussion regarding the removal or hand-over of infrastructure on their property.

The underground cables are buried below ploughing depth and contain no harmful substances. They would be left in the ground and only recovered if economically and environmentally viable. Terminal connections would be cut back to below ploughing levels.

The DRP will incorporate many of the measures outlined in the CEMP, however key considerations that will also frame the DRP include:

- Adherence to regulations and guidelines of the day;
- Recycling, reuse or disposal of on-site materials to pre-approved recycling / disposal locations or end users;
- Minimisation of additional impacts during decommissioning activities, whilst having regard for any refurbishment works that may occur post decommissioning;
- Consultation to include:
    - Host landowners with regard to the extent of decommissioning;
    - Neighbouring landowners with particular regard to traffic management and noise;
    - Local Councils and other road authorities in regard to the nature of required activities; and
    - TransGrid with regard to the extent of decommissioning.
- Safe and careful disassembly of blades, nacelle and tower components;
- Removal of all liquids and other consumables (lubricants, oils, greases, coolants, etc.) from wind turbines and substation plant; and
- Ongoing site monitoring and rehabilitation, which may include:
    - Spreading of additional subgrade material, backfill or topsoil;
    - Works to restore drainage to areas when ponding is occurring, or to prevent excessive stormwater runoff from causing erosion;

- Aeration and / or fertilisation of soil to promote growth of grasses or foliage; and
- Replanting of any impacted trees or reseeding of impacted grasses.

Funding for decommissioning: At present, it is considered likely that wind turbines will have significant resale value when decommissioned. As such, the process of dismantling the blades, towers and nacelle will be undertaken with care and precision to ensure their reuse and resale value is retained.

The Proponent is not aware of any instances where a wind farm has been decommissioned (and not refurbished) within 15 years from commencement of operations. The Proponent therefore proposes that from year 15 of the Project's operating life (and every two years subsequent) the Project owner undertakes a decommissioning cost versus resale / scrap value survey to determine the inherent value of the Project components.

Resale value for the latest models of wind turbines are not available, however data is emerging for small numbers of units being sold in Europe. **Table 18.5** provides a summary of those wind turbines currently available with models greater than or equal to 1 MW highlighted in blue.

Table 18.5 Summary of used wind turbines available for sale (March 2015)

Wind turbine	Size MW	Tower Height	Qty	Unit Price	Currency	Price AUD (2015)	Age
Bonus 1000	1	70	1	240,000	Euros	350,000	11
Enercon E40	0.6	65	2	210,000	Euros	310,000	13
Enercon E44	0.6	65	1	205,000	Euros	300,000	13
Enercon E40	0.5	78	2	260,000	Euros	380,000	10
Enercon E40	0.5	65	3	180,000	Euros	265,000	15
GE 1.5SLE	1.5	77	6	1,100,000	USD	1,465,000	6
GE 1.5S	1.5	70	4	350,000	Euros	515,000	9
Mitsubishi MWT1000	1	69	15	720,000	USD	960,000	3
NEG Micon NM92	2.75	70	1	1,085,000	Euros	1,600,00	5
Enercon E44	0.6	65	3	175,000	Euros	258,000	12
Vestas V66	1.65	70	5	335,000	Euros	490,000	13
Enercon E44	0.6	65	8	175,000	Euros	258,000	12
Vestas V47	0.66	65	9	157,000	Euros	231,000	12
NEG Micon NM52/900	0.9	50	3	250,000	Euros	368,000	12
GE1.5S	1.5	80	6	300,000	Euros	442,000	12

Exchange rate used: 1 AUD = 0.8 Euro / 1.06 USD

A per unit analysis of these figures is provided in **Table 18.6**.

Table 18.6 Price analysis of used wind turbines available for sale (March 2015)

Description	Price AUD (2015)
Average price per unit (1 to 7 years)	1,342,000
Average. price per unit (8 to 15 years)	347,000
Average price per unit ≥ 1,000 kW (1 to 7 years)	1,342,000
Average price per unit ≥ 1,000 kW (8 to 15 years)	449,000

Wind turbines with a capacity of ≥ 1.5 MW are proposed for this Project. Assuming that the current average resale price per wind turbine ≥ 1 MW of approximately $449,000 (see **Table 18.6**) will in some way be representative of the future, a decommissioning fund for the Project of up to $54.8 million (approximately) from resale of the wind turbines could be available to undertake the DRP.

Current cost estimates to undertake decommissioning works based on Wind Prospect Group's experiences in the United Kingdom suggest an approximate cost of $300,000 per wind turbine is necessary. This figure is based on costs associated with projects that have less than seven wind turbines and therefore it can be expected that economies of scale can be derived from this for much larger projects. However, if this cost estimate were a reflection of the cost to decommission the Project (as a worst case) then approximately $36.6 million would be required to fund the works. Therefore, assuming a resale value of $54.8 million, there would be a net profit of $18.2 million once decommissioning had been undertaken.

Estimated decommissioning costs will be presented in the DRP from year five and every five years thereafter. If, as a result of the decommissioning cost versus resale / scrap value surveys from 15 years onwards there is a calculated deficit, then a percentage of revenue will be retained from the Project each year and held in a reserve account for future decommissioning requirements.

Refurbishment: After approximately 20 to 25 years of operation (or sooner if deemed economically viable) the blades, nacelles and towers could be removed and replaced. Old blades, nacelles and towers are removed from site for recycling (where applicable) and new components installed on existing or new foundations, as appropriate. Refurbishment would extend the life of the Project for a further 20 to 25 years. At this time, the DRP would be updated to reflect the new Project design.

Any material change to the Project layout, or significant changes to the wind turbine technology, will be referred to the relevant NSW planning authority at that time as an amended proposal. Such changes would also be subject to the regulations and guidelines of the day. Refurbishment requires the transportation, installation equipment and facilities, similar to that used during initial construction.

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CHAPTER 19

Socio-Economic Assessment

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19. SOCIO-ECONOMIC ASSESSMENT

This chapter, in addition to **Chapter 18** General Environmental Assessment, addresses aspects of the proposed Project beyond the key issues identified in the Secretary's Environmental Assessment Requirements (SEARs). In summary the following chapter contains sections on land value, mineral exploration, tourism, community wellbeing, the Community Fund, the local economy, and health.

19.1 Land Value

As with any property and land holding there are many factors which can influence perceived and actual property values, including prevailing and permitted land uses, economic conditions, access / proximity to markets / workplaces and lifestyle considerations. In most agricultural areas the main determinant of property and land values is the productivity of the land for agricultural or livestock purposes.

There have been several international studies seeking to find a connection between wind farms and property values. The evidence that wind farms generally don't harm property values is robust, methodologically sound and from reliable organisations. The limited evidence that wind farms harm property values is much weaker, methodologically challenged at best and usually from much less reliable organisations. By comparing the positive and negative impacts of the construction and operational stages of a wind farm to existing knowledge of what causes changes in property values, it is possible to predict the relationship between wind farms and property values.

In the Australian context, Henderson and Horning Property Consultants (H&HPC 2006) conducted a study covering a fifteen year period into the relationship between wind farms and property / land values by assessing local property values around the operating Crookwell 1 Wind Farm in the NSW Southern Tablelands. The study also reviewed other overseas wind farms to compare with the Australian market. The conclusions from H&HPC relevant to this Project are:

- That agricultural productive capacity of the land subject to the wind farm and the surrounding property is not in any measured way affected by the wind farm;
- The associated property has additional revenue and benefits from the lease agreement, improved roads, erosion control and passive wind protection for stock from the substation and wind turbine towers;
- The future development of the land under existing planning controls would continue as zoned 1(a) Rural Zone;
- The wind farm development has the potential to slow down the shift of productive agricultural land to rural residential use in the short to medium term;
- There was no measurable reduction in values of properties that have a line of sight to the Crookwell 1 Wind Farm; and
- Soils, improvements and access to services are more important drivers of property values than visual impacts.

In a straw poll conducted by Nuridin (2009), she spoke with the Real Estate Institute of Australia and several other real estate agents operating in locations with wind farms to see if wind farms did influence property / land values. All interviewed agents replied that;

> *"there is no indication of any depreciation in the value of properties hosting wind farms, or those adjacent to, or in sight of turbines" .*

In fact according to some agents in Albany, Western Australia, the wind farm is used as a marketing tool and in Ararat, Victoria, the wind farm has caused the town to prosper (Nuridin 2009).

The NSW Valuer General released a report summarising the impact of wind farms on land values in Australia, analysing impacts of eight wind farms across NSW and Victoria (NSW Valuer General 2009). This report found that wind farms do not appear to negatively affect property values across varying land uses, including rural, rural residential and residential. Results suggested that a property's underlying land use may affect the property's sensitivity to price impacts. There were no evident reductions in sale price for rural or residential properties located in nearby townships with views of the wind farm. Due to the remoteness of the wind farms, only a small number of samples were available for inclusion, limiting the conclusions that could be drawn, and highlighting the need for future studies.

Internationally, the study with the longest duration and by far the largest statistical base was conducted by the Centre for Economics and Business Research in the UK (RenewableUK & CEBR 2014). The study which was published in March 2014 covered over one million property transactions in countries with wind farms over 18 years. The findings concluded;

> *"Our analysis of the raw house price data for transactions completed within the vicinity of the wind farms yielded no evidence that prices had been affected by either the announcement, construction or completion of the wind farms for six out of seven sites.*
>
> *In fact, the analysis shows that on average, house prices near wind farm sites grew faster for the periods between the start of construction and mid-2013 (0.8% annual growth) than at the wider county-level (0.5% annual growth). One site did see a noticeable downturn following the announcement that a wind farm would be built; however once the turbines were erected, local house price growth returned to the county-wide norm."*

It is common for surrounding landholders to raise the fear that the wind farm will reduce the value of their properties. This fear has been further promoted by negative media coverage of the matter. South Gippsland Council decided in early 2013 to reduce rates for a coastal property which abuts the yet to be constructed Bald Hills Wind Farm. The CEO of the council made the relevant comment that it may be that after construction has been completed, the impact is less than perceived and the valuation may rise again. The leading research in this area is by Hoen (2011), whose key conclusion is that;

> *"conclusive evidence of persistent post-construction effects from wind facilities have not been discovered despite a number of studies using a variety of sophisticated statistical techniques".*

In fact the Pyrenees Shire Council in Western Victoria is home to one of Australia's largest operating wind farms, Waubra. A land evaluation report presented to council in August 2012 showed that from 2010 to 2012, residential properties in the Waubra area increased in value by 10.1 %.

The value of land suitable for subdivision or land which possesses a dwelling entitlement could be affected. In this regard, and as discussed in **Chapter 4** Project Justification, the Proponent has identified where potential land use conflicts occur surrounding the Project, and will continue to discuss the potential impacts with relevant landowners. Beyond these, subdivision applications which have been approved in the region by Yass Valley Council and Boorowa Council will not be directly impacted upon. Conversely, due to the additional revenue from hosting wind turbines to associated landowners, subdivision of involved landowner properties is less likely to occur in the short to medium term and the land will continue to be used for sheep and cattle grazing which is consistent with the intent of the RU1 Primary Production zoning in the area around the wind farm.

Some surrounding landowners have raised the concern that construction and operation of the wind farm will decrease the number of potential buyers within the market, which in turn could diminish property values. As already discussed, there are many factors that influence an individual's decision when purchasing a property and the presence of a wind farm may or may not have an influence on this decision. For example, a potential buyer may seek a lifestyle with a green energy aesthetic or have no issue with wind turbines.

It should be noted that the Project cannot be developed without some risk of property value impacts during the construction and operational phases, including to those properties within 2 km of the proposed wind turbine locations, as personal perceptions and tastes will likely come into play. Due to the difficulty in assessing the real impacts on property values there are no suggested mitigation methods to apply. However as the Community Wellbeing and Local Economy (see **Sections 18.4** and **18.5**) can be positively affected by the construction of the Project, such effects can be considered to contribute to the mitigation of any loss of property value that may occur.

19.1.1 *The Concept of Blight*

Compensation for blight, relating to the loss of future property value or from loss of amenity, was scrutinised in the Land and Environment Court in the case of Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd, 2007. The Taralga Landscape Guardians Inc sought compensation in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* NSW. However the proposition presented a number of insurmountable hurdles according to Chief Judge, Justice Preston.

The Taralga Wind Farm was proposed by a private developer on land where the development was permitted. The Chief Judge summarised that if the concept of blight and compensation were to be applied to the Taralga project, then any otherwise compliant private project which had some impact in lowering the amenity of another property would be exposed to a claim. The Chief Judge went further in saying that:

> *"Creating such a right to compensation would not merely strike at the basis of the conventional framework of land use planning, but would also be contrary to the relevant objective of the Act, in s 5(a)(ii), for 'the promotion and co-ordination of the orderly and economic use and development of land'".*

The resulting decision from the Taralga judgement is relevant to the Project, as the Proponent has leased the land for a permitted land use.

19.2 Mineral Exploration

19.2.1 *Existing Situation*

The Project area overlies one geological formation, namely the Hawkins Volcanics Unit of the Douro Group. The geology is Silurian to early Devonian and consists of biotite-cordierite-garnet rhyolitic to dacitic ignimbrite with flow-banded, vesicular rhyodacitic to dacitic lava, volcanic sandstone, minor rhyodacitic agglomerate and rhyolitic lapilli tuff (Colquhoun et al. 2008; Johnson et al. 2002). In some areas a surface layer of alluvial or colluvial gravel, sand, silt and clay or residual-eluvial-saprolite deposits exists (Colquhoun et al. 2008; Johnson et al. 2002) (Geoscience Australia 2011).

There is one current Exploration Licence (EL) in the area, EL8313, one Exploration Licence Application (ELA) both held by Ochre Resources Pty Ltd and two expired ELs held by Tungsten NSW Pty Ltd and Oakland Resources Pty Ltd. The current EL and ELA are for metallic minerals prospecting. There are no current mineral drill holes and one operating major industrial mineral sites held by Boorowa Council for extracting unprocessed construction materials within the Project site.

19.2.2 *Potential Impacts*

The Project has potential to inhibit any current or future exploration of the area for mineral resources during the construction and operation phases. To determine the degree of potential impact, the Proponent contacted Ochre Resources Pty Ltd, as discussed in **Chapter 6** Stakeholder Consultation and provided them with information relating to the proposed Project.

During the operation of the Project mineral exploration can still occur around the wind turbines and associated infrastructure, and the upgrading of roads can assist in the matter. There will be a limit on the proximity such activity can occur to a wind turbine, to prevent any instability in ground conditions leading to wind turbine failure.

Cumulative Impacts: Existing and proposed wind farms in the region are a sufficient distance from the Project site, and exploration or mining licences tend not to overlap multiple projects. However, where broad-scale exploration licences exist it is impossible to predict where mining activity may take place unless exploration activity has already commenced. Therefore there are no anticipated cumulative impacts likely to occur from mining operations.

19.2.3 *Management and Mitigation*

The Proponent will continue to liaise with Ochre Resources Pty Ltd, and provide updates of any modifications to the Project design that arise prior to and during the construction of the Project. The Proponent is prepared to work with exploration licence holders to ensure that prospecting can continue within the Project site, until such time as the wind farm is operational.

