Liverpool Range
Wind Farm

Environmental Assessment | July 2014

MP10-0225

EPURON

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Prepared By:

Epuron Pty Ltd
Level 11, 75 Miller Street
North Sydney NSW 2060
AUSTRALIA

www.epuron.com.au

Foreword

Epuron is pleased to submit this proposal to build the Liverpool Range Wind Farm. This wind farm will provide multiple opportunities to capture much needed investment and job creation in the local area and also brings environmental benefits that clean, green, renewable energy provides to the wider community.

Wind farms play a vital role in delivering renewable energy to meet New South Wales and Australia's growing demand for cleaner sources of electricity. They also reduce harmful greenhouse gas emissions and help to secure a more sustainable future.

Epuron strives to ensure that its projects are developed in a manner that recognises the importance of an ongoing, long-term relationship with its landowners and the local community.

We believe this renewable energy project enjoys the support of the majority of people living in the local community and trust this application demonstrates our thoroughness and allows you to make an informed decision on the project's merits.

In preparing this Environmental Assessment for the Liverpool Range Wind Farm we would like to thank the many stakeholders and community members that have provided their feedback and contribution towards its preparation.

Sincerely,

Martin Poole
Executive Director

Andrew Durran
Executive Director

Addendum 21 March 2014

The Environmental Assessment for the Liverpool Range Wind Farm (MP10-0225) was prepared in accordance with Part 3A of the Environmental Planning and Assessment Act 1979. On 07 July 2014 the NSW Department of Planning and Environment advised that the Environmental Assessment was adequate for public exhibition.

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

For clarity when reading this Environmental Assessment and relevant attachments any reference to Part 3A is to be read as a reference to State Significant Development (Division 4.1 of Part 4, Environmental Planning and Assessment Act 1979).

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1 Executive Summary

1.1 Introduction

The purpose of the executive summary is to provide an overview of the key elements of the proposed Liverpool Range Wind Farm, a 288 turbine wind farm project located to the east of Coolah and northwest of Cassilis, New South Wales. The site is approximately 325 km northwest of Sydney in the New England Tablelands and is located on freehold and leasehold land within and adjacent to agricultural areas, predominantly used for grazing sheep and cattle.

The site has been selected for its exposed windy ridges, cleared grazing land and proximity to the national electricity grid. The majority of land in the region is currently used for commercial agriculture (sheep and cattle grazing) and has been cleared and grazed over many decades.

The Environmental Assessment (EA) has been prepared to assess the potential environmental impacts and highlight the key benefits associated with the development of the Liverpool Range Wind Farm. The project will be assessed as State Significant Development (SSD) under Part 4 of the NSW Environmental Planning and Assessments Act 1979.

The Proponent for the project is Epuron Pty Ltd, an Australian renewable energy company established in North Sydney in 2003. Epuron is one of the most experienced wind energy development companies in NSW, with approved projects including Cullerin Range, Conroy's Gap, Gullen Range, Silverton and White Rock wind farms.

This executive summary provides an overview of the EA. Further details of each aspect of the EA can be found throughout the document and in the specialist studies that are appendices to this EA.

Figure 1-1 A cleared ridgeline forming part of the Liverpool Range Wind Farm

1.2 Project Outline

The Liverpool Range Wind Farm would involve the construction, operation and maintenance of up to 288 wind turbines, together with the ancillary structures, access tracks and electrical infrastructure required to connect the project into the existing national electricity network. Figure 1-2 on the following page shows the proposed turbine layout and site boundary.

This wind farm site would directly involve approximately 21 properties that are currently used for agriculture and grazing purposes. These existing uses would continue with minimal interruption from the wind farm during construction and operation.

The wind turbines would have a maximum tip height (tower plus blades) of 165 metres above ground level and would be located on a series of ridgelines running generally southwest to northeast near the towns of Coolah and Cassilis and Coolah Tops National Park.

The wind turbines would be electrically connected by a series of underground and overhead cables joining each wind turbine to one of six on-site collection substations. A new overhead powerline, rated at up to 330 kV (nominal) capacity and approximately 53 km in length, running the length of the wind farm site would connect to the six collection substations and south from the project boundary to the wind farm connection substation at Ulan. The overhead powerline will connect the wind farm to the existing 330 kV TransGrid Wellington – Wollar transmission line.

Additional permanent structures such as an operations and maintenance facility would be required as well as temporary construction facilities. Minor upgrades to local roads would be required for the delivery, installation and maintenance of wind turbines and the related facilities.

Table 1-1 Summary of the project

Aspect of the Project	*Description*
Project Summary	Construction and operation of a 288 turbine wind farm approximately 325 kilometres northwest of Sydney, NSW. The project would have the ability to produce around 2,724,700 MWh of renewable energy every year, equivalent to the average consumption of around 340,600 homes (based on a 36% capacity factor).
Infrastructure & Facilities	The site will accommodate a wind farm connection substation, up to six collection substations, overhead powerlines and an operations and maintenance facility. Access tracks approximately 5-6 metres wide (wider at bends) would connect all of the wind turbines and associated infrastructure.
Electrical Connection	Underground and overhead electrical cabling and a new overhead powerline would connect the wind turbines to the on-site collection substations and wind farm connection substation. The collection substations would include transformers to step up the voltage from 22 kV or 33 kV to 330 kV and the wind farm would be connected to the existing transmission network via connection substation into the existing TransGrid 330 kV Wellington – Wollar transmission line.
Employment	The construction phase would create up to 829 jobs in direct employment and there would be a requirement for up to 78 ongoing operation and maintenance jobs during the life of the wind farm.
Project Life	Once installed, the turbines would operate for an economic life of up to thirty years. After this time the turbines may be refurbished to improve their performance or decommissioned and removed from the site.
Environmental Benefits	Carbon Dioxide (CO_2) emissions reductions of 2,634,800 tonnes per year and an increased renewable generation source for NSW.
Installed Capacity	The project would have 288 turbines with an installed capacity in the range of 432 –1,008 MW based on 288 wind turbines at 1.5 - 3.5 MW each.

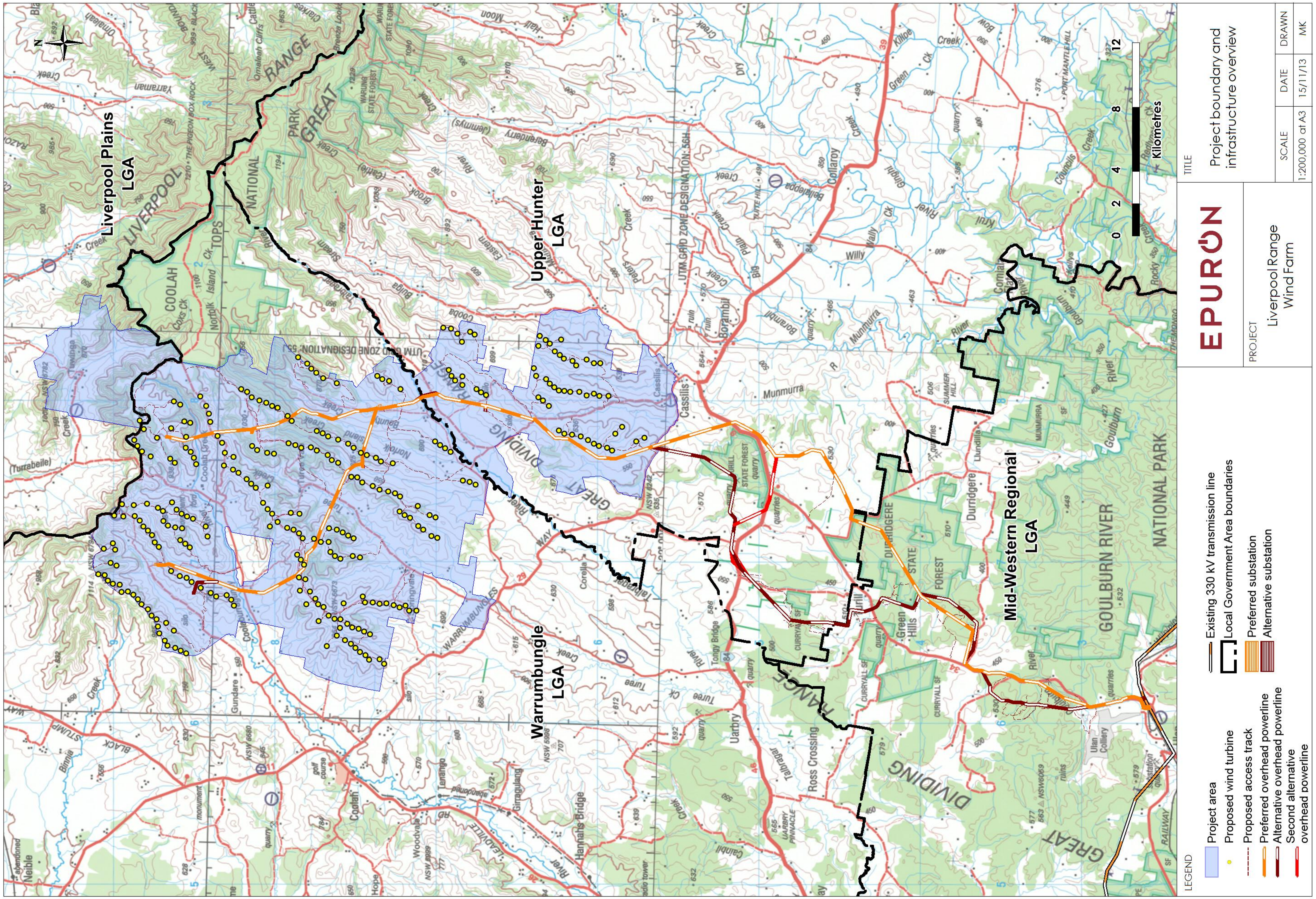


Figure 1-2 Liverpool Range Wind Farm turbine layout, proposed transmission routes and site boundary

1.3 Strategic Justification

The NSW Government has released its draft of the Renewable Energy Action Plan (REAP) to support the achievement of the national target of 20% renewable energy by 2020. The REAP positions NSW to increase the use of energy from renewable sources, such as wind energy, at least cost to the energy customer and with maximum benefits flowing to NSW.

The need for power

Primary drivers for developing renewable energy projects in NSW such as the Liverpool Range Wind Farm are: meeting a growing demand for electricity, the need for reducing greenhouse gas (GHG) emissions through clean energy generation sources, and contributing towards state and federal renewable energy targets.

Electricity consumption continues to grow, and the additional demand must be met by either increased fossil fuel generation such as coal or gas or an increase in generation from renewable sources such as wind power.

TransGrid's Annual Planning Report (2012) and AEMO's Annual Electricity Statement of Opportunities (2012) confirms that growth in demand for electricity will soon exceed supply during peak times. Over the next 10 years energy use in NSW is expected to increase at an average of 1.6% per year. By 2020 electricity demand in NSW is expected to be 87,745 GWh/an, an increase of approximately 13,000 GWh per annum over today's consumption (AEMO, 2012; TransGrid, 2012).

Meeting this demand will require our existing electricity generators to increase their annual output and the development of additional power generation will also be required. AEMO has estimated that additional power generating capacity will be required to manage peak periods in NSW by summer 2018/19. Alternative sources of generation need to be developed to meet this expected demand growth to ensure reliability of supply and avoid power outages and blackouts (TransGrid, 2012). The lead time for new generation to be available is several years.

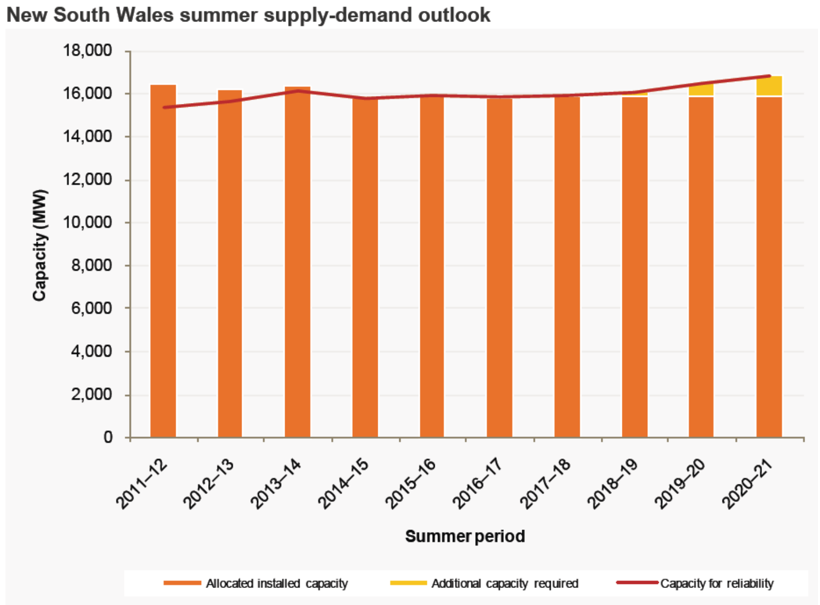


Figure 1-3 AEMO NSW Summer Generation Capacity Outlook (AEMO, 2010)

The Liverpool Range Wind Farm would contribute towards this growing demand for generation and decrease the country's dependence on fossil fuel power stations, which currently contribute over 90% of electricity generation in the National Electricity Market (NEM). The Liverpool Range Wind Farm represents a large sized wind farm with an installed capacity of around 864 MW based on a 3.0 MW turbine.

Based on the *NSW wind farm greenhouse gas savings tool* developed by the Department of Environment, Climate Change and Water (DECCW), the Liverpool Range Wind Farm will reduce greenhouse gas emissions by around 2,634,800 tonnes of carbon dioxide equivalent (CO_2e) per annum. This is equivalent to taking 717,000 cars off our roads, and will contribute to global efforts to mitigate climate change.

The Benefits to the Region

There are also benefits to the local economy through job creation and investment. The Proponent is committed to developing this project in a way which minimises the adverse local impacts while maximising the potential energy in the wind resource and the benefits to the local community.

The project offers the following benefits:

- Production of more than 2,724,700 MWh of electricity per year - sufficient for the average consumption of around 340,600 homes;
- Improvement to the security of electricity supply through diversification of generation sources and locations;
- Reduction of greenhouse gas emissions by approximately 2,634,800 t CO_2e per annum;
- Contribution to the State and Federal Governments' target of providing 20% of consumed energy from renewable sources by 2020;
- The creation of up to 829 direct employment jobs in the region during the construction phase and up to 78 permanent jobs for the life of the project; and
- An injection of up to $3,905 million into the Australian economy through the inclusion of flow on effects and multipliers.

1.4 Consideration of Alternatives

Site Selection

The site for the proposed Liverpool Range Wind Farm was fundamentally identified due to its excellent wind resource, proximity to an existing strong transmission network and the identification of willing landowners. A prefeasibility assessment revealed the site had excellent potential due to its elevated ridgelines, access via a main highway and relatively low density of residential houses.

Design Principles

Potential wind farm sites in NSW are typically located in areas with elevated ridgelines and strong prevailing winds. Due to these geographical attributes the potential turbine locations are more limited than on flatter areas such as near the coastal plains. Standard distances between turbines must be considered in conjunction with the prevailing wind conditions to avoid unnecessary turbulence that can lead to a decrease in energy yield and mechanical stress on the turbines. While the final turbine model has not yet been selected, a likely turbine size of 3.0 MW was considered when developing the layout for this EA as this presents the representative design impact.

Layout Adjustments

The design of the wind farm layout was an iterative process that sought to maximise the energy potential of the site while minimising amenity impacts to the surrounding community. Community feedback and various expert assessments were considered when adjusting the turbine locations in order to design the most appropriate layout given the surrounding environment. In some instances, turbines were relocated and in some cases deleted to minimise or avoid impacts in response to issues such as noise, ecological, heritage and community concerns.

1.5 Planning Context

State Legislation

The determination process for the proposed Liverpool Range Wind Farm is governed by the NSW Environmental Planning and Assessment Act 1979 (EP&A Act). The Liverpool Range Wind Farm will be assessed as State Significant Development (SSD) under Part 4 of the NSW Environmental Planning and Assessments Act 1979.

The Director General of the Department of Planning and Environment (DP&E) has issued requirements for Epuron to consider and address in this EA (known as the Director General's Requirements or DGRs). These requirements incorporate inputs from the various government agencies that will provide advice to the DP&E in the assessment of this proposal.

The steps in the planning determination process are outlined in Table 1-2.

Table 1-2 Planning Assessment Process

Stage of the Assessment	Description
Project Application and Preliminary Environmental Assessment	A Preliminary Environmental Assessment (PEA) is conducted by the Proponent to support the Project Application and give context to the site and potential issues that would need to be considered. This was submitted by Epuron in February 2011.
Director General Requirements (DGRs)	Using the PEA and advice from other governmental departments the Department of Planning and Environment (DP&E) issues DGRs. This is a list of issues that must be addressed by the proponent in an EA. The DGRs were issued to Epuron on 31 March 2011 and Supplementary DGRs were issued to Epuron on 16 August 2011.
Environmental Assessment and Consultation	The Proponent prepares an EA following the DGRs. This involves extensive studies to be conducted on site as well as consultation with the local community and other stakeholders.
Submission and Departmental Review of the EA	The Proponent submits the EA and supporting studies to the DP&E who undertakes a review of the EA to ensure the document is acceptable and addresses all issues raised in the DGRs. The DPI may require further work to be carried out by the Proponent.
Public Exhibition	The EA is placed on display locally and electronically for the public to review and provide feedback via submissions to the DPI. It is expected the EA will be on display for a minimum of 60 days.
Response to Submissions	The DPI provides the Proponent with a summary of issues raised in submissions. The Proponent is required to respond to each issue that is raised in the submissions and submit a Submissions Report to support the EA.
Determination	The DP&E considers the EA and the Submissions Report, preparing its advice and recommendations for the Minister for Planning and Infrastructure, and the Minister or the minister's delegate determines the application.

About This Report

This EA was prepared with the intention of providing the reader with a clear concise overview of the project details, the rationale behind the project and the issues that have been considered from a social and environmental perspective. Additional detail is provided in the attachments and appendices. The EA references these sections wherever relevant in order to aid the reader in locating the more detailed sections.

This EA document comprises the following sections and the hard copy version has been printed in two volumes:

Main Report: Environmental Assessment for the proposed Liverpool Range Wind Farm

Attachments:

Attachment 1 - Detailed Site Maps

Attachment 2 – Involved Land Parcels

Attachment 3 – Residence Coordinates

Attachment 4 – Turbine Coordinates

Attachment 5 – Letter Confirming Part 3A Position

Attachment 6 – Director General's Requirements and Supplementary Director General's Requirements

Attachment 7 – Community Consultation Plan

Attachment 8 – Consultation Material

Appendices:

Appendix A – Landscape and Visual Assessment

Appendix B – Noise Assessment

Appendix C – Biodiversity Assessment

Appendix D – Aboriginal and European Heritage

Appendix E – Traffic and Transport Assessment

Appendix F – Telecommunications Impact Assessment

Appendix G - Decommission and Rehabilitation Plan

Appendix H - Addressing the Terms of Reference (TOR) for Matters of National Environmental Significance (MNES) for the proposed Liverpool Range Wind Farm and Transmission Line

1.6 Consultation

In 2010 the NSW Government commissioned a report *'Community Attitudes to Wind Farms in NSW'* to assess residents attitudes towards targets set to achieve 20% renewable energy sources by 2020. The survey was conducted by telephone of 2022 resident's aged 18 years and older and 300 businesses across the 6 Renewable Energy Precincts, including the Upper Hunter and New England Tablelands areas and a control area in regional NSW.

One of the key findings from this study was the overall support for wind farms as a source of energy generation within the vicinity of a residence. 85% of the population across the precincts supported wind farms in NSW, with 80% supporting them within their local region, 79% supporting a wind farm being built 10 km from their residence, and 60% supporting a wind farm being built 1-2 km from their residence.

Based on this survey, including observations made by the project consultation team, it can be concluded that communities in the region are generally supportive of wind farms. The survey also showed that a majority of the population did not feel they had adequate information about wind farms, even in areas where general wind farm awareness was much greater.

Epuron prepared a Project Consultation Plan to inform and guide the community consultation and development program for the Liverpool Range Wind Farm. The Project Consultation Plan focused on providing information to the local community about the project and the assessment process and outlining the mitigation of potential impacts. The Project Consultation Plan continues to be implemented and has proved to be effective and has included individual consultation with neighbouring residents of the project, distribution of newsletters as well as an information 'Open House' day held in Cassilis in November 2012. A Community Consultation Committee has been established for the project and has currently met on four occasions prior to exhibition of the EA.

1.7 Landscape and Visual impact

The Liverpool Range Wind Farm Landscape and Visual Impact Assessment (LVIA) has been prepared by the landscape architectural consultancy and visual assessment specialist Green Bean Design (GBD). The LVIA involved a comprehensive evaluation of the visual character of the landscape in which the wind farm would be located, and an assessment of the potential significance of landscape and visual impacts that may result from the construction and operation of the wind farm, taking into account appropriate mitigation measures.

In terms of overall landscape sensitivity, the LVIA determined that in aggregate each of the five Landscape Character Areas (LCAs) within the 10 km wind farm viewshed had a medium sensitivity to accommodate change, and represented a landscape that is reasonably typical of other landscape types found in surrounding areas.

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

The LVIA identified a total of 23 potential involved and uninvolved residential view locations within the Liverpool Range wind farm 2 km viewshed. Unoccupied residential dwellings have been included and assessed as part of this LVIA where structures and buildings were considered to be potentially habitable at the time of the field work.

An assessment of each potential residential view location indicated that for the Liverpool Range wind turbine design layout:

- 1 of the 23 residential view locations has been determined to have a low visual significance;
- 3 of the 23 residential view locations have been determined to have a low to medium visual significance;
- 9 of the 23 residential view locations have been determined to have a medium visual significance;

- 9 of the 23 residential view locations have been determined to have a medium to high visual significance; and
- 1 of the 23 residential view locations has been determined to have a high visual significance.

The residential view location with a high visual significance will be an involved residential dwelling.

The LVIA determined that the majority of residential dwellings and public viewpoints located beyond the 2 km wind turbine offset are unlikely to be significantly impacted by the wind farm development. The localised influence of topography, as illustrated in the Zone of Visual Influence (ZVI) diagrams, has a direct and marked impact on the extent and nature of views within the 2 km and wider viewshed.

Taking into account the mitigation measures outlined in Section 9 of the LVIA concludes that the Liverpool Range wind farm project would have an overall low to medium visual significance on the majority of uninvolved residential view locations within the 10 km viewshed as well public view locations.

1.8 Cumulative Impacts

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

There are a number of proposed, approved and operating wind farm developments within New South Wales which are illustrated in the Appendix A of the LVIA. The number and location of wind farms is likely to change as more wind farm projects are announced and enter the planning system.

The Kyoto wind farm development is currently the only approved wind farm development in the Upper Hunter Renewable Energy Precinct. With an approval for up to 34 wind turbines, the Kyoto wind farm development has yet to commence construction. The Liverpool Range wind farm development would be located approximately 70 km to the west of the Kyoto project site, therefore the opportunity for any significant 'direct' or 'indirect' visual impacts are likely to be limited.

'Sequential' visual impacts will be limited by the absence of additional wind farm developments within the regional context and would not be expected to be significant between the approved Kyoto wind farm development and the Liverpool Range project.

1.9 Environmental Noise

SLR Consulting Australia Pty Ltd (SLR Consulting) has completed a noise impact assessment of Liverpool Range Wind Farm. The methodology and criteria used in the assessment are in line with the South Australia Environmental Protection Authority (SA EPA) Environment Noise Guidelines for Wind Farms (February 2003), World Health Organisation (WHO) limits, construction noise guidelines (DECC Interim Construction Noise Guideline 2009) and blasting impact to the ANZECC Guidelines.

Noise predictions were made from selected receptors within 6 km of a proposed turbine. Turbine noise for a layout of 288 Vestas V112 turbines has been predicted. The predicted noise levels were assessed against the relevant criteria prescribed.

The predicted noise levels of the layout were determined to meet the relevant criteria at all receptors. The project is yet to select and finalise the turbine make and model. Upon finalising turbine selection for the project a revised noise prediction and assessment will be completed to confirm compliance.

Construction noise has been predicted for all receivers; a number of these are deemed 'noise affected' under the NSW Construction Noise Guidelines. In order to ensure all appropriate measures are being taken to manage construction noise, a more detailed construction management plan should be developed by the Proponent. This document will provide detailed guidance on various noise mitigation strategies for the construction stage.

Vibration impacts from construction have been assessed and the 'worst case' scenarios modelled were found to be acceptable.

Blasting impacts have been assessed to the ANZECC Guidelines and found to be acceptable. With a maximum instantaneous charge (MIC) of up to 98 kg, the airblast overpressure is anticipated to be below the acceptable level of 115 dB Linear for all existing residences. Similarly, vibration levels are anticipated to be well below the acceptable criteria.

Construction traffic noise impacts have been assessed and the 'worst case' maximum construction traffic scenario would comply with the NSW Road Noise Policy (RNP) requirements, due to the typically large setback of dwellings from the road network. Night-time deliveries are unlikely to cause sleep disturbance based on predicted maximum noise levels.

Transmission line noise (corona noise) has also been assessed against NSW Industrial Noise Policy (INP) noise limits and has been found to be acceptable as all receiver locations are greater than 240 m from the proposed transmission line.

1.10 Ecology

Epuron commissioned a Biodiversity Assessment (BA) by NGH Environmental to assess the biodiversity impacts of the project with particular attention to threatened entities (species, populations and communities).

The ranges and undulating areas within the project area are characterised by cleared farmland, mostly derived from Box Gum Woodland on the lower slopes and flats, with Norton Box Woodland and to a lesser degree, Brittle Gum Stringybark Woodland or Mountain Gum Silvertop Stringybark Forest vegetation on the steeper sheltered slopes. Sandstone Forest is common within the flats of the southern half of the Project Area (i.e. Transmission Line study area). In particular, the composition and structure of vegetation types have been modified as a result of managed stock grazing as well as grazing by feral goats. Remnant stands of the original vegetation remain as paddock trees or larger scattered patches of forest/woodland. The midslopes and steeper ridge tops contain the majority of remnant native vegetation, from sparse to moderately treed woodlands. The pasture ranges from exotic to native species dominated. This pattern of vegetation and land use onsite is common across the locality.

Eleven vegetation types occur within the development envelope. Assessment results indicated 46 threatened species or their habitat and six endangered ecological communities could occur in the Project Area. A threatened species evaluation was undertaken to evaluate the presence of habitat in the Project Area and the likelihood of occurrence and impact from the proposal for each identified species and community. The proposal would require the removal of both TSC and EPBC listed EEC as follows:

- TSC EEC Up to 462.8 ha to be removed or modified (284.3 ha of poor or poor-moderate condition), and
- EPBC EEC Up to 23 ha to be removed or modified.

Fauna assessment results indicated 88 threatened species or their habitat could occur in the Project Area. Five species of common raptors were seen in the Project Area and include: Brown Falcon (*Falco berigora*); Nankeen Kestrel (*Falco cenchroides*); Australian Hobby (*Falco longipennis*); Black-shouldered Kite (*Elanus axillaris*); and Wedge-tailed Eagle (*Aquila audax*). Raptors were seen in a variety of landscape types, but mostly in pasture with scattered trees or along the edges of forest or woodland

The proposal has been developed with input from a biodiversity constraints analysis to assist in avoiding biodiversity impacts as a starting point. Detailed mitigation prescriptions have been developed to address the remaining risks, aimed at avoiding a significant impact on any listed threatened entity. The development of an offset strategy and agreement of an appropriate offset management plan with OEH, or other appropriate mitigation, forms part of the proposal.

The pattern of development proposed would comprise a series of sparsely distributed discrete footprints (turbines, substations and control buildings) and narrow linear footprints (transmission line and tracks). Considering the habitat within and surrounding these areas and the ecological characteristics of the Project Area, the impacts identified appear able to be managed such that significant impacts can be avoided and a maintain or improve outcome can be met for the proposal. On balance, the impacts are considered acceptable. The proposal would have benefits as the development of a large scale renewable energy project would address, to some extent, rising greenhouse gas emissions which stands to have broader far reaching negative ecological impacts.

1.11 Cultural Heritage

A Cultural and Archaeological Heritage Assessment was undertaken for the project by NSW Archaeology with involvement from the local Aboriginal community and other interested stakeholders. The assessment considered the heritage and archaeological context of the project area and included development of a methodology to help target a field survey of the study area for Aboriginal and non-indigenous heritage items.

The 17 Registered Aboriginal Parties for the project area and other stakeholders were consulted during the assessment of the project; some of these parties were included in the 15 day field survey, traversing around 169 km. Epuron would like thank these local groups and stakeholders for their contribution and assistance to the project.

The Aboriginal object locales (and any undetected and subsurface artefacts) and heritage values of the project do not surpass archaeological and cultural significance thresholds which would act to preclude the construction of the proposed wind farm.

The assessment and field survey effort has resulted in the following summary of key conclusions for the project;

- Based on a consideration of the small and discrete nature of proposed impacts and the identified archaeological and cultural values, the subject areas do not warrant subsurface test excavation.
- The level of assessment achieved during the field survey is considered to have been adequate for the purposes of determining the cultural and archaeological status of the proposal area.
- The recorded Aboriginal object locales and the predicted generally very low density subsurface artefact distribution in the proposal area does not surpass archaeological significance thresholds which would act to entirely preclude the proposal. There are no identified Aboriginal archaeological and cultural constraints.
- It is recommended that when the design is finalised, additional archaeological assessment is conducted in any areas which are proposed for development that have not been surveyed during the current assessment.
- The Proponent should, in consultation with an archaeologist, develop a Cultural Heritage Management Protocol, which documents the procedures to be followed for impact mitigation and management.
- Personnel involved in the construction and management phases of the project should be trained in procedures to implement recommendations relating to cultural heritage, as necessary.
- Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development.

1.12 Additional Issues

Traffic and Transport

The construction phase of the project generates the greatest volume of traffic and accordingly presents the most issues. A Traffic and Transport Assessment considered the potential issues associated with the proposed wind farm and provided mitigation measures to minimise and avoid such issues.

Access to the site would primarily be via the Golden Highway and the Warrumbungle Way at the southern end of the site. New unsealed tracks would be constructed to access the temporary construction compounds, operation and maintenance facility, connection substation, collection substations and the turbine locations across the site. Additional traffic generated from the project would not constitute a significant or material increase in existing volumes on the Golden Highway.

The operational phase would have a very minimal impact to traffic volumes as the turbines would be maintained by a selected crew of technicians likely to be based out of Coolah or Mudgee.

Aviation

Epuron has consulted with the relevant aviation associations in relation to air safety and potential hazards caused by the construction of turbines. The location of the proposed turbines would not encroach on an Obstacle Limitation Surface (OLS) of any registered or regulated aerodrome. The closest Civil Aviation Safety Authority (CASA) registered aerodrome to the proposed wind farm site is Coolah Aerodrome, which is 17.3 km from the closest proposed wind turbine. Epuron has consulted with Andrew Wilkes from Warrumbungle Shire Council (registered operator) and will continue to consult during the assessment process.

The presence and location of 18 active agricultural airstrips identified within 5 km of the project have been assessed and considered in the design of the wind farm to ensure turbines do not encroach on any of the existing landing areas. 8 airstrips occur within 500 m of a proposed wind turbines, yet each of these complies with the CASA take-off and approach clearance areas.

1.13 Land Management

Land Use

The wind farm project infrastructure is located on private property that is primarily used for grazing and agricultural purposes. Once operational the wind farm will have a negligible impact on normal farming operations and the agricultural capacity of the land as it would occupy only a few per cent of land from the involved landowner properties.

Hydrology and Drainage

The layout for the wind turbines and associated wind farm infrastructure has been designed with particular emphasis on protecting existing streams and ephemeral watercourses. The layout avoids crossing or interfering with watercourses wherever possible. This is to avoid and minimise any adverse impacts to the existing drainage and hydrological regime in the local area.

The water required for construction of this project will be predominantly locally sourced from natural water bodies.

Once the wind farm is completed it will require only a small volume of water. This will be obtained through the use of storage tanks collecting water runoff from any of the permanent structures.

Soils and Landforms

The project is not predicted to have any significant adverse environmental impacts on the geology or soils of the site or its surrounds, as the overall surface disturbance is relatively small in size and manner.

A detailed geotechnical assessment would be conducted once the turbine locations have been finalised to determine the ground conditions and stability at each turbine site.

An Environmental Management Plan (EMP) would be developed in accordance with the Best Practice Guidelines for Wind Energy Projects and the project consent conditions to ensure that issues such as erosion, weed control, air quality (such as dust management) and drainage are appropriately addressed.

1.14 Environmental Management

Prior to the commencement of construction works a Construction Environmental Management Plan (CEMP) will be prepared to the satisfaction of the relevant authorities to manage and mitigate environmental impacts on the wind farm site and powerline. The CEMP will incorporate all relevant processes and mitigation measures for development activity and will include:

- Traffic and Transport;
- Erosion & Sediment Control Plan;
- Landscape Management Plan;
- Soil & Water Management;
- Chemical and Fuel Storage - to avoid pollution of surface and ground waters;
- Fire Management;
- Waste Generation and Disposal; and
- Additional measures mentioned in the Statement of Commitments.

Prior to the commencement of permanent wind farm operations an Operational Environmental Management Plan (OEMP) will be prepared to the satisfaction of the relevant authorities to manage and mitigate environmental impacts on the wind farm site. The OEMP will incorporate all relevant processes and mitigation measures for wind farm operations and will include:

- Health and Safety;
- Community and Communications
- Waste Generation and Disposal; and
- Additional measures mentioned in the Statement of Commitments.

1.15 Draft Statements of Commitment

A number of Draft Statements of Commitment are proposed by the Proponent to address significant impacts predicted and are set out in Section 17 of the EA.

These Draft Statements of Commitment aim to avoid, mitigate, manage or offset all significant impacts from the development of the wind farm.

These measures will be generally incorporated and addressed in the proposed CEMP and OEMP.

1.16 Contact Information and Further Details

Address:	Epuron Pty Ltd Level 11, 75 Miller Street North Sydney NSW 2060
Phone:	(02) 8456 7400
Email:	info@epuron.com.au
Web:	www.epuron.com.au

2 Introduction

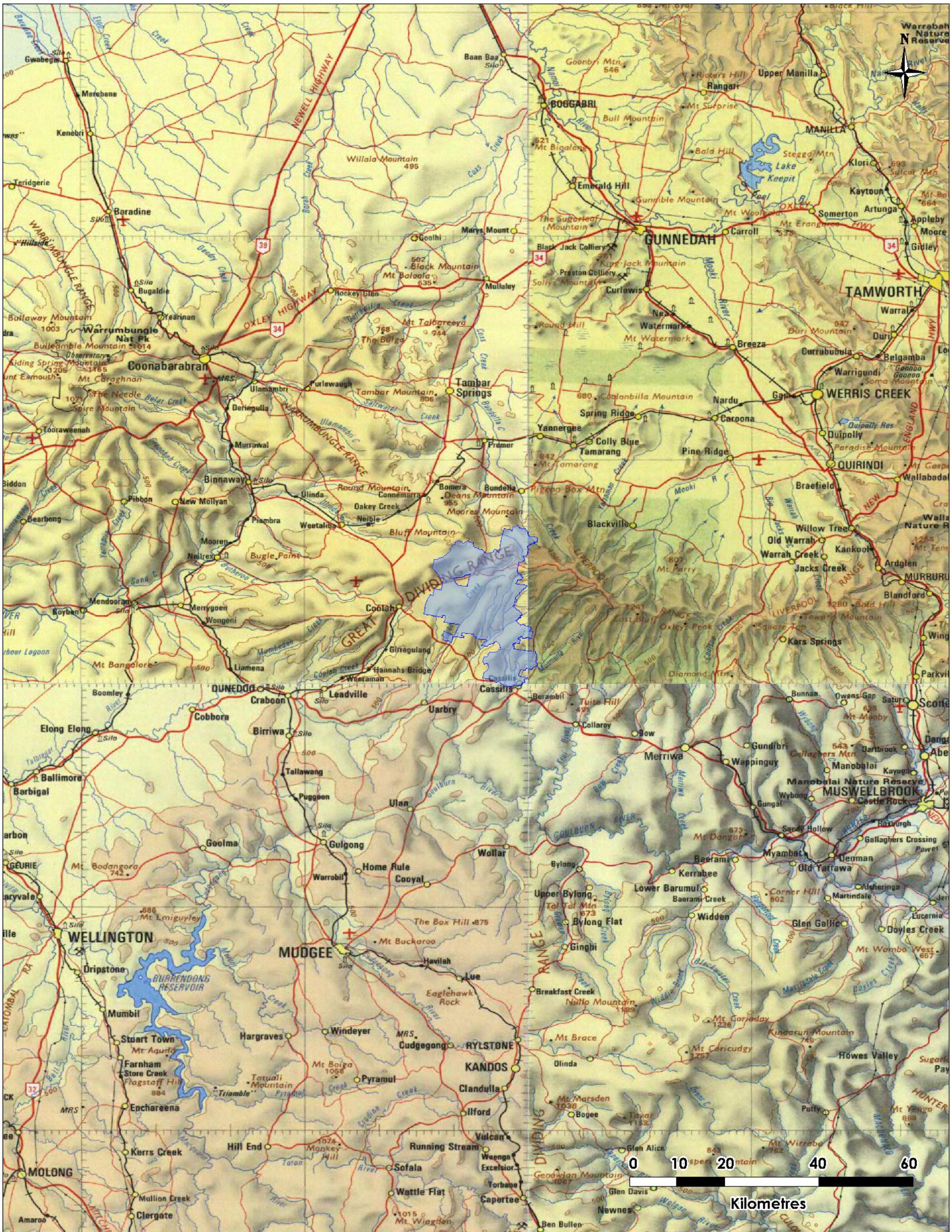
2.1 Overview of the Project

The proposed Liverpool Range Wind Farm is located in the New England Tableland region of New South Wales. The site is located between the rural centres of Coolah to the northwest and Cassilis to the southeast. The site is in close proximity to a number of proposed and constructed wind farms, as shown in Figure 2-1.

The proposed site is located on freehold land within and adjacent to agricultural areas. There are a number of local residences that surround the site; these have been identified through reviews of cadastral and topographic mapping, on-site inspection and aerial imagery.

The project would involve the construction, operation and maintenance of up to 288 wind turbines, together with the ancillary structures, access tracks and electrical infrastructure required to connect the project into the existing electricity network.

The turbines would be placed along a series of ridgelines and surrounding hilltops in order to maximise the renewable energy produced by the wind (discussed in detail in Section 3). The site would contain both wind turbines and electrical infrastructure (substations and powerlines) and continues south down a powerline corridor to connect into the existing electricity network.



LEGEND	PROJECT	TITLE		
Project area	Liverpool Range Wind Farm	Regional overview		
		SCALE	DATE	DRAWN
		1:1,000,000 at A4	08/08/13	MK

Figure 2-1 Regional overview of the proposed Liverpool Range Wind Farm

2.2 Proponents and Stakeholders

Proponent: Epuron Pty Ltd

The Proponent of the proposed Liverpool Range Wind Farm is Epuron Pty Ltd. Epuron is one of the most experienced wind energy development companies in NSW. Epuron commenced its operations in 2003 as Taurus Energy Pty Ltd and since that time, in NSW, has developed the largest wind farm, the largest number of wind farms and the largest number of wind turbines as indicated in Table 2-1.

Epuron is therefore one of the largest wind farm developers in Australia and has focussed on NSW as the most populous state which should benefit accordingly from new development.

Epuron operates out of its offices in North Sydney where it has a professional team with considerable development expertise and a proven track record. Epuron undertakes its own developments including wind monitoring, site layout and design. For environmental assessments such as ecology, archaeology, noise and visual, appropriate specialists are engaged.

Table 2-1 New South Wales wind farm projects developed by Epuron

Project	Turbines / Size	Development Status	Region
Cullerin Range	15 turbines 30 MW	Operating – now owned by Origin Energy	Southern Tablelands
Conroy's Gap	15 turbines 30 MW	Development Approved	Southern Tablelands
Snowy Plains	15 turbines 30 MW	Development Approved – now owned by Origin Energy	Monaro
Gullen Range	73 turbines	Development Approved – now owned by Goldwind Australia and under construction	Southern Tablelands
Silverton	598 turbines Stage 1 - 282 Stage 2 - 316	Joint Venture (JV) with Macquarie Capital Wind Fund – now owned by AGL Project Approval - stage 1 Concept Approval - stage 2	Far Western NSW
Yass Valley	152 turbines	Preparing Submission Report	Southern Tablelands
White Rock	119 turbines 238 MW	Development Approved	New England Tablelands
Rye Park	Up to 126 turbines	Environmental Assessment lodged	Southern Tablelands

Consent Authority: Department of Planning and Environment

The project will be assessed as State Significant Development (SSD) under Part 4 of the NSW Environmental Planning and Assessments Act 1979. The determination is to be made by the Minister or the Minister's delegate.

An additional consent is required from the Federal Government, through the Department of Sustainability, Environment, Water, Population and Communities, under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999.

An outline of the assessment processes including consultation with the community and other government agencies is found in Sections 6 and 7.

Key Stakeholders

During the development of this project, Epuron and its consultants has engaged with a number of key stakeholders including:

- local councils – Liverpool Plains Shire, Mid-Western Regional, Upper Hunter Shire and Warrumbungle Shire;
- State Government agencies – to receive specialised advice on the assessment of key issues;
- local community – involved and neighbouring or nearby landowners as well as community groups; and

- TransGrid – the high voltage transmission infrastructure that the project would connect into is owned and operated by TransGrid.

During the assessment process the Department of Planning and Environment (DP&E) will seek comments on the project from key stakeholders and relevant government agencies, which will include a review of this Environmental Assessment (EA).

2.3 Development Application Process

Purpose of this document

This EA has been prepared to support the Development Application for the Liverpool Range Wind Farm and to address the Director General's Requirements (DGRs) issued by the NSW Department of Planning and Environment.

This EA presents:

- a detailed description of the project;
- a summary of the development and assessment process;
- findings and recommendations from the detailed EA studies; and
- a description of the consultation plan Epuron is implementing in relation to this project.

Overview of the planning process

The Project will be assessed as State Significant Development (SSD) under Part 4 of the NSW Environmental Planning and Assessments Act 1979, and the federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The proposal will also have regard, where possible, to the draft NSW Wind Farm Planning Guidelines (2012).

The assessment process for the project is as follows:

- The Proponent of a Major Project first submits a Project Application for the approval of the Minister for Planning and Environment.
- The Department of Planning and Environment seeks input from key government agencies in detailing the requirements of the EA.
- The Director-General of the Department of Planning and Environment then issues the Proponent with requirements for the EA, indicating the issues to be addressed, the level of assessment required and consultation requirements. These are the DGRs.
- The DGRs may also require the Proponent to include in the EA a Statement of Commitments (SOC) the Proponent is prepared to make for environmental management and mitigation measures on the site.
- After an EA has been prepared and submitted to the DP&E, the report is placed on public exhibition for up to 60 days during which time submissions from the community, local government and state agencies are accepted.
- Following the consultation period, the Director-General may require the Proponent to respond to the submissions, revise the proposal or revise the Statement of Commitments.

Consistent with the former Part 3A requirements, this assessment was preceded by an issues scoping exercise to identify and prioritise issues related to the project. A Preliminary Environmental Assessment identifying and prioritising issues relating to the project was submitted to the Department of Planning and Infrastructure (DPI) on 11 February 2011. The DPI responded on 31 March 2011 and 16 August 2011 with the DGRs and Supplementary DGRs for this EA.

2.4 Content in this Environmental Assessment

This EA draws together a number of specialist studies investigating the potential impacts of the wind farm. The findings of these studies have been summarised into the EA and are also included as standalone documents appended to this EA. This EA concludes with a Statement of Commitments to which the Proponent would commit, pending approval of the proposal, in order to manage identified impacts.

A brief summary of the sections in this EA is as follows:

- **Section 1** – The Executive Summary aims to give a brief overview of the wind farm and how impacts will be managed.
- **Section 2** – Introduces the project and the process.
- **Section 3** – Provides a detailed description of the project and the activities involved with each stage of development.
- **Section 4** – Provides a context for the project in the form of an overview of the current energy situation and how wind energy fits in to this, including justification for the project.
- **Section 5** – Describes the alternatives considered for this project
- **Section 6** – Provides a description of the planning process
- **Section 7** – Details Epuron's community consultation process
- **Section 8** – Addresses the risk analysis of the issues identified in the DGRs
- **Section 9** – Visual and Landscape Impact Assessment
- **Section 10** – Operation and Construction Noise Impacts
- **Section 11** – Ecological Assessment
- **Section 12** – Aboriginal and European Heritage Assessment
- **Section 13** – Traffic and Transport
- **Section 14** – Hazards and Risks
- **Section 15** – Water Supply, Water Quality and Hydrology
- **Section 16** – General Environmental Assessment
- **Section 17** – Epuron's Draft Statements of Commitment
- **Section 18** – Conclusions
- **Section 19** – Glossary and Acronyms
- **Section 20** – Acknowledgement by authors of EA
- **Section 21** – EA reference documents

3 The Project

3.1 Description of the Project

Wind Farm Infrastructure

This section of the EA provides a detailed description of the project and in particular outlines the work associated with the construction and operation of the wind farm and all associated infrastructure.

This EA has assessed the impacts of locating wind farm components within an up to 200 m wide corridor across the wind farm site and powerline routes in which all proposed infrastructure will be contained (**Project Corridor**).

The main components of the proposed wind farm and grid connection infrastructure included in this application, each of which will be located within the assessed Project Corridor, are:

- ***Wind Turbines***: up to 288 wind turbines, each with:
  - a capacity between 1.5 and 3.5 MW;
  - three blades mounted on a tubular steel tower, with a combined height of blade and tower limited to a maximum tip height of 165 metres;
  - an adjacent pad mounted turbine transformer, crane hardstand area, and related turbine lay down area;
- ***Connection Substation***: a 330 kV Connection Substation located in the vicinity of Ulan, allowing connection to the existing TransGrid 330 kV Wellington - Wollar transmission line approximately 35 km to the south of the site;
- ***Main Powerline***: a double circuit overhead powerline of up to 330 kV running from the Connection Substation at Ulan to the wind farm site, and then on to the wind farm collection substations;
- ***Collection Substations***: a number of collection substations increasing the voltage from the wind turbine reticulation voltage (22 kV or 33 kV) to the main powerline voltage (330 kV);
- ***Site Reticulation***: underground and overhead 22 kV or 33 kV electrical reticulation cabling and powerlines linking the wind turbines to the Collection Substations;
- ***Access tracks***: access tracks required for each wind turbine and the related facilities above;
- ***O&M Facility***: operation and maintenance facilities incorporating a control room, maintenance and equipment storage facilities;
- ***Construction Facilities***: various construction facilities including temporary concrete batching plants, rock crushing equipment, temporary laydown facilities, and construction compounds;
- ***Road Upgrades***: minor upgrades to local roads, as required for the delivery, installation and maintenance of wind turbines and the related facilities above; and
- ***Wind Monitoring***: permanent wind monitoring masts for wind speed verification, weather and general monitoring purposes.

An overview of the wind farm layout can be seen in Figure 3-1, with more detail of the site shown in Figure 3-2. In general, high level maps are included in this chapter with more detailed maps of the wind farm site outlined in Attachment 1 – Detailed Site Maps.

Wind Farm Precincts

In designing the wind farm a number of broadly defined geographical Precincts were established as outlined in Figure 3-3. The Precincts indicate areas of turbines and infrastructure that from a construction perspective are likely to be built as a group. This potentially allows for staged construction of the project to suit future operational requirements.

In principle, each group within a Precinct is likely to connect to a common collection substation; therefore allowance has been made for at least one collection substation within each Precinct. However, it is possible that a collection substation could be used for multiple Precincts, or that multiple collection substations could be required in a single Precinct.

EPURON

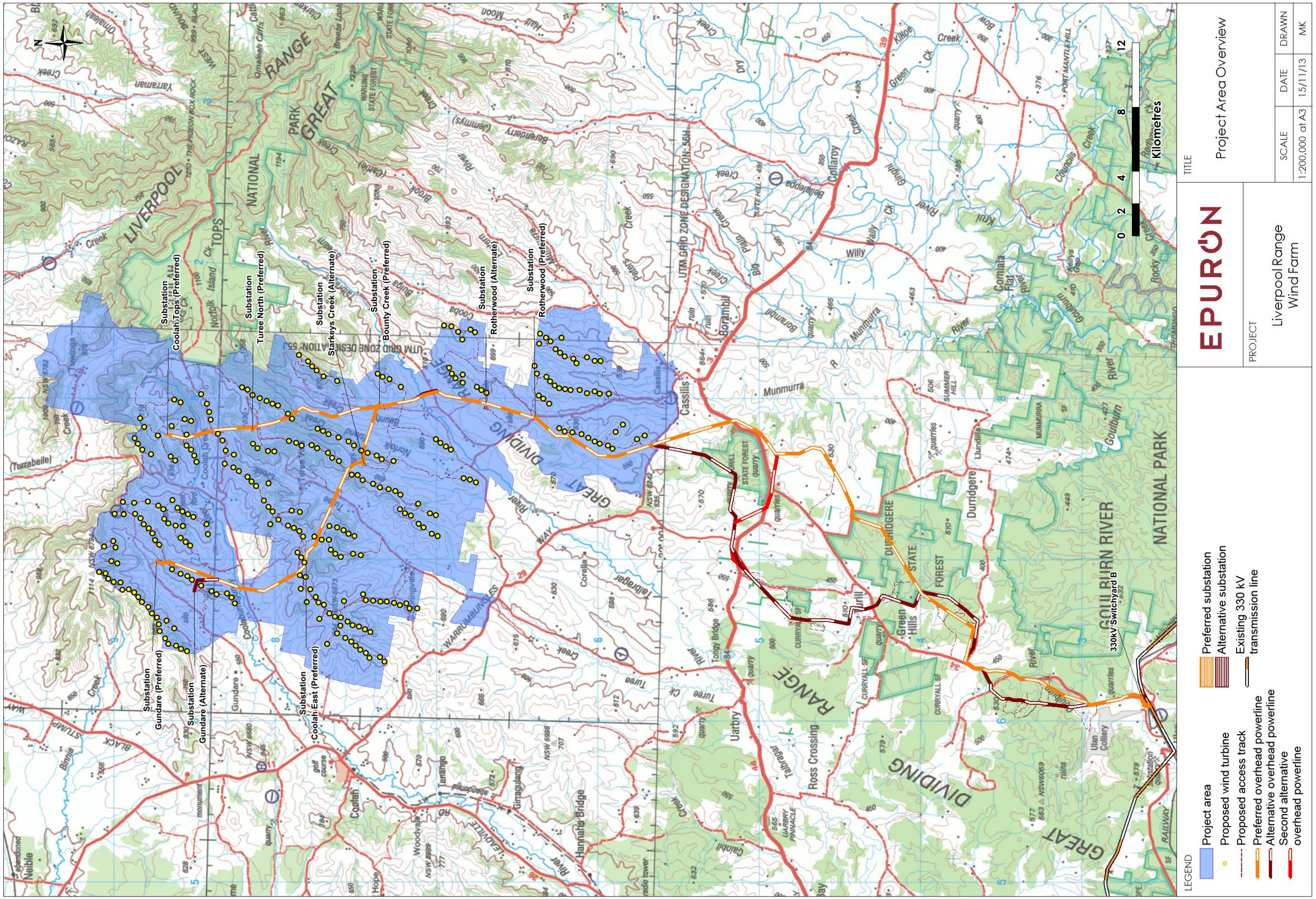


Figure 3-1 Liverpool Range Wind Farm wind turbine layout and grid connection overview

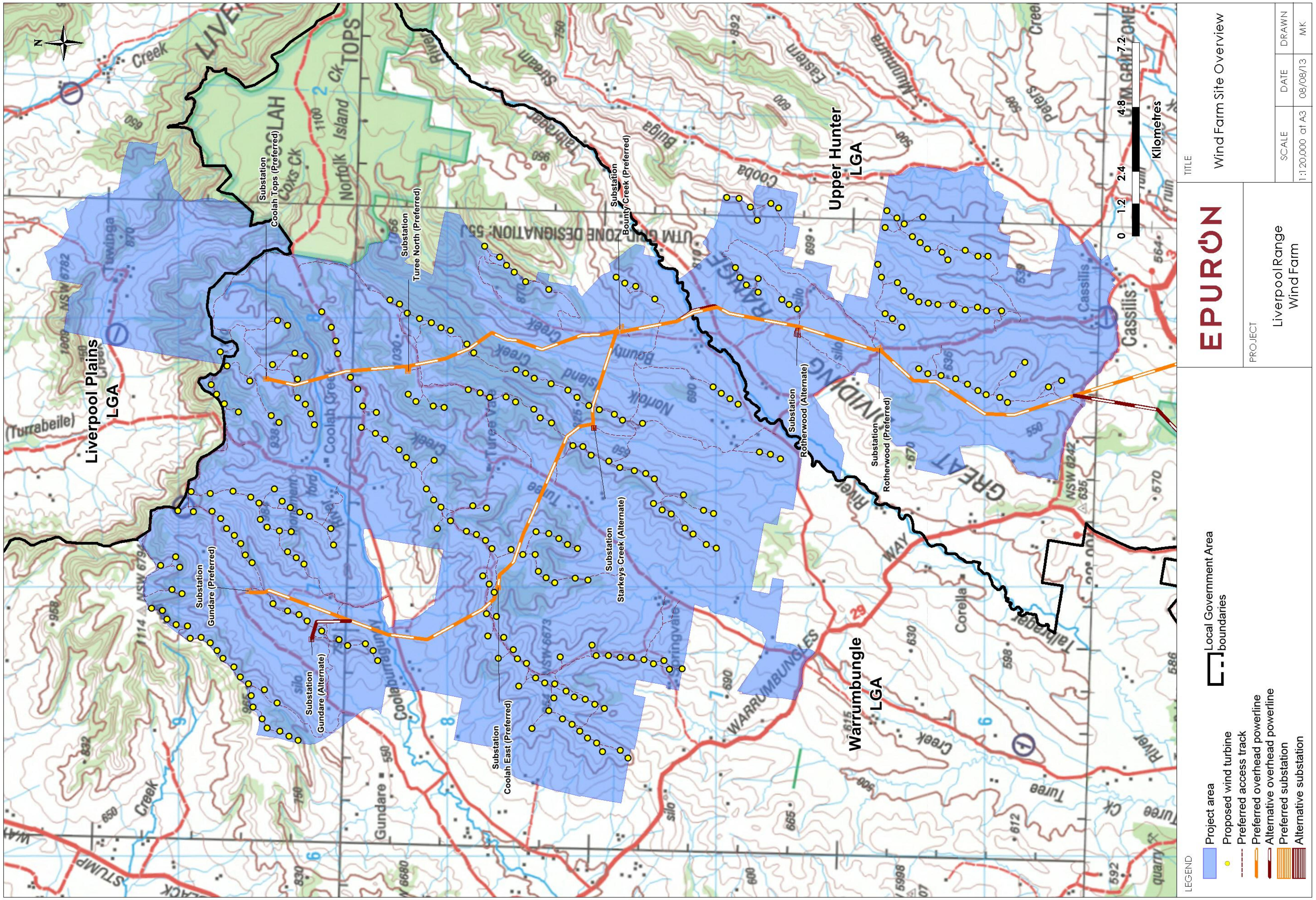


Figure 3-2 Detailed wind farm site overview

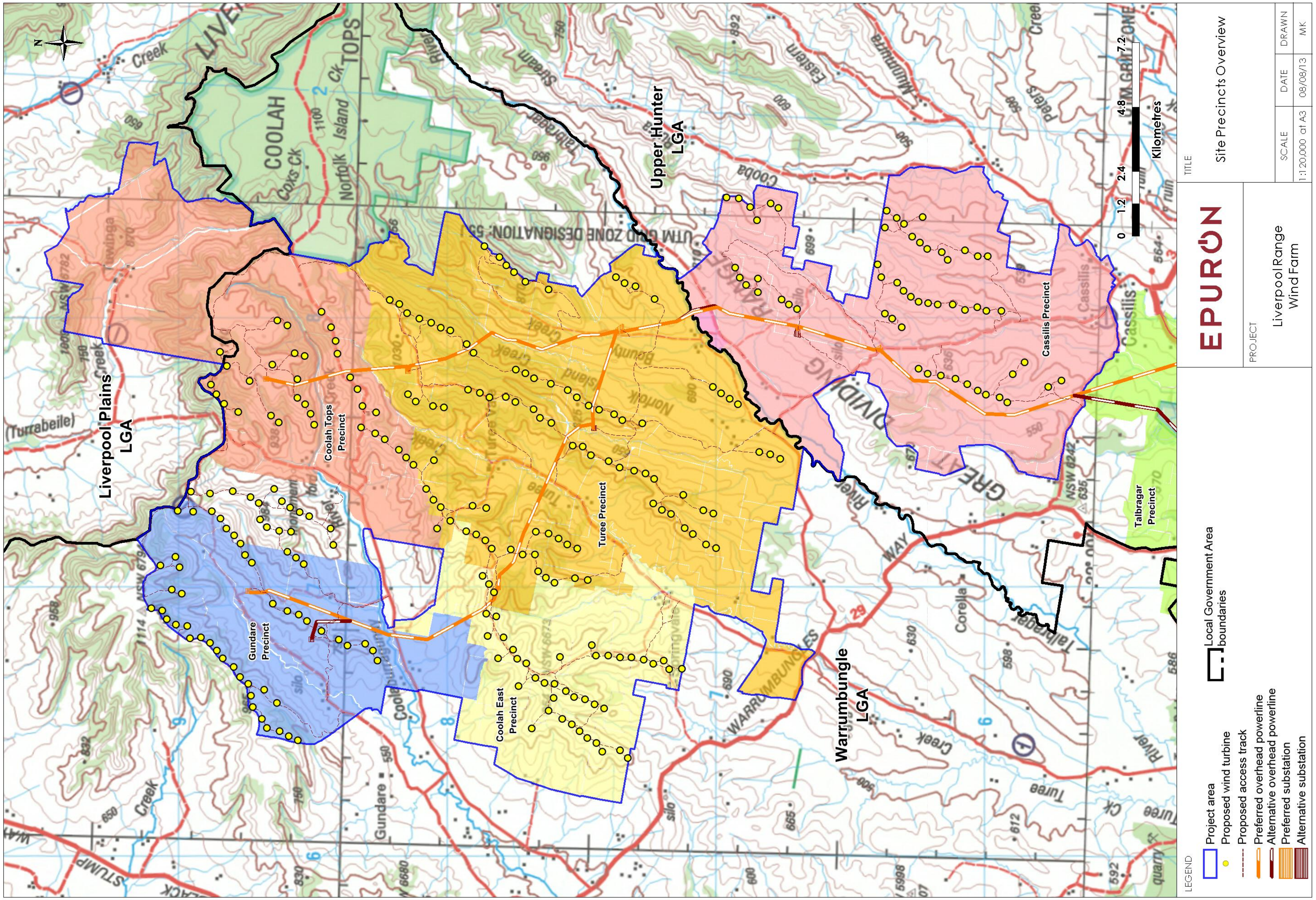


Figure 3-3 Liverpool Range Wind Farm development precincts

3.2 Wind Turbine Layout & Site Boundary

General

As outlined above, all wind farm components will be located within the assessed Project Corridor.

This EA has assessed an indicative wind farm layout which has been through a number of design iterations. The design process is focused around three core principles:

- minimising and/or avoiding negative environmental and community impacts;
- maximising positive impacts (clean energy production and greenhouse gas reduction); and
- incorporating practical limitations in relation to the construction and operation of the site, including costs.

Where trade-offs are required between these core principles, Epuron has used its experience and judgement, taking into consideration a balanced view of the public good in finalising the layout.

Preliminary Layout

In 2010-11 a preliminary layout accommodating approximately 550 wind turbine locations was prepared to guide initial landowner discussions and the progression of community consultation engagement. This layout was based primarily on early wind speed analysis and a desktop review of available terrain and mapping data. While some early feedback was available from discussions with landowners, this initial layout could not take into consideration many constraints which were not known at the time the preliminary layout was prepared.

The Preliminary Environmental Assessment was based on this preliminary layout.

Site Boundary and Stage 1 Development

During the development of the project, Epuron has negotiated with a large number of landowners in relation to their involvement in the project. A number of areas of land in the vicinity of the site which are suitable for turbines were not included in the Preliminary Environmental Assessment, however Epuron continued to liaise with these landowners in relation to their potential involvement. This has led to some small additions to the previous site investigation area.

In parallel, a number of properties have changed hands or are in the process of changing hands. This has meant that some land which was previously part of the project has new owners, and on some properties the ownership is still in transition.

On 24 August 2012, the Department of Planning advised that it was bringing forward the timeframes for assessment of Part 3A projects. This significantly reduced the time available for Epuron to finalise land negotiations with respect to the proposal and, in order to meet these revised timeframes, Epuron focused its attention on a reduced initial development stage which is the subject of this Application.

Accordingly, the area outside of this initial stage has been removed from this application. While Epuron remains keen to develop further stages of the proposal, these will be through a new Development Application process.

Figure 3-4 shows the site boundary of this revised application compared with the site boundary identified in the Preliminary Environmental Assessment.

Layout Revisions

The preliminary layout has been subsequently revised to take into account the revised site boundary, with a number of turbine areas removed from consideration under this application.

Having finalised the proposed wind turbine development area, a revised layout proposing 417 wind turbines was prepared in October 2012 for consultation. This layout was largely prepared by incorporating:

- consideration of the Draft NSW Planning Guidelines: Wind Farms;
- the final wind turbine development area identified for Stage 1;
- landowner and community feedback in relation to the preliminary layout;
- revised wind speed assessments based on additional wind data;
- proximity to final house locations identified through field surveys;
- constraints identified during initial field studies;

- technical constraints including in relation to access; and,
- consideration of commercial viability.

This "Version 2" layout was also featured in the October 2012 newsletter and also shown at the public open day held in Cassilis on 1 November 2012, where Epuron staff discussed the specifics of the layout in detail with members of the community. This layout has also been provided to the involved landowners for their consideration and feedback.

Various improvements to this "Version 2" layout were then made following further input from the community consultation process, including feedback at the public open day, as well as the results of specialist studies as they were finalised.

A description of the key improvements made to the layout over time with reasons for each improvement is included in Section 5.

Current Layout

The current wind turbine layout is shown in Figure 3-2, with more detailed maps in Attachment 1 – Detailed Site Maps. The wind turbine coordinates for this 288 turbine layout are provided in Attachment 4 – Turbine Coordinates. This EA seeks planning approval to locate all wind farm components within the assessed Project Corridor.

The current project layout contained in this EA 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 EA. The Project assessed in this EA has assumed the maximum impact of each of the project components to ensure that the "worst-case" scenario is assessed.

The current 288 wind turbine layout reflects the typical spacing required for the wind turbines under consideration, while maximising the total energy output of the wind farm and taking into consideration the identified constraints.

Issues identified through the community consultation process guided the design and implementation of the various impact assessments, which informed the preparation of this layout.

To prepare this current layout, key parameters and constraints were considered for the site, including:

- high resolution aerial photography and topographic contours (to produce vegetation and roughness maps);
- wind speed data collected on site and correlated with locally available data sources;
- location of residences in the vicinity, particularly those within 2 km of a proposed turbine;
- results of background noise assessment including background noise logging and predicted noise limits at residences;
- results of ecological assessments including constraint mapping and field surveys;
- results of heritage assessments including field surveys;
- results of landscape and visual impact assessment of and around the site;
- results of telecommunication interference studies;
- results of aviation assessments including identification of landing grounds in the vicinity of the site;
- information on other known constraints within the site; and,
- accessibility for delivery of large scale wind turbine components.

Following the preparation of the wind turbine layout, the remaining site infrastructure has also been finalised as outlined in this EA, including the powerline (see Sections 3.4 & 3.5).

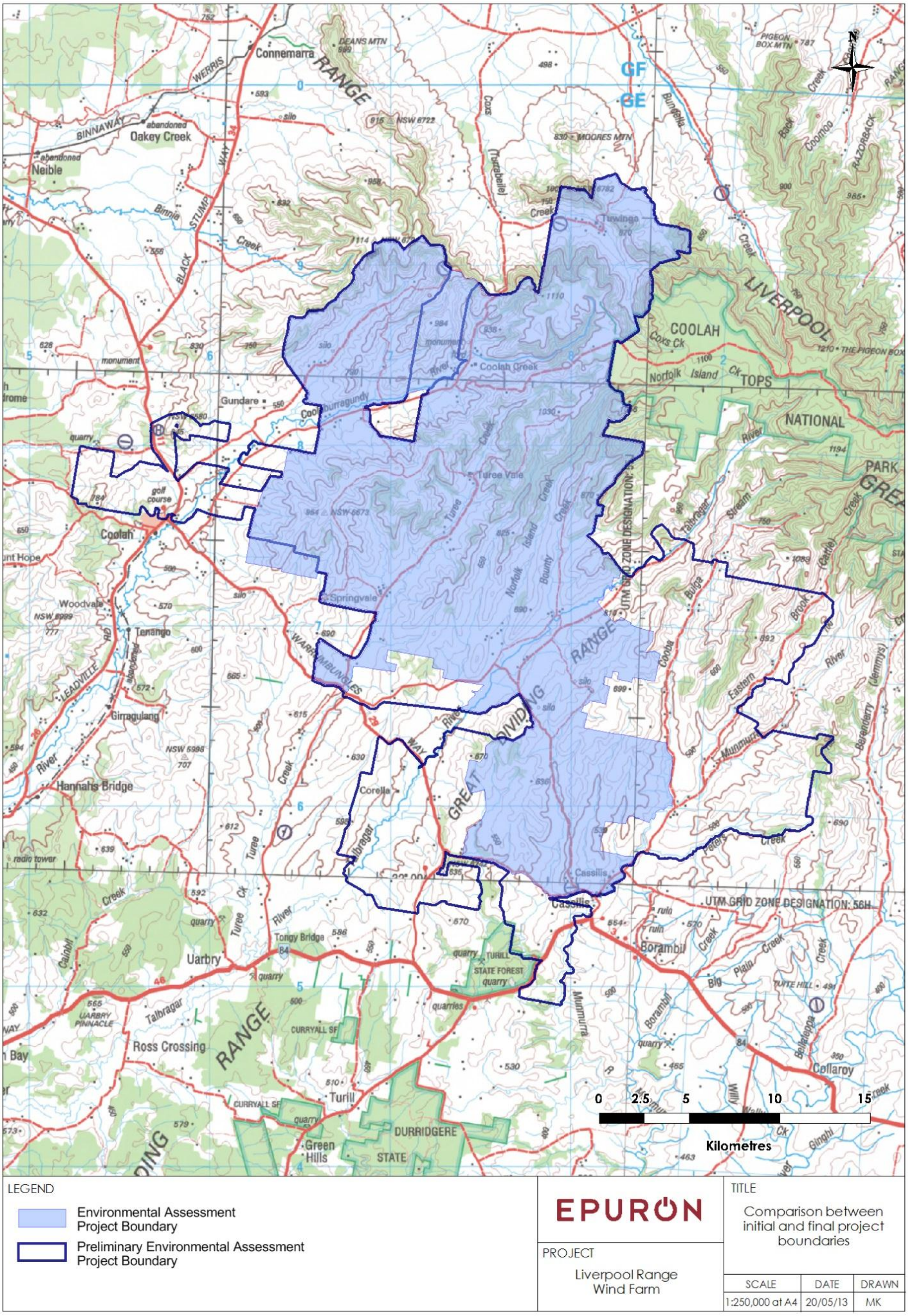


Figure 3-4 Comparison between the preliminary and final site boundaries

Final Construction Layout

Detailed geotechnical investigations and final engineering design can only be carried out once consent conditions are known and a turbine supplier has been selected. This is because each wind turbine model is different and requires different spacing, access and exit gradients and crane requirements. Accordingly, the detailed design of the final wind farm layout (including the final locations of all turbines, on-site access roads and hardstands and associated infrastructure) cannot be determined until the construction contractor surveyor traverses the entire project site and incorporates the requirements of the final conditions of approval. It is therefore essential for efficient project delivery that the consent authority provides this necessary flexibility by authorising the micrositing of infrastructure, in accordance with the conditions of approval, anywhere within the assessed Project Corridor. Accordingly:

- the current layout is indicative only and subject to detailed design; and
- Epuron seeks consent to microsite turbines and infrastructure anywhere within the assessed Project Corridor.

The current 288 turbine layout has undergone a preliminary review to determine if the layout is reasonably suitable for construction, meets planning guidelines and would comply with expected consent conditions. However, relocations of specific turbines and infrastructure within the assessed Project Corridor may be required prior to construction to take into account a number of factors including:

- detailed geotechnical works
- final turbine selection and wind farm design;
- final wind speed assessment and energy yield analysis;
- additional site constraints identified through ongoing investigations;
- constraints identified in relation to constructability or construction cost minimisation; and
- constraints identified after the results of final geotechnical investigations at each turbine location are completed.

Depending on final turbine selection, it is possible that not all turbines proposed would be installed. For example to ensure that the project continues to meet all conditions of approval.

To that end, a final layout would be prepared after final turbine selection has taken place and prior to the commencement of construction. This final layout would include adjustments to ensure all criteria are achieved. Further surveys and variations would be submitted for approval by the Director-General of Planning in accordance with the final conditions of approval.

Epuron would ensure that any minor changes do not create a detrimental overall impact and if any revisions are material, will resubmit noise and visual impact assessments if required based on the revised layout prior to construction.

Following this final construction layout, further detailed information will become available on site as geotechnical investigations progress and construction commences which may require minor relocation of equipment. As a result wind turbines and associated infrastructure may be relocated up to 100 m in any direction during construction to accommodate any localised issues (such as design and ground conditions, newly identified constraints etc.) arising during the excavations phase.

3.3 Wind Turbine Selection & Ancillary Infrastructure

Wind turbines Under Consideration

Epuron has not yet selected the turbine model to be used for this project. A number of turbines are under consideration for the proposal, each with varying characteristics including physical dimensions and technical attributes, production capacity and cost considerations.

In general, different characteristics of turbine models require different turbine layouts, however to simplify the environmental assessment of the project, an indicative layout has been developed that reflects the characteristics of a large range of turbine models.

For the purpose of assessing the wind farm impacts, Epuron bases its assessment on understanding both typical and worst-case impacts likely from the range of turbines under consideration. In general, only three impacts are materially affected by the turbine selection:

- **visual impacts** are carried out on typical and worst case turbine sizes, using the blade tip height when vertical as the indicator of turbine size;
- **noise impacts** are carried out on typical and worst case noise profiles; and
- **energy production** (which typically increases with the physical size of the wind turbine).

All other impacts are driven primarily by the turbine layout rather than the selection of the turbine model.

Final wind turbine selection would be carried out based on commercial and technical considerations within the consent conditions stipulated by the DPI. In particular, a final assessment of potential noise impacts would be undertaken prior to construction based on the final turbine selection and layout.

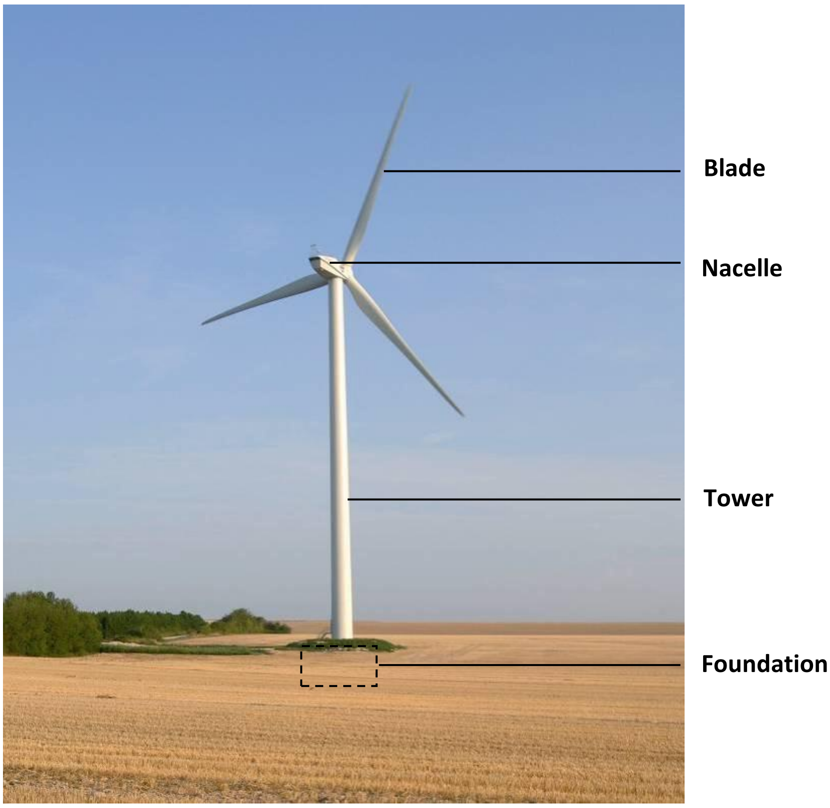


Figure 3-5 Typical wind turbine installed on an 80m tower (Photo courtesy REpower Systems AG)

Wind Turbines

The wind turbines under consideration are expected to have a typical hub height of approximately 80 m – 101 m and a typical blade length of 50 m – 65 m (approx. 100 m – 130 m overall rotor diameter). The overall turbine parameters are outlined in Section 3.1.

Each wind turbine would be a three bladed type of the “up-wind” design, meaning that the blades face into the wind and in front of the tower and nacelle. This design reduces noise levels generated during operation.

The maximum expected tip height is 165 m.

Nacelle

The nacelle is the housing at the top of the tower which encloses the generator, gearbox (unless direct drive), and control gear including motors, pumps, brakes and electrical components. This control gear ensures that the wind turbine always faces into the wind, and adjusts blade angles to maximise power output and minimise blade noise. The nacelle also houses winches to assist in lifting maintenance equipment or smaller replacement parts to the nacelle.

The nacelle design takes into account acoustic considerations to minimise noise emissions from mechanical components.

Tower

The tower is of tubular steel or steel and concrete construction typically 80-101 m high, tapering from around 5-6 m in diameter at the base to around 4-5 m at the top. Exact dimensions would depend on the wind turbine design selected.

The tower is constructed in up to five sections, each section bolted or welded together via an internal flange. Within the core of the tower are the power and control cables and an access ladder or mechanical person lift to the nacelle (with safety climb system).

Transformer

Each wind turbine generator would produce power at typically 690 V, and up to 1,000 V. Power is then transformed at each wind turbine to either 22 kV or 33 kV for reticulation around the site. The transformer for each wind turbine would be located either within the base of the tower, in the nacelle, or externally adjacent to the tower as a small pad-mount transformer installed on the ground, depending on the specific wind turbine model selected. The transformer would be either a dry-type transformer, or would be suitably bunded.

Lightning Protection

Each wind turbine would have a lightning protection system installed. This system includes lightning rods through each wind turbine blade, an earth mat built into the foundations of the wind turbine, and lightning protection around the various electronic components within the wind turbine.

Obstacle Lighting

Depending on the requirements of the aviation authorities including CASA, aviation obstacle lighting of turbines may be required to be installed. This lighting requirement is usually a number of red flashing beacons mounted on the nacelle of some of the wind turbines.

The guidelines in relation to aviation warning lighting are currently changing as described in Section 14.1.

Epuron will not install aviation obstacle lighting unless required to do so by CASA, the consent conditions relating to the project or the requirements or recommendations of any other relevant authority.

Wind Turbine Controls and Operation

Each wind turbine would have its own individual control system, and would be fully automated. Start-up and shutdown (including safety shutdowns) are fully automated, with manual interruption available via onsite control systems and remote computer.

Generally, wind turbines would commence operation at wind speeds around 3 – 5 metres per second (11 – 18 kilometres per hour) and gradually increase in production to their rated capacity, usually at wind speeds around 12 – 15 metres per second (44 – 54 kilometres per hour). Once at this maximum capacity, the wind turbine would control its output by altering the pitch of the wind turbine blades. Under high wind conditions in excess of 25 metres per second (90 kilometres per hour) the wind turbine would automatically shut down to prevent damage. It would continue measuring the wind speeds during this state via an anemometer mounted on the nacelle, and would restart once wind speeds drop to a suitable level.

Various operating constraints can be programmed into the control system to prevent or limit operation under certain conditions. For example, if operational issues are identified such as excess noise or shadow flicker under certain conditions, these conditions can potentially be pre-programmed into the control system and individual wind turbines automatically controlled, shut down or limited whenever these conditions are present.

Access Tracks, Hardstands and Foundations

The tower would be mounted on a reinforced concrete foundation and would require removal of rock and subsoil at the base of each turbine. A number of foundation design options are under consideration including a gravity foundation (where subsoil geology is less stable) and a rock-bolted foundation (where subsoil geology provides good bedrock). A combination of different foundation designs may be used on the site depending on the geology identified at each turbine location.

Each wind turbine would require an access track and electrical cabling to the collection substation. Access tracks would be a minimum of 5 -6 m wide (wider at bends and passing lanes) and be all weather graded gravel tracks. Hardstand areas are required beneath each turbine for delivery, storage and assembly of turbine components, and for the safe operation of turbine installation cranes. Each hardstand area would be approximately 25 m x 45 m (1,125 m^2). The shape and exact size of the hardstand area is subject to final turbine selection and crane lifting requirements.

Access tracks and hardstands areas would generally be left in situ after construction to allow for any required maintenance and repairs.

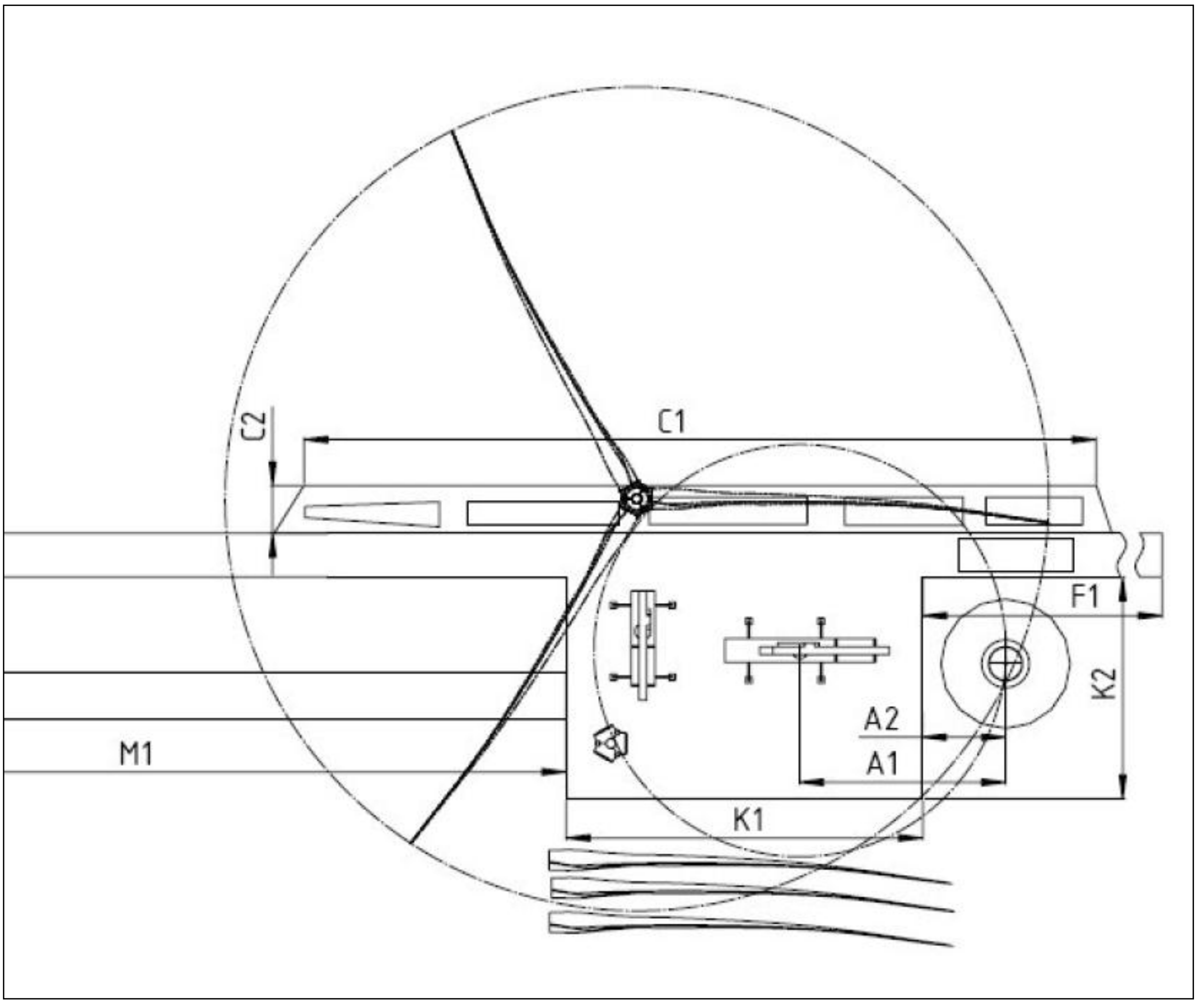


Figure 3-6 Example crane hardstand area (Source: REpower)

3.4 Grid Connection Corridor

Introduction

To export power from the wind farm, it is necessary to connect the wind turbines to the electricity grid. This is achieved through a combination of underground and overhead electricity cables connecting the turbines to the collection substations, which in turn are connected into the electricity grid via an overhead powerline to the wind farm Connection Substation.