19.3 Tourism

Wind farms appear to generate great public interest, as experienced in many regions of Australia, including the Esperance and Albany Wind Farms in the southern region of Western Australia, Windy Hill Wind Farm near Ravenshoe, Queensland, Lake Bonney Wind Farm near Tantanoola, South Australia and Capital Wind Farm near Bungendore, Canberra. Tourists are able to drive around these wind farms on local roads, and even walk up to a wind turbine at the Albany Wind Farm. Wind farms are appearing on top destination lists with the Albany Wind Farm, Western Australia voted number 16 out of 20 for Western Australia's Top 20 Tourist Destinations and it is believed that more than 100,000 vehicles visit the wind farm annually (MAP Marketing 2008; Verve Energy 2008). Additionally Wattle Range Council in South Australia promotes its Woakwine Range Wind Farm tourist drive using the slogan "Experience 'Clean and Green' Living with the Canunda and Lake Bonney Wind Farms". With the potential for increased traffic from visitors, other economic opportunities exist through activities such as wind farm tours, souvenirs, food and drink and accommodation which could form the basis of a wind tourism industry. Similarly, increased visitor numbers attracted by the wind farm could result in increased exposure to other local attractions and amenities not associated with the wind farm.

The Boorowa Council LEP (2012) notes the importance of sustainable economic growth and development within Boorowa, including encouraging sustainable primary industry production. The Boorowa and Yass Valley LGAs regularly host community events, as shown in **Table 19.1**.

Table 19.1 Community events local to the Project (as of 2012)

• Boorowa LGA	• Yass Valley LGA
• Irish Woolfest • Boorowa Show • Reid's Flat Gymkhana and Rodeo • International Women's Day • Boorowa Picnic Races • All Jazzes Up in the Hilltops at Boorowa •	• Yass Farmers Markets • Australia Day Breakfast • Summerside Festival • Humes Heyday Family Festival • Wine Harvest Festival • Bookham Sheep Show and Country Fair • Fireside Festival • Wee Jasper Naturally Weekend • Yass Relay for Life

The Project will have the potential to increase visitor numbers to both councils, as demonstrated with other wind farms in Australia. However, as the Project occurs on private land, tourists will only be able to access the wind farm area from public roads. If increased traffic is recorded within the area, parking / stopping bays to provide a vantage point for the wind farm could be considered on appropriate local roads by the Proponent, subject to the suitability and availability of land.

19.4 Community Wellbeing and Community Fund

19.4.1 *Existing Situation*

Both Yass Valley Council and Boorowa Council have Community Strategic Plans which outline environmental, social and economic objectives for the area, and methods that may be used to achieve these. Overarching purposes of the Yass Valley Community Strategic Plan 2011-2030 (Yass Valley Council 2013) include "the need to develop sustainable and innovative solutions to manage our environmental impact" and "to manage the transition from an economy based more on traditional agricultural practices to one which is more diverse, robust and sustainable" (Yass Valley Council 2013). The Project will positively contribute to a number of the outlined long term goals, including supporting "development strategies for agricultural resilience against climate fluctuations and change" and promoting "Yass Valley to a range of best practice examples of environmental sustainability in local industry and agriculture" (Yass Valley Council 2013).

Boorowa Council's Community Strategic Plan 2032's (Boorowa Council 2013) vision is to ensure the "economy is strong and productive, based on viable agriculture, innovative business enterprises and a skilled local workforce" (Boorowa Council 2013). In the context of these goals, the Council aims to "identify and develop partnerships to promote and encourage suitable renewable energy projects" and to "develop education and other initiatives that foster agricultural resilience against climate fluctuations and change" (Boorowa Council 2013). The Council also aims to "explore opportunities for diversification of local agriculture" and minimise their 'environmental footprint'" (Boorowa Council 2013). The Project is well suited to meet these long term goals and aspirations by encouraging sustainability and promoting employment in the region.

19.4.2 *Potential Impacts*

Community wellbeing will be positively influenced by the Project during the construction and operation phases in a number of ways, including:

- A short term increase in population during construction due to the incoming work force;
- A potential increase in population during operation due to increased money in the economy, which supplies local infrastructure;
- A small increase in full-time employment during operation for a select skilled workforce;
- With increased money in the economy and increased population, the potential for improved tertiary study; and
- The upgrade of roads to accommodate heavy vehicles during construction and operation (as required).

AGL Energy Ltd (AGL) has constructed and own several wind farms in the mid-north region of South Australia. In July 2010 AGL engaged Sinclair Knight Merz (SKM) to undertake an Economic Impact Assessment into the benefits that their Hallett Wind Farm projects have had on the economy in the region. The Hallett Wind Farm projects (Stages 1, 2, 4 and 5) comprise of 167 wind turbines totalling 350 MW of installed, operating capacity (SKM, 2010).

Regional employment outcomes of the Hallett Wind Farm projects include:

- To June 2010, total direct employment of 450 Full Time Equivalent (FTE) construction job years plus 15 in operations with an average annual employment of 98;
- To completion of Hallett 1, 2, 4 and 5 total direct construction employment would increase to 540 job years at a average annual employment of 90 plus 36 operations jobs over the life of the projects; and
- To completion of Hallett 1, 2, 3, 4 and 5 total direct construction employment numbers would increase to 640 job years at an average of 80 per annum plus 42 operations jobs over the life of the projects.

In addition to these raw figures, key qualitative highlights of the report include:

- Evidence of strong local business support for the Hallett projects;
- Accommodation and food service providers had a significant increase in sales over the construction period;
- Local contractors were employed directly in the construction of the wind farms;

- Other businesses benefitted from additional people and increased expenditure in the region; and
- Local businesses that benefitted from contracts with the wind farm included:
  - Domestic-scale electricians;
  - Transport operators;
  - Competent machine operators;
  - Quarries; and
  - Concrete businesses.

The Clean Energy Council (CEC) commissioned SKM to undertake an independent study to present an updated national and state based snapshot on wind farm investment, jobs and carbon abatement in July 2012. In summary the report highlights the likely economic benefits resulting from a wind farm of 50 megawatts (MW) capacity. A 50 MW wind farm generates direct employment of up to 48 construction jobs, with approximately $25,000 per person being spent in the local area (shops, restaurants, hotels and other services), totalling up to $1.2 million. The wind farm would directly employ around five staff, which would contribute $125,000 per annum of personal expenditure locally. Therefore, a wind farm would have indirect employment during construction, of approximately 160 people locally, 504 state jobs and 795 nation-wide jobs.

A wind farm of 50 MW also provides up to $250,000 for farmers in land rental income per annum and can contribute up to $80,000 on Community projects each year.

Independent research commissioned by Infigen Energy concerning the Capital Wind Farm in 2012 surveyed over 200 local residents and businesses about economic impacts resulting from the wind farm. 'Community perceptions of wind farms' (Qdos 2012) found that 64 % of local business operators thought local businesses had benefitted from the wind farm, and 68 % of respondents supported future wind farm developments.

At the Snowtown (Stage 1) Wind Farm in South Australia, which has 47 wind turbines and an installed capacity of 98.7 MW, there were an average of 55 to 65 workers on-site each week. Overall it is estimated that there were 130 people hired directly during the construction phase of the Project, including contracted companies (pers. comm., Campbell 2009). The Bango Wind Farm will have up to 122 wind turbines (two and a half times the number at Snowtown (Stage 1)) and a greater installed capacity by comparison, which would result in more people hired during the construction phase of the Project.

Concern about community division: Some members of the community near the Project site have raised concerns regarding social division in the community and the breakdown of long-term relationships. Planning Panels Victoria (2006), in its report on the Mount Mercer Wind Farm, made the following observations in relation to the potential for community division:

> *"So far as social impacts are concerned…we would observe that a potentially negative 'social division' is… apparent between those who are participating in the project and those who are not. It seems to us that those in the community who are non-participants in the project are perhaps feeling that they have suffered or will suffer an injustice. They perhaps see themselves as potentially bearing a range of*

> *impacts from this project – with no compensation, while their neighbours are receiving financial recompense for the same impacts.*
>
> *It may be that social ties within the group arising from other factors are stronger – at least in the longer term. It is also possible that even if the wind farm permit was to be refused or the project did not proceed for some other reason, the social division might remain."*

There is a risk of some community division as a result of the development, construction and operation of the Project which may be influenced in various ways due to the complexity of the social fabric of the community and individual perception of the benefits and impacts of the project. Community enhancement funds can help to assist in offsetting potential residual amenity impacts associated with wind farm projects.

Cumulative Impacts: It is not anticipated that the development of other proposed wind farms in the region will have an adverse cumulative effect to community wellbeing. Instead, these wind farms will provide additional jobs and resources into the surrounding Councils and will help both Councils achieve their aspirations and visions.

19.4.3 ***Management and Mitigation***

The Proponent is committed to providing a Community Fund to benefit the community in the vicinity of the Project. The purpose of the fund is to support community groups, programmes and activities that the community values or for which it requires support. Such programmes have been successfully established for Wind Prospect Group developments in South Australia and the United Kingdom, and at the Boco Rock Wind Farm south of Cooma.

The Proponent is proposing to contribute $2,500 per installed wind turbine per annum to a Community Fund as each stage of the Project commences commercial operation, as outlined in **Section 3.9.2**. Contributions will continue annually for the lifetime of the Project until such date that the Project ceases operation and is decommissioned. Based on the two layout options proposed for the Project this could total between $240,000 and $305,000 per annum, equating to up to $4.8 to $6.1 million over an estimated 20 year Project life. It is proposed that decisions on how the funds are to be allocated should be determined by a committee made up of representatives from the local community, Council and the Proponent.

The structure and administration of the Community Fund could include, but is not limited to:

- The fund split appropriately between the two Councils;
- The fund managed by a publicly-elected group;
- Funding to sporting clubs, infrastructure, education, etc;
- Funding to local environment and cultural heritage projects; and / or
- Variable funding to groups based on their proximity to the Project.

With the addition of the Community Fund and other secondary effects from the construction and operation of the Project, both Councils and surrounding towns are expected to experience an overall increase in community wellbeing.

Cumulative Impacts: There is the possibility of a significant economic benefit to the council areas, supporting community-based projects from the combination of Community Funds provided by other proposed wind farms in the region.

19.5 Local Economy

19.5.1 *Existing Situation*

As previously discussed, the Project occurs across two Councils, Yass Valley and Boorowa, so any existing or potential impacts will be localised within these Council areas. Comparative employment figures for a range of industries in each Council area are displayed in **Tables 19.2** and **19.3**.

Table 19.2 Most common industries of employment in Yass Valley LGA, 2011.

Industry	Yass Valley (%)
Central Government Administration	7.8
Sheep, Beef Cattle and Grain Farming	6.2
School Education	3.9
Cafes, Restaurants and Takeaway Food Services	3.9
Defense	2.8

Source: 2011 Census QuickStats – Yass Valley (A) LGA

Table 19.3 Most common industries of employment in Boorowa LGA, 2011.

Industry	Boorowa (%)
Sheep, Beef Cattle and Grains Farming	28.8
School Education	4.8
Local Government Administration	4.6
Agriculture and Fishing Support Services	3.4
Hospitals	2.9

Source: 2011 Census QuickStats – Boorowa (A) LGA

19.5.2 *Potential Impacts*

Of all the stages of the Project, the construction and decommissioning stages will generate the largest economic gain for the greatest number of people and businesses in both Council areas. This is due to the hiring of a large temporary workforce over approximately two years of construction and later approximately one year of decommissioning. Employment opportunities would involve concreting, earth works, steel works and electrical cabling during construction, with demolition, removal and rehabilitation during decommissioning. Indirect employment opportunities would involve food industries, fuel, accommodation and other services that contractors coming to the area. Where practicable the Proponent will source from local companies (as has commonly been the case with other wind farm developments around Australia), which is likely to include the utilisation of nearby quarries during construction. The Proponent has created a form on the Project website (www.bangowindfarm.com.au) to gather local business and contractor information. This is located under the 'Contact Us' section of the website, and by following the link to 'Contractors'.

Once the Project is operational there would be a small number of permanent jobs available. The Community Fund as discussed above and in **Chapter 4** Project Justification would also provide financial benefits and improved equity to the surrounding communities, improving the existing economic situation.

More broadly, it is also anticipated that the Project could inject up to $365 million into the Australian economy. This estimate of the financial benefit to the Australian economy is based on a typical approximation of cost associated with building a project of this size, whilst recognising that the associated components (i.e. wind turbines) will be manufactured and procured overseas.

Cumulative Impacts: Other proposed wind farms in the region will not have an adverse cumulative effect on the local economy through the introduction of the proposed development into the area. Instead these wind farms will provide additional jobs and utilise existing resources in the surrounding area where feasible.

19.5.3 *Management and Mitigation*

To ensure that the local Council areas benefit from the construction of the Project, local contractors will be used where feasible. This will involve the Proponent liaising with local industry representatives to utilise the full potential of local resources. A number of local businesses have already made themselves and their services known to the Proponent.

19.6 Health

19.6.1 *Existing Situation*

Existing wind farm guidelines relating to noise, electromagnetic fields and visual amenity provide a robust framework which ensures that impacts, including purported health impacts, on the community are avoided, minimised or mitigated to an acceptable level.

Wind energy enjoys considerable public support, but it also has its detractors who have publicised their concerns that wind turbines can cause adverse health consequences. In response to concerns raised, over 25 reviews into wind turbines and human health have been undertaken around the world since 2003.

The Australian National Health and Medical Research Council (NHMRC) undertook a 'rapid review of the evidence' on 'Wind Turbines and Health' in 2010, and in 2013 commissioned the University of Adelaide to undertake a systematic review of the human health effects of wind farms" (NHMRC 2013). The evidence collected in the review led to the conclusion that:

> *"There is no consistent evidence that noise from wind turbines—whether estimated in models or using distance as a proxy—is associated with self-reported human health effects. Isolated associations may be due to confounding, bias or chance."*

The 'NHMRC Statement: Evidence on Wind Farms and Human Health' (NHWMC 2015) was subsequently released in February 2015. The Statement concluded:

> *"...there is currently no consistent evidence that wind farms cause adverse health effects in humans."*

and stated that:

> *"Given the poor quality of current evidence and the concern expressed by some members of the community, there is a need for high quality research into possible health effects of wind farms, particularly within 1,500 metres"*

NHMRC issued a Targeted Call for Research into wind farms and human health in March 2015.

NSW Health has provided commentary on the issue, most notably in a submission on the *Draft NSW Planning Guidelines: Wind Farms* in 2012 stating that:

> *"there is currently no health evidence to support generic 2 km separation distances from proposed wind turbines".*

Furthermore, since the release of the NHMRC review in 2010, documents received under a Freedom of Information request to NSW Health in January 2012 "found the claims of the anti-wind energy group to be of the 'lowest category of scientific evidence', and having major methodological flaws". NSW Health went on to say that the national approach, taken by NHMRC, is consistent with the international scientific opinion, which is based on lack of a current link between wind turbines and adverse health effects.