The overhead powerline line will need to be designed and built with sufficient capacity to export the full output of the proposed wind farm. The assumed output of the wind farm is in the order of 800-1000 MVA.

Epuron has assessed a number of easement routes for placement of the proposed powerline infrastructure, and has considered a number of potential grid connection options and powerline corridors available in the vicinity of the wind farm.

The assessment determined the most viable grid connection option and powerline route for the project is within the corridor from the wind farm boundary to TransGrid's existing Wollar – Wellington 330 kV Transmission Line near Ulan to the south of the site (Corridor A). The grid connection option at Ulan has the capacity to receive and export the wind farms power output and a Preferred and Alternate powerline route has been selected within this corridor for further development.

The primary grid connection and wind farm electrical works would include:

- A new 330 kV wind farm grid Connection Substation located in the vicinity of the existing Transgrid Wollar – Wellington 330 kV Transmission Line near Ulan to the south of the wind farm site;

- A new overhead powerline operating at up to 330 kV (nominal) from the Ulan connection substation to the wind farm site, and then on to the wind farm collection substations;
- Multiple new collection substations located on the wind farm site, reducing the voltage of the powerline down to a reticulation voltage;
- A reticulation system comprising a network of underground and overhead electrical cables, at 22 kV or 33 kV, reticulating power from each turbine to the collection substations;
- Associated communications network necessary for site operations and control; and,
- An operations and maintenance facility.

Preliminary Corridor Selection

In 2010-11 at the same time as preparing the preliminary wind farm layout Epuron commenced investigations into the various grid connection options and general powerline corridors available for connecting the project. A number of broad grid connection options and powerline corridors were identified for connecting the project to the grid as indicated in Figure 3-7 and Figure 3-8. These grid connection options and powerline corridors were then assessed in more detail, and preliminary consultation carried out with potentially involved stakeholders to identify a Preferred and Alternate powerline route suitable for further development.

The following grid connection options were identified as being proximate to the wind farm site;

- Transgrid's Wollar – Wellington 330kV Transmission Line near Ulan.
- Transgrid's Wollar – Wellington 330kV Transmission Line near Gulgong.
- Transgrid's Wollar – Bayswater 500kV Transmission Line south of Merriwa.
- Country Energy's 66kV Substation located at Dunedoo.
- Country Energy's 132kV Substation located at Beryl (near Gulgong).

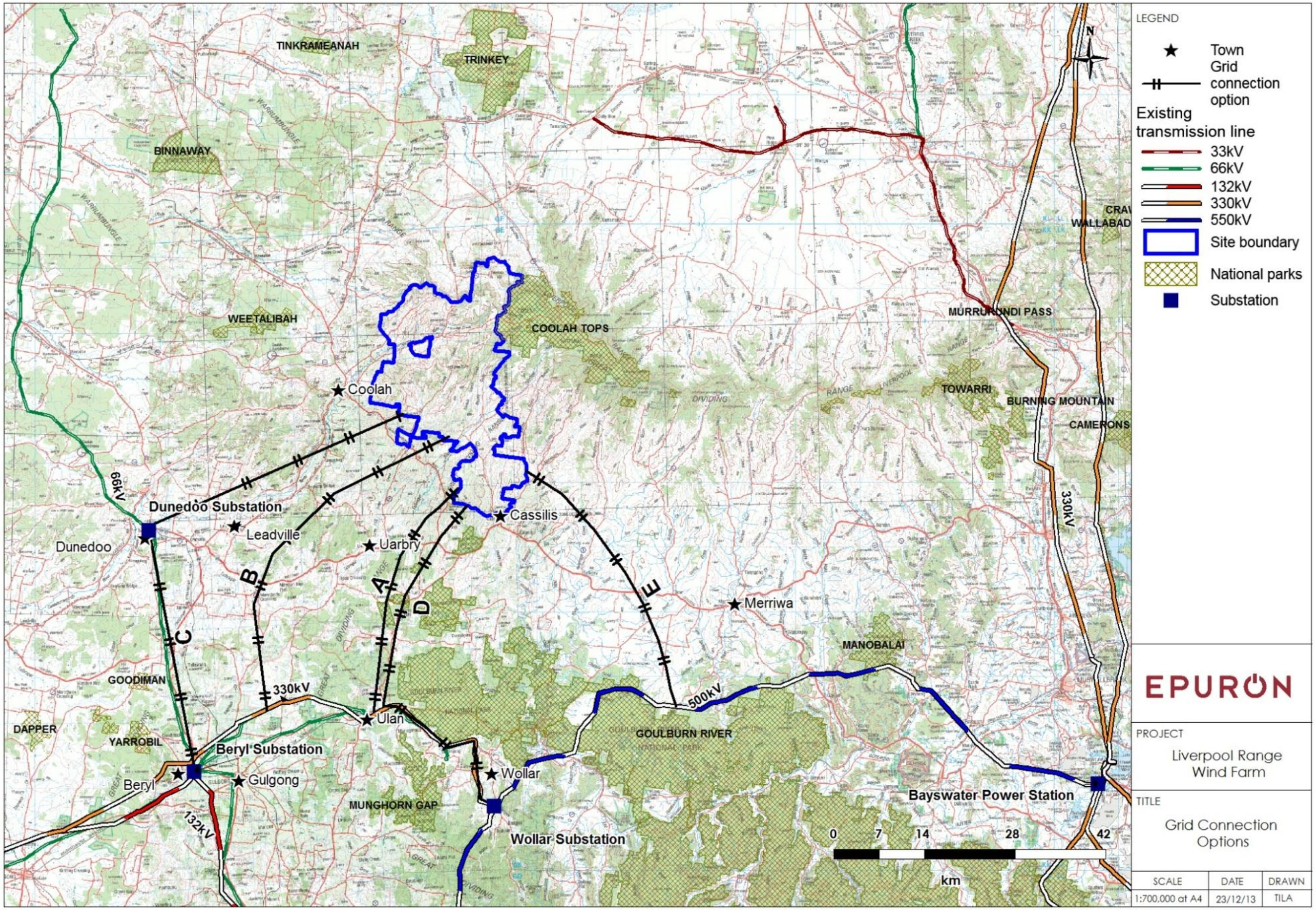


Figure 3-7 Grid Connection Options

Powerline Corridors

A grid connection assessment was carried out for the project with the aim to;

- Assess the viability of the identified grid connection options available in the vicinity of the wind farm.
- Assess the various lands, technical and environmental constraints for developing a powerline corridor to connect to the identified grid connection options from the wind farm site boundary.
- Identify and select a Preferred and Alternate powerline route suitable for further development within an identified corridor.
- Prepare an initial concept design of the Preferred and Alternate powerline routes to facilitate consultation with stakeholders and to enable development works to progress.

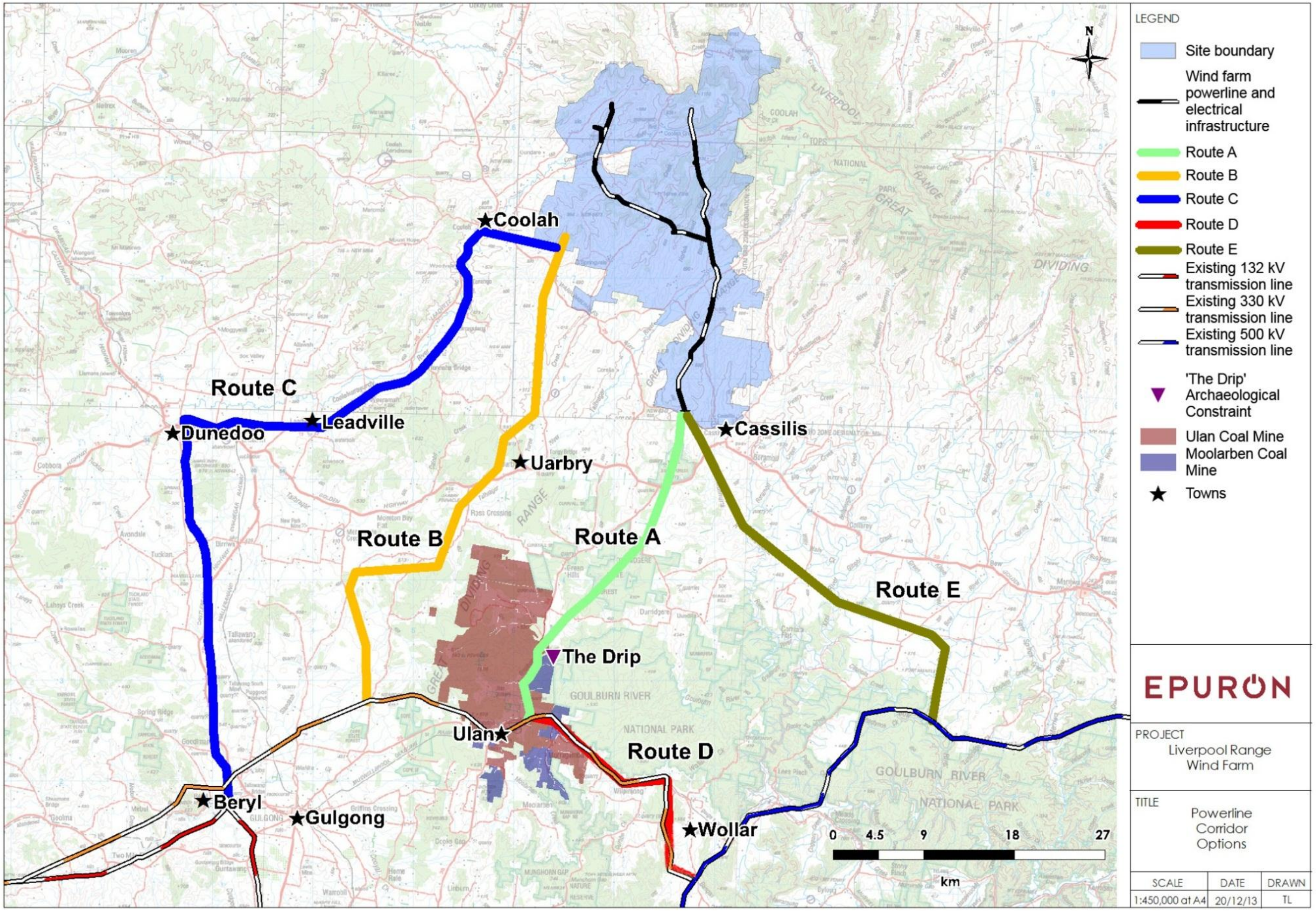


Figure 3-8 Powerline Corridor Options

Corridor A – South to 330 kV line near Ulan

This corridor starts at the southern boundary of the wind farm site and heads south west through the Durridgere State Conservation Area (DSCA). Beyond the southern limits of the DSCA the corridor continues south west through private land holdings and heads south along parts of Ulan Road reserve corridor and is proximate to the Ulan and Moolarben Mines. The corridor continues south and connects to the existing Transgrid Wollar – Wellington 330 kV transmission line near the town of Ulan.

Corridor Features:

- Overall Length
    - 35km
- Number land parcels route intersects
    - 57
- Number of Landowners
    - 11
- Number of Houses within 1000m
    - 7
- Key Constraints
    - Land limitations proximate to Ulan and Moolarben Coal Mines
    - Traversing Durridgere State Conservation Area
    - Minimising and avoiding impacts to identified environmental and heritage constraints
- Favourable Attributes
    - 800-1000 MVA of available grid connection capacity
    - Private landowners willing to enter powerline easement agreements
    - Most viable corridor in terms of length, cost, technical and environmental considerations

Corridor B – South west to 330 kV line via Uarbry

This option avoids the Ulan Coal Mine by heading in a more south westerly direction. This corridor heads south west from the site and avoids the small town of Uarbry. The corridor then zig zags south west where it connects to the existing Transgrid Wollar - Wellington 330 kV transmission line approximately half way between the Wollar 500 kV Substation and Beryl 132 kV substation.

Corridor Features:

- Overall Length
    - 56km
- Number land parcels route intersects
    - 87
- Number of Landowners
    - 28 Landowners
- Number of Houses within 1000m
    - 18
- Key Constraints
    - Close to Uarbry township and houses
    - Large number of landholdings and some unwilling landowners
    - Longer indirect route resulting in high costs and changes of direction
- Favourable Attributes

- Generally large and open land parcels
- 800-1000 MVA of available grid connection capacity

Corridor C – West to Beryl 132 kV substation via Dunedoo 66 kV substation

This option heads west from the site to intersect the disused rail easement from Coolah to Dunedoo (Via Leadville). The proposed transmission follows the easement all the way though until about 10km out from Dunedoo where it breaks away from the easement following a much more direct alignment to the Dunedoo substation. This break-away avoids using the curvy disused railway easement near the town of Dunedoo. The proposed transmission then travels south from Dunedoo along the existing 66 kV transmission line to the Beryl 132 kV Substation at Beryl (near Gulgong) where it would connect to the existing Transgrid Wollar – Wellington 330 kV transmission line via a new connection substation.

Corridor Features:

- Overall Length
  - Site to Dunedoo – 49km
  - Dunedoo to Beryl (Gulgong) – 38km
  - Overall length 87km
- Number land parcels route intersects
  - Site to Dunedoo – 34 parcels (of which1 parcel being disused rail easement)
  - Dunedoo to Gulgong – 101 parcels
  - Total 135
- Number of Landowners
  - 40 to 50 (researched estimate)
- Number of Houses within 1000m
  - 131
- Key Constraints
  - Insufficient grid connection capacity available
  - Close to Leadville and Beryl townships
  - Greatest length of all options and high cost
  - Large number of landholdings and some unwilling landowners
- Favourable Attributes
  - Generally large and open land parcels

Corridor D – South then east to Wollar 500 kV substation

This corridor generally follows Corridor A as far as Ulan and then turns east to the existing 500 kV Wollar substation at Wollar. This option was discounted early for detailed assessment due to the prohibitive cost to connect at 500 kV, and in addition to the other added constraints such as the additional distance and larger number of landholdings compared with Corridor A.

Corridor Features:

- Overall Length
  - 62km
- Number land parcels route intersects
  - 62
- Number of Landowners
  - 18
- Number of Houses within 1000m
  - 11
- Key Constraints

  - Not viable and high technical barriers
- Favourable Attributes
  - Sufficient export capacity

Corridor E – South east to Wollar – Bayswater 500 kV transmission line

This corridor follows south east from the site to meet the existing 500 kV powerline. This option was discounted early due to the prohibitive cost of a new 500 kV substation that would be required, and the difficulty and time involved in achieving TransGrid's consent to such a substation. In addition, this route appeared largely similar to Route A in terms of length, number of landowners and potential impacts.

Corridor Features:

- Overall Length
  - 45km
- Number land parcels route intersects
  - 36
- Number of Landowners
  - 21
- Number of Houses within 1000m
  - 3
- Key Constraints
  - Not viable and high technical barriers
- Favourable Attributes
  - Sufficient export capacity

Table 3-1 Summary of possible grid connection corridors considered

Corridor	Overall Length (km)	Number of Land Parcels	Number of Landowners	Dwellings within 1 km	Estimated Cost ($M)	Land access constraints	Environmental Constraints	Grid connection and technical constraints	Assessment
Corridor A - South to 330 kV line near Ulan (Preferred and Alternate powerline route selected within this corridor)	35	57	11	7	65	low	medium	low	Most viable connection corridor overall. Land limitations in vicinity of Ulan and Moolarben Mines. Traversing Durridgere State Conservation Area. Sufficient connection capacity available for wind farm output.
Corridor B - South west to 330 kV line via Uarbry	56	87	45	18	85	high	low	low	Close to Uarbry township. Large number of landholdings but unwilling landowners. Long and indirect route increases cost and visual impact.
Corridor C - West to Beryl 132 kV substation via Dunedoo 66 kV substation	87	135	50	131	85	high	low	high	Insufficient grid connection capacity for wind farm output. Close to population centres at Beryl, Dunedoo and Gulgong Greatest length of all options and lowest viability. Large number of landholdings and unwilling landowners
Corridor D - South then east to Wollar 500 kV substation	62	62	18	11	100	high	medium	high	Significantly more expensive and complex than other routes and with greater impacts for no additional benefits.
Corridor E - South east to Wollar – Bayswater 500 kV transmission line	45	36	21	3	100	high	low	high	Cost prohibitive due to line length plus requirements for new 500kV substation and technical complexities.

The initial grid connection and powerline corridor assessment determined that connection to the existing TransGrid 330kV Wollar to Wellington transmission line in the vicinity of Ulan would be the most appropriate primarily due to its proximity to the wind farm, available capacity and least overall impact in terms of landowner, community, technical and environmental impacts. Accordingly, a Preferred and Alternate powerline route was identified and selected within the broader Corridor A for further investigation and development.

Preferred and Alternate Powerline Routes – Assessment

Epuron has now assessed the Preferred and Alternate powerline routes within Corridor A in further detail, including mapping of all nearby residences and completing appropriate specialist studies. The Preferred and Alternate powerline routes are shown in Figure 3-9 and has been consulted with route landowners. Large scale layouts of the proposed land and infrastructure arrangements near the grid connection point at Ulan and overall powerline routes to the wind farm boundary are shown in Attachment 1 – Detailed Site Maps.

In developing the Preferred and Alternate powerline routes and number of layout design iterations were necessary to accommodate landowner requirements, consultation feedback and outcomes of specialist studies. The Preferred route is generally located to the eastern side of Corridor A running through the Durridgere State Conservation Area and the Alternate route is generally located to the western side of Corridor A mainly traversing private landholdings and Ulan Road reserves. Both powerline routes utilise land proximate to Ulan and Moolarben mines and existing Ulan Road reserves near the connection point at Ulan. Once the Preferred and Alternate routes were selected, a Powerline Easement Information brochure was prepared and provided to powerline stakeholders for consultation purposes setting out information regarding easements and powerlines.

Accordingly, it is proposed a new overhead powerline will be built from the grid Connection Substation near Ulan to the new Collection Substations on the wind farm site. A single corridor is required for the Connection Powerline from the Connection Substation up to a central location on the wind farm site, where it will then diverge to the Collection Substations.

The Preferred and Alternate route options for location of the powerline infrastructure remain under consideration, and the final route has not yet been finalised and selected. Epuron's Preferred route, together with a likely Alternate route, is outlined in Figure 3-9, with more detailed maps in Attachment 1 – Detailed Site Maps. A number of additional nearby routes including a Second Alternate route have been identified as being suitable for the powerline as indicated in the attached consultant reports. Ultimately only one route and powerline will be finalised and built as the wind farm only needs to establish one powerline and grid connection point to enable export of power to the national grid. The final route selected may utilise a combination of the Preferred and Alternate routes. However, all of these route options remain under consideration, with the final selection to be carried out based on the following criteria:

- consent being provided by potentially involved landowners (including the Crown and, where relevant, the Minister for the Environment);
- avoiding and minimising impact on existing vegetation where possible, and particularly any sensitive native vegetation;
- avoiding where possible existing vegetation offset areas (e.g. in the Ulan Coal Mine area);
- avoiding where possible existing reserves where an alternate corridor exists (e.g. the Durridgere SCA);
- minimising biodiversity, archaeology, visual and noise impacts;
- technical and commercial feasibility consideration; and
- Consideration where possible to address any nearby stakeholder and community issues raised.

Each powerline route section has various constraints associated with it which make it impractical to select a final corridor until the Development Consent has been achieved. For example:

- involved landowners want certainty that the project is likely to proceed before committing to a powerline easement on their land, therefore not all land has been secured at this stage;
- the consent of the Minister for the Environment is required for the Preferred route through the Durridgere SCA, this can only practically be given after a thorough environmental assessment has taken place for the project; and,

- some powerline routes, while perhaps being preferred from an environmental perspective, are potentially restricted due to existing covenants and / or proposed biodiversity offset areas.

In addition, each powerline route has competing environmental impacts – for example, some may have lower aboriginal heritage impacts but higher native vegetation impacts, while others may minimise native vegetation impacts but increase social and visual impacts at nearby dwellings.

Table 3-2 indicates the various route options for each powerline section, and outlines the key constraints identified for that section. The detail of the possible impacts is included in the various specialist studies accompanying this EA and is summarised later in this section.

Table 3-2 Summary of current grid connection powerline route options being investigated

Section	Route Option	Positives	Negatives
Section A - B	Single option (Preferred and Alternate)	Generally follows existing disturbed road reserve corridor and land between road and coal mine.	Minimal. Need to observe and avoid existing mine infrastructure on and near the road reserve.
Section B - C	Western Option (Alternate)	Follows existing disturbed area on Ulan Coal Mine land. Principally follows existing drainage water pipeline and existing mine infrastructure corridor. Avoids new vegetation clearance corridor in vicinity of "Hands On Rock" and no known aboriginal heritage impacts nearby.	Encroaches on and near proposed environmental offset area declared for Ulan Coal Mine. Possible impacts on Ulan Coal Mine activities, therefore approval required. May not be possible due to proposed conservation covenant and approval requirements.
Section B - C	Eastern Option (Preferred)	Avoids negatives of Alternate option.	Proximity to aboriginal heritage sites including rock shelters and "Hands on Rock". New vegetation clearance corridor in vicinity of "Hands On Rock".
Section C - D	Eastern Option (Preferred)	Direct route over private landholding.	Minimal. Some vegetation clearance.
Section C - D	Western Option (Alternate)	Direct Route	Minimal. Some vegetation clearance.
Section D - E	Eastern Option (Preferred)	Most direct route with lower overall environmental impacts when compared to section D – F. Reduced clearing requirements and number of houses	Traverses DSCA.
Section D - F	Western Option (Alternate)	Avoids need to cross Durridgere SCA. Route options available for crossing Golden Highway.	Some impacts remain to sensitive vegetation. Proximity to houses in the vicinity of Turill.
Section F - E	Eastern Option (Preferred)	Most direct route. Utilises road reserve corridors.	Road crossing at Golden Highway and Ulan Road. Clearing vegetation on road reserves.
Section F - G	Western Option (Alternate)	Avoids negatives of preferred option F – E.	Longer and more expensive corridor. Traverses edge part of Turill State Forest.
Section E - G	Single Option (Preferred)	Avoids impacts to sensitive vegetation identified in F – G section. Avoids impacts to a larger number of landowners and residences, particularly in the vicinity of Turill.	Minimal. Crosses Golden Highway near Cassilis.

In all cases, landowner consent from both public and private landowners is required before the powerline can be built and a number of landowner arrangements are already in place. Given that Epuron does not have statutory power to compulsorily acquire land; this could prevent any of these options from proceeding without intervention. Epuron has undergone extensive consultation with landowners on and in the vicinity of the powerline routes and based on our consultation to date we expect landowner approvals to be achievable. A number of landowner arrangements are already in place and negotiations are ongoing.

Approval is sought for all of the above Preferred, Alternate and Second Alternate powerline route alignment options, subject to landowners agreement. It should be noted that while a number of powerline route options are sought only one route is ultimately required for the construction of the powerline to export power from the wind farm. The final powerline route selected may utilise a combination of the Preferred and Alternate powerline routes.

Durridgere State Conservation Area

Particular constraints in relation to the Preferred powerline route located within Corridor A are various former logging areas which were previously managed by NSW State Forests and subsequently declared as State Conservation Areas (SCA). In refining this Preferred powerline route, Epuron has managed to avoid impacts to the (formerly) Curryall State Forest and Turill State Forest. However, it is not possible to avoid the Durridgere State Conservation Area without increasing impacts on residences in the locality of Turill, as well as increasing impacts to native vegetation which the Biodiversity Assessment has shown to be more sensitive overall than that protected in the Durridgere SCA.

The Durridgere State Forest was declared circa 2005 to be part of the Durridgere State Conservation Area (DSCA), and its management transferred to the National Parks & Wildlife Service. While powerlines and powerline easements are permissible in a State Conservation Area, the consent of the Minister for the Environment is required in accordance with the National Parks and Wildlife Act. Any consent is entirely at the discretion of the Minister and subject to any reasonable conditions the Minister sees fit to impose.

Accordingly, Epuron has been in consultation with the OEH in relation to this SCA. The OEH have indicated a preference that the powerline route not cross the Durridgere State Conservation Area, however have indicated that they will consider an application in this respect once Epuron has considered all other options and completed a route comparison for assessment.

A key question answered in this EA is whether the Preferred powerline route crossing the DSCA would provide a better overall environmental outcome than the Alternate powerline route options which cross areas currently not protected. Accordingly the potential environmental impacts have been assessed in the Biodiversity Assessment as part of this EA and show that the Preferred powerline route traversing the DSCA has a lower overall environmental impact when compared to the Alternate powerline routes nearby. From a community perspective there are benefits in developing the Preferred powerline route as there are, in addition to the environmental benefits, less residences to be potentially impacted and reduced visual impacts. Consultation outcomes also reveal the community feels more comfortable with the powerline following the Preferred route as opposed to the Alternate route.

Epuron will continue to consult with OEH in relation to this access and, if the determination of this EA approves access through the SCA, will then seek the Ministers consent to establish an appropriate easement through the SCA.

Justification supporting the selection of the powerline route that traverses the DCSA as Preferred incorporates a number of contributing factors and influences, including;

- Feasibility of the Preferred powerline route, against all other routes, provides the the best overall outcome when considered against land access, proximity to dwellings, easement length, cost to build, local amenity and environmental considerations. Refer assessment findings set out in Table 3-1.
- The biodiversity assessment concluded that the Alternate powerline route has no apparent advantage towards biodiversity conservation over the Preferred route. Refer Sections 7, 8, 9 and 10 of the Biodiversity Assessment – Transmission Line Study Area attached to the EA as Appendix C.
- The Landscape and Visual Impact Assessment found that the Preferred powerline route provides a lower overall visual impact over the Alternate powerline route. Refer Section 12 of the attached to the EA as Appendix A.
- Consultation with easement landowners reveals general support for the Preferred powerline route through the DSCA as it minimises impacts to nearby private properties and dwellings by traversing one large land parcel in lieu of many smaller parcels.
- Powerlines and powerline easements are permissible in the Durridgere State Conservation Area with Ministerial consent.

Preferred and Alternate Powerline Routes – Potential Impacts

Potential impacts relating to the overhead powerline infrastructure to be sited along the Preferred and Alternate powerline routes are outlined below. On balance the overall impacts are reduced in relation to the Preferred powerline route when compared to the Alternate powerline route.

- ***Ecology***. – The biodiversity assessment found that the Alternate powerline route has no apparent advantage over the Preferred powerline route towards overall biodiversity conservation other than the avoidance of the DSCA. In DSCA, more recent logging, when the area was a State Forest, has meant that in general the trees are considerably younger than in many of the forest remnants on nearby private property. So with respect to vegetation quality and fauna habitat, there are large tracts of vegetation on private land that have an equal or higher biodiversity value than the vegetation of the DSCA. This also applies to the habitat for EEC vegetation as the DSCA did not contain much Box Gum Woodland.
- ***Visual***. The primary visible infrastructure traversing the powerline routes would be the 330kV overhead powerline structures and cables. The powerline infrastructure would collect and distribute electricity generated by the wind turbines and deliver it to the grid network. The potential visual impact of the proposed 330kV powerline routes is unlikely to have a significant impact on surrounding residential view locations associated with either the Preferred or Alternate powerline routes. The electrical works would be contained within a landscape with an overall moderate to high visual absorption capability, which would have some ability to accept modifications and alterations without the loss of landscape character or significant deterioration of existing levels of visual amenity. Further details can be found in Section 12 of the Landscape and Visual Impact Assessment attached as Appendix A to the EA.
- ***Proximity to dwellings***. A total of 20 residential dwellings have been identified within a 2km offset from the Preferred powerline route extending south from the wind farm boundary to Ulan. Of these 20 dwellings, 16 are uninvolved and 4 are involved landowers. Comparitively, there are 44 residential dwellings associated with the Alternate powerline route, of which 34 are uninviolved and 10 are involved landowners. In all cases an assessment of visual significance for the 330kV powerline is determined to be in the low to medium range of visual significance. In some instances the impact is considered to be nil due to the presence of topographical landforms and or vegetative screening between the dwelling and proposed powerline. Further details can be found in Section 12 of the Landscape and Visual Impact Assessment attached as Appendix A to the EA.
- ***Noise***. The noise consultant assessed and measured corona (powerline) noise. The results show that at a distance of 240m from a powerline the noise level would be below 35 dBA. Assuming a minimum RBL (Rating Background Level) value of 30 dBA, the minimum intrusive criteria as determined by the NSW INP would be 35 dBA. As such powerline line noise has also been assessed against NSW INP noise limits and has been found to be acceptable as all receiver (dwelling) locations are greater than 240 m from the Preferred and Alternate powerline line routes.
- ***Heritage***. The proposed works entail ground disturbance and, accordingly, the construction of the powerline has the potential to cause impacts to any Aboriginal areas, places or objects which may be present within the zones of direct impact. Impacts in the powerline area will be generally located on land utilised for sheep and cattle grazing and forestry purposes. Previous land use has resulted in relatively significant environmental impacts and a generally degraded landscape. European activated geomorphological processes and other natural processes associated with land degradation, will have caused significant prior impacts to Aboriginal objects within the proposal area. At the southern end of the powerline it would traverse land currently used for coal mining and other infrastructure such as roads. In addition, it is emphasised that proposed impacts are discrete and small in area. However, irrespective of prior impacts and the small and discrete nature of those proposed imacts, the construction of the powerline would entail ground disturbance and, accordingly, the project has the potential to cause impacts to any Aboriginal objects which may be present within the individual components of the proposal.
- ***Land use***. There are no material impacts predicted to ocurr to existing land uses or farming practises through the introduction of a powerline along the Preferred or Alternate powerline routes.

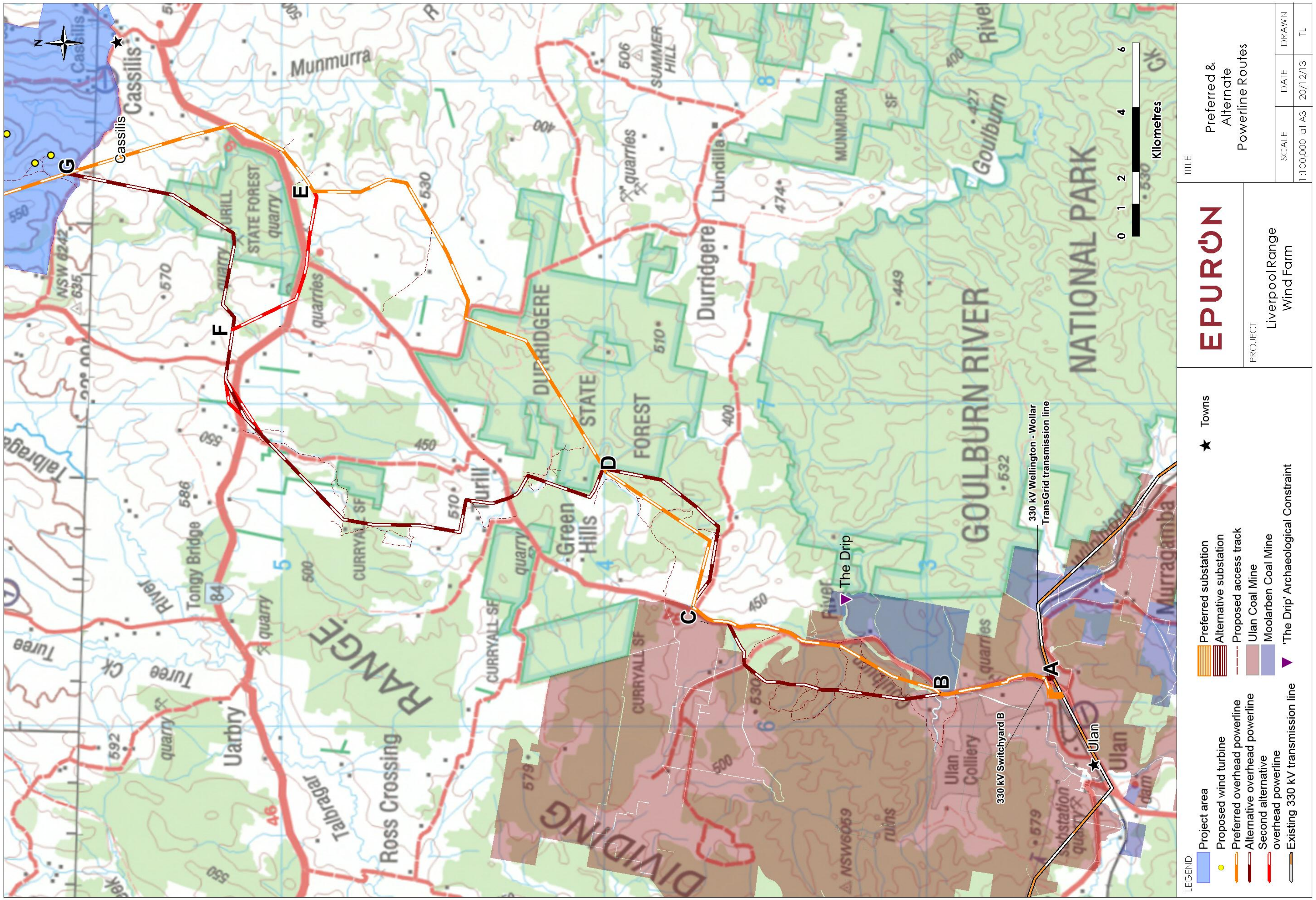


Figure 3-9 Preferred and alternate powerline routes

3.5 Wind Farm Electrical Connection Design

Connection to TransGrid Transmission Line

Epuron has submitted a Grid Connection Enquiry to TransGrid and carried out a grid connection assessment to confirm that TransGrid's existing 330 kV Wollar to Wellington transmission line that crosses to the south of the site has sufficient capacity to allow export from the wind farm.

A new 330 kV wind farm Connection Substation will be built to connect the wind farm into TransGrid's existing 330 kV Wollar - Wellington transmission line, located approximately 35 km to the south of the site. This Connection Substation would cover an area up to approximately 300 m x 300 m, plus an appropriate access road.

Two locations for the Connection Substation have been identified as shown in Figure 3-11:

A preferred location on the western side of Ulan Road in the vicinity of Ulan Coal Mine; and

An alternate location in the vicinity of the existing Moolarben Mine facilities buildings.

Only one of these locations will be used for construction as only one Connection Substation is required.

The connection substation will include all necessary ancillary equipment such as lengths of connecting powerlines, control room and cubicles, communication equipment and amenities. The connection substation also requires telecommunications (cable, optic fibre and/or microwave links) and backup electricity connections (415 V – 11,000 V) from local services.

The Connection Substation area would be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress. The ground would be covered partly by crushed rock and partly by concrete pads for equipment, walkways and cable covers. There would be an earth grid extending outside of the boundary of the security fence.

If the powerline voltage differs from the existing transmission line voltage (330 kV), the Connection Substation may require up to four large power transformers to change the powerline voltage up to 330 kV. The transformers are likely to be of the oil-cooled variety, and therefore may contain considerable quantities of oil. In addition, lower power auxiliary transformers may be required. Provision would be made in the design of the Connection Substation for containment of any oil which may leak or spill.

The connection substation will include an appropriate bushfire Asset Protection Zone (APZ) that complies with the RFS *Planning for Bushfire Protection* guidelines. This has been evaluated based on the vegetation type and slope. The site parameters (predominantly flat land) indicate that a compliant inner protection area (which can be maintained under continued grazing practices) and outer protection area could be achieved.

A short length of 330 kV connecting transmission line would connect the Connection Substation to the existing 330 kV TransGrid transmission line as indicated in Figure 3-11.

Figure 3-10 **TransGrid's 330 kV Macarthur Substation in western Sydney**

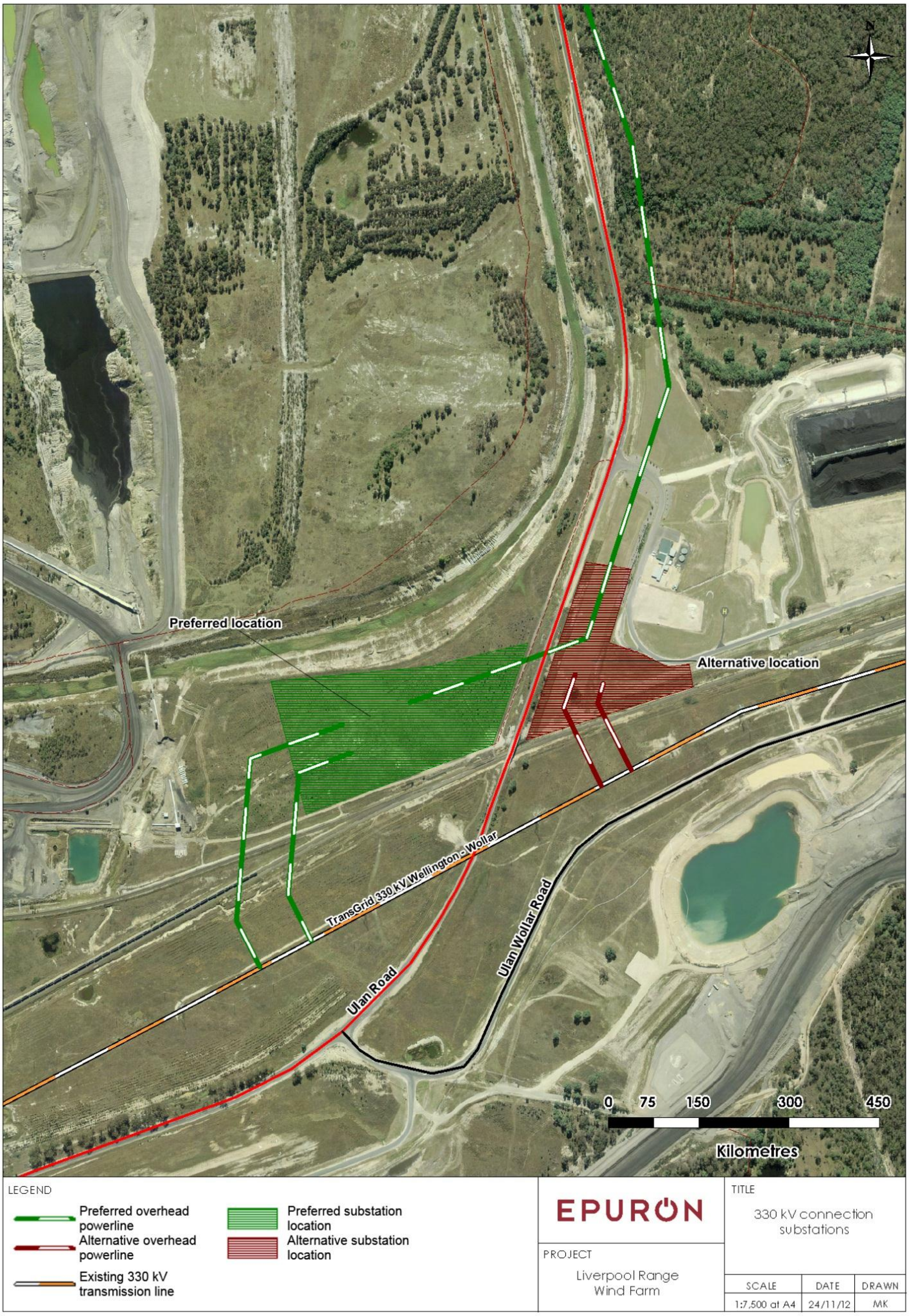


Figure 3-11 Detailed view of the proposed 330 kV connections substation options

Connection Powerline Design

The Connection Powerline is expected to be a double circuit design for most of its length, though this may reduce to a single circuit design towards the northern extremities of the site.

Powerline structures come in many designs however most are either steel or concrete pole design or a steel lattice tower design. The type of design used may vary depending on the preferred voltage, different ground conditions, carrying weights, strain angles, clearance requirements as well as local environmental conditions including local constraints (e.g. archaeological) and visual amenity.

Based on electrical design assessments for the wind farm it is proposed the new overhead powerline will be mounted on a combination of single pole, multiple pole or lattice structures, with a preference for single pole structures where visual amenity impacts are likely to be high if alternate structures are used.

Typical 132 kV and 330 kV mounting structures, together with indicative powerline heights and easement widths, are shown in Figure 3-12. Where single pole structures are used they are likely to have similar heights and easement widths to the structures shown. Where lower voltage structures are used, these are likely to be similar in appearance but lower in height to the options indicated.

The powerline will include an appropriate lightning protection system including earth mats, lightning rods, earthing conductors and earth wires as necessary.

While some clearing of the easement will be necessary for safety reasons, the amount of clearing will be minimised and lower growing species will be used to revegetate any cleared areas. In general, access tracks for construction and maintenance of the powerline will be built within this easement area.

The final confirmation of the structure type and design of the structure will be determined following further assessment by an appropriately qualified transmission line design consultant in consultation with TransGrid and nearby landowners. Final design is also dependant on selection of the construction contractor and completion of detailed design phase prior to commencement of construction.

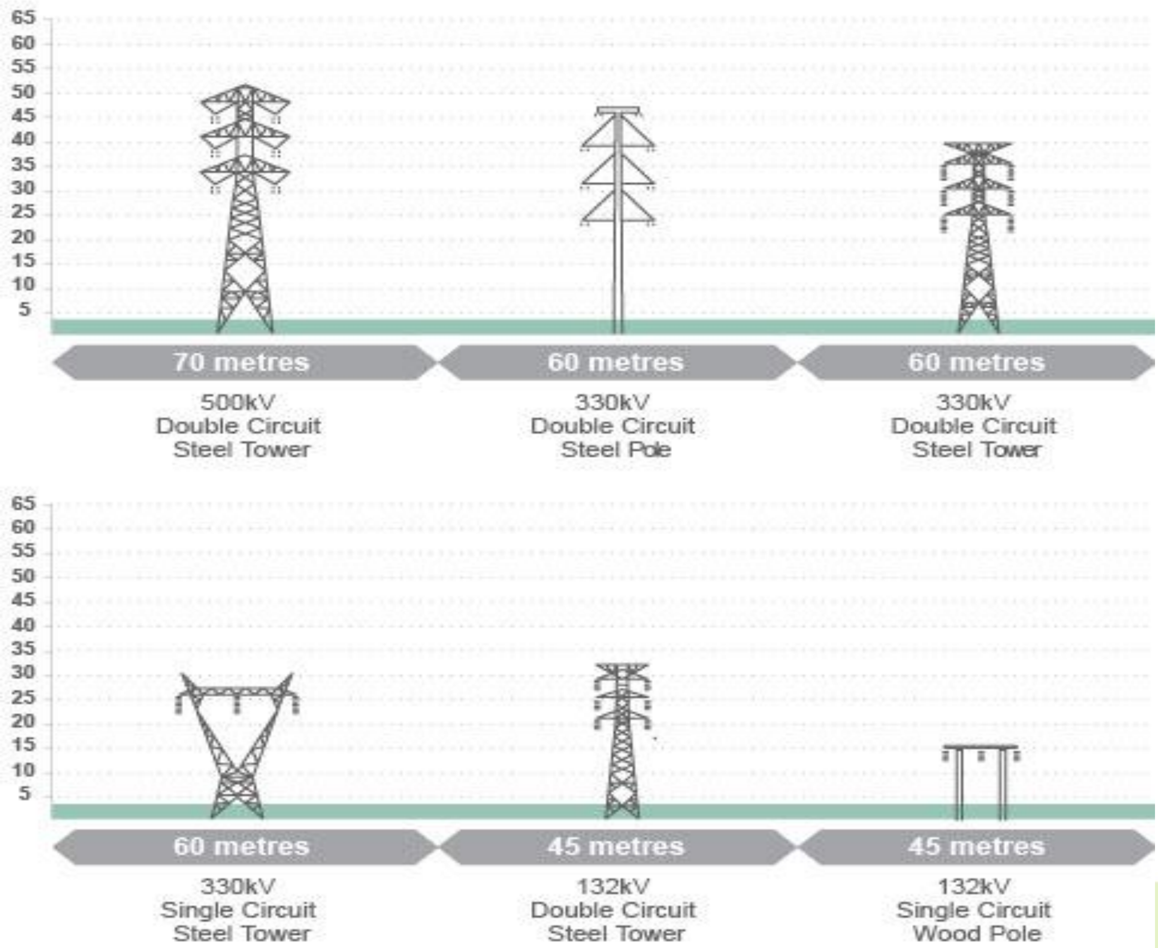


Figure 3-12 Typical 132 kV and 330 kV overhead powerline mounting structures

Collection Substations

Up to six new Collection Substations will be located on the wind farm site as indicated in Figure 3-2. The Collection Substations will collect power generated by the turbines and deliver it to the new overhead powerline. Table 3-3 indicates the preferred and alternate collection substations, with the final site selection to be based on technical and engineering requirements.

Table 3-3 Preferred and alternative collection substation locations

Wind Farm Precinct	Preferred Collection Substation Location(s)	Alternate Collection Substation Location(s)
Cassilis	Bounty Creek	Rotherwood Rotherwood (Alternate) Bounty Creek
Turee	Bounty Creek	Turee North Starkey's Creek
Coolah Tops	Coolah Tops	Turee North
Coolah East	Coolah East	
Gundare	Gundare	Gundare (Alternate) Coolah East

Each Collection Substation will include all necessary ancillary equipment such as lengths of connecting powerlines, control room and cubicles, communication equipment and amenities. The connection substation also requires telecommunications (cable, optic fibre and/or microwave links) and backup electricity connections (415 V – 11,000 V) from local services, and an appropriate access road.

Each Collection Substation area would be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress. The ground would be covered partly by crushed rock and partly by concrete pads for equipment, walkways and cable covers. There would also be an earth grid extending outside of the boundary of the security fence.

Each Collection Substation will include up to two large power transformers to change the voltage from the reticulation voltage (expected 22 kV or 33 kV) up to the powerline voltage. Further, some Collection Substations may include step-down transformers if the voltage of the Connection Powerline is reduced (e.g. from 330 kV down to 132 kV). The transformers are likely to be of the oil-cooled variety, and therefore may contain considerable quantities of oil. In addition, lower power auxiliary transformers may be required. Provision would be made in the design of each Collection Substation for containment of any oil which may leak or spill.

Each Collection Substation will include an appropriate bushfire Asset Protection Zone (APZ) that complies with the RFS *Planning for Bushfire Protection* guidelines. This has been evaluated based on the vegetation type and slope. The site parameters (predominantly flat land) indicate that a compliant inner protection area (which can be maintained under continued grazing practices) and outer protection area could be achieved.

Typically each Collection Substation would take up an area up to 200 m x 200 m. The proposed locations for each Collection Substation have been identified and are shown in more detail in Attachment 1 – Detailed Site Maps.

Approval is sought for the preferred and alternative Collector Substations, however only up to six Collection Substations will be built.

Onsite Electrical Reticulation

From each wind turbine, the power voltage is stepped up from generation voltage to either 22 kV or 33 kV for reticulation from each group of turbines to the Collection Substations. Each turbine is then connected from its own transformer via a combination of underground cable and overhead powerline reticulation back to the Collection Substation.

Typically underground cabling is used to connect turbines along the ridgelines and overhead powerlines are used to transport power between adjacent ridges and from groups of turbines to the Collection Substations. In general, overhead powerlines offer benefits as they minimise ground disturbances and are significantly lower in cost. There are practical limitations to installing overhead cabling on ridges where turbines are located, as well as a greater visual impact. Overhead powerlines will be located along the lower lying areas and slopes of the ridgelines to minimise visual and practical impacts where possible.

An indicative reticulation layout is shown in in Figure 3-13, with more detailed maps in Attachment 1 - Detailed Site Maps.

Cable trenches would, where practical, be dug within or adjacent to the onsite access tracks to minimise any related ground disturbance. Short spur connections would diverge from the main cable route which would approximately follow the main access route at each group of turbines. Subject to ground conditions, underground cables would typically require a trench of 0.75 to 1 m deep and 0.5 to 1 m wide.

Statements of Commitment accompany this proposal to ensure that micro-siting is used to minimise environmental (particularly ecological) impacts. Micrositing would be undertaken with the assistance of an ecologist, especially where routes are located near sensitive environmental features.

Communications Equipment

A suitable communications network will be established across the wind farm site to enable appropriate operation and control including the required interaction with the TransGrid electricity grid. In addition to underground and overhead communications cabling, this network could include UHF, VHF or microwave communications equipment.

In addition to the electrical cabling, control and communications cabling is required from the maintenance facility to each wind turbine, and to the various substations. This communication cabling is typically optical fibre cable and would be installed using the same method and route as the power cabling described above, that is, strung from the same poles as overhead lines, or buried in the same cable trench as the electrical cables.

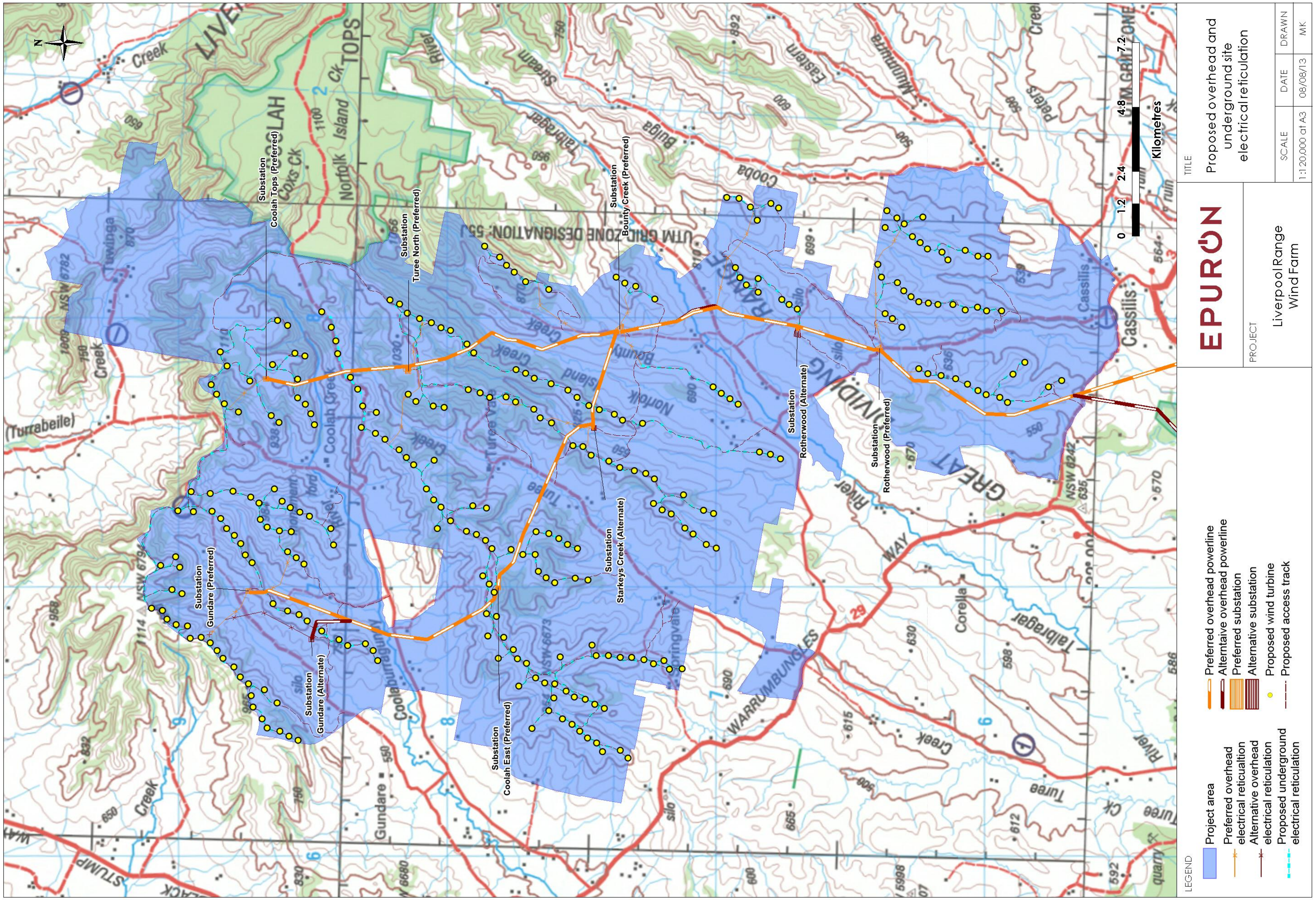


Figure 3-13 Indicative proposed overhead and underground site electrical reticulation

3.6 Access to and Around the Site

Main Site Access

The primary access to the project site will be via the Golden Highway. This is a major highway between Newcastle and Dubbo and will be able to handle the additional traffic generated during the construction of the wind farm. Minor rearrangement of street furniture and powerlines may be required at Denman to navigate through a 90 degree right hand turn at the edge of town.

From the Golden Highway, major vehicle access to the site will be via Ulan Road, Warrumbungles Way, Rotherwood Road, Turee Vale Road, Coolah Road and Coolah Creek Road, and various subsidiary public roads coming off these. These routes avoid heavy vehicles transiting the townships of Coolah and Cassilis during construction. Further, the Burragundy Bridge on the outskirts of Coolah is not suitable for oversized vehicles.

Alternate access to the site for smaller vehicles may be via the townships of Cassilis or Coolah, particularly during the operation and maintenance phase where workers are expected to travel to site from these towns.

The turn off to and from the wind farm will be signposted and designed to allow vehicles to exit and enter the roadways safely. Minor works may also be required to these public roads as outlined in the Traffic and Transport assessment summarised in Section 13.

Access tracks

On site access tracks required for construction and operation would be unsealed formations with a minimum width of 5 m. Access tracks are required to the base of each wind turbine location and to the location of the Connection Substation, Collection Substations, overhead powerline route, operation and maintenance facilities and other infrastructure. New gates and possibly new or realigned fences may also be required to protect stock during the construction phase and at property boundary crossings.

Once the construction phase has finished, the crane hardstands and access tracks would be maintained to allow maintenance and repairs to the wind turbines. These tracks can also be used for normal farm access.

In locating access tracks on site, every effort would be made to:

- minimise the number and length of access tracks;
- locate access tracks along the route of existing farm tracks;
- locate access tracks to minimise clearing of native vegetation;
- locate access tracks to minimise impact on sensitive ecological or heritage areas;
- construct access tracks with due regard to erosion and drainage; and
- construct access tracks with due regard to landowners ongoing farming practices.

Vehicle management

Prior to the commencement of construction a Traffic Management Plan (TMP) would be prepared to properly manage traffic impacts on public roads as detailed in Section 13. It would be developed in consultation with the roads authorities to ensure that the measures are adequate to address potential safety and asset degradation impacts.

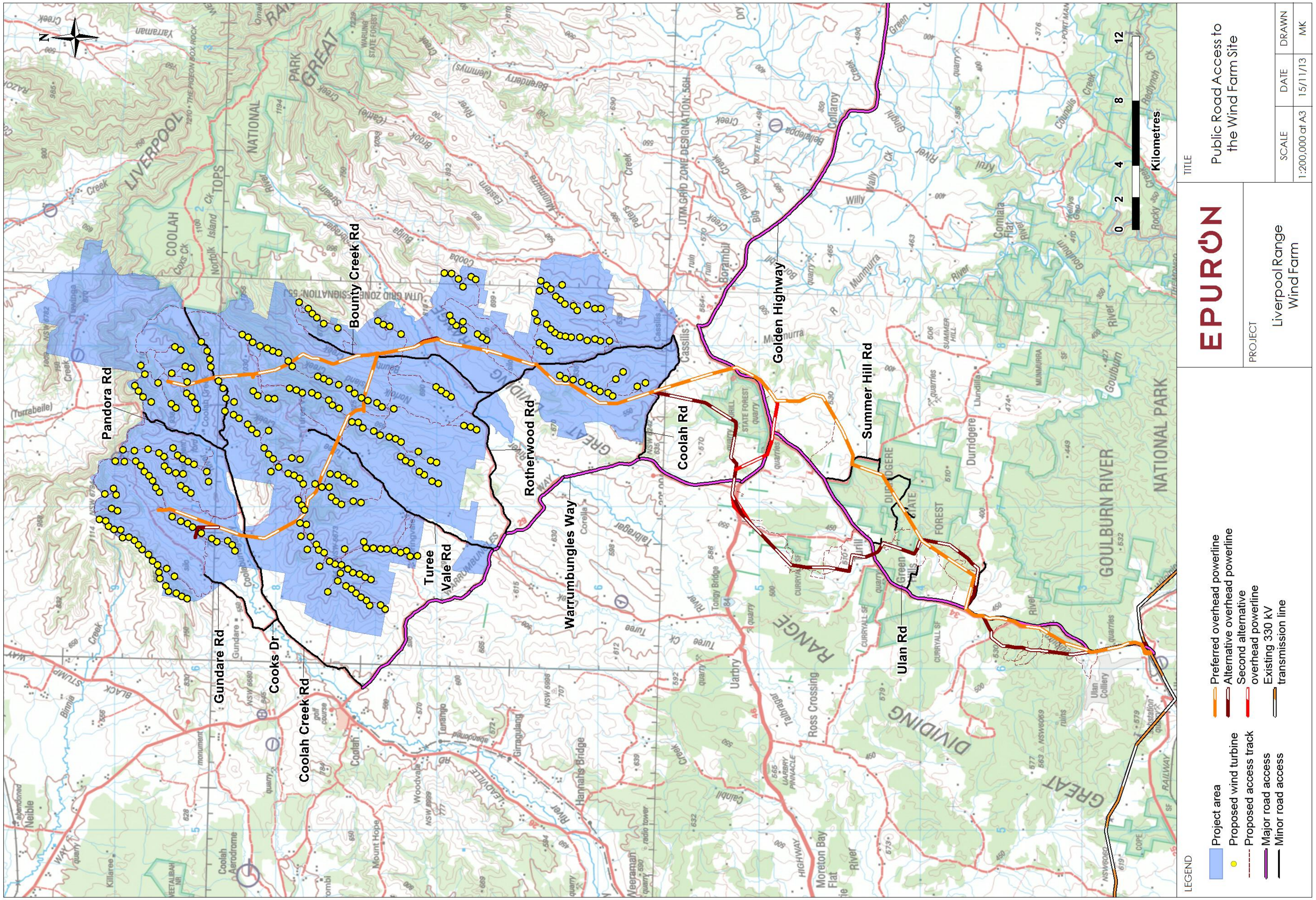


Figure 3-14 Site access to the proposed wind farm

3.7 Construction Facilities

During the construction phase up to two construction compounds will be established on the site. The compounds will include car parking, site offices, and amenities for the construction work force, and lay down areas for the temporary storage of construction materials, plant, equipment and wind turbine components. A temporary power supply will be required to be connected to the construction compounds.

Site Offices

During the construction phase up to 829 staff would be working on site at any time. Suitable locations for up to four site offices would be selected, avoiding areas that are regarded as having environmental constraints. The site offices may include several demountable buildings and amenities blocks located on site for the duration of construction. Sufficient parking would be provided for the expected usage.

Lay down areas and Construction Compounds

Temporary lay down areas to store materials and carry out pre-assembly works will be located at the construction compounds and at selected locations across the project site where require. These areas would be typically fenced off and secured but may also include the use of paddocks for a short term where required across the site.

Temporary construction compounds will be erected and maintained during the construction phase. Locations of these compounds are shown in Figure 3-15 through Figure 3-18. The temporary construction compounds will typically include amenities, offices, staff facilities, stores, car parks, communication equipment, visitor facilities and safety areas.

Concrete Batch Plants

Up to four portable concrete batching plants would be required on site and are typically located in the vicinity of the construction compounds. A typical concrete batch plant would involve a level area of approximately 100 m x 100 m to locate the loading bays, hoppers, cement and admixture silos, concrete truck loading hardstand, water tank and stockpiles for aggregate and sands. The batching plant would include an in-ground water recycling / first flush pit to prevent dirty water escaping onto the surrounding area, and would be fully remediated after the construction phase. The proposed locations are shown in Figure 3-15 through Figure 3-18.

The concrete batching plant would produce up to 400 m^3 of concrete per day when a turbine foundation is being poured. The operational period of the concrete batching plant would be for the life of the construction phase and the plant would produce a maximum of 850 tonnes per day. This is equivalent to 355,000 tonnes total during the construction phase. The batch plant operations would therefore require a license to be issued by DECCW (under the Protection of the Environment Operations Act 1997), given the amount exceeds the license threshold of 150 tonnes per day. License conditions specified by DECCW are likely to include operational protocols and monitoring.

Rock Crushing

Materials excavated during the construction of wind turbine foundations may be able to be reused for other purposes, such as road base for the road surface upgrades. For these purposes mobile rock crushers would be used during construction.

Gravel

Gravel would be sourced from suitable nearby quarry and raw material suppliers. Due to the presence of vast mining interests in the region the sourcing of gravel and other raw material is found to be widely and readily available. There are nearby gravel and quarry facilities capable of supplying all raw material needs for the project, including;

- Yarrawa Ridge Gravel Supplies - Turnerman’s Road, Denham.
- CMG Sand and Gravel - Cawsey Road, Denham.
- Stoneco - Middlebrook Road, Scone.
- Boral Quarries - Mitchell Highway, Maryvale.

Water Use

During construction it is estimated 59 ML of water will be required for general construction purposes and dust suppression control. Locating concrete batching plants on site will require an additional 6-7 ML of water for concrete foundations etc.

Water for the project will be sourced primarily from Burrendong Dam near Scone and transported to onsite water storage tanks. The proponent has discussed the proposed arrangements with NSW Office of Water and has written to State Water seeking to progress the necessary arrangements to formalise the use of water during construction. As the water requirements for the project represents less than 0.006% of the capacity of the Burrendong Dam, the project is not expected to have a significant impact on ongoing dam operations. Sourcing water from Lake Windamere is an alternative to the proposed use of Burrendong Dam water.

3.8 Additional Permanent Facilities

Operations and Maintenance Facilities

An operation and maintenance facility would be located as shown in Figure 3-17. The facility will include car parking, offices and amenities for the maintenance staff, a control room and storage facilities for spares and equipment needed for the maintenance and operation of the wind turbines.

Figure 3-15 Location of northern site facilities

Figure 3-16 Location of western site facilities

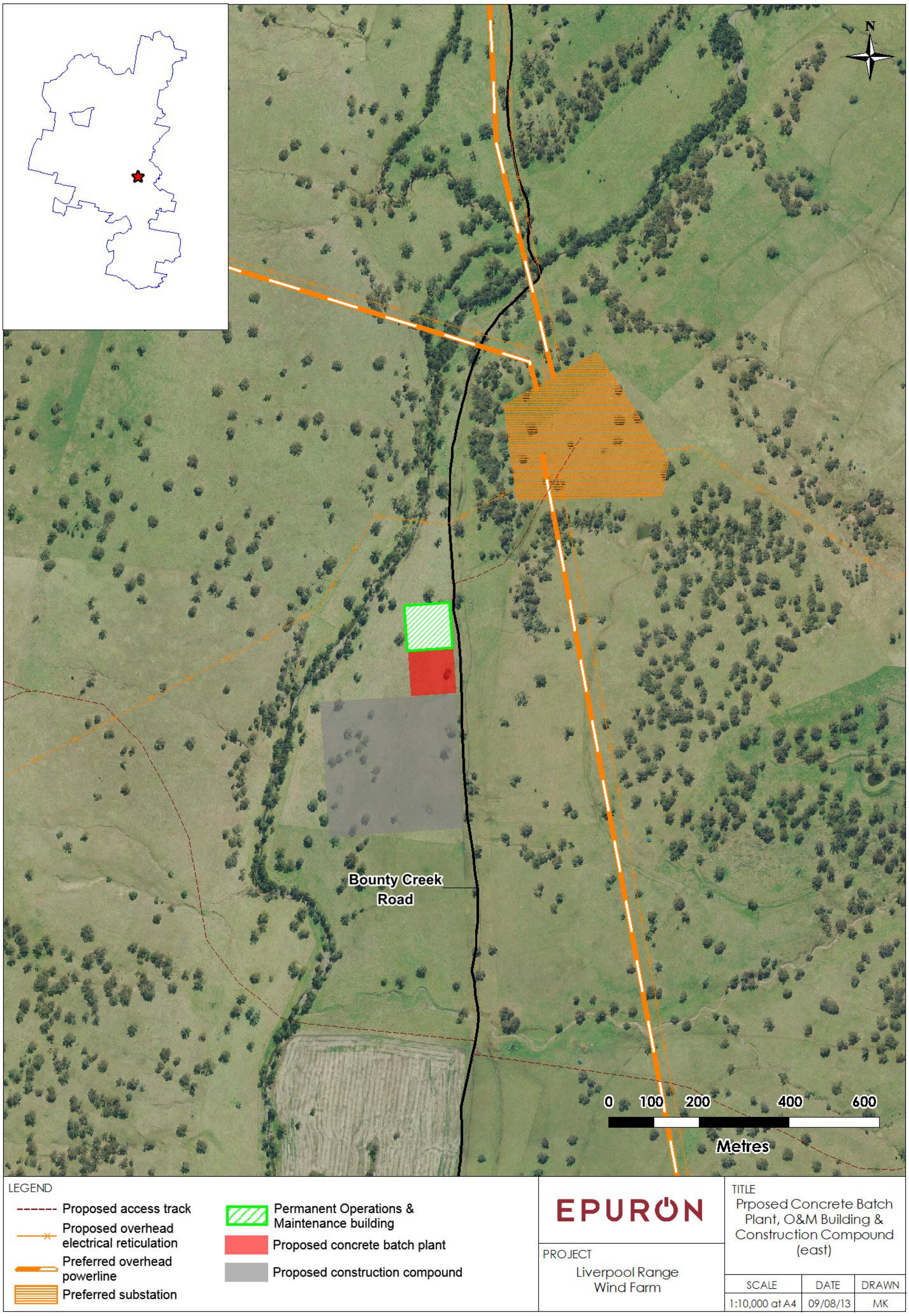


Figure 3-17 Location of eastern site facilities

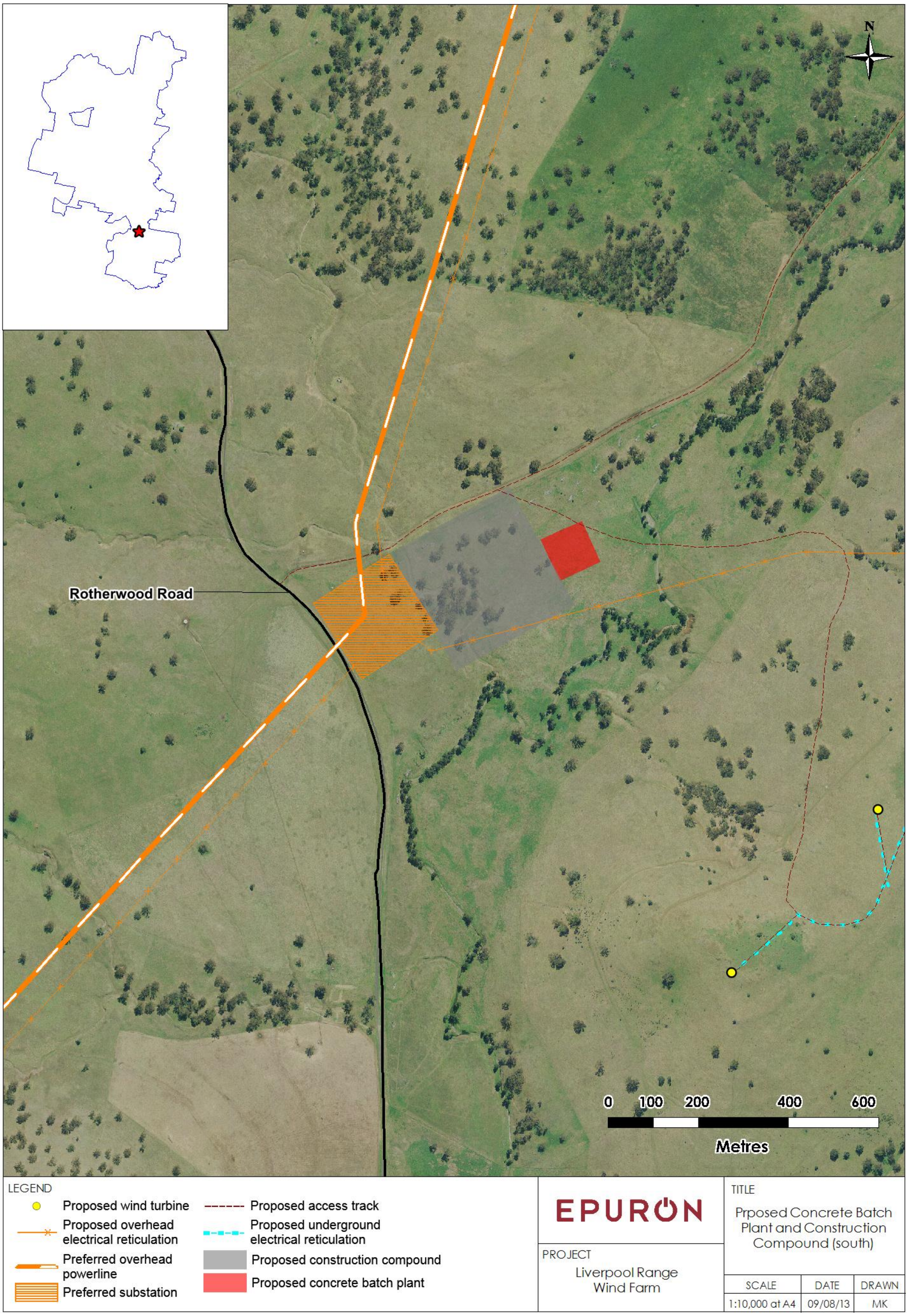


Figure 3-18 Location of southern site facilities

Wind Monitoring Equipment

Epuron is currently operating five wind monitoring masts on the site to assess wind speeds at or near proposed turbine locations. Following construction, permanent wind monitoring masts would be required to assist with the control and operation of the wind farm. These would be static guyed masts with remotely operated wind monitoring equipment installed at multiple heights on each mast. Each mast could require hub-height wind monitoring; therefore masts are expected to be at least 80 m tall.

Pending final wind turbine placements, it may be necessary to move or install additional permanent wind monitoring masts to verify wind speeds across the site.

The temporary and permanent masts would be located within the development envelope assessed in the various studies reported in this document.

Epuron will inform CASA and the Department of Defence of the location of any monitoring masts constructed.

3.9 Site Disturbance and Impact Areas

The proposed wind farm requires the construction of a number of elements including turbines, turbine foundations, underground and overhead powerlines, substations, control buildings and access roads on the site.

During the construction activities additional areas of the site would be impacted to provide construction compounds, concrete batching plants and storage areas. These areas can be rehabilitated and restored following the completion of the construction program. Table 3-4 presents the calculated area of the site impacted by the project based on the turbine layout.

Table 3-5 provides a calculated volume of vegetation that may be modified or removed based on the site footprint described in Table 3-4. Some of these impacts would be for the duration of the wind farm operation and some are temporary impacts during the construction phase. More detail can be found in Section 11 Ecology.

Table 3-4 Development footprint and site disturbance areas

Project Components	Typical Dimensions	Quantity	Total Area (ha)
Permanent Infrastructure:			
Foundation and Hardstand#	25 m x 60 m	288	44.5
Access tracks and spurs*#	10 m	10 m	359.2
Underground reticulation powerlines onsite**	1 m	210.9 km	21.09
Overhead reticulation cabling / easement^	25 m	56.2 km	140.5
Overhead Powerline^	60 m	94.8 km	568.8
Connection Substation	300 m x 300 m	1	9
Collection Substations	200 m x 200 m	6	48
Operations and Maintenance facilities and Control Building	100 m x 100 m	1	1
Temporary Infrastructure:			
Concrete batch plants	100 m x 100 m	4	4
Construction compounds, staging and storage areas	300 m x 300 m	4	36

* Access tracks around the site are anticipated to be 5 - 6 metres in width, however, a 10 metre width has been used to assess the likely impact due to cut and fill operations in order to achieve the required slope.

**The impact area associated with underground cables has been incorporated into the figures for access tracks.

Habitat permanently removed

^ Habitat would be modified for transmission and power line maintenance. This would include clearing and trimming vegetation for each power pole and maintaining clearance from electrical conductors between poles.

Table 3-5 Total impacted vegetation

Vegetation Type	Condition							Total (ha)
	Good	Mod-Good	Moderate	Poor-Mod	Poor	Exotic	Not Assessed	
Wind Farm Study Area								
Brittle Gum Stringybark Woodland			1.8		1.8			3.7
Mountain Gum Silvertop Stringybark Forest					1.0			1.0
Norton's Box Woodland	11.5	9.5	20.3	26.1	37.9			105.4
Riparian Forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box					45.1			45.1
River Oak Woodland					15.7			15.7
White Box / Grey Box Grassy Woodland			5.2	27.7	103.2			136.1
Yellow Box Woodland					3.6			3.6
Native Pasture			167.0	17.6	39.8			224.4
Exotic Pasture						737.7		737.7
Not Assessed							131.2	131.2
Total	**11.5**	**9.5**	**194.4**	**71.4**	**248.2**	**737.7**	**131.2**	**1404.0**
Transmission Line Study Area								
Riparian Forest - Rough-barked Apple and Blakely's Red Gum	12.1	2.0	2.9	9.5				26.5
Riparian Forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box	1.3	2.6			0.4			4.3
Sandstone Forest - Black Cypress Pine dominant			2.9					2.9
Sandstone Forest - Inland Scribbly Gum dominant	7.8	23.7						31.5
Sandstone Forest - Narrow-leaved Ironbark dominant	7.5	27.7	15.3	0.5	0.2			51.1
Sandstone Forest - Red Ironbark dominant	2.8	15.0						17.8
White Box / Grey Box Grassy Woodland				1.8	8.9			10.7
Native Pasture			0.4	106.8	5.1			112.3
Exotic Pasture						14.4		14.4
Not Assessed							87.7	87.7
Total	**31.6**	**71.1**	**21.5**	**118.6**	**14.6**	**14.4**	**87.7**	**359.4**

3.10 Project Implementation

Following development, the establishment of the wind farm can be considered as occurring in four phases. These include construction, operation, refurbishment and/or decommissioning of the wind farm. A description of activities under these headings follows.

3.10.1 Phase 1: Wind Farm Construction

The construction phase of the wind farm is likely to occur over at least a 24-36 month period and would include activities such as:

- transportation of people, materials and equipment to site;
- civil works for access track construction, turbine foundations and trenching for cables;
- establishment, operation and removal at completion of any required construction equipment such as rock breaking equipment and concrete batching plants;
- potential use of blasting in foundation excavation, if required;
- installation of wind turbines using large mobile cranes;
- construction of collection substations, connection to on-site 330kV transmission line, and onsite overhead powerlines and electrical cables;
- construction of additional facilities (temporary and permanent) as required;
- construction, use and removal of temporary offices and facilities;
- temporary storage of plant and equipment; and
- restoration and revegetation of disturbed onsite areas on completion of construction works.

In general, construction would commence with site establishment, construction of access tracks and all other site civil works, including preparation of hardstand areas, and laying of cables. This would be followed by preparation of concrete and steel reinforced foundations, which must be cured prior to installation of wind turbines.

Wind turbine construction and erection can be relatively fast once the foundations are prepared, with wind turbines installed at a rate of approximately 2-3 per week, subject to weather. The towers are erected in sections, the nacelles lifted to the top of the towers, and finally blades lifted and bolted to the hub.

The necessary substation construction and grid connection works would be carried out in parallel.

The commissioning phase would include pre-commissioning checks on all high-voltage equipment prior to connection to the TransGrid transmission network. Once the wind farm electrical connections have been commissioned and energised, each wind turbine is then separately commissioned and placed into service.

On completion of construction, disturbed areas would be remediated and all waste materials removed and disposed of appropriately.

3.10.2 Phase 2: Wind Farm Operation

While the wind farm operates largely unattended, the wind turbines and other equipment would require regular maintenance. It is possible that some equipment may require major repair or replacement. In addition, during the initial operating years, operator attendance may be more regular while wind farm operation is being fine-tuned and optimised.

Once installed, the turbines would operate for an economic life of twenty to thirty years. After this time the turbines may be refurbished to improve their performance or decommissioned and removed from the site.

Routine Maintenance

To ensure the wind farm operates in a safe and reliable manner, it would require regular inspection and maintenance on an 'as needs' basis. This would generally be carried out using standard light vehicles.

In addition, regular scheduled maintenance is required, generally at 3, 6 and 12 monthly intervals. As a guide, each turbine requires approximately 7 days of maintenance per year. This does not require the use of major equipment, and could be carried out in a normal utility or small truck and would not require any additional works or infrastructure.

Major Repairs

It is possible that major unexpected or unscheduled equipment failures could take place during the life of the wind farm. While wind turbines and electrical components are designed for a 20 - 30 year life, failures can occur, for example due to lightning strike.

Most repairs can be carried out in a similar manner to routine maintenance, with some exceptions:

Replacement of wind turbine blades, if necessary, would require bringing new blades to the affected turbine and installation of these blades using large cranes. The requirements are similar to the construction phase, and the access tracks established for construction may need to be brought into operation again.

Replacement of wind turbine generators or gearboxes may require a crane and low loader truck to access the wind farm.

Replacement of substation transformers would require a low loader truck to access the site.

Site monitoring program

A post-construction monitoring program would be established to determine any additional impacts resulting from the operation of the wind farm. The Operational Environmental Management Plan would contain specific monitoring programs required and would assess key issues such as noise compliance.

Further details of the monitoring and adaptive management mechanisms are included in Section 17.

3.10.3 Phase 3: Wind Turbine Refurbishment / Replacement

The life of a modern wind turbine is typically 20 - 30 years, at which point individual wind turbines would be refurbished, replaced, overhauled or removed. Individual turbines may also fail at shorter intervals for various reasons as discussed above.

Replacement, refurbishment and recommissioning would involve similar road access arrangements to construction, and would require access for large cranes and transport vehicles to dismantle and remove the existing turbines and to install replacement turbines.

Existing substations and cabling would be largely reused wherever possible. It is also possible that the existing foundations and towers could also be reused, subject to the design of turbines available at the time of replacement / recommissioning. This would allow a significant cost saving for the wind farm.

Any refurbishment or turbine replacement would comply with the requirements of the project approval under this application.

3.10.4 Phase 4: Wind Turbine Decommissioning

Decommissioning the wind farm at the end of its commercial life is the Proponents obligation and at their cost. It would involve reinstating similar road access arrangements to construction, and would require access for large cranes and transport vehicles to dismantle and remove the turbines. All underground foundations and cable trenches would remain in situ and all above ground infrastructure would be removed. The decommissioning period is likely to be significantly shorter and with significantly fewer truck movements than the construction phase.

It should be noted, based on current market data, that the scrap value of turbines and other equipment is expected to be more than sufficient to cover the costs of their dismantling and site restoration.

Agreements with involved landowners ensure that the wind farm operator is responsible for decommissioning of the wind farm including the associated costs and site clean-up.

A Decommissioning and Rehabilitation Plan for the project is attached as Appendix G.

3.10.5 Staging of Works

It is possible that not all turbines, access tracks or other equipment outlined in this EA would be ultimately required for the project. Likewise, market, seasonal, or operational requirements may mean that the actual construction of the wind turbines may occur in stages or groups over a number of years.

The Precinct design concept outlined in Section 3.1 indicates how construction of the site could be broken down into different stages over time. Each construction stage would go through similar processes and a similar timeframe to that outlined above.

3.10.6 Construction hours

In general, construction activities associated with the project that would generate audible noise in excess of the requirements of the NSW Interim Construction Noise Guideline at any residence would be undertaken during the daylights hours of:

Monday – Friday: 7am – 6pm

Saturday: 8am – 1pm

Sunday and public holidays:Not currently proposed

These working hours have been proposed to allow reasonable efficiencies of effort to achieve maximum productivity and to minimise the overall construction duration but should not be restricted to daylight hours. Variations to these hours may be required subject to weather and seasonal impacts.

However, some activities (including delivery to site of major equipment, and turbine installation) may occur outside of these hours due to logistic, safety or weather related reasons.

Turbine crane lifts, for example, can only be carried out during periods of lower wind speeds because of operational limitations with the tall cranes and it is possible that out of hours work would be required for this purpose. This scenario has occurred at other wind farms (for example Cape Bridgewater, Victoria) where night crane operations have been required because of strong winds occurring during the day.

Likewise, the requirements of NSW Police or roads authorities may limit transport of major equipment to and from the site to outside of normal working hours.