Internationally, the most recent and comprehensive study into wind turbines and health was conducted by Health Canada between mid 2012 and late 2014 involving 1238 households in Ontario and Prince Edward Island in the vicinity of wind farms that represented 315 and 84 wind turbines respectively. All potential homes within approximately 600 m of a wind turbine were selected, as well as a random selection of homes between 600 m and 10 km.

The research concluded that there is no evidence of a causal relationship between exposure to wind turbine noise and self-reported medical illnesses and health conditions. Specifically, the Health Canada study found:

- No evidence to support a link between exposure to wind turbine noise and any of the self-reported illnesses and chronic conditions;
- No association between multiple measures of stress and exposure to wind turbine noise;
- No association between wind turbine noise and self-reported or measured sleep quality; and
- No association between wind turbine noise and any significant changes in reported quality of life, or with overall quality of life, and satisfaction with health.

The study did find a correlation, but not a causal relationship, between increasing levels of wind turbine noise and annoyance. The Health Canada summary identified a number of other factors that may contribute to annoyance levels, including economic benefit, visual appearance and noise sensitivity.

W. David Colby, the Acting Officer of Medical Health at Chatham Kent Health Unit in Canada, and one of seven experts involved in an AWEA and CanWEA 2009 review wrote in a letter to the Chatham Kent Council:

> *"In summary, there is no scientifically valid evidence that wind turbines are causing direct health effects… It is unlikely that evidence of adverse health effects will*

> *emerge in the future because there is no biologically plausible mechanism known by which wind turbines could cause health effects.*
>
> *"An annoyance factor undoubtedly exists to which there is individual variability. Associated stress from annoyance, exacerbated by all the negative publicity, is the likely cause for the purported erosion of health that some people living near rural wind turbines are reporting. Stress has multiple causes and is additive."*

A study by Pederson et al. (2009) of sound response in the Netherlands, published in the Journal of the Acoustic Society of America, found a high correlation between the absence of economic benefits and opinion of visual impact and annoyance. This indicates that the perception of sound is potentially subjectively driven, rather than purely a negative aural response.

Claims that wind farms generate physiological health effects such as "vibroacoustic disease" (VAD) or "wind turbine syndrome" (WTS) have also been refuted by numerous studies. The 2009 AWEA and CanWEA expert panel review, comprising three medical doctors and four acoustics experts, specifically criticised studies showing a link between wind farms and VAD or WTS for failing to conduct an epidemiological study that is needed to show a causal association. Instead all such studies, unpublished in peer reviewed journals, rely on 'case studies', with self-selected cases being used to form an untested opinion. The expert panel review made it clear that only 'case controlled' or 'cohort' studies, where large sample sets are selected at random or in a controlled way to avoid biased results, are appropriate. As yet no such studies have been conducted into VAD or WTS.

As an alternative explanation for some of these reported health effects from wind farms, the idea of a 'nocebo effect' has been advanced. A 'nocebo' is a harmless substance or procedure which is perceived by the recipient to be harmful.

The 2009 AWEA and CanWEA study investigated the 'nocebo affect' concluding that:

> *"The large volume of media coverage devoted to alleged adverse health effects of wind turbines understandably creates an anticipatory fear in some that they will experience adverse effects from wind turbines. Every person is suggestible to some degree. The resulting stress, fear, and hyper-vigilance may exacerbate or even create problems which would not otherwise exist. In this way, anti-wind farm activists may be creating with their publicity some of the problems that they describe".*

Results from these reviews, studies and numerous other studies overwhelmingly indicate that there is no current evidence to suggest a direct causal link between wind turbines and deterioration of human health. No evidence is available to suggest that there is any statistically significant increase in risk to human health to residents living within 2 km of operating wind turbines.

19.6.2 ***Potential Impacts***

The Project is not expected to cause any adverse human health impacts. There is some potential however for annoyance which is expected to be limited by compliance with noise guidelines that the wind farm will comply with (**Chapter 9** – Noise), mitigation measures proposed regarding visual impact and a commitment to providing community funding. Additionally, no wind turbines will be constructed within 1 km of any non-involved residence.

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Chapter 20

Summary of Assessments: Residences

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20. RESIDENCE ASSESSMENT SUMMARY

Table 20.1 summarises the outcomes of noise and visual assessments at residences, where impacts have been identified. The status of the relationship between the residence and the Project has been identified to demonstrate where agreements have been reached. Consultation with these residences will continue during the course of Project development. Commitments have also been made with respect to these impacts in **Chapter 21** Statement of Commitments.

Table 20.1 key assessment outcomes at residences in the Project locality

Residence ID	Status	Progress	Visual			Noise Exceedence	Distance to Nearest Wind Turbine
			Visual Significance Rate	Cumulative visual impact rating	Shadow Flicker (hrs/year)		
100	Involved	-	High	-	136.19	Yes	0.5 km
119	Involved	-	High	-	60.4	No	1.0 km
225	Involved	-	High	-	28.5	No	1.0 km
101	Neighbour Agreement	Signed	High	-	73.34	No	1.1 km
115	Neighbour Agreement	Signed	High	-	26.43	No	1.3 km
136	Neighbour Agreement	Signed	High	-	0	No	1.5 km
154	Neighbour Agreement	Signed	High	-	0	No	1.9 km
155	Neighbour Agreement	Signed	High	-	0	No	1.4 km
235	**Non-involved**	Declined a Neighbour Agreement, consultation ongoing	High	-	0	No	1.7 km
282	**Non-involved, Approved DA**	DA approved December 2015, consultation in progress	High	-	0	No	1.7 km

Residence ID	Status	Progress	Visual			Noise Exceedence	Distance to Nearest Wind Turbine
			Visual Significance Rate	Cumulative visual impact rating	Shadow Flicker (hrs/year)		
087	Involved	-	Medium to High	-	0	No	1.5 km
117	Involved	-	Medium to High	-	0	No	1.7 km
160	Involved	-	Medium to High	-	0	No	1.7 km
062	**Non-involved**	Consultation in progress	Medium to High	-	0	No	2.1 km
260	**Non-involved**	Consultation in progress	Medium to High	-	0	No	2.0 km
009	Involved	-	Medium	-	0	No	1.4 km
021	Involved	-	Medium	-	0	No	1.7 km
158	Neighbour Agreement	Signed	Medium	-	0	No	2.1 km
238	Neighbour Agreement	Under negotiation	Medium	-	0	No	1.0 km
076	**Non-involved**	Declined a Neighbour Agreement, consultation ongoing	Medium	-	0	No	1.9 km
060	**Non-involved**	Declined a Neighbour Agreement, consultation ongoing	Medium	-	0	No	2.4 km
283	**Non-involved, Approved DA**	DA approved December 2015, consultation in progress	Medium	-	0	No	2.7 km
051	**Non-involved**	Consultation in progress	Low	Moderate to Low	0	No	3.7 km
048	**Non-involved**	Consultation in progress	Low	Moderate to Low	0	No	2.9 km
009	Involved	-	Medium	-	10.5	No	1.4 km
032	Involved	-	Low to Medium		75.03	No	1.0 km
041	Involved	-	Low to Medium	-	95.59	No	0.7 km

CHAPTER 21

Statement of Commitments

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21. STATEMENT OF COMMITMENTS

The Statement of Commitments (SoC) is a summary of all management and mitigation measures collated from chapters of this EIS. The SoCs have been developed to inform Development Consent Conditions of Approval which are to be managed through Environmental Management Plans (EMPs) as the Project is constructed and operated.

The Construction Environmental Management Plan (CEMP) outlines the environmental management practices and procedures that are to be followed during construction. The CEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Community information management;
- Compounds and ancillary facilities management;
- Noise and vibration;
- Traffic and access;
- Soil and water quality and spoil management;
- Air quality and dust management;
- Aboriginal and non-Aboriginal heritage management;
- Soil contamination, hazardous material and waste management;
- Ecological impact management; and
- Hazard and risk management.

The Operational Environmental Management Plan (OEMP) outlines the environmental management practices and procedures that are to be followed during operation. The OEMP will be supported by a number of sub-plans, typically covering the following key management aspects:

- Community information management;
- Noise management;
- Landscaping;
- Bird and bat management;
- Telecommunication interference; and
- Decommissioning.

21.1 Impact, Objective, Responsibility and Timing

Table 21.1 provides a summary of environmental aspects identified in undertaking this EIS. Each aspect is defined by an impact, objective, a proposed mitigation measure and the responsible party. Each aspect is further defined by Project stage, for the purposes of informing Development Consent Conditions of Approval. Stage timing is defined by the following:

- Pre-Construction (PC);
- Construction (C);
- Operation / Maintenance (OM); and
- Refurbishment / Decommissioning (RD).

To enable ease of referencing to chapters the SoC mitigation measures have been split into the associated chapters.

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	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
Management Plans								
001	Environmental	Minimise impact	A CEMP will be developed which outlines environmental practices and procedures to be followed during construction.	Proponent	✓	✓		✓
002	Environmental	Minimise impact	An OEMP will be developed, which outlines environmental management practices and procedures that are to be followed during operation.	Proponent			✓	
Landscape and Visual								
003	Impact to receptors	Minimise impact	• Use of a matt and / or off-white finish on the structures to reduce visual contrast between wind turbine structures and the viewing background (this is subject to final wind turbine selection and aviation safety requirements); • Limit amount of advertising, signs or logos mounted on wind turbine structures, except those required for safety purposes; and • Where feasible select materials and colours for ancillary structures with consideration of reflective properties.	Proponent	✓			
004	Impact to receptors	Minimise impact	• If aviation lighting is required, the Proponent will commit to shielding provisions allowed under existing CASA guidelines. Shielding restricts the downward component of light to 5 % of nominal intensity emitted below 5° below horizontal and zero light emission below 10° below horizontal.	Proponent in consultation with CASA	✓			
005	Impact to receptors	Minimise impact	• Reinstate disturbed soil areas immediately after completion of construction and decommissioning, where practicable, including re-contouring and re-seeding with appropriate plant species and local materials where feasible; • Where practicable use local materials to reconstitute disturbed areas to minimise colour contrast; • Enforce safeguards to control and minimise dust emissions during construction and decommissioning; and	Proponent in consultation with contractor		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	Stage C	Stage O M	Stage RD
			• Limit the height of stockpiles to minimise visibility from outside the Project.					
006	Impact to receptors	Minimise impact	Where visual impacts at non-involved residences have been determined to be Medium, Medium to High or High, where cumulative visual impacts have been assessed to be Moderate-Low or where shadow flicker is identified in Table 20.1, the Proponent will offer visual impact mitigation to the owner during the construction phase based on the final Project layout. Alternatively, Neighbour Agreements will also be discussed with the relevant residences.	Proponent		✓	✓	
006	Impact to receptors	Minimise impact	Except for emergencies, minimise activities that may require night time lighting and, if necessary, use low lux (intensity) lighting designed to be mounted with the light projecting inwards to the Project site to minimise glare.	Proponent in consultation with contractor		✓	✓	✓
Noise								
007	Impact to receptors	Compliance	Predicted operational noise levels of chosen wind turbine model (including any micro-siting of the layout) are to comply with relevant criteria.	Proponent in consultation with noise consultant, and where applicable, EPA and landowners	✓			
008	Construction noise	Minimisation	Where practicable, construction is to occur within recommended working hours. Wind turbine erection and concrete pours to be	Proponent in consultation		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
	exceedance		permitted outside of these set hours where climatic conditions are favourable to ensure construction program is maintained. (Protocol to be provided within CEMP).	with DPE				
009	Construction noise exceedance	Minimisation	Prior notification of affected public and restricted use of exhaust / engine brakes in built up areas for night-time deliveries. (Protocol to be provided within CEMP).	Proponent		✓		✓
010	Substation noise exceedance	Compliance	If selected substation locations are non-compliant with the *NSW Industrial Noise Policy*, mitigation measures would be applied as appropriate, including; • The use of transformer(s) with a lower sound power level output; • Landscaping, including raised embankments and vegetation, around the substation; and • Providing acoustic upgrades (glazing, façade, masking noise etc) to affected residences.	Proponent		✓		
011	Wind turbine operational noise exceedance	Compliance	If, during operation, wind turbine noise impacts are non-compliant with stated criteria used for the assessment, then an 'adaptive management' approach (protocol to be provided within OEMP) can be implemented to mitigate or remove the impact. This process could include: • Investigating the nature of the reported impact; • Identifying exactly what conditions or times lead to undue impacts; • Consideration of operating wind turbines in a reduced 'noise optimised' mode during offending wind directions and at night-time (sector management); • Providing acoustic upgrades (glazing, façade, masking noise etc) to affected residences; and	Proponent in consultation with noise consultant, and where applicable, EPA and landowners			✓	

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
			• Turning off wind turbines that are identified as causing the undue impact.					
Ecology								
012	Spread of weeds	Minimise spread	A CEMP sub-plan will be developed, which includes: • Soil which may contain exotic species to be piled at least 50 m from any water source, or areas of native vegetation; • All construction staff and sub-contractors to be educated on noxious weeds present at the Project site and on ways to prevent spread; • Where a specific weed risk has been identified, all machinery, equipment and vehicles are to be washed down before entry and egress of the Project site; • Where practicable, topsoil in areas that have a high proportion of native vegetation and is limited in weeds to be harvested to salvage the native soil seed bank and reintroduced into disturbed areas. Otherwise, revegetate with locally native endemic species characteristic of the cleared vegetation type; • Control of perennial weed grasses within the disturbance zone for three to five years after construction; • Where practicable, and in consultation with host landowners, manage stock access during periods of revegetation; and • Imported soil and rubble to be certified as free of weeds and weed seeds.	Proponent in consultation with ecologist and associated landowners		✓	✓	✓
013	Loss of biodiversity value	Minimise impact	A CEMP sub-plan will be developed, which includes: • All site staff are to be inducted on the procedures of the CEMP sub-plan in relation to flora and fauna; • Where practicable, Project vehicles are to remain within the extent of the earth works designed specifically for the Project to minimise vegetation disturbance; • Laydown or temporary disturbance areas will be sited in already	Proponent in consultation with ecologist, OEH and DoE	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	O M	RD
			disturbed areas where practicable to avoid any unnecessary clearing of native vegetation and habitat; • Where practicable, and in consultation with host landowners, logs and large rocks removed from within the proposed development area are to be redistributed following the completion of works in temporary clearance areas or adjacent areas to supplement habitat; • Where practicable, trenches to be dug at least 15 m away from the base of trees and outside drip lines; • Native vegetation that is removed will be chipped and mulched for on-site use where practicable; • Native vegetation greater than 3 m in height to be retained during transmission line construction where practicable; • Minimise dust creation during construction through the use of water carts; • If micro-siting of the Development Footprint occurs, where practicable, maintain a 30 m buffer between all turbines and hollow-bearing trees; • Where practicable, boundaries of the construction area are to be clearly marked to prevent breaches of construction boundaries; • Outside of the Development Footprint tree clearance will be avoided where practicable; • Rehabilitation of internal access roads that are not required following construction to be undertaken; and • Landscaping around the main collector and switching substation sites is to incorporate native species where appropriate.					
014	Loss of biodiversity value	Minimise impact	An appropriate offset package will be secured within 12 months of commencing construction to compensate for the loss of habitat within the Study Area outlined within this EIS. Final calculation of the offset area will be carried out during the pre-construction phase once wind turbine selection has taken place and the final	Proponent in consultation with ecologist, OEH, DoE and associated land	✓			

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
			Development Footprint is known.	owners				
015	Habitat Loss – Golden Sun Moth	Minimise impact	A CEMP sub-plan will be developed to include specific measures to address loss of habitat for Golden Sun Moth (GSM). Measures include: • Movement through and disturbance to mapped GSM habitat will be minimised during the flying period, from November to January, if possible • Areas of habitat will be delineated by barrier tape (or similar) to clearly demarcate these areas and limit risk of vehicles traversing through habitat accidently; and • All vehicle movements will be contained to roads and tracks where possible.	Proponent in consultation with ecologist, OEH and DoE	✓	✓	✓	✓
016	Habitat Loss – Box-Gum Woodland	Minimise and manage impact	A CEMP sub-plan will be developed to include specific measures to address loss of habitat for Box-Gum Grassy Woodland and Derived Native Grassland (DNG). Measures include: • Where micro-siting of transmission lines and easements is to occur, impacts are to be minimised by siting in areas that are already cleared for existing driveways and access gates where possible; • Where hollow bearing trees are removed the material will be placed in adjacent habitat, where practicable; • Clearing will be restricted to the canopy and mid-storey; and • Remaining Box-Gum Grassy Woodland areas (including areas of DNG) will be delineated by barrier tape (or similar) to clearly demarcate these areas and limit the risk of vehicles or machinery causing damage to these areas.	Proponent in consultation with ecologist, OEH, DoE and associated land owners	✓	✓	✓	✓
017	Fauna Mortality	Pre-clearance protocol	A CEMP sub-plan will be developed to include specific measures to minimise fauna mortality. Measures include: • Designing a pre-clearance protocol to manage the removal of fauna	Proponent in consultation with ecologist,	✓	✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
			from hollow-bearing trees; • Undertaking pre-clearance surveys to determine if roosts, nests or dens are present in any hollow-bearing trees; • An Environmental Compliance Manager or field officer qualified in the handling of fauna to be present on-site during clearing of hollow-bearing trees to capture and re-release fauna, where appropriate; • A trench monitoring protocol will be prepared and implemented to rescue trapped fauna; • Where practicable, fencing to be erected along open trenches to prevent fauna falling in; and • Management measures will be defined to reduce fauna mortality on roads and access tracks.	OEH and DoE				
018	Erosion, Runoff and Dust	Manage impact	Erosion and sediment control measures to be included in the CEMP to limit runoff to adjacent habitat areas and watercourses. Details to include devices to be installed, monitoring requirements and corrective actions. Management measures to include: • All erosion and sedimentation control devices regularly checked, cleared and repaired, particularly after periods of heavy rainfall; • Rehabilitation and stabilisation methods to limit erosive and dust generation potential of earth areas exposed that are not required for permanent infrastructure; • Disturbed soil surfaces should be stabilised as soon as practical after works have ceased in the area; • Stockpiles will be covered to prevent the loss of material during high wind and rain events, and appropriate sediment barrier fencing will be used in areas to inhibit the flow of sediment into surrounding areas; and • Stock pile locations will consider shelter from the wind where practical.	Proponent	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	 C	 OM	 RD
019	Wind turbine Collisions or Barotrauma	Minimise impact	A specific Bird and Bat Adaptive Monitoring Plan (BBAMP) to be developed with the objective of minimising the impacts of the operational wind farm on threatened bird species. The ABBMP will include: • The required monitoring measures; • Key thresholds for determining permissible impacts and corrective actions that are required in order to achieve the objectives of the plan; and • The roles and responsibilities for the proponent, operator and agencies in implementing, assessing and enforcing the plan. The frequency of reporting strike data will be determined during the preparation of a monitoring program. Adaptive management measures that could be implemented should strike thresholds be reached will be negotiated with OEH and DoE if significant strike rates are detected. Bird and bat strike monitoring will be undertaken with consideration of relevant monitoring guidelines.	Proponent in consultation with OEH and, where applicable, DoE	✓	✓	✓	
Cultural Heritage								
020	Loss of cultural heritage items	Minimise impact	A CEMP sub-plan will be developed with consideration of the list of mitigation and management strategies contained within **sections 7 and 9** of **Appendix 13**. In summary, these include: • The Proponent, in consultation with an archaeologist, relevant Aboriginal communities and OEH, developing a Cultural Heritage Management Protocol which provides procedures to be followed for impact avoidance and accidental discovery; • Personnel involved in the construction and management phases of the Project trained in procedures to implement recommendations	Proponent in consultation with OEH and where applicable, relevant Aboriginal communities	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	O M	RD
			relating to cultural heritage, where necessary, to decrease impact; and • Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development. Further, the following mitigation and management strategies are suggested to minimise the impact on Aboriginal objects and places: • Ground disturbance impacts associated with the Project be kept to a minimum and to defined areas, to ensure minimum impact on Aboriginal objects, which can be expected to extend in a relatively continuous, albeit very low to low density distribution, across the broader landscape encompassed by the Project; • It is recommended that additional archaeological assessments are to be carried out if any new impacts are to occur outside the Study area. If a significant Aboriginal object is identified, prior to impact, mitigation strategies will be implemented. It may be culturally appropriate to salvage artefacts from certain sites; and • Aboriginal Site Impact Recording Forms are to be completed (and submitted to the OEH) for each Aboriginal object / locale harmed during construction of the Project.					
Traffic and Transport								
021	Safety and asset protection	Minimise risk	Contract a licensed haulage contractor with experience in transporting heavy and over-size loads, to be responsible for obtaining all required approvals and permits from the RMS and Councils and for complying with any conditions specified in the aforementioned approvals. The contractor is required to be cognisant of the proposed route upgrades outlined in **section 12.4.2** of this EIS and **Appendix 14**,	Proponent in consultation with contractor, RMS and Councils	✓			

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	Stage C	Stage O M	Stage RD
			with appropriate upgrades and mitigation measures to be agreed in consultation with the relevant authorities during detailed design.					
022	Safety and asset protection	Minimise risk	A CEMP sub-plan will be developed, to include, but not be limited to: • Scheduling of deliveries, timing of transport, limiting the number of trips per day, and reducing traffic during school bus route hours, i.e., 7.00 to 9.00 am and 3.00 to 4.30 pm; • Undertaking community consultation before and during all haulage activities and providing a dedicated telephone contact list to enable any issues to be rapidly identified and addressed; • Letterbox drop along affected routes; • Minimise disruption to local vehicles by ensuring average and maximum wait times due to Project related traffic along local roads are kept to a minimum (typically an average maximum of 3 minutes wait time); • Managing the haulage process, including temporary, short term road closures, the erection of warning signs and / or advisory speed signs posted in advance of isolated curves, crests, narrow bridges and changes of road conditions; • Designing and implementing temporary modifications to intersections and roadside furniture as appropriate; • Assessing, designing and implementing potential alignment changes to the existing road and culverts; • Producing a Transport Code of Conduct which would be made available to all contractors and staff detailing traffic routes, behavioral requirements and speed limits; • Establishing procedures to monitor traffic impacts on public and internal access tracks during construction, including noise, erosion, sediment, dust nuisance and travel times, and to implement modified	Proponent in consultation with licensed haulage contractor and road authorities	✓	✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
			work methods to reduce such impacts where practicable; • Where reconstruction or provision of a temporary crossing is required over a creek or drainage structure, the design of this structure will be discussed with the relevant authority; and • Reinstating pre-existing conditions after temporary modifications to the roads and pavements along the route, where applicable, in consultation with relevant authorities.					
023	Safety and asset protection	Minimise risk	A CEMP sub-plan will be developed to minimise and manage impacts on local roads and infrastructure, which shall include: • Prepare road dilapidation reports covering pavement, drainage and bridge structures, in consultation with RMS and the local Councils, for all of the proposed transport routes before and after construction. • Develop a program of inspection regimes in consultation with the local Councils. • Damage resulting from construction traffic, except that resulting from normal wear and tear, would be repaired at the Proponent's cost. • Alternatively, the Proponent may negotiate other forms of compensation for road damage with the relevant road authorities, as appropriate.	Proponent in consultation with Council and road authorities	✓	✓		✓
024	Safety and asset protection	Minimise risk	Consideration for establishing a transport pool for employees from nearby towns to minimise traffic volumes.	Proponent	✓	✓	✓	✓
025	Safety and asset protection	Minimise risk	Establish a procedure to ensure the ongoing maintenance of the Project site internal access roads during the operation phase. This maintenance would include sedimentation and erosion control structures, where necessary.	Proponent			✓	
026	Safety and asset	Minimise risk	Prior to decommissioning, prepare and implement an EMP sub-plan reflecting change in traffic operation and volume in future	Proponent in consultation				✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
	protection		years.	with Council and road authorities				
Aviation Assessment								
027	Creation of hazard	Minimise risk	The Proponent will provide the RAAF AIS, CASA, AsA, AAAA, RFDS and NSW RFS with the final wind turbine and monitoring mast locations and dimensions prior to construction. After construction is complete, the Proponent will provide RAAF AIS, CASA, AsA, AAAA, RFDS and NSW RFS with the "as constructed" details.	Proponent	✓	✓	✓	
028	Creation of hazard	Minimise risk	The Proponent will provide CASA with notification of any cranes (temporary obstacles) that exceed 110 m above ground level.	Proponent	✓	✓		✓
029	Creation of hazard	Minimise risk	Appropriate information regarding the wind turbine layout and dimensions, including monitoring masts will be supplied to the NSW RFS, if required, to assist in their planning and execution of airborne fire response.	Proponent	✓	✓	✓	✓
030	Creation of hazard	Minimise risk	On receipt of Development Consent for the Project, and with particular regard to the Aeronautical Impact Assessment and Obstacle Lighting Review, the Proponent will consult with CASA on the issue of obstacle lighting.	Proponent in consultation with CASA	✓			
Communication								
031	Deterioration of signal strength	Minimise deterioration	Where practicable, use equipment complying with appropriate Electromagnetic Emission Standards.	Proponent	✓	✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
032	Deterioration of signal strength	Minimise deterioration	Establish a system for recording any complaints on interference, to allow for further investigations with the affected party, and to reach an amicable solution.	Proponent			✓	✓
033	Deterioration of signal strength	Minimise deterioration	General mitigation methods for radio-communication, if impacts occur, may include: • Modifications to or relocation of existing antennae; • Installation of a directional antennae; and • Installation of an amplifier to boost the signal.	Proponent			✓	✓
034	Deterioration of signal strength	Minimise deterioration	If television interference is experienced and reported by an existing receiver in the vicinity of the Project, the source and nature of the interference would be investigated by the Proponent. Should the cause of interference be attributed to the Project, then the Proponent will put suitable mitigation measures in place after consultation and agreement with the affected landowner or television broadcaster. These could include: • Replacement / re-orientation of existing aerials to an alternative transmitter; • Provision of a land line between the affected receiver and an antenna located in a suitable reception area; • Provision of satellite (including new VAST Satellite TV service); and • Installation of a new repeater station in a location where interference can be avoided.	Proponent			✓	✓
Electromagnetic Fields								
035	Exposure to EMFs	Minimise exposure	Bury electrical cables where feasible to shield electrical fields.	Proponent		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
036	Exposure to EMFs	Minimise exposure	Place appropriate security fencing around emitting structures (e.g. collector substation and switching station sites).	Proponent	✓			
037	Exposure to EMFs	Minimise exposure	Ensure the public, including tourists, that need to go near emitting structures are accompanied by a trained and qualified staff member.	Proponent			✓	✓
Fire and Bushfire								
038	Increase risk of fire ignition or spread	Minimise risk	Adherence to all regulations under the *NSW Rural Fires Act 1997* and the Southern Tablelands and South West Slopes Bushfire Risk Management Plans.	Proponent in consultation with relevant authorities	✓	✓	✓	✓
039	Increase risk of fire ignition or spread	Minimise risk	Prepare an Emergency Response Plan in accordance with the '*Guide to Developing a bushfire Evacuation Plan'* (NSW RFS 2004) and the AS 3745:2010 *'Planning for Emergencies in Facilities'*	Proponent in consultation with NSW RFS and NSW Fire Brigade	✓			
040	Increase risk of fire ignition or spread	Minimise risk	The NSW RFS and NSW Fire Brigade will be consulted regarding the adequacy of bushfire prevention measures to be implemented on-site during pre-construction, construction, operation and decommissioning. These measures will potentially cover hot-work procedures, asset protection zones (APZs), safety, communication, site access and response protocols in the event of a fire originating in the Project infrastructure, or in the event of an external bushfire threatening the Project or nearby properties.	Proponent in consultation with RFS and NSW Fire Brigade	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
041	Increase risk of fire ignition or spread	Minimise risk	Provide NSW RFS with the locations of individual wind turbines, wind monitoring masts, ancillary infrastructure, construction work schedule, location of additional water supplies for construction, potential landing pads for firefighting aircraft and helicopters and access gates for firefighting services.	Proponent	✓	✓	✓	✓
042	Increase risk of fire ignition or spread	Minimise risk	Installation of access tracks of appropriate width and vertical clearances with access suitable for all weather conditions.	Proponent	✓	✓		✓
043	Increase risk of fire ignition or spread	Minimise risk	Construction and maintenance staff trained in the basic first response fire fighting techniques.	Proponent in consultation with NSW RFS and NSW Fire Brigade		✓		✓
044	Increase risk of fire ignition or spread	Minimise risk	Provide and maintain firefighting equipment capable of controlling and suppressing small initial outbreaks of fire.	Proponent		✓		✓
045	Increase risk of fire ignition or spread	Minimise risk	Maintain provision for mobile telephone and UHF radio communications.	Proponent in consultation with NSW RFS and NSW Fire Brigade		✓		✓
046	Increase risk of fire ignition or	Minimise risk	The collector substations will be bunded with a capacity exceeding the volume of the transformer oil. The facility will be regularly	Proponent	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
	spread		inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including the removal of any rainwater).					
047	Increase risk of fire ignition or spread	Minimise risk	Placement and maintenance of APZ around project infrastructure where appropriate to minimise the spread of fire, to include: • Maintain fuel reduced zones for all overhead transmission lines in consultation with TransGrid and / or Essential Energy; • Surround collector substations with a gravel and concrete area, free of vegetation; • Maintain a reduced fuel zone (APZ or defendable space) around each turbine to ensure adequate defendable space in accordance with the performance criteria and acceptable solutions of PBP 2006; • Maintain a fuel reduced zones around construction activities that may result in ignition of a fire, i.e. welding; and • Ignition creating activities such as welding not to be undertaken outside on days of total fire ban.	Proponent	✓	✓	✓	✓
048	Increase risk of fire ignition or spread	Minimise risk	Wind turbines will be shut down if monitored components reach critical temperatures or if directed to by the NSW RFS in the case of a nearby bushfire being declared (an all-hours contact number would be available to the NSW RFS during the bushfire period).	Proponent in consultation with the RFS			✓	
049	Increase risk of fire ignition or spread	Minimise risk	Flammable materials and ignition sources brought onto the Project site will be handled and stored as per manufacturer's instructions.	Proponent		✓	✓	✓
050	Increase risk of fire ignition or spread	Minimise risk	Lightning protection will be installed correctly and maintained to minimise risk of malfunction.	Proponent		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
051	Increase risk of fire ignition or spread	Minimise risk	Total fire ban days will be considered in regard to hours within which construction takes place, minimising the risk of fire and bushfire ignition.	Proponent		✓		✓
052	Increase risk of fire ignition or spread	Minimise risk	Undertake regular inspections of overhead transmission lines to ensure they are not fouled by branches.	Proponent	✓	✓		✓
053	Increase risk of fire ignition or spread	Minimise risk	Where appropriate, ensure adequate access to water for NSW RFS and firefighting crews as detailed in the Bushfire Management and Emergency Response Plan.	Proponent in consultation with the NSW RFS		✓	✓	✓
054	Increase risk of fire ignition or spread	Minimise risk	All site vehicles to have diesel engines and to use the site access roads to minimise the likelihood of igniting dry grass.	Proponent		✓	✓	✓
Water								
055	Loss of integrity to riparian corridor	Minimise loss	Works and disturbances not identified as part of the Development Footprint within this EIS (with the exception of crossings) should not be located in any riparian corridors.	Proponent in consultation with NOW	✓	✓		✓
056	Loss of integrity to riparian corridor	Minimise loss	NOW guidelines for river crossing designs, based on the Strahler Stream Order Categorisation to minimise environmental impact, will be followed in the design and upgrade of existing roads and river crossings.	Proponent in consultation with NOW	✓	✓		✓
057	Impact on	Minimise	All waterway crossings are to undergo detailed assessment and	Proponent in	✓	✓		