Any construction activities outside of the standard construction hours will only be undertaken in the following circumstances;

- Construction activities that generate noise that is:
  - no more than 5dB(A) above rating background level at any residence in accordance with the ICNG (Table 2 of the ICNG); and
  - no more than the noise management levels specified in Table 3 of the ICNG at other sensitive receivers; or
- for the delivery of material required outside those hours by the NSW police Force or other authorities for safety reasons (section 10.11.2); or
- where it is required in an emergency to avoid the loss of life, property and/or to prevent environmental harm;
- works as approved through the out-of-hours work protocol outlined in the Construction Noise and Vibration Management Plan as part of the Construction Environmental Management Plan.

3.11 Crown land

The proposed Liverpool Range Wind Farm has no turbines and associated blades that impact on any Crown Land which includes Crown Parcels, Crown Roads and Crown Waterways. Permanent and temporary facilities including O&M building, construction compound, substation and concrete batching plant also do not impact on any Crown Land. Each individual infrastructure item is documented relative to its potential impact on the type of Crown Land, shown in Table 3-6 to Table 3-8.

A survey of all infrastructures relative to the cadastre will be carried out prior to construction to accurately confirm there are no turbines and associated blades encroaching on Crown Waterways, Parcels and Roads.

In some instances access tracks, underground cabling cross or overhead powerline crosses Crown Parcel. Table 3-6 represents the number of instances where infrastructures cross a Crown Parcel.

In some instances access tracks, underground cabling cross or overhead powerline crosses Crown Parcel. Table 3-7 represents the number of instances where infrastructures cross a Crown Parcel.

In some instances access tracks, underground cabling and overhead powerline's cross Crown Waterways. Only two Crown Waterways are crossed, however there are multiple instances of this as summarised in Table 3-8.

Consultation has occurred with the NSW Trade and Investment, Crown Land division and it has been advised that during detailed design prior to construction all impacts on Crown land will be further investigated and the appropriate approvals sought. At that time the proposal will be fully investigated and if unobjectionable, the most appropriate form of tenure negotiated. Any use or occupation of Crown land will be authorised by NSW Trade and Investment before any use or occupation occurs.

Table 3-6 Infrastructure relative to Crown Parcel

Infrastructure	Parcels crossed
Turbines and blade	0
Facilities - O&M building, construction compound, substation, concrete batching plant	0
Access tracks	15
Underground cabling	1
Overhead powerline	21[1]

Table 3-7 Infrastructure relative to Crown Road

Infrastructure	Roads crossed
Turbines and blade	0
Facilities - O&M building, construction compound, substation, concrete batching plant	0
Access tracks	103
Underground cabling	62
Overhead powerline	45[2]

Table 3-8 Infrastructure relative to Crown Waterways

Infrastructure	Waterways crossed
Turbines and blade	0
Facilities - O&M building, construction compound, substation, concrete batching plant	0
Access tracks	6
Underground cabling	0
Overhead powerline	11[3]

[1] Overhead powerline has 3 route options: Preferred, Alternate and Second Alternate. Where an alternate is built the preferred route that it replaces will not be. The number of Crown Parcels crossed by the preferred line is 9 instances, Alternate is 9 instances and the Second Alternate is 4 instances.

[2] Overhead powerline has 3 route options: Preferred, Alternate and Second Alternate. Where an alternate is built the preferred route that it replaces will not be. The number of Crown Roads crossed by the preferred line is 25 instances, Alternate is 13 instances and the Second Alternate is 7 instances.

[3] Overhead powerline has 3 route options: Preferred, Alternate and Second Alternate. Where an alternate is built the preferred route that it replaces will not be. The number of Crown Waterways crossed by the preferred line is 8 instances and Alternate is 3 instances.

4 Strategic Justification

This section provides a justification for the project in the context of its local and regional setting. It provides a summary of the energy context and in particular the need for additional electricity supply in NSW. It also outlines the benefits of the project including reducing Australia's greenhouse gas emissions, supporting Federal and State renewable energy targets as well as other local and wider community benefits.

The NSW State Plan has created specific goals underlining the States commitment to achieving 20% renewable energy by 2020 and driving economic growth in regional NSW. The Minister for Energy recently released the draft NSW Renewable Energy Action Plan which states that NSW is open for business in renewable energy and is keen to capture the jobs and investment that comes with it. Below is an outline of the NSW government's plans to assist the development of renewable energy in NSW.

The justification for the Liverpool Range Wind Farm development is based on the following forecasts:

- In full operation, it would generate more than 2,725 GWh of electricity per year - sufficient for the average consumption of around 340,600 homes.
- It would improve the security of electricity supply through diversification of generation locations.
- It would reduce greenhouse gas emissions by approximately 2,634,800 tonnes of carbon dioxide equivalent (CO_2e) per annum[4] or the equivalent of 717,000 cars removed from the roads
- It would contribute to the State and Federal Governments' target of providing 20% of consumed energy from renewable sources by 2020.
- It would contribute to the NSW Government's target of reducing greenhouse gas emissions by 60% by the year 2050.
- It would create local employment opportunities and inject funds of up to $1,272 million into the Australian economy.
- In addition to these primary benefits there are also secondary benefits and opportunities for improvements in infrastructure, tourism and ecology.

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[4] Calculated using the NSW Wind Farm Greenhouse Gas Savings Tool developed by DECCW

4.1 Meeting Our Growing Electricity Demand

Electricity consumption continues to grow, and the additional demand must be met by either increased fossil fuel generation or an increase in generation from renewable sources such as wind power.

TransGrid's Annual Planning Report (2012) and AEMO's Annual Electricity Statement of Opportunities (2012) confirms that future electricity demand, although not as high as previously predicted, continues to rise. AEMO's latest annual energy projection for the National Electricity Market (NEM) predicts average annual growth of 1.7%, while NSW is expected to increase annually at an average of 1.2%.

Meeting this demand will require our existing electricity generators to increase their annual output, however at some point additional power generators will be also be required. AEMO has estimated that additional power generating capacity will be required to manage peak periods in NSW by summer 2021/22. Options need to be developed to meet this expected demand growth to ensure reliability of supply and evade power outages and blackouts (TransGrid, 2012). This is detailed in AEMO's Annual Electricity Statement of Opportunities report, as illustrated in Figure 4-1.

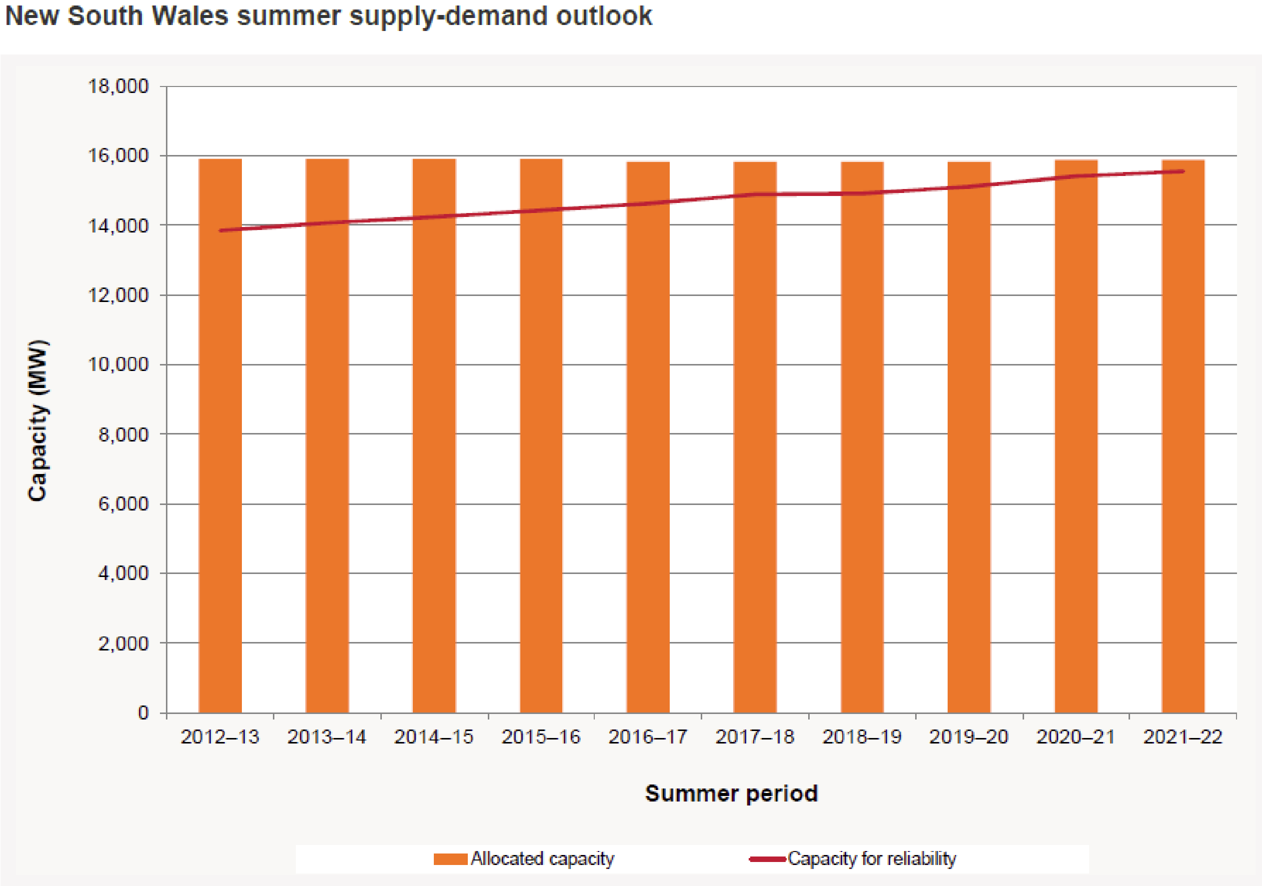


Figure 4-1 AEMO NSW Summer Generation Capacity Outlook (AEMO, 2010)

4.1.1 Quantifying the Electricity Generation from this Project

Electricity production from wind farms is variable. At any point in time a wind farm could be generating anywhere in the range of 0 to 100% of its power output, depending on the local wind speeds.

However, in the same way that the weather can be predicted hours to weeks in advance, the likely wind farm power output at any point in time can also be predicted with reasonable accuracy. In its role as electricity market operator, AEMO has established a Wind Energy Forecasting System to help it understand the likely wind farm production from minutes to days in advance. This system enables AEMO to reliably operate the electricity market taking into consideration the variability of all components including the constantly changing load, availability of and loading on transmission lines, plant outages at major power stations, and the changing output of wind farms.

In that context, while the output of wind farms is variable, it is also predictable and dependable.

The Liverpool Range Wind Farm represents a large sized wind farm with an installed capacity likely to be approximately 864 MW (based on 288 wind turbines with a capacity of 3.0 MW).

Epuron has carried out significant wind monitoring on the site to confirm the expected long term wind regime. Based on Epuron's analysis of wind speeds at the site, the project is expected to produce in the order of 2,725 GWh of electricity per year over its operating life.

The energy produced from the wind farm would be 100% renewable energy and would be fed directly into the electricity grid and sold on the National Electricity Market (NEM).

4.2 Reducing Greenhouse Gas Emissions

4.2.1 Context

There is scientific evidence that the earth's climate is changing. Observations have shown global increases in air and ocean temperatures, the widespread melting of snow and ice and rising sea levels (IPCC, 2008). It has further been observed that many of the world's natural systems are already being affected by the change of regional climates, in particular temperature increases (IPCC, 2008). Other indicators include altered rainfall patterns and more frequent or intense weather patterns such as heatwaves, drought, and storms. In Australia, this change in the climate is anticipated to have an impact on water supply and quality, ecosystems and conservation, agriculture and forestry, fisheries, settlements and industry and human health.

The drivers for climate change have been identified as being from both natural and anthropogenic forces, however a main contributor is the release of greenhouse gases GHG into the atmosphere (IPCC, 2008).

The Intergovernmental Panel for Climate Change (IPCC) has acknowledged that it is very likely that human greenhouse gas emissions have directly influenced global temperatures to increase, as well as lead to other climate impacts. As greenhouse gas emissions stay in the atmosphere for decades, a predicted warming of 0.2°C or higher per decade is already expected regardless of future emission levels. However, if greenhouse gas emissions continue to be emitted at their current rate then further and more extreme changes to the global climate system will be experienced. Therefore, a reduction in greenhouse gas emissions could assist in reducing the rate and magnitude of climate change. The IPCC recognises that mitigation efforts over the next 20-30 years will be crucial to stabilising the amount of change (IPCC, 2008).

Referring to the Australian context, Department of Climate Change and Department of Sustainability, Environment, Water, Population and Communities reports show that greenhouse gas emissions from the stationary energy sector, is the largest and fastest growing area in terms of greenhouse gas emissions in Australia. The stationary energy sector accounted for 52% of total emissions in 2009 and within this sector, emissions from electricity generation contributed over 70%. Furthermore, stationary energy emissions between 1990 and 2009 energy have increased by 51% (DSEWPC, 2011).

In regards to NSW, the vast majority of Greenhouse Gas Emissions in 2007 were from the stationary energy sector, emitting 61 Mt CO_2-e. During this year, the generation of electricity accounted for over 37% of all emissions in NSW. Between 1990 and 2007 emissions from stationary energy grew by 33% to a total amount of 79 Mt CO_2-e (OEH, 2009).

4.2.2 Options to Reduce our Emissions

The IPCC has identified key technologies and practices for the energy sector that are currently commercially available which could be used to mitigate the effects of Greenhouse Gas emissions. They include:

- improved supply and distribution efficiency (transmission and distribution of electricity);
- fuel switching from coal to gas;
- utilisation of nuclear power;
- utilisation of renewable heat and power (hydropower, solar, wind, geothermal and bioenergy);
- utilisation of combined heat and power technologies; and,
- early applications of carbon dioxide capture and storage (e.g. storage of removed CO_2 from natural gas).

In addition the IPCC has also identified policies, measures and instruments shown to be environmentally effective. These include:

- reduction of fossil fuel subsidies;
- an increase of taxes or carbon charges on fossil fuels;

- feed-in tariffs for renewable energy technologies;
- renewable energy obligations; and
- renewable energy producer subsidies.

In 2006 the NSW Government committed to reduce greenhouse gas emissions by 60% by 2050 (DECCW, 2009). In considering this level of reduction to the power generation sector in NSW, we should note:

- By 2050 electricity consumption is expected to more than double compared to 2006 (DPMC, 2006).
- Achieving a 60% reduction in emissions, whilst doubling our electricity use, requires an >70% reduction in greenhouse gas emissions per unit of electricity generated.
- Even if our entire fossil fuel power generation fleet was converted to natural gas, this would not even halve our existing level of emissions, and do nothing to address growth.
- Accordingly, to achieve this target, as a minimum all of our electricity growth over the next 40 years must be met with zero emission power sources.
- Wind energy is currently the most economic zero emission power source.

4.2.3 Contributions to reducing greenhouse gas emissions

During its operational phase, the Liverpool Range Wind Farm would generate electricity without producing greenhouse gas emissions. In addition the wind farm would be displacing electricity produced by fossil fuel sources (coal and gas), and hence, would reduce the overall amount of GHG emissions produced by the stationary energy sector (electricity generation).

To estimate the potential GHG emissions savings that large scale wind farm developments would have in NSW, DECCW commissioned McLennan Magasanik Associates (MMA) to conduct a study and subsequently developed a tool to calculate the expected savings from the wind farm based on its size and location. This tool can be accessed via the DECCW website at http://www.environment.nsw.gov.au/climatechange/greenhousegassavingstool.htm.

The results of the study as they relate to this project showed the following:

- In NSW wind farms would initially almost exclusively displace fossil fuel generation from coal and, to a lesser extent, gas.
- The savings from a wind farm the size of Liverpool Range in the South Western Slopes would initially reduce GHG emissions by 2,634,800 t CO_2e per annum.
- If CPRS was introduced in 2015 the overall emissions in the NSW energy sector would be reduced as a result of gas generation replacing coal, therefore reducing the GHG emissions savings directly related to wind generation.
- The impact on the management of the network due to the variability of wind would be negligible and the emissions savings would greatly outweigh any such impact.

Figure 4-2 presents the results from the study, showing the estimated GHG emissions savings for three different scenarios; a single wind farm of 150 MW, 500 MW representing future developments in each region, and 3,000 MW representing the total capacity estimated for wind development in NSW (DECCW, 2010d).

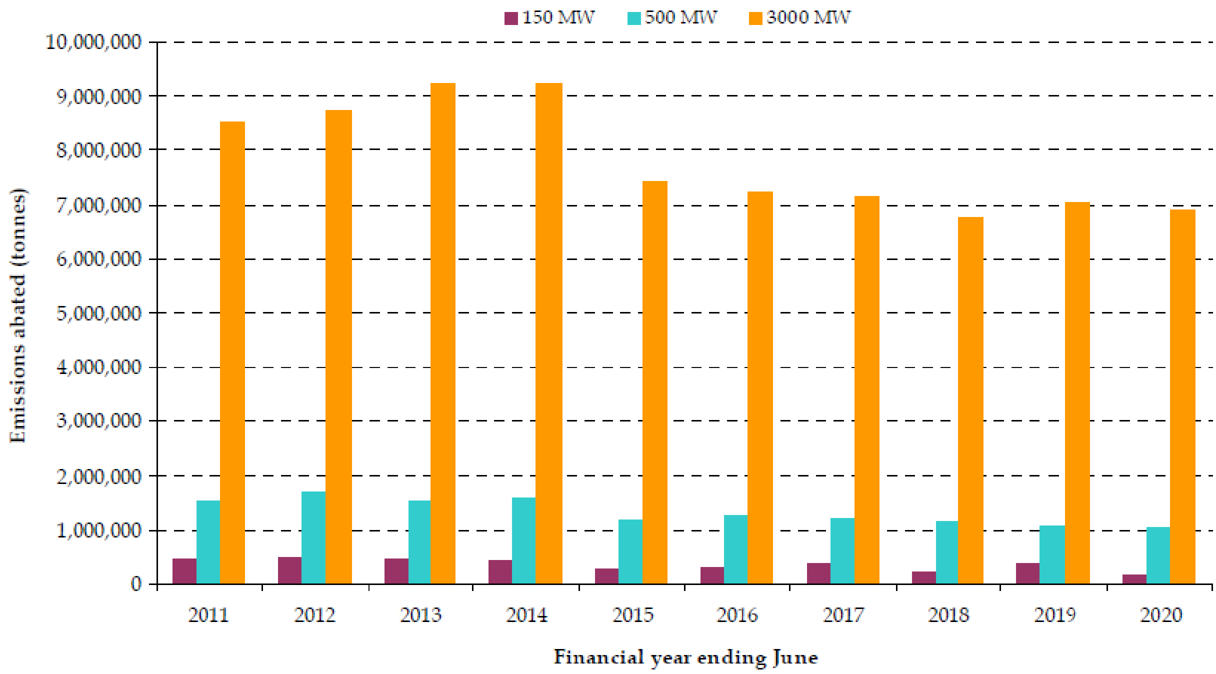


Figure 4-2 Estimated GHG emissions savings for three different scenarios

Since the MMA study the Carbon Tax has been introduced by the Federal Government and the 2015 CPRS scenario is no longer foreshadowed but an Emissions Trading Scheme (ETS) is scheduled to commence instead.

The greenhouse gas contributing the most to climate change is CO_2. Between 1970 and 2004 the amount of CO_2 being emitted from human-based activities increased by 80% and the current level of CO_2 in the atmosphere is now higher than ever measured (IPCC, 2008). This large increase is predominantly due to the burning of fossil fuels, such as coal, gas and oil. Between 1990 and 2007 emissions from stationary energy grew by 33% to a total amount of 79 $MtCO_2$-e (OEH, 2009).

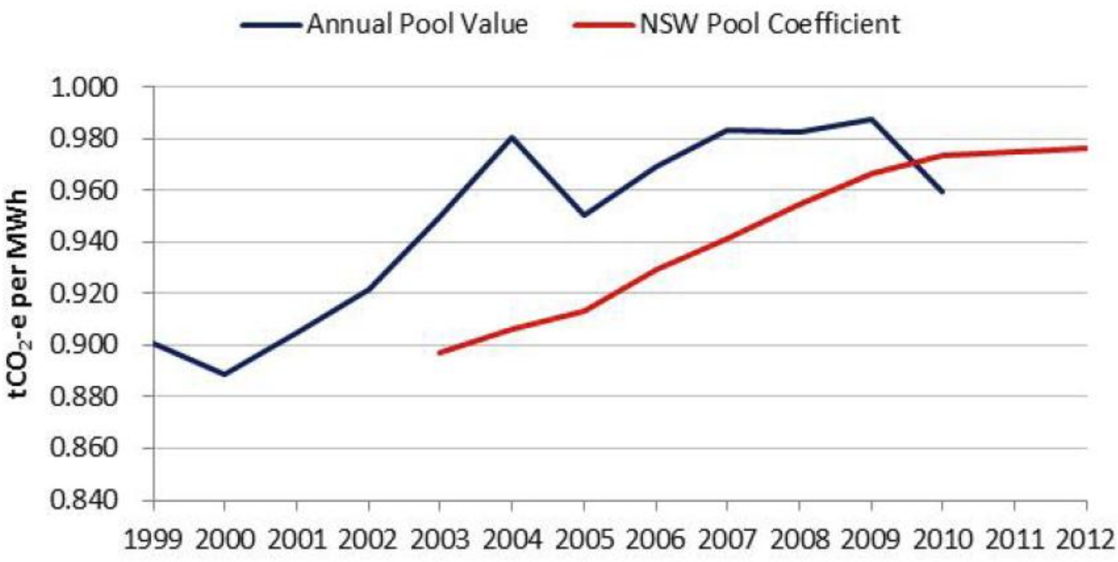
An indicator used to determine the amount of greenhouse gases emitted per MWh of electricity supplied to the NSW grid in a particular year is the NSW Annual Pool Value (GGAS, 2011). Table 4-1 shows that the Annual Pool Value is calculated by dividing the total energy supplied to the NSW grid by the total NSW emissions in that year.

To account for one-off highs or lows that may be experienced in a particular year the Pool Coefficient is determined. This value is calculated by averaging the five Annual Pool Values from previous years, with a lag of two years (GGAS, 2010). So the NSW Pool Coefficient for 2011 is the average of the Annual Pool Values from 2003 to 2009.

Table 4-1 NSW Annual Pool Values and Pool Coefficients (2003-2009)

Year	Total NSW emissions (tCO_2-e)	Total NSW sent out generation (MWh)	Annual pool value tCO_2-e /MWh	Pool coefficient tCO_2-e /MWh
2003	63,431,793	66,800,866	0.950	0.897
2004	65,979,036	67,276,401	0.981	0.906
2005	65,896,606	69,341,455	0.950	0.913
2006	70,010,515	72,222,646	0.969	0.929
2007	69,810,669	71,015,242	0.983	0.941
2008	71,394,801	72,646,917	0.983	0.954
2009	68,585,696	69,450,575	0.988	0.967
2010	66,242,294	69,051,955	0.959	0.973
2011	TBA	TBA	TBA	0.975

Source: GGAS, 2011



Source: GGAS, 2012

Figure 4-3 Historical NSW Pool Value and Pool Coefficient (2000-2010)

The 2012 Pool Coefficient value indicates that presently for every MWh of electricity supplied to the NSW electricity pool, 975 kg of greenhouse gases are emitted. At this point in time, approximately 90% of electricity in NSW is generated by fossil fuel power stations, primarily coal fired. Therefore it can be assumed that for every megawatt-hour of electricity generated at a coal power station 975 kg of greenhouse gases are emitted.

The Annual Pool Value is calculated using the total sent out electricity from all technologies, including that from renewable energy. It is expected that the more electricity supplied to the pool from renewable sources, reducing the amount required from coal power stations, the lower the Annual Pool Value and the lower the Pool Coefficient.

The Liverpool Range Wind Farm will generate 2,725 GWh per annum and on this basis, would result in a reduction in greenhouse gas emissions of approximately 2,634,800 tonnes of $C0_2$.

4.3 The Role of Renewable Energy

4.3.1 Federal Renewable Energy Target

The Australian Government's Mandatory Renewable Energy Target (MRET) scheme was established in 2001 to expand the renewable energy market and increase the amount being utilised in Australia's electricity supply. The MRET advocated that an additional 2%, or 9,500 GWh, of renewable energy was to be sourced by 2010 (DCC, 2009).

In 2007, the NSW State Government introduced new legislation called the Renewable Energy (NSW) Bill as part of their Greenhouse Policy to encourage additional generation of renewable energy. The NSW Renewable Energy Target (NRET) required 10% of electricity to be sourced from renewable energy by 2010 and 15% by 2020 (DEUS, 2006). This Bill was overtaken by the introduction of legislation at the Federal level and therefore not legislated.

In August 2009 the Federal Government introduced a revised renewable energy scheme. The Renewable Energy Target (RET) is an expansion of the MRET and required an additional 45,000 GWh of electricity (approximately 20% of Australia's total electricity supply) to be sourced from renewable projects by 2020 (DCC, 2009). This requires an additional 8,000 - 10,000 MW of new renewable energy generators to be built across Australia in the next decade.

In February 2010 the Federal Government amended the RET scheme by dividing the renewable sources into two categories, the small-scale renewable energy generators (SRET) and large scale renewable energy generators (LRET). The purpose of this move was to ensure continued ongoing investment in large scale renewable energy projects (i.e. those projects greater than 30 MW).

In 2012 the current RET was reviewed by the Climate Change Authority. The outcome of the RET Review Discussion Paper was that existing LRET target should not be changed, and that the benefits of any change at this time (either an increase or decrease) would be outweighed by the costs of increased regulatory uncertainty. The final report is expected in December 2012 (GGAS, 2011).

The LRET provides large-scale renewable energy generators with an ongoing source of revenue in addition to electricity sales through the NEM, through the creation and sale of Large-scale Generation Certificates (LGCs). Prior to 2011, these certificates were called Renewable Energy Certificates (RECs) and could be created by large-scale and small-scale renewable energy generators. Figure 4-4 below shows the REC and LGC contributions to the LRET.

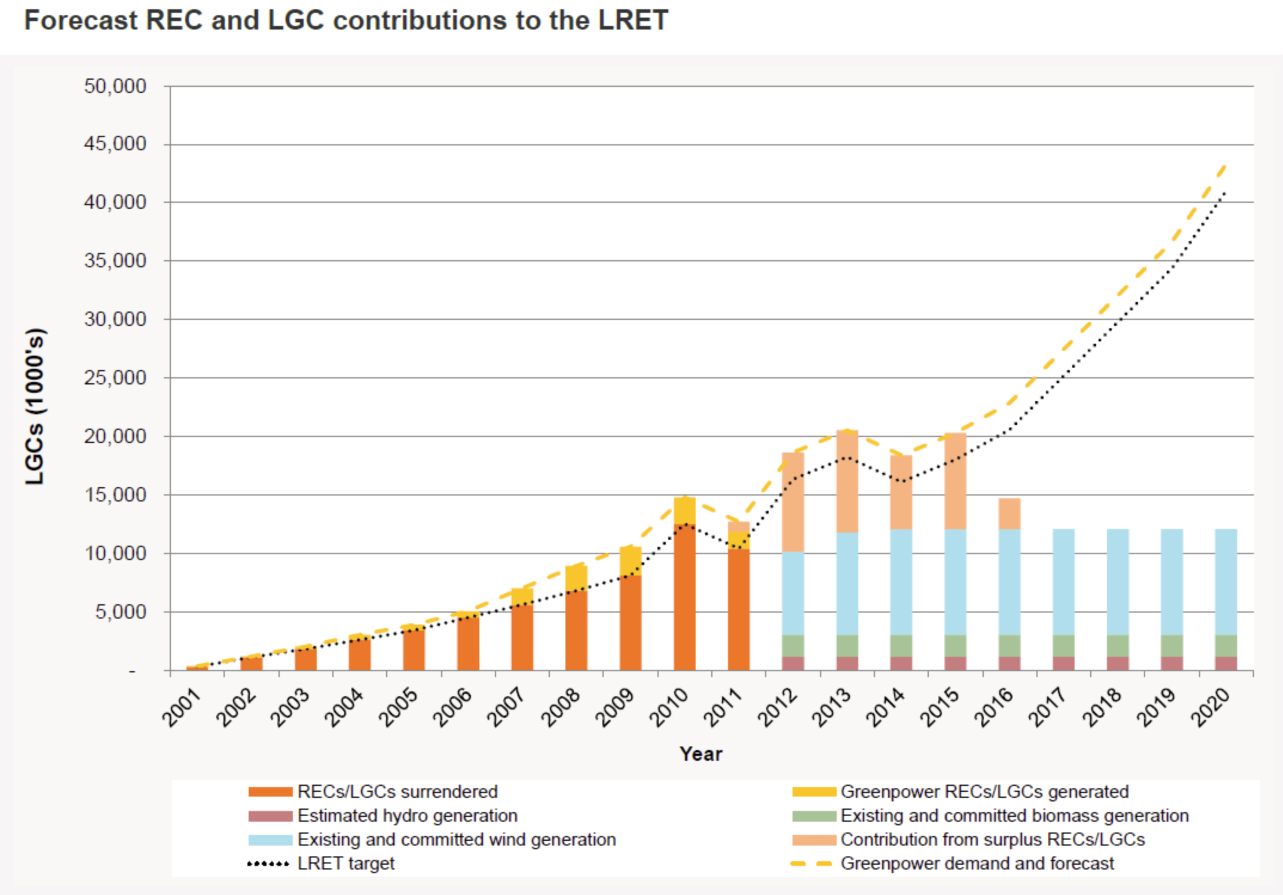


Figure 4-4 Forecast REC and LGC contributions to the LRET (AEMO, 2012)

AEMO estimates that enough RECs and LGCs have been created, or are likely to be created from existing generators, to satisfy the LRET until 2015. Given the scale of the deficit from 2016 onwards, however, this analysis suggests there is still a strong driver for additional investment in large-scale renewable energy technologies under the LRET.

Figure 4-5 shown below is a table sourced from the AEMO 2012 Electricity Statement of Opportunities which states the deficit of LGCs towards the LRET from 2016 onwards. For example, in 2019 24,600 GWh worth of extra LGCs will be required, which is approximately 8500 MW of wind generation capacity.

Forecast LGC deficit

Year	2016	2017	2018	2019	2020 to 2030
Forecast LGC deficit (GWh, non-cumulative)	8,200	15,400	20,000	24,600	31,200
Equivalent wind generation capacity required to supply LGC deficit (cumulative, based on South Australian output) (MW)	2,800	5,300	6,900	8,500	10,800

Figure 4-5 Forecast LGC deficit (AEMO, 2012)

Epuron estimates that around one third of the renewable energy generation required to meet the Mandatory Renewable Energy Target will need to be built in NSW, and predominantly be supplied by wind generation.

The Liverpool Range Wind Farm would have a generation capacity of 864 MW and would contribute directly to the LRET.

4.3.2 State Renewable Energy Targets

The Draft NSW Renewable Energy Action Plan 2012 supports the national target of 20% renewable energy by 2020. In 2011 renewable generation in NSW was 7.8% which includes Snowy Hydro. The plan promotes the use of energy from renewable sources at least cost to the energy consumer and with maximum benefits to NSW. The Plan cites Bureau of Resources and Energy Economics statistics 2012 indicating that wind is presently the lowest cost renewable technology but for biogas (landfill), and that wind is predicted to be the least cost renewable source of electricity beyond 2030.

The proposed Liverpool Range Wind Farm supports the Draft NSW Renewable Energy Action Plan 2012 objective of 20% renewable energy by increasing the supply of electricity from wind, the most economical form of large-scale renewable energy.

4.4 Economic Stimulus

The Clean Energy Council commissioned Sinclair Knight Merz (SKM) to prepare a report into the investment costs and benefits of wind farms in Australia. SKM released the report '*Wind Farm Investment, Employment and Carbon Abatement in Australia'* in June 2012 which presents an updated national and state-based snapshot of wind farm investment, jobs and carbon abatement.

The model used in this report has been applied to the proposed Liverpool Range Wind Farm to estimate the potential economic stimulus. It predicts that the Liverpool Range Wind Farm will have a capital expenditure of $1,272 million and a direct impact of $256.6 million in the local region during the construction phase. It is expected to create up to 829 jobs in the region during the construction phase and up to 78 ongoing fulltime roles.

This economic injection would also contribute to the local economy through:

- use of local contractors (where possible) in construction of the wind farm;
- use of local services (food and accommodation, fuel, general stores etc.) during the construction period;
- ongoing use of these local services during the operation of the wind farm;
- lease payments to local landholders; and
- provision of ongoing local jobs in operating and maintaining the wind farm.

4.5 Secondary Project Benefits and Opportunities

In addition to the increase in renewable energy supply, the proposed Liverpool Range Wind Farm would provide a variety of benefits and opportunities.

4.5.1 Infrastructure

Infrastructure required for development of the wind farm would also benefit the local community. The proponent would fund the upgrading of some local roads as outlined in the Traffic and Transport report. The works that would mainly benefit the region include the modifications necessary to segments along Coolah Creek, Rotherwood and Turee Vale Roads. Other infrastructure works would include the provision of traffic signs and guide posts.

4.5.2 Tourism

Although the establishment and operation of a tourist facility is not part of this proposal, the Liverpool Range Wind Farm would provide an opportunity to increase the regional tourism industry, which currently is a main contributor to the economy. In the year ending June 2012, domestic tourism generated $850 million in the Hunter region of NSW and $815 million in the Central NSW region which the site also borders (DCC, 2009). While initial interest is likely to be higher than on-going interest, the wind farm could be utilised as an additional attraction to secure visitors to the local townships. This would lead to further contributions to the local service industry.

4.5.3 Social impacts

Public perception studies have shown that more realistic and positive perceptions accompany actual physical experience of wind farms. Fear of the unknown can exaggerate perceptions of visual and noise impacts particularly (Tourism NSW, 2012).

While it is certain that not all members of the community will view the proposed development of wind farms favourably, in some communities, investment in clean energy production can become a point of pride to local residents. For example, during wind farm community consultation in Berridale, NSW, many participants spoke with pride about the Snowy Hydro Scheme and the appropriateness of similar clean energy developments in their shire. The Southern and Central Tablelands region looks well placed to become a leader in the Australian wind industry. The results of the NSW DECCW Survey 2010 ((Warren et al., 2005)- refer to Section 7.1) indicate that support for renewables is high.

4.5.4 Community Enhancement Fund

Under the Part 4 planning process in NSW, contributions from a project to a community enhancement fund are voluntary.

During the consultation process for the project Epuron sought feedback on how best to establish a community fund and to identify what type of local support is required from the project.

As part of Epuron's consultation process the following position was outlined regarding the establishment of a community fund for the project:

- Epuron designs its wind farms to minimise impacts to the environment and local community.
- Each project should be assessed (by DP&E) and determined specifically on its merits (and without being influenced by any promise of community or other funding).
- Epuron strongly believes in the value of community contributions and believes that the final investor who funds the construction and operation of the project should engage with and support the local community, including through annual financial contributions to the community.
- Epuron believes that such community contributions should be:
  - applied towards local environmental, social and community initiatives led by local residents;
  - directed to initiatives raised by residents proximate to the development or likely to be impacted;
  - established at the commencement of operation and continue for the life of the development; and,
  - regularly reviewed to ensure they are providing ongoing benefits to the community.
- Epuron considers that the CCC, working with the developer and ultimate project owner, is ideally placed to help develop a community fund and its administration process.
- The project is a major infrastructure project that can only be built by a major energy utility. Epuron will not be the ultimate project owner and accordingly it is not appropriate for Epuron to determine the final details of any community fund, and nor should these be determined as part of a development application or consent process.
- Accordingly, Epuron will not propose any specific amount payable to a community fund as part of its development application. However, it will commit to an ongoing consultation process to determine an appropriate basis for the establishment of a community fund.
- The EA's Statement of Commitments will set out the Community Fund details

Accordingly a community enhancement fund has not been proposed for the project, however, the proponent will continue consultation on a possible format for a community enhancement program, as well as suggesting useful projects for the local area, so as to maximise the benefit of the project to the wider community.

The statement of commitments proposed by Epuron will require that the proponent:

- At least 6 months prior to the commencement of operations, call a meeting of the Community Consultation Committee and consult with Council(s) with respect to establishment of the community fund;
- Prior to the commencement of operation of the project, establish that community fund as required and publically announce the administration processes and current funding commitments of the fund; and,
- Regularly make publicly available the details of the fund including its administration processes, funds made available, funding commitments and outcomes.

4.6 Suitability of the Project

A comprehensive assessment of the proposed project has recognised that the development is suitable on a local level in terms of existing and future land use impacts. The following sections outline where this EA discusses the suitability of the project and the reasons behind the justification.

4.6.1 Strategic Land Use

The proposed wind farm site and the adjacent land parcels are zoned as land use 1(a) Rural Agriculture, RU1, RU3, and E1 & E3. This land has been set aside by the local councils for agricultural purposes, and the land is currently used for commercial agriculture (primarily sheep and cattle grazing) and rural residences.

While in operation the proposed wind farm would not impact on the day-to-day farming activities currently being carried out by the existing landowners. The turbine footprint and access tracks would occupy only a very small percentage (typically around 2%-3%) of the landowners' overall property and through strategic planning and consultation infrastructure would not occupy highly productive farming land. Normal farming operations may be affected during the construction phase, primarily due to increased construction traffic and activity on site. The magnitude of these construction impacts is such that it is not expected to cause material economic loss to the landowners ongoing agricultural use of the land and is temporary in nature.

The large separation between the placement of turbines allows the proposal to co-exist with the predominantly agricultural land use of the project site, with only the very small portions of land to be occupied by turbine infrastructure and access roads being removed from agricultural production. In design terms, wind turbines typically need to be separated widely across (approx. 600m) and along (approx. 300m) the prevailing wind direction to allow the turbines to function and follow the wind, and to allow the wind speed to recover sufficiently to power the succeeding row of turbines downwind. The project is also not expected to alienate land for residential purposes and information received from the local Councils showed there are currently no approvals for new dwellings in the immediate vicinity of the project. The siting of proposed turbines has taken into consideration potential impacts including areas of environmental, ecological and heritage sensitivity which have been minimised or avoided wherever possible. The layout of proposed turbines has also been designed to minimise the potential noise and visual impacts on the local community particularly neighbouring dwellings located within 2km of a proposed turbine.

When considering the existing and future land uses, the proposed site is suitable for a wind farm. All local councils have strategically identified the site and its surrounds as being important agricultural land and there is no future intention to modify this zoning. The wind farm would coexist with the existing farming operations without any major disturbances to productivity but would make the land more economically viable for future agriculture and grazing.

The proposed wind farm will not have any negative impacts on land of high agricultural value, rural residential development, building entitlements or subdivision potential. The agricultural land on the project site is not classified as land of significant scenic or visual value, forestry, or conservation areas. There may be a limited impact to the Durridgere State Conservation Area depending on the ultimate powerline route selected, and this is addressed in section 3.4. Minor impacts to Crown Land are acceptable and have been organised in consultation with NSW Trade & Investment. Impacts on Crown Land have been thoroughly addressed in Section 3.11.

4.6.2 Grid Connection

An assessment into the capacity and security of the existing transmission network was conducted to determine the feasibility of the site and the impact that the project could have on the network. Connection strategies for proposed projects in the area have been assessed using publicly available information and best estimates where this information is not available.

The likely timing for construction of the other proposed projects in the area and the status of their grid connection process is unknown. Technical studies required as part of the connection process will ensure that there will be no material impact on the security or performance of the electricity network from other proposed wind farms connecting in the vicinity of the Liverpool Range Wind Farm.

A grid connection enquiry has been lodged with the Network operator, TransGrid. Epuron has also had several meetings with Sean Buggy of Transgrid in 2012 in relation to the electrical connection of the project, and Epuron has begun the Connection Investigation and Negotiation Agreement (CINA) with Transgrid. These meetings and processes will ensure that the site is suitable to connect to the proposed grid connection location.

4.7 Strategic Justification Summary

This section set out the justification for the project in the context of its local and regional setting. It provides anoverview of the energy supply/demand context and in particular the need for additional electricity supply in NSW. The key factors justifying the need for the project in the current market conditions includes;

- Electricity consumption continues to grow, and the additional demand must be met by either increased fossil fuel generation or an increase in generation from renewable sources such as wind power.
- The use of renewable energy, such as wind, to provide additional capacity for electricity generation in NSW supports state and federal government policy objectives. These policy objectives are primarily set to combat climate change impacts through a reduction in greenhouse gases.
- In full operation, the project would generate more than 2,725 GWh of electricity per year - sufficient for the average consumption of around 340,600 homes.
- The project would reduce greenhouse gas emissions by approximately 2,634,800 tonnes of carbon dioxide equivalent (CO_2e) per annum[5] or the equivalent of 717,000 cars removed from the roads
- The project would contribute to the State and Federal Governments' target of providing 20% of consumed energy from renewable sources by 2020.
- The project would contribute to the NSW Government's target of reducing greenhouse gas emissions by 60% by the year 2050.

The section also outlined the suitability of the project site in terms of location, scale, wind energy potential and compatibility with existing land uses. The key factors justifying development of the project at this location are;

- The areas excellent wind resource which has been proven feasible for the development and long term operation of a wind energy facility.
- The relatively sparse density of residences within the vicinity of the project site.
- Suitable proximity to an existing high voltage electricity grid network for connection.
- Acceptable environmental impacts, as demonstrated by the specialist technical studies and investigations.
- General community support for the project in the region from the community and local government.
- create local employment opportunities and inject funds of up to $1,272 million into the Australian economy.
- Creation of potential secondary benefits and opportunities for improvements in infrastructure, tourism and the establishment of a a community enhancement fund.
- The project site is well suited to development in regards to landowner support, land use, wind resource and grid connection.

[5] Calculated using the NSW Wind Farm Greenhouse Gas Savings Tool developed by DECCW

5 Consideration of Alternatives

5.1 Site Selection

Site selection is crucial in wind farm development due to the market based structure of the electricity industry. The projects that exhibit the best characteristics for wind farm development (best energy yield with the lowest cost) will be the projects that get built. It is the combination of these characteristics that makes suitable sites for wind farms reasonably rare in NSW. Appropriate locations are found where:

- wind speeds are consistently high (around 7.5-8 m/s as an annual hub height average);
- capacity at existing transmission lines is available on or near the project site;
- transportation of turbines would be possible with only minor upgrades to roads;
- native vegetation cover is sparse or would be minimally impacted;
- housing in the immediate vicinity is relatively sparse; and
- involved landowners are interested in housing turbines on their land.

To date Epuron has successfully developed nine wind farm projects in NSW, six of which have been granted development approval, with two currently in the assessment phase and one awaiting formal determination.

Epuron has developed projects in the Northern Tablelands, the South-West Slopes, South Coast and Far West New South Wales, prior to investigating sites in the Central Tablelands area. As a result Epuron has developed a wide network of monitoring masts with around 30 currently active across NSW and South Australia (including five on site). After modelling data from these masts further investigations were undertaken to assess the feasibility of the project. In addition to having a consistently high wind resource, the project area also featured:

- suitably cleared ridgelines for suitable turbine locations;
- a low population density (DECCW, 2010c; CCA, 2012); and
- an existing transmission network.

In addition to these characteristics, the engagement of interested landowners enabled the project development to progress. The selected development envelope for the turbine and infrastructure layout was chosen over earlier alternatives based on its commercial viability, landowner consent and reduced environmental impacts.

As part of the Ecology Assessment in Section 11, the Liverpool Plains Shire Council, the Warrumbungle Shire Council, the Upper Hunter Shire Council and the Mid-Western Regional Council were consulted in regards to any Environmentally Sensitive Area mapping in the vicinity of the project. No relevant Environmentally Sensitive Area mapping was available from these LGAs, and therefore has no impact on site local suitability.

5.2 Improvements to Infrastructure Layout

The current layout that is presented in this EA has gone through an iterative design and assessment process, with turbine locations being repositioned, deleted and in some cases added to areas previously not utilised. The purpose of this process is to design a layout that efficiently harnesses the energy in the wind with minimal impacts to the existing environment (including ecology, land use productivity as well as visual and noise amenity for surrounding residents) whilst considering community feedback and incorporating it where possible.

Two major iterations of the layout initially proposed for the Liverpool Range Farm contained a total of 452 turbines and 417 turbine locations, proposed overhead power line corridor options, and 8 potential substation locations. These two major iterations are herein referred to as the initial layout and the previous layout (December 2012).

This initial layout was developed using a wind resource map created from existing monitoring mast data, along with preliminary topographic features (contours) and satellite imagery. Experience gained from previous projects was applied to areas such as noise and ecology in determining the exact locations, however, detailed studies would be required to confirm these locations were appropriate.

Epuron received feedback from the open house and neighbouring dwelling landowners regarding nearby turbines. As such a number of turbines were removed to reduce both noise and visual impacts to neighbouring dwellings. Turbines were also relocated or removed from parts of the site to minimise impacts to native flora and other identified constraints, such as communications and airstrips. This formed the previous (December 2012) layout. Over the past year further feedback from community consultation, environmental studies, landowner negotiations and wind resource monitoring have further impacted the layout. This has resulted in the current layout. The main changes between the previous and current layout in terms of landowner involvement is the addition of two landowners who were previously uninvolved.

Figure 5-1 shows the division of the site into a grid reference system which is used to assist with the locations under discussion in Table 5-1, Table 5-2, Table 5-3.

The initial turbine layout overlaid on the previous and current layout can be seen Figure 5-2 and a comparison between all preliminary transmission line and substation locations overlaid on the current line and locations can be viewed in Figure 5-2. Figure 5-3 and Figure 5-4 show detailed areas of the wind farm site that have undergone infrastructure changes from one layout to another.

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

Section 3.4 covers the grid connection and power line corridor options that were considered. This selection details the iterations in power line routing based on the final power line corridor option that was chosen. See Section 3.4 for further information on grid connection and corridor options. The power line route were rerouted or deleted, where possible, to: minimise the impact to biodiversity and archaeological constrained areas. The power line, particularly from the wind farm boundary to the grid connection location, had considerable rerouting due to continuous consultation with surrounding landowners and feedback from neighbouring dwellings. In many instances where a landowner did not want to be involved, significant rerouting of the power line upstream and downstream was required.

Table 5-3 provides comments on the redesign of the power line route, it is broken down into grid id system for ease of referencing to the associated map, Figure 5-5 and Figure 5-6.

In summary a total of 35 turbines were removed from the initial to the previous layout and a further 129 turbines removed from the previous to current layout, not that these are net i.e. actual number of turbines removed is greater but offset by the addition of turbines in utilised areas.A majority of the turbines were relocated or microsited due to spacing optimisation in addition to constraints identified such as environmental or feedback from consultation with surrounding landowners mostly regarding proximity, noise and visual impact.

Table 5-1 List of improvements made from initial to previous (December 2012) layout

Grid ID	Turbines in initial Layout	Turbines in current layout	Comments on redesign from initial layout to previous layout (December 2012)
C2	0	0	No change.
D2	8	9	1 turbine microsited from Grid D3.
E2	12	11	Turbines microsited. 1 turbine removed due to airstrip.
F2	0	0	No change.
G2	2	0	2 turbines removed due to high ecological constraint and consultation feedback from G2-1, G2-2, G2-3 regarding visual and noise impacts.
C3	5	5	All turbines microsited further away from dwellings D4-1 to D4-4 due to consultation feedback regarding visual and noise impacts.
D3	20	22	3 turbines added in unconstrained areas. 1 turbine removed due to spacing constraint
E3	33	19	3 turbines removed due to airstrip. 13 turbines removed due to landowner of dwelling E4-1, E4-2, E4-3 requesting not to be involved & consultation feedback from E3-2 and E3-3 regarding visual and noise impacts. 2 turbines added in unconstrained areas.

Grid ID	Turnines in initial Layout	Turbines in current layout	Comments on redesign from initial layout to previous layout (December 2012)
F3	41	38	3 turbines removed in high ecological constraint area. Turbines microsited into areas of lower ecological constraint.
G3	10	23	3 turbines removed in high ecological constraint areas. Turbines microsited into lower constraint areas. 16 turbines added in low constraint areas.
C4	0	0	No change.
D4	8	8	Turbines microsited into lower ecological constraint areas and feedback from D4-7 regarding visual and noise impacts.
E4	18	10	5 turbines removed due to airstrip. 2 turbines removed due to E4-1, E4-2, E4-3 requesting not to be involved & consultation feedback from E3-2, E3-3, E4-5, E4-6 regarding visual and noise impacts. 1 turbine removed due to ecological constraint
F4	27	34	1 turbine removed due to airstrip. 8 turbines added in unconstrained area.
G4	9	6	3 turbines removed due to community consultation identification of house G4-1. Microsite turbines further away from dwelling G4-1 due to consultation feedback from G4-1 regarding visual and noise impact.
C5	4	3	1 turbine microsited into Grid D5.
D5	34	23	2 turbines removed due to ecological constraint. 9 turbines removed due to spacing optimisation and consultation feedback from C5-10, D4-5 and D4-6 regarding noise and visual impacts.
E5	28	26	1 turbine removed due to consultation feedback from E5-1, E5-2, E6-2 regarding visual and noise impact. 1 turbine removed due to consultation feedback from E5-3, E5-4, E5-6 regarding visual and noise impact. Microsited turbines further away from E5-3, E5-4, and E5-6 due to consultation feedback regarding visual and noise impact.
F5	32	30	1 turbine removed in ecological constrained area. 1 turbine removed due to spacing constraint. Microsited turbines into lower ecological constraint areas.
G5	12	12	Turbines microsited.
C6	7	4	3 turbines removed due to consultation feedback from C6-1, C6-3, and C6-4.
D6	13	10	1 turbine removed due to consultation feedback from C6-1, C6-3, and C6-4. 2 turbines removed due to airstrip. 2 turbines microsited due to airstrip. 1 turbine reallocated into unconstrained area.
E6	25	25	Turbines microsited due to southern airstrip.
F6	18	19	3 turbines removed due to airstrip and consultation feedback from F6-1, F6-4, G6-1, F7-2 F7-1 regarding noise and visual impacts. Turbines microsited into lower ecological constraint areas. 3 turbines added into unconstrained areas. 1 turbine added due to micrositing from grid G6.
G6	9	8	1 turbine removed due to ecological constraint and consultation feedback from G6-3, G6-2 and G6-2 regarding noise and visual impact.
C7	0	0	No change.
D7	0	0	No change.
E7	11	8	4 turbines removed due to consultation feedback from D7-7, E7-1, D7-5 regarding noise and visual impact. 1 turbine added into unconstrained area.
F7	4	3	1 turbine removed due to spacing constraint.
G7	18	16	2 turbines removed due to airstrip. 2 turbine microsited into lower ecological constraint area.
F8	8	10	2 turbines added into unconstrained areas.
G8	27	27	Turbines microsited into lower ecological constraint areas.
F9	6	6	Turbines microsited further away from dwellings due to consultation feedback from F9-2, F9-3, F9-4, F9-5, F9-6.
G9	3	2	1 turbine microsited into Grid G8.

Table 5-2 List of improvements made from previous to current layout

Grid ID	Turbines in initial Layout	Turbines in previous (December 2012) layout	Turbines in current layout	Comments on redesign from Previous layout (December 2012) to Current layout
C2	0	0	0	No change.
D2	8	9	5	2 turbines removed due to consultation feedback from E2 and F2 dwellings and C2-4 and C2-3 regarding visual impacts. 2 Turbines microsited to Grid D3
E2	12	11	4	8 turbines removed due to consultation feedback from E2 and F2 dwellings regarding visual impacts. 1 turbine microsited to Grid E3.
F2	0	0	0	No change.
G2	2	0	0	No change.
C3	5	5	4	1 turbine removed due consultation feedback from dwellings D4-1, D4-2, D4-3, D4-4 regarding visual and noise impacts.
D3	20	22	19	6 turbine removed due consultation feedback from dwellings D4-1, D4-2, D4-3, D4-4 regarding visual and noise impacts. 2 turbines microsited from Grid E2. 1 turbine added in a low constraint area.
E3	33	19	25	13 turbines added due to involvement of landowner E4-1, E4-2, E4-3. 7 turbines removed due to consultation feedback from D4-7, D4-8, E4-1, E4-2, E4-3 regarding visual and noise imapct.
F3	41	38	19	3 turbines removed due to high ecological constraint. 1 turbine microsited into area of lower ecological constraint. 16 turbines removed due to consultation from E3-2, E3-3, E4-5 and E4-6 regarding visual and noise impact.
G3	10	23	0	23 turbines removed due to high ecological constraint or surrounding areas of high ecological constraint
C4	0	0	0	No change.
D4	8	8	6	2 turbines removed due to consultation feedback from D4-1, D4-2, D4-3, D4-4, D4-7 and D4-8 regarding noise and visual impact.
E4	18	10	9	2 turbines added due to involvement of landowner E4-1, E4-2, E4-3. 3 turbines removed due to consultation feedback from E4-4, E5-3, E5-4, E5-5, E5-6 regarding visual and noise impact.
F4	27	34	18	16 turbines removed due to consultation feedback from G4-1, E4-4 regarding noise and visual impact.
G4	9	6	4	2 turbines removed due to consultation feedback from G4-1 regarding noise and visual impact.
C5	4	3	3	No change.
D5	34	23	19	3 turbines removed due to consultation feedback from E6-1, D6-1, D6-3, D6-2 regarding noise and visual impact. 1 turbine microsited to Grid D6
E5	28	26	21	5 turbines removed due to consultation feedback from E5-1, E5-2, E5-3, E5-4, E5-5, E5-6 regarding noise and visual impact.
F5	32	30	19	11 turbines removed due to consultation feedback from E5-3, E5-4, E5-5, E5-6 regarding visual and noise impact.

Grid ID	Turbines in initial Layout	Turbines in previous (December 2012) layout	Turbines in current layout	Comments on redesign from Previous layout (December 2012) to Current layout
G5	12	12	6	6 turbines removed due to consultation feedbck from G6-3, H6-1, H6-2 regarding visual impact.
C6	7	4	5	1 turbine added in unconstrained areas
D6	13	10	13	2 turbines added due to consultation with landowner relaxing no go area constraint. 1 turbine added in unconstrained areas.
E6	25	25	17	8 turbines removed due to consultation feedback from E6-1, E6-2, E5-1, E5-2 regarding noise and visual impact.
F6	18	19	6	7 turbines removed due to consultation feedback from F7-1, F7-2, F7-3 regarding noise and visual impact. 5 turbines removed due to consultation feedback from F6-1, F6-2, F6-3, G6-1 regarding noise and visual impact.
G6	9	8	4	4 turbines removed due to consultation feedback from F6-1, F6-2, F6-3, G6-1, G6-2, G6-3 regarding noise and visual impact.
C7	0	0	0	No change.
D7	0	0	0	No change.
E7	11	8	3	3 turbines removed as landowner no longer involved. 2 turbines removed due to consultation feedback from D7-6, D7-5 regarding noise and visual impact.
F7	4	3	3	No change.
G7	18	16	14	2 turbines removed due to consultation feedback from H7-1, H6-3 regarding visual impact.
F8	8	10	9	1 turbines removed due to consultation feedback from F8-1 regarding visual impact.
G8	27	27	25	2 turbines removed due to consultation feedback from H7-1, H8-1, H9-1 regarding visual impact.
F9	6	6	6	No change.
G9	3	2	2	No change.

Table 5-3 List of improvements made to the power line and substation location

Grid ID	Comments on redesign
D3	Addition of substation location and power line due to further detailed electrical design.
F3	No change.
D4	Changed power line route to the new preferred substation in D3. Power line moved to lower elevated land due to feedback from D4-1, D4-2, D4-3, and D4-4.
F4	No change.
D5	Removed power line alternative due to removal of turbines.
E5	No change.

Grid ID	Comments on redesign
F5	No change.
F6	Additional alternate power line after consultation feedback from landowner F6-4.
G6	No change.
F7	No change.
G7	No change.
F8	Rerouted due to better construction conditions from consultation feedback from landowner F9-2.
F9	Microsite of power line.
D10	Microsite of power line due to consultation feedback from D10-7 regarding involvement. Microsite of power line due to to consultation feedback from D10-6 regarding visual impact.
E10	Removed power line due to consultation feedback from landowner E10-2 and E10-4, E10-5 regarding impacts and involvement. Subsequently power line rerouted to avoid E10-2, E10-4 and E10-5 parcels.
F10	Removed powerl ine due to consultation feedbck from landowner E10-4 and E10-5 regarding impacts and involvement. Microsite of powerline in Turill State Forest to minimise ecological impact.
D11	Removed power line due to consultation feedback from landowner D11-2 and E11-1 regarding impacts. Subsequently power line rerouted to avoid D11-2 and E11-1. Microsite of power line to reduce impacts on D12-17 after consultation feedback from landowner D12-17.
E11	Removed power line options due to consultation feedback from E11 dwellings regarding visual impacts.
F11	Removed power line alternative due to consultation feedback from landowner, dwelling E11-9 regarding visual impact and consultation feedback from crown land, also a more direct route.
D12	Removed power line option due to feedback from landowner D12-16, D12-17, D12-18, D12-19 after consultation feedback regarding willingness to be involved and visual impacts. Microsite of line to reduce ecological and environmental impacts in Durridgere State Forest with consultation from National Parks.
E12	Removed power line route due to consultation feedback at open house regarding proximity to archaeological constraint. Microsite of line to reduce ecological and environmental impacts in Durridgere State Forest with consultation from National Parks.
C13	Removed power line option due to consultation feedback from dwelling C13-1 as it is Ulan lease land. Removed power line option due to consultation feedback from dwelling C13-6 as it is Moolarban lease land.
D13	Rerouted power line due to consultation feedback from D13-2 regarding visual impacts. Rerouted power line option due to consultation feedback from dwelling C13-6 as it is Moolarban lease land. After consultation with Crown Land, route now runs through Crown Land.
C14	Rerouted power line option due to consultation feedback from dwelling C13-6 as it is Moolarban lease land. After consultation with Crown Land, route now runs through Crown Land.
C15	No change.

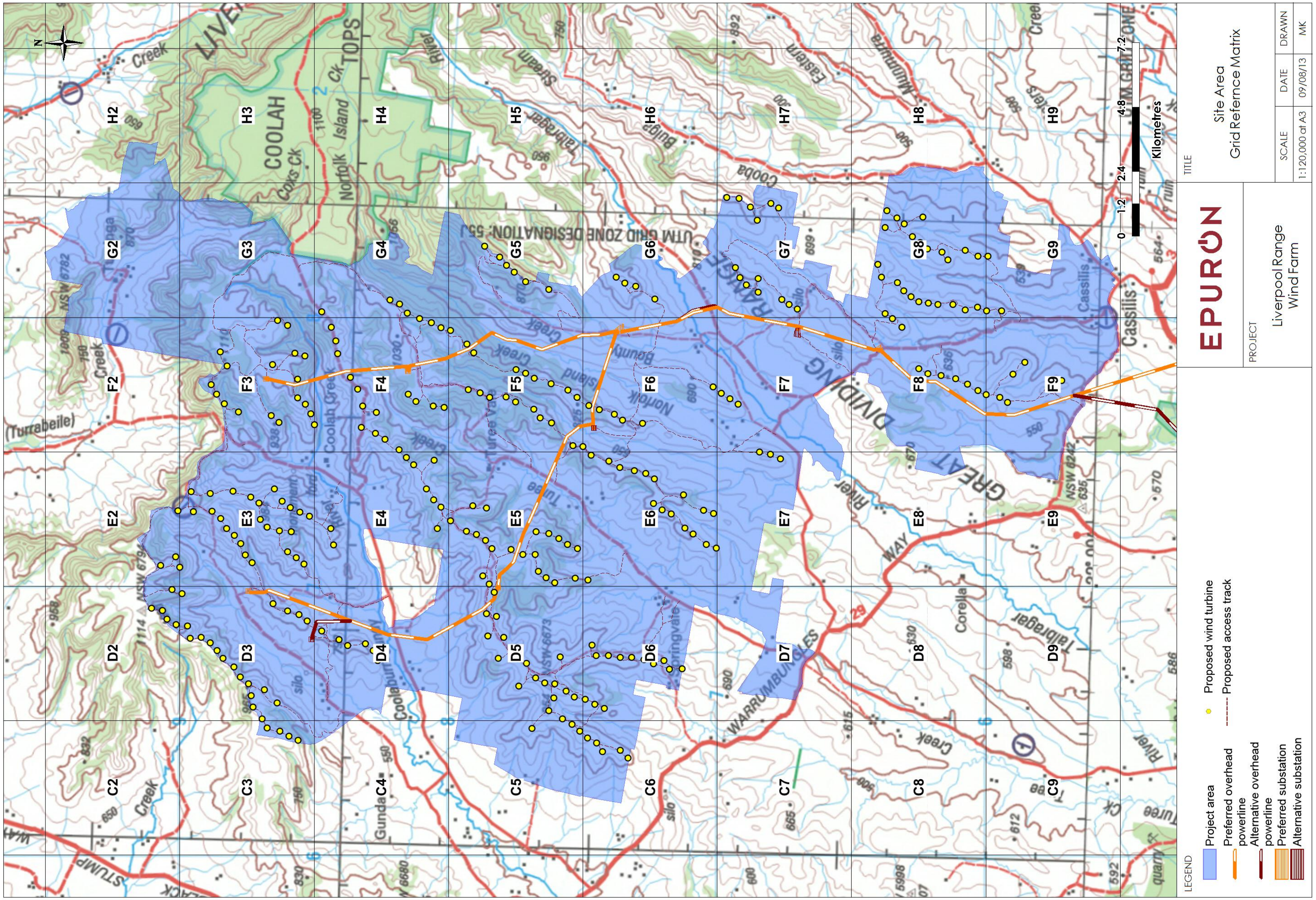


Figure 5-1 Liverpool Range Wind Farm grid reference system

EPURON

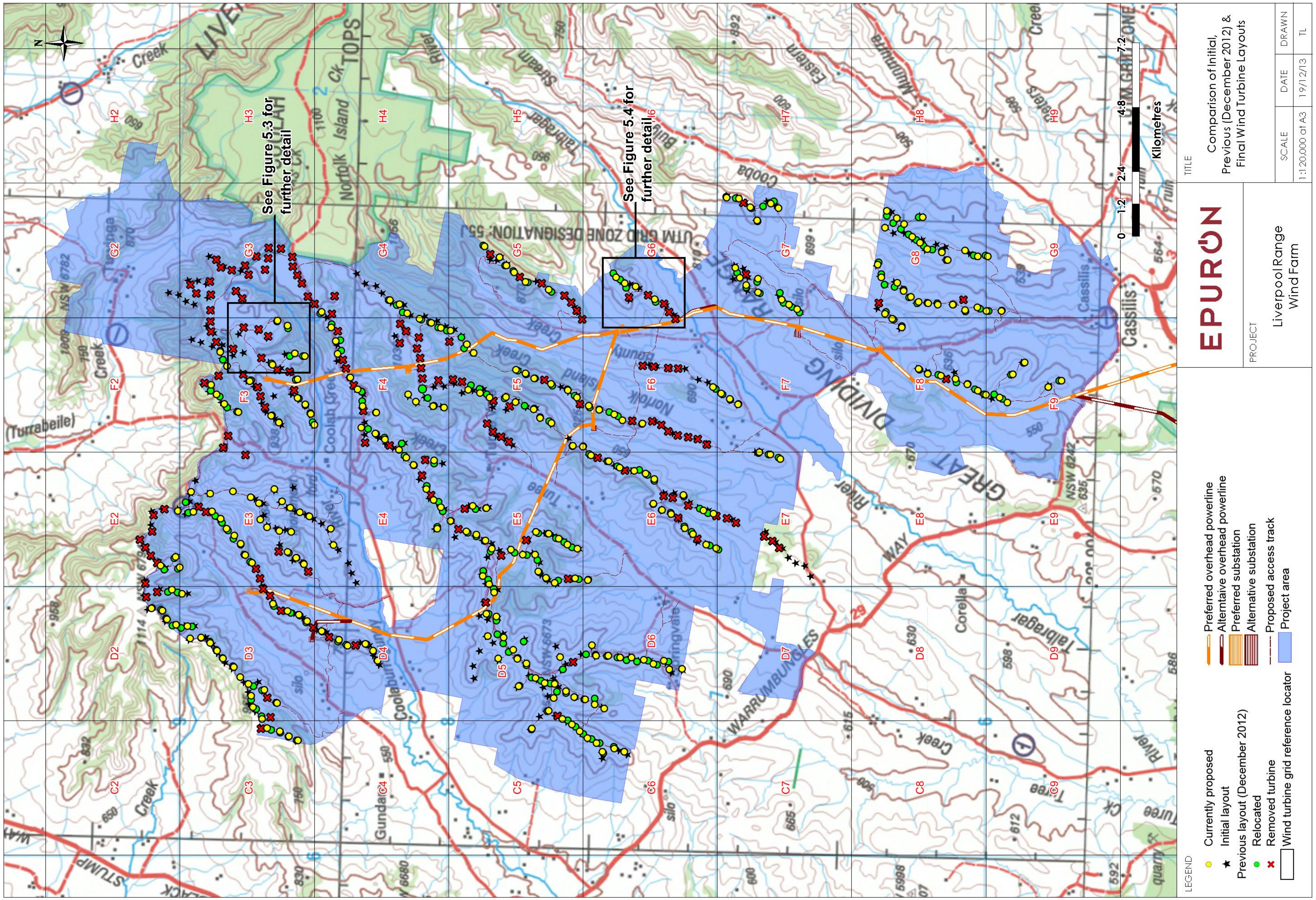


Figure 5-2 Comparison of the initial and final wind turbine layouts

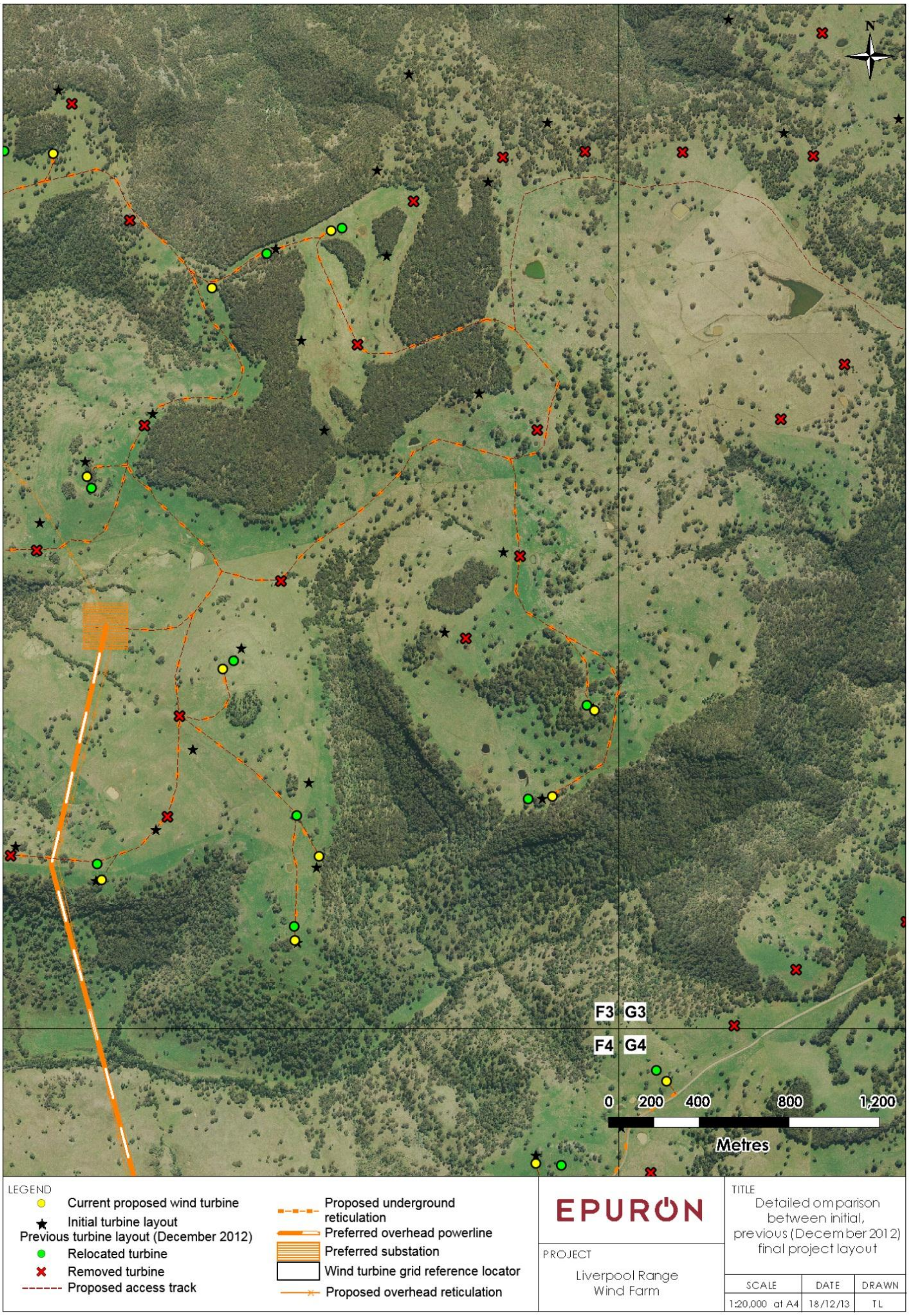


Figure 5-3 Detailed changes made to wind turbine placements (map 1)

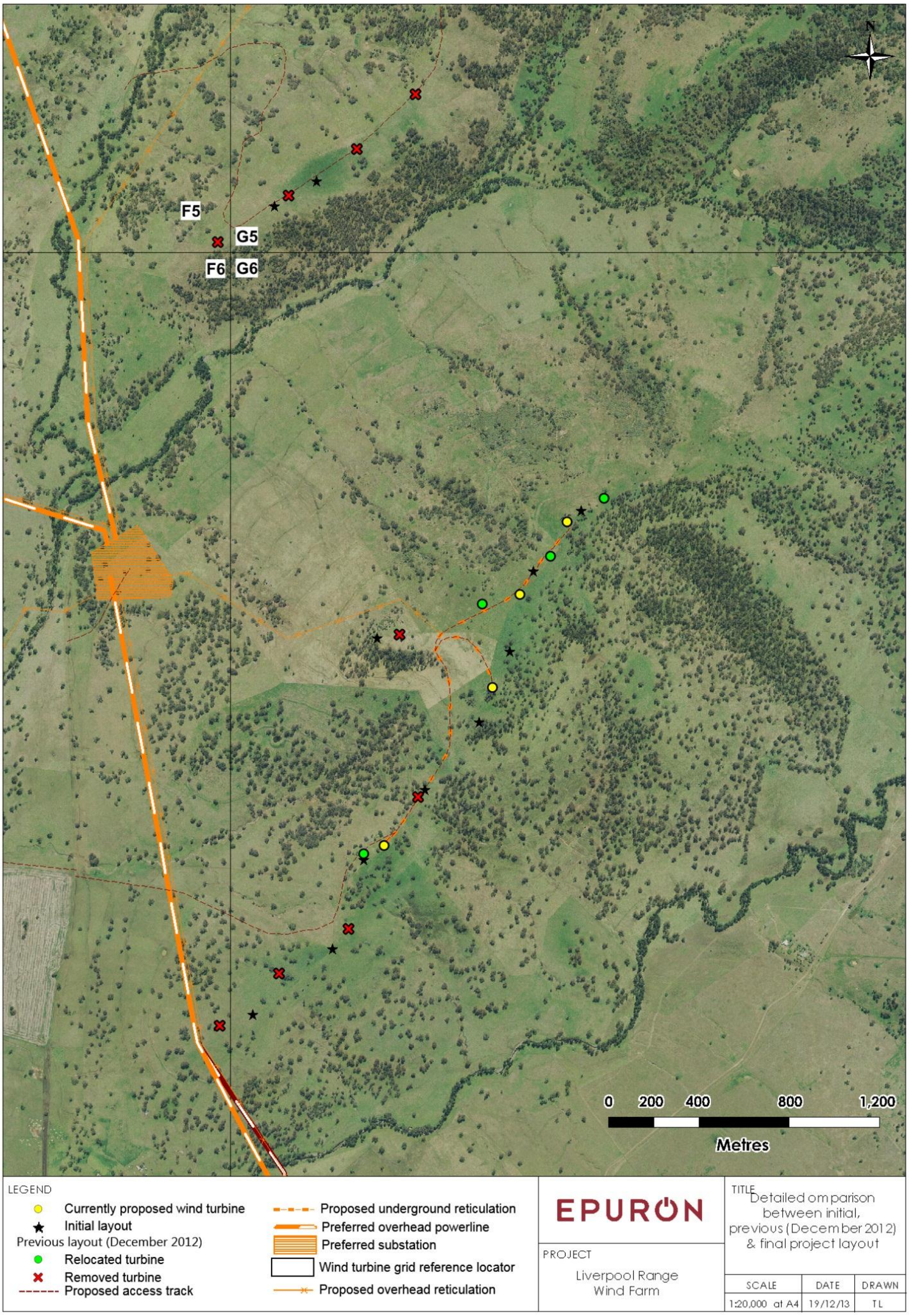


Figure 5-4 Detailed changes made to wind turbine placements (map 2)

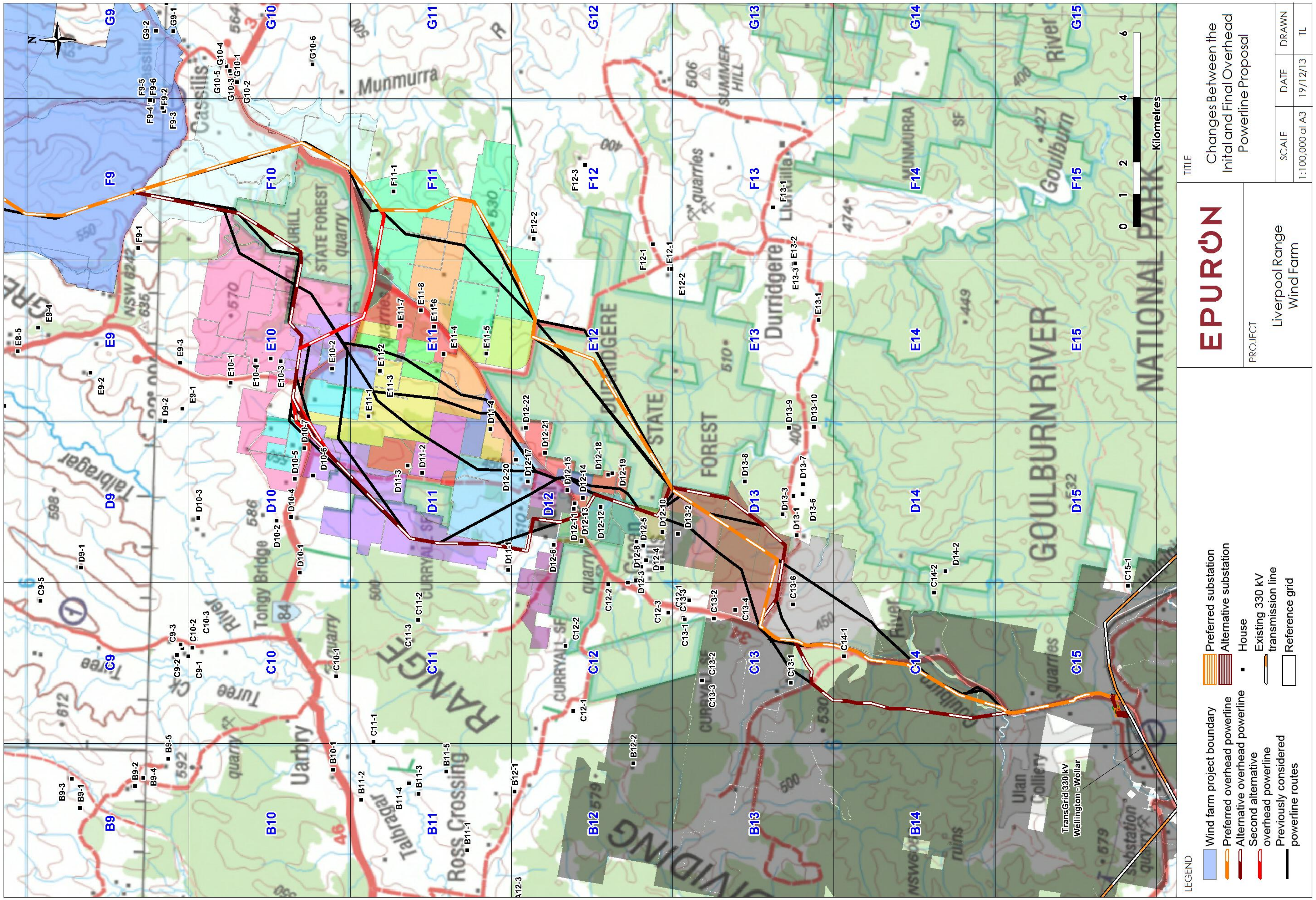


Figure 5-5 Changes between the initial and current transmission lines proposals (map 1)

EPURON

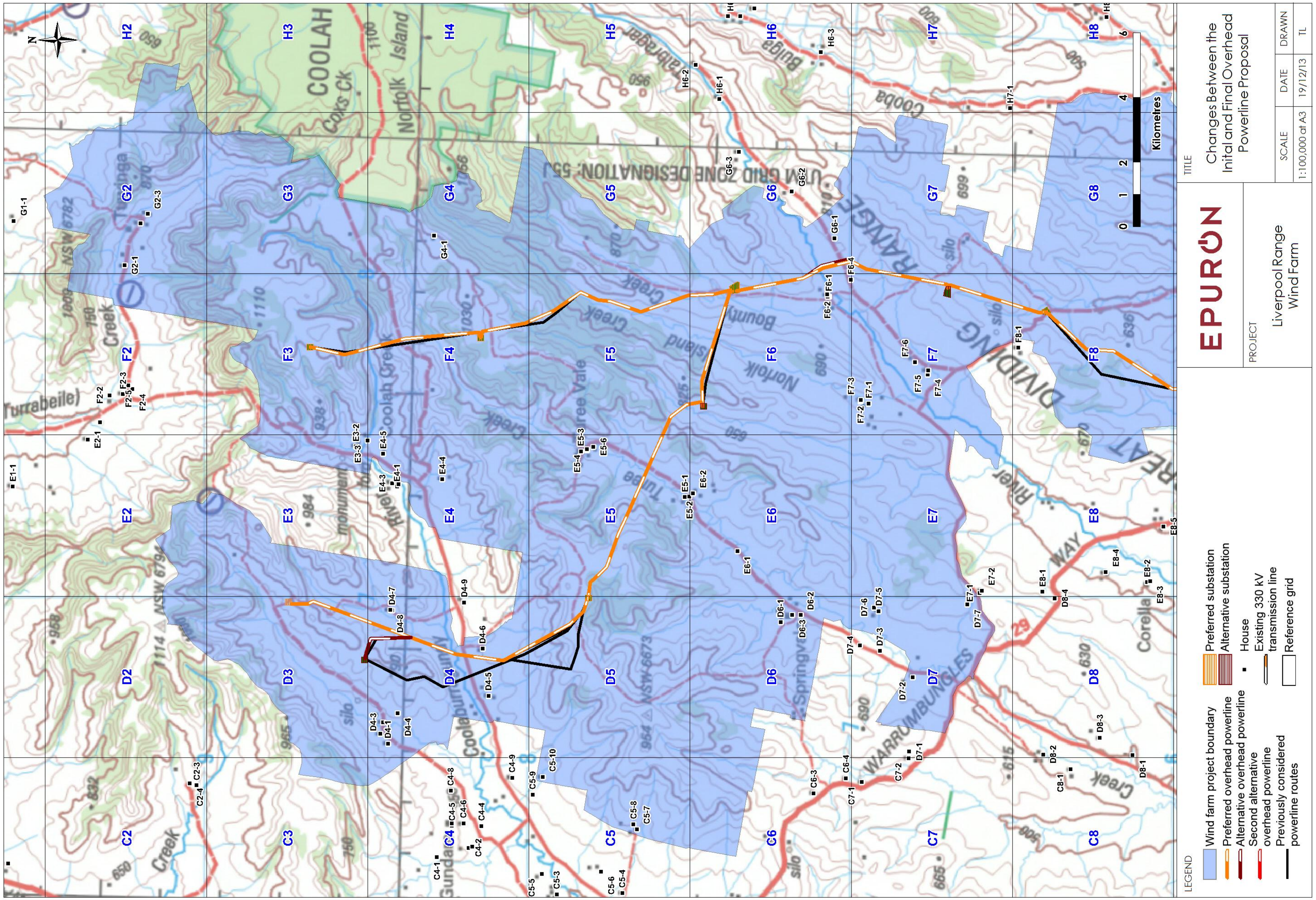


Figure 5-6 Changes between the initial and current transmission line proposals (map 2)

6 Planning Assessment Process

This section of the EA provides an outline of the relevant statutory provisions for the planning assessment process at the State, Local and Commonwealth levels in turn.

6.1 State Government Legislation and Policy

6.1.1 Environmental Planning and Assessment Act 1979

Planning in NSW is governed by the *Environmental Planning and Assessment Act 1979* (*EP&A Act*).

The Director General of the Department of Planning and Environment has issued the requirements for environmental assessment of the project.