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
	watercourses	impact	design post-approval, and are to be constructed in consultation with NOW and DPI (Fisheries) and in line with the NOW *Guidelines for Controlled Activities* and DPI (Fisheries) guidelines: *Policy and Guidelines for Fish Friendly Waterway Crossings* (2004) and *Why do Fish Need to Cross the Road* (2004).	consultation with NOW and DPI (Fishing and Aquaculture)				
058	Impact on watercourses	Minimise Impact	All required watercourse crossings will be designed to protect and enhance water flow, water quality, stream ecology and existing riparian vegetation.	Proponent in consultation with NOW	✓	✓		
059	Loss of water quality and change to hydraulic regime	Minimise loss and impact on adjacent watercourses	A CEMP sub-plan will be developed to ensure soil disturbance and erosion from surface runoff is minimised and in order to minimise disturbance to water resources and riparian zones in the area. This sub-plan will include: • Construction and operation of the Project to comply with Section 120 of the *Protection of the Environment Operations (POEO) Act 1997*; • Project design and construction to not worsen existing flooding characteristics in the vicinity of the Project; • Monitoring of low- and high- flow conditions is to be regularly undertaken prior to the commencement of works to determine baseline water quality parameters. Surface water monitoring locations should include: ○ Junction of Dirt Hole Creek and Bank Creek; ○ Junction of Langs Creek and Rocky Creek; ○ Junction of Dry Creek and Langs Creek; ○ Upper reaches of Fat Jack Creek; ○ Upper reaches of Gorham Creek; ○ Upper reaches of Hardiman Creek; ○ Upper reaches of Kangiara Creek; and ○ Upper reaches of Thorsby Creek.	Proponent in consultation with NOW and in reference to Landcom 2004	✓	✓	✓	✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
			• All ancillary drainage infrastructure, e.g., sediment and litter traps are to, where practicable, be located outside the riparian corridor. Runoff is to be of an appropriate water quality and quantity before discharge into a riparian corridor or watercourse; • All stockpiles are to be located away from drainage lines and natural watercourses, road surfaces and trees and, where necessary, are to be appropriately protected to contain sediment and runoff (e.g. sediment fencing); • Regular inspection, maintenance and cleaning of water quality and sedimentation control devices; and • Due regard for the Lachlan (Kalare) CAP in the preparation of the CEMP and OEMP.					
060	Loss of water quality and change to hydraulic regime	Minimise loss and impact on adjacent watercourses	Mitigate for any impacts on groundwater as a result of the construction or operation of the Project, including contamination and impacts on flow rates. Ensure that there are no lasting impacts on groundwater following decommissioning.	Proponent in consultation with Landcom 2004		✓	✓	✓
061	Loss of water quality and change to hydraulic regime	Minimise impact on groundwater	Carry out a groundwater investigation prior to any blasting on-site (if required) to ensure that there is no adverse impact on groundwater for users or dependent ecosystems. If the investigation highlights areas of concern, then appropriate mitigation or alternative methods will be used.	Proponent in consultation with NOW	✓	✓		
062	Supply of water for construction	Obtain water for construction	Calculate all necessary water demands once final Development Footprint has been determined. Identify water requirements, including the locality of proposed works, extraction points, times, volumes and rates. Secure the necessary water licensing permits	Proponent in consultation with NOW	✓	✓		

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
			required at the time of extraction.					
063	Supply of water for construction	Obtain water for construction	Should the on or near-site provision of water be insufficient, water will be sourced from commercial suppliers as required.	Proponent	✓	✓		
Air Quality								
064	Deterioration of air quality	Minimise impact	A CEMP sub-plan will be developed to minimise and manage impacts on air quality which shall include: • The identification of potential sources of dust; • Dust management objectives; • Mitigations measures to be implemented, including measures during weather conditions where high level dust episodes are probable; • A monitoring program to assess compliance with identified objectives; and • Mechanisms for the monitoring, review and amendment of this plan.	Proponent	✓	✓		✓
065	Deterioration of air quality	Minimise impact	During excavation topsoil will be stockpiled. After excavation topsoil will be replaced for seeding and excess subsoil will be disposed of in an appropriate manner. If any excavation occurs on steep slopes the topsoil may need to be stabilised.	Proponent		✓		✓
066	Deterioration of air quality	Minimise impact	Where practicable, stockpiled material will be covered with plastic, seeded or otherwise bound to reduce dust. Dust levels at stockpile sites are to be visually monitored. Dust suppression (e.g. water sprays) will be implemented if required.	Proponent		✓		✓
067	Deterioration of air quality	Minimise impact	During dry and windy conditions a water cart or alternative (non-chemical) dust suppression would be available and applied to work areas.	Proponent		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage			
					PC	C	OM	RD
068	Deterioration of air quality	Minimise impact	If blasting is required, appropriate guidelines for control of blasting impacts will be followed. (i.e. Australian New Zealand Environment and Conservation Council).	Proponent in consultation with ANZECC		✓		✓
Soil and Landforms								
069	Disturbance to soil and water	Minimise disturbance	Soil and water management measures consistent with Landcom (2004) to be employed during construction to minimise soil erosion and the discharge of sediment and other pollutants to land and / or water.	Proponent in reference to Landcom 2004	✓	✓		
070	Disturbance to existing land formations	Minimise disturbance	A CEMP sub-plan will be developed to provide specific measures for soil, including: • Procedures for personnel to manage suspected contaminated soils disturbed during earthworks; • All disturbed soil surfaces to be stabilised as soon as practicable after works have ceased in the area; • All stockpiles to be covered where practicable to minimise the loss of material during high wind and rain events. Where practicable, stockpiles to be placed in areas sheltered from the wind; • Planning for erosion and sediment control concurrently with engineering design, prior to any works commencing; • Progressive rehabilitation of disturbed land as soon as practicable; • Jute matting or similar to be used to stabilise the soil and minimise weed invasion; and • Implementation of management measures to minimise sediment and runoff entering watercourses.	Proponent	✓	✓		✓
071	Soil compaction	Minimise impact	A CEMP sub-plan will be developed which will have specific measures for stock management:	Proponent in consultation		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
			• Removal of stock access from construction areas for entire construction periods to allow for regeneration – subject to landowner participation; and • Before remediation works, grazing to be removed where practicable, and subject to landowner participation and the grass sward allowed time to recover and minimise areas of bare soil.	with associated landowners				
Waste								
072	Waste generation	Minimise waste and maximise recycling	Provide skip bins and recycling bins on-site to handle packaging materials and domestic waste.	Proponent		✓	✓	✓
073	Waste generation	Minimise waste and maximise recycling	Mulch vegetation and use on-site where feasible, otherwise burn on-site with permission from Council, provide firewood to landowners or take to the Boorowa Garbage Depot operated by Boorowa Council or Murrumbateman Transfer Station / Landfill operated by Yass Valley Council.	Proponent		✓		✓
074	Waste generation	Appropriate disposal of waste	On-site toilets will either be drained by a septic tank or be an enclosed unit.	Proponent		✓	✓	✓
075	Waste generation	Appropriate disposal of waste	All chemicals and oils will be treated as contaminated waste at the Boorowa Garbage Depot, the Murrumbateman Transfer Station / Landfill or via ChemClear.	Proponent		✓	✓	✓
076	Waste generation	Appropriate disposal of waste	Any disposal of unsuitable excavated material will require approval from local Council.	Proponent		✓		✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	OM	RD
Crown Roads and Trigonometrical Stations								
077	Damage to Trigonometrical Stations	Avoid damage	Commitment to avoid disturbing and damaging the Trigonometrical Stations and adjacent witness marks.	Proponent		✓		✓
078	Crown roads	Liaise with the DPI (Catchments and Lands (CaL))	Relevant permits will be sought from CaL where Project infrastructure impacts upon Crown Roads.	Proponent in consultation with CaL	✓	✓		✓
Construction								
079	Environmental	Minimise impact	Micro-site Project infrastructure with respect to the Study Area and Development Footprint assessed within this EIS, whilst minimising impacts to non-involved residences and ecologically sensitive habitats and species.	Proponent in consultation with DPE	✓	✓		✓
080	Environmental	Minimise impact	On-site Environmental Representative to be granted authorisations to permit minor modifications to the project design with general regard to this EIS following detailed design activities.	Proponent	✓	✓		✓
081	Decommissioning	Manage process	A Decommissioning and Rehabilitation Plan (DRP) will be prepared during the pre-decommissioning phase, towards the end of the Project's life. The DRP will detail the process of decommissioning, including addressing whether components are to be removed or left in situ. All decommissioning work will be the responsibility of the Project owner, which is a provision within the lease	Proponent in consultation with Landowners				✓

	Impact	Objective	Mitigation Measure	Responsibility	Stage PC	C	O M	RD
			arrangements with relevant landowners.					
Mineral Exploration								
082	Future land use for mineral exploration	Minimise impact	Liaise with relevant mining companies and provide updates of any modifications to the Project design that arise during the construction of the Project.	Proponent		✓		
083	Future land use for mineral exploration	Minimise impact	At the time of decommissioning, communicate with associated landowners and mineral title holders that may wish to retain roads.	Proponent				✓
Community Wellbeing								
084	Effect on local area	Maximise positive effect of proposal	A contribution of $2,500 per installed wind turbine annually into a Community Fund as each stage of the Project commences commercial operation. This fund will be established in close cooperation with Yass Valley and Boorowa Councils with decisions on how funds are to be allocated determined by a committee made up of representatives from the local community, Council and the Proponent.	Proponent in consultations with Councils and community	✓		✓	✓
Economic								
085	Effect on local area	Maximise positive effect of proposal	Local contractors will be used where feasible, which will allow the Proponent to utilise the full potential of local resources.	Proponent in consultation with local industry reps	✓	✓		✓

CHAPTER 22

Conclusion

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22. CONCLUSION

This Environmental Impact Statement (EIS) has assessed the potential environmental impacts that may result from the proposed Bango Wind Farm (the Project), a proposal incorporating up to 122 wind turbines and capable of generating up to 326 MW of new renewable energy.

The Project is consistent with the State's priorities to secure a reliable electricity supply with an increased renewable energy component, and contributes significantly to the achievement of the State's renewable energy target. The Project will also play an important role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of Global Warming and Climate Change; contributing up to 3 % (dependent on the installed capacity) additional renewable energy generation to meet the legislated Australian target. Moreover the Project site and size has been carefully selected using a number of factors and will displace up to 875,000 tonnes of CO_2-e by 2020.

The Project has been assessed in accordance with the *Environmental Planning and Assessment Act 1979* and has taken into consideration the *Environment Protection and Biodiversity Conservation Act 1999*, along with other Federal, State and Local Government legislation, policy and guidelines. The scope of the assessment covered the Secretary's Environmental Assessment Requirements, the requirements of other State and Federal agencies, and consideration of the wellbeing of community stakeholders. The Environmental Impact Statement process entailed consultation with a wide range of Project stakeholders. Specialists were also engaged to provide independent predictive modelling and impact assessment expertise in key environmental and technical areas.

The operation of the Project would entail environmental and social impacts, in particular the introduction of visually prominent structures on the rural landscape of the Project site, and some loss to the agricultural production of land which will be occupied by wind farm infrastructure. As part of the iterative process of project development, the Project layouts and siting of associated infrastructure have been optimised to avoid areas of environmental significance, minimise disruption to agricultural production, and reduce as much as possible visual, noise and amenity impacts on the local community. The same environmental and sustainability objectives will continue to be significant considerations in the final choice of model and micro-siting of the wind turbines.

This EIS has demonstrated the suitability of the site as the potential impacts of the Project could be avoided or mitigated to reduce any residual environmental risks to low levels. **Chapter 21** Statement of Commitments details all environmental aspects related to the Project which should be used to inform Development Consent Conditions of Approval. The Proponent is committed to ensuring the measures proposed in developing the Project are best practice, and that they maintain the high standard set in all regions within which CWP Renewables operate.

The Project is in the public interest as it would deliver a sustainable source of energy with minimal environmental and social impact to the Project Site and region, addressing climate change, improving the resilience of our energy supply and delivering local and regional jobs and economic stimulus. The environmental performance of the Project will be continually monitored so that the positive environmental and social outcomes are achieved and maintained. The existing land use within the project site will continue concurrent with the operation of the wind farm, thereby maintaining the Project Site's agricultural production capacity. Aside from the reduction in greenhouse gases, opportunities to offset residual loss of native vegetation and habitat through the protection and enhancement of existing habitat will help achieve a net environmental benefit from the Project.

It is therefore considered that the construction, operation and decommissioning of the proposed Bango Wind Farm is justified on the basis of the environmental benefits it will bring, even as the range of mitigation measures identified in this EIS minimises its potential environmental impacts.

CHAPTER 23

Acronyms and Glossary

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23. ACRONYMS AND GLOSSARY

ACRONYMS

AsA	Airservices Australia
AAAA	Aerial Agricultural Association of Australia
ABS	Australian Bureau of Statistics
ACMA	Australian Communications and Media Authority
AEMO	Australian Electricity Market Operator
AGL	Above ground level
AGO	Australian Greenhouse Office
AIS	Aeronautical Information Service
ALC	Aboriginal Land Claim
ALA	Airport Landing Area
AM	Amplitude Modulated
APZ	Asset Protection Zone
ARA	Appropriate regulatory authority
ARG	Australian Research Group Pty Ltd
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ASB	Aviation Support Branch
AusWEA	Australian Wind Energy Association
Auswind	Australia Wind Energy Association
BFCC	Bushfire Coordinating Committee
BGW	Box-Gum Woodland
BioBanking	Biodiversity Banking
BoM	Bureau of Meteorology
BWEA	British Wind Energy Association
CAAP	Civil Aviation Advisory Publication
CAP	Catchment Action Plan
CASA	Civil Aviation Safety Authority
CAR	Civil Aviation Regulations
CCC	Community Consultative Committee
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CINA	Connection Investigation Network Agreement
CMA	Catchment Management Authority
CMA Act	Catchment Management Authority Act 2003
CO2	Carbon dioxide

CO2 -e	Carbon dioxide equivalent
COAG	Council of Australian Governments
COP2	Conference of the Parties
CPRS	Carbon Pollution Reduction Scheme
CRZ	Core riparian zone
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Development Application
DCC	Department of Climate Change
DCCEE	Department of Climate Change and Energy Efficiency
DCP	Development Control Plan
DE	Dwelling entitlement
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DGRs	Director General's Requirements
DIISRTE	Department of Industry, Innovation, Science, Research and Tertiary Education
DIT	Department of Infrastructure and Transport
DLWC	Department of Land and Water Conservation
DoD	Department of Defence
DoE	Department of Environment
DoL	Department of Lands
DPC	Department of Premier and Cabinet
DPI	Department of Primary Industries
DPE	Department of Planning and Environment
EA	Environmental Assessment
ECO	Emergency Control Organisation
ECRTN	Environmental Criteria for Road Traffic Noise
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment / Ecological Impact Assessment
EIS	Environmental Impact Statement
ELF	Extremely Low Frequency
EMF	Electric and magnetic field
EMI	Electromagnetic Interference
EMP	Environmental Management Plan
EP&A Act	Environmental Planning and Assessment Act, 1979
EPA	Environment Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act, 1999
eRET	Enhanced Renewable Energy Target
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development

EU	European Union
FM	Frequency Modulated
GSM	Golden Sun Moth
GWEC	Global Wind Energy Council
HF	High Frequency
ICAO	International Civil Aviation Organization
IEC	International Electrotechnical Commission
IGACC	Interim Guidelines for Aboriginal Community Consultation
INP	Industrial Noise Policy
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organisation for Standardisation
L_{Aeq}	A-weighted equivalent noise level measured in decibels
LCA	Life Cycle Assessment / Landscape Character Areas
LEP	Local Environmental Plan
LGA	Local Government Area
LOS	Line of Sight
LPMA	Land and Property Management Authority
LSALT	Lowest Safe Altitude
LRET	Large-scale Renewable Energy Target
LVIA	Landscape and Visual Impact Assessment
MIC	Maximum instantaneous charge
MRET	Mandatory Renewable Energy Target
NASAG	National Airports Safeguarding Group
NEM	National Electricity Market
NES	National Environmental Significance
NER	National Electricity Rules
NGA	National Greenhouse Accounts
NHMRC	National Health and Medical Research Council
NOW	NSW Office of Water
NPS	NSW Police Service
NPW Act	National Parks and Wildlife Act 1974
NPWS	National Parks and Wildlife Service
NSW	New South Wales
NTG	Natural Temperate Grassland

NW	Noxious Weeds Act 1993
OEH	Office of Environment and Heritage (NSW)
OEMP	Operational Environmental Management Plan
OLS	Obstacle Limitation Surface
PANS OPS	Procedures for Air Navigation Services
PEA	Preliminary Environmental Assessment
PFM	Planning Focus Meeting
PM10	Particles effectively less than 10µm diameter
POEO Act	Protection of the Environment Operations Act 1997
PSPD	Power System Planning and Development
RAAF	Royal Australian Air Force
RBL	Rating background level
REC	Renewable Energy Certificates
REF	Review of Environmental Factors
RET	Renewable Energy Target
RFS	Rural Fire Service
RMS	Roads and Maritime Services
RoTAP	Rare or Threatened Australian Plant
RTA	Roads and Traffic Authority (NSW)
SA EPA	South Australian Environmental Protection Authority
SCADA	Supervisory Control and Data Acquisition
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SES	State Emergency Service
SoC	Statement of Commitments
SoE	State of the Environment Report
SRES	Small-scale Renewable Energy Scheme
SSD	State Significant Development
TS	Trigonometrical Stations
TSC Act	Threatened Species Conservation Act
TV	Television
UHF	Ultra high frequency
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

VAC	Visual Absorption Capability
VFR	Visual Flight Rules
VHF	Very High Frequency
WBZ	Water Bearing Zones
WHO	World Health Organisation
WM Act	Water Management Act 2000
WMO	World Meteorological Organisation
WoNS	Weed of National Significance
WSP	Water Sharing Plan
WTG	Wind Turbine Generator
ZVI	Zone of Visual Influence

UNITS

°	degree
°C	degree Celsius
dBA	decibels (A range)
GWh	gigawatt hour
H	hour
ha	hectare
Hz	hertz
kg	kilogram
km	kilometre
kph	kilometres per hour
kV	kilovolt
kV/m	kilovolts per metre
kW	kilowatt
L	litre
L_{Aeq}	Amenity Criterion
m	metre
m^2	square metres
m^3	cubic metres
mG	milligauss
mm	millimetre
m^3/h	cubic metres per hour
mHz	mega hertz
ML	mega litre
m/s	metre per second
MVA	megavolt Ampere
MW	megawatt
MWh	megawatt hours
MWh/y	megawatt hours per year
%	percent
rpm	revolutions per minute
y	year
µT	microTesla

GLOSSARY

Ambient Noise	The all-encompassing noise associated with a given environment. It is the composite of sounds from many sources, both near and far.
Artefact Locale	The exact location of where the artefact was found within the Project site.
Asset Protection Zone	Is land cleared of vegetation, designed to protect assets (houses, buildings, etc.) from potential bushfire damage.
Biodiversity	First coined in 1998 as a contraction of biological diversity; diversity traditionally referring to species richness and species abundance. Biodiversity has been defined subsequently as encompassing biological variety at a genetic, species and ecosystem scales (DASETT 1992). The maintenance of biodiversity, at all levels, is acknowledged internationally as a high conservation priority, and is protected by the International Convention of Biological Diversity 1992.
Biodiversity Banking	The Biodiversity Banking and Offset Scheme (Biobanking) has been established by the NSW DECC to help address loss of biodiversity and threatened species.
Bund	An earthwork or wall to contain and control spillages, normally associated with fuelling and chemical storage facilities.
Buried Earth Grid	Refers to physically connecting a part of an electrical system to the ground, carried out as a safety measure, be means of a conductor embedded in the earth.
Capacity Factor	Factor used to account for variation in wind speeds at the site and minor electrical losses when determining the electricity output of a wind farm compared to its installed capacity.
Clusters	A group of wind turbines which are likely to be constructed and commissioned in one stage.
Conditions of Approval	Conditions of Development Consent provided by the relevant State and Federal approval authority.
Construction Environmental Management Plan	An element of an Environmental Management Plan that addresses the control, training and monitoring measures to be implemented during the construction phase of a project in order to avoid, minimise or ameliorate potentially adverse impacts identified during environmental assessments.

Crown Land	Land that is owned and managed by State Government. Crown land accounts for over half of all land in NSW and includes Crown lands held under lease, licence or permit, community managed reserves, lands retained in public ownership for environmental or travelling stock route purposes, land within the Crown public roads network, and other unallocated lands.
Cumulative Impact	Refers to the accumulation of impacts at a locality from a range of developments of similar or different type over time.
dBA	The noise level in decibels, obtained using the 'A' weighted network of a noise level meter as specified in Australian Standards AS 1259-1990 Noise Level Meters. The 'A' weighting is designed to adjust the noise level (very approximately) in line with human hearing.
Development Consent	Issued by the relevant State and Federal authority including a date of endorsement, a date of expiration and a list of Conditions of Approval that must be adhered to while building the Project.
Development Footprint	The impact area from all proposed infrastructure related to the Project.
Ecologically Sustainable Development	Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future can be increased. Incorporates four key principles: the precautionary principle; inter-generational equity; conservation of biological diversity and ecological integrity; improved valuation and pricing of environmental resources.
Effective Survey Coverage	A percentage estimate of the proportion of the Survey Unit which provided the potential to view archaeological material.
Endangered Ecological Community	A community listed under Schedule 1, Part 3 of the NSW *Threatened Species Conservation Act 1995*.
Environment	The physical, biological, cultural, economic and social characteristics of an area, region or site.
Environmental Assessment	For a development that constitutes a Major Project under the State Environmental Planning Policy - Major Project, prepared pursuant to the *Environmental Planning and Assessment Act 1979*. The term is a legacy of the now repealed Part 3A and no longer applies to the Project.

Environmental Impact Statement	For a development that constitutes a State Significant Development under the State Environmental Planning Policy – State and Regional Development, prepared pursuant to the *Environmental Planning and Assessment Act 1979*.
Environmental Management Plan	The control, training and monitoring measures to be implemented during the design, construction and operation phases of a project in order to avoid, minimise or ameliorate potentially adverse impacts, identified during environmental (being socio-economic, cultural, physical, biological) assessments.
Fauna	Animals
Flora	Plants
Fresnel Zone	In optics and radio communications the Fresnel zone is an elliptical region surrounding the line of sight path between transmitting and receiver antennas which must be obstruction free for a microwave radio link to work without interference.
Geotechnical	Relating to the form, arrangement and structure of the geology.
Grid	With reference to electricity, the electrical transmission and distribution network.
Groundwater	All water which is below the surface of the ground in the saturation zone and in direct contact with the ground of the soil.
Hydrology	Surface water and groundwater and their interaction with earth materials.
Indigenous Objects and Sites	A place where physical remains or modification of the natural environment indicate the past and 'traditional' activities by Aboriginal people. Site types include artefact scatters, isolated artefacts, burials, shell middens, scarred trees, quarries and contact sites.
Installed Capacity	The maximum electrical output of wind turbines installed in a wind farm.
LA_{eq}	The average noise level over the sample period.
Locality	Area encompassing all lands within a 10 km radius around the Project site.
Monitoring	The checking of impacts of a proposal or an existing activity in order to improve or evaluate environmental management practices; To check the

	efficiency and effectiveness of the environmental impact assessment process; To determine if the requirements of environmental legislation and associated regulations are being met.
Operational Environmental Management Plan	An element of an Environmental Management Plan that addresses the control, training and monitoring measures to be implemented during the operational phase of a project in order to avoid, minimise or ameliorate potentially adverse impacts identified during environmental assessments.
Peak Demand	The greatest demand for electricity in a stated period of time, such as the greatest demand during a week or a year.
Photomontages	A composite image combining two or more photographs.
Precautionary Principle	The precautionary principle states that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Procedures for Air Navigation Services	Allows aircraft to conduct an instrument approach to airports in poor weather conditions, by using a published Instrument Approach and Departure Procedures which apply varying minimum altitude requirements above terrain.
Project	Relating to construction and operation of the proposed Bango Wind Farm development.
Project Site	Land within the cadastre boundaries of all properties likely to be directly impacted by the proposal.
Proponent	In relation to an activity, means the person proposing to carry out the activity.
Ramsar	Australia is contracting party to the Ramsar Convention on wetlands. This obliges us to designate and protect wetlands of international significance.
Riparian	Relating to the banks of a natural course of water.
Risk	Likelihood of a specific undesirable event occurring within a specified period or in specified circumstances. Listed as a frequency or probability.
Risk Assessment	A process used to determine whether people and the environment are at risk (e.g. health and safety) from exposure to hazardous substances used or produced (mainly in an industrial or work place) so that appropriate control

	measures or management practices can be introduced to prevent or minimise the risk.
Rotor	The assembly of blades and hub that is used to intercept the wind, producing rotational energy.
SCADA	Supervisory Control and Data Acquisition system. The term implies that there are two activities that are necessary: The acquisition of data (from a wind farm) and subsequent transfer to some central location, and the control of some process or equipment from this central location.
Statement of Commitments	A summary document detailing the Proponent's general management measures in relation to the Project to minimise and, where practicable, avoid impacts. The Statement of Commitments is to be used to inform Development Consent Conditions of Approval.
Study Area	200 m wide corridor in which the wind turbine footprint, roads and reticulation will be contained.
Soil Profile	A vertical section of soil, which allows for the examination of soil structure.
Survey Unit	Area defined according to landform morphological type for cultural heritage field surveys.
Topsoil	The upper layer of soil, usually containing more organic material and nutrients than the subsoil beneath it.
Transformer	A device consisting of two or more insulated coils of wire wound around a magnetic material such as iron, used to convert one AC voltage to another or to electrically isolate the individual circuits. Usually used to increase generation voltage to transmission voltage.
Visibility	Measure of extent to which particular aspects of a development may be visible from surrounding areas.
Visual Catchment	The area from which the proposed wind farm would be potentially visible.
Weed	Naturalised, non-indigenous plant species which may be noxious weeds (or agriculture), environmental weeds or any other generally undesirable introduced species.

Wetlands	Areas largely inundated with water, yet offering elevated land as a habitat for wildlife, notably waterfowl. Can be landlocked.
Wind	The movement of air, caused by heating of the atmosphere, land and sea. Usually measured as metres per second, knots or kilometres per hour.
Wind Monitoring Mast	A guyed, narrow lattice or tubular steel design mast, in this case up to 100 m in height, with anemometers and wind vanes attached at different heights on the mast, to monitor and record the wind's characteristics.
Wind Turbine	Electrical generators rotated by the movement of wind over blades that feed power into the mains electricity grid.

CHAPTER 24

References

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24. REFERENCES

American Wind Energy Association and Canadian Wind Energy Association 2009. *Wind Turbine Sound and Health Effects - An Expert Panel Review*. Prepared by W.D Colby, R. Dobie, G. Leventhall, D.M. Lipscomb, R.J. McCunney, S.T. Seilo, B. Søndergaard. Accessed January 2013, <http://www.awea.org/issues/siting/upload/Executive_Summary_AWEA_and_CanWEA_Sound_White_Paper.pdf >

AMR Interactive 2010. *Community attitudes to wind farms in NSW.* Commissioned by Department of Environment, Climate Change and Water.

Arnett, E 2005. *Relationships between bats and wind turbines in Pennsylvania and West Virginia: An assessment of fatality search protocols, patterns of fatality, and behavioural interactions with wind turbines*. Prepared for Bats and Wind Energy Cooperative.