Objects of the EP&A Act

Liverpool Range Wind Farm is consistent with the objects of the planning legislation, as stated in section 5 of the EP&A Act:

- The project promotes the welfare of the community and a better environment by providing construction jobs, rental income to landowners, electricity to the community, and reducing dependency on carbon-polluting energy sources;
- Orderly and economic use and development of land is encouraged as traditional grazing and farming activity can continue, while additional income can be earned by landowners hosting the wind farm, and through construction and maintenance jobs;
- The wind farm provides a utility service (electricity generation);
- The wind farm protects the environment by utilising large areas of cleared, grazing land for power generation, by biodiversity safeguards in relation to existing remnant native vegetation, and by helping the transition to a low carbon economy (through the exploitation of wind energy to generate electricity);
- The wind farm promotes ecologically sustainable development in the manner described in 6.1.5 (below);
- The wind farm promotes the sharing of responsibility for environmental planning between different levels of government in the manner that local government has been consulted. Each of the four local councils whose areas will host the wind farm are represented on the community consultation committees for the project. The requirements of State government agencies such as the Office of Environment and Heritage have been addressed.
- The wind farm provides opportunities for public involvement and participation in environmental planning and assessment through the community consultation committees, through community open days and newsletters for local people to learn about proposals and to provide comment, as well as through the public exhibition process.

Transitional Part 3A Project

The Liverpool Range Wind Farm was previously considered a transitional Part 3A project (*EP&A Act,* Schedule 6A Transitional arrangements—repeal of Part 3A – clauses 1, 2 and 3). This is because it has a capital investment value of more than $30 million and was confirmed to be a project to which Part 3A of the EP&A Act applies by the Director-General of the Department of Planning and Environment on 2 June 2010, refer to Attachment 5.

Part 4 Project

The Liverpool Range Wind Farm will now be assessed as State Significant Development (SSD) under Part 4 of the NSW Environmental Planning and Assessments Act 1979, as of the 11th of February 2014 as advised by the Department of Planning and Environment.

Consent Authority

The Minister or the Minister's delegater determines State Significant Development projects (section 89E).

Director General's Requirements

The Director General of the Department of Planning and Environment issued requirements for the Proponent to consider and address in this EA on 31 March 2011, with supplementary requirements on 16 August 2011. These requirements incorporate input from the various government agencies that will provide input to the DP&E in the assessment of this project.

The following table contains the Director General's Requirements (DGRs) and indicates where they are addressed in this EA. The full DGRs are also presented in Attachment 6.

Table 6-1 Director-General's Requirements

Director-General Requirement's	*Addressed in:*
General Requirements	
The Environmental Assessment (EA) must include: • an executive summary; • a detailed description of the project (both the wind farm and associated infrastructure) including: → construction, operation and decommissioning details; → the location and dimensions of all project components including the wind turbines (including map coordinates and AHD heights), underground / overhead cabling between turbines, electrical substation and transmission line linking the wind farm to the grid, temporary concrete batching plant(s), construction compounds, access roads/road upgrades (including internal access tracks) and obstacle lighting; → a timeline identifying the proposed construction and operation of the project components including staging, their envisaged lifespan and arrangements for decommissioning; → supporting maps/plans clearly identifying existing environmental features (e.g. watercourses, vegetation), infrastructure and landuse (including nearby residences and approved residential developments or subdivisions, if any) and the location / siting of the project including associated infrastructure in the context of this existing environment; and → resourcing requirements (including, but not limited to, water supply and gravel). • consideration of any relevant statutory provisions including the consistency of the project with the objects of the *Environmental Planning and Assessment Act* 1979 (i.e. Section 5 of the Act) and any relevant development control plans; • an assessment of the key issues outlined below, during construction, operation and decommissioning (as relevant). The Environmental Assessment must assess the worst case as well as representative impact for all key issues; • consideration of any cumulative impacts as relevant, taking note of proposed wind farms in the locality; • demonstration that the wind farm will be capable of meeting relevant Building Code of Australia (BCA) standards and other relevant codes / manufacturers' specifications for the construction of wind farms; • a draft Statement of Commitments detailing measures for environmental mitigation, management and monitoring for the project; • a conclusion justifying the project taking into consideration the environmental, social and economic impacts of the project; the suitability of the site; and the public interest; and • certification by the author of the EA that the information contained in the Assessment is neither false nor misleading. The EA should present, with respect to each relevant transmission line impact, a considered overview of potential impacts along the length of the line, to Identify areas of potentially significant impact for further, more detailed assessment. In addition to detailed assessment of areas of potentially significant impact, other areas along the length of the line should be assessed in a more general manner, with a particular focus on the development of frameworks for the mitigation, management and monitoring of more minor and generic environmental issues.	Section 1 Section 3 Section 3 Section 3 Section 3.10 Section 3 and Attachment 1 Section 15 Section 6 Section 9 to 16 Section 9 Section 6.1.10 Section 17 Section 18 Section 20
Key Assessment Requirements	
The EA must include assessment Of the following key issues for both the wind farm and transmission line: • **Strategic Justification** -the EA must: → include a strategic assessment of the need, scale, scope and location for the project in relation to predicted electricity demand, predicted transmission constraints and the	

Director-General Requirement's	Addressed in:
strategic direction of the region and the State in relation to electricity supply, demand and electricity generation technologies, and its role within the Commonwealth's Renewable Energy Target Scheme. The EA must clearly demonstrate that the existing transmission infrastructure has sufficient capacity to accommodate the project; → include a clear demonstration of quantified and substantiated greenhouse gas benefits, taking into consideration sources of electricity that could realistically be replaced and the extent of their replacement, with reference to the Department of Environment, Climate Change and Water NSW wind farm greenhouse gas savings tool (http://www.environment.nsw.gov.au/climatechange/greenhousegassavingstool.htm); → include an analysis of the suitability of the project with respect to potential land use conflicts with existing and future surrounding land uses (including rural residential development, building entitlements and subdivision potential, land of significant scenic or visual value, land of high agricultural value, mineral reserves (particularly Petroleum Exploration Licence 433 held by Eastern Star, Petroleum Exploration Licence 456 held by Santos/Apollo/Gas/Dart, mining lease A286 held by Industry and Investment and Exploration Licence 7597 held by Australian Bauxite), forestry, Crown land and conservation areas including Coolah Tops and Goulburn River National Parks), taking into account local and strategic landuse objectives and the potential for social and economic impacts on the local community. In particular justification should be provided regarding the suitability of the transmission line route through Durridgere State Conservation Area. Consideration should be given to any potential conflicts with the proposed Coolah to Newcastle gas pipeline and any operating or proposed extractive industries. The analysis of site suitability shall consider any Environmentally Sensitive Area Mapping held by Liverpool Plains Shire Council, Warrumbungle Shire Council, Upper Hunter Shire Council and Mid-Western Regional Council; and → describe the alternatives considered (location and/or design) for all project components, and provide justification for the preferred project demonstrating its benefits on a local and strategic scale and how it achieves stated objectives and any measures to offset residual impacts (for example community enhancement programmes).	Section 4.1 and 4.7 Section 4.2 Section 4.6 and 4.7 Section 5
• **Visual Impacts** -the EA must: → provide a comprehensive assessment of the landscape character and values and any scenic or significant vistas of the area potentially affected by the project, including an assessment of the significance of landscape values and character in a local and regional context. This should describe community and stakeholder values of the local and regional visual amenity and quality, and perceptions of the project based on surveys and consultation; → assess the impact of shadow "flicker", blade "glint" and night lighting from the wind farm; → identify the zone of visual influence of the wind farm including consideration to night lighting (no less than 10 kilometres) and assess the visual impact of all project components on this landscape; → include an assessment of any cumulative visual impacts from transmission line infrastructure; → include photomontages of the project taken from potentially affected residences (including approved but not yet developed dwellings or subdivisions with residential rights), settlements and significant public view points, and provide a clear description of proposed visual amenity mitigation and management measures for both the wind farm and the transmission line. The photomontages must include representative views of turbine night lighting if proposed; and → provide an assessment of the feasibility, effectiveness and reliability of proposed mitigation measures and any residual impacts after these measures have been implemented.	Section 9 and Appendix A
• **Noise Impacts** -the EA must: → include a comprehensive noise assessment of all phases and components of the project including: turbine operation, the operation of the electrical substation, corona and / or aeolian noise from the transmission line, construction noise (focusing on high noise-generating construction scenarios and works outside of standard construction hours), traffic noise during construction and operation, and vibration generating activities (including blasting) during construction and / or operation. The assessment must identify noise / vibration sensitive locations (including approved but not yet developed dwellings), baseline conditions based on monitoring results, the levels and	Section 10 and Appendix B

Director-General Requirement's	Addressed in:
character of noise (e.g. tonality, impulsiveness, low frequency etc) generated by noise sources, noise / vibration criteria, modelling assumptions and worst case and representative noise / vibration impacts; → in relation to wind turbine operation, determine the noise impacts under operating meteorological conditions (i.e. wind speeds from cut in to rated power), including impacts under meteorological conditions that exacerbate impacts (including varying atmospheric stability classes and the van den Berg' effect for wind turbines). The probability of such occurrences must be quantified; → include monitoring to ensure that there is adequate wind speed/profile data and ambient background noise data that is representative for all sensitive receptors; → provide justification for the nominated average background noise level used in the assessment process, considering any significant difference between daytime and night time background noise levels at background noise levels higher than 30 dB(A); → identify any risks with respect to tonal, low frequency or infra-noise; → clearly outline the noise mitigation, monitoring and management measures that would be applied to the project. This must include an assessment of the feasibility, effectiveness and reliability of proposed measures and any residual impacts after these measures have been incorporated; → if any noise agreements with residents are proposed for areas where noise criteria cannot be met, provide sufficient information to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements; and → include a contingency strategy that provides for additional noise attenuation should higher noise levels than those predicted result following commissioning and/or noise agreements with landowners not eventuate. The assessment must be undertaken consistent with the following guidelines: → Wind Turbines -the South Australian Environment Protection Authority's Wind Farms - Environmental Noise Guidelines (2003); → Substation -NSW Industrial Noise Policy (EPA, 2000); → Site Establishment and Construction -Interim Construction Noise Guidelines (DECC, 2009); → Traffic Noise -Environmental Criteria for Road Traffic Noise (NSW EPA, 1999); and Vibration -Assessing Vibration: A Technical Guideline (DECC, 2006).	
• **Ecological Impacts** -the EA must include an ecological assessment considering terrestrial and aquatic ecosystems (as relevant), including groundwater dependent ecosystems, consistent with Guidelines for Threatened Species Assessment (DEC, 2005); The EA must: → identify threatened species, populations and communities listed under both State and Commonwealth legislation that have the potential to occur on site; → map existing vegetation by vegetation / community type and include details on existing site conditions, including whether the vegetation comprises a highly modified or over-cleared landscape and the types and quality of habitat resources available. Vegetation mapping should consider any Environmentally Sensitive Area Mapping held by Liverpool Plains Shire Council, Warrumbungle Shire Council, Upper Hunter Shire Council and Mid-Western Regional Council. → provide details of the survey methodology employed including survey effort and representativeness for each species targeted and clear justification for species that were discounted from requiring field surveys or further assessment; → demonstrate a design philosophy of impact avoidance on ecological values, and in particular, ecological values of high significance; → provide a worst case estimate of vegetation to be cleared (in hectares), including quantifying impacts (in hectares) by vegetation type and threatened species habitat (as relevant); → assess the significance of impacts to native vegetation, listed' threatened species, populations and communities and their habitats with consideration to local and region-based ecological implications, including habitat connectivity and distribution of species. The assessment must consider impacts to in-stream and riparian ecology from works close to waterways and / or waterway crossings. In addition, impact of the project on birds and bats from blade strikes, low air pressure zones at the blade tips (barotrauma), and alteration to movement patterns resulting from the turbines must be assessed, including demonstration of how the project has been sited to avoid and! or minimise such impacts;	Section 11 and Appendix C

Director-General Requirement's	*Addressed in:*
→ include details of how flora and fauna impacts would be managed during construction and operation including adaptive management, rehabilitation! regeneration measures and maintenance protocols; → demonstrate how the project (with the incorporation of all proposed measures to avoid, mitigate and / or offset impacts) achieves a biodiversity outcome consistent with "maintain or improve" principles. Sufficient details must be provided to demonstrate the availability of viable and achievable options to offset the impacts of the project and to secure these measures in perpetuity; and → address the risk of weed spread and identify mitigation measures.	
• **Heritage Impacts** -the EA must include an assessment of impacts on Aboriginal and historic heritage. The EA must: → include sufficient information to demonstrate the likely impacts of the project on Aboriginal heritage values / items (archaeological and cultural) and outline proposed mitigation measures (including consideration of the effectiveness and reliability of the measures) in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005). The assessment must be undertaken by suitably qualified heritage consultants and demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, developing options and selecting options and mitigation measures (including the final proposed measures); and → provide sufficient information to demonstrate the likely impacts of the project on historic heritage values (Including heritage vistas) and, where impacts to State or local historic heritage items are proposed, outline proposed mitigation and management measures (including consideration of the effectiveness and reliability of the measures) generally consistent with the guidelines in the NSW Heritage Manual. Where impacts to State or local historic heritage items are proposed, a statement of heritage significance must be included.	Section 12 and Appendix D
• **Traffic and Transport** -the EA must assess the construction and operational traffic impacts of the project including: → details of traffic volumes (both light and heavy vehicles) and transport routes during construction and operation; → assess the potential traffic impacts of the project on road network function (including intersection level of service) and safety; → assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-dimensional traffic) during construction and operation, including full details of any required upgrades to roads, bridges, site access provisions (for safe access to the public road network) or other road features; → details of measures to mitigate and/or manage potential impacts, including construction traffic control, road dilapidation surveys and measures to control soil erosion and dust generated by traffic volumes; → details of access roads within the site including how these would connect to the existing public road network (i.e. site access) and ongoing operational maintenance requirements for on-site roads; and → consideration of relevant Council traffic / road policies.	Section 13 and Appendix E
• **Hazard/Risks** - the EA must include an assessment of the potential impacts on aviation safety, including the need for aviation hazard lighting, considering nearby aerodromes and aircraft landing areas, defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems, and navigation aids. Aerodromes within 30km of the turbines should be identified and impacts on obstacle limitation surfaces addressed. In addition, the EA must assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line. Possible effects on telecommunications systems must be identified. Potential hazards and risks associated with electric and magnetic fields and bushfires/use of bushfire prone land must also be assessed.	Section 14
• **Water Supply, Water Quality and Hydrology** -The EA must: → identify water demands, and determine whether an adequate and secure water supply is available for the project; → identify water sources (surface and groundwater), water disposal methods and water storage structures in the form of a water balance;	Section 15

Director-General Requirement's	Addressed in:
→ include the statutory (licensing) context of the water supply sources; → assess potential environmental impacts associated with the use of the identified water sources including impacts on groundwater and implications for existing licensed users/basic landholder rights; → assess the potential to intercept groundwater, including predicted dewatering volumes, zone of drawdown and associated impact, water quality and disposal methods; → where the project involves crossing or works close to waterways, identify likely impacts to the waterways, how the waterways are proposed to be crossed and be designed in accordance with the NSW Office of Water Guidelines for Controlled Activities (August 2010); → describe the measures to minimise hydrological, water quality, aquatic and riparian impacts; → identify how works within steep gradient land or highly erosive soil types will be managed during construction and operation; and → consideration is to be given to water sharing plans and ground water and surface water access embargoes, as relevant.	
• **Waste** -The EA must identify, quantify and classify the likely waste streams to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste.	Section 16.6
• **General Environmental Risk Analysis** - notwithstanding the above key assessment requirements, the EA must include an environmental risk analysis to identify potential environmental impacts associated with the project, proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of the additional key environmental impact(s) must be included in the EA.	Section 16
Consultation Requirements	
The Proponent must undertake a consultation programme as part of the environmental assessment process, including consultation with, but not necessarily limited to, the following parties: • Liverpool Plains Shire Council; • Warrumbungle Shire Council; • Upper Hunter Shire Council; • Mid-Western Regional Council; • Department of Environment, Climate Change and Water; • NSW Office of Water; • Industry and Investment NSW; • NSW Roads and Traffic Authority; • NSW Rural Fire Service; • Land and Property Management Authority; • Central West Catchment Management Authority; • Hunter Central Rivers Catchment Management Authority; • Namoi Catchment Management Authority; • Commonwealth Department of Defence; • Civil Aviation Safety Authority; • Airservices Australia; • Aerial Agricultural Society of Australia; • relevant service providers; • relevant minerals stakeholders (including exploration and mining title holders); and • the local community and landowners (including "associated" and "non-associated" properties). The consultation process shall include measures for disseminating information to increase awareness of the project as well as methods for actively engaging stakeholders on issues that would be of interest / concern to them. The EA must: • demonstrate effective consultation with stakeholders, and that the level of consultation with each stakeholder is commensurate with their degree of interest / concern or likely impact;	Section 7

Director-General Requirement's	Addressed in:
• clearly describe the consultation process undertaken for each stakeholder/group including details of the dates of consultation and copies of any information disseminated as part of the consultation process (subject to confidentiality); and • describe the issues raised during consultation and how and where these have been addressed in the EA.	

Supplementary Director-General's Requirements

*The Director-General of the Department of Planning and Environment issued s*upplementary DGRs on 16 August 2011. These supplementary DGRs related to the requirement:

"…that the community must be consulted during the preparation of the Environmental Assessment and relevant issues must be addressed in the document."

Table 6-2 contains the supplementary DGRs and highlights the sections in which the appropriate responses have been made. The full supplementary DGRs are presented in Attachment 6.

Table 6-2 Supplementary Director-General's Requirements

Supplementary Director-General's Requirements	Addressed In:
1. a comprehensive, detailed and genuine community consultation and engagement process must be undertaken. This process must ensure that the community is both informed of the proposal and is actively engaged in issues of concern to them, and is given ample opportunity to provide its views on the proposal. Sufficient information must be provided to the community so that it has a good understanding of what is being proposed and of the impacts. There should be a particular focus on those non wind farm associated community members who live in proximity to the site; 2. the Environmental Assessment must clearly document and provide details and evidence of the consultation process and who was consulted with; 3. all issues raised during the consultation process must be clearly identified and tabulated in the Environmental Assessment; and 4. the Environmental Assessment must state how the identified issues have been addressed, and how they have informed the proposal as presented in the Environmental Assessment. In particular, the Environmental Assessment must state how the community's issues have been responded to.	Section 7

The Director-General of the Department of Planning and Infrastructure issued further supplementary DGRs on 25 March 2014. These supplementary DGRs related to the requirement to assess the potential impacts on listed threatened species and communities under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. As detailed in Section 6.1.11 the bilateral assessment process will apply to the assessment of this project under the EPBC Act, so that the Department of Planning and Infrastructure can undertake an environmental assessment of the project to satisfy the requirements of both NSW and Commonwealth legislation.

The table attached as Appendix H contains the supplementary DGRs and highlights the sections in which the appropriate responses have been made. The full supplementary DGRs are presented in Attachment 6.

6.1.2 Draft NSW Wind Farm Planning Guidelines

The Draft NSW Wind Farms Planning Guidelines have been prepared to ensure effective consultation with local communities and to deliver improved consistency, transparency and rigour in the planning assessment process. These guidelines were exhibited from 23 December 2011 to 14 March 2012 and public comments on the draft guidelines were sought.

The Draft Guidelines provided a table of key aspects relevant to applications that can be seen in Table 6-3.

Table 6-3 Key issues of the Draft NSW Planning Guidelines for Wind Farms

Potential Issues for Consideration	***Addressed In:***
Consultation	
Form a Community Consultation Committee	Section 7.2
Document the consultation process undertaken, including the stakeholders consulted. Identify and tabulate the issues raised by the stakeholders during consultation. Describe how the issues raised have been addressed.	Section 7
Consult with all neighbours with dwellings within 2km of a proposed wind turbine.	Section 7.2
Consider seeking an agreement with neighbours with dwellings within 2km of a proposed turbine.	Section 7.2.2
Landscape and Visual Amenity	
Provide photomontages from all non-host dwellings within 2km of a proposed wind turbine.	Section 9 & Appendix A
Identify the zone of visual influence of the wind farm (no less than 10km) and likely impacts on community and stakeholder values. Consider cumulative impacts on landscapes and views.	Section 9
Outline mitigation measures to avoid or manage impacts.	Section 9
Noise	
Undertake assessment based on separate daytime (7am to 10pm) and night time (10pm to 7am).	Section 10
Predict noise levels at all dwellings within 2km of a proposed turbine.	Section 10
Consider special audible characteristics, including tonality, amplitude modulation, and low frequency noise (apply penalties where relevant)	Section 10
Outline measures to avoid, minimise, manage and monitor impacts.	Section 10
Health	
Consider and document health issues, focusing on neighbours with dwellings within 2km of a proposed wind turbine.	Section 8.1
Ecological Issues	
Consider the impact on birds and bats, particularly migratory species and outline the proposed monitoring and mitigation strategy.	Section 11 & Appendix C
Aviation Safety	
Outline current agricultural aerial uses on neighbouring properties.	Section 14.1
Consider the potential for the proposed wind farm to impact on aviation safety associated with agricultural aerial uses consistent with the draft guidelines.	Section 14.1
Bushfire Hazard	
Consider bushfire issues consistent with the draft guidelines, including the risks that a wind farm will cause bushfire and any potential impacts on the aerial fighting of bushfires.	Section 14.5
Blade Throw	
Assess blade throw risks consistent with the draft guidelines.	Section 14.6
Outline measures to avoid, minimise, manage and monitor impacts.	Section 14.6
Economic Issues	
Consider whether the wind farm is consistent with the relevant local or regional land use planning strategies	Section 6.1.8
Consider the potential impact upon mining/petroleum leases and exploration licenses.	Section 16.3
Consider any potential impacts upon property values consistent with the draft guidelines, including properties within 2km.	Section 8.1
Decommissioning	

Include a Decommissioning and Rehabilitation Plan in the EA, including proposed funding arrangements.	Section 3.10.4 and Appendix G
Confirm that the proponent not the landowner is responsible for decommissioning	Section 3.10.4
Monitoring and Compliance Program	
Outline program to monitor the environment performance to ensure compliance including mechanisms for reporting outcomes and procedures to rectifying non-compliance – including any provisions for independent reviews.	Section 17 - Draft Statement of Commitments
Council Planning Controls	
Outline whether the proposal is consistent with any relevant provisions of the relevant council's Development Control Plan and list any variations	Section 6.1.8

6.1.3 State Environmental Planning Policy

State Environmental Planning Policies (SEPPs) only apply 'to the extent that the provisions of such a policy expressly provide that they apply to and in respect of the particular project' (former section 75R(2)(b) EPA&A). No SEPPs expressly provide that they apply to and in respect of the Liverpool Range Wind Farm project, with the result that SEPPS do not apply to this application. However 'In deciding whether or not to approve the carrying out of a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of section 75R) apply to the project if approved' (former section 75J(3)). Accordingly, the Minister may wish to take into account *State Environmental Planning Policy No 44 – Koala Habitat Protection ('Koala SEPP').*

The *Koala SEPP* applies to the Coolah and Merriwa local government areas (Schedule 1, *Koala SEPP*). While Liverpool Plains and Mid-Western Regional local government areas are not listed in Schedule 1 as areas to which the *Koala SEPP* applies, the former local government areas of Quirindi and Rylstone, now part of Liverpool Plains and Mid-Western Regional local government areas respectively, are listed in Schedule 1. Accordingly, the Minister may wish to take into account the provisions of the *Koala SEPP* in considering the Liverpool Range Wind Farm application.

The Minister may also wish to take into account *SEPP (Infrastructure) 2007*. Electricity generating works, such as the Liverpool Range Wind Farm, may be carried out with consent in certain prescribed zones (clause 34). These zones, defined in clause 33, are consistent with the rural zonings in the Liverpool Range Wind Farm local government areas, as further discussed in 'Local Environmental Plans' in this EA.

6.1.4 Protection of the Environment Operations Act 1997

The proposed development of the Liverpool Range Wind Farm does not currently require an environment protection licence under the Protection of the Environment Operations Act 1997 (POEO Act) because wind power generation is excluded from the definition 'general electricity works' that must be licensed (POEO Act, section 48 and Schedule 1, clause 17(1)). However a draft regulation is currently on exhibition which may result in the requirement for a licence under revisions to the POEO Act. On the basis that a licence will be required under the POEO Act by the time this EA is determined, a licence in line with the intention of the exhibited amendment is sought.

6.1.5 Ecologically Sustainable Development

Ecologically sustainable development (ESD) involves the effective integration of social, economic and environmental considerations in decision-making processes. In 1992, the Commonwealth and all state and territory governments endorsed the *National Strategy for Ecologically Sustainable Development*. In NSW, the concept has been incorporated in legislation such as the *EP&A Act* and Regulation.

Sustainable development in the context of a proposed wind farm, climate change, renewable energy, wind assets and threatened flora and grasslands was considered by Preston CJ in *Taralga Landscape Guardians Inc v Minister for Planning and RES Southern Cross Pty Ltd* [2007] NSWLEC 59.

For the purposes of the *EP&A Act* and other NSW legislation, the Intergovernmental Agreement on the Environment (1992) and the *Protection of the Environment Administration Act 1991* outline the following principles which can be used to achieve ESD:

- The precautionary principle: 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
- In the application of the precautionary principle, public and private decisions should be guided by:
  - Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
  - An assessment of the risk-weighted consequences of various options.
- Inter-generational equity: that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations;
- Conservation of biological diversity and ecological integrity: that conservation of biological diversity and ecological integrity should be a fundamental consideration;
- Improved valuation, pricing and incentive mechanisms: that environmental factors should be included in the valuation of assets and services, such as:
  - Polluter pays: that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement;
  - The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and
  - Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The precautionary principle has been adopted in the assessment of impacts. All potential impacts have been considered and mitigated where a risk is present. Where uncertainty exists, measures have been suggested to address the uncertainty.

The impacts of the project on ecology, including EPBC listed species, have been assessed in detail in the attached Ecology Assessment (summarised in Section 11).

The aims, structure and content of this EA have incorporated these ESD principles. The Draft *Statement of Commitments* in Section 17 provides an auditable environmental management commitment to these parameters. Based on the social and environmental benefits accruing from the project at a local and broader level, and the assessed impacts on the environment and their ability to be managed, it is considered that the development would be ecologically sustainable within the context of the above ESD principles.

6.1.6 Catchment Action Plans

Catchment Action Plans (CAPs) are strategic, statutory plans under the *Catchment Management Authorities Act 2003* that provide a framework for natural resource management in a catchment. CAPs include general principles for biodiversity, land and water management.

Each catchment management authority is required to prepare a catchment action plan in partnership with regional community and government agencies. Catchment action plans guide natural resource management investment in the 13 catchment regions across NSW. They bring together government priorities, best available science and the values of catchment communities into a strategic plan for making improvements in NSW's natural resources (ABS, 2010).

The majority of the proposed Liverpool Range Wind Farm falls in the Central West catchment region, with the northern and southern sections falling in the Namoi and Hunter/Central Rivers catchment regions respectively.

Overall, the Liverpool Range Wind Farm will only have a small effect on the key principles of:

- water management;
- regional vegetation management;
- floodplain management;
- regional action plans;

- property management;
- local environment plans.

While vegetation clearing would be required on site, the amount required would be relatively small in size. The impact of this native vegetation clearing has been assessed as part of the proposal and was concluded to be manageable with effective implementation of the Construction Environmental Management Plan.

Of these other principles which the development may affect, prevention and mitigation measures have been identified to reduce their potential impact. These measures have been developed using best practice and will be implemented into both the Construction and Operational Environmental Management Plans.

6.1.7 Renewable Energy Action Plan

In September 2013 the NSW government published the final version of its Renewable Energy Action Plan to guide NSW's renewable energy development and to support the national target of 20% renewable energy by 2020. The Plan positions NSW to increase energy from renewable sources at least cost to the energy customer and with maximum benefits to NSW.

The Plan details three goals and 24 actions to most efficiently grow renewable energy generation in NSW. The strategy is to work closely with NSW communities and the renewable energy industry to increase renewable energy generation in NSW.

The Plan replaces the government's previous Renewable Energy Precincts program established in February 2009.

6.1.8 Local Government Instruments and Policies

Local Environment Plans

As stated above (in relation to SEPPs) 'In deciding whether or not to approve the carrying out of a project, the Minister may (but is not required to) take into account the provisions of any environmental planning instrument that would not (because of section 75R) apply to the project if approved' (EP&A Act, former section 75J(3)). Local Environmental Plans are environmental planning instruments (EPA&A section 4). Accordingly the Minister may (but is not required to) take into account the applicable Local Environmental Plans (LEPs), namely:

- Coolah LEP 2000. The wind farm is 'generating works' and 'public utility undertaking', as defined in the Model Provisions and adopted in Coolah LEP 2000, being the LEP within the Warrumbungle Shire local government area applicable to part of the proposed Liverpool Range Wind Farm site. The land is zoned 1(a) (General Rural) under Coolah LEP 2000. The proposed wind farm is permissible with development consent in that zone.
- Merriwa LEP 2000. The wind farm is 'generating works' and 'public utility undertaking', as defined in the Model Provisions and adopted in Merriwa LEP 1992, being the applicable LEP within the Upper Hunter local government area applicable to part of the proposed Liverpool Range Wind Farm site. The land is zoned 1(a) (General Rural) under Merriwa LEP 1992. The proposed wind farm is permissible with development consent in that zone.
- Liverpool Plains LEP 2011. The wind farm is 'electricity generating works', as defined in the Dictionary to Liverpool Plains LEP 2011, being the applicable LEP within the Liverpool Plains local government area applicable to part of the proposed Liverpool Range Wind Farm site. The land is zoned RU1 Primary Production, in which the proposed wind farm is prohibited. However Liverpool Plains LEP 2011 is subject to the provisions of any State environmental planning policy (clause 1.9). State Environmental Planning Policy (Infrastructure) 2007 ('SEPP Infrastructure') is applicable, and prevails to the extent of any inconsistency with any other environmental planning instrument (SEPP Infrastructure, clause 8). The RU1 Primary Production land under Liverpool Plains LEP 2011 is 'prescribed rural zone' under clause 33 of SEPP Infrastructure, in which electricity generating works are permissible with consent (clause 34(1)).
- Mid-Western Regional LEP 2012. The transmission lines for the wind farm are 'public utility undertaking' as defined in the Dictionary to the Mid-Western Regional LEP 2012. The potential transmission line corridor land includes land zoned RU1 Primary Production, RU3 Forestry, E1 National Parks and Nature Reserves and E3 Environmental Management. Transmission lines are permissible with consent in Zone RU1. In Zone RU3 transmission lines would be permissible without consent if the use was authorised under the Forestry Act 1916 (for example, in accordance with a special purpose permit under section 32F), but would otherwise be prohibited. Similarly in Zone E1 National Parks and Nature Reserves the transmission lines would be

permissible without consent if the use was authorised under the National Parks and Wildlife Act 1974 (for example through an easement for the transmission of electricity under section 153), but would otherwise be prohibited. In Zone E3 Environmental Management, transmission lines are prohibited.

Development Control Plans and local council policies

In the same way that the Minister may wish to (but is not required to) take into account the provisions of LEPs (EPAA former section 75J(3), the Minister may wish to take into account the current Development Control Plans (DCPs) and other local council policies which specifically addresses the development of wind farms.

Upper Hunter Shire Council Development Control Plan 2008

Section 1.4 (Notification and Advertisement), Section 1.5 (Documentation), Section 1.6 (Environmental Considerations), Section 1.7 (Contributions), Section 1.8 (Tourism), Section 1.9 (Consultation with other authorities), and Section 1.10 (Reference material) of Upper Hunter Development Control Plan 2008 (including section on wind power generation adopted 25 July 2011) (Upper Hunter DCP) provide a guide to the Council's expectations in relation to wind farms, and accordingly have been considered by the Proponent.

While the project does comply with most of the controls proposed by the Upper Hunter DCP (see Table 6-4), it should be noted that there are some exceptions.

The project does not comply with set-back distances suggested in this DCP; however, it achieves compliance with the SA EPA Guidelines. Furthermore, the layout has been assessed for visual impact. The noise and visual studies are based on an assessment of amenity and consider site specific factors relating to the project design and minimisation of overall impacts. In *Gullen Range Wind Farm Pty Limited v Minister for Planning [2010]* NSWLEC 1102 (at [167]) the Court described the 2 km setback proposed in the DCP as arbitrary, and rejected it. The project achieves the desired objectives of the DCP and complies with the other requirements, particularly the noise criteria.

This assessment also considers the criteria set out in the Draft NSW Wind Farm Guidelines.

Table 6-4 Criteria from the Upper Hunter Shire Council DCP 2008 (section on wind power generation adopted 25 July 2011)

Wind Power Generation - DCP Issues	Relevant section in this EA
Section 1.4 (Notification and Advertisement):	
Notification radius of at least 10 km	Section 7
(Not applicable). (iii) The applicant must hold at least one public information session to which the public will have access to both during the day and evening per town covered within the proposal and notification radius. In the event no towns are covered by the proposal and notification radius one information session must be held in the nearest town centre. Public notice of an information sessions must be given at least 21 days in advance and advertised in the local newspapers and on Upper Hunter Shire Council's website.	Section 7.2.2
Applicants are encouraged at the earliest opportunity, to actively engage in public consultation with non-hosting adjoining owners prior to lodgement of an application	Section 7
Section 1.5 (Documentation)	
Site plan(s) showing all wind farm infrastructure including wind turbine envelopes, site and property boundaries, land contours, native and existing vegetation, land uses within the proposal area, the location and uses of all buildings on the site, power and transmission lines, sub-stations(s), fences on site, temporary structures including accommodation and extent of ground disturbance.	Section 3
Specifications of the proposed wind turbines	Section 3.3
Proposed route of any transmission lines	Sections 3.4 & 3.5
Comprehensive noise impact survey and modelling of the proposed development (worst case scenario) in relation to the existing environmental surroundings. Noise modelling shall as a minimum include all residential dwellings and other likely noise receptors within a 3km radius of a proposed wind turbine.	Section 10
Traffic and road management impact assessment including proposed haulage routes, new roads required, proposed upgrading of local roads whether private or	Section 13

EPURON

Wind Power Generation - DCP Issues	Relevant section in this EA
Council owned, existing road and bridge weight limits and strategies to overcome deficiencies in the network.	
Where wind turbines are proposed to be placed on ridgelines or part of the wind turbine structures will be visible above a ridgeline a visual impact assessment must be undertaken including computer assisted modelling to a minimum distance of 10km from the affected ridgelines. The assessment shall include photomontages which should also depict night lighting in accordance with any requirements of the Civil Aviation Safety Authority (CASA).	Section 9
The heritage significance of the subject site, nearby sites and surrounds including but not limited to indigenous and non-indigenous cultural, archaeological and built environment issues/items.	Section 12
A detailed assessment of flora and fauna impacts with specific mention of migratory and threatened species potentially impacted by the development	Section 11
Copies of all agreed and proposed noise agreements that have been entered into or are intended to be entered into.	Not applicable
Section 1.6 (Environmental Considerations)	
a) The proposed development must take into account the surrounding environment. All elements of the project shall be sited and carried out to minimise impacts on the locality and not conflict with current land uses on and surrounding the proposal.	Section 6
b) The applicant must take into consideration and assess the cumulative impact of the proposed development in connection to existing or approved undeveloped wind farms. Ridgelines dominated with wind turbines will not be favoured.	Section 1.8 and Section 9
c)Where wind turbines are proposed to be significantly higher than nearby properties or where the wind turbines will dominate the immediate view from the dwelling or an approved dwelling lot, consideration to be given to increasing the separation distances to reduce the visual impact	Section 9
d) The development as a minimum shall not be located within a distance 1.25 times the height of the turbine (including the tip of the blade) from the boundary of a formed public road or a non-related property boundary.	Not applicable
e) Distances between proposed wind turbine locations in relation to any dwellings shall be on merit supported fully by aesthetic, acoustic and amenity assessments which shall give due consideration to issues of excessive noise, shadow flicker, infrasound and visual amenity.	Sections 10 & 14.4
f) Where a non-related property has wind turbines adjacent to more than one boundary of the property, setback distances should be increased above the minimum requirements to the development in order to minimise the visual and noise impacts of that property.	Not applicable
g) An assessment of the likely impacts on the local, regional and state communications networks (television, radio, mobile phones & two way radios) in operation within the locality shall be undertaken including the establishment of benchmarks on quality and service. Any reduction in either must be suitably addressed to overcome the loss.	Section 14.2
h) The Upper Hunter Shire Council operates a regional airport in Scone. In addition it is likely that there are other airstrips, helipads and aviation facilities within the Shire. An assessment of the likely impacts on such facilities in operation within the locality shall be undertaken.	Section 14.1
i) A bushfire risk assessment is to be provided with the any application prepared by a suitably qualified bushfire consultant and include (but not limited to): (i) the potential for the wind farm to trigger/influence a bushfire; and, (ii) the potential for damage should a bushfire enter the subject site; and, (iii) bushfire management strategies; and (iv) provision of fire retardant devices within the nacelle.	Section 14.5

Wind Power Generation - DCP Issues	Relevant section in this EA
j) Any development consent will be subject to the inclusion of a condition seeking the dismantling and removal of all structures associated with the development within a period of six (6) months and site rehabilitation of the wind farm or any wind turbines becoming redundant (not used for generation of electricity for a continuous period of 12 months or more).	Section 3.10.4
k) Any development consent will require the development of an environmental management plan (EMP) to comprise in detail the construction, commissioning, operation and post monitoring of the development. Applications will be assessed on merit and the requirements of the monitoring program identified as a result of the development assessment process.	Section 17
Section 1.7 (Contributions)	
Council will require the developer to make contributions in accordance with the Upper Hunter Shire Council S94A Development Contributions Plan 2008 (as amended). Council may also consider an offer from a developer to enter into a Voluntary Planning Agreement (VPA), in accordance with S93F of the Act. Under a VPA the developer may offer to pay money, dedicate land, carry out works or provide other material public benefits for public purposes.	Section 4.5.4
Section 1.8 (Tourism)	
Where a wind farm includes 25 or more wind turbines an area where vehicles and pedestrians (the public) can manoeuvre safely should be provided in a position which allows for the safe viewing of the wind farm and provides information on the development. Consultation with Council's and the RTA (where applicable) should be undertaken to identify a suitable location.	Not applicable
Section 1.9 (Consultation with other authorities)	
Applicants are advised to consult first with public authorities that may have a role in the assessment of a development application to ensure the application appropriately addresses all relevant and necessary considerations. Council may consult the following Agencies in connection with the development application: - NSW Department of Planning & Environment - NSW Department of Primary Industries - NSW Office of Environment and Heritage - NSW Department of Trade and Investment, Regional Infrastructure and Services - NSW Roads and Traffic Authority - The relevant Catchment Management Authority - Civil Aviation Safety Authority (CASA) - Australian Rail Track Corporation - NSW Rural Fire Service - Department of Defence - Airservices Australia	Section 7

Draft Mid-Western Regional Comprehensive Land Use Strategy

The Mid-Western Regional Comprehensive Land Use Strategy – Part C (Draft Strategy) (Mid-Western Regional Council, October 2009) lists a set of principles to address rural planning considerations. One of the principles is 'Support the consideration (merit based) for the development of wind farms and solar farms in rural areas' (page 11).

6.1.9 Subdivision

This EA seeks the approval for any subdivision of land as may be required by the relevant electricity transmission authority for substations and related purposes, and the eventual issuing of a subdivision certificate (if a survey plan of subdivision in registrable form is submitted to the Minister to enable the subdivision to be registered on land titles).

6.1.10 Building Code of Australia and manufacturer's specifications

The terms of engagement for the proponent's engineering, procurement and construction contractor will require compliance with Building Code of Australia requirements, and installation of wind turbines and other wind farm infrastructure in accordance with manufacturer's specifications. At completion of construction the propopent's engineer can certify such compliance. Commonwealth Legislation

6.1.11 Environment Protection and Biodiversity Conservation Act 1999

This *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides for a Commonwealth assessment and approvals system for:

- actions that have a significant impact on 'matters of national environmental significance';
- actions that (indirectly or directly) have a significant environmental impact on Commonwealth land; and
- actions carried out by the Commonwealth Government.

A Proposal requires the approval of the Environment Minister if an action is likely to have a significant impact on a matter of national environmental significance or listed as a matter of national significance which includes:

- World Heritage properties;
- wetlands of international importance (Ramsar wetlands);
- Commonwealth listed threatened species and ecological communities;
- Commonwealth listed migratory species;
- nuclear action;
- the Great Barrier Reef Marine Park;
- Commonwealth marine areas; and
- a water resource, in relation to coal seam gas and large mining development.

Threatened Species and Ecological Communities

The EPBC Act aims to ensure the conservation and recovery of flora and fauna species and communities at a state and national level. The requirements of the EPBC Act under Part 13 - Species and communities, are that the Minister must establish a list of threatened species, threatened communities and key threatening processes. The list must contain threatened species and communities as contained in Schedules 1 and 2 of the *Endangered Species Protection Act 1992*. Listed species are divided into the following categories: Extinct, extinct in the wild, critically endangered, vulnerable and conservation dependent. Threatened communities are divided into the following categories: Critically endangered and endangered. Key threatening processes are contained in Schedule 3 of the *Endangered Species Protection Act 1992*.

A search for Matters of National Environmental Significance based on the study area and a 10 kilometre buffer was undertaken using the Commonwealth Government's Protected Matters Search Tool. This tool covers World Heritage properties, National Heritage places, significant wetlands, migratory species, nationally listed threatened species and communities and other matters protected by the EPBC Act. The report generated by the Matters of National Environmental Significance Commonwealth Government's Protected Matters Search Tool is provided in full and discussed within the Ecology Assessment, provided in Appendix C. A summary of the results of the Protected Matters Search Tool is provided in Table 6-5 below.

Table 6-5 Summary of the results of the Protected Matters search tool

Liverpool Range Wind Farm	
Threatened Species	25
Migratory Species	14
World Heritage Properties	-
Australian Heritage Sites	-
Ramsar Wetlands	1
Commonwealth Marine Areas	-
Commonwealth land	-
Threatened Ecological Communities	5

EPBC Referral

While ecological investigations consider it unlikely the project will have a significant impact on EPBC listed species, as defined by the *EPBC Act 1999*, an EPBC referral for the project was submitted in February 2014 as a precautionary measure.

On 17 March 2014 the Commonwealth Department of the Environment advised Referral 2014/7136 for the proposed action is considered a controlled action and, as such, requires assessment and a decision on approval under the EPBC Act before it can proceed.

Bilateral agreement

In accordance with subsection 45(4) of the *EPBC Act* and Division 16.1 of the EPBC Regulations 2000, the Commonwealth of Australia entered into a bilateral agreement with New South Wales in December 2013. One of the aims of the agreement is to minimise duplication of environmental impact assessment processes, ensuring a co-ordinated approach for actions requiring approval from both the Commonwealth and the State. As the project has been considered a 'controlled action' under the *EPBC Act* the referral will be assessed by the NSW Department of Planning and Environment.

On 25 March 2014 the NSW Department of Planning and Environment issued a Supplement to the Director General's Requirements seting out the Commonwealths assessment requirements (Matters of National Environmental Significance Terms of Reference) under the EPBC Act.

The proponents response to EPBC matters raised in the Supplementary Director General's Requirements issued by the NSW Department of Planning and Environment on 25 March are addressed in Appendix H attached to this EA.

6.1.12 DEH Supplementary Significant Impact Guidelines 2.1.1: Wind Farm Industry Sector 2005

The purpose of these guidelines is to assist operators in the wind farm industry to decide whether or not actions which they propose to take require assessment and approval under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*).

These guidelines have been considered in the preparation of this EA, particularly with reference to Section 11, Ecology Assessment.

7 Public Consultation

7.1 Community Attitudes

NSW Government Report 'Community Attitudes to Wind Farms in NSW', DECCW, 2010

In 2010 the NSW Government commissioned the report *'Community Attitudes to Wind Farms in NSW'* to assess residents attitudes towards targets set to achieve 20% renewable energy consumption by 2020 (DECCW, 2010c). The survey was conducted by telephone of 2022 resident's aged 18 years and older and 300 businesses across the 6 Renewable Energy Precincts, including the Southern Tablelands and a control area in regional NSW.

The outcomes of the study are as follows:

- Of the total surveyed 81% believed wind power was acceptable for power generation.
- General awareness of wind turbines was very high, with 97% of people having heard about wind farms or wind turbines generating electricity and 81% of the population had seen a wind farm or wind turbine in person or via media.
- The majority (68%) of the population living in these precincts knew about wind farms currently operating in NSW. However, the average of the New England Tablelands Precinct was well below the state average at only 38%.
- Eighty five per cent (85%) of the population across the precincts support wind farms in NSW, with 80% supporting them within their local precinct, and 79% support for a wind farm being built 10 km from their residence.
- A similar trend occurs with business opinion with 88% support for wind farms within NSW, 83% support for a wind farm in the precinct, 82% support for a wind farm 10 km from the residence and 60% support for a wind farm within 1-2 km of the residence.

The NSW Government study concludes that the general adult residents of the survey area are well aware of the potential of wind farms or wind turbines to generate renewable energy. Additionally, the respondents were generally aware of wind turbines and how wind turbines appear within the landscape and are generally supportive. The results further indicated that the respondents were generally not adverse to the development of wind farms in the immediate locality.

CSIRO Report 'Exploring community acceptance of rural wind farms in Australia: a snapshot', CSIRO, 2012

The CSIRO released a report in 2012 exploring community acceptance of wind farms in rural Australia. This research explores community acceptance levels regarding Australian wind farms. The research employed a range of methods, including a literature and information review, a media analysis of newspaper articles, case studies, and semi-structured qualitative interviews with a range of stakeholders associated with wind farms (CSIRO, 2012).

A summary of the outcomes of the study are as follows:

- There is strong community support for the development of wind farms, including support from rural residents who do not seek media attention or political engagement to express their views.
- The actual and perceived local costs and benefits of wind farms are strongly influenced by the design, implementation, and community engagement processes. Many of the benefits can be shared or communicated in ways that would enhance community support for the development of wind farms in a region. Many of the potential costs can be reduced by appropriate design, siting, and project implementation.

Based on the above independent surveys, it is reasonable to assume that the communities within the ACT/NSW Border Areas Precinct are generally supportive of wind farms. However, the surveys showed that a majority of the population did not feel like they had adequate information about wind farms, even in areas where general wind farm awareness was much greater.

7.2 Community Consultation

Wind farm developments and their approvals in Australia have, at times, elicited polarised responses from the community, highlighting the need to appropriately identify and commence consultation with community stakeholders early in the development process.

Prospective wind energy projects in NSW are generally limited to sites with large elevated land parcels, good wind speeds, usually in rural areas, and with good electricity transmission line access. Such sites are relatively rare, and often, these sites are located in the vicinity of rural dwellings and in some cases in the vicinity of small to medium sized regional communities. This can cause conflict where some local community members feel impacted by the development and yet do not see any direct benefits from the development.

While unfortunate, the limited number of appropriate wind farm sites means that this conflict is often unavoidable and cannot be eliminated by simply moving the wind farm to a different location.

Accordingly, community consultation is focussed on understanding and mitigating the impacts of the wind farm, and on showing and maximising its benefits to the local community.

7.2.1 Project Consultation Plan

A Project Consultation Plan (PCP) was prepared by Epuron for the proposal (Attachment 7).

The PCP was prepared to guide stakeholder engagement and consultation activity during the development phase (up to project approval). The plan reflects the corporate requirements set out in Epuron's Community Consultation Framework and the Director Generals Requirements issued for the project by the NSW Department of Planning and Environment.

The PCP is dynamic and can be periodically updated, as required, during the course of the development phase and community engagement activity.

The PCP highlights the key objectives of consultation for the proposal, which are:

- to minimise undue community concern in relation to the proposal, particularly at an early stage where little information on the project is known;
- to ensure the community and other stakeholders are fully informed and aware of the proposal, it's likely impacts, and its likely benefits;
- to ensure that Epuron fully understands the local context for the proposal, including any local impacts that the proposal may have or opportunities that it could provide;
- to incorporate the communities suggestions and feedback into the design of the wind farm where possible;
- to explain where and how this feedback can be, and has been, incorporated; and,
- in that context, to provide multiple opportunities for dialogue in various forms to allow the community to receive information and provide feedback about the proposal.

The approach taken to the project consultation plan was to use a variety of communication channels to achieve the desired objectives. These included:

- access to website containing corporate and project details;
- periodical newsletters;
- media opportunities where available;
- public open house / information day in the local area;
- establishment of a Community Consultation Committee;
- letters to identified residents at a minimum within 2km of a proposed turbine; and
- phone calls and/or individual meetings with landowners at a minimum within 2km of a proposed turbine.

The plan was used to guide consultation during the development of the project. The plan was reviewed and adapted where necessary as community feedback was received so that consultation activities were a pragmatic response to the issues raised by the community.

Key consultation activities included an open house day attended by specialists working on the project, follow-up phone calls, emails and other correspondence, including face-to-face meetings with neighbouring and concerned landowners. A Community Consultation Committee is being established for the project and is expected to meet prior to exhibition of the EA.

7.2.2 Implementation of the Project Consultation Plan

While the majority of the consultation process focussed on informing the community about issues relating to the project, activities to engage the community in two-way dialogue were also undertaken for the purpose of receiving feedback for incorporating community concerns, local knowledge and thereby maximising the suitability of the project to the site and the community's acceptance of the project. A schedule of the key consultation activity undertaken for the project prior to lodgement of the EA is outlined below.

Table 7-1 Schedule of consultation activities throughout the project

Activity	Timing	Objectives	Stakeholders	Status
Website	Ongoing	• Provide information about Epuron and the project to public over the internet • Updated maps, layouts of the wind farm and powerline • Seek feedback and enquiries	• All stakeholders • General public	Completed (but ongoing)
Community information presentation	June 2009	• Introduce Epuron and the proposed wind farm project • Provide accurate information about wind farms • Seek feedback as to key issues from the community • Build trust with the local community	• Involved Landowners • Invited community stakeholders • Coolah District Development Group	Completed
Project Newsletter 1	November 2009	• Introduce Epuron and proposed project to the local community and key stakeholders • Provide feedback on recent activity.	• Involved landowners • Uninvolved stakeholders • General public and interested stakeholders	Completed
Project Newsletter 2	December 2009	• Supplementary project update following the newsletter released in November • Wishing community merry Christmas	• Involved landowners • Uninvolved stakeholders • General public and interested stakeholders	Completed
Project Newsletter 3	May 2010	• Update development activities and progress. • Provide feedback on recent activity.	• Involved landowners • Uninvolved stakeholders on mailing list • General public and interested stakeholders	Completed
Project Newsletter 4	November 2010	• Update development activities and progress. • Provide feedback on recent	• Involved landowners • Uninvolved stakeholders on mailing list	Completed

Activity	*Timing*	*Objectives*	*Stakeholders*	*Status*
		activity.	▸ General public and interested stakeholders	
Project Newsletter 5	February 2011	▸ Update development activities and progress. ▸ Provide feedback on recent activity.	▸ Involved landowners ▸ Uninvolved stakeholders on mailing list ▸ General public and interested stakeholders	Completed
Consult with neighbours of proposed wind turbines (via telephone, email and face-to-face meetings)	Mid 2011	▸ Communications with near neighbours to the proposed development (dwellings within 2km of proposed wind turbine) ▸ Explain potential impacts and benefits of the proposed wind farm ▸ Discuss and arrange further assessment (if required) ▸ Provide accurate information and seek feedback	▸ Uninvolved neighbours	Completed (but ongoing)
Project Newsletter 6	December 2011	▸ Update development activities and progress. ▸ Provide feedback on recent activity.	▸ Involved landowners ▸ Uninvolved stakeholders on mailing list ▸ General public and interested stakeholders	Completed
Establish Community Consultation Committee	May 2012	▸ Commitment to establish CCC ▸ Call for member nominations ▸ Identify independent chair ▸ Prepare to hold meeting	▸ Independent chairperson ▸ Local Councils ▸ Involved landowners ▸ Uninvolved landowners ▸ Community groups ▸ Proponent	Completed (but ongoing)
Project Newsletter 7	May 2012	▸ Announced and displayed revised wind farm and powerline layouts ▸ Update development activities and progress. ▸ Provide feedback on recent activity.	▸ Involved landowners ▸ Uninvolved stakeholders on mailing list ▸ General public and interested stakeholders	Completed
Project Newsletter 8	October 2012	▸ Outlined changes to Part 3a projects ▸ Update development activities and progress. ▸ Provide feedback on recent activity.	▸ Involved landowners ▸ Uninvolved stakeholders on mailing list ▸ General public and interested stakeholders	Completed

Activity	*Timing*	*Objectives*	*Stakeholders*	*Status*
Community Open House	November 2012	▸ Update on development status ▸ Release of current layouts ▸ Outline preliminary results from expert studies where completed ▸ Display preliminary photomontages ▸ Provide accurate information and seek feedback	▸ Involved landowners ▸ Uninvolved neighbours ▸ Community stakeholders ▸ General invitation to interested parties	Completed
Pre DA submission follow up	November 2012	▸ To consider any project feedback and incorporate any final amendments prior to lodging EA for assessment	▸ Involved landowners ▸ Uninvolved neighbours ▸ Community stakeholders	Completed
CCC meeting 1	February 2013	▸ First community consultation committee meeting ▸ Introducing members and role of the CCC ▸ Providing details about project	▸ Invited CCC members ▸ Community observers	Complete
Project Newsletter 9	May 2013	▸ Project update including layout optimised to 288 turbines ▸ Details of first CCC meeting and request for feedback ▸ General industry information including sound and health	▸ Involved landowners ▸ Uninvolved stakeholders on mailing list ▸ General public and interested stakeholders	Complete
CCC meeting 2	June 2013	▸ Update project details ▸ Maps of wind farm layout and powerline ▸ Outline project benefits	▸ Invited CCC members ▸ Community observers	Complete
Proponent and landowner consultation meetings	July 2013	▸ To discuss wind farm and powerline layout with involved landowners ▸ Inform and consult with uninvolved neighbours ▸ OEH Information Kiosks	▸ Involved and uninvolved landowners proximate to the project ▸ General stakeholders	Complete
CCC meeting 3	August 2013	▸ Update project details ▸ Photomontages of wind farm layout and powerline ▸ Discussion of benefits, opportunities to community and proposed community enhancement fund	▸ Invited CCC members ▸ Community observers	Complete

Activity	Timing	Objectives	Stakeholders	Status
Coolah and Cassilis Business Meeting	November 2013	‣ Update community about project ‣ Advise employment and investment opportunities ‣ Seek capability information from businesses and employees	‣ Invited Coolah and Cassilis business representatives ‣ Invited CCC members ‣ Community observers	Complete
CCC meeting 4	November 2013	‣ Update project details ‣ Updated photomontages of wind farm layout and powerline ‣ Discussion of benefits, opportunities to community and proposed community enhancement fund	‣ Invited CCC members ‣ Community observers	Complete
CCC Meeting 5	April 2014	‣ Update project details ‣ Further Discussion of community enhancement fund ‣ Discussion of next stages once project on exhibition	‣ Invited CCC members ‣ Community observers	Complete

Community Open House

The community open house forum allows the opportunity for members of the community to speak individually or in small groups to the Proponent representatives and to persons undertaking parts of the EA. The open house format is helpful in avoiding potential conflict in a public meeting for contentious issues, allowing a flow of stakeholder dialogue throughout the event rather than a more constrained discussion that can be hijacked by the most vocal individuals. It allows for a larger proportion of stakeholders to voice their individual concerns with the relevant representatives in a less confrontational situation. It also allows the presentation of issues and information to be tailored to individual queries.

The community open house session for the project was held on 1 November 2012 at the Cassilis Bowling Club. A community newsletter, distributed to residents, preceded the event that was also advertised in the local newspapers beforehand.

The event ran from 2:00pm to 7:00pm and representatives from the Proponent, including the specialist visual consultant, were present to discuss the project specifics (including general questions about wind farms and wind farm development) and the environmental planning process.

The objective of the open house day was to display current project information and to seek feedback that would ultimately contribute towards preparation of the final design and wind farm layout.

On the day 73 people attended the event, primarily local residents within the vicinity of the wind farm, as well as community stakeholders. Outcomes and statistics observed from the event included;

- of the 73 people in attendance, the majority (approximately 54) were supportive of the project;
- approximately 19 people were opposed or expressed negative views to the project or wind farms in general;
- more than 20 people asked for follow up information to be sent to them or arranged for a follow up meeting; and
- 6 people/companies registered their interest in future construction jobs and tender contracts.

Details of the proposed wind farm project that were on display included:

- latest wind farm and powerline layouts showing the planned locations of wind turbines and other associated infrastructure including construction compounds, substations, overhead powerlines, underground cables and access tracks;
- photomontages showing the likely view of the completed wind farm from 4 public road locations around the site;
- general wind farm, industry and corporate information; and
- copies of recent project newsletters.

Notable observations or comments made on the day included:

- a number of attendees expressed interested in the various environmental studies underway and the proposed management plan necessary during construction phase.
- Most people were interested in viewing the photomontages to gain an understanding of the visibility of the project from public road routes such as Coolah to Cassilis.
- A few people were concerned about the potential noise, health and property value impacts that may result from the operation of the wind farm. Copies of the following reports were on hand during the open day as reference for people to view on these two matters and to alleviate any concerns in this regard
  - NSW Valuer General – Impact of Wind farms on Property Values – August 2009
  - NHMRC (National Health & Medical Research Council) Review of Wind Turbines & Health – July 2010
- Some people located away from the wind farm site were interested to view details about the new overhead powerline heading south to the Ulan connection point.
- A number of people expressed their support for the project and the potential benefits available to the local area (such as jobs and investment), including general support for renewable energy and wind farms. In particular benefits that would flow to the local towns of Cassilis and Coolah were seen as a positive boost for the area.

Epuron was pleased with the overall positive response and feedback received during the open house day. The opportunity to engage with the local community was greatly appreciated.

Figure 7-1 Liverpool Range Wind Farm Community Open Day at Cassilis Bowling Club

Community Business Meeting

On 20 November 2013 a meeting of local businesses from the Coolah and Cassilis communities was held at the Coolah Sports Club. The meeting was an initiative arranged by local business, supported by Epuron and OEH, and there were 46 people in attendance. The purpose of the meeting was to discuss the potential benefits available from construction of the project and how local businesses could participate and capture benefit. The meeting was facilitated by the CCC chairperson and speakers on the evening included local businesses, OEH representative and the proponent (Epuron). The meeting was received enthusiastically and local businesses were keen to ready themselves to capture a share of the local investment and employment opportunities available when the project proceeded to construction.

Face-to-face consultation

A common criticism of major project developers is a lack of consultation with surrounding neighbours. While newsletters, websites and open houses forums are effective at engaging with the wider community, there is no guarantee that this information will be received or interpreted correctly by everyone.

Epuron has taken this on board in designing the project consultation plan and has placed an importance on consultation with the immediate neighbours of the project. During the feasibility phase of the project representatives from Epuron identified all landowners that reside within a few kilometres of the project, particularly those residents within 2 km of a proposed turbine, and proceeded to make contact for consultation purposes. In most cases this involved an initial phone conversation, visit to the property or a letter box drop to introduce the proponent and the project. Usually a face-to-face meeting or discussion followed to provide additional detail about the project and to answer any questions. Landowner contact details were entered on the Epuron database to enable follow up dialogue and for future information about the project to be sent to landowners when required.

Uninvolved landowners with a dwelling within 2 km

Consistent with corporate requirements set out in Epuron’s Community Consultation Framework and in consideration of the draft NSW Wind Farm Planning Guidelines, Epuron specifically focussed consultation efforts on those uninvolved landowners identified to have a dwelling within 2 km of a proposed wind turbine.

As set out in the DGR’s and the DPI correspondence, consultation obligations and scope with this uninvolved landowner group included, but was not limited to, potential impacts around landscape and visual amenity issues, noise, health, property values, blade glint and shadow flicker. These landowners were also offered a photomontage from their dwelling to show what the wind farm would look like, and if accepted, a photomontage was prepared and forwarded to the landowner at the EA lodgement stage.

Under the project consultation plan this group of uninvolved landowners were identified early on and actively contacted for an initial discussion. Wherever possible further engagement followed which included a meeting and or written correspondence to ensure information and feedback about the project was communicated in both directions with landowners or those occupants renting/living in the dwelling.

There are 2 uninvolved landowner dwellings that have been identified as being located within 2 km of a proposed wind turbine.

The following table lists the identified uninvolved landowner dwellings and the consultation activity undertaken. These landowners are also shown in Figure 7-2.

Table 7-2 Consultation activity with uninvolved landowners with a dwelling within 2 km

Residence ID	Newsletter List	Telephone Contact	Face to Face Meeting	Written Correspondence	Photomontage Offered & Accepted
G6-2	yes	yes	yes	yes	yes & yes
H7-1	yes	yes	yes	yes	yes & yes

Involved landowners with a dwelling within 2 km

There are 21 involved landowners, some of which have been identified to have a dwelling located within 2 km of a proposed wind turbine. This group was actively consulted in accordance with the project consultation requirements and have wind farm agreements in place for participating in the project.

Residents outside 2 km

Landowners and residents outside the 2 km dwelling consultation zone were engaged and consulted with as necessary and any feedback received was incorporated where possible. Landowner details were entered on the mail-out data base to receive correspondence such as newsletters and meetings/discussions were held with them as required.

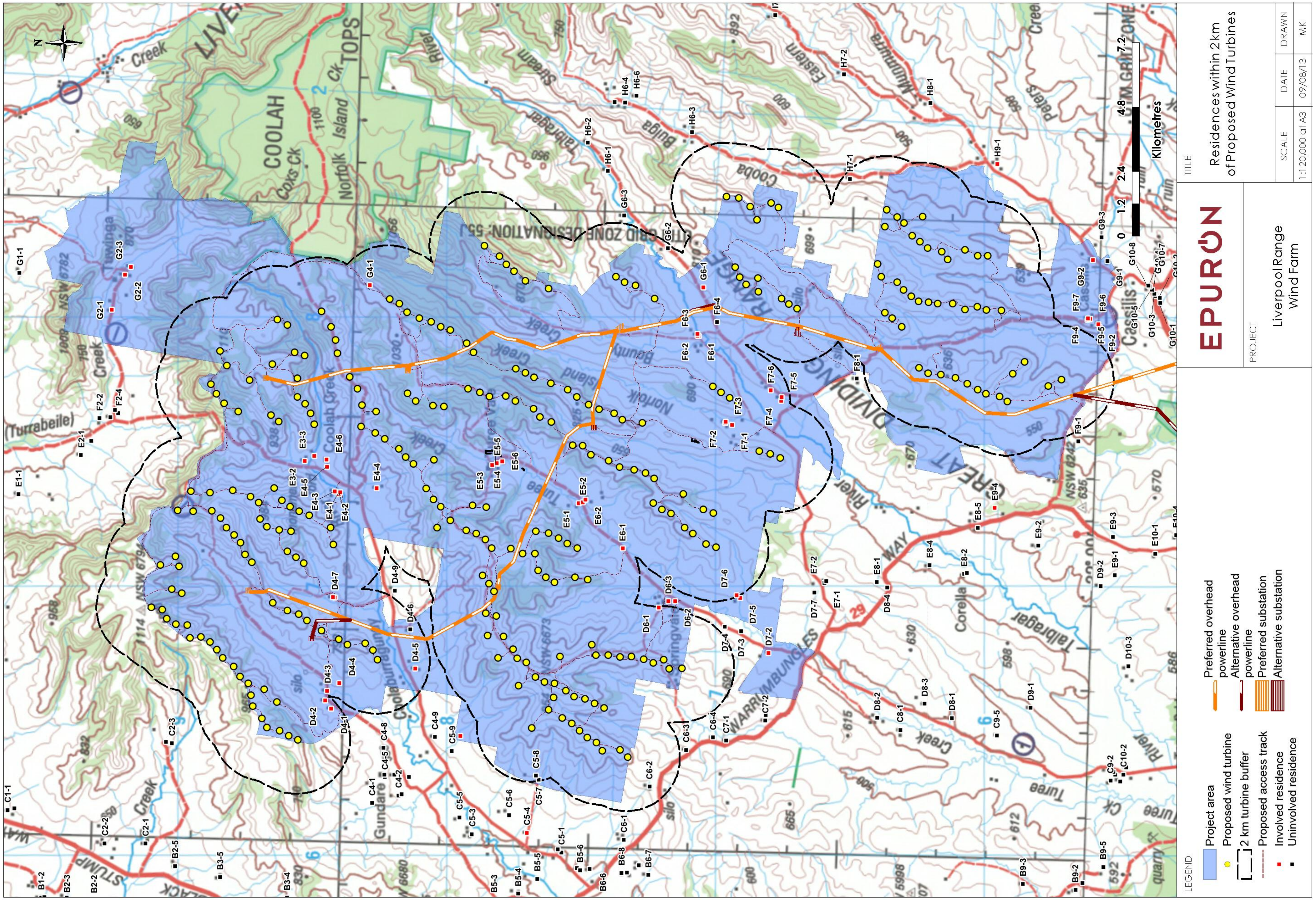


Figure 7-2 Involved and uninvolved residences within 2 km

Newsletters

Newsletters have been used throughout the development process as a means of informing the local community about the project, announcing upcoming activity and progress of development phases, as well as any status updates that may be relevant when milestones are achieved. Newsletters were also used to advertise events such as the open house, where people were invited to come and ask questions and provide feedback on the project, and to seek feedback on the proposal.

Newsletters are distributed by mail and / or email to all residents on the project database and generally cover those properties within a few kilometres of the project. Newsletters are also distributed to identified absentee landowners and broader community stakeholders such as councils and local groups. Newsletters are also available on the project website, are delivered to letter boxes in the general area and handed to stakeholders during consultation meetings.

Newsletter 1 - The first newsletter introduced the project in November 2009, introducing Epuron and the Liverpool Range Wind Farm project area and advising residents of opportunities for community input, including recent sponsorship of the "Tour de Coolah" event.

Newsletter 2 – As a follow-on supplement to the first newsletter, a second newsletter was released just prior to Christmas in December 2009. The newsletter provided some updated project information and wished the community a merry Christmas.

Newsletter 3 - The third newsletter in May 2010 provided a summary of the development activities underway including an update on the sites wind resource analysis and a preliminary ecological assessment. The newsletter also announced the preferred grid connection point at the existing 330 kV Wollar to Wellington transmission line to the south of the wind farm site.

Newsletter 4 - In November 2010 a project newsletter was released providing updated project information including lodgement of the project application requesting DGRs. Epuron outlined early consultation requirements and activity and requested feedback for the community and other stakeholders.

Newsletter 5 – The newsletter in February 2011 primarily announced the lodgement of the Part 3a planning application with the department of planning and provided an overview of the planning process. The newsletter also outlined the project scope and current activity including an update on grid connection.

Newsletter 6 - In December 2011 Epuron was pleased to announce receipt of the DGRs for the project and the launch of its new website. An overview of the project consultation plan was provided and indicated where the community could be involved in the development and provide its feedback.

Newsletter 7 – A seventh newsletter was released in May 2012 and announced Epuron's commitment to establish a Community Consultation Committee. A CCC nomination form was also enclosed with the newsletter calling for community members to participate. An update on grid connection was also provided.

Newsletter 8 – In October 2012 an eight newsletter was released to update the community on the government's legislative change to fast track Part 3a projects requiring lodgement by 30 November. The newsletter announced a public open day to display project information and called for feedback in finalising the design. Updated maps of the wind farm and powerline development areas were provided including the study program necessary to meet the government's targets.

Newsletter 9 – The ninth newsletter released in May 2013 informed the community about the submission of the EA and provided a copy of an updated wind farm and powerline layout (turbines optimised from 417 to 288). An update on CCC activity was provided including some general wind industry news around sound, health and a wind farm fire related matter in SA.

Further newsletters will continue to be provided to the community, including a newsletter to advise the Community of the submission and exhibition of the EA, and to indicate where the reports can be viewed by the public and to thank the community for their participation to date.

Copies of all relevant community consultation material including the project consultation plan, surveys, community newsletters, media releases, presentations and letters received from key stakeholders are included within Attachments 7 & 8.

Community Consultation Committee

Consistent with corporate requirements set out in Epuron's Community Consultation Framework and in consideration of the draft NSW Wind Farm Planning Guidelines, Epuron has committed to the establishment of a Community

Consultation Committee (CCC) for the project. In May 2012 a CCC member nomination form was distributed seeking expressions of interest from willing community participants wanting to sit on the committee. Epuron received a number of nominations from the community and the required committee membership were appointed including representatives from local councils. Four CCC meetings have been held at local venues up to the EA lodgement stage and have been chaired by an independent chairperson.

The purpose and objectives of the CCC are:

- to enable Epuron to formally provide the local community with information about the proposal;
- to enable the community to express and for Epuron to understand any concerns regarding the potential impacts of the proposal;
- to enable Epuron to consider whether and how to incorporate any suggestions and feedback into the design of the proposal;
- to demonstrate how and where feedback has been incorporated and resulted in amendments to the proposal;
- to formally advise potential community benefits that can be integrated into the proposal; and,
- to establish and strengthen good working relationships between the proponent and the local community.

While individual membership of the CCC is likely to change from time to time, the committee membership generally comprises representation from the following groups within the community, where available;

- an independent chairperson;
- two involved landowners;
- two uninvolved landowners;
- a representative local community group;
- a representative from each of the four local councils (Liverpool Plains, Mid-Western Regional, Upper Hunter & Warrumbungle Shire);
- observer participation by OEH; and
- the proponent (Epuron).

Around 8-10 members attended each CCC meeting and generally represent one of the above groups.

During the development phase the CCC met on four occasions at local venues in Cassilis and Coolah. Copies of the meeting presentation material, minutes of the meetings and CCC members in attendance are made available to the public on the project website and are included within Attachment 7. A summary of proceedings and key outcomes from meetings are also outlined in project Newsletters and media releases locally.

- meeting 1 – 28 February 2013 in Cassilis;
- meeting 2 – 3 June 2013 in Cassilis;
- meeting 3 – 13 August 2013 in Cassilis; and
- meeting 4 – 21 November 2013 in Coolah

Epuron would like to sincerely thank those people who participated in the CCC meetings and contributed feedback about the project on behalf of the community. This exchange of information fed into the wind farm layout and design process wherever possible.

The CCC reviewed and discussed a wide range of matters and material relating to the project. The key feedback points provided by the CCC based on these matters, and how that feedback was considered or incorporated into the project, is set out in the following table (in no particular order of importance).

Table 7-3 Key issues raised during the Community Consultation Committee meetings

Issue	*CCC Feedback Provided*	*How Considered or Incorporated into Project*
Increases community awareness and access to project information.	Members require the community be provided with CCC consultation information regarding the project on a regular basis to increase awareness and provide further avenues for	After each CCC meeting the following local media outlets are provided with a summary of the meeting outcomes and discussion information so that interested community

Issue	CCC Feedback Provided	How Considered or Incorporated into Project
	feedback.	stakeholders can keep abreast of project progress and or provide feedback if desired. Merriwa Ringer Coolah Diary
Consider impacts on local roads used for access during construction including repair and maintenance requirements.	Members asked that local councils review and have input to the Traffic and Transport Plan. It is important that the selected access roads/routes are appropriate and any impacts on local roads are considered.	The Traffic and Transport Plan (TTP) was made available to councils and was also appended to the submitted EA which was reviewed by local councils. The following key feedback points received from council have been incorporated/addressed in the EA and or TTP. Upper Hunter – Concern for impact to their local council roads and require preconstruction negotiation with proponent to ensure they are not adversely affected. This has been clarified in the TTP/EA. Council will make a formal submission during exhibition of the EA. ▸ Mid-Western Regional – Require the submission of a road dilapidation report prior to the commencement of construction including implementation of a monitoring and repair program. This has been clarified in the TTP/EA. Council will make a formal submission during exhibition of the EA. Liverpool Plains – Councils concern for impacts to their "local road assets" have been noted. This has been clarified in the TTP/EA. It should also be noted that with the revisions to the layout that no council roads are used/impacted. Only one proposed turbine remains on private land in the LGA. Warrumbungle – Council has concerns the impact on local roads may be understated. The TTP has been updated to provide council with more detailed information.
Roadwork construction contracts.	Members from council, particular Warrumbungle, expressed an interest to tender for any roadwork contracts associated with construction of the project.	Epuron has entered council details on the construction contractor's database for the project to be notified when any roadwork tenders are available for quotation.
Community Enhancement Funding……."During consultation and discussions the CCC *has been seeking community feedback on;* *1. How best to establish a community enhancement fund; and to* *2. Identifying what type of local support is required from the project.*	1. How best to establish a community enhancement fund. ▸ Councils generally prefer that if a community enhancement fund is established it is more effective to be managed by them (local councils). ▸ Community wants to have a say in where and how any community funds are managed and spent. It is preferred a local group or trust (or part of CCCs ongoing role) be established to manage allocation of funds. ▸ Draft Wind Guidelines say community contributions may be required under the EP&A Act 1979 or through a voluntary planning agreement.	Following consultation feedback Epuron outlined its position, generally as follows, to the CCC regarding the establishment of a community fund for the project and the type of support required from the project; ▸ Epuron designs its wind farms to minimise impacts to the environment and local community. ▸ Each project should be assessed by the consent authority specifically on its merits and not by funding influences to the community. ▸ Epuron strongly believes in the value of community contributions and believes that the final investor who will commit funds to the construction and operation of the

Issue	CCC Feedback Provided	How Considered or Incorporated into Project

	- Existing community funds where implemented for other wind farm projects have been considered and established through combinations of the above mechanisms.
	
	2. Identifying what type of local community enhancement funding support is required from the project.
	- Improve tourism attraction and information facilities in the local towns.
	- Opportunity to revitalise Cassilis.
	- Improvements to the townships of Coolah and Cassilis and better local amenities.
	- Chance to reopen some businesses or support existing businesses.
	- Provide attraction to keep younger people and families in the local area through long term benefits and job creation.
	- Support for improving local educational and training capabilities locally, such as apprenticeships and TAFE teaching.
	- Increase local accommodation and aged care facilities.
		project should engage with the community in a meaningful way.
		- Epuron believes that such community contributions should be:
		  ○ applied towards local environmental, social and community initiatives led by local residents and community stakeholders;
		  ○ directed to initiatives raised by residents and stakeholders proximate to the development or likely to be impacted;
		  ○ established at the commencement of operations and continued for the life of the development; and,
		  ○ regularly reviewed to ensure they are providing ongoing benefits to the community.
		- Epuron considers that the CCC working with the developer and ultimate project owner is ideally placed to help develop a community fund and its administration process.
		- Epuron, like most wind farm proponents, is not the ultimate project owner and accordingly it is not appropriate for Epuron to determine the final details of any community fund.
		- Accordingly, at this stage Epuron has not proposed any specific amount payable to any community fund in its development application. However, it will commit to an ongoing consultation process to determine an appropriate basis for the establishment of a community fund.
		- The EA's Statement of Commitments will set out the community fund details.

Public display of photomontages and wind farm layouts.	Members requested selected public road photomontages and the wind farm layouts be made available locally in large scale format for the public to view and provide their feedback. The CCC clarified that as set out in the draft wind guidelines that the proponent will offer to prepare a photomontage for all uninvolved landowners with a dwelling within 2km of a proposed turbine.	The proponent provided 2 sets of selected public road photomontages and the wind farm layouts (mounted of board) for public display at venues in Cassilis and Coolah. All uninvolved landowners who have a dwelling within 2km of a wind turbine have been offered, and where accepted by the landowner, provided with a photomontage at the EA lodgement stage.
Information displayed on maps and layouts.	Mudgee District Environment Group (MDEG) asked that local roads be better displayed on maps and layouts including a local landmark called "The Drip".	The proponent updated all maps and layouts to display the local information more clearly in the future.

Media

Various forms of media have been utilised for communicating details about the project. Information articles have appeared in the local newspapers from time to time including advertisements for events such as the community open house.

After each CCC meeting the following local media outlets are provided with a summary of the meeting outcomes and discussion information so that community stakeholders can keep abreast of project progress.

- Merriwa Ringer
- Coolah Diary

The CCC plans to extend this media notification to the Mudgee Guardian following future meetings.

Epuron's corporate website is also available for viewing company and project details at www.epuron.com.au.

7.3 Government Consultation

7.3.1 Initial meetings

The proponent began consultation with the consent authority, the NSW Department of Planning and Environment (previously Department of Planning and Infrastructure), from around mid-2010, introducing the project and seeking advice on the assessment process.

During the development process the proponent and their consultants liaised with governmental stakeholders including:

- Neville Osborne and Diane Sarkies, NSW Department of Planning and Environment;
- Pauline Dunn, Regional Coordinator NSW Renewable Energy Precincts, Office of Environment and Heritage, Department of Premier and Cabinet.
- Robert Taylor, David Geering and Mark Irvine from the Dubbo office of NSW Office of Environment and Heritage regarding biodiversity and cultural heritage matters.
- Four involved Local Councils, Liverpool Plains Shire, Mid-Western Regional, Upper Hunter Shire and Warrumbungle Shire, including their participation in the Community Consultation Committee.
- National Party Policy Committee, Chaired by Mike Blake, including a presentation and a wind farm site visit.

7.3.2 Key Stakeholders

Planning for the development of the Liverpool Range Wind Farm has included specific consultation with the stakeholders listed in Table 7-4.

Consultation with stakeholders has occurred through a variety of means including phone conversations, face-to-face meetings, email and letter correspondence and in some cases attendance at local information days.

Through the feasibility and design stages of the project, consultation has involved the proponent informing the relevant stakeholders of the project details and seeking advice to enable the design of the wind farm and to reduce potential impacts to the existing environment. Specific issues raised by these stakeholders have been discussed within the relevant Sections of this EA. The consultation process will continue through the development and operation of the wind farm.

Table 7-4 Key stakeholders

Sector	Organisation or Group	Contact Person	Telephone Contact	Face to Face Meeting	Written Correspondence	Newsletter List	Summary of Key Feedback Provided	How Considered or Incorporated into Project	Where addressed in the EA
Local Community	Local community including involved and uninvolved landowners	Stakeholder database	Yes	Yes	Yes	Yes	A wide range of matters have been discussed with the local community including the involved and uninvolved landowners. The key themes from these discussions generally centred on provision of current project information, layouts, maps, industry issues and explanation of potential impacts including noise, health, visual and property values.	The community including involved and uninvolved landowners have been consulted in line with the Draft NSW Wind Guidelines and the Supplementary DGRs. Newsletters are released regularly to provide the local community and landowners with up to date project information, including maps and layouts. Follow up meetings are held with stakeholders as required and any feedback received has been considered and or incorporated where possible.	Section 7
	Community Consultation Committee (CCC)	Danielle Annells, Independent Chairperson	Yes	Yes	Yes	Yes	The CCC raised a number of community and stakeholder issues for consideration by the project including establishment of a community enhancement fund and provision of consultation information.	The project has addressed a number of issues raised by the CCC and distributed a wide range of information by methods including discussion, website, newsletter and media.	Section 7
Local Government	Warrumbungle Shire Council	Michael Marks, Manager Regulatory Services	Yes	Yes	Yes	Yes	Correspondence from council and follow up consultation has identified the following key areas of concern regarding the project; 1. Potential effect on Three Rivers Community Radio transmission service located near Coolah. 2. Effect the projects construction will have on local roads. 3. Establishment of a VPA preferred over a community fund. 4. Concern the noise assessment is not being calculated using the actual	Matters raised by council have been considered and incorporated where possible. 1. Consultation has occurred with Three Rivers Community Radio and requirements considered in layout. 2. The Traffic and Transport Plan has been updated to provide more detail. 3. The project has committed to establish a community fund instead of VPA. 4. Noise assessment has been updated regarding predicted noise from	Section 14.2 Section 13 Section 7 Section 10

Sector	Organisation or Group	Contact Person	Telephone Contact	Face to Face Meeting	Written Correspondence	Newsletter List	Summary of Key Feedback Provided	How Considered or Incorporated into Project	Where addressed in the EA
							turbines to the used.	selected turbines.	
	Mid-Western Regional Council	Catherine Van Laeren, Group Manager Planning and Development	Yes	Yes	Yes	Yes	Correspondence from council and follow up consultation indicates they are committed to critiquing the EA in more detail during exhibition but have provided the following comments to date; 1. Clarification as to whether temporary workers accommodation will be established during construction. 2. Preference for Section 94 Developer Contributions to manage road funding. 3. More detail regarding selection of offset land. 4. Provision of minutes from Community Consultation Committee meetings.	Matters raised by council have been considered and incorporated where possible. 1. Temporary workers accommodation is not proposed during construction as workforce will be hosted across accommodation available in local communities. 2. The project commits councils (roads) will not be worse off by the project and is discussing scope and funding requirements for road works. 3. The Biodiversity Assessment discusses offset requirements in detail. 4. Minutes from CCC meetings are placed on proponent's website and provided to all members.	Section 13 Section 11 Section 7
	Upper Hunter Shire Council	Sean Constable, Manager Economic Development and Tourism	Yes	Yes	Yes	Yes	Correspondence from council and follow up consultation indicates they will make a more detailed submission during exhibition of the EA but have provided the following initial comments;	Matters raised by council have been considered and incorporated where possible. 1. The Traffic and Transport Plan has been updated to provide more detail.	Section 13

Sector	Organisation or Group	Contact Person	Telephone Contact	Face to Face Meeting	Written Correspondence	Newsletter List	Summary of Key Feedback Provided	How Considered or Incorporated into Project	Where addressed in the EA
							1. Impact of wind farm on local roads. 2. Establishment of VPAs for management of road funding requirements.	2. The project commits councils (roads) will not be worse off by the project and is discussing scope and funding requirements for road works.	Section 13
	Liverpool Plains Shire Council	Donna Ausling, Manager Planning and Development	Yes	Yes	Yes	Yes	Correspondence from council and follow up consultation indicates a need for more information regarding the following points of concern; 1. To facilitate community engagement during the public exhibition process. 2. Improved presentation of maps. 3. More useable information regarding the schedule of affected lands. 4. More detail regarding the traffic and transport assessment.	Matters raised by council have been considered and incorporated where possible. 1. A number of communication channels have been established for the project to facilitate community engagement including website, newsletters, meetings, CCC, email and community open days. 2. All maps and figures have been reviewed and updated to make information clear where possible. 3. A detailed set of maps has been added to the schedule of affected lands. 4. The Traffic and Transport Plan has been updated to provide more detail.	EA Attachment 1 Section 13
NSW	Office of Environment	Robert Taylor, Manager	Yes	Yes	Yes	Yes	OEH have been consulted regarding biodiversity and heritage requirements	The Biodiversity Assessment and Heritage assessments have been updated to reflect	Sections 11 and 12

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Sector	Organisation or Group	Contact Person	Telephone Contact	Face to Face Meeting	Written Correspondence	Newsletter List	Summary of Key Feedback Provided	How Considered or Incorporated into Project	Where addressed in the EA
Government Agencies	and Heritage (OEH)	Regional Operations and David Geering, Senior Officer Dubbo					including site survey program.	OEH comments to DGR's and EA feedback consultation.	
	Roads and Maritime Service (RMS)	Andrew McIntyre, Manager Western Region	Yes	No	Yes	Yes	Correspondence from RMS and follow up consultation highlighted areas where RMS requires more information in the Traffic and Transport Plan. These matters include costs road upgrades, details around alternate routes, assessment of operational traffic and cumulative traffic impacts.	The Traffic and Transport Plan has been updated and considered and or incorporate matters raised by RMS.	Section 13 and Appendix E
	NSW Rural Fire Service (RFS)	Stuart Midgley, Director Operational Services	Yes	No	Yes	Yes	RFS was consulted regarding operational fire matters relating to wind farms.	The design and layout of the wind farm has considered fire related matters and feedback from RMS.	Section 14.5
	Department of Primary Industries	Greg Paine, Manager Planning, Policy and Business Services	Yes	No	Yes	Yes	Office of Water – EA is adequate Fisheries NSW – EA is adequate Forests NSW – EA is adequate Agriculture NSW – EA is adequate	The design and layout of the wind farm has considered feedback from Department of Primary Industries.	Section 3
	Department of Primary Industries	Elizabeth Burke, Group Manager Central Region	Yes	No	Yes	Yes	Crown Lands. Crown Lands were consulted regarding access and use of Crown Lands relating to the wind farm. Preapproval required prior to any use or occupation Requirement to licence use or occupation	The design and layout of the wind farm has considered feedback from Crown Lands.	Section 3.11
	Trade and	Gary Burton,	Yes	No	Yes	Yes	Correspondence from the Resource and	Consultation has occurred with identified	Section

Sector	Organisation or Group	Contact Person	Telephone Contact	Face to Face Meeting	Written Correspondence	Newsletter List	Summary of Key Feedback Provided	How Considered or Incorporated into Project	Where addressed in the EA
	Investment	Senior Geologist Orange					Energy division raises no concerns with the EA but requests consultation details with mineral and petroleum exploration companies be included in the EA.	mineral and petroleum exploration companies. The design and layout of the wind farm has considered feedback from these companies.	16.3
	Catchment Management Authorities	Various	Yes	No	No	Yes	Relevant catchment management authorities are Central West, Namoi and Hunter Central Rivers. Discussion held with environmental consultant prior to undertaking survey work to establish overall biodiversity issues and identify land attributes relevant to development of the project.	Consultation has occurred with identified CMAs and the design and layout of the wind farm has considered following feedback. Key consultation issues considered during development of the wind farm include impacts on nearby IBRA Subregions, grazing management practises, salinity, vegetative clearance, pests and weeds.	
Federal Government Agencies	Department of Defence	Gary Lee	Yes	No	Yes	Yes	Correspondence from the Department of Defence and follow up consultation advised no objection to the proposal subject to the implementation of certain safety precautions and CASA review of the aviation assessment.	The design and layout of the wind farm has considered feedback from the Department of Defence.	Section 14
	Department of Sustainability, Environment, Water, Population and Communities	Frances Daniels, Assessment Officer	Yes	No	Yes	Yes	Consultation has occurred with the Referrals Branch at the Department SEWPaC regarding matters relating to the EPBC Act and the project.	A separate referral will be lodged under the EPBC Act prior to the commencement of construction.	Section 6.2
Other organisation or group	TransGrid	Sean Buggy, Customer Access and Relationship Manager	Yes	Yes	Yes	Yes	Consultation has occurred with Transgrid to assess grid connection. A connection enquiry has been lodged.	Grid technical requirements have been incorporated into the substation / electrical design. Technical assessments and the connection enquiry continues to be progressed with Transgrid.	Sections 3.4, 3.5 and 4.6
	Civil Aviation Safety Authority	Slavica Despotovic,	Yes	No	Yes	Yes	CASA feedback requested contact with Warrumbungle Shire Council to obtain OLS	Contact has been made with council and OLS data has been provided for Coolah	

Sector	Organisation or Group	Contact Person	Telephone Contact	Face to Face Meeting	Written Correspondence	Newsletter List	Summary of Key Feedback Provided	How Considered or Incorporated into Project	Where addressed in the EA
		Aerodrome Inspector					data as council is operator of the Coolah Aerodrome.	Aerodrome and considered in design and layout.	
	Airservices Australia	Jessica Neidert, Airport Development Assistant	Yes	No	Yes	Yes	ASA feedback advised guidelines for wind farm are in development and will require an aviation assessment to be sent to ASA.	• Subject to the outcome of the ASA guidelines an aviation assessment will be prepared and issued to ASA prior to construction works.	
	Aerial Agricultural Society of Australia	Phil Hurst CEO –	No	No	Yes	Yes	Feedback is that AAAAs formal policy position on all wind farm developments and wind monitoring towers is to automatically oppose such developments.	Epuron will continue to keep AAAA informed about project details.	Section 14

8 Approach to Environmental Assessment

The approach to this Environmental Assessment was developed and submitted for the Preliminary Environmental Assessment (PEA), which accompanied the project application sent to the Department of Planning and Environment on the 11 February 2011. During the assessment the approach was expanded to include a wider range of issues as they were identified, however it has largely remained as described in the PEA.

8.1 Initial General Risk Analysis

The following section outlines the key issues in relation to the Liverpool Range Wind Farm, and summarises Epuron's approach to addressing each issue. As a general rule, in undertaking this assessment:

- Issues identified as "Key Issues" will be addressed through use of an independent expert assessment together with specific on-site assessment and field work.
- "Additional issues" will be addressed, where necessary, via desktop assessment, precedent and consultation.

The focus on this delineation is to ensure that every issue is adequately addressed considering the potential risks and impacts associated with the issue, and without burdening the EA with details which are unlikely to affect the ultimate assessment of the project.

Epuron has carried out a risk analysis based on the requirements of the DGRs and information collected to date on site, at nearby sites, generally within the region and based on similar proposals in other regions.

In relation to each risk, Epuron has established a priority which takes into consideration:

- the level of information already available about that issue;
- the extent to which site specific assessment is required to define that issue;
- the likelihood of that issue occurring, and potential impacts of that issue if it did occur; and
- the extent to which standard industry practice, statutory requirements, and standard consent conditions adequately address the issue.

The results of this general risk analysis can be seen in Table 8-1. The model considers the key assessment requirements from the DGRs and the nature of the potential impact on them (i.e. is it temporary, reversible, likelihood of secondary impacts), the receiving environment and the likelihood of the impact occurring. The assessment strategy was then determined based on the overall risk rating for each issue.

Where the overall risk rating was very low and where the issues have previously been assessed in relation to wind farms in general and have been demonstrated to not affect the assessment or the consent conditions, no further assessment was carried out.

Where the risk rating was moderate or high this risk has then been reassessed following the application of available avoid, manage, mitigate and offset measures.

Table 8-1 Risk analysis of issues

Aspect	Potential Impacts	Likelihood	Consequence	Unmitigated Risk	Proposed Management	Mitigated Risk
Visual						
Visual impacts of turbines	Visual impact of turbines on the local community and significant vistas	Almost Certain	Minor	High	Removal of 32 turbines due to potential visual impacts The visual impact of the project has been assessed in Section 9 and vegetative screening can be implemented at landowner residences that are in areas of high visual sensitivity.	Low – moderate
Visual impacts of infrastructure	Visual impact of supporting infrastructure on the local community and significant vistas	Possible	Minor	Moderate	Permanent supporting infrastructure will generally be located away from the community. Temporary infrastructure will be as unobtrusive as possible and will be removed after construction. Overhead powerline will be located away from houses where possible but visible from some sections of public roads	Low
Shadow flicker	4 dwellings have been assessed to experiences shadow flicker, of which none are predicted to exceed the limitations.	Likely	Minor	High	4 turbines were removed due to the potential of shadow flicker Appropriate mitigation measures will be negotiated and implemented, where necessary, including potential limiting hours of operation on selected turbines. The impact of shadow flicker has been assessed in Section 14.4	Low
Blade glint	Sun reflecting off blades at certain times causing annoyance to local community and distraction to road users	Possible	Moderate	High	Modern turbine blades have been designed to limit reflections with the use of non-reflective finishes. The impact of shadow flicker has been assessed in Section 14.4	Low
Cumulative impact within the area	Other wind farm developments in the vicinity compounding the above stated impacts to local community	Possible	Minor	Moderate	Consider other projects proposed in the area to understand adjacent issues regarding cumulative effects.	Low
Noise Impacts						
Operational noise including low frequency noise	Potential of exceedance of operation noise guidelines and limits at receptor locations nearby.	Unlikely	Moderate	Moderate	The wind farm has been designed and modelled with background noise monitoring to comply with the relevant standards.	Low

Aspect	*Potential Impacts*	*Likelihood*	*Consequence*	*Unmitigated Risk*	*Proposed Management*	*Mitigated Risk*
or infrasound					In the event that noise from a turbine is exceeding the operational standards, mitigation measures would be investigated and implemented to ensure compliance, including potentially operating the turbine in a reduce noise mode.	
Construction noise including traffic and vibration generating activities	Potential for exceedance of construction noise limits through activities such as increased traffic, heavy machinery, blasting and vibration.	Unlikely	Minor	Low	Construction activities would be located away from residential areas where possible and during permissible times. A construction noise management plan will be developed as part of the CEMP.	Low
Substation operation and transmission line noise	Potential for noise associated with the operation of electrical and substation equipment	Unlikely	Minor	Low	Substations and electrical infrastructure will be located away from residents	Low
Ecological Impacts						
Avifauna strikes	Potential of avifauna deaths due to blade strike.	Likely	Minor	High	Wind farm design has implemented the recommendations from the BA and sited infrastructure away from sensitive areas i.e. identified nests and supportive habitat.	Low
Removal of EEC / CEEC and other native vegetation or habitats	Local vegetation / habitat being removed or altered from the site to accommodate turbines and associated infrastructure including powerline	Almost Certain	Moderate	Extreme	Turbines and infrastructure (including overhead powerlines) will be microsited where possible to avoid or minimise the loss of vegetation. The loss of vegetation will be offset where required	Low-Moderate
Threatened species	The development of wind farm infrastructure adversely effects identified species population	Possible	Moderate	High	Wind farm infrastructure has been microsited away from known threaten species populations where ever possible to minimise impacts	Low-Moderate
Heritage Impacts						
Impact on Indigenous heritage values	Potential for disturbance to Indigenous heritage sites or objects.	Possible	Minor	Moderate	Studies have shown that the site is of low Indigenous cultural significance. The impact on Indigenous heritage values has been assessed in Section 12.	Low
Impact on European	Potential for disturbance to European heritage sites or objects.	Unlikely	Minor	Low	Studies have shown that the site is of low European cultural significance.	Low

Aspect	Potential Impacts	Likelihood	Consequence	Unmitigated Risk	Proposed Management	Mitigated Risk
heritage values					The impact on Indigenous heritage values has been assessed in Section 12.	
Traffic & Transport						
Overweight loads causing damage to local roads Impact of increased traffic loads	Impacts caused to the roads and users by over mass and oversized vehicles used during construction, operation and decommissioning periods.	Likely	Moderate	High	Careful selection of access routes and roads to be used during construction. Local improvements and upgrades will be applied where necessary. A Traffic Management Plan (TMP) will be developed in consultation with local councils and RMS. The impact on traffic and transport routes has been assessed in Section 13.	Low-Moderate
Off-road driving causing erosion and disturbing natural habitats	Impacts caused to natural habitats when driving to off-road locations on site.	Possible	Moderate	High	The roads constructed on site will be well designed, all weather access tracks. A TMP will be prepared to guide the use, restriction, speed limits and maintenance requirements to ensure safe and proper use of off access tracks.	Low
Hazards & Risks						
Impact of wind turbines on commercial and agricultural aircraft safety	Turbines may impact upon the safe operation of aircraft in the region for recreational and agricultural purposes.	Likely	Moderate	High	A 500 m no-fly zone has been implemented around the operation turbines and local air operators will be notified. Aircraft landing areas have been identified around the site and turbine placements comply with CASA take-off and landing clearance restrictions. The impact on aviation has been assessed in Section 14.1.	Low-Moderate
Interference of television, radio, mobile phone coverage or electromagnetic fields	Potential signal interferences to services as a result of operational wind turbines.	Unlikely	Minor	Low	A study was undertaken using ACMA data or registered transmitters and receivers and this has been taken into account for the design of the wind farm. It is unlikely that that wind farm will affect signals from existing mobile phones towers, microwaves or digital television signals. The impact on aviation has been assessed in Section 14.2.	Low
Fire or bushfire near the turbines	Ignition of a bushfire as a result of	Possible	Moderate	High	A bush fire management plan will be created in consultation	Low–moderate

Aspect	*Potential Impacts*	*Likelihood*	*Consequence*	*Unmitigated Risk*	*Proposed Management*	*Mitigated Risk*
or local community	construction or operational activities. Any compounding risk caused by the wind farm to an existing bush fire in the region.				with the RFS While the use of aerial fire fighting may be limited in some situation, the wind farm access tracks will provide a small fire break and improved access for fire fighting. In the event of a bush fire on or in close proximity to the wind farm it would be operated in accordance with the Bushfire Management Plan. The impact on aviation has been assessed in Section 14.5.	
Water Supply, Water Quality and Hydrology						
Impact of erosion and sediment run-off Use of local water and its effects on the waterways	Increase sediment run off and erosion. Excessive use of local water supply.	Possible	Moderate	High	The majority of water required will be transported from outside the area and stored on site, in addition to small amounts of captured rain water from buildings. A CEMP will be developed to manage soil erosion, drainage and sediment control. Hydrological impacts have been assessed.	Low
General Environmental Assessment						
Impacts on soils & landforms	Soil erosion due to inadequate construction techniques. Poor management controls for excavated materials and stockpiles.	Possible	Minor	Moderate	Vegetation removal will be minimised to prevent soil erosion and controls will be in place to minimise erosion and runoff due to high rainfall and wind events. The CEMP will address the impacts on soils and landforms	Low
Impacts on climate & air emissions	Dust and vehicle emissions may affect the local area during the construction and decommissioning periods	Possible	Minor	Moderate	During construction and high wind events, water trucks will be used to minimise dust. The exposed area of the construction footprint will only be a very small percentage of the overall site.	Low
Impacts on mineral exploration	Future prospecting may be limited due to wind farm infrastructure	Possible	Minor	Moderate	Consultation has occurred with the current mineral license holders about their future plans. The infrastructure footprint of the wind farm and powerline is a very small percentage of the total site and located away from known mining areas	Low
Social and economic impacts	The flow on effects of investments and jobs in the local community are less than anticipated	Rare	Unlikely	Low	It is not anticipated that the wind farm will cause any negative social or economic impacts as they are generally considered to be positive.	Low

Aspect	*Potential Impacts*	*Likelihood*	*Consequence*	*Unmitigated Risk*	*Proposed Management*	*Mitigated Risk*
					The benefits anticipated have been modelled against other constructed and operational projects in Australia.	
Property values	Potential of the wind farm to affect local land and property values	Unlikely	Minor	Low	A review of published studies in New South Wales confirms that wind farms do not negatively impact on property values.	Low
Impacts on health (electromagnetic fields & epilepsy)	Potential to impact human health as a result of wind farms and electrical infrastructure	Unlikely	Minor	Low	There is currently no published scientific evidence to positively link wind turbines with adverse health effects.	Low
Waste						
Generation of construction related wastes	Poor waste management practices leading to an environmental impact	Possible	Moderate	High	Proper waste management strategies will be implemented across the site to reduce or remove wastes create A waste management plan will be developed as part of the CEMP	Low

8.2 Assessment Approach

8.2.1 Director General's Requirements

The Director General's Requirements (DGRs) are compiled by the DP&E, with consultation from various government departments in order to identify the issues that the proponent must address in their Environmental Assessment.

Epuron has used these DGRs to structure this EA and has ensured that all issues raised have been individually addressed and consultation requirements have been met. A copy is found in Attachment 6.

8.2.2 Best Practice Guidelines

Epuron's assessment has in general followed the advice provided in a number of industry guidelines, including:

- the Draft NSW Planning Guidelines: Wind Farms; and
- Auswind's Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia (ABS, 2008).

While much of the assessment pre-dated the draft NSW Wind Farm Planning Guidelines (2012), these draft guidelines have also been taken into account to the fullest extent possible.

The above guidelines were developed to establish the process for identifying, developing and implementing wind energy projects, recognising that each project would require assessment on its individual merits. They are focused primarily on technical and planning issues.

These guidelines have been considered in the preparation of this EA, particularly with respect to the chronological flow of the project phases.

8.2.3 Consultation

Epuron's assessment is designed to satisfy the supplementary DGRs for community consultation (see Attachment 6), in addition to making use of all information provided by the relevant parties in relation to environmental issues which were identified though the consultation processes outlined in Section 7. This includes consultation with stakeholders whose input was used to refine the design of the project.

8.2.4 Specialist Studies

Independent consultants were engaged to complete specialist reports on the following key issues:

- Landscape and Visual – summarised in Section 9 and in full in Appendix A;
- Environmental Noise – summarised in Section 10 and in full in Appendix B;
- Ecology – summarised in Section 11 and in full in Appendix C; and
- Aboriginal and European Heritage – summarised in Section 12 and in full in Appendix D.

8.2.5 Wind Turbine Selection for Assessments

Some impact assessments require an understanding of specific wind turbine characteristics which are not known until the final wind turbine model has been selected. An approach is therefore required to carry out an assessment based on reasonable assumptions, and ultimately confirming that these assumptions are valid.

The majority of issues identified with respect to this proposed development are not impacted by specific turbine model selection. For example, the assessment of ecology and archaeology constraints is based on a development envelope, that is, the entire geographic area where infrastructure may be located. This approach allows ecological and archaeological constraints to be defined within the development envelope and as a consequence allows for minor relocation of infrastructure within the development envelope without further assessment.

However, the final turbine selection could have a material impact on some issues and in these cases the decision as to whether to present a representative or worst case turbine must be considered.

The approach taken is to present the representative impact assessment for specialist studies where physical dimensions and technical characteristics of turbines are related to the extent of the potential impact. Examples of this are visual impacts and noise propagation. However as discussed in Section 3.1, the most likely turbine model to be ultimately selected for the project is not the largest but one that sits in the middle of the turbine size range (physical size and generation capacity). Therefore in this context, the EA also considers and presents the indicative or likely impacts.

Wind Farm Layout

The wind turbine layout design is based on a Vestas V112 turbine.

Wind farm layout and design is impacted by the minimum required spacing between turbines, which is a function of their rotor diameter. Therefore an assumption of the likely rotor diameter must be made at the time of the assessment.

The Vestas V112 is a mid to upper range turbine, known to be suitable for the site and has been installed in Australia. If a larger physical turbine is selected, fewer turbines may be installed, a consequence of the requirement for larger separation distances between turbines. In this scenario, some associated impacts may be reduced (such as visual impacts). Conversely, a layout using the smallest turbine option would represent the worst-case scenario in terms of the number of turbines able to be developed but may overstate other impacts. Use of the Vestas V112 is therefore considered a likely and representative turbine for the purposes of assessment.

Energy and Greenhouse Gas Calculations

The energy production and greenhouse calculations are based on an indicative 3.0 MW turbine.

Energy production calculations are most important for determining the options for connecting the wind farm into the transmission network. A wind farm output may be restricted by the size of the transmission line running through the site, or if other generators are already attached to the line. Energy production is also used to calculate the potential greenhouse gas emissions that would be reduced by the project.

A turbine with a name plate rating of 3.0 MW sits in the middle to upper range of turbines under consideration and is a likely turbine size to be ultimately selected. It is therefore considered representative of the energy production and greenhouse abatement benefits from the project.

Visual Impacts

The photomontages, Zone of Visual Influence, and Shadow Flicker analysis are prepared using the Vestas V112, which is a turbine with a 112m rotor diameter on a 101 m hub height.

Photomontages, Zone of Influence and Shadow Flicker maps are created to assess the potential impact to visual amenity. Using a turbine with a large rotor diameter (blades) and a large overall tip height allows for the worst case scenario to be assessed. While the visual assessment has been conducted using a turbine with a tip height of 157 m, the maximum tip height for the project is expected to be up to 165 m.

In some cases, the worst case presents an unrealistic portrayal of impacts when compared to the most likely turbines to be selected for the project. Therefore, in some areas, the EA also considers and presents the indicative or likely impacts for comparison. Noting that the layout would require review and likely removal of a number of turbines to accommodate the physically largest turbine, this assessment would overstate the visual impacts. The photomontages were prepared using the likely turbine sizing of a 101 m hub height with a 112 m rotor diameter (tip height of 157 m) to present the likely and representative scenario. The maximum expected tip height is up to 165 m.

Noise Impacts

The noise assessment was conducted using the Vestas V112 3.0 MW

Each turbine has a slightly different noise curve, and must be individually assessed prior to construction taking place to ensure that compliance will be achievable. Rather than testing every turbine model available, a conservative approach has been adapted to demonstrate that compliance is achievable. Thus other turbines considered would theoretically comply with the same criteria.

The noise assessment presents the modelling of the Vestas V112 3.0 MW turbine on 80 m towers as a conservative estimate for the project. The V112 presents the representative impacts as it has noise characteristics typical of modern wind turbines and therefore offers a good approximation of the likely noise impacts of the project. The physical and noise characteristics of these turbines are considered to be indicative of the wind turbines available. The analysis demonstrates that it is possible to achieve the noise limits set by the SA EPA guidelines and WHO guidelines using the Vestas V112.

The current layout, as presented in this EA, has been prepared to demonstrate that compliance can be achieved across a wide range of turbine models. Accordingly by contemplating that turbines can be relocated within a reasonable distance of their proposed location or removed to achieve the SA EPA Guidelines, a single flexible indicative layout can be presented and assessed. Additional analysis of the sensitivity of the physical dimensions (hub height and maximum tip height) on noise propagation and a worst case scenario, requiring mitigation, is presented in the noise assessment.

The approach undertaken simplifies the noise assessment process by avoiding a different layout for each proposed turbine model. The Statement of Commitments affirms that modelling of the final turbine on the final layout would be undertaken to ensure compliance with the SA EPA guidelines.

8.3 Environmental Management Plans

A Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP) will be prepared to manage and mitigate environmental impacts on the wind farm site. The CEMP will incorporate all relevant processes and mitigation measures for the development/construction phase while the OEMP will incorporate measure for operations phase. The CEMP will be prepared prior to the commencement of construction and the OEMP will be prepared prior to the commencement of operations. The plans will generally address:

- Soil & Water Management;
- Fuel and Chemical Storage - to avoid the pollution of surface and ground waters;
- Erosion & Sediment Control Plan;
- Landscape Management Plan;
- Traffic and Transport;
- Fire Management;
- Waste Generation and Disposal;
- Rail Safety Management Plan; and
- Additional measures mentioned in the Statement of Commitments

The CEMP and the OEMP will follow the philosophy of adaptive management. The philosophy of adaptive management is followed when policies and practices are continually improved by learning from the outcomes of previous work. As part of the adaptive management process the management measures provided by the EMP will also include a review and assessment program where works and monitoring are regularly reviewed and reassessed to ensure the environmental outcomes are achieved. This process is illustrated in Figure 8-1.

During construction, the site will be protected from erosion and sedimentation by the installation and maintenance of standard erosion and sediment control measures, such as sedimentation fences and swales in accordance with *Managing Urban Stormwater: Soils and Construction 4th Edition* – Vol 1 (the “Blue Book”) (CSIRO, 2012) and Managing Urban Stormwater: Soils and Construction (DEWHA, 2009).

Surface water management procedures will be maintained in accordance with an Erosion and Sediment Control Plan. This plan will detail the use of sedimentation fences, and drainage controls to direct surface water into appropriate sediment basins and through a filter before being discharged into the site drainage system.

Specific environmental management measures will be used around the batching plant area and other temporary facilities. The temporary concrete batching plants will have a bunded storage area and a temporary concrete slab beneath the loading area. To capture surface water, sediment runoff (including any imported materials which may influence the pH and water quality) a swale drain is anticipated around the perimeter of the batching plant. This will be channelled into an enclosed retention pond, where water will be evaporated off and any solid waste disposed of at landfill. To ensure water pH levels remain at a reasonable level as a result of the potential of mixing with imported materials, checks will be set up and if deemed appropriate acid dosing (anticipated to be hydrochloric) will be added to ensure pH is controlled or alternatively the contaminated water would be transported by tanker off site. This type of approach is common in the construction industry.

Controls to avoid spillage of oil or erosion and sediment loss from the site will be supported by emergency response procedures where required.

These management procedures will remain in place until the site is rehabilitated suitable for the intended land use. This will effectively protect the site and its surrounding areas from any significant impacts on topography, surface water and water quality.

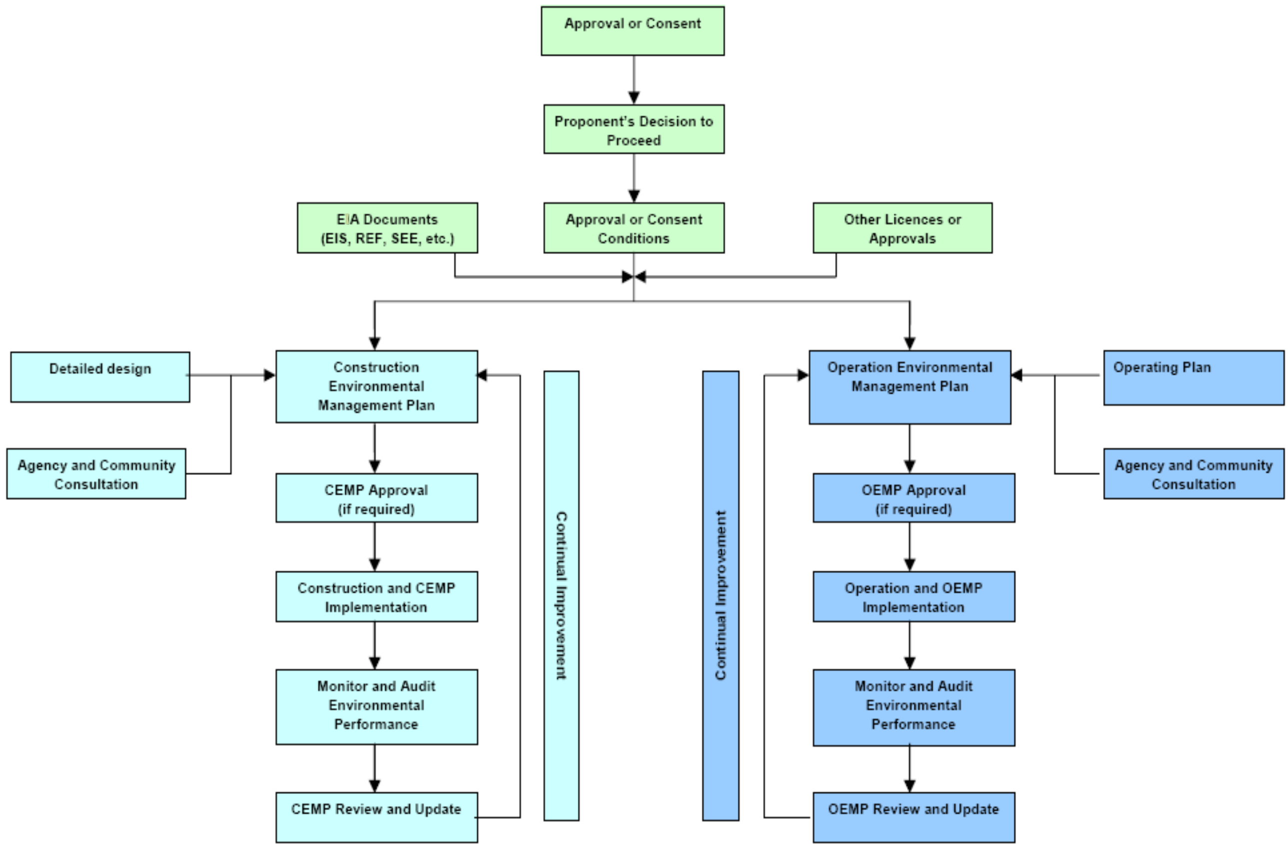

Figure 8-1 Post approval Environmental Management Plan process

9 Visual Assessment

9.1 Visual Amenity

The Liverpool Range Wind Farm Landscape and Visual Impact Assessment (LVIA) has been prepared by the landscape architectural consultancy and visual assessment specialist Green Bean Design (GBD). The LVIA involved a comprehensive evaluation of the visual character of the landscape in which the wind farm would be located, and an assessment of the potential significance of landscape and visual impacts that may result from the construction and operation of the wind farm, taking into account appropriate mitigation measures.

This Section presents a summary of the LVIA methodology as well as the key results and findings arising from the assessment. The detailed LVIA is included in Appendix A.

9.1.1 Methodology

The LVIA was undertaken in accordance with the DGRs and, although not directly applicable to the assessment process, is cognisant with the Upper Lachlan Shire Council's Development Control Plans (DCP) for Wind Power Generation.

The LVIA addresses key issues outlined in the Australian Wind Energy Association and Australian Council of National Trust's publication *Wind Farms and Landscape Values National Assessment Framework* (AusWEA, 2007), and encompasses the general assessment framework outlined in the National Assessment Framework. The LVIA has also given regard to the Draft NSW Planning Guidelines for Wind Farms (December 2011).

As well as consideration of existing guidelines, the LVIA methodology has been applied to a number of similar Part 3A Major Project wind farms prepared by GBD, for assessment by the NSW Department of Planning and Environment (DP&E).

The LVIA methodology included the following key activities:

- desktop study addressing visual character and identification of view locations within the surrounding area;
- fieldwork and photography;
- preparation of ZVI diagrams;
- assessment and determination of landscape sensitivity;
- assessment of significance of visual impact;
- describing the potential impact of night time lighting;
- determining the potential for cumulative impacts; and
- preparation of photomontages and illustrative figures.

9.1.2 Assessment

Visual components of the wind farm

The key visual components of the wind farm that are likely to be visible from surrounding areas include, but are not limited to:

- up to 288 wind turbines;
- up to 288 individual 33kV external kiosk transformers and switchgear with associated control systems to be located in the vicinity of the wind turbine towers (in some turbine models transformer equipment will be integrated within the tower or nacelle);
- underground and overhead electrical and communication cable network linking turbines to each other within the project boundary;

- up to eight new 22 or 33/330 kV collection substations located across the wind farm;
- a new overhead powerline rated at up to 330 kV (nominal) capacity. The new powerline would be mounted on a single pole type structure and may be single-circuit or double-circuit as required;
- up to 10 permanent wind monitoring masts. The permanent monitoring masts may be either static guyed or un-guyed structures and will be to a minimum height of the wind turbine hubs;
- on site access tracks for construction, operation and ongoing maintenance; and
- wind farm signage and maintenance facilities.

Temporary works associated with the construction of the wind farm that may be visible during construction and operational phases include a mobile concrete batching plant and rock crushing facilities.

The wind turbines would be the most visible element of the wind farm from the majority of surrounding view locations. The final selection for the turbine model will be made closer to construction; however, a turbine representative of the larger options was selected for the visual assessment.

Table 9-1 Wind Turbine Parameters

Element	Description
Tower height	100 m
Rotor Diameter	130 m
Overall height from ground level to tip of blade	165 m
Proposed number of wind turbines	288

Community Perceptions 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.

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

A recent survey was conducted by ARM Interactive on behalf of the NSW Department of Environment, Climate Change and Water (September 2010). The survey polled 2,022 residents across the 6 Renewable Energy Precincts established by the NSW Government; including the Upper Hunter Renewable Energy Precinct. Key findings of the survey indicated that:

- 97% of people across the Precincts had heard about wind farms or turbines, and 81% had seen a wind farm or turbine (in person or the media);
- 85% of people supported the construction of wind farms in New South Wales, and 80% within their local region; and
- 76% supported wind farms being built within 10km of residences and 47% of people surveyed supported the construction of wind turbines within 1 to 2km from their residences.

Whilst individual perception and local community attitudes toward wind farm development are an important issue, these need to be considered in terms of potential landscape and visual impacts from a broad community perspective.

Proximity to Urban Areas

Small towns and localities surrounding and beyond the proposed Liverpool Range wind farm include:

- Coolah (approximately 4.6 km to the south west). Population 798;
- Cassilis (approximately 4.5 km to the south east). Population 350;

- Dunedoo - (approximately 42 km to the south west). Population 836;
- Gulgong (approximately 56 km to the south west). Population 1,866; and
- Merriwa (approximately 40 km to the south east). Population 973.

Population figures from the Australian Bureau of Statistics 2011 Census.

Existing Landscape

The landscape surrounding the wind farm is predominantly rural in character and occupied by medium sized landholdings as well as larger commercial pastoral operations. Areas of cultivated farmland and livestock pasture are interspersed with occasional rural homesteads surrounded by cultural planting and windbreaks. Human modifications within the broader landscape are consistent with common adaptations to rural life and include roads (sealed and unsealed), drainage structures, agricultural buildings, electrical transmission infrastructure, and communication structures. A series of hills are joined by ridgelines extending north to south across the wind farm site with areas of timber located on hillside slopes. The undulating topography within and surrounding the wind farm also creates a series of valleys from which views are largely contained and restricted.

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 wind farm. The relationship between viewshed, zone of visual influence and visibility is outlined in the following table. Extended descriptions are found in the full report in the LVIA Appendix A.

Table 9-2 Definitions used in Landscape and Visual Impact Analysis

	Definition	*Relationship*
Viewshed	An area of land surrounding and beyond the Project area which may be potentially affected by the wind farm.	Identifies the majority of the LVIA study area that incorporates view locations that may be subject to a degree of visual impact.
Zone of Visual Influence (ZVI)	A theoretical area of landscape from which the wind farm structures may be visible.	Determines areas within a viewshed from which the wind turbines may be visible.
Landscape Character	Defined as 'the distinct and recognisable pattern of elements that occur consistently in a particular type of landscape' (SNH, 2009).	Determines the ability of the landscape to accommodate change.
Landscape Sensitivity	The British Landscape Institute describes Landscape Sensitivity as 'the degree to which a particular LCA can accommodate change arising from a particular development, without detrimental effects on its character'.	Quantifies the level of impact that a development would have on the landscape.
Visibility	A relative determination at which a wind turbine or cluster of wind turbines can be clearly discerned and described.	Describes the likely number and relative scale of wind turbines visible from a view location.

The distance effect within the 10 km viewshed is outlined in the following table. Distance effect is not site specific and can be applied consistently to any wind farm based on the size and distance of turbines to the viewer. Note, in all cases visibility is nil where influenced or screened by surrounding topography and vegetation.

Table 9-3 Visual effect based on distance from wind turbines

Distance from turbine	Distance effect
>20 km	Wind turbines become indistinct with increasing distance. Rotor movement may be visible but rotor structures are usually not discernible. Turbines may be discernible but generally indistinct within viewshed resulting in **Low** level visibility and **Nil** where influenced or screened by surrounding topography and vegetation.
10 km – 20 km	Wind turbines noticeable but tending to become less distinct with increasing distance. Blade movement may be visible but becomes less discernible with increasing distance. Turbines discernible but generally less distinct within viewshed (potentially resulting in **Low** level visibility).
5 km – 10 km	Wind turbines visible but tending to become less distinct depending on the overall extent of view available from the potential view location. Movement of blades discernible where visible against the skyline. Turbines potentially noticeable within viewshed (potentially resulting in **Low to Moderate** level visibility).
3 – 5 km	Wind turbines clearly visible in the landscape but tending to become less dominant with increasing distance. Movement of blades discernible. Turbines noticeable but less dominant within viewshed (potentially resulting in **Moderate** level visibility).
1 – 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 view location, their location, sensitivity and subject to other visibility factors. Turbines potentially dominant within viewshed (potentially 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. Turbines dominant and significant within viewshed (potentially resulting in **High** level visibility).

Landscape Character Areas and Landscape Sensitivity

Landscape character is defined as 'the distinct and recognisable pattern of elements that occur consistently in a particular type of landscape' (SNH, 2009).

The LVIA identified six Landscape Character Areas (LCAs), which generally occur within the viewshed of the project and include:

- LCA 1 – Upper plateau;
- LCA 2 – Plateau spur;
- LCA 3 – Slope and hill;
- LCA 4 – Cultivated agricultural land;
- LCA 5 – Woodland (State Forest)
- LCA 6 – Settlement.

The British Landscape Institute describes landscape sensitivity as 'the degree to which a particular LCA can accommodate change arising from a particular development, without detrimental effects on its character'.

In terms of overall landscape sensitivity, the LVIA determined that in aggregate each of the six LCAs within the 10km wind farm viewshed had a medium to high sensitivity to accommodate change, and represent a landscape that is reasonably typical of other landscape types found in surrounding areas of the Upper Hunter regional landscape.

With a medium to high sensitivity to accommodate change, some characteristics of the landscape are likely to be altered by the wind farm development; however, the landscape is likely to have some capability to accommodate change. This capability is largely derived from the presence of predominantly large scale features within the landscape character areas and portions of the wind farm area, together with the relatively low density and dispersed nature of human settlement patterns and potential receptors located within the wind farm viewshed.

Table 9-4 Landscape Character Areas and Landscape Sensitivity

Landscape Character Area	Description	Landscape Sensitivity
LCA 1	Upper plateau	Medium to High
LCA 2	Plateau spur	Medium to High
LCA 3	Slope and hill	Medium to High
LCA 4	Cultivated agricultural land	Medium
LCA 5	Woodland (State Forest)	Medium to High
LCA 6	Settlement	Medium

The six LCA are located in Figure 9-1 and illustrated in Figure 9-2 Example of Landscape Character AreasFigure 9-2.

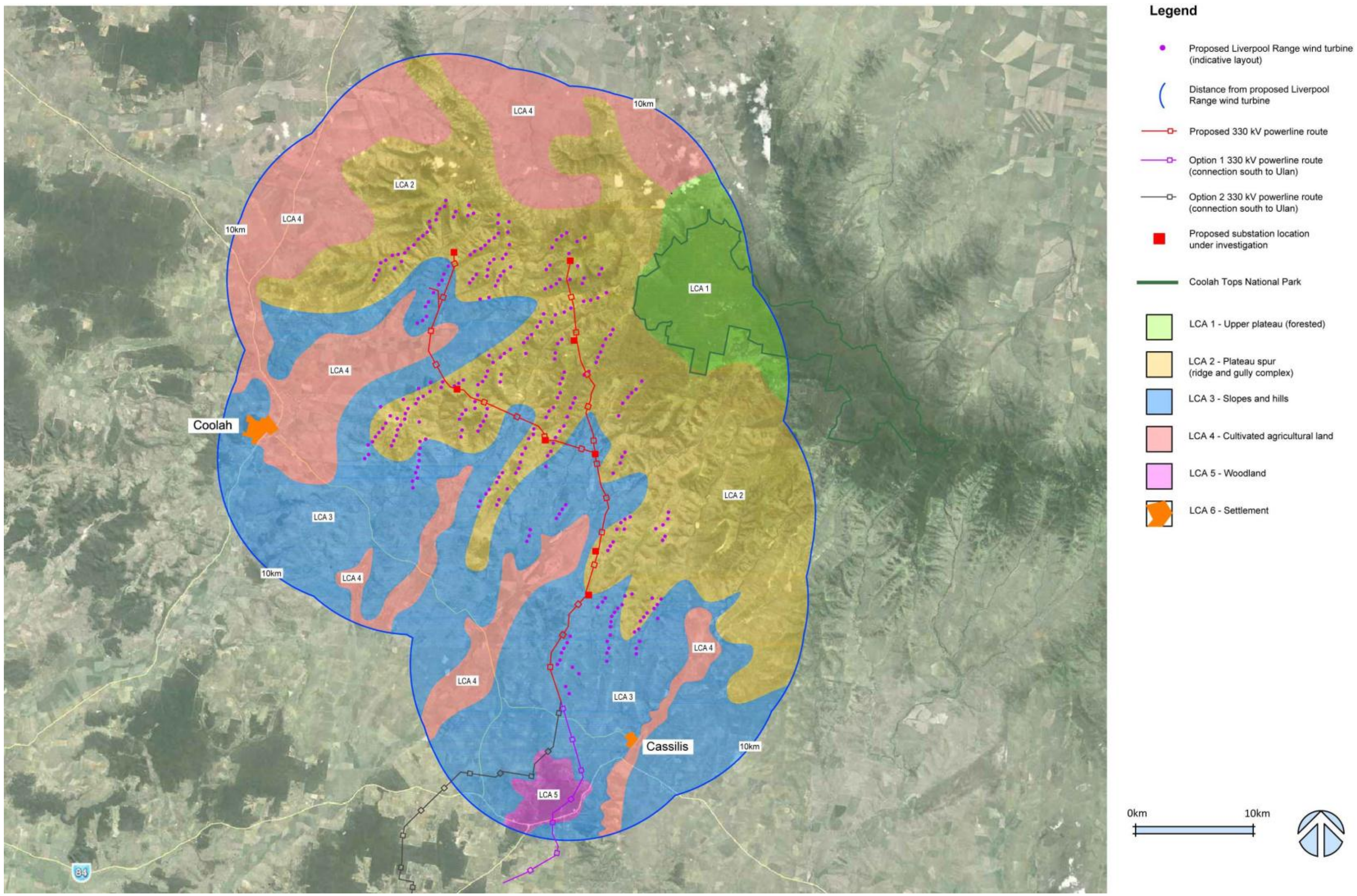

Figure 9-1 Landscape Character Areas

Typical view toward upper plateau (LCA 1)

Typical view toward plateau spur (LCA 2)

Typical view toward slope and hill (LCA 3)

Typical views across cultivated agricultural land (LCA 4)

Typical views toward woodland (LCA 5)

Typical views toward settlement (LCA 6)

Figure 9-2 Example of Landscape Character Areas

Zone of Visual Influence Diagrams (ZVI)

The ZVI diagrams are used to identify theoretical areas of the landscape from which a defined number of wind turbines, or portions of turbines, may be visible within the viewshed. They are useful for providing an overview as to the extent to which the Liverpool Range Wind Farm may be visible from surrounding areas.

Three ZVI diagrams have been prepared to demonstrate the extent to which the wind turbines would be visible at a distance up to 10 km from the site. Three different ZVI diagrams have been prepared to show the zone of visual influence from:

- any part of the wind turbines (i.e. tip of blade).
- half the swept path of rotor (i.e. hub height to tip of blade); and
- the entire turbine structure (i.e. ground to tip of blade).

The ZVI methodology is conservative as the screening effects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm 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 in included in the LVIA Appendix A.

The level of wind turbine visibility within the viewshed can result from a number of factors including the distance between a receptor and the wind farm, 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 the wind turbines is a primary factor to consider when determining potential visibility, there are other issues, for example the level of tree cover, which may also affect the degree of visibility.

The ZVI diagrams are illustrated in Figures 9-3 to 9-5, which show from each location the number of turbines visible in each category.

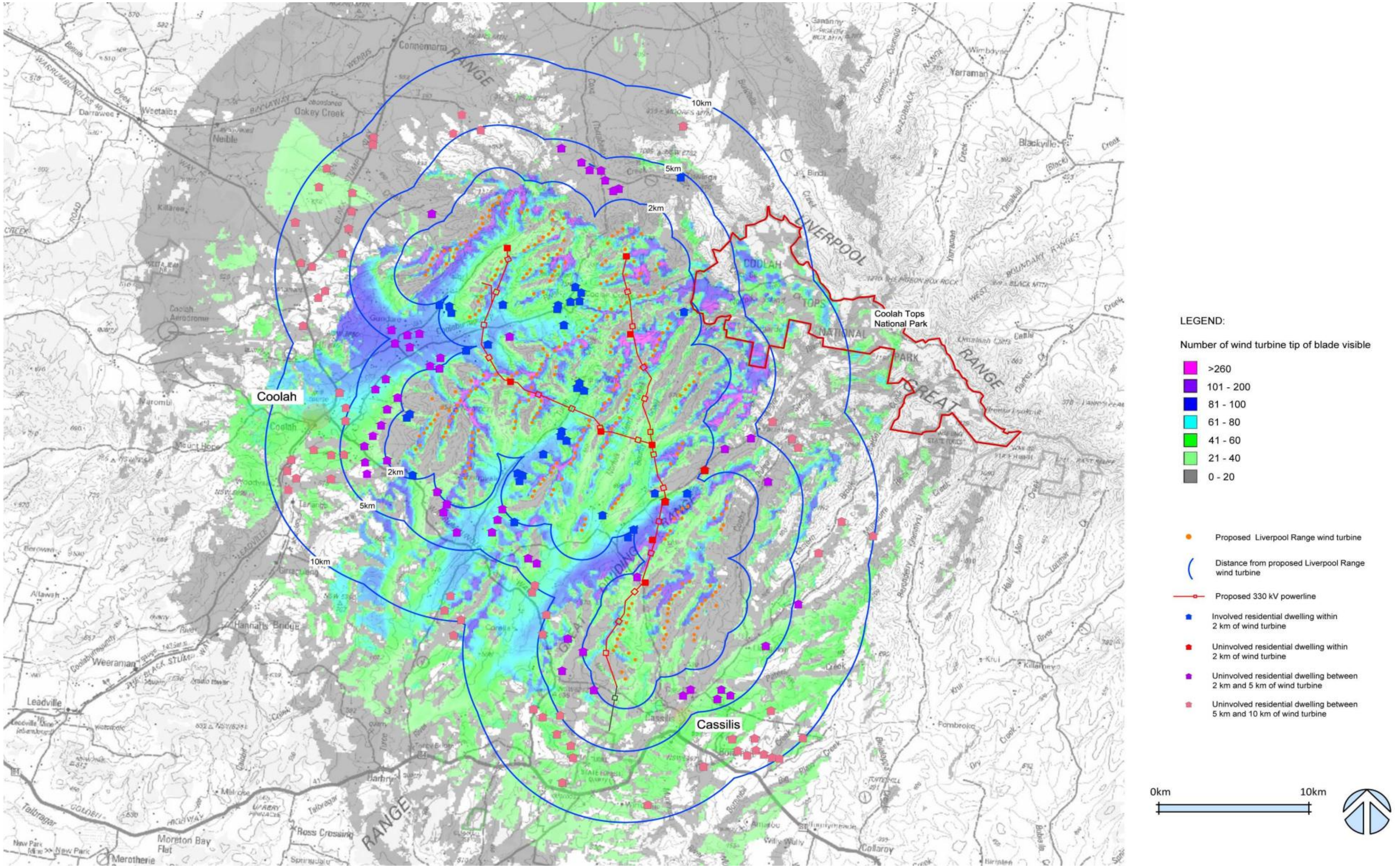

Figure 9-3 Zone of Visual Influence (turbine tips visible)

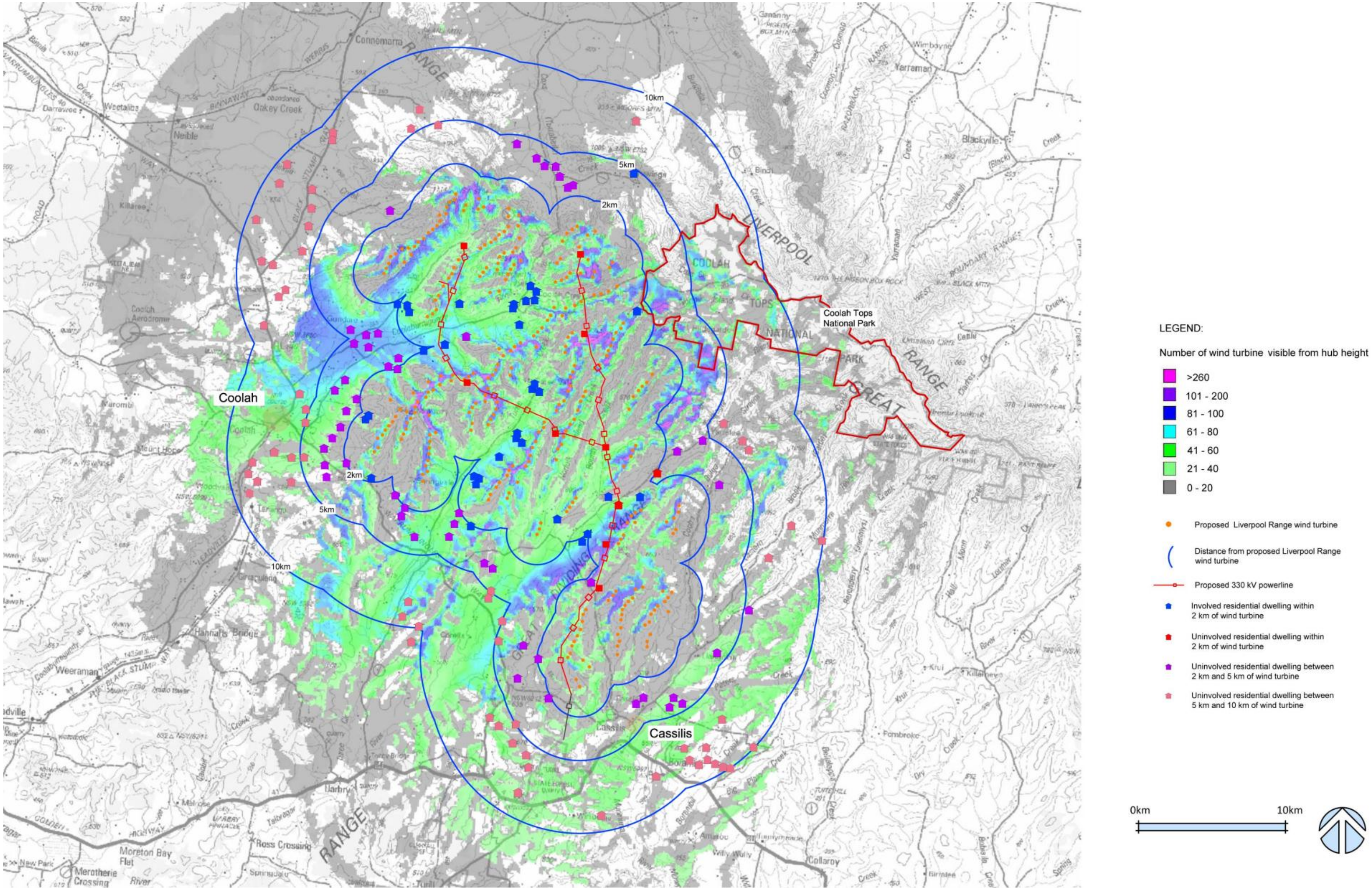

Figure 9-4 Zone of Visual Influence (turbine hubs visible)

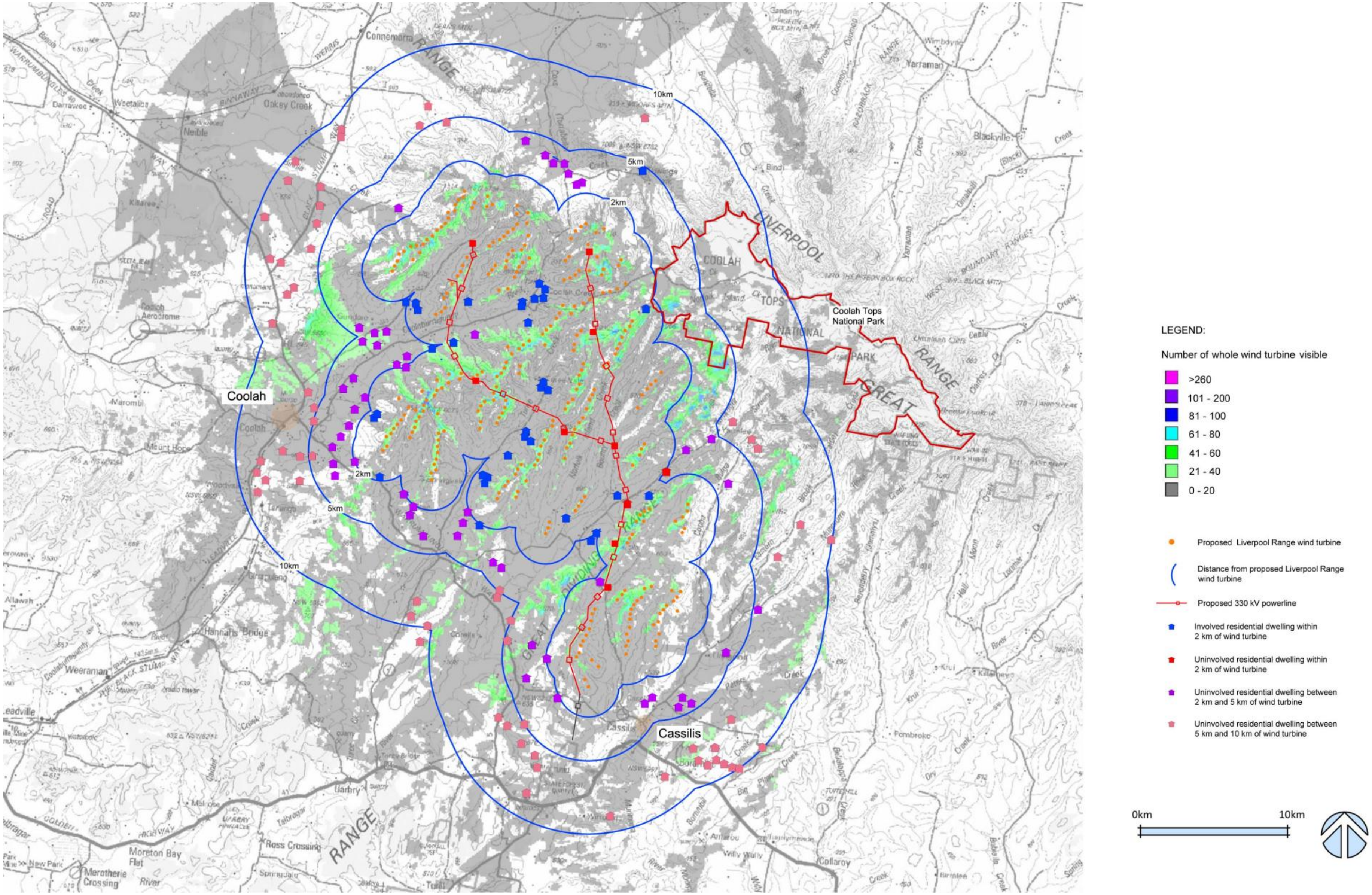

Figure 9-5 Zone of Visual Influence (whole turbines visible)

Photomontages

Photomontages have been prepared to illustrate the general appearance of the wind farm following construction. Eight locations were selected to illustrate the wind farm from public view points in the landscape surrounding the wind farm project area. These locations are shown in Figure 9-5 and listed below:

Table 9-5 Public photomontages locations

Photomontage Location	*LVIA Figure ref*	*Status:*
L2 Rotherwood Road	**Figure 19** and **20**	Unsealed road corridor (minor local road)
L3 Rotherwood Road	**Figure 21** and **22**	Sealed road corridor (minor local road)
L5 Glenwood	**Figure 23** and **24**	Uninvolved and unoccupied residential dwelling
L7 Bill's block	**Figure 25** and **26**	Uninvolved residential dwelling
L8 Turee Vale Road	**Figure 27** and **28**	Sealed road corridor (minor local road)
L9 Cassilis Road	**Figure 29** and **30**	Sealed road corridor (local road)
L10 Coolah	**Figure 31** and **32**	Sealed road corridor (local road)
L11 Cooks Road	**Figure 33** and **34**	Sealed road corridor (minor local road)
L13 Warung State Forest Road	**Figure 35** and **36**	Unsealed road corridor (minor local road)
L14 Pandoras Road	**Figure 37** and **38**	Unsealed road corridor (minor local road)
L23 St Antoine	**Figure 39** and **40**	Uninvolved and unoccupied residential dwelling

The public photomontages locations were selected following a review of preliminary ZVI maps, together with a site inspection to identify potential representative viewpoints. The public photomontage locations were selected from publically accessible sections of surrounding road corridors.

In addition to the public photomontages locations, a total of 3 photomontages were prepared from uninvolved residential dwellings within 2 km of the Liverpool Range wind farm turbine locations. These photomontages locations are illustrated in the LVIA Appendix A.

The process used to generate the photomontages is detailed in the LVIA Appendix A. An example of a public and uninvolved photomontage is illustrated in Figure 9-7 and Figure 9-8. All eleven photomontages are illustrated in the LVIA Appendix A.

GBD undertook to independently verify the scale of the Liverpool Range wind turbines within the photomontages through a photographic comparison of the photomontage methodology against constructed and operational wind turbines. The results of this verification are included in the LVIA Appendix A.

Whilst a professional photomontage provides an image that illustrates a realistic 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 photomontage than in real life, and is partly due to the fact that a flat image does not allow the viewer to perceive any information relating to depth or distance.

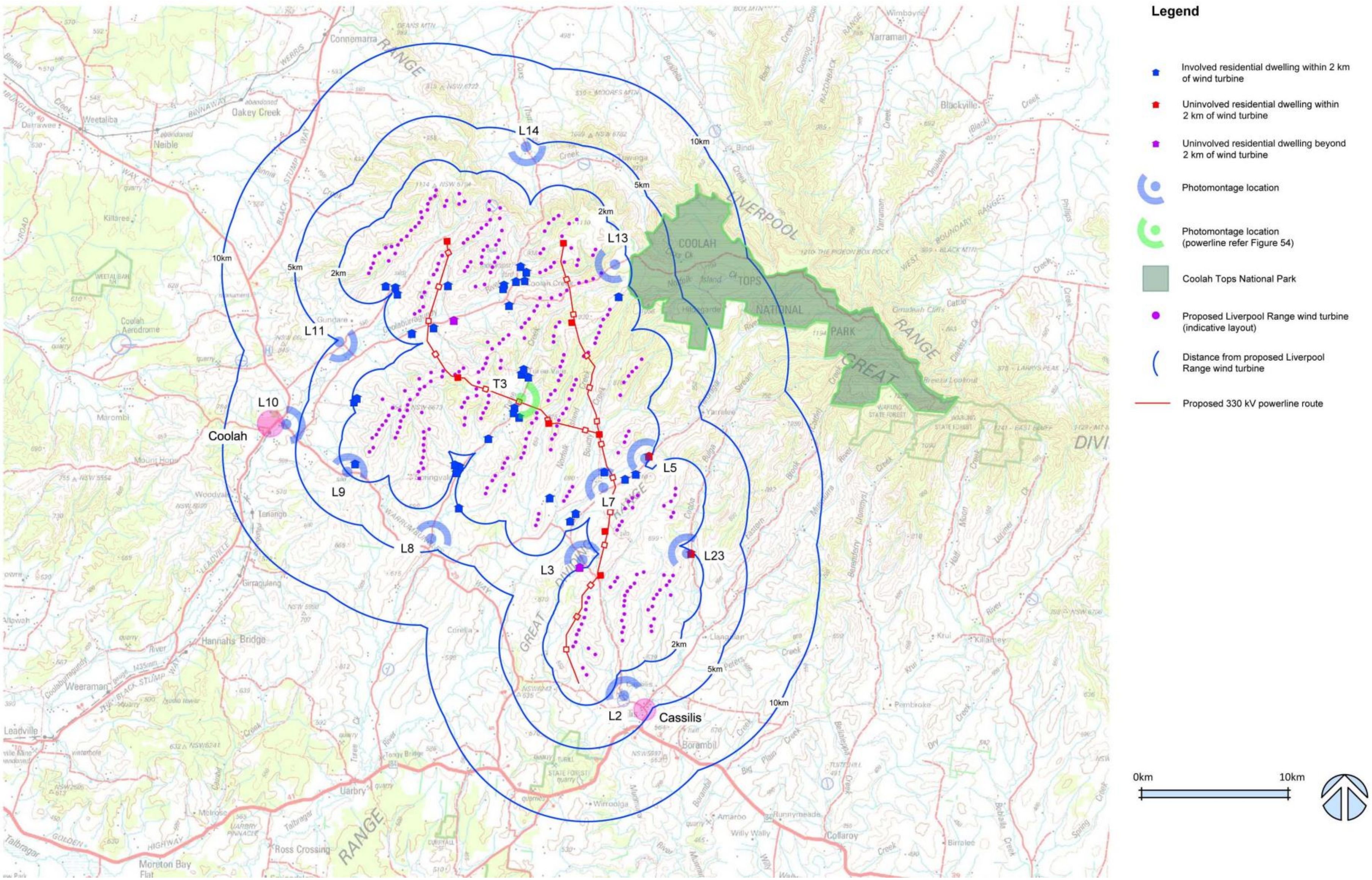

Figure 9-6 Photomontage Locations

Public view location L14 Rockgedgiel-Pandoras Road - Existing view north north east to south east. Photo coordinate Easting:780415 Northing:6484831 (MGAz55)

Public view location L14 Rockgedgiel-Pandoras Road - Proposed view through 120°. Approximate distance to closest visible wind turbine 3.8 km

Notes

Composite panorama photograph taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Individual panorama photograph coordinate map datum is MGAz55 to ± 5 m.

Extent of potential wind turbine visibility and directional bearing illustrated on each photomontage is indicative only.

The Nikon D700 digital SLR camera with a 50mm lens results in a single photograph with a view angle equivalent to a 35mm digital SLR camera photograph taken with a 50mm lens.

Refer Figure 17 for photomontage locations.

Indicative extent of a single frame photograph (in landscape format) taken with the Nikon D700 digital SLR camera with a 50mm lens

Extent of wind turbines visible in panorama

Figure 9-7 Public Photomontage Location L14

EPURON

Public view location L7 Bill's block (uninvolved residential dwelling) - Existing view south west to north east. Photo coordinate Easting:779774 Northing:6466870 (MGAz55)

Public view location L7 Bill's block (uninvolved residential dwelling)- Proposed view through 120°. Approximate distance to closest visible wind turbine 2.1km

Notes

Composite panorama photograph taken with a Nikon D700 digital SLR camera with 50 mm prime lens.

Individual panorama photograph coordinate map datum is MGAz55 to ± 5 m.

Extent of potential wind turbine visibility and directional bearing illustrated on each photomontage is indicative only.

The Nikon D700 digital SLR camera with a 50mm lens results in a single photograph with a view angle equivalent to a 35mm digital SLR camera photograph taken with a 50mm lens.

Refer Figure 17 for photomontage locations

Indicative extent of a single frame photograph (in landscape format) taken with the Nikon D700 digital SLR camera with a 50mm lens

Extent of wind turbines visible in panorama

Figure 9-8 Photomontage for uninvolved residential dwelling R17

Night Lighting

Although not currently proposed, the Liverpool Range wind farm may require obstacle lighting in the future. The future requirement for lighting would be subject to the advice and endorsement of the Civil Aviation Safety Authority (CASA) (see Section 14.1). CASA is currently undertaking a safety study into the risk to aviation posed by wind farms to develop a new set of guidelines to replace the Advisory Circular with regard to lighting for wind turbines that was withdrawn by CASA in mid 2008.

Should future CASA regulations require a lighting assessment; the proponent will undertake an Aeronautical Impact Assessment, to first determine the risks posed to aviation activities by the wind farm. If required, an Obstacle Lighting Assessment would be undertaken by an Aeronautical Impact Assessment expert to stipulate the turbine lighting layout which would mitigate any risks to aviation. The outcomes of the Aeronautical Impact Assessment and the Obstacle Lighting Assessment would then be submitted to CASA for their comment.

A small number of existing night time light sources are present in the vicinity of the wind farm, including lights within and surrounding settlements, dispersed homesteads, vehicles travelling along local roads and communication towers. Potential night time light sources from the wind farm could result from:

- low intensity night lights for substations, control and auxiliary buildings; and
- night time obstacle lights mounted on some wind turbines (if required in the future).

Night time lighting has the potential to be visible from distant view locations, and well beyond the 10km viewshed for the Liverpool Range wind farm, although the level of impact will diminish when viewed from more distant view locations, with a greater probability of night time lighting being screened by landform and/or tree cover.

Electrical works

The Liverpool Range wind farm would include a range of electrical infrastructure to collect and distribute electricity generated by the wind turbines. Electrical works would include elements such as:

- up to 8 collection substations and 1 connection substation;
- a double circuit 330 kV powerline;
- generator transformers; and
- underground and overhead electrical and control cables.

These elements of the project are fully described and illustrated in the LVIA Appendix A. The potential visual impact of electrical infrastructure works, including the proposed 330kV powerline routes, is unlikely to have a significant impact on surrounding residential view locations. The electrical works would be contained within a landscape with an overall moderate to high visual absorption capability, which would have some ability to accept modifications and alterations without the loss of landscape character or significant deterioration of existing levels of visual amenity.

Pre-Construction and Construction Activities

The key pre-construction and construction activities that may be visible from areas surrounding the proposed wind farm include:

- ongoing detailed site assessment including sub surface geotechnical investigations;
- various civil works to upgrade local roads and access point;
- construction compound buildings and facilities;
- construction facilities, including portable structures and laydown areas;
- various construction and directional signage;
- mobilisation of rock crushing equipment and concrete batching plant (if required);
- excavation and earthworks; and

- various construction activities including erection of wind turbines, monitoring masts and substation with associated electrical infrastructure works.

The majority of pre-construction and construction activities, some of which would result in physical changes to the landscape, are generally temporary in nature and for the most restricted to various discrete areas within or beyond the immediate wind farm wind farm area. The majority of pre-construction and construction activities would be unlikely to result in an unacceptable level of visual impact for their duration and temporary nature. The LVIA determined that the wind farm is likely to be an acceptable development within the viewshed, which in a broader context also contains approved wind farm developments and built elements such as roads, agricultural industry, aircraft landing strips, communication and transmitter towers and powerlines.

9.1.3 Results of Visual Impact Assessment

The significance of visual impact resulting from the construction and operation of the Liverpool Range wind farm would result primarily from a combination of:

- the overall sensitivity of visual receptors in the surrounding landscape; and
- the scale or magnitude of visual effects presented by the wind farm development.

The sensitivity of visual receptors has been determined and described in the LVIA by reference to:

- the location and context of the view point;
- the occupation or activity of the receptor; and
- the overall number of people affected.

The scale or magnitude of visual effects associated with the project have been determined and described by reference to:

- the distance between the view location and the wind farm turbines;
- the duration of effect;
- the extent of the area over which the wind farm could be theoretically visible (ZVI hub height)
- the degree of visibility subject to existing landscape elements (such as forested areas or tree cover).

The LVIA notes that although a large number of viewers in a category that would otherwise be of low or moderate sensitivity may increase the sensitivity of the receptor, it is also the case that a small number of people (such as residents) with a high sensitivity may increase the significance of visual impact. The criteria used to establish the significance of visual impact are detailed in the LVIA Appendix A. Residential dwelling locations are presented in Figure 16, located in the LVIA Appendix A.

Residential viewpoints within 2km of the proposed wind turbine locations

The LVIA identified a total of 23 potential involved and uninvolved residential view locations within the Liverpool Range wind farm 2 km viewshed. Unoccupied residential dwellings have been included and assessed as part of the LVIA where structures and buildings were considered to be habitable at the time of the field work.

An assessment of each potential residential view location indicated that for the Liverpool Range wind turbine design layout:

- 1 of the 23 residential view locations has been determined to have a low visual significance;
- 3 of the 23 residential view locations have been determined to have a low to medium visual significance;
- 9 of the 23 residential view locations have been determined to have a medium visual significance;
- 9 of the 23 residential view locations have been determined to have a medium to high visual significance; and
- 1 of the 23 residential view locations has been determined to have a high visual significance.

The residential view location with a high visual significance will be an involved residential dwelling.

Other viewpoints

The LVIA determined that the majority of residential dwellings and public viewpoints located beyond the 2 km wind turbine offset are unlikely to be significantly impacted by the wind farm development. The localised influence of topography, as illustrated in the ZVI diagrams, has a direct and marked impact on the extent and nature of views within the 2 km and wider viewshed.

Overall conclusion

Taking into account the mitigation measures outlined in the LVIA concludes that the Liverpool Range wind farm project would have an overall low to medium visual significance on the majority of uninvolved residential view locations within the 10 km viewshed as well public view locations.

9.1.4 Cumulative Visual Impact Assessment

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

'Direct' cumulative visual impacts may occur where two or more winds farms have been constructed within the same locality and are simultaneously viewed from the same receptor location.

'Indirect' cumulative visual impacts may also arise as a result of multiple wind farms being observed from the same receptor location, but do not overlap or occur within a single field of view.

'Sequential' cumulative visual impacts may also arise as a result of multiple wind farms being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which may form an impression of greater magnitude within the construct of short term memory.

There are a number of proposed, approved and operating wind farm developments within New South Wales which are illustrated in the LVIA Appendix A. The number and location of wind farms is likely to change as more wind farm projects are announced. The Kyoto wind farm development is currently the only approved wind farm development in the Upper Hunter Renewable Energy Precinct. With an approval for up to 34 wind turbines, the Kyoto wind farm development has yet to commence construction. The Liverpool Range wind farm development would be located approximately 70 km to the west of the Kyoto project site, therefore the opportunity for any significant 'direct' or 'indirect' visual impacts are likely to be limited. 'Sequential' visual impacts will be limited by the absence of additional wind farm developments within the regional context and would not be expected to be significant between the approved Kyoto wind farm development and the Liverpool Range project.

9.1.5 Mitigation Measures

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

- Consideration of a matt and/or off-white finish of the structures to reduce visual contrast between turbine structures and the viewing background (this is subject to final turbine selection);
- A commitment to undertake landscape planting at any residence within 2km of a wind turbine.
- A commitment to minimise activities that may require night time lighting and, if necessary, use low intensity lighting designed to be mounted with the light wind farming inwards to the site to minimise glare;
- Substation and other ancillary infrastructure have been sited sympathetically with the nature of the locality and away from major roads and residential dwellings where practical to mitigate visual impact;
- The majority of electrical connections within the site (i.e. cables between the turbines) have been designed to be located underground (where practical), in order to further reduce potential visual impacts.

These are outlined in the Statement of Commitments in Section 17.

10 Operational and Construction Noise

10.1 Background

SLR Consulting Australia Pty Ltd (SLR Consulting) was engaged as the acoustic consultant for the proposed Liverpool Range Wind Farm. A full assessment of the operational and construction noise has been completed and can be found in Appendix B. The layout assessed comprised 288 wind turbines modelled as Vestas V112 model.

10.2 Operational noise

The operational noise impact assessment predicts noise levels for receptors within 6 km of a proposed turbine and compares the predicted level to the limits set out in the South Australian Environmental Protection Authority (SA EPA) *Environment Noise Guidelines for Wind Farms (February 2003)* and World Health Organization (WHO) limits, as appropriate. The assessment procedure involved the following:

- Noise monitoring was conducted by Epuron in the period 19 September 2012 through to 4 November 2012 and 13 August 2013 through to 16 September 2013 at 12 locations to determine baseline conditions and establish indicative criteria for surrounding residential receivers.
- Noise was predicted using ISO 9613-2:1996 as implemented in the SoundPLAN computer noise model. The model predicts noise levels through spherical spreading and includes the effect of air absorption, ground attenuation and shielding. The predicted noise levels for the wind range 3 to 12 m/s are then calculated from the sound power levels determined in accordance to the recognised standard IEC-61400-11:2002. The Joule Report was considered in the assessment but it was shown that ISO 9613 produced more conservative prediction results as well as superior correlations to local conditions as found by recent studies.
- Preliminary analysis was undertaken and a simplified limit of 35 dBA for non-project involved receivers and 45 dBA for project involved receivers was adopted. For the majority of non-project involved receivers, assessment has been undertaken for a 35dBA criterion for all wind speeds. This is the minimum criteria value i.e. most conservative.–Locations which had a predicted exceedance of the simplified criteria had background regression curves derived for the nearest monitoring location.
- The captured background noise data was screened for validity, so that data monitored during periods of rain or where the average wind speed at the microphone position likely exceeded 15 m/s (10 m AGL) was discarded from the data set. In addition extraneous data, such as local fauna noise was manually removed. A regression analysis of all valid data is used to determine a line of ‘best fit’ from which the noise limit is established. Note that the wind speed at ground level is not usually monitored. The exception might be where the weather station (used for rain exclusion) was used. The weather station wind speed measurements show an average of 0.9 to 1.2m/s over the various background noise monitoring periods. The wind speed at microphone height (approximately 1.2m) may have an adverse effect on monitored noise levels when sufficiently high wind turbulence on the microphone or wind shield noise contaminates the monitored level. It is generally accepted that a standard 90mm open cell foam wind shield is sufficient provided the local wind speed is less than 5m/s average over the monitoring period, which holds true for this case. A wind shield of this specification was used for background noise monitoring. It is SLR’s experience that for most rural properties with established gardens, windbreak trees and out-buildings, it is rare for the average wind speed to exceed an average of 5m/s at 1.2m above ground level over a 10 minute period. The properties surrounding Liverpool Range Wind Farm fit into this characteristic of rural properties.
- Turbine noise based on the Vestas V112 was then assessed against relevant criteria prescribed by the SA EPA Guideline and World Health Organisation (WHO) goals where appropriate to determine compliance.

10.2.1 Assessment

The criteria for the prioritised locations discussed above, were determined using the following approach:

- Unattended noise loggers were deployed at receptor locations around the proposed wind farm site by Epuron Pty Ltd, with a standard 90mm open cell foam wind shield.
- The loggers were set up to collect background noise data (L_{A90}) in 10-minute intervals. Simultaneous wind speed measurements at wind masts around the site were used to correlated wind speed to background noise. Hub height height wind speed is used for correlation to background noise. Hub height wind speed is derived using the calculated shear value (based on the logarithmic law) for each time stamp using data monitored at several heights above ground.
- The data set was then analysed by SLR Consulting to exclude data that is not representative due to influence of rain or other localised, non-wind induced sources of noise. This is conducted by manual scrutiny of results. Noise levels typically vary quite significantly in rural areas, especially when the dominant sources of noise are wind induced. When higher statistical indices of noise such as the L10 and the average noise level (Leq) are very close to the L90, it can be surmised that the dominant source of noise did not very greatly during the measurement period. Where it was found that constant elevated noise levels combined with the times of day (dawn, dusk etc.) it can be determined that local fauna (insects, frogs, birds etc.) unduly influenced the results and excluded data points are based on this judgement. This approach reduces the influence of non-wind-induced extraneous noise on the background regression curves. Low correlation coefficients occur at sites where background noise levels are not determined by local wind driven sources. This may be for a multitude of reasons including: lack of nearby foliage, other dominant sources e.g. traffic, insects, frogs etc., location is sheltered from wind by topography. For the majority of locations, assessment has been undertaken for a 35dBA criterion for all wind speeds. This is the minimum criteria value i.e. most conservative. As such the background noise curves are only relevant for a small number of receivers.
- A polynomial line was then plotted through the data set to establish a background noise regression curve. This was used to determine the noise limit for that measurement site, which is either:
    - 35 dBA or Background Noise (L_{90}) + 5 dBA, whichever is higher; for non-project involved receivers (SA EPA Criteria)
    - 45 dBA or Background Noise (L_{90}) + 5 dBA, whichever is higher; for project involved receivers (WHO Criteria)

The noise emission of each turbine was modelling at a hub height of 80m above ground level. The reference sound power values listed, based on a hub height of 84 m above ground level, are still valid for prediction purposes. Differences from this change in hub height are unlikely to significantly change the total sound power emitted by the turbine.

The relationship between ground level wind speed and hub height wind speed is specified as part of the measurement standard IEC 61400-11 (Section 8.1 – Wind Speed) i.e. logarithmic law profile. This same equation is used to convert 10 m AGL wind speed back to hub height wind speed, using a roughness of 0.05. Considering the difference in predicted wind speed (8m/s 10m AGL) from the logarithmic profile law between 80 m and 84 m hub heights, the difference in wind speed would be 0.07 m/s. The corresponding difference in emitted sound power level would be negligible.

In addition sound power data from the manufacturer has been provided at multiple heights up to 119m with no change in maximum sound power level, as such modelling the source at 100m would make an insignificant change to the resulting predicted levels.

The assessment of noise from turbines was completed by plotting the predicted noise levels against the limit curves for all wind speeds. An example regression plot is shown in Figure 10-1; the assessment curves for the same location are shown in Figure 10-2.

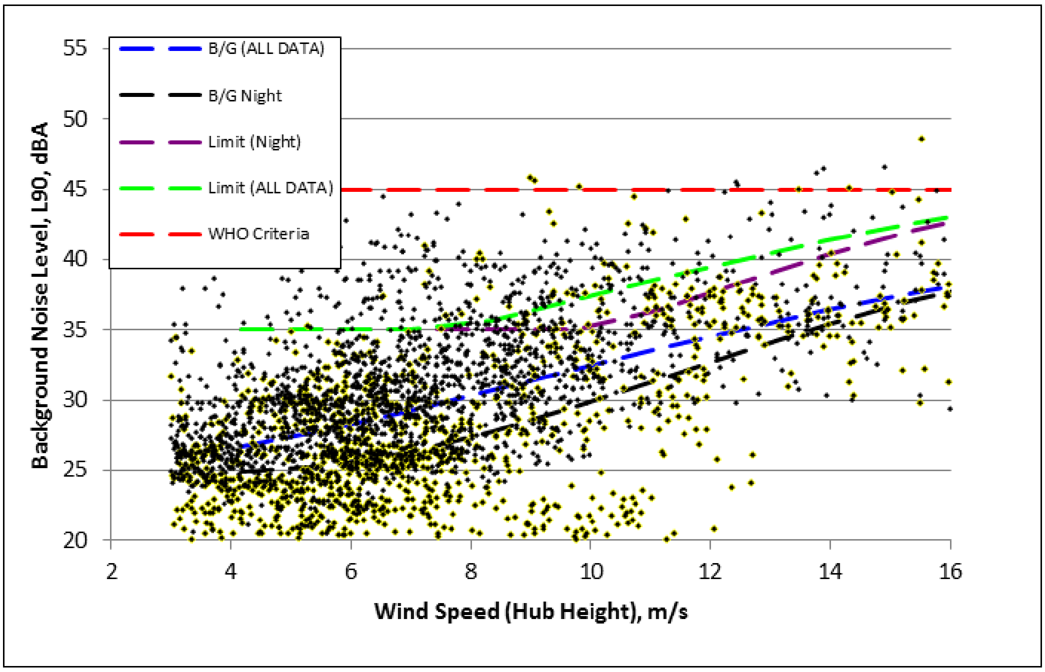

Figure 10-1 Example Background Noise Regression Curve (Location G6-2)

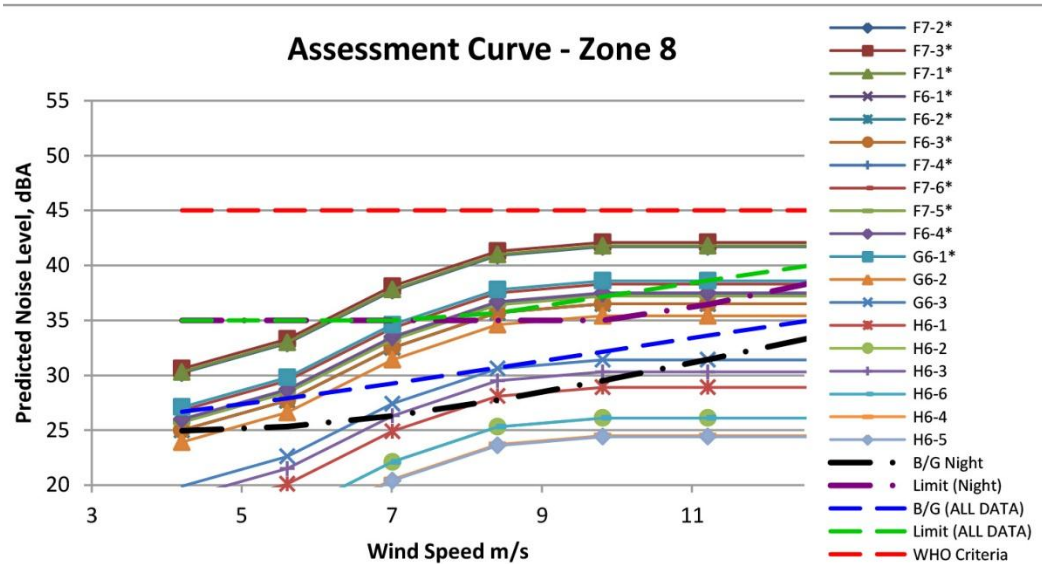

Figure 10-2 Example Assessment Curve (Location G6-2)

In addition to these assessment curves, predicted noise contours have been created for the project, these are shown in Figure 10-3. These are for a wind speed of 8m/s which is both the reference wind speed and also the wind speed at which maximum sound power level occurs.