Atlas of Living Australia (ALA) 2013. *Atlas of Living Australia* Accessed March 2013, <http://www.ala.org.au/>

Audit Office of NSW 2011. *Auditor General's Report to Parliament 2011, Volume Four.* Accessed March 2013, <http://www.audit.nsw.gov.au/ArticleDocuments/224/12_Volume_Four_2011_Transgrid.pdf.aspx>

Australian Bureau of Agricultural and Resource Economics and Science (ABARES) 2012, *Australian Groundwater Management Units*. Accessed January 2013 <http://adl.brs.gov.au/anrdl/metadata_files/pa_agmu_r9nnd_00311a01.xml >

Australian Bureau of Statistics (ABS) 2010. Environment. *1338.1 NSW State and Regional Indicators, Dec 2010.* Accessed December 2012, <http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/1338.1Main+Features5Dec+2010>

Australian Bureau of Statistics (ABS) 2011. *2011 QuickStats: Boorowa (A).* Accessed January 2012, http://www.censusdata.abs.gov.au/census_services/getproduct/census/2011/quickstat/LGA11050?opendocument&navpos=220

Australian Bureau of Statistics (ABS) 2011. *2011 QuickStats: Yass Valley (A).* Accessed January 2012, <http://www.censusdata.abs.gov.au/census_services/getproduct/census/2011/quickstat/LGA18710?opendocument&navpos=220>

Australian Greenhouse Office 2006. *National code for wind farms – a discussion paper*.

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) 2011. *Electricity and health*. Accessed January 2013, <http://www.arpansa.gov.au/pubs/factsheets/019is_electricity.pdf

Australian Research Group Pty Ltd 2003. *National renewable energy – quantitative research*. Unpublished report to Australian Wind Energy Association.

Australian Wind Energy Association (Auswind) 2006. *Best practice guidelines for the implementation of wind energy projects in Australia*.

Australian Wind Energy Association (AusWEA) 2004. *Wind farm safety in Australia*. Accessed January 2013, < http://www.synergy-wind.com/documents/BP11_Safety.pdf >

Australian Wind Energy Association and Australian Council of National Trusts 2007. *Wind farms and landscape values national assessment framework*.

Bacon, DF 2002. *Fixed-link wind-turbine exclusion zone method*. OFCOM UK. **Version 1.1**.

Baidya Roy, S, Pacala, SW & Walko, RL 2004. Can large wind farms affect local meteorology? *Journal of Geophysical Research* **109**: D19101.

Baidya Roy, S & Traiteur, JJ 2010. *Impacts of wind farms on surface air temperatures*. Accessed January 2013, <http://www.pnas.org/content/early/2010/09/28/1000493107.full.pdf>

Beyers, M & Roth, M 2012. Evaluation of Proposed NRWC Wind Farm on Local Microclimate: Preliminary Review and Work Plan. Accessed January 2013, <http://www.grapegrowersofontario.com/sites/default/files/OVIP%20Effects%20of%20NRWC%20Windfarm.pdf>

BirdLife Australia 2013. *Threatened and Migratory Species Database*. Accessed February 2013, <http://www.birdsaustralia.com.au/resources/threatened-bird-lists.html>

Boorowa Council 2012. *Boorowa Community Strategic Plan 2032.* Boorowa Council, Boorowa, NSW. Accessed January 2013, <http://www.boorowa.nsw.gov.au/images/documents/boorowa/boorowa%20community%20plan%20draft%20council%20endorsed%2023-4-2012.pdf>

Braam, H & Rademaker, LWMM 2004. *Guidelines on the Environmental Risk of Wind Turbines in the Netherlands*. Presented at the Global Wind Energy Conference, Paris, 2002. Accessed February 2012, <http://ebookbrowse.com/guidelines-on-the-environmental-risk-of-wind-turbines-in-the-netherlands-pdf-d125603296>

Brett Lane and Associates Pty Ltd associated with Aria Professional Services Pty Ltd 2005. *Wind farms and birds: Interim standards for risk assessment*. Prepared for the Australian Wind Energy Association.

British Wind Energy Association 2005. *Low frequency noise and wind turbines technical annex*. British Wind Energy Association, Renewable Energy House: London.

Bureau of Meteorology 2013. *Climate data online*. Accessed January 2013, <http://www.bom.gov.au/climate/averages/index.shtml>

Campbell, D 2009. Personal communication. Trust Power.

Canadian Epilepsy Alliance 2008. *Photosensitive epilepsy*. Accessed August 2009, <http://www.epilepsymatters.com/english/faqphotosensitive.htlm#kindsoflights>

Center for Climate and Energy Solutions 2012. Renewable Energy. Accessed October 2012, <http://www.c2es.org/technology-solutions/renewables>

Chatham-Kent Health Unit 2009. *Letter "Re: Request for Further Clarification on Health Effects of Wind Turbines"*. W. D. Colby. Accessed September 2010, <http://www.windworks.org/LargeTurbines/Dr%20Colby%20New%20Report%20June%201%20full%20version.pdf>

Chief Medical Officer of Health (CMOH) Ontario 2010. *The Potential Health Impact of Wind Turbines.* Accessed January 2013, <http://www.southpointwind.com/files/The_Potential_Health_Impact_of_Wind_Turbines_May_2010_Dr._Arlene_King.pdf>

Civil Aviation Authority 1992. *Guidelines for aeroplane landing areas*. Civil Aviation Advisory Publication 92:1(1)

Clean Energy Council 2012. *Wind Farm Investment, Employment and Carbon Abatement in Australia.* Sinclair Knight Merz Pty Ltd. Accessed January 2013, <https://www.cleanenergycouncil.org.au/dms/cec/reports/2012/CEC_WindJobsInvestment_FullReport/Wind%20Farm%20Investment%2C%20Employment%20and%20Carbon%20Abatement%20in%20Australia.pdf>

Clean Energy Regulator 2012, *About the Renewable Energy Target*. Commonwealth of Australia. Accessed January 2013, < http://ret.cleanenergyregulator.gov.au/about-the-schemes>

Committee on Environmental Impacts of Wind Energy Projects, National Research Council (NRC) 2007. *Environmental impacts of wind-energy projects*. The National Academies Press. Chapter 4: 171.

Commonwealth of Australia, The Senate 2012. *Renewable Energy (Electricity) Amendment (Excessive Noise from Wind Farms) Bill 2012.* Environment and Communications Legislation Committee. Accessed January 2013, <http://www.aph.gov.au/Parliamentary_Business/Committees/Senate_Committees?url=ec_ctte/completed_inquiries/2010-13/renewable_energy_2012/report/index.htm>

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM) *Climate Change in Australia: Technical Report 2007.* <http://www.climatechangeinaustralia.gov.au/technical_report.php >

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM) 2009. *Climate Change in Australia*: Science update 2009. **Issue 1**. <http://www.climatechangeinaustralia.gov.au/documents/resources/CC%20science%20update%202009%20issue1.pdf>

Cotton, R 2007. *Numerical Modelling of Wind Turbine Blade Throw*. Report Number ESS/2006/27. Health and Safety Laboratory, Derbyshire, UK.

Council of Australian Governments (COAG) 2004. *National inquiry on bushfire management and mitigation*. Commonwealth of Australia, March 2004. ISBN 0-646-43442-X.

David Suzuki Foundation 2009. Impacts. *Solving global warming*. Accessed December 2012, <http://www.davidsuzuki.org/Climate_Change/Impacts/>

Department of Climate Change (DCC) 2009. *National greenhouse accounts (NGA) State and Territory Greenhouse Gas Inventories*. Department of Climate Change, Canberra.

Department of Climate Change and Energy Efficiency (DCCEE) 2010. *National greenhouse accounts (NGA) factors*. Department of Climate Change and Energy Efficiency, Canberra.

Department of Climate Change and Energy Efficiency (DCCEE) 2012a Multi-Party Climate Change Committee Meeting. Accessed January 2013, <http://www.climatechange.gov.au/en/~/media/publications/committee/mpccc-dccee-climate-change-overview-pdf.ashx>

Department of Climate Change and Energy Efficiency (DCCEE) 2012b *Stationary Energy Emission Projections 2012.* Accessed December 2012, <http://www.climatechange.gov.au/~/media/government/aep/AEP-20121031-StationaryEnergy.pdf>

Department of Climate Change and Energy Efficiency (DCCEE) 2012c. *Fact Sheet: Australia's emissions reduction targets*. Department of Climate Change and Energy Efficiency, Canberra. Accessed September 2012, <http://www.climatechange.gov.au/government/reduce/national-targets/factsheet.aspx>

Department of Climate Change and Energy Efficiency (DCCEE) 2012d. *An overview of the Clean Energy Legislative Package* Department of Climate Change and Energy Efficiency, Canberra. Accessed January 2013, <http://www.cleanenergyfuture.gov.au/clean-energy-future/an-overview-of-the-clean-energy-legislative-package/>

Department of Climate Change and Energy Efficiency (DCCEE) 2012e. *The Critical Decade: International Action on Climate Change.* Department of Climate Change and Energy Efficiency, Canberra. Accessed May 2013, <http://wwwclimatecommission.gov.au/wp-content/uploads/climatecommission_internationalReport_20120821.pdf>

Department of Environment and Conservation NSW (DEC) 2004a. *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft)*. DEC, Hurstville, NSW.

Department of Environment and Conservation NSW (DEC) 2005. *Draft Guidelines for Aboriginal cultural heritage impact assessment and community consultation*.

Department of Environment and Conservation NSW (DEC) 2006. *Plan of Management Kosciuszko National Park*. Department of Environment and Conservation NSW

Department of Environment and Climate Change NSW (NSW DECC) 2009b. *Interim Construction Noise Guideline.*

Department of Environment, Climate Change and Water (DECCW) 2008. Wind Energy in NSW: Myths and Facts. <http://masg.org.au/wp-content/uploads/2008/06/Wind-Energy-In-NSW-Myths-and-Facts.pdf>

Department of Environment, Climate Change and Water (NSW DECCW) 2010a. *Aboriginal cultural heritage consultation requirements for proponents 2010*

Department of Environment, Climate Change and Water (NSW DECCW) 2010b. *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales*

Department of Health (VIC DoH) 2013. *Wind Farms, Sound and Health (Technical and Community Information).* Accessed May 2013, <http://docs.health.vic.gov.au/docs/doc/Wind-farms-sound-and-health:-Technical-information> <http://docs.health.vic.gov.au/docs/doc/Wind-farms-sound-and-health:-Community-information>

Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) 2013. Clean Technology Program. Accessed January 2013, <http://www.innovation.gov.au/INDUSTRY/CLEANENERGYFUTURE/Pages/CleanTechnologyProgram.aspx>

Department of Infrastructure and Transport (DIT) 2012. *National Airport Safeguarding Framework: Managing the Risk to Aviation of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers.* Accessed February 2013, <http://www.infrastructure.gov.au/aviation/environmental/airport_safeguarding/nasf/files/4.1.3_Guideline_D_Wind_Turbines.pdf>

Department of Land and Water Conservation NSW 1994. *Guidelines for planning, construction and maintenance of tracks.*

Department of Planning and Environment (DP&E) 2011. *NSW Planning Guidelines: Wind Farms. A resource for the community, applicants and consent authorities*. Accessed December 2012, <http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=5yeY6yw_wRE%3D&tabid=205&mid=1081&language=en-AU>

Department of Planning and Environment (DP&E) 2012. *Major Project Register*. Accessed December 2012, <http://majorprojects.planning.nsw.gov.au/page/>

Department of Premier and Cabinet (NSW DPC) 2011. *NSW 2021: A Plan to Make NSW Number One.* Accessed January 2013, < http://www.2021.nsw.gov.au/ >

Department of Primary Industries (DPI) 2011a. MinView 2 Build 104. Titles Data. Accessed April 2013, <http://minview.minerals.nsw.gov.au/mv2web/mv2>

Department of Primary Industries (DPI) 2012 *Submission to Department of Planning and Infrastructure re Draft NSW Planning Guidelines: Wind Farms*. Accessed February 2013, <http://www.planning.nsw.gov.au/LinkClick.aspx?fileticket=I87Ed4nrJaU%3d&tabid=205&mid=1081&language=en-US >

Department of Environment (DoE) 2013. *Protected Matters Search Tool*. Accessed March 2013, <http://www.environment.gov.au/epbc/pmst/index.html>

Department of Territory and Municipal Services (DTAMS) 2010. *Namadgi National Park Plan of Management 2010*. Department of Territory and Municipal Services, Canberra.

Department of Trade and Industry 2006. *The Measurement of Low Frequency Sound at Three UK Wind Farms*. Hayes and McKenzie Partnership LTD. Accessed December 2009, <http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk//whatwedo/energy/sources/renewables/explained/wind/onshore-offshore/page31267.html>

Department of Trade and Investment (NSW DTI) 2012. *Draft NSW Renewable Energy Action Plan*. NSW Government. Accessed January 2013, <http://haveyoursay.nsw.gov.au/renewableenergy>

Devereux, CL, Denny, MJH & Wittingham, MJ 2008. Minimal effects of wind turbines on the distribution of wintering farmland birds. *Journal of Applied Ecology*. **45**: 1689 – 1694.

EDP Renewables 2005. *Wild Horse Wind Power Project: Final Environmental Impact Statement*. Accessed December 2012, < http://www.efsec.wa.gov/wildhorse/feis/whfeis.shtm>

Elsam Engineering 2004. *Life cycle assessment of offshore and onshore sited wind farms*. Accessed December 2012, <http://130.226.56.153/rispubl/NEI/nei-dk-4908.pdf>

Energy Networks Association 2006. *Electric and magnetic fields, what we know*. Accessed January 2013, < http://www.ena.asn.au/udocs/2009/08/Electric-and-Magnetic-Fields-What-we-know.pdf >

Environment Protection and Heritage Council 2010. *National wind farm development guidelines – Public Consultation Draft*.

Epilepsy Action Australia 2008. *Understanding epilepsy, photosensitive epilepsy*. Accessed August 2009, <http://www.epilepsy.org.au/photosensitivity.asp>

Erickson, WP, Johnson, G D, Strickland, MD, Young Jr, DP, Sernka, KJ and Good, RE 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 Coordinating Committee Publication.

Environmental Resource Management (ERM) 2008. *Gullen Range Wnd Farm, Landscape and Visual Assessment*.

Garnaut, R 2008. *Garnaut climate change review*. Cambridge University Press. Gale S.J. and R.J. Haworth. 2004. *Catchment-wide soil loss from pre-agricultural times to the present: transport and supply limitation of erosion*. Geomorphology **58** (3-4) 314-333

Geoscience Australia 2011. *Australian Stratigraphic Names Database*. www.ga.gov.au.

Greenfleet 2010. *Technical information*. Accessed December 2012, <http://www.greenfleet.com.au/TechnicalInformation/TechnicalInformation.aspx>

Global Wind Energy Council (GWEC) 2011*. Global wind statistics 2011*. Accessed December 2012, <http://gwec.net/wp-content/uploads/2012/06/GWEC_-_Global_Wind_Statistics_2011.pdf>

Hafemeister, D 1996. Power line fields and public health, Background paper. *American Journal of Physics* **64**: 974-981.

Hall, N, Ashworth, P and Shaw, H 2012. *Exploring community acceptance of rural wind farms in Australia: a snapshot*. CSIRO Science into Society Group, Commonwealth Scientific and Industrial Research Organisation.