All receiver locations are predicted to comply with their respective criteria.

It should be noted that all predicted noise levels are considered to be conservative with the model assuming 'hard ground' and average downwind propagation from all turbines to each receiver or a well-developed moderate ground based temperature inversion.

Research into the accuracy of various noise prediction algorithms has been undertaken for Australian conditions, the results being published by the Australian Acoustical Society in April 2012 ('Comparison of predicted and measured wind farm noise levels and implications for assessments of new wind farms, Tom Evans and Jonathan Cooper, Acoustics Australia Vol.40 No.1'). The study compared predicted noise levels with measured results. The study also investigated adjustment of various modelling parameters and ground terrain cross section. For locations where the cross section of ground terrain is 'concave' (as is the case with Liverpool Range Wind Farm) the most accurate results overall were predicted using ISO9613 with ground absorption set to 0 (hard ground assumption). The Joule Project report was not listed as a required con

sideration in the Direction General Requirements and has not been used on other wind farm Noise Impact Assessments undertaken by SLR Consulting. It proposes modifications to the ISO 9613 method for the $A_{barrier}$ and applied a +3dBA correction to terrain cross-section that are deemed 'concave'l the ground absorption value is set to soft ground (G=1). In order to determine the noise predictions that would have been determined from the Joule Report proposed correction to ISO 9613, further analysis has been undertaken. A comparison between the predicted levels with ISO 9613 and the levels predicted with the modified method proposed by the Joule Report has been completed for each receiver. The results showed that the predicted noise levels under a 'hard ground' assumption (SLR method) were higher than the predicted noise levels with soft ground assumption and Joule Project's proposed correction (amended method) by between 1.7dBA and 5.2 dBA. Given the more conservative prediction results, as well as the more recent findings of superior correlation to local conditions by ISO 9613, SLR Consulting are of the opinion that the methodology adopted in the NIA is appropriate in this case.

The project is yet to select and finalise the WTG make and model. Upon finalising the WTG selection a revised noise prediction and assessment will be completed to confirm compliance.

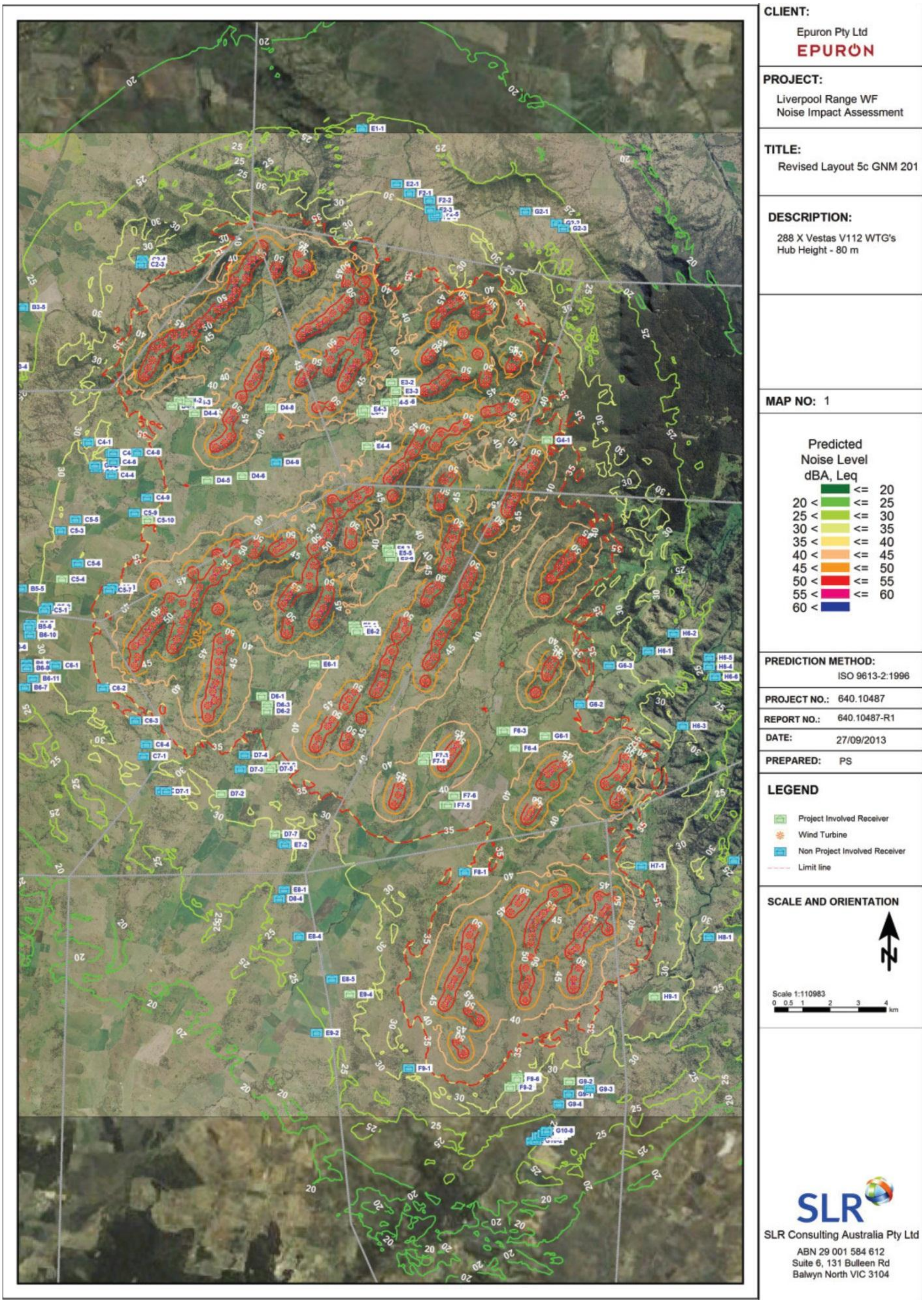

Figure 10-3 Predicted Noise Levels Contour Map, LAeq, vref=8m/s

As requested by the NSW Department of Planning and Environment, additional assessments have been undertaken under the recently released NSW Draft Wind Farm Noise Guidelines. Assessments into low frequency noise and tonality have been undertaken and the results do not indicate any further investigation into these Special Audible Characteristics is required under the draft guidelines.

10.2.2 Mitigation Measures, Monitoring and Adaptive Management

Mitigation measures are required when the turbine layout does not comply with the criteria and as such need to be carried out to ensure compliance. Mitigation measures will be used if necessary once the final turbine is selected and documented in the updated Noise Impact Assessment at pre-construction to ensure compliance. Mitigation would be undertaken on a case by case basis and the appropriateness of any mitigation would depend on a number of factors including:

- the predicted level of exceedance;
- the number of turbines contributing to that noise level;
- any prevalence of noise from a particular direction (turbine or background noise); and
- available background monitoring data for that location

Mitigation measures that may be used include: operating turbines in a reduced 'noise optimised' mode during identified times and conditions (sector management) or removing turbines from the layout.

Monitoring will form part of the compliance monitoring program. The compliance program will commence 3 months before construction commencement and continue on a permanent basis for 2 years post commissioning. Permanent noise loggers will be installed at selected receivers for the duration of the compliance program, with noise data regularly downloaded and any potential exceedances noted for detailed analysis. The selected house locations will comprise of all houses within 2km of a turbine and selected representative houses within 2-5km. A complaint hotline or other means will receive and document noise impacts. This will lead to further investigation and aid in identifying exactly what conditions or times lead to these impacts.

If noise impact complaints arise and upon assessment the wind farm exceeds the relevant criteria then an 'adaptive management' approach could be implemented to mitigate or remove the impact. This process could include;

- Receiving and documenting noise impact complaint through 'hotline' or other means.
- Investigating the nature of the reported impact.
- Identifying exactly what conditions or times lead to the impacts.
- Operating turbines in a reduced 'noise optimised' mode during identified times and conditions (sector management).
- Turning off turbines that are identified as causing the undue impact.
- Providing acoustic upgrades (glazing, façade, masking noise etc.) to affected dwellings.

The type of mitigation required would depend on the conditions which occur when the noise is shown to have an impact as well as site-specific details at the location where the impact is demonstrated. Any noise impact would need to be appropriately investigated by a qualified acoustics consultant to understand which mitigation strategy is most appropriate. Nominating an appropriate management technique is dependent on the nature and times of the impact. The measures outlined above are feasible and can be implemented with the current technology and control systems available in the turbines. Acoustical upgrades can be retrofitted as required using standard building and construction applications. In terms of effectiveness and reliability there are multiple measures for both mitigation and management measures. Having multiple measures provides both redundancy and options to ensure an effective result is achieved. At worst case turbine removal/turbine shutdown will be the final mitigation and management measure that would be carried out if other measures fail. In addition once mitigation or management measurements are carried out the compliance and monitoring program will ensure that these measures are both effective and reliable and that any residual impacts if any would be detected and provide a basis for further management as required. Specific details of the steps involved to mitigate, monitor and manage potential adverse noise impacts would form a part of a Construction Environmental Management Plan for the project which would be completed following approval of the wind farm.

10.2.3 Substations

Australian Standard AS 60076 Part 10 2009: *"Power Transformers – Determination of sound levels"* indicates that the 250 MVA transformer facilities may produce sound power levels up to 100 dBA. The dominant frequency of such transformers is 100 Hz.

Noise predictions for transformer substations have been made and compared to the appropriate NSW Industrial Noise Policy limit and was found to comply at all receptor locations.

10.2.4 Transmission line

SLR have previously measured corona (transmission line) noise. The results show that at a distance of 240m the noise level would be below 35 dBA. Assuming a minimum RBL value of 30 dBA, the minimum intrusive criteria as determined by the NSW INP would be 35 dBA. As such transmission line noise has also been assessed against NSW INP noise limits and has been found to be acceptable as all receiver locations are greater than 240 m from the proposed transmission line.

10.3 Construction

The appropriate criteria for construction noise are provided in the Interim Construction Noise Guidelines (DECCW, 2009).

Proposed construction activities associated with the wind farm include construction of access roads, establishment of turbine tower foundations and electrical substation, digging of trenches to accommodate underground power cables, erection of turbine towers, and assembly of turbines.

The construction period is anticipated to be 24-36 months, with civil works expected to span approximately 12 to 24 months, however, due to the large area of the wind farm site, intensive works will be located within close proximity to individual residential receivers for only very short and intermittent periods of time.

Construction activities associated with the project are planned to be undertaken during standard construction hours as set out in the Interim Construction Noise Guideline (ICNG). Any construction activities outside of the standard construction hours will only be undertaken in the following circumstances:

- Construction activities that generate noise that is:
  - no more than 5dB(A) above rating background level at any residence in accordance with the ICNG (Table 2 of the ICNG); and
  - no more than the noise management levels specified in Table 3 of the ICNG at other sensitive receivers; or
- for the delivery of material required outside those hours by the NSW police Force or other authorities for safety reasons (section 10.11.2); or
- where it is required in an emergency to avoid the loss of life, property and/or to prevent environmental harm; and
- works as approved through the out-of-hours work protocol outlined in the Construction Noise and Vibration Management Plan as part of the Construction Environmental Management Plan.

Construction noise has been predicted to all receivers using SoundPlan Noise modelling software. To examine the possible worst case construction noise impacts for all nearby receivers, four different construction scenarios were modelled at each turbine location and the highest noise levels for each receiver predicted. These are:

- Construction of Access Roads
- Establishment of Turbine Foundations
- Trench Excavation
- Turbine Erection and Assembly

In addition a number of concrete batching plants will be required to supply concrete onsite and modelling using SoundPlan has been carried out.

A number of receivers are deemed to be 'noise affected' under the NSW Construction Noise Guidelines. In order to ensure all appropriate measures are being taken to manage construction noise, a more detailed construction management plan will be developed by the proponent. This document will provide detailed guidance on various noise mitigation strategies for the construction stage.

10.3.1 Blasting

Blasting impact has been assessed to the ANZECC Guideline and found to be acceptable. With a maximum instantaneous charge (MIC) of up to 98 kg, the airblast overpressure is anticipated to be below the acceptable level of 115 dB Linear for all existing residences.

10.3.2 Vibration

The activities and equipment with the potential to generate the highest levels of ground vibration are the operation of the vibratory roller during construction of access roads and the operation of the rock breaker during establishment of turbine tower foundations. It is evident that given the large distances between receptors and structures where construction works are likely to be undertaken (greater than 500m), the building damage and human comfort vibration criteria will easily be met during construction.

10.3.3 Traffic

Construction traffic noise impact has been assessed and the 'worst case' maximum construction traffic generated scenario would comply to the NSW Road Noise Policy requirements, due to the typically large setback of dwellings from the road network. Night-time deliveries are unlikely to cause sleep disturbance based on predicted maximum noise levels.

10.3.4 Mitigation for construction noise

The ICNGH recommend that where residences are deemed 'noise affected', that work practices and mitigation measures deemed feasible and reasonable should be applied. Possible mitigation measures may include:

- Scheduling construction works for less critical times of day
- Using alternative, quieter equipment
- Noise controls including temporary walls/earth beams and exhaust silencers
- Keeping the community informed about upcoming works in the area
- Detailing tracking regarding complaints about construction noise, including how each complaint was addressed.

A detailed construction noise management plan will be developed closer to the construction of the wind farm to ensure that all reasonable steps are taken to reduce noise from construction sources including batching plants, and that appropriate community engagement occurs with respect to construction noise.

10.4 Conclusion

The noise assessment has fed into iterations of the layout to produce the final layout. The predicted noise levels of the layout were determined to meet the relevant criteria at all receptor locations

As the project is yet to select and finalise the WTG make and model a revised noise prediction and assessment will be completed to confirm compliance once this is carried out.

Construction noise prediction has shown a number of receptors to be deemed 'noise affected' under the NSW Construction Noise Guidelines, as such this will be managed with a construction management plan. Construction traffic noise, blasting impact, vibration impact and transmission line noise has all been found to be acceptable.

11 Ecology

11.1 Introduction

A Biodiversity Assessment (BA) has been prepared to assess the ecological impacts of the proposal. The BA covers construction and operational impacts of the proposal.

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

11.1.1 Site description

The Project Area is approximately 40 km (east-west) by 50 km (north-south) and is located between the towns of Coolah and Ulan on the Liverpool Range, central NSW. For the BA, the Project Area was assessed as two study areas: 1) Wind Farm Study Area (development envelope for 288 turbines and associated infrastructure); and 2) Transmission Line Study Area (development envelope for a 330 kV, 60 m wide easement).

11.1.2 Project area

The ranges and undulating terrain within the Project Area are characterised by cleared farmland, mostly derived from Box Gum Woodland on the lower slopes and flats, with Norton Box Woodland and to a lesser degree, Brittle Gum Stringybark Woodland or Mountain Gum Silvertop Stringybark Forest vegetation on the steeper sheltered slopes. Sandstone Forest is common within the flats of the southern half of the Project Area (i.e. Transmission Line Study Area).

In particular, the composition and structure of vegetation types have been modified as a result of managed stock grazing as well as grazing by feral goats. Remnant stands of the original vegetation remain as paddock trees or larger scattered patches of forest/woodland. The midslopes and steeper ridge tops contain the majority of remnant native vegetation, from sparse to moderately treed woodlands. The pasture ranges from exotic to native species dominated. This pattern of vegetation and landuse onsite is common across the locality.

11.1.3 Regional

The Project Area is located along a series of broad ridges and valleys, within the Liverpool Range of NSW. It occurs within three Catchment Management Authority (CMA) regions: 1) Central West CMA; 2) Hunter Central Rivers CMA; and 3) Namoi CMA and is located across four Local Government Areas (LGAs): 1) Warrumbungles; 2) Upper Hunter; 3) Liverpool Plains; and 4) Mid-Western Regional.

The following National Parks (NPs), Nature Reserve (NR) and State Conservation Area (SCA) occur in the vicinity of the Project Area:

- Coolah Tops NP is approximately 2 km east of the Wind Farm Study Area;
- Goulburn River NP is approximately 1.5 km south-east of the Transmission Line Study Area;
- Munghorn Gap Nature Reserve is approximately 4.5 km south of the Transmission Line Study Area at its nearest point; and
- Durridgere SCA will either fall within the transmission line easement, or lie 1.2 km east depending on its final alignment.

The region is largely agricultural, characterised by intensively modified broad floodplains (cereal cropping and grazing) beneath broad basalt ridges (grazing) which has resulted in a significant loss of biodiversity (CMA 2012). Regional biodiversity issues include inappropriate grazing management, habitat degradation and fragmentation, increasing dryland salinity, loss of native vegetation (i.e. clearing of native woodlands and grasslands), invasive pest species (foxes, goats, environmental, agricultural and noxious weeds), and conserving remnant vegetation on private lands (CMA 2012).

11.2 Approach, Survey Methods and Effort

11.2.1 Impact assessment approach

The BA was preceded by a Biodiversity Constraints Analysis (**ngh**environmental 2012) to spatially identify key ecological values that represent a constraint to the proposal. All field surveys and the *Biodiversity Constraints Analysis* (**ngh**environmental 2012) were undertaken based on a development envelope, that is, a broad area within which the wind farm components and associated infrastructure would be located. A larger area than needed is considered, giving the proponent flexibility to make design changes in response to biodiversity values and constraints identified.

The development envelope has been progressively refined over the course of the assessment phase with indicative turbine locations sited and indicative alignment options investigated. An initial assessment was based on field work conducted in 2012. Additional survey work and was undertaken in spring 2013 following changes to the proposed layout and transmission line route options. The impact assessment has been applied to the worst case scenario which incorporates the longest transmission line route and assessment of all 288 turbine footings and associated infrastructure (i.e. proposed tracks, overhead powerlines, and substations).

11.2.2 Desktop assessment

A desktop assessment was undertaken involving database searches of NSW and Commonwealth threatened (and migratory) species, populations and communities. Database searches included the *Atlas of NSW Wildlife* database, searched by the three CMAs (searched 3 October 2012 and again on 5 November 2013) and an EPBC Act *Protected Matters Search Tool,* using the Project Area boundary as the search area with a 10 km buffer (searched 3 October 2012 and again on 5 November 2013).

Topographic maps, aerial imagery, previous surveys, web-based literature and other databases (i.e. Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) website for Species Profiles and Threats (SPRATs), Birds Australia and Shorebirds 2020 websites), recovery plans, conservation advice and policy statements for nationally listed species and ecological communities were also consulted. These information sources were used to identify known and potential ecological values, as well as analyse landscape connectivity.

11.2.3 Field work

The Project Area was visited three times during the preparation of the BA. An overview site reconnaissance was undertaken by three ecologists over a two day period in November 2009, prior to field surveys, to understand the variability of the site and broad habitat types and condition. Two Spring-time surveys were undertaken as part of the detailed assessment, the first over a 12 day period (the 8th to 19th October 2012) and the second over a nine day period (1st to 8th October 2013). The 2013 survey focussed primarily on the Transmission Line and was undertaken to address specific information gaps and survey alternative route options.

11.2.4 Flora methods and effort

Combined survey effort for flora over the wind farm and transmission line study area amounts to:

- 210 random meanders / flora plots including targeted searches;
- 166 rapid vegetation inspection points; and
- 133 person hours of survey effort.

11.2.5 Fauna methods and effort

Approximately 435 person hours were spent on fauna surveys (131.2 (WF) and 303.4 (TL)), excluding camera trap and Anabat survey effort. Habitat assessment was the primary survey method for species with potential to be affected by habitat loss. Targeted surveys focussed on fauna known to be most affected by wind farms, that is, fauna with potential for blade-strike impacts (birds and bats). Survey types and methods are listed below (refer to the appended BA for a full description):

- 133 habitat assessment plots;
- Targeted surveys including:
  - 80 bird utilisation surveys including recording abundance and classifying flight height (30 minute census);
  - 39 reptile hand searches targeting the potential threatened reptile habitat (30 minute search);
  - 434 rapid herpetofauna and bird surveys (10 minute census);
  - 58 microbat trap nights using 'Anabat' ultrasonic microbat call detection recording equipment (27 sites);
  - 134 nocturnal surveys including call playback and spotlighting, focussing on threatened owls and mammals in suitable habitat; and
  - 67 infra-red motion-sensitive camera trap nights, targeting threatened mammals.

- The following were recorded by hand-held GPS to assist spatial analysis:
  - All raptor sightings;
  - All threatened species sightings; and
  - All habitat features of importance.

11.3 Results: Vegetation and Flora

11.3.1 Vegetation types

Seventeen vegetation types were observed within the development envelope. Descriptions of the following are presented in the BA documents and their locations and condition are mapped in Appendix E.3 of the BA:

- Black Cypress Pine - Ironbark -/+ Narrow-leaved Wattle low open forest mainly on Narrabeen Sandstone in the Upper Hunter region of the Sydney Basin Bioregion (ID480);
- Bottlebrush riparian shrubland wetland (ID333);
- Brittle Gum - Silvertop Stringybark grassy open forest of the Liverpool Range (ID495);
- Derived Speargrass – Wallaby Grass – wire grass mixed forb grassland mainly in the Coonabarabran – Pilliga – Coolah region (395);
- Grey Box x White Box grassy open woodland on basalt hills in the Merriwa region (ID483);
- Inland Scribbly Gum – Red Stringybark – Black Cypress Pine – Red Ironbark open forest on sandstone hills in the southern Brigalow Belt South Bioregion and northern NSW South Western Slopes Bioregion (ID477);
- Narrow-leaved Ironbark - Black Cypress Pine +/- Blakely's Red Gum shrubby open forest on sandstone low hills in the southern BBS Bioregion (ID468);
- Narrow-leaved Ironbark- Black Cypress Pine - Stringybark +- Grey Gum +- Narrow-leaved Wattle shrubby open forest on sandstone hills in the southern BBS - Sydney Basin Bioregions (ID479);
- Red Ironbark - Black Cypress Pine - Stringybark -/+ Narrow-leaved Wattle shrubby open forest on sandstone in the Gulgong - Mendooran region, southern BBS Bioregion (ID478);
- River Oak – Rough-barked Apple – Red Gum – box riparian tall woodland (ID084);
- Rough-barked Apple - Blakely's Red Gum - Narrow-leaved Stringybark +/- Grey Gum sandstone riparian grass fern open forest on in the southern BBS and Upper Hunter regions (ID481);
- Rough-barked Apple – Blakely's Red Gum – Yellow Box woodland on alluvial clay to loam soils on valleys floors in the northern South-west Slopes and BBS Bioregions (ID281)

- Silvertop Stringybark – Forest Ribbon Gum very tall moist open forest on basalt plateau on the Liverpool Range (ID490);
- Silvertop Stringybark - Yellow Box – Norton's Box grassy woodland on basalt hills mainly on northern aspects of the Liverpool Range (ID488);
- Yellow Box grassy woodland on lower hillslopes and valley flats in the southern Brigalow Belt South bioregion (ID437);
- Planted Vegetation (windbreaks); and
- Exotic Pasture and Crops

11.3.2 Threatened flora and vegetation communities

11.3.2.1 Threatened species / communities evaluation

The database searches (EPBC Act Protected Matters and NSW Wildlife Atlas databases) indicated 46 threatened species or their habitat and six endangered ecological communities could occur in the Project Area. A threatened species evaluation was undertaken to evaluate the presence of habitat in the Project Area and the likelihood of occurrence and impact from the proposal for each identified species and community. This evaluation is presented in full in Appendix C.1 and C.2 of the BA. Table 11-1 lists threatened flora species or EECs that are considered possible to occur and have at least marginal (or potential or known) habitat present in the Project Area.

Table 11-1 Threatened flora and ecological communities with potential to occur in the Project Area

Flora Species or EEC	***Status***	***Habitat***	***Identified on site?***
Box Gum Woodland	EEC TSC CEEC EPBC	Grassy woodland on flats, slopes or ridges on higher fertility soils.	Yes
Austral Toadflax (*Thesium austral*)	V TSC V EPBC	Grassy woodland and secondary grassland in areas with low grazing pressure	No
Ausfeld's Wattle (*Acacia ausfeldii*)	V TSC	Forest on sandstone	Yes
Bluegrass (*Dichanthium setosum*)	V TSC V EPBC	Woodland or native pasture on basalt soils	No
Finger Panic Grass (*Digitaria porrecta*)	E TSC E EPBC	Woodland or native pasture on basalt soils	No
Homoranthus darwinoides	V TSC V EPBC	Forest on sandstone	No
Capertee Stringybark (*Eucalyptus cannonii*)	V TSC V EPBC	Forest on sandstone	No
Kennedia retrorsa	V TSC V EPBC	Forest on sandstone	No
Ozothamnus tesselatus	V TSC V EPBC	Forest on sandstone	No
Calendula Geebung (*Persoonia marginata*)	V TSC V EPBC	Forest on sandstone	No
Lasiopetalum longistamineum	V TSC V EPBC	Forest on sandstone	No
Leek Orchid (*Prasophyllum* sp. Wybong)	CE EPBC	Open woodland and grassland, most likely vegetation community 481, which is less affected by grazing.	No
Philotheca ericifolia	V EPBC	Forest on sandstone	No

Flora Species or EEC	***Status***	***Habitat***	***Identified on site?***
Wollemi Mint Bush (*Prostanthera cryptandroides*)	V TSC V EPBC	Forest on sandstone	No
Mount Vincent Mint Bush (*Prostanthera stricta*)	V TSC V EPBC	Forest on sandstone	No
Pultenaea sp. Olinda	E TSC	Forest on sandstone	No
Rulingia procumbens	V TSC V EPBC	Sandy soils, often near water or in seasonally wet areas.	No
Silky Swainson-pea (*Swainsona sericea*)	V TSC	Grassy woodland and secondary grassland in areas with low grazing pressure	Yes

KEY: TSC Act – Threatened Species Conservation Act 1995; EPBC – Environment Protection and Biodiversity Conservation Act 1999; V – Vulnerable; E – Endangered; CE – Critically Endangered.

11.3.2.2 Endangered Ecological Community: Box Gum Woodland

The Box Gum Woodland EEC listed under the NSW TSC Act was recorded during the 2012 and 2013 surveys as the Yellow Box grassy woodland, Grey Box x White Box grassy open woodland, and Rough-barked Apple – Blakely's Red Gum – Yellow Box woodland vegetation communities. The EEC community may consist of (1) woodland areas with or without native understorey and (2) grasslands and pastures dominated by native grasses that are derived from the community. The Commonwealth EPBC Act sets more stringent criteria for the recognition of the Box Gum Woodland Critically Endangered Ecological Community (CEEC) listed under that Act.

The proposal would require the removal of both TSC and EPBC listed EEC as follows:

- TSC EEC Theoretical maximum of 462.8 ha to be removed or modified (of which 284.3 ha is considered to be in poor or poor-moderate condition) and
- EPBC EEC Theoretical maximum of 23 ha to be removed or modified.

Approximately 192.3 ha (42%) of the maximum 462.8 ha of Box Gum Woodland within the development envelope is in 'low condition' according to the NSW OEH Biometric condition definitions (DECC 2008), and the remaining 270.5 ha is considered to be in 'moderate-good' condition.

11.3.2.3 Vegetation Condition

Vegetation condition varies considerably throughout the Project Area and includes woodland and fragmented woodland which has been logged and is regenerating, native pasture with scattered trees, pasture dominated by exotic species, and, mainly in the Transmission Line Study Area, some large tracts of relatively undisturbed forest. Woodland areas do not support a mosaic of tree ages and consist largely of regrowth. The majority of the Wind Farm Study Area has been subject to long-term grazing (cattle and goats) which has reduced the diversity of native flora. In many areas, the canopy layer is present (often sparsely) but the mid- or shrub-layer is absent. The dry forest vegetation communities that are common throughout the Transmission Line Study Area consist of remnant and long-term regrowth vegetation, or have been selectively logged historically. These areas often contain a diversity of canopy tree species as well as numerous shrubs and groundcover species. Habitat features such as hollow-bearing trees, fallen timber, and rocky outcrops can be common or infrequent depending on the disturbance history of the locality.

Common pasture weeds associated with grazing are widespread and have invaded areas of more intact woodland and forest vegetation. Nine noxious weeds listed in the Mid-Western Regional and Warrumbungle Council control areas were recorded in the Project Area. Of these, only Sweet Briar (*Rosa rubiginosa*), St John's Wort (*Hypericum perforatum*) and Prickly Pear (*Opuntia* sp.) are common in restricted areas. The presence of large numbers of goats, either semi-feral or domestic, over much of the Wind Farm Study Area has contributed to keeping the extent of woody weed growth and invasion relatively low.

11.4 Results: Fauna

11.4.1 Habitat types

Fauna habitat in the Project Area includes open pasture (native or exotic) with scattered trees, open woodland, and dry forest. Additional habitat features occurring within the four main habitat types include hollow-bearing trees, fallen timber, rocky outcrops, and riparian/aquatic zones.

Habitat condition across the Project Area was variable due to differing soil types, disturbance histories and present land management. Habitat condition was generally of low to moderate quality due to past clearing and ongoing grazing; however, habitat quality increased in the north-eastern and southern sections of the Project Area which supported more intact forest in close proximity to protected areas (national parks and state reserves).

11.4.2 Threatened and migratory fauna

The database searches (EPBC Act protected matters search and NSW Wildlife Atlas) indicated 88 threatened species or their habitat had the potential to occur in the Project Area. A threatened species evaluation was undertaken to determine the presence of habitat in the Project Area and the likelihood of occurrence and impact from the proposal for each species and community identified. This evaluation is presented in full in Appendix C.3 of the BA. Table 11-2 lists threatened fauna species that are considered possible to occur and have at least marginal (or potential or known) habitat present in the Project Area. Species recorded during the survey are identified within the table.

Table 11-2 Threatened fauna with potential to occur in the Project Area

Species	*Status*	*Habitat*	*Identified on site?*
Reptiles			
Pink-tailed Worm Lizard (*Aprasia parapulchella*)	V TSC; V EPBC	Open woodland with predominantly native grasses and natural temperate grasslands on well-drained slopes with scattered, partially-buried rocks.	No
Birds			
Speckled Warbler (*Chthonicola sagittata*)	V TSC	Habitats typically are structurally diverse with a grassy understorey, a sparse shrub layer and an open canopy.	Yes
Brown Treecreeper (*Climacteris picumnus victoriae*)	V TSC	Occurs in eucalypt woodlands, mallee and drier open forest of eastern Australia, preferring woodlands lacking dense understorey.	Yes
Varied Sittella (*Daphoenositta chrysoptera*)	V TSC	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands.	Yes
White-fronted Chat (*Epthianura albifrons*)	V TSC	Damp open habitats along the coast, and near waterways in the western part of the state.	No
Painted Honeyeater (*Grantiella picta*)	V TSC	Inhabits dry open forests and woodland including Boree, Brigalow and Box Gum Woodlands and Box-Ironbark open forests, also paperbark and casuarinas.	Yes
Black-chinned Honeyeater (*Melithreptus gularis gularis*)	V TSC	Drier open forests or woodlands dominated by box and ironbark eucalypts, particularly Mugga Ironbark, White Box, Grey Box, Yellow Box and Forest Red Gum.	Yes
Regent Honeyeater (*Anthochaera Phrygia*)	E TSC; E EPBC; M EPBC	Most records are from box-ironbark eucalypt associations and it appears to prefer wetter fertile sites within these associations.	No
Hooded Robin (*Melanodryas cucullata cucullata*)	V TSC	Woodland remnants with high habitat complexity and uses stumps, posts or fallen timber for nesting and locating prey on the ground.	No
Scarlet Robin (*Petroica boodang*)	V TSC	Open forests and woodlands from the coast to the inland slopes. Scarlet robins breed in dry eucalypt forests and temperate woodland.	Yes
Flame Robin (*Petroica*	V TSC	Breeds in upland forests and woodlands and migrates to more open	No

Species	Status	Habitat	Identified on site?
phoenicea)		lowland habitats in winter.	
Diamond Firetail (*Stagonopleura guttata*)	V TSC	Restricted largely to ungrazed or lightly grazed woodland remnants of grassy eucalypt woodlands, including Box-Gum and Snow Gum Woodlands, grassland and riparian areas.	Yes
Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)	V TSC	Prefers Box Gum Woodlands although also inhabits open forests, scrub lands, even farmlands and suburbs.	Yes
Little Lorikeet (*Glossopsitta pusilla*)	V TSC	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also forages in Angophoras, Melaleucas and other tree species, as well as riparian habitats.	Yes (off-site)
Glossy Black-cockatoo (*Calyptorhynchus lathami*)	V TSC	Inhabits open forest and woodlands of the coast and the Great Dividing Range up to 1000 m in which stands of She-oak species are present.	Yes
Gang-gang Cockatoo (*Callocephalon fimbriatum*)	V TSC	Often a seasonal altitudinal migrant, moving to lower altitudes and more open forests and woodlands (particularly Box-Ironbark assemblages for winter.	Yes
Turquoise Parrot (*Neophema pulchella*)	V TSC	Occurs in grassy woodland and open forest carrying a mixed assemblage of White Box, Yellow Box, Blakely's Red Gum, Red Box and Red Stringybark.	No
Square-tailed Kite (*Lophoictinia isura*)	V TSC	Occurs primarily in coastal and sub-coastal open forest, woodlands and mallee and has been recorded inland along timbered watercourses.	Yes
Little Eagle (*Hieraaetus morphnoides*)	V TSC	Occupies open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used.	No
Grey Falcon (*Falco hypoleucos*)	E TSC	Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.	No
Spotted Harrier (*Circus assimilis*)	V TSC	Occurs in a variety of habitats including grassy open woodland and riparian woodland.	No
Barking Owl (*Ninox connivens*)	V TSC	Occurs in dry box-dominated forest and woodlands and roosts in dense foliage of Acacia, Casuarina or Eucalyptus species. It nests in large hollows of large, old eucalypts.	No
Powerful Owl (*Ninox strenua*)	V TSC	This species occurs primarily in tall, moist productive eucalypt forests of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests on undulating, gentle terrain nearer the coast.	Yes
Masked Owl (*Tyto novaehollandiae*)	V TSC	Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Lives in dry eucalypt forests and woodlands from sea level to 1100 m.	No
White-throated Needletail (*Hirundapus caudacutus*)	M EPBC	Recorded in the airspace above woodlands, forests and farmlands. Often seen 'patrolling' favoured feeding grounds above ridges and hilltops. This species migrates to Australia from mid-October and is a regular summer migrant until April when it returns to breed.	No
White-bellied Sea-eagle (*Haliaeetus leucogaster*)	M EPBC	Occurs around coastal areas, islands and estuaries, but is also found in inland areas around large rivers, wetlands and reservoirs.	Yes (off-site)
Mammals			
Squirrel Glider (*Petaurus norfolcensis*)	V TSC	Mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest.	Yes
Koala (*Phascolarctos cinereus*)	V TSC; V EPBC	Occurs in woodland communities, coastal forests, woodlands of the tablelands and western slopes and the riparian communities of the	No

Species	***Status***	***Habitat***	***Identified on site?***
		western plains.	
Large-eared Pied Bat (*Chalinolobus dwyeri*)	V TSC; V EPBC	Found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. It roosts in caves (near their entrances), crevices in cliffs, old mine workings.	Yes
Little Pied Bat (*Chalinolobus picatus*)	V TSC	Occurs in dry open forest, open woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, bimbil box.	No
Little Bentwing-bat (*Miniopterus australis*)	V TSC	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas.	No
Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	V TSC	Roosts and raises its young in caves and mine tunnels. The species appears to forage above the forest canopy in a diverse range of forest types.	Yes
Corben's Long-eared Bat (*Nyctophilus corbeni*)	V TSC; V EPBC	Overall, the distribution of the south eastern form coincides approximately with the Murray Darling Basin with the Pilliga Scrub region being the distinct stronghold for this species.	Yes
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V TSC	It roosts alone or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows.	Yes
Eastern Cave Bat (*Vespadelus troughtoni*)	V TSC	Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW.	Yes
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V TSC	Found in wet sclerophyll forest and coastal mallee. It appears to prefer wet sclerophyll forest although also utilises open forest at lower altitudes.	No
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V TSC	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.	No
Greater Long-eared Bat (*Nyctophilus timoriensis*)	V TSC V EPBC	Inhabits a variety of vegetation types, including mallee, bulloke but more commonly box/ironbark/cypress-pine communities that occurs in a north-south belt along the western slopes and plains of NSW and southern Queensland.	No

11.4.3 Raptors

Seven species of common raptors were seen in the Project Area and include: Brown Falcon (*Falco berigora*); Nankeen Kestrel (*Falco cenchroides*); Australian Hobby (*Falco longipennis*); Black Kite (*Milvus migrans*), Whistling Kite (*Haliastur sphenurus*), Black-shouldered Kite (*Elanus axillaris*); and Wedge-tailed Eagle (*Aquila audax*). These raptors were seen in a variety of landscape positions, mostly in pasture with scattered trees or along the edges of forest or woodland. In addition to the common species, an adult White-bellied Sea-eagle (*Haliaeetus leucogaster*) was observed off-site in the Transmission Line Study Area, and a Square-tailed Kite (*Lophoictinia isura*) utilising an active nest was recorded along the Goulburn River. White-bellied Sea-eagles are not listed as threatened in NSW, however they are considered a migratory species under the EPBC Act due to the potential for young birds and some adults to disperse over large distances. The Square-tailed Kite is listed as a vulnerable species under the TSC Act, and is a summer breeding migrant to the south-east region.

11.5 Design Measures to Avoid Impact

The proposal has been developed with input from a biodiversity constraints analysis to assist in avoiding biodiversity impacts as a starting point. Detailed mitigation prescriptions have been developed to address the remaining risks, aimed at avoiding a significant impact on any listed threatened entity. The development of an offset site to be managed for biodiversity conservation in perpetuity forms part of the proposal.

The calculation of estimated impact area has been defined as the 'worst case impact area' and was identified as the longest transmission line route option being considered. It also includes the upper number of turbines (288) and associated infrastructure (i.e. proposed tracks, overhead powerlines, and substations). The impact assessment was applied to the Project Area, but focused on this worse cast scenario.

Avoidance measures to minimise vegetation clearing have included:

- a substantial reduction in the size of the wind farm, from 417 turbines to 288 turbines, to mitigate impacts on birds and bats;
- the assessment of two additional alternative transmission line routes to determine which route will minimise impacts on biodiversity, including vegetation clearing; and
- modifying the proposed transmission line routes to avoid particularly sensitive sites of high biodiversity value (e.g. relocating the transmission line to avoid any impacts on the active Square-tailed Kite nest).

11.6 Impact Assessment

11.6.1 Types of impacts

Three primary adverse biodiversity effects were assessed:

- Habitat loss (vegetation clearance);
- Blade-strike (bird and bat collisions with turbines or barotrauma); and
- Alienation or barrier effects (behaviour change in fauna).

11.6.2 Habitat loss (vegetation clearance)

The proposal originally included scope for the development of up to 417 turbines. This was reduced to 288 turbines due to the north-eastern section of the wind farm potentially impacting the birds and bats of Coolah Tops National Park. The proposal would result in the removal of vegetation within the development footprint, as a result of (1) turbine towers, surrounding hardstand and crane operation areas, substations, control building, access tracks and overhead powerlines and (2) an extended (approximately 38 km) 330 kV transmission line that joins to the existing grid near Ulan. Electrical cabling would be installed adjacent to disturbed areas for the access tracks where possible.

Quantitative worst-case clearing estimates of permanent habitat loss are given below for each vegetation type and condition class and for Box-Gum Woodland. Impact areas by vegetation type were calculated using GIS mapping software, however it should be noted that total habitat loss figures are *overestimated* due to (1) the assessment of a 60 m-wide clearing effort despite the actual extent of clearing being considerably less, and (2) overlaps of infrastructure, for example tracks crossing hardstand areas (Table 11-3).

The Project Area covers approximately 7,127.7 ha. Within the development envelope the bulk of vegetation clearance affects exotic vegetation (approximately 750 ha, of which the bulk falls within the Wind Farm Study Area). Of the native vegetation types identified within the Project Area, few were recorded in moderate-good condition; those most evident included (1) Sandstone Forest on the sandstone soil flats in the south of the Project Area supported up to 45.9 ha of good condition forest, which was substantially higher than any other vegetation type and (2) Norton Box Woodland on basalt slopes of the Project Area (ridges) supports 11.5 ha of good or 9.5 ha of moderate-good condition vegetation. Norton Box Woodland is considered to be 'vulnerable' by Benson *et al.* (2010), as substantial areas have been cleared or subject to grazing. The Sandstone Forest vegetation communities are considered to be of least concern by Benson *et al.* (2010), as substantial areas are conserved in protected areas in the region.

Over the vast majority of the Project Area, the Box Gum Woodland EEC is characterised by low diversity native pasture in poor condition. Within the development envelope, the estimated amount of EEC to be cleared accounts for up to 462.8 ha (depending on the realised transmission line route), of which 284.3 ha of is in poor or poor-moderate condition and 164.5 ha are of moderate condition. High-quality areas estimated to be cleared account for up to 23 ha of the area assessed, with substantially lower areas for the preferred and 2nd alternative routes. These high-condition areas also fall under the definition of the EPBC-listed Box Gum Woodland CEEC.

Table 11-3 Estimated permanent impact areas by vegetation condition

Vegetation Type	Condition							Total (ha)
	Good	Mod-Good	Moderate	Poor-Mod	Poor	Exotic	Not Assessed	
Wind Farm Study Area								
Brittle Gum Stringybark Woodland			1.8		1.8			3.7
Mountain Gum Silvertop Stringybark Forest					1.0			1.0
Norton's Box Woodland	11.5	9.5	20.3	26.1	37.9			105.4
Riparian Forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box					45.1			45.1
River Oak Woodland					15.7			15.7
White Box / Grey Box Grassy Woodland			5.2	27.7	103.2			136.1
Yellow Box Woodland					3.6			3.6
Native Pasture			167.0	17.6	39.8			224.4
Exotic Pasture						737.7		737.7
Not Assessed							131.2	131.2
Total	**11.5**	**9.5**	**194.4**	**71.4**	**248.2**	**737.7**	**131.2**	**1404.0**
Transmission Line Study Area								
Riparian Forest - Rough-barked Apple and Blakely's Red Gum	12.1	2.0	2.9	9.5				26.5
Riparian Forest - Rough-barked Apple, Blakely's Red Gum and Yellow Box	1.3	2.6			0.4			4.3
Sandstone Forest - Black Cypress Pine dominant			2.9					2.9
Sandstone Forest - Inland Scribbly Gum dominant	7.8	23.7						31.5
Sandstone Forest - Narrow-leaved Ironbark dominant	7.5	27.7	15.3	0.5	0.2			51.1
Sandstone Forest - Red Ironbark dominant	2.8	15.0						17.8
White Box / Grey Box Grassy Woodland				1.8	8.9			10.7
Native Pasture			0.4	106.8	5.1			112.3
Exotic Pasture						14.4		14.4
Not Assessed							87.7	87.7
Total	**31.6**	**71.1**	**21.5**	**118.6**	**14.6**	**14.4**	**87.7**	**359.4**

11.6.3 Blade-strike (bird and bat collisions)

A range of direct and indirect impacts of wind farms on birds and bats have been recognised in recent years, with mortality via direct collision with moving turbine rotors being an obvious impact (Madders and Whitfield 2006; Smales 2006). Collision risk can be defined as the likelihood of individual species migrating, feeding or roosting in the proximity of a wind farm which may lead to collisions with wind turbines and other infrastructure (Drewitt and Langston 2006). Industry research reveals that the species that appear to be most susceptible to population scale impacts due to blade-strike are common species and are of the groups: large sedentary raptors, fast high flying microchiropteran bats, and fast high flying non-passerines (MacMahon 2010, Roaring 40s Renewable Energy 2010, Smales 2006).

The potential magnitude of operational impacts upon populations of individual species is difficult to predict without undertaking population viability analysis, outside the scope of this assessment. However, we can assume population scale impacts are likely to be greater for species with low fecundity and that occur at naturally low numbers in the landscape. Based on the analysis presented in the BA documents, the following species are most likely to be at high risk from operational impacts of the proposal: Little Lorikeet, Wedge-tailed Eagle; Little Eagle; Brown Falcon; Eastern Bentwing Bat; White-striped Freetail-bat; and Gould's Wattled Bat; Yellow-bellied Sheathtail-bat; and Eastern Cave Bat.

Based on the collision risk modelling, suggesting birds avoid turbines 98-99% of the time (with the exception of Wedge-tailed Eagles which have an avoidance rate of 90-95%), it is considered that the proposal will not have an adverse effect on these raptor species. Additionally, these species were not recorded in high abundance during the field survey, especially Brown Falcons. The high risk bat species generally forage above the canopy and are at risk of blade-strike. Carcasses of the White-striped-bat and Gould's Wattled Bat have been found at a number of monitored wind farms in NSW and Victoria (Richards, unpublished). The implementation of an Adaptive Bird and Bat Management Plan with focus on these raptor and microbat species will provide detail on habitat utilisation and foraging patterns.

11.6.4 Alienation or barrier effects (including landscape connectivity)

Alienation involves changes in behaviour (such as avoiding nesting or foraging resources) and habitat utilisation (such as diverging around the broad area where turbines are located). A barrier effect may cause birds and microchiropteran bats to alter their flight pathways to avoid the wind farm area (Brett Lane & Associates 2009).

Within the proposed layout the turbines will be placed around 300-600 m apart. The current distance between turbine clusters (e.g. ridgelines or properties) and the distance between individual turbines is likely to allow for safe passage between turbines for birds and bats, without creating a barrier effect; however, within areas of intact woodland or forest the greater the turbine spacing (i.e. 600 m apart) the better for biodiversity. A minimum buffer of 100 m from the turbine blades has been recommended for areas of high habitat value for birds and bats (i.e. areas of moderate-good or good condition woodland / forest). For high risk fauna, a 50 – 100 m buffer around nest sites is also prescribed to avoid locating turbines in these areas. It is considered that tracks and other infrastructure can be micro-sited to avoid impacting such features.

As the development layout is largely within a highly disturbed and fragmented agricultural landscape there is limited opportunity for the turbine layout to sever movement corridors for faunal species. However, two areas were highlighted as a potential barrier effect to fauna and included the north-east section (near Coolah Tops NP) and the southern section of the wind farm (near Durridgere SCA and Goulburn River NP). Operational impacts to the Powerful Owl, microchiropteran bats or habitat loss (fragmentation or breeding sties) for the Squirrel Glider, Glossy Black-cockatoo and woodland birds are most worthy of consideration and have been discussed further in the BA documents.

11.6.5 Indirect and peripheral impacts

As well as direct impacts already discussed, ecological impacts may arise from vehicle access and parking, as well as the laydown and stockpiling of materials. Peripheral impacts may include smothering of vegetation, soil compaction and erosion, introduction and spread of weed species, pollution associated with the generation of dust and use of concrete, fuels, lubricants and construction chemicals, and noise, vibration and activity during the construction phase.

With the implementation of specific measures for these peripheral impacts such as weed control, erosion and sediment control, these risks are considered manageable. Further it is noted that indirect impacts are likely to be of low magnitude temporally and spatially, considering the spread and design of infrastructure proposed.

11.7 Assessment of Significance

Assessments of Significance (AoS) were undertaken for threatened species that are present or will potentially occur in the Project Area and were considered to be at moderate or high risk of being impacted. The assessments are presented in Appendix D and discussed in Section 10 of the Wind Farm Study Area BA report.

11.7.1 Flora and vegetation communities

Assessments of Significance have been undertaken for Box Gum Woodland. The proposal would result in the removal of up to 462.8 ha of the TSC-listed Box Gum Woodland EEC, of which a considerable portion (284.3 ha) is in poor to poor-moderate condition with little chance of recovery. The proposal would also remove up to 23 ha of the Commonwealth Box Gum Woodland CEEC, although will likely remove less than 10 ha. Assessments of significance under TSC and EPBC Acts concluded that the removal of this extent of Box Gum Woodland from the region is not considered to be significant. However, this is subject to the implementation of the controls and recommendations of the BA, including offsetting impact to the CEEC. In particular, the proposal would not produce impacts on this community such that the local extent would be placed at risk of extinction.

Assessments of Significance were also undertaken for the plant species Dichanthium setosum, Digitaria porrecta, Bothriochloa biloba and Swainsona sericea, and Acacia ausfeldii. No known individuals are expected to be removed by the proposal, although some habitat may be removed temporarily and a smaller amount will be removed permanently. These AoSs determined that there is unlikely to be a significant impact on any of the threatened flora species known or expected to occur within the boundaries of the Project Area.

11.7.2 Fauna

Assessments of Significance have been undertaken for: Speckled Warbler; Brown Treecreeper; Diamond Firetail, Varied Sittella; Painted Honeyeater; Black-chinned Honeyeater; Grey-crowned Babbler; Scarlet Robin; Turquoise Parrot; Little Lorikeet; Glossy Black-cockatoo; Square-tailed Kite; Powerful Owl; Masked Owl; Barking Owl; Squirrel Glider; Eastern Bentwing-bat; Yellow-bellied Sheathtail-bat; Eastern Cave Bat; Corben's Long-eared Bat; and the Large-eared Pied Bat.

Seven threatened small woodland/forest bird species were recorded within Project Area: the Speckled Warbler; Brown Treecreeper; Varied Sittella; Painted Honeyeater; Black-chinned Honeyeater; Grey-crowned Babbler; and the Scarlet Robin. An eighth species, the Little Lorikeet, was recorded to the north of the Project Area during the survey period. These species were considered unlikely to occur over the majority of the Wind Farm Study Area due to the degradation, fragmentation and open nature of habitats.

Glossy Black-cockatoos were recorded a number of times in 2013 (despite not being recorded in 2012), often in the larger tracts of Sandstone Forest communities in the Transmission Line Study Area, where the two species of feed trees, *Allocasuarina diminuta* and *A. gymnanthera*, were relatively abundant.

Of the threatened owl species predicted to occur in the region, only Powerful Owls were recorded during the surveys. Masked and Barking Owls are considered to be possible occurrences, based on local records and habitat characteristics. These owls may be impacted by loss of habitat, including potential roost hollows and loss of habitat affecting the prey base for these species (e.g. arboreal mammals for the Powerful Owl).

A TSC-Act listed vulnerable Square-tailed Kite was observed nesting on the proposed transmission line route, which has since been relocated to avoid impacting this sensitive site. As the species is a slow flyer (frequently circling immediately above the canopy) and at little risk of being impacted by the turbines or transmission line infrastructure, the proposal is not considered likely to significantly impact this species. The threatened raptor species Little Eagle and Grey Falcon are considered 'possible' and 'possible but unlikely' occurrences, respectively. Operational impacts (blade-strike) have some potential to affect these species. As no active nests of these species were found or considered likely within 100 metres of surveyed proposed turbine locations, the risk to fledging Little Eagles is considered low to moderate. The Grey Falcon is highly unlikely to nest in the locality, and any records of the species in the region are likely to be vagrants because the core distribution of the species is further inland.

Squirrel Gliders were recorded in open woodland vegetation along a valley floor within the Wind Farm Study Area, and in an ecotone of forest and woodland communities in the Transmission Line Study Area. Squirrel Gliders are unlikely to occur on higher elevation ridges to be affected by any tree removal for turbine location or ridgetop tracks. The distance that Squirrel Gliders can travel in a single glide is a function of the height of the tree from which they take off. Tree heights in good quality forest areas of the transmission line easement were generally 25 m or less and a clearing of 60 m (although likely to be less) for the transmission line easement may impact on movement opportunities for the Squirrel Glider. It is possible that the proposal could affect a viable local population within the locality and mitigation strategies related to removal of hollows (potential denning sites) have been incorporated into the BA documents. Recommendations have been provided in Section 9 of the Transmission Line Study Area report to minimise the clearance for the transmission line in areas of good Sandstone Forest habitat and site glide poles along the route to support movement of this species.

The Eastern Bentwing Bat, Eastern Cave Bat, Large-eared Pied Bat, Corben's Long-eared Bat, and Yellow-bellied Sheathtail Bat were recorded during the Anabat survey program. The Eastern Bentwing Bat and Eastern Cave Bat roost in caves and are not considered likely to be affected by loss of tree hollows. No roost or maternity caves are known nearby the Project Area. Activity of these species was highest in good quality Sandstone Forest communities. With implementation of recommendations, the proposal is considered generally consistent with recovery objectives, and will not be likely to cause a significant impact on any threatened bat species.

Of the species assessed, the Glossy Black-cockatoo, Powerful Owl, Squirrel Glider, and microchiropteran bats were specifically highlighted in the 2012 BA document as species requiring follow up survey work before development proceeds within specific locations of the Project Area. This assessment considers that there will be low potential for significant impact to woodland birds, mammals and bats, particularly considering (1) the removal of over 100 turbines from the proposal, (2) the selection of a transmission line route that minimises impacts to biodiversity, and (3) the specific mitigation measures that have been recommended.

The specific mitigation measures that have been prescribed in Section 9 of the BA to mitigate impact to threatened species include micrositing infrastructure, pre-clearance surveys for hollow-bearing trees, installation of gliding poles, application of buffers in areas of good quality habitat, and the creation of a draft offset strategy. In particular, these species would be considered a focus species in the Flora and Fauna Management Plan and/or the Adaptive Bird and Bat Management Plan. In addition to the design measures already implemented, a number of recommendations are given to offset the impacts of the proposal upon the species.

11.8 Management Measures

A Flora and Fauna Management Plan and/or the Adaptive Bird and Bat Management Plan should be prepared prior to construction and would be the vehicle to manage species and communities with a moderate and high risk of impacts. Prescriptions for inclusion in the plan are set out below. These measures are required to ensure a significant impact is avoided where possible, reduced as much as practical and that the residual impact is offset. Together, this ensures an overall 'maintain or improve' outcome is met for the proposal. Where uncertainty exists, a precautionary approach has been adopted to guard against unforseen impacts; specifically, follow up surveys, threatened species preclearance surveys for species considered to have potential for adverse impact, and operational monitoring for birds and bats.

11.8.1 Measures to avoid impacts

During the process of biodiversity assessment the design of the proposal has been refined, taking into account biodiversity constraints and constraints analysis. The proposal has been refined to focus on avoidance of good condition patches of vegetation where possible; avoidance of sensitive fauna sites; avoidance of moderate-good quality EEC and development of detailed recommendations for moderate-high constraint areas to ensure a significant impact is avoided. Table 11-4 details the area of interest, the target species / vegetation communities of concern, and recommendations to avoid potential impact.

11.8.2 Measures to minimise impacts

Measures to minimise impact during the design, construction and operational phase of the wind farm proposal are highlighted in Table 11-5. In particular, a Flora and Fauna Management Plan as well as an Adaptive Bird and Bat Management Plan should be prepared prior to construction. These management plans would focus on migratory and at-risk bird and bat species to address inherent uncertainty related to bird and bat collision risks at this site.

11.8.3 Measures to offset impacts

Measures to offset impacts are provided within Table 11-6 to ensure that an overall 'maintain or improve' outcome is met for the proposal. Where impacts cannot be avoided, or sufficiently minimised, the residual impact will be offset in perpetuity. Appendix F of the BA (Draft Offset Strategy) details how offsets are best identified, managed, and the offset ratios to be applied.

11.9 Conclusion

The pattern of development proposed would comprise a series of sparsely distributed discrete footprints (turbines, substations and control buildings) and narrow linear footprints (transmission line and tracks). Considering the habitat within and surrounding these areas and the ecological characteristics of the Project Area, the impacts identified appear able to be managed such that significant impacts can be avoided and a maintain or improve outcome can be met for the proposal. On balance, the impacts are considered acceptable. The proposal would have benefits as the development of a large scale renewable energy project would address, to some extent, rising greenhouse gas emissions, which may assist in avoiding dangerous climate change.

Table 11-4 Design measures to avoid impacts

MEASURES TO AVOID IMPACTS					
Item	***Area***	***Target Species***	***Objective***	***Timing***	***Recommendation***
Design Phase					
Moderate – good quality Box Gum Woodland (CEEC and EEC areas)	Wind Farm and Transmission Line Study Areas	N/A	Keep clearance of good quality Box Gum Woodland to a minimum and avoid where possible	After final alignment / development envelope is confirmed	If areas of moderate – good quality Box Gum Woodland are not avoided, turbines and infrastructure are to be microsited with input from an ecologist and the area is to be offset at a ratio of 1:10.
Good quality habitat for threatened species (supporting breeding and/or foraging habitat)	Southern half of Transmission Line Study Area	Glossy Black-cockatoo Woodland Birds Mammals (Squirrel Glider) Microchiropteran bats Threatened plants associated with Sandstone Forest	Targeted survey work and assessment to determine the importance of area for threatened species / habitats	Before any development of these areas	<u>No clearing works to be undertaken</u> in these patches unless targeted fauna / flora surveys have been undertaken for the relevant area. Further survey work will involve a targeted hollow-bearing tree survey to determine the significance of hollows as important breeding or roosting sites for threatened species within these areas. Based on the survey results, either: <u>No development to occur</u> if survey results indicate development will result in 'significant impact' and cannot be mitigated with management controls. OR <u>Development to only occur</u> if survey results indicate adverse impacts to threatened species and/or their habitats will <u>not</u> be incurred. In this case microsite infrastructure with input from an ecologist, where required.
Threatened Native Grasses	Wind Farm Study Area	Finger Panic Grass and Bluegrass	Pre-clearance survey in good quality Box-Gum Woodland (CEEC)	After final alignment / development envelope is confirmed	A pre-clearance survey is to be conducted for Finger Panic Grass and Bluegrass within good quality Box-Gum Woodland (CEEC) during flowering season from mid-January to late February. If found, turbines and infrastructure are to be microsited to avoid areas of at least moderate quality condition of these species in this vegetation type.
Threatened Reptiles	Wind Farm Study Area	Pink-tailed Worm-lizard	Pre-clearance survey in good quality Box-Gum Woodland (CEEC)	After final alignment / development envelope is confirmed	Turbines and infrastructure would be micro-sited to avoid rocky outcrops in this habitat.
Hollow-bearing Trees	Transmission Line Study Area within sandstone forest	Focus species: Squirrel Glider, Glossy Black-cockatoo,	Targeted hollow-bearing tree survey to accurately record the	After final alignment / development envelope is confirmed	Pre-clearance survey within final development envelope and alignment for hollow-bearing trees. Infrastructure micro-sited to avoid hollow-bearing trees, where

MEASURES TO AVOID IMPACTS					
Item	***Area***	***Target Species***	***Objective***	***Timing***	***Recommendation***
	vegetation communities Wind Farm Study Area within moderate or moderate-good quality Box Gum Woodland	microchiropteran bats Other species: other threatened hollow dependent fauna considered to be at moderate risk from development (i.e. woodland birds)	number of hollows to be cleared		possible. Ideally, construction and any required tree clearance should avoid the peak breeding time for fauna and nesting time for birds (e.g. spring-summer). In particular, clearance of hollow-bearing trees potentially suitable for Glossy Black-cockatoo and Squirrel Gliders should not be undertaken within a 100 m radius over the breeding season between March and August for Glossy Black-cockatoo and latter half of the year for Squirrel Gliders. For hollow-bearing trees to be cleared a management plan should be prepared by an ecologist detailing: procedures to minimise impacts to, and relocate resident fauna; timing of works to avoid breeding periods; number and type of hollow-bearing trees to be removed and offset (to be included in Flora & Fauna Management Plan). Where hollow-bearing trees are to be cleared a standard pre-clearance survey, such as that described in *Biodiversity Guidelines* (**ngh**environmental / RTA 2011), should be undertaken and details of hollow-bearing trees cleared including number and size of hollows and number of hollow-bearing trees recorded.

Table 11-5 Design, construction and operational measures to minimise impacts

MEASURES TO MINIMISE IMPACTS					
Item	*Area*	*Target Species*	*Objective*	*Timing*	*Recommendation*
Design Phase					
General Measures	Wind Farm Study Area	High risk birds and bats	Turbine infrastructure design to minimise operational impacts on birds and bats	Prior to operation	Turbines and infrastructure would be micro-sited to avoid rocky outcrops in this habitat. Red flashing lights should be fitted to turbine towers to reduce insect attraction and potentially night-flying birds. No guy lines to be fitted to turbine towers. Flags and/or marker balls to be fitted to wind monitoring mast guy lines Turbines (e.g. nacelles) should minimise perching opportunities.
Construction Phase					
Box Gum Woodland and good quality fauna habitat	Wind Farm Study Area	Box Gum Woodland areas and threatened species	Prevent unauthorised clearance Minimise track and transmission line impacts in areas of high conservation value	During construction	Clearly demarcate works areas nearby or within Box Gum Woodland areas to strictly define permitted clearance zone. Minimise track width to the minimum required for safe access and operation. Install the 33 kV powerlines (co-aligned with roads) as underground where possible. Removal of topsoil and subsoil for trenching to be replaced and revegetate disturbed areas with local native grasses (i.e. Kangaroo Grass, Wallaby Grass or Spear Grass).
General Measures	Wind Farm Project Area	All species and vegetation communities	Minimise clearance and disturbance	During construction and as required	Clearly demarcating works areas and restricting impacts to these. Including vehicle and equipment parking and access routes. Co-locating underground and overhead 33 kV powerlines with the track network to minimise additional impact area, where possible. Establish construction compound in a disturbed area. Use disturbed areas for vehicle and machinery access, materials laydown, stockpiling of cleared vegetation and deposition and retrieval of spoil, wherever practicable. Fill in trenches as soon as possible. Trenches left open overnight to be inspected at first light for trapped fauna. Trapped fauna to be released appropriately in a nearby location. Hollow-bearing trees and sensitive features to be retained to be

MEASURES TO MINIMISE IMPACTS					
Item	*Area*	*Target Species*	*Objective*	*Timing*	*Recommendation*
					communicated to staff via inductions and other methods.
Riparian Area Management	Project Area	All species and vegetation communities	Minimise clearance and disturbance	During construction	Creek crossing to be designed in accordance with: NSW Fisheries Policy and Guidelines for Fish Friendly Waterway Crossings (2003). Creek works not to be undertaken when heavy rain is forecast and should be avoided when there is flow. Implement sedimentation and erosion controls in accordance with best practice guidelines.
General Habitat Management	Project Area	All species and vegetation communities	Minimise disturbance	During construction	Bird and bat activity levels are generally concentrated around areas of vegetation. A buffer of 100 m from the turbine blades is recommended for areas of high habitat value for birds and bats. Fallen timber > 50cm to be left in place or moved to a nearby area to retain fauna habitat. Where rocky outcrops cannot be avoided, replace rock in nearby areas in consultation with an ecologist.
Weed Management	Project Area	All species and vegetation communities	Pre-construction inspection for noxious weeds within Project Area Prevention of spread of weeds and pathogens Weed monitoring	Before commencement of works and as required Monitoring – late spring / early summer after construction	Control noxious weeds in works area according to plans and control measures of the LGAs. Minimise use and adhere to best practice guidelines for herbicide treatment in environmentally sensitive areas (i.e. Box Gum Woodland). Establish hygiene plan to ensure vehicle and machinery is absent of organic matter pre- and post-site access. Sign environmentally sensitive areas (i.e. CEEC areas) and designate clean-down area for entry / exit points into these areas. Monitoring and weed control in areas of known noxious or invasive species. Understorey vegetation in easements should be managed to maintain composition and quality to prevent weed invasion
Pollution Prevention	Project Area	All species and vegetation communities	Prevention of contaminants and erosion outside works zones	As required	Establish a spill plan to prevent chemicals or pollutants from having an adverse effect on the environment. Backfill cable trench where cement is used; at least 20 cm of cement free topsoil to be replaced as the top layer in the back fill. Establish an erosion and sediment control plan so appropriate controls are in place prior to commencement of works.

MEASURES TO MINIMISE IMPACTS					
Item	*Area*	*Target Species*	*Objective*	*Timing*	*Recommendation*
Site Management	Project Area	All species and vegetation communities	Stabilisation of soil, rehabilitation and revegetation to be undertaken progressively to re-establish ground cover	As required	Lightly mulch exposed soils with chipped vegetation or sterile hay in areas dominated by exotic groundcover species. Sow with an appropriate cover crop in consultation with land owners. Lightly mulch exposed soils with chipped vegetation or sterile hay in areas dominated by native grasses using local provenance species. Fertiliser should not be used to promote revegetation in areas dominated by native grasses.
Operational Phase					
Flora & Fauna Management Plan	Project Area	All species and vegetation communities	To avoid significant impact to flora and fauna outside of the accepted clearance boundaries and prevent 'unassessed' impacts occurring	Implement prior to construction	An ecological professional to develop and implement a Flora and Fauna Management Plan to report on and manage impacts. The management plan should highlight ecological important areas (vegetation communities and threatened fauna species habitat) and their management. Specific areas requiring monitoring or management should be highlighted as well as timing for monitoring. Weed species should be highlighted along with prescriptions for their management.
Adaptive Bird & Bat Management Plan	Wind Farm Study Area	High risk raptors and bats Threatened Owls (Powerful Owl, Masked Owl, Barking Owl)	Development of an 'insurance' monitoring program to address uncertainty inherent in the assessment	Implement prior to construction. Survey and monitor during 'high risk' periods, when species may be moving through or foraging in the area	An ecological professional to develop and implement a Bird and Bat Monitoring Program to report on, and manage impacts with potential to be significant. Monitoring surveys should include an understanding of breeding activity (i.e. nest locations) and foraging movements. Baseline (pre-construction) and operational collision and abundance data would be collected, focused on higher risk species and higher risk locations in order that actions can be taken to address unforseen impacts, should they occur. Management Plan methods would utilise AusWEA (2006) best practice guidelines. Management Plan should include management response options (i.e. restriction of lambing on ridges with high raptor activity to reduce collision risks) to be implemented where significant impacts are anticipated.

MEASURES TO MINIMISE IMPACTS					
Item	*Area*	*Target Species*	*Objective*	*Timing*	*Recommendation*
Habitat Connectivity	Transmission Line Study Area	All common species, as well as threatened fauna, particularly owls, gliders and bats	Minimise fragmentation of landscape connectivity	After construction	Promote growth of vegetation under the transmission line to the maximum allowable height to maintain fauna habitat connectivity. Understorey vegetation in easements should be managed to maintain composition and quality to prevent weed invasion. Install gliding poles for glider species, particularly the Squirrel Glider, if clearing for the transmission line easement exceeds 40m in areas of habitat for this species. Near areas of intact woodland or forest a spacing of 600m should be considered for turbines.

Table 11-6 Offset measures to maintain or improve biodiversity

OFFSET MEASURES TO MAINTAIN OR IMPROVE BIODIVERSITY					
Item	***Area***	***Target Species***	***Objective***	***Timing***	***Recommendation***
Construction Phase					
Development of offset strategy and offset plan	Project Area	Box Gum Woodland, Hollow-bearing trees, Threatened species habitat	Proponent will develop an offset plan to offset all permanent native vegetation removal to maintain or improve biodiversity in the longer term	Prior to construction	Develop an offset strategy with input from OEH, the CMA and an ecological professional which will be finalised prior to any construction impacts an ecological professional, in accordance with the Draft Offset Strategy provided in Appendix F. Develop an offset plan with input from OEH and the CMA prior to operation, demonstrating the suitability of the final offset site and providing detailed management actions specific to the site. Ensure the offset strategy complies with the *Principles for the use of biodiversity offsets in NSW* guidance document. The offset ratio will be determined with reference to: the conservation status of the vegetation; the condition of the vegetation; and the actual threatened species habitat value lost (i.e. known threatened species habitat, not potential habitat). Where Box Gum Woodland and threatened species habitat is to be cleared and cannot be avoided an offset ratio to be applied at: 1:20 for good condition areas; 1:10 for moderate-good condition areas; 1:5 for moderate condition areas; and 1:2 for poor condition areas. Where non-threatened vegetation is cleared an offset ratio to be applied at 1:1. Where hollow-bearing trees are to be cleared and cannot be avoided an offset ratio to be applied at 1:1 and is supplementary to other areas offset. Include provisions for offsetting Commonwealth listed EEC to demonstrate compliance with the Commonwealth offset policy.

12 Aboriginal and European Heritage

12.1 Overview

New South Wales Archaeology Pty Ltd was commissioned by Epuron Pty Ltd to undertake an Aboriginal cultural and archaeological heritage assessment in relation to the proposed Liverpool Range Wind Farm Stage 1. This report documents the proposed impact areas, the assessment process, findings, interpretation of results and recommendations.

The assessment was conducted in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005), the NSW Office of Environment and Heritage's Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW (OEH, 2011) and the Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW, 2010b).

12.2 Methodology

A process of Aboriginal community consultation was undertaken in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005) and OEH's Aboriginal cultural heritage consultation requirements for proponents 2010 (DECCW, 2010a).

The study sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the subject areas, and to formulate management recommendations based on the results of the community consultation, background research, field survey and a significance assessment.

12.3 Survey

The wind farm subject area has been found to be of generally very low cultural and archaeological potential and significance. There are no previously recorded sites known to be present, however, three Aboriginal object locales (stone artefact sites) were recorded during the field survey. Micro-siting of turbines, roads etc., to avoid impacts are a potential management strategy in respect of these. Undetected or subsurface stone artefacts are predicted to be present in densities which range from low to very low/negligible. Five European heritage items have been recorded in the wind farm area. None of these warrant heritage listing, however, micro-siting to avoid impacts is recommended.

One of the transmission line options was surveyed during the assessment, while the others were subject to a desk top assessment only. Previously recorded Aboriginal objects sites are located along these routes, and several new recordings (3 stone artefact sites and a rock shelter with potential archaeological deposit) were made during the field assessment. Micro-siting of power poles to avoid impacts is recommended. Two European heritage items were recorded in the transmission line option surveyed. They do not warrant heritage listing, but micro-siting to avoid impacts is recommended. When a final transmission line route is selected, and if it differs to that surveyed during this assessment, it is recommended that a field survey of the alignment is undertaken in order to formulate detailed management strategies in respect of micro-siting power pole locations, as required.

A total of 169 kilometres of turbine alignments, roads and transmission lines was surveyed (walked) during the field inspection. The coverage achieved is considered sufficient to characterise the nature of Aboriginal object distribution. The survey results are therefore assessed to be a relatively accurate reflection of the archaeological status and artefact density in the two subject areas. Accordingly, based on the relevant predictive model of site distribution and the results of the field survey, the proposed impacts are assessed to be of generally low potential to cause harm to cultural and archaeological values. This assessment forms the basis for the formulation of recommendations relating to the proposal.

The Aboriginal object locales (and any undetected and subsurface artefacts) and heritage values do not surpass archaeological and cultural significance thresholds which would act to preclude the construction of the proposed wind farm.

12.4 Results

Based on a consideration of the predictive model applicable to the environmental context in which impacts are proposed, the results of the study, and the nature of proposed impacts, the following conclusions and recommendation are made:

- Based on a consideration of the small and discrete nature of proposed impacts and the identified archaeological and cultural values, the subject areas do not warrant subsurface test excavation. The level of assessment achieved during the field survey is considered to have been adequate for the purposes of determining the cultural and archaeological status of the proposal area.
- The recorded Aboriginal object locales and the predicted generally very low density subsurface artefact distribution in the proposal area does not surpass archaeological significance thresholds which would act to entirely preclude the proposal. There are no identified Aboriginal archaeological and cultural constraints.
- It is recommended that when the design is finalised, additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment. Significant Aboriginal objects can occur anywhere in the landscape and, accordingly, they need to be identified and impact mitigation strategies implemented prior to impacts. This applies particularly to the transmission line route, which in the sandstone country at its southern end, has the potential to traverse areas in which significant Aboriginal heritage items and values occur.
- The proponent should, in consultation with an archaeologist, develop a Cultural Heritage Management Protocol, which documents the procedures to be followed for impact mitigation and management. The development of an appropriate Cultural Heritage Management Protocol should be undertaken in consultation with an archaeologist, the registered Aboriginal parties and the NSW Office of Environment and Heritage. It would aim to ensure the effectiveness and reliability of mitigation and management strategies.
- Personnel involved in the construction and management phases of the project should be trained in procedures to implement recommendations relating to cultural heritage, as necessary.
- Cultural heritage should be included within any environmental audit of impacts proposed to be undertaken during the construction phase of the development.

13 Traffic and Transport

13.1 Approach

A Traffic Impact Study was prepared by Epuron. A full copy of the study is presented in Appendix E. The assessment considered the potential impacts of the proposed wind farm and provides mitigation measures to minimising potential traffic impacts associated with the project. The Traffic Impact Study is primarily focused on the construction phase as it is considered that the construction phase would generate the greatest volume of traffic.

The methodology adopted for the assessment included:

- reviewing the RMS checklist for preparing traffic impact studies;
- mapping of the proposed wind farm site and surrounding area;
- review of planning documentation for other wind farm developments in the area;
- roads were inspected and photographed;
- RMS data was reviewed to establish traffic volumes on the main roads;
- personal communication with the RMS;
- consultation with Local Shire Councils;
- information on road conditions from property owners at the Information Day on 01/11/2012; and
- information from turbine suppliers on access track requirements and turbine component transport.

13.2 Existing Environment

The roads in the vicinity of the project area are generally classified as follows:

- State Highway – Golden Highway is owned and maintained by the RMS.
- Regional Roads – Part funded by a grant agreement administered by the local RMS.
- Local Roads – All other roads that are owned by the council.

The southern end of the wind farm site is located 2 km north of the Golden Highway near the regional town of Cassilis. The Golden Highway provides a safe connection with up to 100 km/h travel speed.

Access requirements for the proposed wind farm can be separated into the following categories:

- Standard road vehicles ranging from 2 wheel drive cars to B-Double trucks. These vehicles are required to access the site as far as the construction compound and associated equipment storage area. They represent the largest portion of vehicles. It would be anticipated that light vehicles would be the source of transport within the construction area of the site.
- 4 wheel drive vehicles may be required for most transport to the turbine locations and would provide ongoing maintenance.
- Specialist vehicles may include off-road construction vehicles, for example vehicles with nonstandard axle combinations. These may include tracked vehicles and reconfigured trailers used to tow components into position. This type of vehicle would not generally be able to be used on sealed local roads
- Over-dimension vehicles transporting turbine components and oversize construction machinery. These vehicles would generally be wider and longer but weights of loads would not be excessive (generally up to 70 tonnes carried over 7 axles).
- Over-mass and over-dimensional vehicles transporting electrical transformers of up to 200 tonnes. These vehicles would possibly require the strengthening of bridges and drainage structures because of the close spacing of axles. Only a small number of these vehicles are anticipated during construction.

13.3 Assessment

Construction and decommissioning phase

Table 13-1 Approximate dimensions and weights of the components of a typical wind turbine

Wind Turbine Component	No. of parts per turbine	Total number of parts for 288 turbines	Approximate component weight (tonnes)
Towers	3 - 5	864 – 1,440	Up to 60
Nacelle	1	288	Up to 80
Hub	1	288	Up to 23
Blades	3	864	Up to 12

Over-mass and over dimension vehicles

The larger vehicles would occupy most of the width of the roadway at many locations thereby requiring traffic control procedures to ensure safe passage for local road users. For nearby property owners, there is likely to be an increase in traffic noise and dust nuisance in addition to the need to control stock from straying on the roads which are not fenced. Dust generated on unsealed roads could impact visibility and result in the loss of pavement materials. Gravel road surfaces would deteriorate and potholes would form under the increased traffic loads, particularly during wet weather when water ponds or drains across a road. Structural damage may occur to some of the culverts, concrete causeway crossings, stock grids and traffic islands. The location of trees and other roadside objects have the potential to obstruct the passage of long wide loads and high loads. Lack of roadside delineation in some locations may impact traffic safety during periods of poor visibility. Some intersections have inadequate pavement width to safely accommodate the turning manoeuvres of the over-size vehicles.

It is considered that these impacts would be temporary, as the equipment haulage is not a continuous program. Most of the heavy haulage would be in the form of convoys and would be managed through a number of specific mitigation measures developed and implemented in conjunction with RMS and Local Councils. These measures usually include escort vehicles.

Decisions on the final routes for these vehicles would be the subject of negotiations between the haulage contractor and the road authorities.

Haulage Route Status

The haulage route from port to Cassilis along the New England and Golden Highways is an approved RMS B-Double route and is suitably designed to accommodate oversize and over mass loads. Where the transport route leaves the Golden Highway on Warrumbungle Way, the RMS B-Double route becomes an '*Approved Area with Conditions*' and any road upgrades required for the project will be updated with the local councils. The assessment of the haulage route capacity from port to Cassilis has found that the existing road design capacity is more than sufficient to accommodate the short term construction impacts.

Traffic impacts at specific location

Golden Highway

The route from the Port of Newcastle to Cassilis, the Golden Highway, provides a safe, single and dual carriage highway for the vast majority of the distance from port to destination. During the construction phase there would be an increase in traffic travelling along this route including standard road vehicles, B-Double trucks and over dimension vehicles transporting turbine equipment.

Impacts on access route roads

There is potential to impact local traffic through the use of standard road vehicles, B-Double trucks and over dimension vehicles transporting turbine equipment. The delivery of equipment along these roads would be done as per the TMP. This increase in traffic volume would require improvements to ensure the safety of road users particularly in relation to conflicts between vehicles and stock.

Isolated curves and crests on looser gravel surfaces could result in drivers losing control. Several drainage structures may need to be upgraded to ensure continued wet weather access.

Several mitigation measures have been developed to manage traffic impacts during the construction phase; key areas are highlighted in Section 13.4. These centre on the development of a TMP, consultation with roads authorities and affected members of the community, to finalise the routes and ensure that safety and protection of assets is managed effectively.

Operation phase

Once operational, the wind farm would be managed and maintained by several crews of technicians, likely to be based at Mudgee or Coolah. The proposed wind farm may generate interest as a visual feature in the locality however, it is considered that this would not significantly increase the number of tourists visiting the Coolah / Cassilis region and therefore the increase in traffic volumes and subsequent impacts are likely to be low. No specific mitigation measures are considered warranted to manage operational traffic impacts.

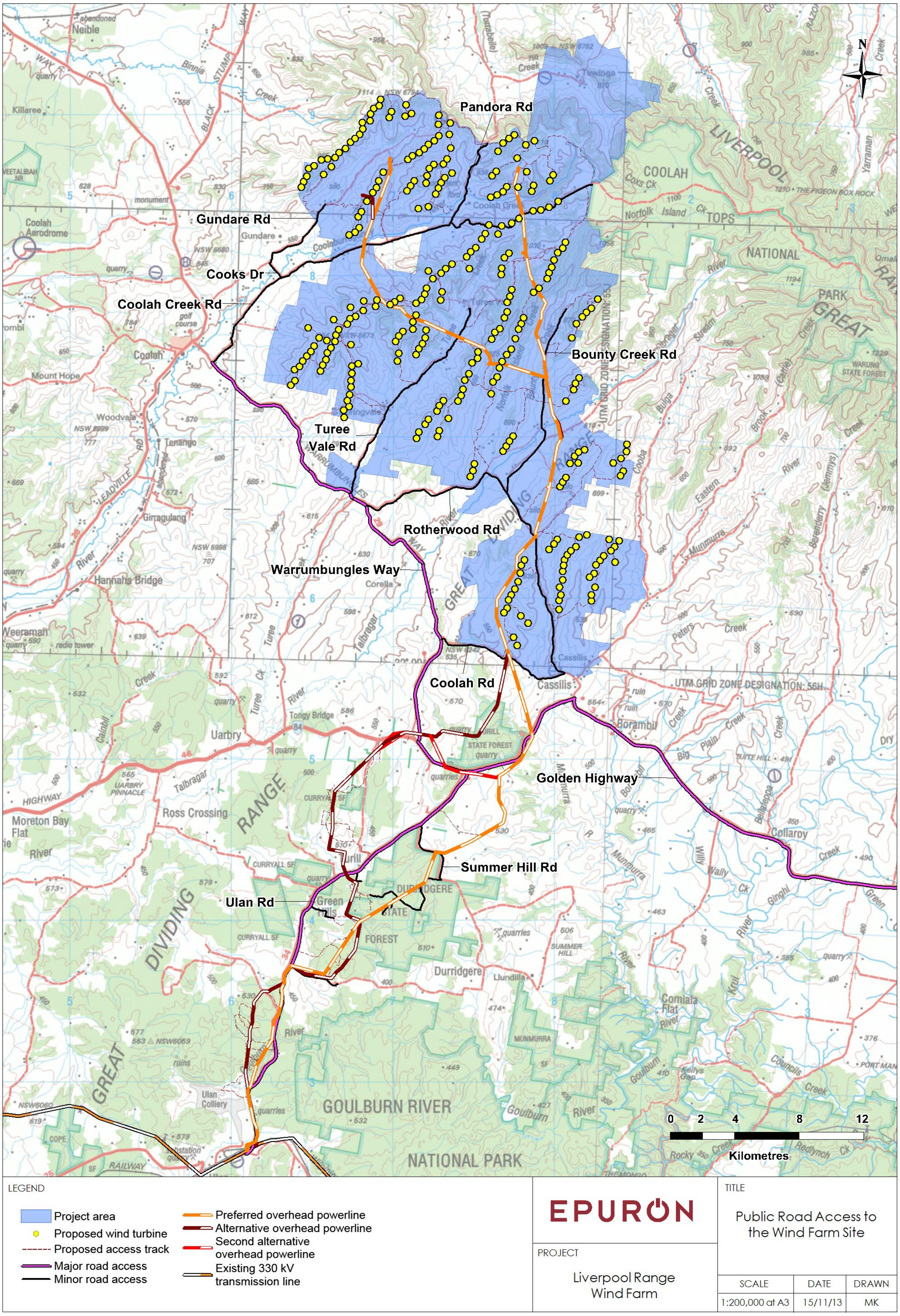

Figure 13-1 Proposed access routes to the Liverpool Range Wind Farm

13.4 Mitigation Measures

The following measures would be adopted to minimise the impacts from construction traffic:

- Development of a Traffic Management Plan that will identify detail actions such as scheduling of deliveries, managing timing of transport near major centres (Mudgee) and local towns (Coolah / Cassilis) to avoid peak times (beginning / end of school), consultation activities during haulage activities, designing and implementing modifications to intersections and street furniture and managing the haulage process.
- Use of a licensed and experienced haulage contractor, to be responsible for obtaining all necessary permits and approvals from the RMS and Councils and for complying with conditions of consents.
- Escorts for oversize and over-mass vehicles will be provided in accordance with RMS requirements.
- The Traffic Management Plan will establish a procedure to monitor traffic impacts during construction such as noise, dust nuisance and travel timings so adjustments can be made to minimise impacts.
- Re-instating pre-existing conditions after temporary modifications, if required.
- Providing a 24hr telephone contact during construction to enable any issue or concern to be rapidly identified and addressed.
- Consult with the local Councils prior to construction and agree any road upgrade or rehabilitation responsibilities and requirements including potential contribution towards road maintenance funding and/or road dilapidation reports prior to the commencement of construction and following completion of construction to determine any damage attributable to the project.

Should deterioration of roads occur during construction activities, an inspection and maintenance program would be established, if required by the Council.

14 Hazards and Risks

14.1 Aviation

14.1.1 Background

The proposed development of the Liverpool Range Wind Farm would involve the construction of wind turbines with a maximum height of up to 165 meters to the blade tip. Due to the height of the wind turbines, potential impacts to the safety of aviation activities have been assessed. This includes:

- identifying nearby aerodromes and local landing strips within 5km of proposed turbines;
- consultation with aviation authorities, lanowners and associations; and
- assessing the risk and impacts to aerial agricultural activities.

Information regarding the existing environment, activities and aircraft, and the nature of landing strips and their operation have been sourced from CASA, ASA, AAAA, previous development applications, relevant reports and local landholders.

14.1.2 Existing Environment

Aerodromes

The closest Civil Aviation Safety Authority (CASA) certified and registered aerodromes to the proposed wind farm site can be seen below in Table 14-1. The table shows Coolah aerodrome is closest to the proposed site at 17.3km.

Table 14-1 CASA registered and certified aerodromes near the proposed site

Aerodrome	Certification or Registration Number	Operator Name	Distance from site (km)
Coolah	R035	Coolah Shire Council	17.3
Quirindi	R150	Liverpool Plains Shire Council	51.0
Coonabarabran	R115	Warrumbungle Shire Council	66.4
Mudgee	1-15S3M	Mudgee Shire Council	70.0
Scone	R131	Upper Hunter Shire Council	76.9
Gunnedah	R139	Gunnedah Shire Council	80.7
Tamworth	1-6FXI	Tamworth Regional Council	102.8
Dubbo	1-6EDH	Dubbo City Council	120.0

CASA uses a term called Obstacle Limitation Surfaces (OLS) to manage the area around an aerodrome. An OLS is a series of surfaces that define the limits to which objects may project into the airspace, and above which, become obstacles to aircraft operations and must be reported to CASA. An assessment of the Coolah aerodrome will take place as it is within 30 km to the development. The location of these airports in relation to the project is presented in Figure 14-1.

Landing Strips

18 private landing strips (known as Aircraft Landing Areas or ALAs) have been identified on private properties within 5 km of the project, which have historically been used for aerial agriculture. The majority of these landing strips are on properties associated with the project. ALAs are not registered or regulated by CASA. Locations of the landing strips are shown in Table 14-2 and Figure 14-2.

Table 14-2 Location of existing landing strips

Ref	Runway Orientation	Location		Distance from nearest wind turbine (metres)	Involved / Non-Involved
		Easting	Northing		
1	NW-SE	779,331	6,492,263	3,240	Involved
2	NW-SE	773,037	6,489,708	160	Involved
3	SW-NE	764,756	6,485,117	760	Involved
4	SW-NE	770,387	6,483,603	1,656	Involved
5	NW-SE	776,442	6,483,091	150	Involved
6	NW-SE	769,005	6,481,568	1,190	Non-Involved
7	NW-SE	762,187	6,477,752	2,610	Non-Involved
8	SW-NE	766,980	6,471,772	150	Involved
9	NW-SE	770,771	6,471,224	660	Involved
10	NW-SE	771,066	6,473,591	950	Involved
11	SW-NE	773,382	6,474,366	1,241	Involved
12	N-S	775,758	6,468,715	790	Involved
13	SW-NE	777,795	6,470,874	240	Involved
14	SW-NE	781,202	6,468,817	100	Involved
15	N-S	783,963	6,464,665	970	Non-Involved
16	SW-NE	777,759	6,461,855	110	Involved
17	WNW-ESE	786,049	6,461,881	2,420	Non-Involved
18	E-W	780,136	6,455,446	2,700	Involved

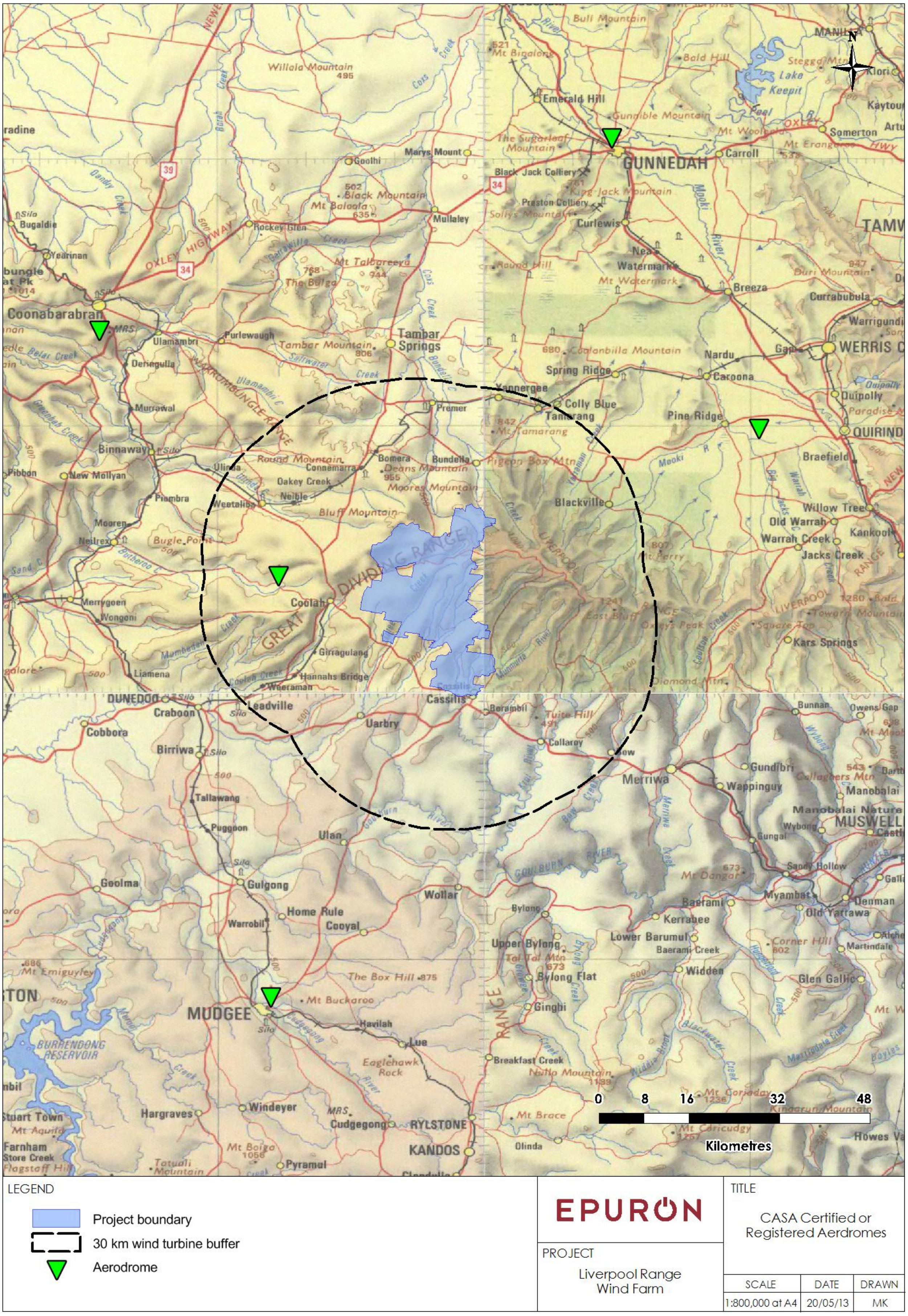

Figure 14-1 Aerodromes within vicinity of the proposed wind farm

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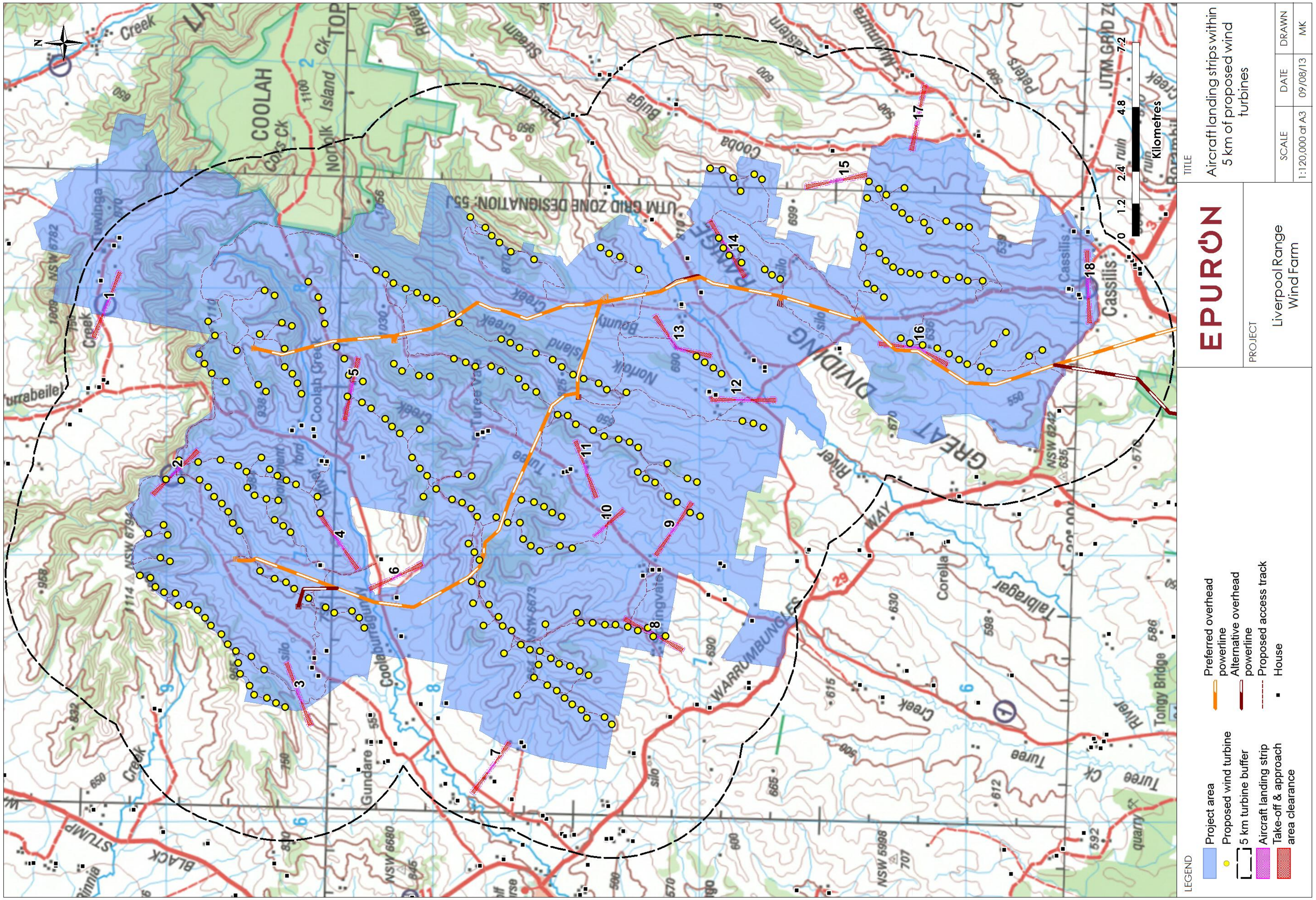

Figure 14-2 Landing strips within 5 km of a turbine

14.1.3 Consultation

Epuron has consulted with the Civil Aviation Safety Authority (CASA), Airservices Australia (ASA), Aerial Agricultural Association of Australia (AAAA), the Department of Defence and local landholders with landing strips in relation to the project.

On the 12th of November 2012 Epuron wrote to the Department of Defence in relation to the project. The Department of Defence is responsible for ensuring that new developments would not conflict with existing military aircraft operations, radio communications and the operation of navigational aids and radars. The Department of Defence responded on the 5th of June 2013 and stated that although a deployable radar site Mt Coolah may be unusable once the wind turbines are constructed, "Defence has no objection to the proposal". The Department of Defence response is attached in Attachment 8.On the 9th of November 2012 Epuron wrote to CASA in relation to the project. CASA is an independent statutory authority whose primary function is to conduct the safety regulation of civil air operations in Australia. No concerns have been raised thus far in relation to the project.

Due to the height of the proposed turbines (greater than 110m), notification to CASA is required in accordance with the C*ivil Aviation Safety Regulations 1998 (CASR)* Part 139, Subpart 139E Obstacles and hazards.

CASA previously recommended that obstacle lighting be provided as per section 5.5 of *Advisory Circular 139-18(0) - Obstacle Marking and Lighting of Wind Farms*, however this Advisory Circular was withdrawn in September 2008. The withdrawn Circular defined that the interval between turbines and obstacle beacons should not exceed 900m.

Since the withdrawal of the Advisory Circular in 2008 there have been no updated recommendations and as such there are currently no CASA guidelines to conform to in relation to obstacle marking of wind farms. CASA has indicated that they are reviewing their position and it appears likely that CASA will align their advice with international guidelines. Epuron does not expect obstacle lighting to be required for the Liverpool Range Wind Farm.

Epuron provided Airservices Australia (ASA) with details of the project on the 9th of November 2012. ASA is responsible for air traffic management and has the expertise to assess the potential impacts of wind farm proposals on precision / non precision navigational aids, HF/VHF communications, radar and satellite links in the area. ASA is also able to provide advice on whether the project would impact Lowest Safe Altitudes (LSALTs). On the 28th of November 2012 ASA responded to Epuron detailing the need for an Aviation Impact Study in relation to the project. Epuron is currently in the process of performing the study and will work with ASA should any issues arise.

The AAAAs formal policy position on all wind farm developments and wind monitoring towers is to automatically oppose such developments, unless the developer is able to clearly demonstrate they have openly and honestly consulted local aerial operators, sought independent expert opinion, ensured no long or short term effect on safety standards and provided a legally binding agreement for compensation for loss of income (AAAA, 2011).

Epuron has consulted with all involved and non-involved landowners that have private landing strips within 5km of the wind farm, as listed in Table 14-2 and shown in Figure 14-2. Consultation has occurred through a mix of personal meetings, written correspondence and follow up phone calls with these landowners. Fourteen out of eighteen of these landowners are involved in the project, and the potential for impact on aviation has been discussed with all these landowners and no concerns have been raised to date. The design and layout of the wind farm has considered and taken into account the landowers farming parctises when siting turbines near exisiting landing strips. As stated in Table 14.2, the distances between the non-involved landowner airstrips and the nearest wind turbines are large, often greater than 2km with the nearest being 1,190m. Due to these large distances between non-involved landowner airstrips and wind turbines it is considered that there will be no material impact to aviation practices for these non-involved landowners. No impacts to aviation are considered likely when turbines are sites more than 500m from non-involved landowner airstrips as considered by independant aviation experts, Amdidji Group.

14.1.4 Assessment

Aerodromes

The Proponent has consulted with CASA and Airservices Australia in order to seek comment on the Coolah Aerodrome. CASA advised that they do not hold any information regarding the OLS for the Coolah Aerodrome, while ASA informed Epuron that no comprehensive OLS information exists for the Coolah Aerodrome due to the small scale and infrequent use of the aerodrome, but Warrumbungle Shire Council should be contacted to obtain any information available. On the 4th of December 2013, the Warrumbungle Shire Council provided Epuron with Coolah Aerodrome survey data as performed by Airport Survey Consultants on the 14/11/2013. The survey includes approach splays, slope, gradient, length, and divergence, as well as surveyed points of obstacles such as trees in the vicinity of the aerodrome. This information has been used in the design of the wind farm and confirms that the Liverpool Range Wind Farm will not have any impact on the operation of the Coolah Aerodrome. The Coolah Aerodrome survey document has been included in Attachment 8 – Consultation Material.

The Proponent will continue to assess and incorporate any further requirements into the design of the wind farm if further information becomes available.

Landing Strips

Eighteen landing strips have been identified within 5 kilometres of the proposed development, two of which are within 2 km of non-involved landowners. These strips are classed as “Aeroplane Landing Areas” by CASA in accordance with Civil Aviation Safety Regulations Part 139.

CASA guidelines for these landing strips are contained in their *Civil Aviation Advisory Publication 92-1 (1) - Guidelines for Aeroplane Landing Areas* (CAA, 1992). The publication contains physical characteristics that define the ‘surfaces’ which should be clear from obstacles around the runway approaches. These characteristics are shown in Figure 14-3 for day operations.

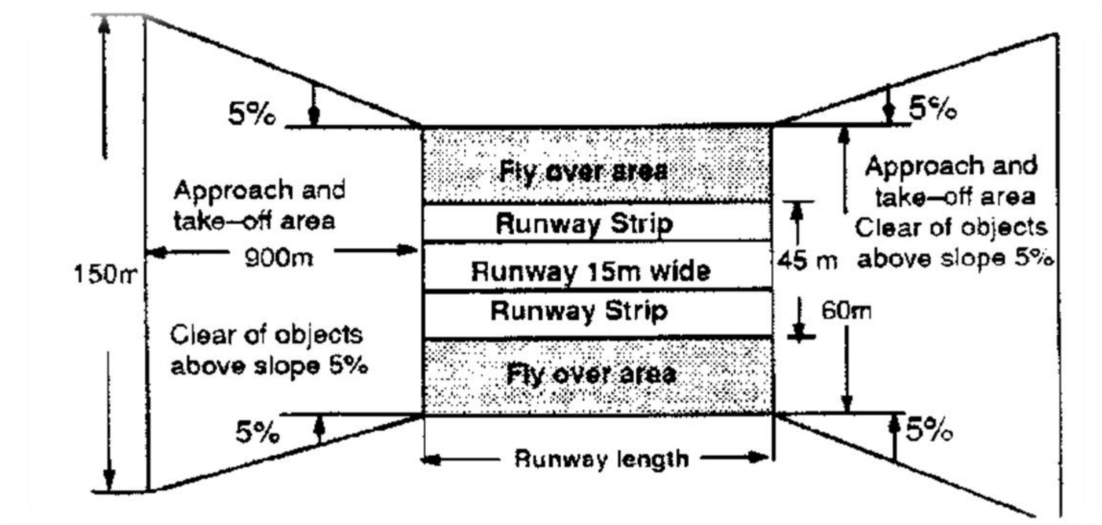

Figure 14-3 CASA’s guideline for characteristics of an Aeroplane Landing Area (CAA, 1992)

For this assessment a worst case scenario basis had been chosen and all landing strips will be assessed as if they were for Single Engine and Centre-Line Thrust Aeroplanes not exceeding 2000 kg maximum take-off weight (MTOW) for day time operations, as stated in *Civil Aviation Advisory Publication 92-1 (1) - Guidelines for Aeroplane Landing Areas* (CAA, 1992). By using this definition of aeroplane landing areas, it increases the clearance required between wind turbines and the approach and take-off areas and will ensure greater safety for both pilots and the wind farm.

A zone extending 900 metres from the approach and take off area is required to be free from obstacles at an angle of 5% extending out from the end of the runway.

The wind farm layout has been designed so that none of the proposed turbines encroach on the CASA designated clearance even though 5 proposed turbines occur within 500 m (they are adjacent to the landing area not at each end).

Figure 14-4 demonstrates that the clearances are in excess of the CASA guidelines for landing strip No. 5. Landing strip No. 5 is shown as an example, the CASA guidelines have been applied to all landing strips listed in Table 14-2. No wind farm infrastructure is within the Aeroplane Landing Area of any of these landing strips.

As these private airstrips rely on visual rather than instrument based landing techniques, and as the turbines being highly visible, it is unlikely that the proposed development would pose any additional hazard to users of these airstrips. It is expected that pilots will continue to use the local landing strips for their farming pratises and have expressed no concerns to date.

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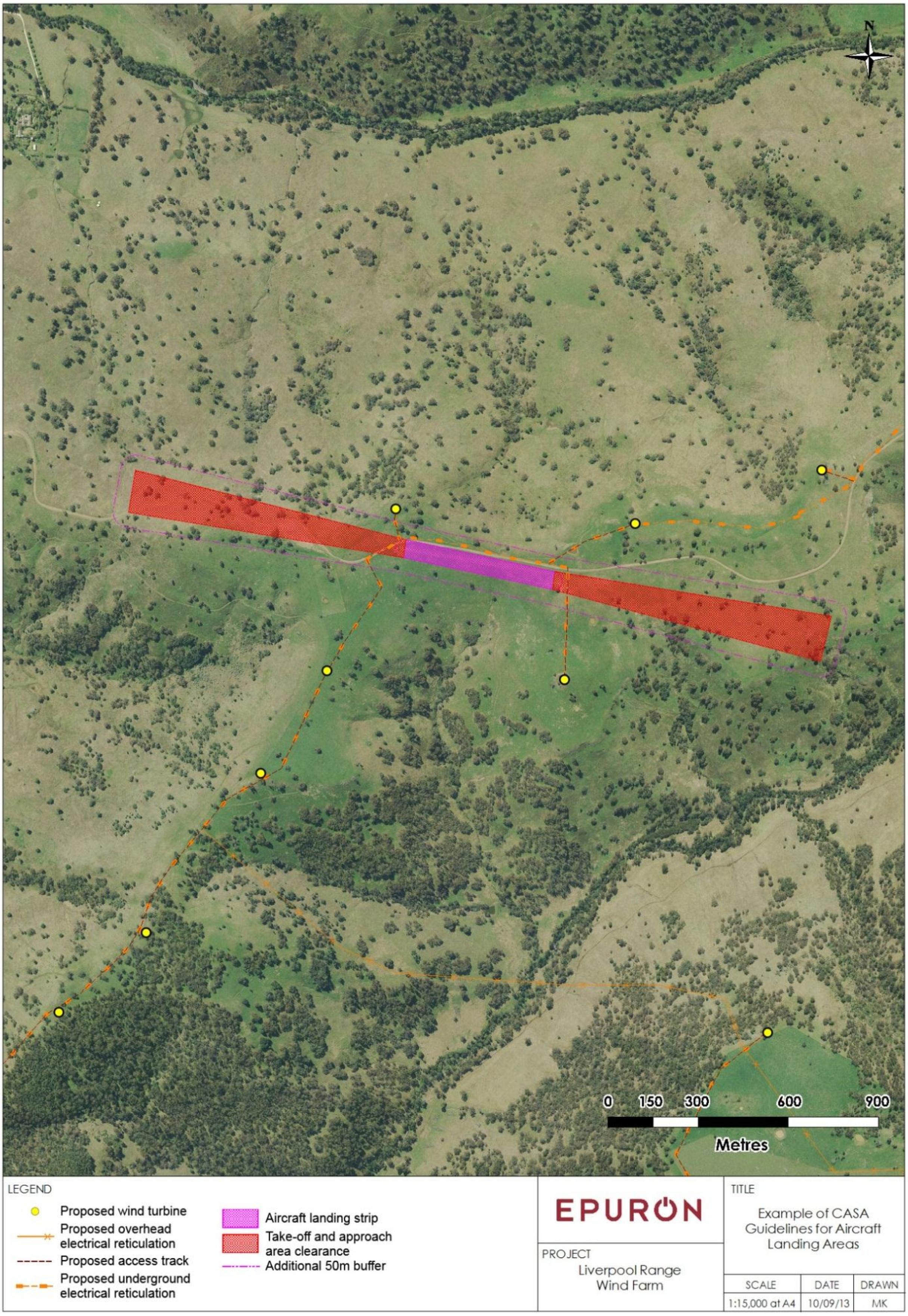

Figure 14-4 Example of CASA guidelines being applied for local landing strip No. 5

Aerial Agriculture

The Proponent acknowledges that the wind farm will likely impact aerial spraying in the area immediately adjacent to the turbine locations. Accordingly, should spraying or spreading of fertilisers be required in this vicinity, ground based methods will need to be considered, potentially at a higher cost.

A report conducted by the Ambidji Group Pty Ltd for the Berrybank Wind Farm concluded that a buffer zone of 500 m should be applied when planning aerial spreading in the close proximity to an installed wind farm (Foster, 2010). This would mean that more time would be required in the pre-planning process as the approach may need to be varied to avoid turbines. The report states:

> *"A standard agricultural aircraft loaded to maximum capacity takes approximately 500 metres to complete this turn. This would have an impact on the direction at which some of the spraying operations would need to be conducted. A distance of 500 metres from the nearest turbines would be required as a buffer zone for this operation."*

This report therefore assumes that aerial spreading would impact the area within 500m from a constructed turbine. Although the project will have some impact on the operations of aerial agriculture on these properties, alternate spreading methods are available, and the overall impact on farming operations is negligible & considered acceptable.

Lighting

Due to the significant physical separation between the wind farm and the closest airports, the fact that the overall wind turbine height will be below the lowest safe altitude for aviation and consideration of general community views on turbine obstacle lighting at night being visually intrusive, it is not considered appropriate to install obstacle lighting on turbines at the Liverpool Range Wind Farm site. The use of private landing strips is restricted to daytime operation and hence there would be no reason to install obstacle lighting for private aviation purposes.

Accordingly, the Proponent would only install obstacle lighting if required to do so by CASA, and to the extent required by CASA.

It should also be noted that the night time lighting installed on the Cullerin Wind Farm has been decommissioned by Origin Energy following a risk based aviation assessment. As a result of this assessment, new wind farm developments do not require individual assessment for night time lighting. A number of recent similar wind farm developments in New South Wales have been approved without requirement for night time lighting or individual assessment, including the Gullen Range and Glen Innes wind farms.

14.1.5 Mitigation Measures

Epuron will continue to liaise with all relevant authorities (CASA, ASA, and Department of Defence) as well as the operators of local airports and airstrips, local aerial agriculture contractors and the AAAA, and supply location and height details once the final details of the wind turbines have been determined and before construction commences. Should any issues arise, Epuron will manage the issues with the relevant authority to ensure the issues are dealt with appropriately.

Epuron will also comply with any requirements of CASA in relation to obstacle marking of wind turbines, although Epuron would not otherwise install obstacle beacons on any wind turbine.

Epuron have advised local landholders with landing strips of the impact on aerial agriculture within 500m of the wind turbines. As the impact on overall farming operations is considered negligible, no further mitigation methods are required. Epuron will continue to consult with landowners and provide any relevant aviation information. This could include funding the cost difference between the pre-wind farm aerial agricultural activities and a reasonable alternative method.

14.2 Communications Impacts

14.2.1 Background

Wind turbines have the potential to interfere with television and radio broadcasting, mobile phone reception, microwave links and other radio links such as mobile and CB radio. There are three mechanisms by which wind turbines may cause interference: reflection, diffraction and near field effects.

Reflection or scattering occurs when a signal becomes obstructed between the transmitter and a receiver, this could be due to a tower or moving blade component as shown in Figure 14-5.

Diffraction occurs when a signal is both absorbed and reflected by an object in the signal path.

Near field effects are caused by electromagnetic fields. This is no longer an issue due to advances in wind turbine technology and compliance with Electromagnetic Emission Standards.

A communication impact assessment report was prepared by Epuron for the Project. The objectives of this investigation were to identify the potential for impacts from the proposed Liverpool Range Wind Farm on existing telecommunications services in the vicinity of the project, and to identify appropriate mitigation strategies for potential impacts. The full investigation including a glossary of acronyms used in the investigation, maps, footnotes and references is presented in Appendix F.

The following approach was adopted to identify the potential impact of the project on telecommunications:

- Identify holders of telecommunications licenses (under the Radiocommunications Act 1992) within a 25km radius of the project, as well as point-to-point links in the vicinity of the project, using information provided on the Australian Communications and Media Authority (ACMA) RADCOM database.
- Provide written notification of the project and seek comments from each license holder identified via the ACMA RADCOM database search.
- Record and review all responses received to identify any issues raised by license holders.
- Discuss issues raised with relevant license holders with the aim to resolve or identify mitigation options.
- Carry out an assessment of the “Fresnel zone” associated with each fixed point-to-point communications link in the vicinity of the project.
- Determine appropriate ‘exclusion zones’ for the proposed turbine layout based on these calculations and advice from license holders.
- Confirm that all turbines (including blades) are located outside the ‘exclusion zone’.
- Determine appropriate additional mitigation measures which may be required.

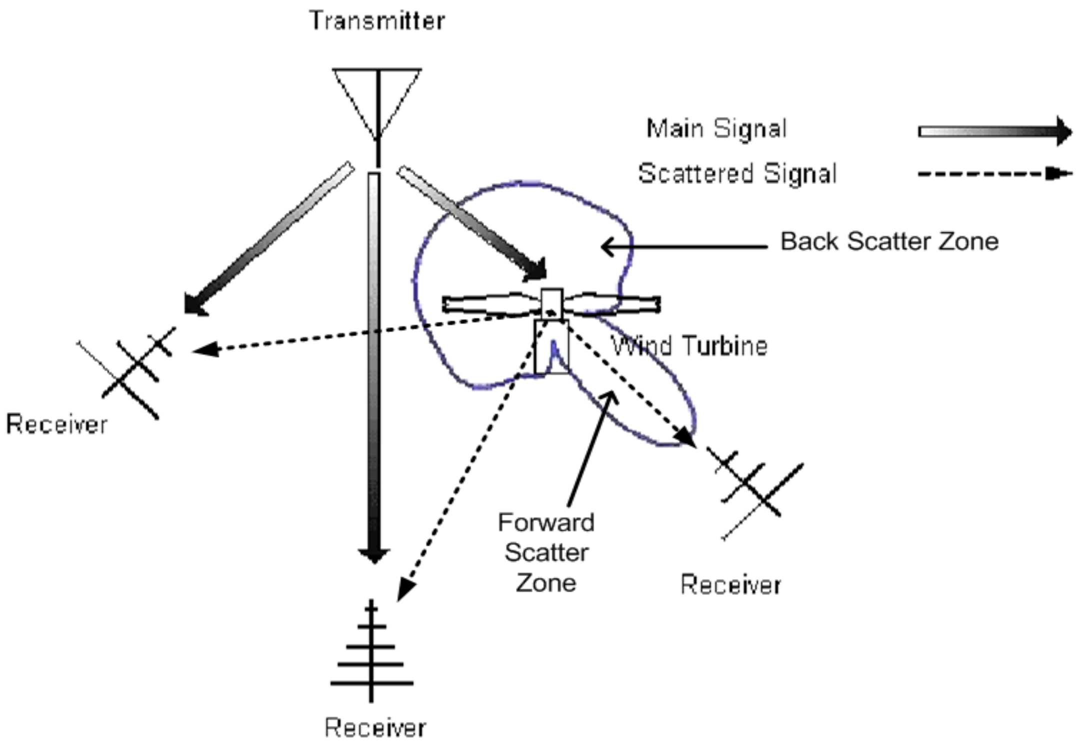

Figure 14-5 Scattering of a signal from a wind turbine

14.2.2 Existing Environment

The potential impacts of the proposed Liverpool Range Wind Farm on the four most commonly used telecommunications services have been investigated separately and are summarised below.

These services include:

- television broadcast services;
- radio broadcast services;
- mobile phone services; and
- radio communication services.

Television Broadcast

The ACMA RADCOM database lists the following broadcasters for television, under postcode 2843, Coolah, NSW.

Television broadcasting

- ABC30, ABC55, SBS52, CBN58, WIN61, CTC64, NBN33, NBN39, ABC42

The closest transmitter of television programs is at Queensborough, Coolah located about 5 kilometres North of Coolah.

Television Interference (TVI) is dependent on a range of factors including: existing environment factors (topography, direct signal strength, transmitter type, and receiver type) and wind farm design factors (turbine elevation, rotor size and orientation, speed of rotation, blade material and pitch). Due to the variability of local conditions and the characteristics of antennae used in particular installations, there is a degree of uncertainty regarding predicted levels of interference.

A Kordia report commissioned by the Long Gully Wind Farm in New Zealand stated that analogue television would be the most likely transmission service to experience interference from a wind farm development, although only within a limited distance. Very High Frequency (VHF) TV reception at dwellings within approximately 1 km of an installed wind turbines would have some probability of noticeable “ghosting” at times (Kordia, 2009).

However, analogue television signals have been 'switched off' and replaced with digital signals in the Coolah by the end of 2013. Digital TV is not susceptible to visible "ghosting" degradation. Any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area.

Satellite based television or internet services may also be received at various locations throughout the area. These services are not subject to the same topographic screening that can affect the land based TV transmissions. Due to the distance of residences from the wind farm it is very unlikely that satellite based television services would be subject to interference due to the wind farm's operation as the wind turbine would have to be within the line of sight from the antenna to the satellite.

Radio Broadcast

The ACMA RADCOM database lists the following broadcasters for radio, under postcode 2843, Coolah, NSW.

Radio broadcasting

- 2TRR

The level of radio broadcast interference experienced can be influenced by a variety of factors including abnormal weather conditions, multi-path distortion (reception of a signal directly from a transmitter and also a reflected signal from hills, structures etc.), overloading (when an FM receiver receives too strong a signal) and electrical interference.

Potential wind farm impacts on FM radio are highly unlikely and therefore the stations serving the area have not been listed.

License holders have been contacted regarding possible impacts to television or radio broadcasting services. The Proponent will work with organisations to resolve issues, should any be identified.

Mobile phone services

A mobile phone network consists of a system of adjoining zones called 'cells', which vary in size with a radius of 2 - 10 km. Each cell has its own base station that sends and receives radio signals throughout its specified zone. Mobile phone antennas need to be mounted clear of surrounding obstructions such as buildings to reduce 'dead spots' and allow the base station to effectively cover its intended cells.

Mobile phone coverage is available in some of the area around Coolah and Cassilis but it is worse further away from these towns and the main highways and where topography limits coverage, especially in the vicinity of the wind farm to the north east.

Due to the separation distance between base antennas for providing mobile phone services and turbine structures due to the wind farm location, transmission of mobile phone signals is not expected to be affected by the wind farm.

Radio Communications

The ACMA issues radio communications licenses in accordance with Part 3.5 of the Commonwealth Radiocommunications Act 1992. The ACMA issues licenses to use specific segments of the radio broadcasting frequency spectrum for different purposes and maintains a register (the ACMA RADCOM Database) of all the licenses issued.

The register allows the ACMA to create a 'density' classification of areas across Australia as high, medium or low depending on the number of licenses in operation in a particular area. According to the ACMA RADCOM database, the area in the vicinity of the proposed wind farm is classified as a "Low Density Area".

License holders operate a range of radio communications services, including fixed link microwave communication and mobile communication systems within a 25 km radius of the proposed wind farm. Multiple license holders use some sites, while sole users employ others. Radio communications site licence holders within a 25 km radius are listed below.

Each license holder has been contacted and asked to provide independent comment on the wind farm development with respect to possible impacts to communication links. The Proponent will work with organisations to resolve issues, should any be identified.

Table 14-3 Radio communication license holders within 25km of the Liverpool Range Wind Farm site

ACMA Licence Holder	ACMA Site ID No.
Ambulance Service of NSW	201640
Australian Broadcasting Corporation	6202, 11281
Australian Communications and Media Authority	137123
Coolah Community UHF Users Group	11282
Department of Finance and Services	11022, 11281, 11282, 54746, 201640
Electrostar Pty Limited	11282
Essential Energy	6202, 11283, 201640
Fire and Rescue NSW	11279
Hello Radio Pty Ltd	54514
Liverpool Plains Shire Council	201640
NBN Ltd	6202
NSW Police Force	6202, 11283, 201640
NSW Rural Fire Service	11282, 11283, 54746, 201640
NSW Volunteer Rescue Association Inc	6201, 11280
Office of Environment and Heritage	54746
Optus Mobile Pty Limited	9012296, 9013052,9014793
Paspaley Pearls Properties Pty Ltd	11282
Prime Television (Southern) Pty Limited	11281
Singtel Optus Pty Limited	201640, 9012296, 9013052
Soul Pattinson Telecommunications Pty Limited	11022
SPECIAL BROADCASTING SERVICE CORPORATION	11281
Talbragar Broadcasters Incorporated	48392
Telstra Corporation Limited	7011, 11022, 11284, 132138, 133163, 205756, 9012347
Warrumbungle Shire Council	11283, 137597
WIN Television NSW Pty Limited	11281

14.2.3 Consultation

License holders identified via the ACMA RADCOM database within a 25 km radius of the wind farm were notified of the project in relation to potential impacts and asked to provide comments. Table 14-4 summarises the organisations that were consulted and their comments received. Responses are included in Attachment 8.

Table 14-4 Consultation with license holders

Organisation	Response	Comment
Ambulance Service of NSW	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.

Organisation	*Response*	*Comment*
Australian Broadcasting Corporation	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Australian Communications and Media Authority	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Coolah Community UHF Users Group	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Department of Finance and Services	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Electrostar Pty Limited	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Essential Energy	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Fire and Rescue NSW	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Hello Radio Pty Ltd	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Liverpool Plains Shire Council	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
NBN Ltd	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
NSW Police Force	No Concern	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
NSW Rural Fire Service	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
NSW Volunteer Rescue Association Inc	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Office of Environment and Heritage	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Optus Mobile Pty Limited	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Paspaley Pearls Properties Pty Ltd	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Prime Television (Southern) Pty Limited	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.

Organisation	Response	Comment
Singtel Optus Pty Limited	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Soul Pattinson Telecommunications Pty Limited	More Information Requested	More Information provided
Special Broadcasting Service Corporation	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Talbragar Broadcasters Incorporated	Concerns Raised	Discussion ongoing. Further study may be required prior to construction.
Telstra Corporation Limited	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
Warrumbungle Shire Council	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.
WIN Television NSW Pty Limited	No Response	Epuron has followed up with stakeholder but received no additional feedback to date. Consultation continues.

14.2.4 Assessment

Television and radio broadcast services

In the event that Television Interference (TVI) is experienced by existing receivers in the vicinity of the wind farm, the source and nature of the interference would be investigated by the Proponent using a before and after approach as detailed in the mitigation measures.

Analogue TV transmission is currently planned to be phased out by 2013 and replaced by digital. Digital TV is not susceptible to visible “ghosting” degradation. Any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area.

Should investigations determine that the cause of the interference can be reasonably attributable to the wind farm; the Proponent would put in place mitigation measures at each of the affected receivers in consultation and agreement with the landowners.

Radio communications services

A fixed link radio transmission is a point to point transmission path typically between two elevated topographical features. Radio links could make use of a number of transmission frequencies including UHF, VHF or microwave. The transmission path may become compromised if a wind farm is located within the direct line of sight or what is known as the ‘Fresnel Zone’ around the line of sight between the sending and receiving antennae.

The potential impact zone will vary with the distance between the transmitter and receiver, frequency of transmission and the location of any particular point along its path. The maximum extent of the Fresnel zone occurs at the midpoint along the path of the microwave link as shown in Figure 14-6. Communications are only likely to be affected if a wind farm is in the line of sight between two sending and receiving antennae or within a zone of the line of sight of these antennae. In general, microwave links (which have very narrow Fresnel zones) are more liable to interference as a greater portion of the Fresnel zone can be impacted by the wind turbine.

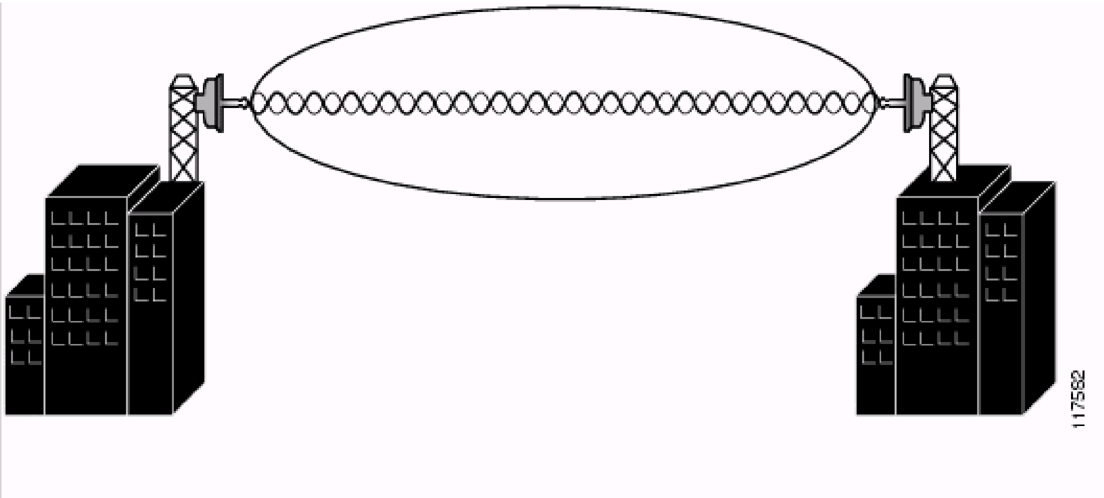

Figure 14-6 The Fresnel zone between a transmitter and a receiver

EPURON has identified and mapped all point to point radio communication links existing in the vicinity of the proposed Liverpool Range Wind Farm site. Table 14-5 lists the eight radio communication links that travel in close vicinity to the location of proposed wind turbines, and Table 14-6 lists radio communication towers within 500 m of wind turbines. Figure 14-7shows an aerial overview of the location of all fixed radio communication links in the vicinity of the Liverpool Range Wind Farm, the two radio communication towers referred to in Table 14-6 are found in the north-west and shown in detail in Figure 14-8. [6]

Table 14-5 – Point to point radio communication links in the vicinity of the Liverpool Range Wind Farm

Link ID	Client Number	Licensee	License Number	Frequency (Hz)
255024	5832	NSW Rural Fire Service	1427518	460350000
255024	5832	NSW Rural Fire Service	1427518	450850000
257595	5832	NSW Rural Fire Service	1229825	460775000
257595	5832	NSW Rural Fire Service	1229825	451275000
328352	1141565	Electrostar Pty Limited	1566428	414100000
328352	1141565	Electrostar Pty Limited	1566428	404650000
367069	5832	NSW Rural Fire Service	1204074	451125000
367069	5832	NSW Rural Fire Service	1204074	460625000

Table 14-6 - Radio communication towers within 500m of wind turbines

Site ID	Site Name	Easting (MGA 94)	Northing (MGA 94)	Zone (MGA 94)	Turbines within 500 m
11,282	Prime Comms site adjacent Oakey Trig Station (9km North of Coolah)	769,000	6,491,150	55	2
48,392	Three Rivers Radio Mast adjacent to Oakey Trig Station (MT OAKY)	768,980	6,490,500	55	3

6 Based on data contained in the ACMA RADCOM database, June 2012

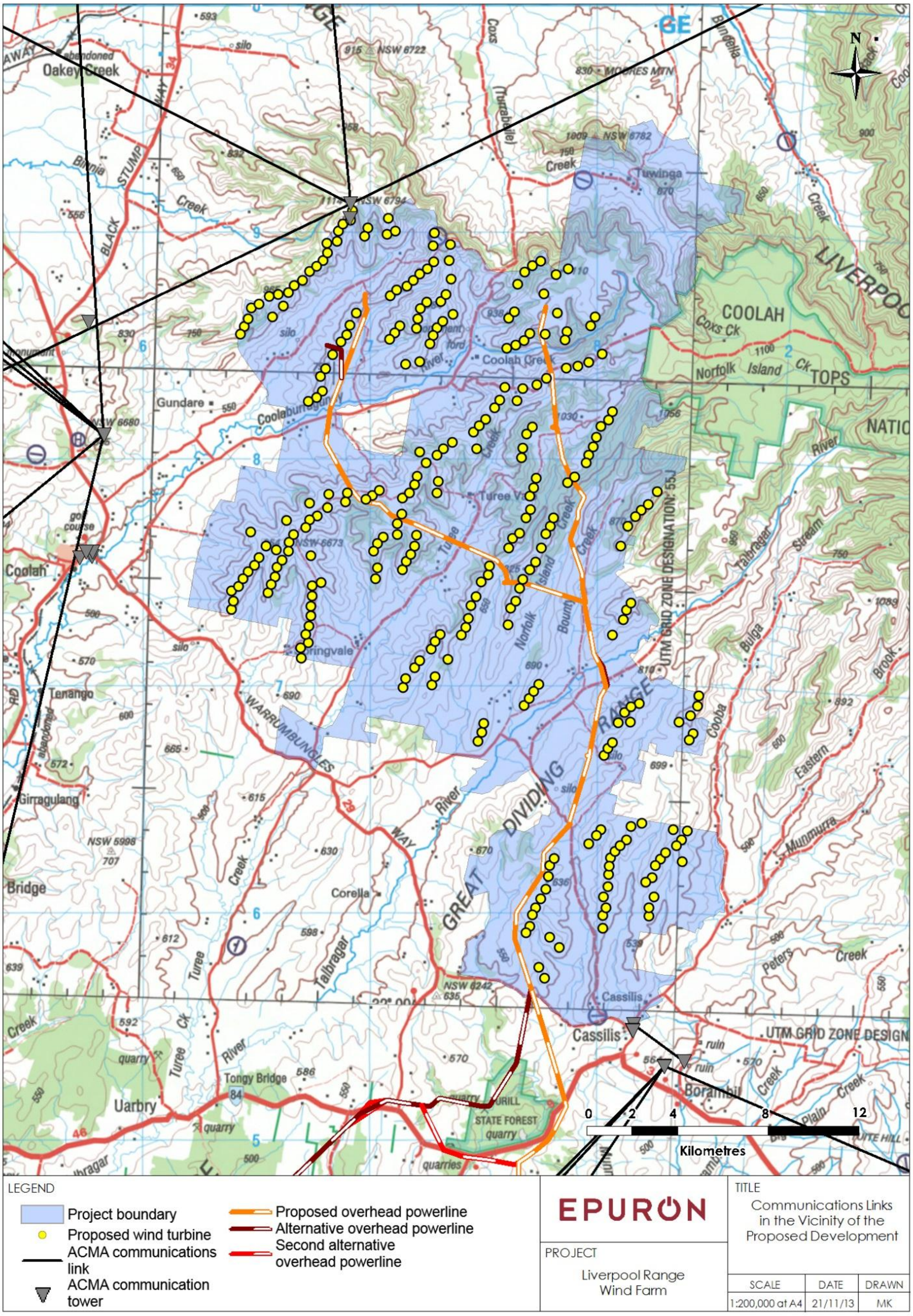

Figure 14-7 Point to point radio communication links in the vicinity of the Liverpool Range Wind Farm

In order to ensure that obstruction to the signal transmission path does not occur, calculations of the 2nd order Fresnel zone of the point to point communications links in close vicinity to the wind turbines were undertaken.

It is suggested that beyond the 2nd Fresnel zone, the power of a scattered signal from a structure such as a wind turbine would be small enough such that it would not result in significant interference at the receiver (Bacon, 2002).

Completion of this Fresnel analysis showed that no turbines were to be located within the 2nd Fresnel zone, in the direct line of sight path of the point to point links. Despite this, there are wind turbines planned within 500 m of one omnidirectional radio broadcast tower and one point to point radio communication tower.

Figure 14-8 shows the proximity of the turbines to the two radio communication towers. Due to the proximity of the wind turbines to the broadcast towers, there is the possibility that near field scattering interference can occur. Epuron is currently in correspondence with the owners and operators (Three Rivers Talbragar Radio) of these two radio communication towers and will ensure that mitigation measures are implemented where required, at the proponent's expense, so that impact on existing services does not occur. Further qualified study may be required to determine the potential impact on these broadcast towers.

Therefore, based on:

- The results of the above literature research;
- Location of turbine layout avoids 2nd order Fresnel zones of all radio communication links, and;
- Discussion with owners and operators of radio communication towers within 25 km of the project;

Interference to the existing point to point communication links from the Liverpool Range Wind Farm is not expected.

Epuron previously contacted all organisations identified as operating radio communication licences (including fixed link communications) within 25 km of the Cullerin Range wind farm proposal, which is now operational and without communications issues in the area.

Each license holder was asked to provide independent comment on the wind farm development with respect to possible impacts to communication links. At that time, no organisation within the 25km radius raised concerns.

Optus, Vodafone and Telstra provided general guidelines to assist in the planning of wind farm.

In response to these enquiries, the following comments were noted,

> *"Provided wind turbines are located well outside the 2nd Fresnel zone of the point to point microwave links, no interference to communications is expected" (pers. comm. Mr. Trong Ho, Optus Mobile)*(Taurus Energy, 2006*)*
>
> *"Clearance criteria is the same for all carriers. Please use the same criteria as proposed by Optus" (pers. comm. Mr. Ganesh Ganeswaran, Senior Engineer / Transmission, AAP Communications Services 22/11/05)*
>
> *"Provided wind turbines are greater than 100 m away from Mobile tower (or in the case of directional panel antennae) not in direct line of sight for panel antennas, wind turbines will have minimal effect on existing coverage." (pers. comm. Mr. Ivan D'Amico, Area Team Manager (Country) - NSW&ACT, Telstra Services, Wireless Access Solutions, Mobile Coverage Delivery)*

The above suggestions have been incorporated in the planning of the Liverpool Range Wind Farm proposal.

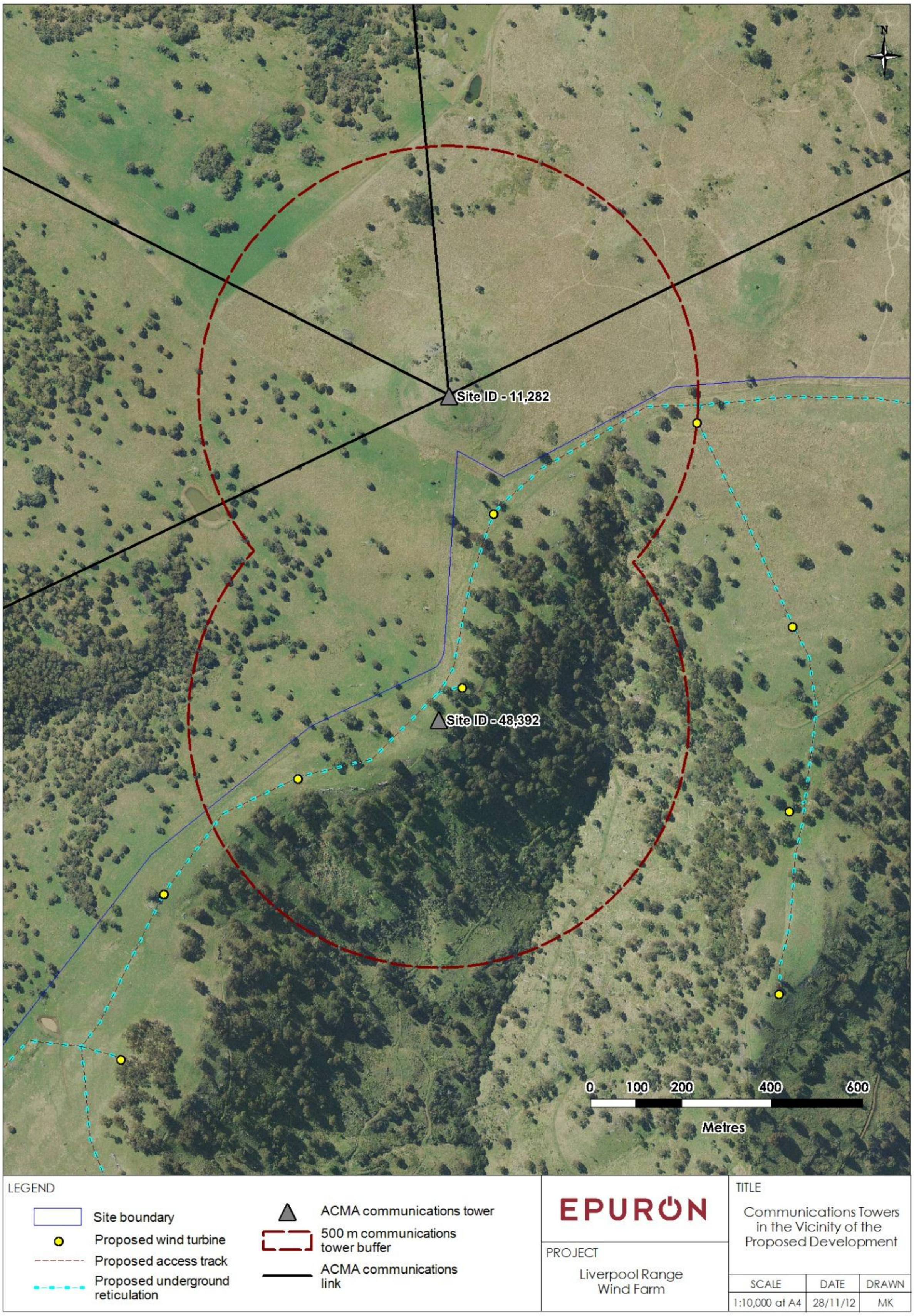

Figure 14-8 Radio Communication Towers within 500 m of wind turbines

14.2.5 Mitigation Measures

As a result of the exclusion zones established in planning the wind farm, the possibility of impacts to existing point to point communication links is reduced. However, in the unlikely event that interference is predicted or observed, the proponent is confident that impacts will be able to be mitigated using the following techniques:

- relocation or removal of wind turbine locations prior to construction;
- modifications to or relocation of the existing antennae;
- installation of a directional antennae to reroute the existing signal;
- installation of an amplifier to boost the signal, and/or;
- utilisation of onsite optical cable to reroute the original signal.

14.3 Electromagnetic Fields

14.3.1 Background

Electromagnetic fields (EMF) (having both electric and magnetic components) are generated by all electrical devices including household appliances (televisions, lights, electric blankets etc.), powerlines, substations and wind turbines. Generally, scientific evidence does not firmly establish that exposure to 50 Hz electric and magnetic fields from these sources are a hazard to human health. Current science would suggest that if any risk exists, it is small (ARPANSA, 2011a).

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has produced fact sheets which state that studies to date have consistently shown that there is no evidence that exposure to low level electric fields (such as those found in the home or in most workplaces) are a health hazard. In the same text, it states the possibility remains that intense and prolonged exposure of magnetic fields may increase health risks (ARPANSA, 2011a).

In relation to EMF, the issues associated with wind farms are no different to the issues associated with the electricity industry in general and the use of industry best practice (and in particular the appropriate location of associated powerlines and related easements) should ensure EMF risk is adequately managed.

ARPANSA was formed in 1998 as a Federal Government agency charged with the responsibility of protecting the health and safety of people and the environment, from the harmful effects of ionising and non-ionising radiation. ARPANSA is currently developing guidelines on exposure limits to EMFs but in the meantime they still refer to the National Health and Medical Research Council Interim Guidelines (ARPANSA, 2011b).

The *National Health and Medical Research Council Interim Guidelines on Limits of Exposure to 50/60 Hz Electric and Magnetic Fields* recommend a limit for 24 hour exposure of 1000 mG for magnetic fields and 5 kV/m for continuous public exposure to electrical fields (NHMRC, 1989). These values are consistent with the 50 Hz values of the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 1998). They note that research suggests that health effects are associated with prolonged exposure; measurements at one point in time do not accurately reflect prolonged exposure levels. As an update in 2009, the ICNIRP stated that based on the latest scientific literature, these recommended limits above remain in place.

Electric fields can be reduced both by shielding and with distance from operating electrical equipment. Magnetic fields are reduced more effectively with distance from the equipment.

Potential for EMF impacts occurs only during the operational phase of the wind farm when electrical infrastructure is capable of generating electromagnetic fields. The electromagnetic fields produced by the wind farm infrastructure would vary at different locations onsite, as discussed below. No impact mitigation is considered to be required for the construction and decommissioning phases.

14.3.2 Assessment

Powerlines

The maximum voltage of the underground and overhead powerline cables connecting turbines to the collection substations within the site would be either 22 kV or 33 kV. At the collection substations, the voltage would be stepped up to a maximum 330 kV, and transmitted along 330 kV overhead powerlines to a connection substation which will be connected to a new adjacent TransGrid connection switchyard, also adjacent to the existing TransGrid transmission network, where it would connect into the existing Wollar to Wellington 330 kV powerline.

The magnetic fields associated with a powerline at any moment in time depend on a range of factors, including the amount of current flowing in the line and the distance of the measurement point from the conductors. The electric field strength created by powerlines is dependent upon the height of the wires above the ground and their geometric arrangement.

Table 14-7 shows maximum electrical and magnetic field strengths for the various types of powerlines expected to be used in the project (National Grid, 2011):

Table 14-7 Maximum electrical and magnetic field strength of various powerlines

Voltage and Type	Maximum electrical field strength under powerline (or over cable) (kV/m)	Maximum magnetic field strength directly under line (over cable) (mG)
33 kV overhead powerline	0.897	257
33 kV underground cable	--	10
330 kV overhead powerline	3.6	304

Note that underground cables do not produce any external electric fields.

All these values are well within the limits of 5 kV/m and 1000 mG recommended for 24 hour exposure mentioned previously (NHMRC, 1989). These values are maximum values and those measured in the project are expected to be less. Furthermore, the strength of both electric and magnetic fields falls away rapidly with distance from the line (National Grid, 2011)

Any off-site electricity lines will be located and designed in accordance with Essential Energy's Easement Requirements (Essential Energy, 2012). This guideline provides requirements for how powerline easements are to be constructed, when they are required and how they are obtained in New South Wales. The electricity cables will be located away from residences, where practical, to minimise magnetic fields from any off-site powerlines.

Substations

Electricity substations are a source of electric fields, although those encountered at the boundary of substations are usually very weak due to effective screening. They are certainly no more than a few hundred volts per meter near the largest installations, well below the 5 kV/m limit.

Magnetic fields from substations occur at their maximum opposite feed pillars, transformers and switching units (Maslanyj, 1996). Fencing around the substations and the location of the substations and control buildings would ensure that the magnetic field exposure to receivers including the public, property owners and workers are well below the 1,000 mG levels determined to be the maximum to safeguard for public health.

Wind Turbines

The areas proposed for the installation of wind farm infrastructure with potential EMI would have limited public access. Access to these areas by the general public would be restricted, with periodic access by appropriately trained and qualified maintenance staff only. Property owners accessing the sites would have no reason to spend extended periods near the infrastructure, which is not located near frequent use areas such as sheds, yards and residences. Should property owners require access to control buildings or other wind farm infrastructure, they would be accompanied by an appropriately trained and qualified maintenance staff member.

A report investigated the expected magnetic field for proposed wind turbines for Windrush Energy in 2004 (Iravani et al., 2004). The study was based on research and measurements of an existing wind turbine. The measured flux density at the door of the existing turbine was 0.4 mG and the typical value around the wind turbine was 0.04 mG. The acceptable level as stated by the International Commission on Non-Ionizing Radiation

Protection (at 60 Hz in this case) is 833 mG (ICNIRP, 1998). The results also concluded that no measurable magnetic field would be expected at a distance of eight metres from the 1,650 kW wind turbine, and hence the magnetic fields produced by generation of electricity from turbines would not pose a threat to public health.

14.3.3 Mitigation

Overhead powerlines and underground cables would generally be located as far as practical from residences and in accordance with the minimum distances set out in Essential Energy's Procedural Guideline – Easement Requirements.

14.4 Shadow Flicker

14.4.1 Introduction

Due to their height, wind turbines can cast shadows on the areas around them. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position, when the turbine is between the viewer and the sun, the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. This is similar to the strobe effect often experienced when driving through scattered trees on a rural highway.

For a particular position, shadow flicker will only occur during periods when the sun's rays pass directly through the swept area of the turbine blades to the viewpoint. The extent of the shadow flicker is dependent on the time of day, geographical location, meteorological conditions of the site and local vegetation.

There are a number of factors influencing the effect and duration of shadow flicker including:

- position of the sun in relation to the turbine;
- time of year (season) and time of day;
- turbine height and rotor diameter;
- viewer's distance from turbine;
- topography of the area;
- vegetation cover;
- weather patterns, number of cloudy days per year; and
- airborne particles, haze

The effect of 'chopping the light' attenuates with distance and is not considered by assessors of shadow flicker to be noticed beyond 500-1,000 m from a turbine (Osten and Pahlke, 1998).

In NSW there are currently no guidelines on which to assess shadow flicker generated by wind turbines. The Victorian Planning Guidelines limit the duration of shadow flicker to a maximum of 30 hours per year (SEAV, 2003). The South Australian Planning Bulletin suggests that shadow flicker is insignificant once a separation of 500m between the turbine and house is exceeded.

14.4.2 Background

Shadow flicker is usually an amenity issue rather than a health risk. Given it is a daytime event; it does not interrupt sleep patterns. However, two issues have been raised as potential health concerns in relation to shadow flicker:

Flicker vertigo

Flicker vertigo is an imbalance in brain cell activity caused by exposure to low frequency flickering or flashing of a light or sunlight seen through a rotating propeller (Rash, 2004). It can result in nausea, dizziness, headache, panic, confusion and – in rare cases – loss of consciousness. Flicker vertigo is usually associated with a light flashing sequence, or flicker frequency, of between approximately 4 Hz (cycles per second) and 20 Hz (NASA, 2001; Rash, 2004).

Photosensitive Epilepsy

Flicker from turbines that interrupt or reflect sunlight at frequencies greater than 3 Hz poses a potential risk of inducing photosensitive seizures. At 3 hertz and below the cumulative risk of inducing a seizure should be 1.7 per 100,000 of the photosensitive population. The risk is maintained over considerable distances from the turbine. It is therefore important to keep rotation speeds to a minimum, and in the case of turbines with three blades ensure that the maximum speed of rotation does not exceed 60 rpm, which is well beyond the normal range for large wind turbines. The layout of wind farms should ensure that shadows cast by one turbine upon another should not be readily visible to the general public. The shadows should not fall upon the windows of nearby buildings (Harding et al., 2008).

In both cases, the cause of the health effect is a flashing of light with the flash frequency in the range of 3 – 30 hertz. Therefore, wind turbines would only provide a health risk of the shadow flicker created was within this range.

14.4.3 Assessment

A detailed analysis of the potential for shadow flicker and blade glint to affect dwellings has been carried out by Epuron. Modelling of the shadow flicker was conducted using specialist industry software, assessing the largest turbine (maximum tip height) proposed for the project to represent the worst case impact scenario. The maximum number of annual hours at each of the nearby houses where shadow flicker may be experienced was calculated using this model.

The number of annual hours of shadow flicker at a given location can be calculated using simple geometrical models incorporating data such as the sun path, the topographic variation and wind turbine details such as rotor diameter and hub height. In such models, the wind turbine rotor is modelled as a disc and assumed to be in the worst case (i.e. perpendicular) to sun-turbine vector. Furthermore, the sun is assumed to be a point light source.

Shadow flicker calculated in this manner overestimates the number of annual hours of shadow flicker experienced at a specified location due to several reasons.

- The occurrence of cloud cover has the potential to significantly reduce the number of hours of shadow flicker.
- The probability of wind turbines consistently yawing to the ‘worst case’ scenario where the wind turbine is facing into or away from the sun- wind turbine vector is less than 1 (i.e. less than 100% of the time).
- The amount of aerosols in the atmosphere has the ability to influence shadows cast due to the following reasons.
- Firstly, the distance from a wind turbine that a shadow can be cast is dependent on the degree to which direct sunlight is diffused, which is in turn dependent on the amount of dispersants (humidity, smoke and other aerosols) in the path between the light source (sun) and the receiver [2].
- Secondly, the quantity of aerosols in the air is known to vary with time and it has the potential to vary the air density, thereby affecting the refraction of light. This in turn affects the intensity of direct light to cause shadows.
- The modelling of the wind turbine blades as discs to determine shadow path overestimates the shadow flicker effect.
- The blades are of non-uniform width with the thickest viewable blade width (maximum chord) occurring closer to the hub and the thinnest being located at the tip of the blade. As outlined in point 3 above, the direct sunlight is diffused resulting in a maximum distance from the wind turbine that a shadow can be cast. This maximum distance is dependent on the human threshold which variation in light intensity can be perceived. When the blade tip causes shadow, the diffusion of direct sunlight means that the light variation threshold occurs closer to the wind turbine than when a shadow is caused by the maximum chord. That is, the maximum shadow length cast by the blade tip is less than by the maximum chord.
- Modelling the sun as a point light source rather than a disc has an effect similar to that of point 4 above.

- Firstly, situations arise where the light rays from different portions of the sun disc superimpose around a shadow resulting in light intensity variations less than human perception.
- Secondly, when the sun is positioned directly behind the wind turbine hub, there is no variation in light intensity at the receiver location and therefore no shadow flicker. However, when the sun is modelled as a point source, shadow flicker still arises.
- The presence of vegetation shields incidences of shadow flicker.
- Periods where the wind turbine is not in operation due to low winds, high winds or operational and maintenance reasons.

Taking the above issues into account, the modelling of shadow flicker has been conducted using simple geometric analyses. The wind turbine has been modelled assuming all wind turbines are disc objects positioned in the worst case with respect to shadow flicker. The sun has been assumed to be a point light source.

To carry out the shadow flicker assessment, the Victorian Planning Guidelines and the South Australian Planning Bulletin discussed earlier were used to determine the inputs to the model. They were:

- a maximum duration of shadow flicker at any residence of 30 hours per year; and
- a conservative assessment distance of 1 km (twice the distance suggested to be affected by shadow flicker).

Therefore, the modelling conducted here represents a very conservative scenario and is believed to overestimate the actual annual hours of shadow flicker experienced at a location.

14.4.4 Actual Conditions at Liverpool Range

When the actual conditions of the Liverpool Range wind farm site are taken into consideration, the number of hours of shadow flicker should be reduced. The major consideration in this respect is the weather patterns and particularly the number of cloudy days experienced that result in no shadow flicker.

Based on 41 years (1967 – 2010) of daily weather observations in Dunedoo (Dunedoo Post Office, Bureau of Meteorology), the nearest source of data, the average number of cloudy days experienced is 94 days/year. The average number of clear days experienced is 104.2 days/year. These are based on observations at 9am and 3pm each day.

Accordingly based on 94 days/year of cloud the number of shadow flicker hours should be reduced by 25%. Further reductions for vegetation screening should be considered and applied where appropriate on a case by case basis.

Dunedoo data was used at it showed the lowest number of cloud cover per year compared to the four closest weather stations in the area: Connabarabran, Mudgee, Gulgong and Dunedoo. This made the calculation more conservative than if another site was chosen.

14.4.5 Results

The modelling has calculated the number of annual hours at each of the nearby houses and the results are presented in

Table 14-8. The second column represents the theoretical maximum hours of shadow flicker, as discussed above and shown in Figure 14-10. This approach is based upon the assumption that the wind turbine is yawed to the worst case position of facing into or away from the sun. Using twelve years of onsite wind rose measurements, the probability of occurrence of various wind directions can be incorporated in the assessment to increase the accuracy. The results are shown in the third column. Additionally a reduction of the theoretical maximum number of hours can be assumed based on the long term observation of cloudy days shown in the fourth column.

Table 14-8 Result of shadow flicker assessment

Residence ID	Theoretical maximum shadow flicker (hrs/yr)	Reduced due to turbine orientation (hrs/yr)	Reduced due to cloud cover (hrs/yr)
F7-1	33	23	17
F7-2	16	10	8
F7-3	17	10	0
G4-1	0	0	0

Only one dwelling has greater than 30 hours per year theoretical shadow flicker F7-1. The two turbines that contribute to shadow flicker to dwelling F7-1 is turbine F7-1 and F7-2. Turbine F7-1 and F7-2 are located 104° and 84° from dwelling F7-1. There is significant vegetation covering the Northern and Eastern sides of the dwelling which would provide additional screening from the wind turbines and hence shadow flicker, this can be seen in Figure 14-9.

In addition based on the 41 years of data the standard deviation is 22.4 days resulting in a 99% likelihood that the cloud cover will exceed 41.9 days per year. Based on 41.9 days of cloud cover per year this reduces the number of shadow flicker hours by 11.5% which would result in shadow flicker below 30 hours per year for dwelling F7-1.

LEGEND		TITLE
Proposed wind turbine	EPURON	Residence F7-1 Vegetation Cover
Residence	PROJECT Liverpool Range Wind Farm	SCALE 1:1,500 at A4 / DATE 25/11/13 / DRAWN TILA

Figure 14-9 Aerial view of F7-1

14.4.6 Health Effects from Shadow Flicker

Flicker frequency of rotating propellers, including wind farm rotors, is derived by multiplying the hub rotation frequency by the number of blades. Based on the rotation speed of the 3 bladed wind turbines proposed for the project, the maximum shadow flicker frequency would be 1 cycle per second (1 Hz), well outside the frequency range associated with flicker vertigo or photosensitive epilepsy.

The operational wind turbines are not anticipated to produce a flicker frequency high enough to pose a health risk. Comparable turbines have been rated 0.45 to 0.95 Hz, significantly below critical levels of 3-30 Hz for public health. The project is therefore unlikely to represent a health risk to local residents in relation to flicker vertigo or photosensitive epilepsy.

This sentiment is also reflected in a recent public statement by the National Health and Medical Research Council titled 'Wind Turbines and Health' has stated that the evidence on shadow flicker does not support a health concern (NHMRC, 2010).

14.4.7 Blade Glint

Blade glint occurs when sunlight is reflected off turbine blades. The concern is that this may affect some motorists or cause annoyance at dwellings.

Turbine manufacturers have acknowledged the possibility of blade glint and use a low reflectivity gel finish to reduce any reflectivity. The turbines proposed for this project would be finished in a matte, non-reflective finish to ensure blade glint impacts do not occur.

14.4.8 Conclusion

The worst case predicted shadow flicker at each dwelling within 1 km of the proposed wind turbines is shown in

Table 14-8. Only one dwelling, F7-1 has greater than 30 hours per year theoretical shadow flicker. Figure 14-10 (below) has been focused on these residences within 1 km to give a visual representation of the worst case shadow flicker results. Additionally an assessment has been made on the level of conservatism associated with the worst case results by reduction in shadow flicker due to turbine orientation based on wind direction occurrences measured on site and cloud cover. The adjusted results are shown in the table and indicate that all dwellings are within the accepted limit of 30 hours per year. In addition to this there is significant vegetation screening at dwelling F7-1 which would further block shadow flicker and likely reduce the theoretical shadow flicker to below 30 hours per year without considering wind direction and cloud cover impacts.

14.4.9 Mitigation Measures

- If shadow flicker is found to be a nuisance at a particular residence at a known location a physical screen can be placed between the location and the wind turbines. Additional trees or other vegetation can be used to accomplish this.
- If shadow flicker is found to be a nuisance at a particular residence, conditions could be pre-programmed into the control system so that individual wind turbines automatically shut down whenever these conditions are present.
- Shadow flicker effects on motorists would be monitored following commissioning and any remedial measures to address concerns would be developed in consultation with the RMS and the Department of Planning.

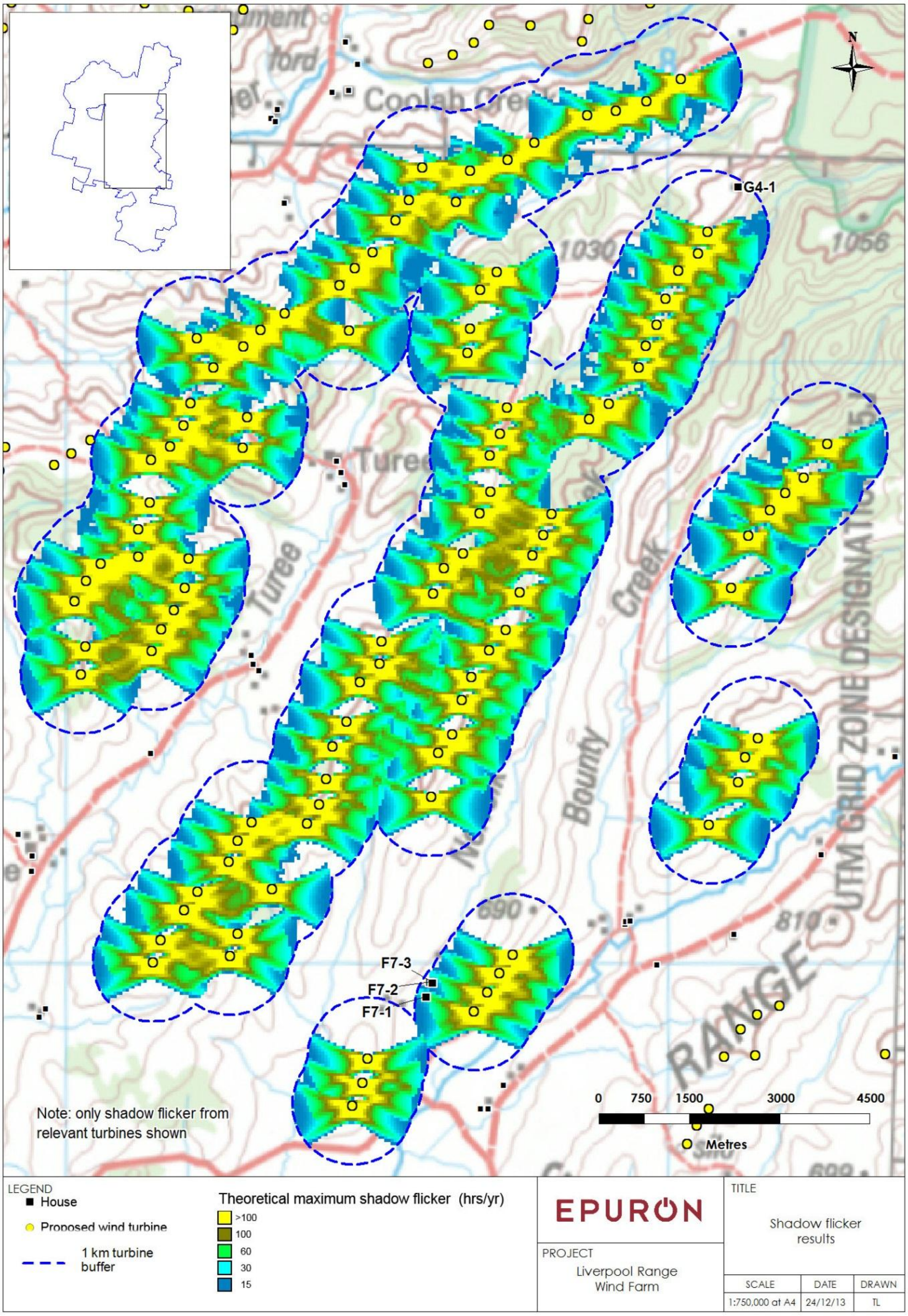

Figure 14-10 Theoretical shadow flicker

14.5 Fire and Bushfire Risks

14.5.1 Background

A bushfire management plan would be prepared prior to construction and included within the Construction and Operational Environmental Management Plans. Bushfire safety Issues that are associated with wind farms include:

- the potential for wind farm infrastructure to cause a fire that may or may not result in a bush fire;
- the potential for the wind farm to be affected by a passing bush fire and the impact the existence of turbines may have on fire management; and,
- the presence of additional ignition sources as a result of the construction, operation or decommissioning of the wind farm.

14.5.2 Existing environment

The development envelope for the project is predominately pasture with patches of remnant Box Gum Woodlands also present.

The bushfire danger period stated by the NSW Rural Fire Service (RFS) is generally between 1st October and 31st March, but can vary subject to local conditions. Summer conditions in these LGAs can be dry and hot with high wind speeds. Existing ignition sources include farm machinery and vehicles, hay storage, vehicles stopping in long grass on road verges, cigarette butts thrown from car windows and lightning strikes. The elevated position of the sites may increase the frequency of lightning strike. The steep topography and absence of built areas or natural fire breaks such as large water bodies may assist the rate of spread of wildfires.

Factors mitigating fire risks within the site include the sparse and fragmented nature of woodland and forest remnants flanking the development envelope and the continued grazing regimes, which acts to reduce fuel loads. However grass fires can spread rapidly and threaten life and property.

The NSW Fire Brigade has the authority to attend, combat and render safe any land-based or inland waterway spillage of hazardous materials within the State. The NSW Fire Brigade defines hazardous materials as (F&R NSW, 2007):

> *"anything that, when produced, stored, moved, used or otherwise dealt with without adequate safeguards to prevent it from escaping, may cause injury or death or damage to life, property or the environment".*

The fuels and lubricants required to construct and operate the wind farm constitute hazardous materials under this definition, and any fire at the wind farm would come under management of NSW Fire Brigade supported by the RFS.

All NSW Fire Brigade fire stations are equipped with trained personnel and resources for dealing with hazmat incidents. The closest NSW fire brigades to the site are Coolah Fire Station (5 km from the site) and Merriwa Station (40km from centre of the site), in addition to a RFS brigade in Cassilis.

The Hazardous Materials Response Unit has a 24 hour phone contact (Tel: 02 9742 7155). Intermediate hazardous materials response is delivered by 20 strategically located units; each unit is equipped with detection equipment and has the capability to access chemical databases with information on chemical, biological, radiological and toxic industrial chemical substances.

14.5.3 Assessment

Construction Activities

Flammable materials and ignition sources brought onto the site, such as fuels, would increase the risk of fire during the construction period. Correct handling and storage procedures would mitigate against the risk of ignition. Appropriate fire fighting equipment would need to be held on site when the fire danger is very high to extreme, and a minimum of one person on site would be trained in its use.

The RFS would continue to be consulted in regard to the adequacy of bushfire prevention procedures to be implemented on site during construction, operation and decommissioning. These procedures would in particular cover hot-work procedures and response measures to control any incident.

Operational Activities

Being electrical equipment and containing petrochemicals, there is potential for the wind turbines, substations, control buildings and powerlines to start or influence the spread of fire. For the wind turbines themselves, the risk of fire can be associated with malfunctioning turbine bearings, inadequate crankcase lubrication, electrical distribution facilities, electrical shorting or arcing occurring in transmission and cable damage during rotation (AusWEA, 2001).

The ready visibility of the turbines and local presence of RFS equipment and personnel would assist detection, response time and control. In addition, shut down mechanisms are installed in the wind turbines, and remote alarming and maintenance procedures would also be used to minimise risks.

Lightning conductors are installed in turbines to ground lightning strikes in order to minimise risk of damage to the turbines and risk of ignition of a wildfire. Relatively minor damage to turbines may occur from lightning strike. At the existing Crookwell I site, a direct strike resulted in damage to one of the turbine blades, which was repaired onsite. No wildfire resulted. The risk of turbine ignition is considered to be low, based on the low likelihood of electrical failure or over-heating and a range of factors mitigating the fire hazard.