Health Protection Agency 2004. *Substations and electromagnetic fields*. Accessed January 2013, <http://www.hpa.org.uk/Topics/Radiation/UnderstandingRadiation/InformationSheets/info_SubstationsAndEmfs/ >

Henderson and Horning Property Consultants 2006. 19.1 *Land value impact of wind farm development, Crookwell, New South Wales*. Prepared for Taurus Energy Pty Ltd.

Hird, C 1991 *Soil Landscapes of the Goulburn 1:250,000 Sheet*. Soil Conservation Service of NSW, Sydney.

Hoen, B 2011. *Wind Facility Effects on Nearby Property Values: The Emerging "Valley" Landscape.* Lawrence Berkeley National Laboratory. Accessed January 2013, <http://192.174.58.155/newengland/pdfs/2011_conference/hoen.pdf>

Horner and MacLennan and Envision 2006. *Visual representation of windfarms – Good practice guidelines*. Scottish Natural Heritage, Inverness, Scotland.Hughes, J. and Anslow, M. 2007. Power On. *The Ecologist*. **37**(9): 35-44.

Illinois Department of Natural Resources 2007. *The possible effects of wind energy on Illinois birds and bats*. Report of the Illinois Department of Natural Resources to Governor Rod Blagojevich and the 95th Illinois General Assembly.

Intergovernmental Panel on Climate Change (IPCC) 2007. *Climate change 2007: The physical science basis. Contribution of working group I to the fourth assessment report of the Intergovernmental Panel on Climate Change*. S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds). Cambridge University Press: Cambridge and New York.

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.

Jain, A, Kerlinger,P, Curry, R &Slobodnik, L 2007. *Annual report for the Maple Ridge Wind Power Project: post-construction bird and bat fatality study- 2006*. Report to PPM Energy and Horizon Energy and Technical Advisory Committee for the Maple Ridge Project Study, McLean, Virginia, USA. Curry and Kerlinger LLC, McLean, Virginia, USA.

Johnson, G, Erickson, W, White, J and McKinney, R 2003. *Avian and bat mortality during the first year of operation at the Klondike phase I wind project, Sherman County, Oregon*. Draft report prepared for Northwester Wind Power.

Kammen, D 2003. *Applicant's Prefiled Direct Testimony - Daniel Kammen*, in the Matter of Application No. 2003-01: Sagebrush Power Partners, LLC; Kittitas Valley Wind Power Project. Exhibit 39 (DK-T). State of Washington Energy Facility Site Evaluation Council.

Kerlinger, P, Curry, R, Culp, L, Lain, A, Wilkerson, C, Fischer, B & Hesch, A 2006. *Post-construction avian and bat fatality monitoring study for the High Winds Wind Power Project, Solano County, California: two year report*. Prepared for FPL Energy and Mountaineer Wind Energy Center Technical and Review Committee. Prepared by McLean, NJ and Curry and Kerlinger LLC.

Kevin Mills and Associates 2005. *Flora and fauna assessment Capital Wind Farm Southern Tablelands, NSW*. Prepared for Capital Wind Farms, March 2005.

Kunz, TH, Arnett, TH, Erickson, WP, Hoar, AR, Johnson, GD, Larkin, RP, Strickland, MD, Thresher, RW & Tuttle, MD 2007. *Ecological impacts of wind energy development on bats, questions, research needs and hypothesis*. Front Ecological Environment; **5**(6), 315-324.

Landcom 2004. *Managing urban stormwater: Soils and construction*. **4th Edition**.

Liu Hai-Jun and Kang Y 2006. Effect of sprinkler irrigation on microclimate in the winter wheat field in the North China Plain, *Agricultural Water Management*, 84, 3-19.

MAP Marketing 2008. *Western Australia top 20 tourist destinations checklist*. Australian Signatures. Accessed January 2013, <http://www.australiansignatures.com.au/PDF/WA.pdf>

Martinez, E, Sanz, F, Pellegrini, S, Jimenez, E & Blanco, J 2009. Life cycle assessment of a multi-megawatt wind turbine. *Renewable Energy*. **34**: 667-673.

McAlpine, K 2012 Submission to Legislative Assembly Public Accounts Committee (Parliament of NSW) Inquiry into the Economics of Energy Generation. Vestas Australian Wind Technology Pty Ltd. Accessed December 2012, <http://www.parliament.nsw.gov.au/Prod/parlment/committee.nsf/0/1a37e39daab215b5ca2579b20001f727/$FILE/Sub.%2024%20-%20Vestas.pdf>

National Health and Medical Research Council 1989. Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields. *Radiation Health Series* **30**. Australian Radiation Laboratory.

National Health and Medical Research Council 2009. *Wind Turbines and Health - A Rapid Review of the Evidence.* Accessed January 2013, <http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/evidence_review_wind_turbines_health%20.pdf >

National Research Council 2007. *Environmental Impacts of Wind-Energy Projects*. Pre-publication copy. Accessed April 2013, <http://www.vawind.org/assets/nrc/nrc_wind_report_050307.pdf>

New South Wales Catchment Management Authority (NSW CMA) 2013. *Lachlan (Kalare) Catchment Action Plan 2013-2023.* <http://www.lachlan.cma.nsw.gov.au/downloads/Catchment_Action_Plan/Lachlan_CAP2013_-2023_web.pdf>

New South Wales Environmental Protection Agency (NSW EPA) 2000. *NSW Industrial Noise Policy.* New South Wales Greenhouse Office (NSW GO) 2005. NSW Greenhouse Plan. <http://www.environment.nsw.gov.au/resources/climatechange/2811FINALNSWGHPlanweb.pdf>

New South Wales Office of Water (NOW) 2010. *State of the Catchments 2010 – Groundwater*, Central West region.

New South Wales Office of Water (NOW) 2012. *Guidelines for riparian corridors on waterfront land.* NSW Department of Primary Industries

New South Wales Rural Fire Service (NSW RFS) 2008. *A Guide to Developing a Bushfire Evacuation Plan*. Planning and Environmental Services, NSW Rural Fire Service, July 2004.

New South Wales Rural Fire Service (NSW RFS) 2008. *Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees. Annex B to Bush Fire Coordinating Committee Policy No. 1/2008 Bush Fire Risk Management*.

New South Wales Valuer General 2009. *Preliminary assessment of the impact of wind farms on surrounding land values in Australia*. Prepared by PRP Valuers and Consultants.

NGH environmental 2008. *Proposed development of the Gullen Range Wind Farm Southern Tablelands New South Wales environmental assessment*. Prepared for Gullen Range Wind Farm Pty Ltd a subsidiary of Epuron.

Nuridin, R 2009. *Wind farm, an asset* in Letters to the Editor. *Cooma-Monaro Express*. 9 April, Page 6.

Office of Environment and Heritage (OEH) 1987, *NSW Wetlands*. GIS dataset. <http://mapdata.environment.nsw.gov.au/geonetwork/srv/en/main.home>

Office of Environment and Heritage (NSW OEH) 2011a. *Bioregions Overview*. Accessed January 2013, <http://www.environment.nsw.gov.au/bioregions/BioregionOverviews.htm>

Office of Environment and Heritage (NSW OEH) 2011b. *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW.*

Office of Environment and Heritage (NSW OEH) 2011c. *NSW Wind Farm Greenhouse Gas Savings Tool*. Accessed May 2013, <http://www.environment.nsw.gov.au/ggecapp/CalculatorStandard.aspx>

Office of Environment and Heritage (NSW OEH) 2012a. *Power use in NSW*. Accessed December 2012, <http://www.savepower.nsw.gov.au/get-the-facts/power-use-in-nsw.aspx>

Office of Environment and Heritage (NSW OEH) 2012b. *Waste Classification Guidelines.* Accessed January 2013, <http://www.environment.nsw.gov.au/waste/classification.htm>

Office of Environment and Heritage (NSW OEH) 2012c. *Biometric Vegetation Type Database May 2012.* Accessed January 2013, <http://www.environment.nsw.gov.au/biobanking/vegtypedatabase.htm>

Office of Environment and Heritage (NSW OEH) 2013a. *NSW Natural Resources Atlas.* Accessed March 2013, http://nratlas.nsw.gov.au/wmc/custom/homepage/home.html

Office of Environment and Heritage (NSW OEH) 2013b. *Threatened Species Database (10km radius search).* Accessed March 2013, <http://www.environment.nsw.gov.au/threatenedspecies/>

Office of the Commissioner for Sustainability and the Environment (OCSE) 2009a. *Regional State of the Environment Report 2004 – 2009. Yass Valley* Accessed January 2013, <http://www.envcomm.act.gov.au/soe/rsoe2009/yassvalley/index.shtml>

Office of the Commissioner for Sustainability and the Environment (OCSE) 2009b. *Regional State of the Environment Report 2004 – 2009. Boorowa* Accessed January 2013, <http://www.envcomm.act.gov.au/soe/rsoe2009/boorowa/index.shtml>

Owen, Anthony D 2009. *Inquiry into electricity supply in NSW*. Energy Policy **37**(2) 570-576.

Pedersen, E, Van den Berg, F, Bakker, R & Bouma, J 2009. *Response to sound from modern wind farms in The Netherlands.* Journal of Acoustical Society of America **126**(2) 634 – 643.

Power System Planning and Development (PSPD) 2009. *NTS consultation: Issues paper*. NEMMCO.

Pyrenees Shire Coucil 2012. *Minutes of the Ordinary Meeting of Council held Tuesday 21st August 2012 at6.00pm at the Council Chamber Beaufort.* Accessed January 2013, <http://www.pyrenees.vic.gov.au/Your_Council/Councillors/Council_Meetings/21082012>

Qdos Research 2012. *Community perceptions of wind farms*. Commissioned by Infigen Energy Pty Ltd

Rogers, J, Slegers, N & Costello, M 2011*. A method for defining wind turbine setback standards.* Wind Energy (2011), published online in Wiley Online Library (wileyonlinelibrary.com) DOI: 10.1002/we.468

Royal Institute of Chartered Surveyors (RICS) 2004. *Impact of wind farms on the value of residential property and agricultural land.*

Sagebrush Power Partners 2007. *Kittitas Valley Wind Power Project: Final Environmental Impact Statement*. Accessed January 2013, <http://www.efsec.wa.gov/kittitaswind/FEIS/kvfeis.shtml>

Sinclair Knight Merz (SKM) 2010. *Economic Impact Assessment of the Hallett Wind Farms*. Prepared by SKM for AGL Energy Ltd.

SLR 2011. *Noise Impact Assessment for Sapphire Wind Farm Environmental Assessment*. Report prepared for CWP Renewables, Newcastle, NSW.

Smales, I 2005. *Modelled cumulative impacts on the White-bellied Sea-eagle of wind farms across the species' Australian range*. Report prepared by Biosis Research Pty Ltd for the Department of Environment and Heritage.

Smales, I & Muir, S 2005. *Modelled cumulative impacts on the Tasmanian Wedge-tailed Eagle of wind farms across the species' range*. Biosis research report to the Department of Environment and Heritage.

Smart and Aspinall 2009. *Water and the Electricity Generation Industry, Implications of use.* Commissioned by the National Water Commission on Key Water Issues, produced by ACIL Tasman and Evans and Peck.

South Australia Environmental Protection Agency (SA EPA) 2003. *Noise Guidelines for Wind Farms*.

South Gippsland Shire Council 2013. *Council Demonstrates 'fair go.'* Accessed January 2013, <http://www.southgippsland.vic.gov.au/Page/Page.asp?Page_Id=1204>

Southern Regional Fire Association 1994*. Improving Bushfire Management for Southern New South Wales.* Southern Regional Fire Association, New South Wales/Stephen Dovey.

Standards Australia 2009. *AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines*.

Standards Australia 2009*. AS/NZS 60076.10:2009 Power Transformers – Determination of Sound Levels*

Takle, G & Lundquist, J 2010. Wind turbines on farmland may benefit crops. Ames Laboratory. Accessed January 2013. <http://www.ameslab.gov/news/news-releases/wind-turbines>

Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd 2007. NSWLEC 59.

Telstra 2011. *Telstra 3G and GSM coverage*. Accessed May 2013, <http://www.telstra.com.au/mobile/networks/coverage/broadband.html>

The Sustainable Energy Development Authority of NSW (TSEDA NSW) 2002. *NSW Wind Energy Handbook 2002.* Accessed January 2013, <http://www.trade.nsw.gov.au/__data/assets/pdf_file/0003/306048/nsw-wind-energy-handbook.pdf >

Transpower 2009. *Fact sheet 3: Electric and magnetic field strengths*. Transpower. Accessed January 2013, <https://www.transpower.co.nz/sites/default/files/publications/resources/EMF-fact-sheet-3-2009.pdf >.

Tremeac, P & Meunier, F 2009. *Life cycle analysis of 4.5 MW and 250 W wind turbines*. Renewable and Sustainable Energy Reviews **13**(8): 2104-2110

United Nations Framework Convention on Climate Change (UNFCCC) 2012. *Doha Amendment to the Kyoto Protocol Article 1: Amendment. Annex B to the Kyoto Protocol*. Accessed January 2013, <http://unfccc.int/files/kyoto_protocol/application/pdf/kp_doha_amendment_english.pdf>

US Department of Interior Fish and Wildlife Service 1993*. Service Interim Guidance on avoiding and minimizing wildlife impacts from Wind Turbines.*

Verve Energy 2008. *Grasmere Wind Farm - Project Description and Updated Environmental Assessment*. **Volume 1***.*

Victorian Country Fire Authority 2012. *Emergency Management Guidelines for Wind Energy Facilities (Version 4 – February 2012).*

Vodafone 2011. *Vodafone 3G network coverage*. Accessed March 2013, <http://www.vodafone.com.au/personal/services/coverage/maps/index.htm>

Wattle Range Council 2013. *Wattle Range Tourism: Windfarm Tourist Drive.* Wattle Range Council, Millicent, SA. Accessed January 2013 <http://www.wattlerange.sa.gov.au/page.aspx?u=353>

White, I & Cane, S 1986 *An Investigation of Aboriginal Settlements and Burial Patterns in the Vicinity of Yass.* Report to the NSW NPWS, Queanbeyan.

CWP Renewables 2009. *Boco Rock Wind Farm Environmental Assessment*. CWP Renewables, Newcastle, NSW.

Windrush Energy 2004. The health effects of magnetic fields generated by wind turbines. *Grand Valley Project Environmental Screening Review Appendix D*. Accessed January 2013, <http://www.windrush-energy.com/update%20Jul%2024/Appendix%20D%20-%20Magnetic%20Field%20Survey/Magnetic%20Field%20Report.pdf >

World Health Organisation 1999. *WHO Guidelines for Community Noise.* World Health Organisation, Geneva, Switzerland.

Yass Valley Council 2011. *Yass Valley 2030 – Our Valley, Our Future: Community Strategic Plan 2011-2030.* Yass Valley Council, Yass, NSW. Accessed January 2013, <http://www.yass.nsw.gov.au/images/documents/yassvalley/Governance/Council%20Documents/communitystrategicplan2011-2030final.pdf>

Zhou L, Tian, Y, Roy, SB, Thorncroft, C, Bosart, LF & Hu, Y 2012. Impacts of wind farms on land surface temperature*. Nature Climate Change* 2, 539–543