Transmission and powerlines would be installed to connect the wind farm to the electricity grid. The powerlines are underground across most of the site and overhead to connect strings of turbines to the substation. The overhead lines have been routed to avoid trees and forest fragments where possible, reducing the need for clearing and eliminating ongoing fire risks from tree growth and in the event of a line breakage. Cable routes would be periodically inspected to monitor any regrowth.

The transformers located in the substation facilities would contain transformer oil for the purpose of cooling and insulation. These facilities would be bunded with a capacity exceeding the volume of the transformer oil to contain the oil in the event of a major leak or fire and would be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater). Transformer oil would be changed regularly at appropriate intervals by qualified staff to minimise the potential for fire caused by contaminated oil. The oil would be removed from the site and disposed of appropriately.

The substations would be surrounded by a gravel and concrete area free of vegetation to prevent the spread of fire from the substation and reduce the impact of bushfire on the structure. The substation areas would also be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress. An asset protection zone would be maintained around the control room and substation buildings, compliant with the RFS Planning for Bushfire Protection guidelines. Workplace health and safety protocols would be developed to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities.

Impacts on fire-fighting operations

The turbines have the potential to present a hazard to fire fighting helicopters and planes, however, the access tracks installed to build and maintain the wind farm would increase the accessibility onsite and would therefore have a positive impact on the response time and ability to fight fires onsite or on neighbouring properties.

The RFS have participated in the environmental assessment process of several wind farms in NSW. Representatives of the RFS have stated that, due to the hazardous materials stored onsite (hydrocarbons within turbines and the substation); the local RFS would only ever act in a support capacity to the NSW Fire Brigade, in the event of an infrastructure related fire onsite. The RFS and NSW Fire Brigade would be consulted regarding safety, communication, site access and response protocols in the event of a fire originating in the wind farm infrastructure, and also in the event of an external wildfire threatening the wind farm. They have also stated that wind farm infrastructure is no different, with regard to bush fire risk, from similar large scale infrastructure developments.

While the risk of bushfires would be increased by the construction and operational activities of the wind farm, the cleared nature of the land and the improvements to site access would aid fire fighters on site.

14.5.4 Mitigation

- Ensure that all project components on the site are designed, constructed and operated to minimise ignition risks, provide for asset protection consistent with relevant RFS design guidelines (NSW RFS, 2006; NSW RFS, 2010) and provide for necessary emergency management including appropriate fire-fighting equipment and water supplies on site to respond to a bush fire.
- Regularly consult with the local RFS to ensure familiarity with the project, including the construction timetable and the final location of the entire infrastructure on the site. The Proponent will comply with any reasonable requests of the local RFS to reduce the risk of bushfire and to enable fast access in emergencies.
- Prepare a Bushfire Management Plan as part of the Construction Environmental Management plan. The RFS and NSW Fire Brigade would be consulted in regards to its adequacy to manage bushfire risks during construction, operation and decommissioning. As a minimum the plan would establish hot-work procedures, asset protection zones, safety, communication, site access and response protocols in the event of a fire originating in the wind farm infrastructure. All flammable materials and ignition sources brought onto the site, such as hydrocarbons, would be handled and stored as per manufacturer's instructions
- During the construction phase, appropriate fire fighting equipment would be held on site when the fire danger is very high to catastrophic, and training in its use would be provided as necessary. Fire extinguishers would be stored onsite in the control building and within any substations.
- Substations would be bunded with a capacity exceeding the volume of the transformer oil to contain the oil in the event of a major leak or fire. The facilities would be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater).
- Shut down of turbine components would commence if the components reach critical temperatures or if directed by the RFS in the case of a nearby wildfire being declared (all hours contact points would be available to the RFS during the bushfire period. Remote alarming and maintenance procedures would also minimise the risk. Overhead powerline easements would be periodically inspected to monitor regrowth of encroaching vegetation.

14.6 Blade Throw

Blade throw refers to the event in which ice or a turbine blade itself becomes separated from the nacelle into the surrounding environment. On the occasions where part of the blade has become separated from the tower, the most common causes are lightning strikes, storms, material fatigue or poor operation and maintenance practices. Wind turbines manufacturers have been implementing new design features to reduce the risk of these events occurring even further. Some of these advances include increasing lightning protection along the blades to reduce the damage from strikes and developing greater control systems to monitor any decrease in structural integrity and implement an automatic shutdown. Furthermore, modern turbines have an automatic braking system when wind speeds exceed a set value. For the case of the Vestas V112 as proposed in this environmental assessment, the cut-out speed for high winds is 25 m/s (90 km/h).

Ice throw occurs when the surrounding environment drops below freezing temperature and ice develops on the turbine blade. The ice is then dislodged when the turbine blade begins to rotate or the surrounding temperature increases. The Liverpool Plains and surrounding regions are not known to regularly have sub-zero nights throughout winter and therefore this must be considered as a very low possibility for the winter months.

While there is a possibility of these events occurring, the likelihood of a landowner being near a turbine during storms or freezing conditions is considered low; however, land owners will be advised to avoid turbines during these conditions.

14.7 Health

Some areas of the community, particularly those proximate to proposed or operating wind farms, have raised concerns for the potential impacts of wind turbine noise on human health. These concerns appear to relate to emissions from either low frequency noise or infrasound which is the two areas generally raised regarding potential health impacts from wind farm noise. Both these potential noise related impacts are addressed in further detail in Section 10 of this EA.

Other areas of concerns for human health related impacts from wind farms include electromagnetic radiation, shadow flicker and blade glint produced by wind turbines. While a range of effects such as annoyance, anxiety, hearing loss, and interference with sleep, speech and learning have been reported anecdotally, there is no published scientific evidence to support adverse effects of wind turbines on human health. There have been a number of studies into the perceived health impacts to humans from wind farms over the last few years and an outline of the key points from some of these studies include:

Environmental Protection Authority of South Australia

In January 2013, the South Australian Environmental Protection Authority (EPA) released findings of a study into the level of infrasound within typical environments in South Australia, with a particular focus on comparing wind farm environments to urban and rural environments away from wind farms.

The study concluded that the level of infrasound at houses near the wind turbines assessed is no greater than that experienced in other urban and rural environments, and that the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment.

National Health and Medical Research Council

In 2010, Australia's peak body for undertaking health and medical research, the National Health and Medical Research Council (NHMRC), undertook a study of available literature on the potential impacts of wind turbines on human health. The objective of the study was to ascertain if the following statement could be supported by the evidence: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.

The study findings noted that: Based on current evidence, it can be concluded that wind turbines do not pose a threat to health if planning guidelines are followed, and concluded by stating that: The health effects of many forms of renewable energy generation, such as wind farms, have not been assessed to the same extent as those from traditional sources. However, renewable energy generation is associated with few adverse health effects compared with the well-documented health burdens of polluting forms of electricity generation. This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines.

The NHMRC public statement accompanying the study also concluded that: It is recommended that relevant authorities take a precautionary approach and continue to monitor research outcomes. Complying with standards relating to wind turbine design, manufacture, and site evaluation will minimise any potential impacts of wind turbines on surrounding areas.

World Health Organisation

The World Health Organisation (WHO) has developed guideline exposure values for various types of community noise emissions. These noise values are designed to avoid long term deterioration in physical or psychological functioning. The guideline of most relevance to the potential impacts of wind farm noise is that for sleep disturbance. The WHO considers that night-time noise levels at the outside façade of a dwelling should not exceed 45dBA with open windows. The noise assessment using different wind turbine models indicates that residences at the project would experience night time noise levels that are unlikely to exceed the WHO recommended levels.

NSW Parliament Inquiry

In 2009 the NSW Parliament conducted an inquiry into rural wind farms in 2009, which included consideration of the potential health impacts of wind farms. The inquiry report (New South Wales Parliament Legislative Council General Purpose Standing Committee No. 5, 2009) noted that "…the health effects associated with wind farm noise appear to be the most common concern…" and observed that "…it was clear that some people are significantly affected by their experience of wind farms, both existing and proposed". However, the inquiry report concluded that "…many purported impacts have created little more than unfounded fear in local communities, for example vibroacoustic disease, wind turbine safety, shadow flicker and 'Wind Turbine Syndrome'" and that "…the level of concern for many impacts is not supported by evidence" with "…such impacts being promoted to support arguments against wind power in general, rather than being used to highlight fundamental problems with wind farms." Notwithstanding that current research has been unable to establish a direct relationship between wind farm noise emissions and health, the NHMRC review (citing Chapman, 2010), note that:

> *"It has been suggested that if people are worried about their health they may become anxious, causing stress related illnesses. These are genuine health effects arising from their worry, which arises from the wind turbine, even though the turbine may not objectively be a risk to health."*

The Proponent will establish a complaints management system to be implemented prior to the construction phase and maintained throughout the operation phase of the development to register noise and other health complaints and concerns about the Proposal from the community.

15 Water Supply, Water Quality and Hydrology

15.1 Catchment Management Regions

The Liverpool Range Wind Farm is located across three Catchment Management Authority (CMA) regions. The majority of the wind farm is located within the Central West CMA region, with a small portion of the south-east corner of the project located in the Hunter/Central Rivers CMA region, and a small portion of the north-east corner of the project located in the Namoi CMA region. Figure 15-1 highlights the location of the wind farm in relation to the surrounding CMA regions.

15.1.1 Central West Catchment Management Authority

The Central West catchment covers an area of approximately 84,800 km^2 and has a population greater than 183,000 people. The catchment encompasses 14 local government areas and is located in central New South Wales, flanked by the Hunter/Central Rivers catchments to the east, Western to the west, Namoi to the north, the Lachlan catchment to the south, and the Hawkesbury/Nepean to the south-east (LCMA, 2007).

15.1.2 Hunter/Central Rivers Catchment Management Authority

The Hunter-Central Rivers CMA region covers 37,000 square kilometres on the east coast of NSW—extending from Taree in the north to Gosford and the coastal waterways of the Central Coast in the south, and from Newcastle in the east to the Merriwa Plateau and Great Dividing Range in the west. The CMA's area of operation also includes an area 1,500 square kilometres three nautical miles offshore to the NSW state limit. The Hunter-Central Rivers region has a population of approximately 1,000,000 people.

The catchment encompasses 13 local government areas and is located in eastern New South Wales, flanked by the Central West catchment area to the west, Northern Rivers and Namoi to the north, and the Hawkesbury/Nepean catchment to the south (LCMA, 2007).

15.1.3 Namoi Catchment Management Authority

The Namoi CMA catchment area is bounded by the Great Dividing Range in the east, the Liverpool Ranges and Warrumbungle Ranges in the south, and the Nandewar Ranges and Mt. Kaputar to the North. Major tributaries of the Namoi River include Cox's Creek and the Moki, Peel, Cockburn, Manilla, and McDonald Rivers, all of which join the Namoi upstream of Boggabri. Stretching from Bendemeer in the east to Walgett on the western boundary the Catchment is over 350 kilometres long. The Namoi CMA catchment area is home to approximately 100,000 people concentrated mostly along the Namoi River and has an area of approximately 42,000 square kilometres.

The catchment encompasses 4 local government areas and is located in central New South Wales, flanked by the Hunter/Central Rivers and Northern Rivers catchments to the east, Western to the west, Central West to the south-west, Border Rivers/Gwydir to the north, and the Hunter/Central Rivers catchment to the south-east (LCMA, 2007).

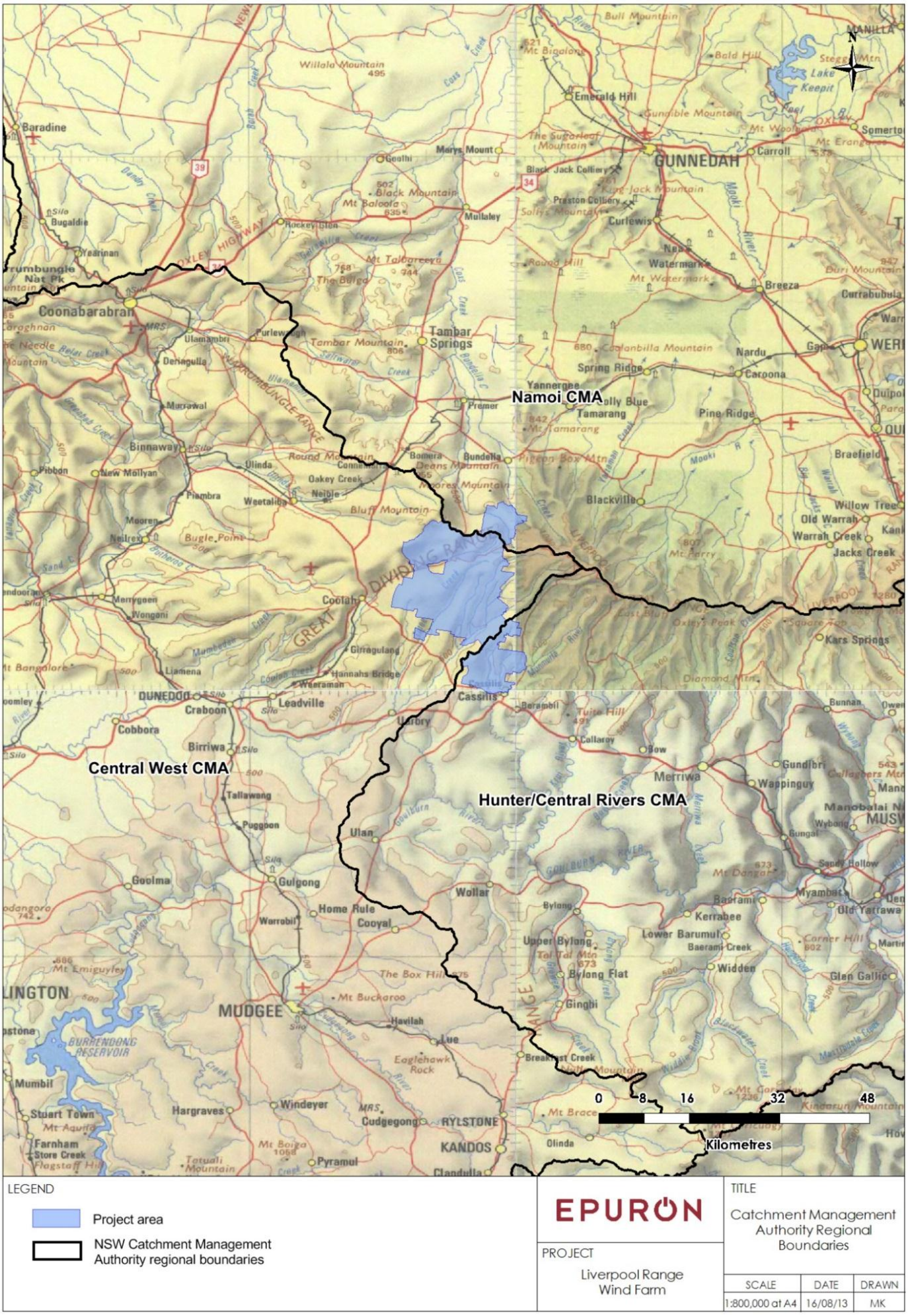

Figure 15-1 Surrounding Catchment Management Authority regions

15.2 Local Water Supplies

15.2.1 Regional Water Sources

The project is situated on the border of the Macquarie-Bogan, Castlereagh, Namoi and Hunter water catchment areas, with the principle water courses nearby being the Coolaburragundy River and the Talbragar River which both cross the site.

Watercourses in the catchment area generally flow in a south-westerly direction until they form with the principle rivers in the catchment. To the west of the site the catchments of the Coolaburragundy River and Talbragar River combine.

The closest reservoirs to the site are:

- Lake Burrendong 100 km to the south-west
- Lake Windamere 90 km to the south
- Lake Glenbawn 90 km to the east
- Lake Keepit 100 km to the north

The Macquarie-Bogan catchment area, where the closest towns to the project Coolah and Cassilis reside, utilises Burrendong Dam, located on the Macquarie River 30 kilometres south east of Wellington NSW, which is the largest storage in the catchment with a capacity of 1,188,000 megalitres. It provides storage for irrigation, town water, stock and domestic use.

Windemere Dam located 19 kilometres south west of Rylestone on the Cudegong River in the North Coast Valley has a capacity of 368,120 megalitres, provides town water, as well as water for irrigators and other water users.

Burrendong Dam operates in conjunction with Windamere Dam to supply water to the Cudgegong and Macquarie valleys. Together there are 1,505 licences with a 724,345ML entitlement within 920km of the river.

- High security/industry entitlements 18,000ML
- General security entitlements 631,716ML
- Stock and domestic requirements 5,568ML
- Town water supplies 18,845ML
- Supplementary flows 50,000ML

Burrendong Dam also provides 50,000ML a year to the Macquarie Marshes which also has first call on any surplus water in the river (State Water Corporation 2009). In addition, there are a number of smaller dams within the catchment area providing town water supplies.

15.2.2 Site Surface Water

The use of aerial photographs, topographical and surface water overlays for any creeks, watercourses and wetland areas were utilised to identify any significant watercourses, standing water bodies, lakes and wetland areas within the study area. No significant water bodies or wetlands have been identified within or around the wind farm site. Some small stock dams are interspersed across the site area. The watercourses through the site and the access track layout are illustrated in Figure 15-2.

The watercourses on site have been assessed based on their stream order. The order of streams was determined based on the Strahler method of stream ordering classification. This method of stream ordering involves labelling all upper tributaries as first order streams, which when two first order streams converge they combine to form a second order stream. Consequently where two second order streams converge they form a third order stream. When a stream of lower order joins a stream of higher order the downstream section of the stream will retain the order of the higher order upstream section (Yang and Kwan, 2001).

The site contains a number of watercourses which are predominantly first order streams with some second order streams. The turbines are generally located on higher ground and the access tracks and underground cabling generally follow the higher ground locations. The layout of the wind turbines, the access tracks and underground cabling has been designed to avoid crossing known watercourses where possible. Three third order watercourses shown in Figure 15-3 are proposed to be crossed on site:

- Coolaburragundy River to be crossed by overhead power line and existing track as shown in Figure 15-4,
- Turee Creek to be crossed by overhead power line as shown in Figure 15-5; and
- Bounty Creek to be crossed by overhead power line and a new access track as shown in Figure 15-6.

Goulburn River is also proposed to be crossed by the overhead power line south of the site. All watercourse crossings, especially Coolaburragundy River due to its relative significance, are sensitive to impacts on hydrology, geomorphology and riparian aquatic ecology. Due to the design of the project to avoid watercourses and adhering to the NSW Office of Water Guidelines for Controlled Activities (August 2010), as well as discussions with NSW Office of Water, impacts on watercourses, hydrology and riparian aquatic ecology will be minimal. Some access tracks on site join with the existing road network of the area, which minimises the requirement to connect all turbine locations via internal access tracks. No underground water crossings will be constructed, all water crossings will either be via overhead electrical powerlines or small bridges.

The location of the substations and switchyard are also positioned away from any watercourses. Overhead powerlines are proposed to connect different segments of the project. The use of overhead powerlines will also be used to avoid the requirement to place underground cables through existing watercourses. Therefore overhead powerline watercourse crossings such as shown in Figures 15-5 and 15-6 will have no impact on the watercourse.

Each watercourse crossing will be designed to be consistent with the 'Guidelines for Controlled Activities on Waterfront Land' as specified by Water NSW. This includes but is not limited to:

- Identify the full width of the riparian corridor and its functions in the design and construction of crossings,
- Minimise the design and construction footprint and extent of proposed disturbances within the watercourse and riparian corridor,
- Maintain existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse,
- Protect against scour, and,
- Where possible stabilise and rehabilitate all disturbed areas including topsoiling, revegetation, mulching, weed control and maintenance to adequately restore the integrity of the riparian corridor.

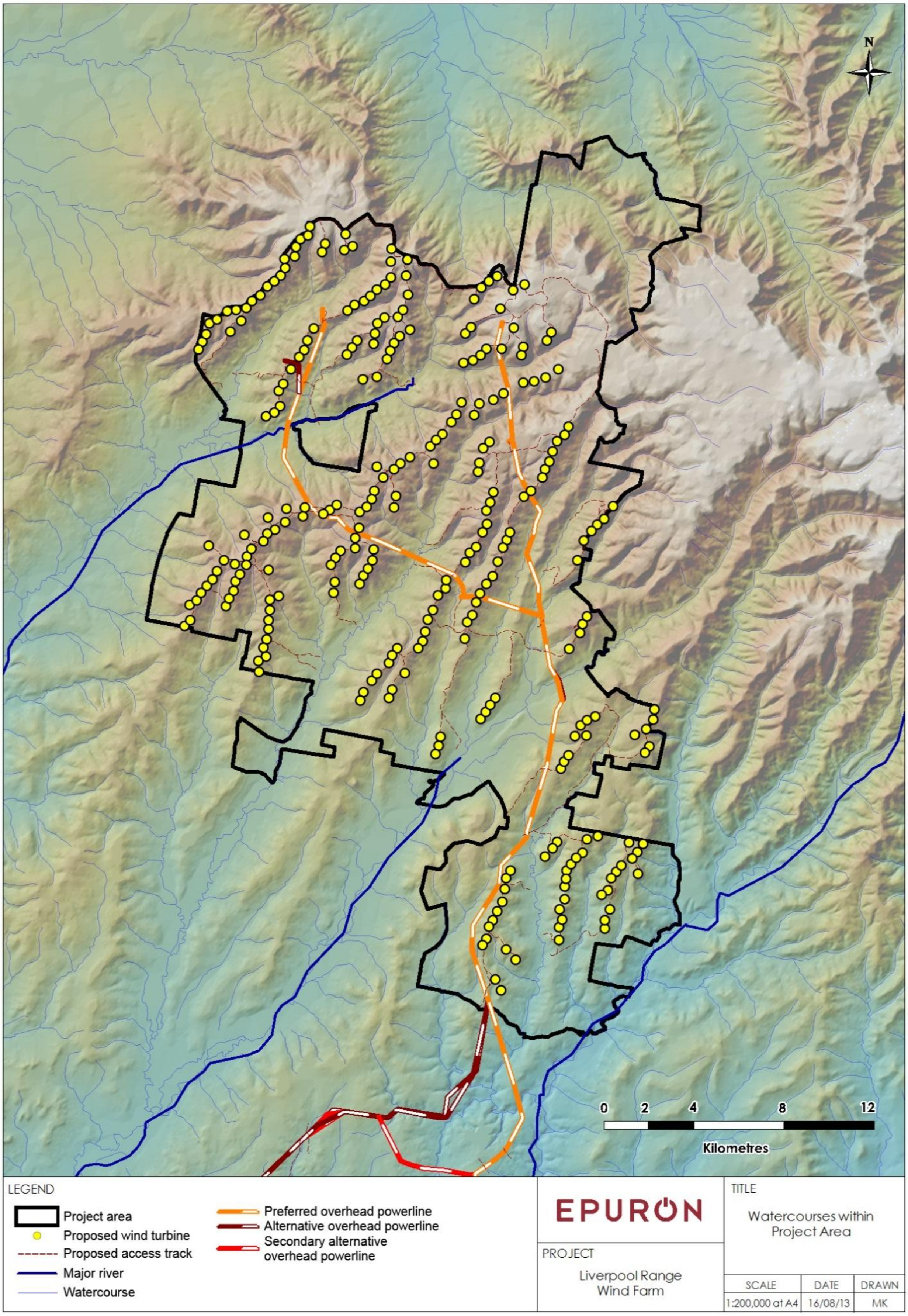

Figure 15-2 Watercourses within project boundary

EPURON

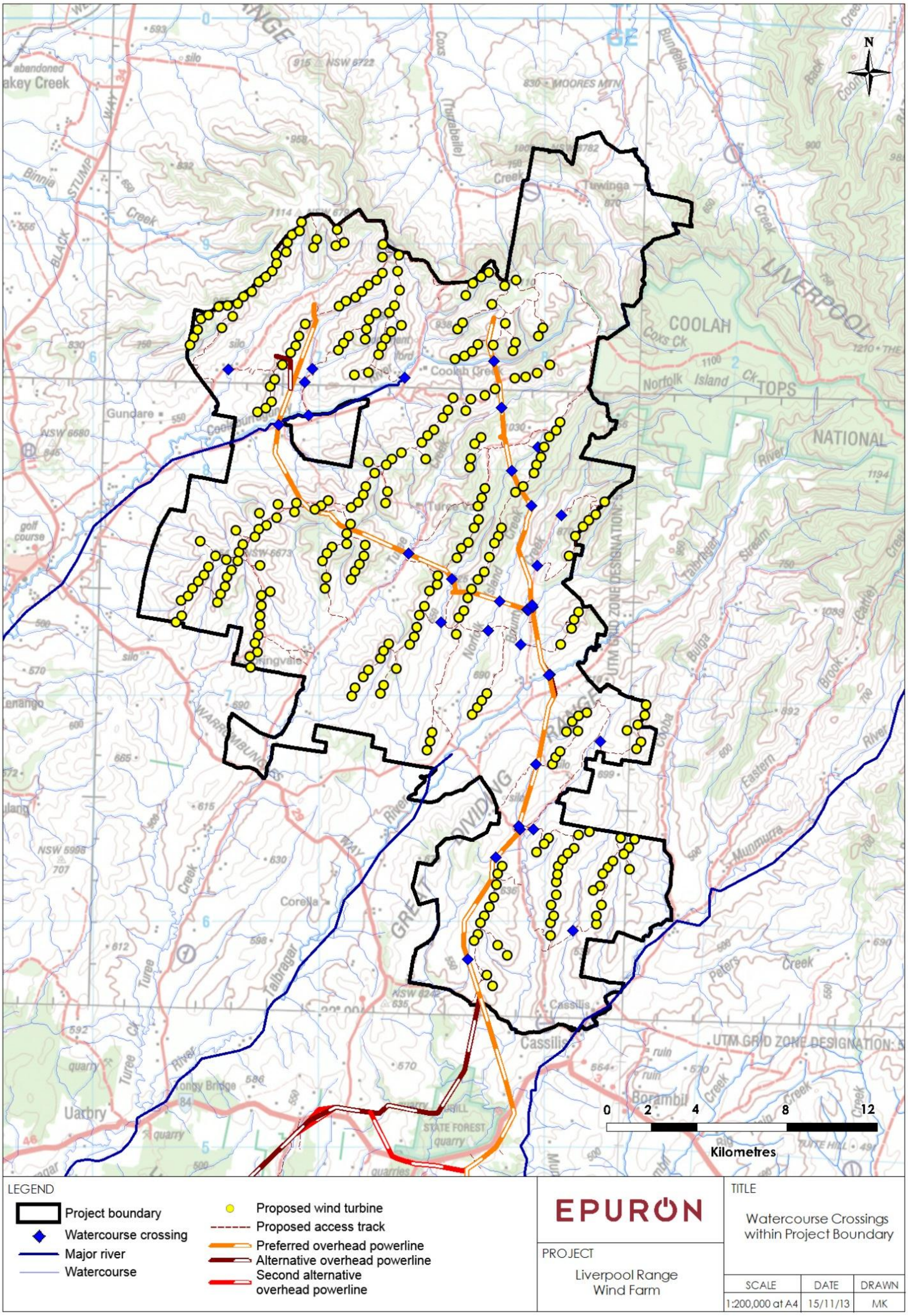

Figure 15-3 Watercourse crossings within project boundary

Figure 15-4 Coolaburragundy River watercourse crossing

LEGEND

- Watercourse
- Preferred overhead powerline
- Proposed access track
- House

EPURON

PROJECT

Liverpool Range Wind Farm

TITLE

Turee Creek Watercourse Crossing

SCALE	DATE	DRAWN
1:10,000 at A4	19/08/13	DG

Figure 15-5 Turee Creek watercourse crossing

Figure 15-6 Bounty Creek watercourse crossing

15.2.3 Groundwater

The Liverpool Range Wind Farm falls within the 'Liverpool Ranges Basalt MDB Groundwater Source' Water Sharing Plan for the NSW Murray-Darling Basin (MDB) Fractured Rock Groundwater Sources which includes rules for protecting the environment, extractions, managing licence holders' water accounts, and water trading in the plan area. The Liverpool Range Wind Farm will comply with the relevant requirements of this water sharing plan as discussed below.

The Liverpool Ranges Basalt MDB Groundwater Source covers an area of 286,000 hectares. The Liverpool Ranges volcanic lava-field province comprises alkali basalt formed 70 to 30 million years ago. The ranges start from the volcanic plateau of Barrington Tops and runs for approximately 100 km westwards, forming the northern boundary of the Hunter Valley district. Parts of the Liverpool Range from the watershed between the coastal and inland drainage of New South Wales and thus form a component of the Great Dividing Range. The western end of the Liverpool Range merges into the Warrumbungle Range.[7]

No impact on current groundwater levels or groundwater users is expected from the project primarily due to significant elevation differences between existing groundwater and proposed turbines regardless of whether a gravity type or rock anchor type foundation is used. For the purposes of this groundwater assessment a worst case scenario has been adopted using only rock anchor type foundations to 20m deep. Suitable steps will be taken to ensure construction run-off and oil does not contaminate local groundwater, and local groundwater will not be used as a water supply source for the project. Water supply for project construction will be sourced from local water supply dams and transported to site.

An assessment of groundwater bores within the project site indicates groundwater levels are generally located in lower lying country, not on the top of ridges where wind turbines are proposed. An example groundwater bore close to wind turbine locations is approximately 1.4km south of proposed turbine locations at the Hinman property (Groundwater number GW043621). Figure 15-7 shows location of the groundwater bore. This groundwater bore has an elevation of 560m above sea level, and the closest turbines have an elevation of 700m above sea level, an increase of 140m. This groundwater bore is 11.6m deep, with water found at 7.01m (NSW Government, National Resource Atlas 2013). As a wind turbine rock anchor type foundation is approximately 20m deep, there is no expected impact on this groundwater bore as there is more than 100m elevation difference between the water level and the proposed turbine.

Figure 15-8 shows all existing groundwater bores within the Liverpool Range Wind Farm project boundary. Of these 57 groundwater bores, the average water depth is 25.1m, and all groundwater bores have water depth levels over 100m deeper than the elevation of the closest turbines.

Table 15-1 examines the elevation difference between all 57 groundwater bores within the project boundary of the Liverpool Range Wind Farm and the closest turbines, and shows that the Liverpool Range Wind Farm will not impact, displace or intercept local groundwater. The Liverpool Range Wind Farm therefore will not impact on existing licenced groundwater users or basic groundwater landholder rights.

[7] NSW Office of Water, January 2012

Figure 15-7 Example groundwater bore location

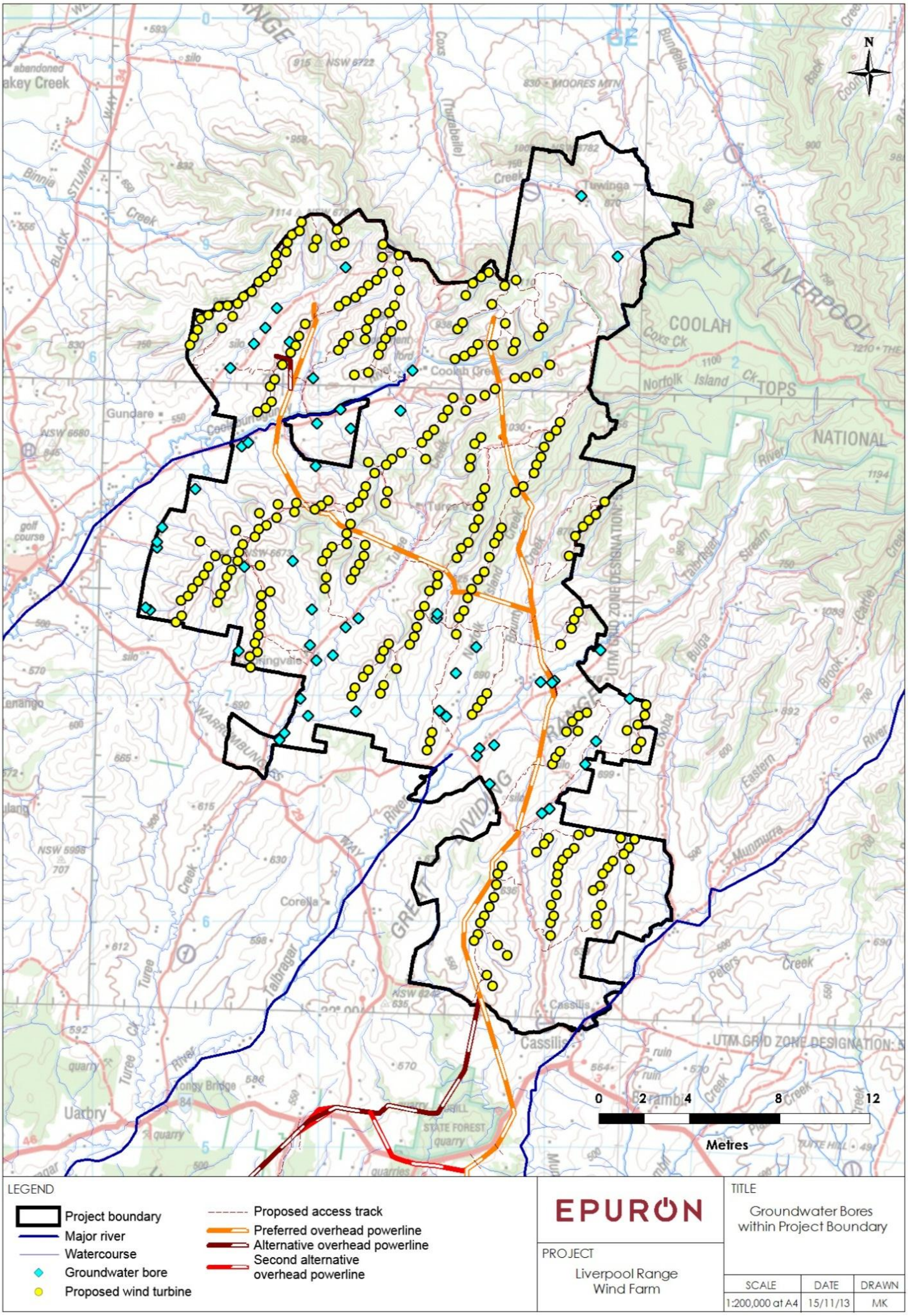

Figure 15-8 Groundwater bores within the project boundary

Table 15-1 – Groundwater bores within the project boundary of the Liverpool Range Wind Farm

Groundwater Bore Number	Completion Date	Final Depth (m)	Water Depth (m)	Ground Elevation of Bore (m)	Ground Elevation of Closest Turbine (m)	Elevation Difference between Water Level & Closest Turbine (20m required for rock anchor type foundation)
GW058367	1/01/1983	14.5	12.5	590	760	182.5
GW009966	1/01/1952	10.4		600	670	N/A
GW030976	1/12/1981	41		640	780	N/A
GW030977	1/12/1981	15.5	10.8	650	780	140.8
GW009704	1/01/1950	48.8		560	650	N/A
GW802394	19/04/2005	86	22	550	650	122
GW802681	10/06/2003	29.26	20	580	800	240
GW032160		9.1		570	780	N/A
GW056228	1/01/1940	8.6		560	770	N/A
GW056227	1/01/1940	39.6		610	730	N/A
GW032158	1/01/1947	6.8		560	740	N/A
GW054508	1/02/1981	5.8	4.9	570	730	164.9
GW802298	28/11/2003	48	10	600	770	180
GW032157		7.3		650	870	N/A
GW055779	1/06/1982	19.2	10.5	640	900	270.5
GW032162	1/08/1966	5.8		840	940	N/A
GW802978	7/04/2005	104	16	590	850	276
GW02679	1/01/1968	91.4	85.3	670	910	325.3
GW031175	1/01/1967	14		560	730	N/A
GW031287	1/11/1968	30.5	18.3	670	770	118.3
GW031286	570	7.6	5.2	570	730	165.2
GW802897	22/07/2004	48	15	570	730	175
GW031170	1/01/1967	22.3		540	640	N/A
GW031171	1/01/1967	15.2		540	630	N/A
GW031158		13.7		540	640	N/A
GW031168	1/01/1967	75.9		570	740	N/A
GW016876	1/11/1957	4.4	2.7	600	840	242.7
GW031165	1/01/1967	38.1		550	640	N/A
GW05012	1/12/1982	31	29	550	630	109
GW031164	1/01/1967	115		600	740	N/A
GW031166	1/01/1967	45.7		620	760	N/A
GW062941	1/08/1986	30.5	19.8	640	910	289.8
GW056017	1/12/1982	33.5	27.4		780	807.4

Groundwater Bore Number	Completion Date	Final Depth (m)	Water Depth (m)	Ground Elevation of Bore (m)	Ground Elevation of Closest Turbine (m)	Elevation Difference between Water Level & Closest Turbine (20m required for rock anchor type foundation)
GW057132	1/04/1983	137	115	560	720	275
GW043621	1/04/1974	9.4	7	560	720	167
GW800717	18/03/1995	17	9	640	860	229
GW033605	1/08/1970	21.3	4.6	600	780	184.6
GW066707	29/09/1989	27	11	620	780	171
GW026685	1/04/1966	15.2		600	920	N/A
GW026684	1/04/1966	122.8		740	380	N/A
GW055851	1/02/1983	151	128	580	900	448
GW026686	1/04/1966	14.6	5.5	620	800	185.5
GW055852	1/11/1982	41.1	36.5	640	860	256.5
GW800209	13/11/1994	7		720	1060	N/A
GW902014		12		600	1080	N/A
GW969133	25/06/2009	42	29	660	1080	449
GW032161		7		630	730	N/A
GW054986		12.2		610	810	N/A
GW059678	1/04/1982	42.7	36	610	810	236
GW038923		158.4		610	850	N/A
GW022191	1/01/1964	73.2		610	850	N/A
GW803490	24/09/2007	156	31.5	600	850	281.5
GW016274	1/03/1960	4.9	3.7	540	730	193.7
GW016275	1/10/1957	4.3	3	550	730	183
GW020071	1/12/1962	5.8		530	730	N/A
GW019925	1/01/1962	4.9		530	730	N/A

15.3 Construction and Operational Water Requirements

During the construction phase an estimated 59 ML of water will be required for general construction purposes and dust control. Locating concrete batching plants on site will require an additional 6-7 ML of water for foundations etc. For reference an average sized Olympic swimming pool contains around 2.5 ML of water.

Water for the project will be sourced primarily from Burrendong Dam and stored in onsite in tanks. The proponent has discussed the proposed arrangements with NSW Office of Water and has written to State Water seeking to progress the necessary arrangements to formalise the use of water during construction. As the water requirements for the project represents less than 0.006% of the capacity of the Burrendong Dam, the project is not expected to have a significant impact on ongoing dam operations.

Sourcing water from Lake Windamere is an alternative to the proposed use of Burrendong Dam water and will be progressed with State Water if required. Once the wind farm is completed and operational it will require only a very small volume of water (less than 1ML). This water will be obtained through the use of onsite storage tanks collecting water runoff from any of the permanent structures and offsite sources if necessary. No treatment of this water is necessary.

Both Burrendong and Windamere Dams are expected to have sufficient capacity to supply the project's water supply requirements under all project operational modes (including construction and operation) and all meteorological conditions (including wet and dry weather scenarios).

15.4 Assessment

Potential Impacts to Drainage and Hydrology

The construction, operation, maintenance and decommissioning of the project has the potential to impact on the current drainage and hydrological characteristics of the site. These include:

- Minor impacts from installing access roads, on site buildings and other associated infrastructure. Correct placement and design of infrastructure reduces the impact to drainage and hydrology.
- Minor impacts from modifying the landscape with minor-medium earthworks and minor vegetation clearing.
- Major impacts from altering or disturbing existing watercourses and significant drainage paths if the layout design is amended to include construction in water course areas.
- Major impacts from the pollution of waters by accidental and uncontrolled spills and excavation works. This is mitigated with correct waste strategies.
- Major impacts from sedimentation and erosional transport of pollutants, soils etc. to water courses in the area.
- Major or minor impacts from unnecessarily traversing or bounding watercourses with access tracks and powerlines in instances where these actions could be avoided.

Major impacts will be avoided or mitigated wherever possible. Any potential impacts are predicted to be most significant during the construction and decommissioning phases, where heavy machinery and vehicles and excavation works are required, large areas of soil and cleared vegetation are exposed, materials are stockpiled and mechanical and construction fluids are stored onsite.

The installation of infrastructure such as foundations, onsite buildings, access tracks, and impermeable hard surfaces can alter and modify the pre-existing flow paths and dynamics of surface and ground water flows as well as impact on the areas general water quality through pollution and sedimentation. Machinery and on-site storage of fluids and chemicals are another potential source of water pollution and contamination, and must be dealt with appropriately.

Areas of steep gradient present a higher hazard for erosion, and where possible existing access tracks will be utilised to minimise impact. Soils are more susceptible to erosion when disturbed or cleared of vegetation which can also lead to dust generation. Appropriate dust suppression and erosion avoidance techniques will be addressed in the CMP.

A water balance showing the total water use for the Liverpool Range Wind Farm is shown in Table 15-2 below.

Table 15-2 – Liverpool Range Wind Farm Water Balance

Water Source	*Water Sourced/Disposal*	**Use of Water**	**Water Quantity (ML)**
Burrendong Dam	Sourced	Construction	66
Onsite Rainwater Tanks	Sourced	Operation	1
Onsite Groundwater	Sourced	N/A	0
Concrete Liquid Waste Evaporated	Disposal	Construction	-7
Water Dust Suppression & General Construction	Disposal	Construction	-59
Onsite Rainwater Tanks	Disposal	Operation	-1
Total Water Use			67-67 = 0

15.5 Mitigation

The following mitigating measures for minimising disturbance and impacts of the site's drainage and hydrology have either been applied during the design phase or will be applied during construction:

- Minimise the amount and degree to which the general topography and landscape is modified and disturbed by infrastructure and associated works through the design phase.
- Where practical upgrade existing access roads as opposed to constructing new access tracks.
- Where practical, restrict access tracks to following the site's ridge lines and natural contours while avoiding steep hill slopes and vegetated area.
- Prepare a Sediment/Erosion Control Plan to be incorporated into the CEMP. Soil and water management practices would be developed as set out in Soils and Construction Volume 1 (CSIRO, 2012).
- Infrastructure would not be sited within 40 metres of a major drainage line or water course, where practical.
- As soon as practical, stabilise exposed or clear areas to minimise erosion and sedimentation that can potentially pollute and block watercourses in the area.
- Design the concrete batch plants to ensure concrete wash would not be subjected to uncontrolled release. Bund areas of the batching plant to contain expected peak rainfall events and remediate after the completion of the construction phase. Waste sludge from the batching plant would be recovered from the settling pond and used in the production of road base manufactured elsewhere onsite.
- A Spill Response Plan would be prepared as part of the CEMP and OEMP.
- Stage excavation works to minimise the amount of exposed areas over time to allow for adequate rehabilitation and reduce the potential for erosion.
- Fuel and oils, materials and soil stockpiles must have designated areas away from any watercourses, with adequate sediment and contamination bunding controls installed to ensure or minimise the impacts of contamination of water sources in the area.
- Watercourse crossings would be designed to be consistent with the 'Guidelines for Controlled Activities on Waterfront Land' as specified by Water NSW[8]. This includes but is not limited to:
    - Identify the full width of the riparian corridor and its functions in the design and construction of crossings,
    - Minimise the design and construction footprint and extent of proposed disturbances within the watercourse and riparian corridor,
    - Maintain existing or natural hydraulic, hydrologic, geomorphic and ecological functions of the watercourse,
    - Protect against scour, and,
    - Where possible stabilise and rehabilitate all disturbed areas including topsoiling, revegetation, mulching, weed control and maintenance to adequately restore the integrity of the riparian corridor.

The site plan for the wind turbines and associated infrastructure has been designed with particular emphasis on protecting existing streams and ephemeral watercourses. The layout avoids crossing or interfering with watercourses by any infrastructure. This is to avoid and minimise any adverse impacts to the areas drainage and hydrological regime. Any major potential impacts on local hydrology will be avoided or mitigated, ensuring that all impacts on draining and hydrology are acceptable.

The altitudes of the ridges across the site are some of the highest elevations in NSW and form a divide for water flowing east to the coast and west to the Murray Darling Basin. As the turbines will be located on the highest elevation points within the site area, with the foundations of the turbines only a few metres in depth and all access roads constructed on the surface, it is considered that the development will not encounter or impact on any groundwater reserves, with negligible dewatering volumes and no impact on drawdown zones or water quality.

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[8] Water NSW. Can be accessed via 'www.water.nsw.gov.auM/ater.Licensing/Approvals/Controlled-activities/default.aspx'

16 General Environmental Assessment

16.1 Soils and Landforms

16.1.1 Existing Environment

Geology

The Brigalow Belt South Bioregion forms the southern extremity of the Qld Brigalow Belt but is not dominated by brigalow (Acacia harpophylla). It consists of landscapes derived from both extensive basalt flows and quartz sandstones and consequently has very variable soils and vegetation depending on the local rock type or sediment source (Drewitt and Langston, 2006).

The Bioregion's bedrock comprises horizontally bedded Jurassic and Triassic quartz sandstone and shale with limited areas of conglomerate or basalts. Some of the sandstone at the heads of streams forms a low but rugged topography of cliffs and small plateau features. Streams follow the direction of major joint planes in the narrow sandstone gorges, depositing colluvial fans of coarse sands and gravels in the wider valleys (Drewitt and Langston, 2006).

Even further down valley the topography is more subdued, partly buried in alluvial debris and largely eroded to rolling plains. Evidence of larger stream courses of Quaternary age occur in the long, sand-filled channels and clay plains with gilgai, or shallow depressions between ridges in which rainwater collects (Drewitt and Langston, 2006).

The Liverpool Range is the largest lava field province in NSW, dated between 32 and 40 million years, with up to 400 m thickness of basalt covering an area of over 6,000 km^2. The lava fields did not have a central volcanic vent but erupted from multiple fissures (Drewitt and Langston, 2006).

Soils

Soils vary greatly across this topography, as do microclimate and aspect, so it is necessary to differentiate areas of hill tops and plateau from slopes and valley floors in both sandstone and basalt areas as all of these factors affect the vegetation (Drewitt and Langston, 2006).

The sandstone ridge tops carry thin, discontinuous soils with stony, sandy profiles and low nutrient status. Downslope, texture contrast soils (soils that have a sharp increase in texture, i.e. increase in clay content, on passing from surface soil layers to subsoil) are more common and are typically found with harsh clay sub-soils, while in the valley floors sediments tend to be sorted into deep sands with yellow earthy profiles, harsh grey clays, or more texture contrast soils with a greater concentration of soluble salts (Drewitt and Langston, 2006).

In basalt country the hill tops have stony, red or brown, well-structured clays with high nutrient values. Similar but often thicker soils are found on the slopes and the valley floors where they too accumulate clay materials.

Topography and Terrain

The site varies from undulating hills with some areas of moderately steep slopes that extend down to small level valleys with numerous saddles and small knolls situated off the main ridgeline. The site has higher elevations in the northern portion with spot heights in excess of 1,100 m and slightly decreases in elevation to the south.

The Liverpool Range is characterised by undulating plateau tops with steep margins grading to long foot slopes while the Talbragar Valley contains residual rocky hills, undulating long slopes and wash plains, wide valley floors with sandy streams (Drewitt and Langston, 2006).

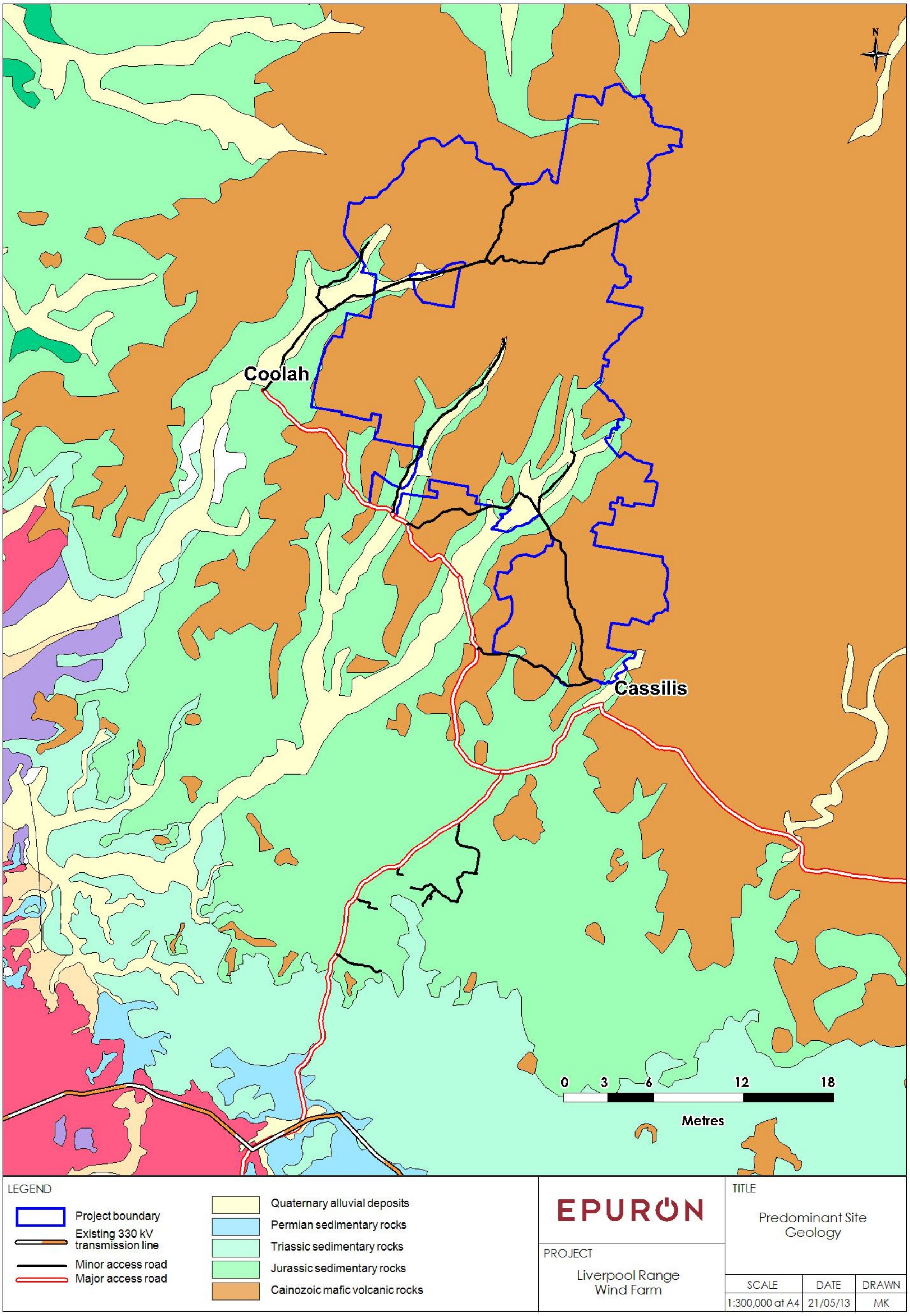


Figure 16-1 Geology of the local area

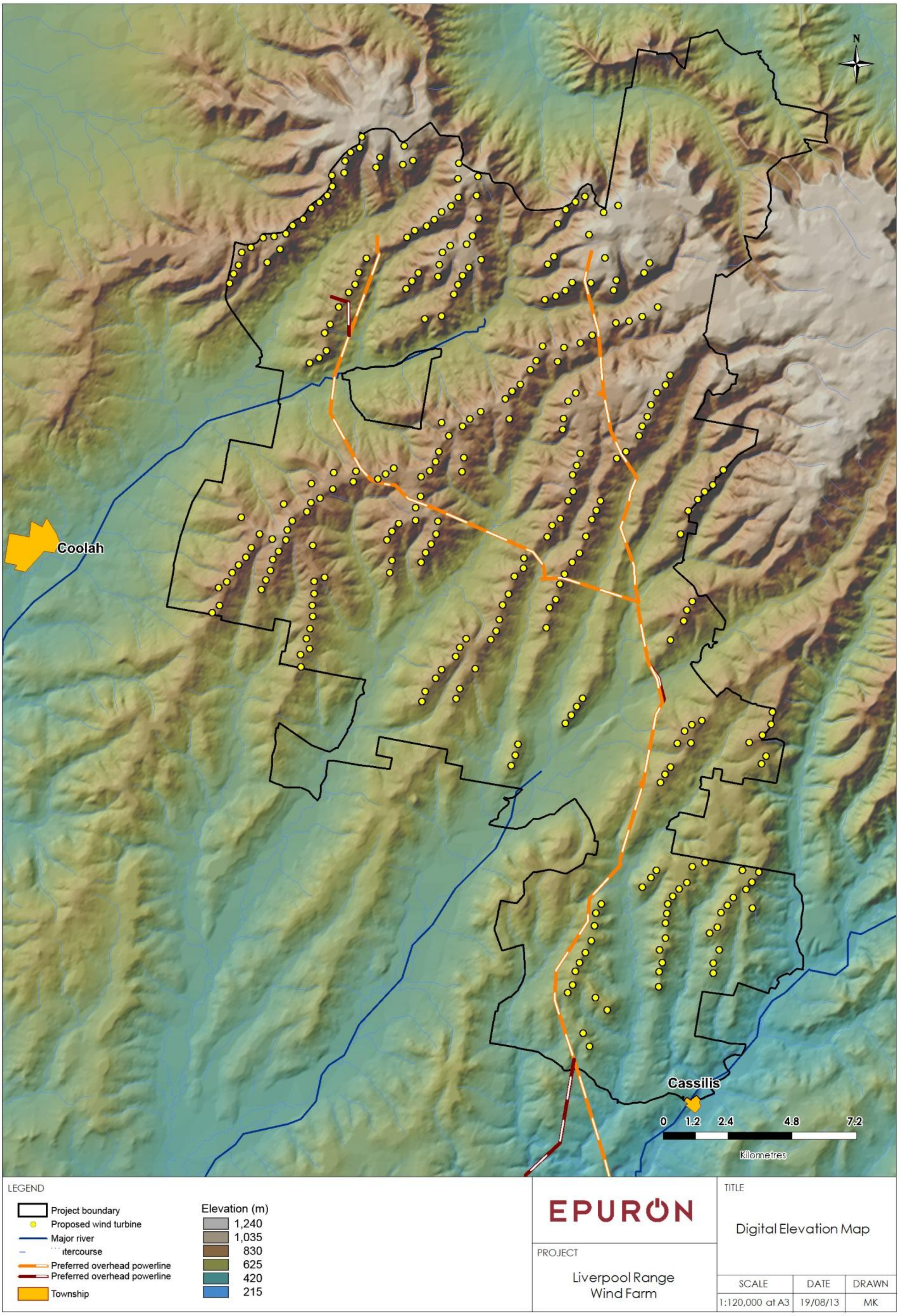


Figure 16-2 Digital elevation model of the Liverpool Range Wind Farm

16.1.2 Assessment

The construction, operation, maintenance and decommissioning of the wind farm has the potential to impact on the current soils and landform of the site. The construction phase and decommissioning phase will impact on the sites landform and soils 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 & rehabilitation works.

These works have the potential to alter and degrade the sites natural soils and landform through increasing the possibilities of:

- 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 dryland salinity; and
- impact on the ground stability.

Areas at particular risk on the site are areas of steeper slopes and thinner soils. During the design phase, amendments to the infrastructure layout, and in particular access tracks, were made to reduce the overall environmental impact. This meant that access tracks predominantly followed the tops of ridgelines in order to prevent cutting into side slopes. For this reason the project is not expected to cause any significant environmental impacts on the site or its surrounding topography and terrain if standard procedures are undertaken to minimise excavation works and prevent erosion and sedimentation through adequate management and rehabilitation measures.

16.1.3 Mitigation

The extent of ground surface disturbance is expected to be relatively small compared to the total site area. The location of the turbines will generally be restricted to the elevated ridgelines of the site, in areas that are generally clear of vegetation. The ridgelines are predominantly on basalt rock just beneath the soil strata making the ridges less prone to erosion risks.

The ridgelines are covered with varying densities of vegetation with the majority of more densely vegetated areas located along the sides of the ridges into the valleys. These slopes are at particular risk of erosion and will therefore be avoided where practical. The surrounding slopes will be largely unaffected by the project, except in the case where powerlines will be routed through them.

Nevertheless, areas will need to be protected by the installation and maintenance of standard erosion and sediment control measures and by minimising the amount of site excavations, land clearing, immediate stabilizing of exposed areas and restricting traffic to access tracks as much as possible. These measures are taken to avoid exacerbating erosion and weathering processes, changing hydrology and drainage paths of the site and contributing to soil and landform degradation.

At the conclusion of the construction period the disturbed areas of the site would be rehabilitated to a level suitable for the ongoing agricultural use of the land. The topsoil removed for construction activities would be stockpiled and reused for the rehabilitation of the areas around the turbine foundations, lay down and hardstand areas and along the access tracks. The concrete batching plant and other areas disturbed by heavy machinery would be rehabilitated. Pasture grass seed will be used to reinstate the vegetation cover for disturbed areas. The verges of the access tracks would be rehabilitated with topsoil and seed.

The rehabilitation process will be carried out progressively as each section of turbines is established. The timing of rehabilitation of the site to the preconstruction level of vegetation groundcover would be dependent upon the time of year that the works are undertaken.

16.2 Climate and Air Quality

Climate

The proposed Liverpool Range Wind Farm lies within the Brigalow Belt South Bioregion in northern NSW and southern Qld, extending from south of Dubbo in central-western NSW to the mid-Qld coast. The Bioregion has a total area of 27,196,933 hectares. A subhumid climate, with no dry season and a hot summer, characterises the south-eastern section of the Bioregion, while a generally dry subtropical climate dominates to the northwest. Minor patches to the southeast of the Bioregion fall within the temperate zone, with no dry season and a warm summer. To the far west of the Bioregion and in the outlier enclosed within the Darling Riverine Plains Bioregion, the climate can be described as hot and semi-arid (Drewitt and Langston, 2006).

Table 16-1 Brigalow Belt South climate summary (Drewitt and Langston, 2006)

South Eastern Highlands Bioregion - climate variable information	
Mean annual temperature range	10 to 19°C
Minimum monthly temperature range	-2.1 to 4°C
Maximum monthly temperature range	18 to 31.3°C
Mean annual rainfall range	449-1015 mm
Minimum average monthly rainfall	23-75 mm
Maximum average monthly rainfall	53-120 mm

Air Quality

The wind farm site is not located near any major industrial areas while parts of the powerline route running south from the wind farm site are proximate to existing mining operations. The wind farm site is located in the vicinity of the Golden Highway which is assumed to receive medium traffic volumes in any period of time. Due to the rainfall patterns in the region and the wind farm sites geographical distance from industry, the area has low levels of air borne particulate pollution. The general vegetation throughout the area will also assist in minimising air borne particles compared to drier, more barren parts of NSW.

16.2.1 Assessment

The project will have minimal impacts on the air quality of the local region and its surrounds due to the development being a low emission form of electricity generation. Activities that are expected to impact on the air quality of the area are predominately associated with the construction, decommissioning and to a lesser extent the maintenance phases. They could include:

- production of concrete at onsite batching plant;
- emissions from transport of equipment and materials to the site;
- operational vehicle emissions; and
- dust generation from excavation and vehicular movement works.

All of these impacts will be relatively minor and can be effectively managed through the implementation of the CEMP.

Wind farms have a positive contribution to reducing total greenhouse gas emissions by providing an alternate source of electricity to fossil fuels.

16.2.2 Mitigation

The CEMP would include measures to ensure that impacts from dust and emissions generated during construction, excavation, road works, and transport of machinery will be adequately controlled through standard industry practices.

The following measures are recommended to reduce the chance of dust and emission issues during the course of the construction, operation and decommissioning phases. These include:

- minimising the surface area that is disturbed at any one time;
- confine vehicle and machinery movement to access tracks or hard stand areas;
- the use of a water truck to minimise windblown dust;
- protect stockpiles from prevailing weather conditions; and
- in the event that remedial measures are found to be ineffective for the control of dust (i.e. prevailing strong winds), work may be suspended as a precautionary measure until conditions are suitable for recommence.

16.3 Mineral Exploration

Geologically, the area proposed for the Liverpool Range Wind Farm lies in the Gunnedah Basin and forms the central part of the Sydney-Gunnedah basin which extends along the eastern margin of Australia. The Gunnedah Basin is a foreland basin with sediments unconformably overlying deformed and metamorphosed Ordivician to Devonian Lachlan Fold Belt strata in the west and abutting Devonian to Carboniferous New England Fold Belt strata to the east, along the east dipping Hunter-Mooki Thrust. The boundary between the Gunnedah Basin and the Sydney Basin, to the south, is argued as being either the Mount Coricudgy Anticline or the Liverpool Range. While the Mount Coricudgy Anticline is a structural boundary, sedimentation typical of the northern Sydney Basin appears to continue north of the anticline. Whereas, it is said that the depositional character of the sediments change across the Liverpool Range in the west of the basins (Brett Lane & Associates, 2009).

There are currently five exploration licenses within the wind farm boundary that have the potential to be impacted as highlighted in Table 16-2.

Table 16-2 Current exploration licences within the project boundary

Licence Number	Holder	Licence Type	Consultation Method	Response to Consultation
AUTH 286	The Director General NSW Department of Trade and Investment, Regional Infrastructure and Services (TIRIS) on behalf of the Crown	Coal Title Authorisation	Written Post Letter	Email Response. No issues raised.
EL 7597	ABX1 Pty Ltd	Group 1 Mineral Exploration	Written Post Letter	No response to follow up consultation
EL 5918	Dronvisa Pty Ltd	Group 5 Mineral Exploration	Written Post Letter	No response to follow up consultation
ML 1219	Dronvisa Pty Ltd	Mining Lease	Written Post Letter	No response to follow up consultation
PEL 12	Australian Coalbed Methane Pty Ltd	Petroleum Exploration Licence	Written Post Letter	No response to follow up consultation
PEL 433	Eastern Star Gas Pty Ltd	Petroleum Exploration Licence	Written Post Letter	Phone call response. No issues raised.
PEL 456	Macquarie Energy Pty Ltd	Petroleum Exploration Licence	Written Post Letter	No response to follow up consultation
EL7963	Merriwa West Pty Ltd	Mineral Exploration	Phone call, as specified by Trade & Investment	No response to follow up consultation

Exploration licenses entitle the holder to carry out exploration and prospecting for minerals and petroleum within the specified area. Lease boundaries are shown on and overlap a portion of the site perimeter.

Epuron has consulted with these licence holders and provided detailed maps showing the proposed location of wind farm infrastructure. At the time of writing no response had been received from the above mentioned licence holders.

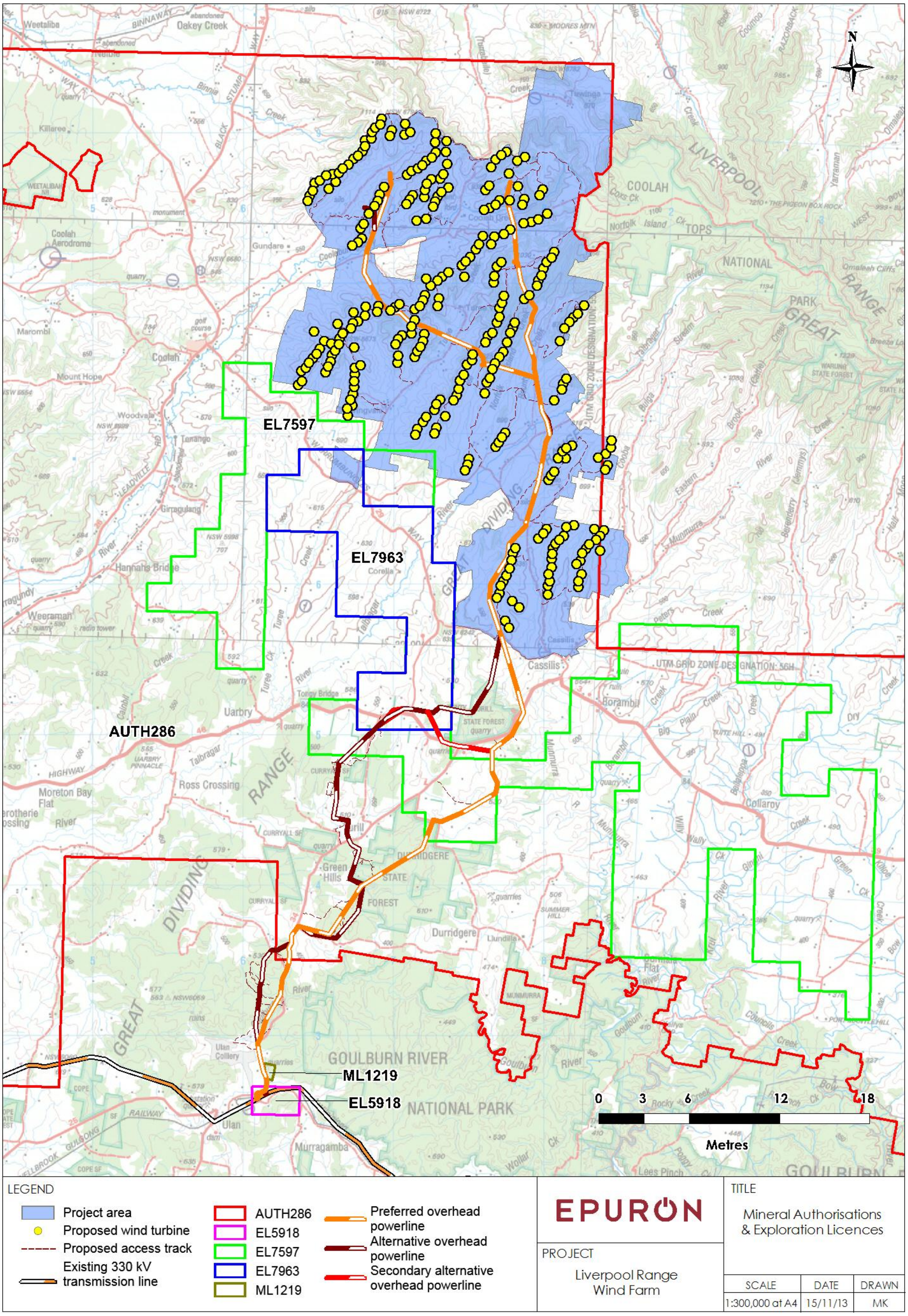


Figure 16-3 Current Mineral Authorisations and Exploration Licenses across the project site

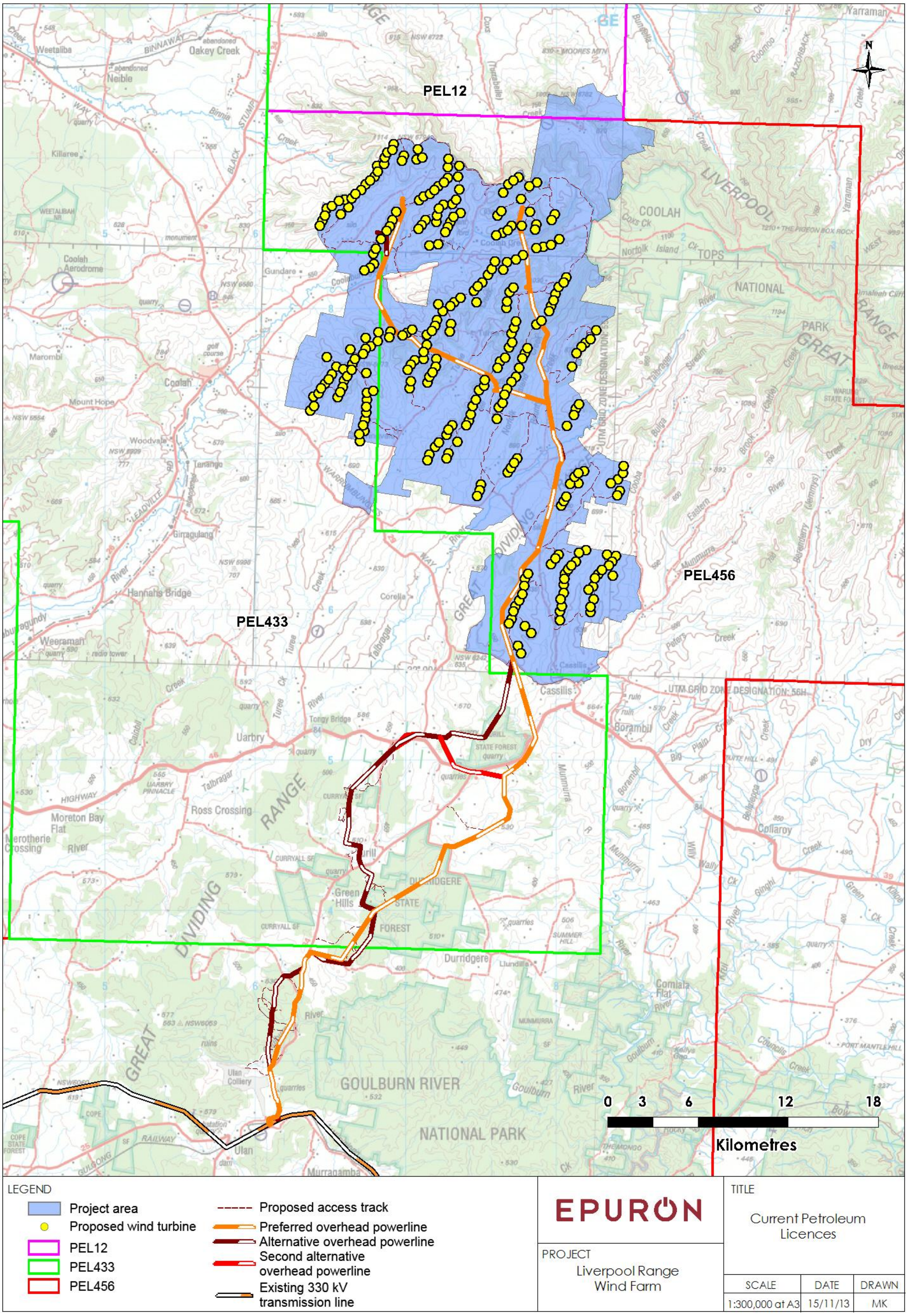


Figure 16-4 Current Petroleum Licenses across the project site

16.3.1 Assessment

There is no reason why the exploration of minerals and petroleum could not occur concurrently with the operation of wind turbines as the direct footprint of the wind farm infrastructure is a very small percentage of the site area. The project would not prevent access to the site area for ground based exploration of minerals except in the close vicinity of the infrastructure where there may be safety, structural, operational or engineering limitations.

The access tracks constructed for the proposed wind farm would facilitate easier access to a greater portion of the exploration license. It is possible that the operational wind farm may impede the exploration of minerals within the licensed area close to the infrastructure such as turbines and substations. This may be due to restrictions of the manoeuvrability of exploration machinery, localised sensitivity of magnetic and gravity remote sensing methods and occupational health and safety considerations. In some instances mineral exploration can also be achieved aerially by low flying planes and ground penetrating radar. The operation of the wind farm may limit the use of these methods.

While only five Exploration Licenses occur within the development envelope at this time, if a mineral deposit were discovered then an application for a Mining Lease can be made. There is no certainty that the discovery would be made or a Mining Lease would be granted, or if granted, that mining would be commercially viable. It is likely that the wind farm could impede some mining options (e.g. open-cut) in its immediate vicinity, or that some mine equipment may need to be built in alternate locations. The relatively small land area impacted suggests that alternate mining methods are likely to be available which would prevent sterilisation of any mineral resource. The reversibility of the project suggests that this impact is justifiable. The possible temporary loss of these areas for mining would be offset by the utilisation of a renewable resource during the project's life.

16.3.2 Mitigation Measures

Final wind turbine locations and details of the access tracks and other wind farm infrastructure will be provided to the exploration licence holders prior to construction. Ongoing consultation will be maintained to ensure that the Proponent is aware of any planned exploration activities in the vicinity of the wind farm.

16.4 Economic

16.4.1 Existing environment

The project would be located within the Liverpool Plains, Mid-Western, Upper Hunter and Warrumbungle Local Government Areas (LGA). The key statistics pertaining to the LGAs are provided in Table 16-3 (DECCW, 2010c; MacMahon, 2010; Roaring 40s, 2010; CCA, 2012).

Table 16-3 Key statistics for the four LGAs

People and Population	***Liverpool Plains***	***Mid-Western***	***Upper Hunter***	***Warrumbungle***
Area of the LGA (km^2)	5,085	2,848	8,103	12,380
Population number	7,880	3,548	13,785	10,323
% Growth since 2004	0.0%	-1.3%	3.0%	0.1%
Median age group	35 – 44 years	45 – 54 years	35 – 44 years	35 – 44 years
Income and Occupation of Local Population				
Average income	$33,937	$40,566	$40,839	$32,041
Managers	26.2%	6.1%	7.3%	30.7%
Labourers	15.4%	18.5%	19.4%	14.3%
Professionals	11.2%	13.6%	12.1%	12.9%
Tradesperson and related workers	11.1%	13.1%	15.6%	11.0%
Clerical and administrative workers	10.4%	15.7%	15.2%	7.9%
Gross value of agricultural commodities ($m)				
Value of crops	61.4	-	8.5	35.6
Value of livestock slaughtering	91.7	-	49.6	53.7

Value of livestock products	3.6	-	13.5	13.9
Total	156.6	-	71.6	103.2

The major industries sectors within the region are agriculture, viticulture, tourism and retail which reflect the predominantly rural nature of the area. The area supports a wide range of beef cattle, sheep and lambs due to its large amounts of cleared agricultural land and rainfall levels. The four LGAs are also dependent on the input of revenue from tourism. The region features a range of historic buildings, vineyards, national parks and a wide range of colonial heritage attractions.

16.4.2 Assessment

The project would provide temporary employment opportunities during construction and decommissioning. The increased demand for services in the local area, most likely during the construction phase, would also accompany the development, as contractors seek accommodation and utilise other services in the local area. While it is hard to predict the exact amount of investment that will be injected into the local economy, there have been studies conducted to calculate the likely impacts based on the size of a proposed wind farm. The Clean Energy Council commissioned Sinclair Knight Merz (SKM) to prepare a report into the investment costs and benefits of wind farms in Australia. SKM released the report '*Wind Farm Investment, Employment and Carbon Abatement in Australia'* in June 2012 which presents an updated national and state-based snapshot of wind farm investment, jobs and carbon abatement. The study aimed to use financial and other data from a range of sources to provide a reasonable set of indicative figures to estimate the financial inputs and outputs for wind farms on a per MW basis (SKM, 2012).

Construction

SKM reviewed data based on the expenditure per MW of a number of wind farms that were recently developed or under construction. It found that this review closely reflected the expenditure data from Hallett 1, Waubra and Macarthur wind farms. These figures have been extrapolated for the Liverpool Range Wind Farm and the results can be seen in Table 16-4.

Table 16-4 Local, State and Australian construction expenditure for a 864 MW wind farm ($million)

Construction Expenditure	Local / Regional	State	Australia
Wind turbine generators	$165.9	$554.7	$824.3
Site administration and design	$20.7	$69.1	$102.8
Site construction works	$20.7	$69.1	$102.8
Site electrical works	$23.3	$76.9	$114.0
Labour	$25.9	$85.5	$127.0
Total construction	$256.6	$856.2	$1,272
Local operational expenses (annual)	$17.3	$26.8	$61.3

Using the estimations from this report, it is anticipated that $259 million could be spent within the region as a result of the construction phase of the wind farm.

There is an opportunity for local contracting and manufacturing services to be contracted during the site development. These may include concreting, earthworks, steel works and electrical cabling. As well, other service-related employment would follow, with the provisions for food, fuel, accommodation and other services for the contractors. Based on the construction phase spanning 24-36 months, employment would likely increase by up to 829 full time equivalent jobs across the local area. It is considered that construction, property and business services and retail trade would make up most of the employment growth. Precise economic benefits would vary on the final site design, turbine suppliers, timing of works and other details. Currently there are no facilities capable of making turbine components (nacelles and blades) in Australia. There may be potential for manufacturing towers in Australia.

There are a number of constraints related to the potential of the socioeconomic impacts described. These include supply-side constraints, primarily the supply of labour. Furthermore, the capacity of local business to service new contracts, together with the quality of local housing, amenities and other physical and social infrastructure are also factors that may affect the ability to attract and retain workers. Using the SKM model it is estimated that over $2.3

million would be spent during the construction period by workers in the local community. Table 16-5 highlights these estimated annual values.

Table 16-5 Estimated local project expenditure within the region

Construction Annual Expenditure	Local / Regional
Accommodation	$742,100
Food	$1,113,100
Fuel	$445,300
Total	$2,300,300

The construction and decommissioning phases of the project would take place over a considerable time period (estimated to be 24-36 months for construction and approximately 12-24 months for decommissioning). There is potential to adversely impact the current grazing activities on the sites that would be developed and for the additional heavy vehicle traffic on public roads to interfere with other economic activities, for example, scenic drives, field days and other tourist related activities. It is anticipated that the grazing impacts would be confined to the involved land holders. Involved land owners would be compensated by the Proponent for allowing the infrastructure to be constructed on the individual properties. It is considered that this compensation would off-set the impacts of grazing.

Operation

Wind farms are an economically viable means to generate electricity. The project would be privately funded and there would be no ongoing financial expenses to the community or any government agency.

Turbine rental provides additional revenue for involved property owners while allowing conventional farming activities to continue as usual. This would create an increased value to these properties and contribute to additional investment in the local area.

Additional benefits include direct investment and job creation in the local area as a result of construction activities. These benefits have been outlined in more detail in Section 4 Strategic Justification. The operational phase of the project is anticipated to create up to 78 annual full time equivalent jobs in the local region for the life of the wind farm.

16.5 Economic Resource Impacts

The project would require natural resources from the Coolah - Cassilis area in order to construct the foundations, access tracks and required facilities. The following information outlines the resource requirements of the project.

16.5.1 Assessment

Resource requirements for the project would include:

- gravel and base course for access tracks, crane hardstand areas, and site buildings/infrastructure;
- concrete for turbine foundations and site building foundations; and
- water for dust control and concrete.

Rock Crusher

To best utilise any existing natural gravel resources resulting from the construction of the wind farm, a rock crusher would be used on site. Materials excavated during the construction of access tracks and wind turbine foundations may, if suitable, be able to be reused as road base for the road surface upgrades. Rock crushing does not trigger Schedule 1 of the *Protection of the Environment and Operations Act 1997* if less than 150 tonnes per day is crushed. The daily rock crushing capacity required will be confirmed following a pre-construction geotechnical assessment on the site to determine the extent of suitable construction materials available.

Concrete Batching Plant

In the likely event that pre-mix concrete is unable to be supplied for the turbine foundations and other facilities, up to four portable concrete batching plants would be established on site.

A typical concrete batch plant would involve a level area of approximately 100m by 100m to locate the loading bays, hoppers, cement and admixture silos, concrete truck loading hardstand, water tank and stockpiles for aggregate and sands. The batching plant would include an in-ground water recycling / first flush pit to prevent dirty water escaping onto the surrounding area, and would be fully remediated after the construction phase.

The concrete batching plant would produce around 350m^3 of concrete per day when a turbine foundation is being poured. The maximum operational period would be the construction period of the wind farm.

Gravel and Road Base Requirements & Supply

Access tracks are required to be 5-6 m wide and approximately 300 – 500 mm in thickness to accommodate the movement of heavy delivery vehicles and cranes. In general all access tracks will be unsealed and constructed from local aggregate. Sealed access tracks will not be used unless safety, geotechnical or economic studies deem them to be necessary. The final access track design would take into account the traffic loadings and ground conditions relevant to the site and the works.

Sands and aggregate would be sourced from excavation of foundations, where possible, or from existing sand and gravel pits within the local area. Every effort would be made to source clean sands and aggregates and to prevent transport of weeds to site.

The estimated volume of gravel/road base required for the access tracks and other works is listed in Table 16-6.

Table 16-6 Estimation of road base volumes

Description	Dimensions	Quantity	Volume
Access tracks	5-6 m wide x 400 mm	359,200 m	718,400 m^3
Construction compounds	300 m x 300 m x 400 mm	4	144,000 m^3
Hardstand areas	25 m x 45 m x 400 mm	288	129,600 m^3
Total volume			1,050,050 m^3
Estimated Rock Extracted from Foundations	512 m^3	288	147,456 m^3

Turbine Foundation Concrete Requirements

The turbine foundations will be excavated, with formwork and reinforcement prepared before the concrete foundation is poured. Each turbine foundation will occupy an area of approximately 25 m x 25 m and 2-3 m deep. Smaller foundations will be used where the geotechnical conditions allow rock anchor style foundations.

Preliminary investigations reveal that all of the required concrete materials can be sourced locally within the region. The estimated materials required for the manufacture of concrete are as follows:

Table 16-7 Concrete materials required

Component	Approximate composition by mass	Required for a single 400m^3 foundation	Required for 288 turbine foundations
Cement	13%	125 tonnes	36,000 tonnes
Sand	34%	325 tonnes	93,600 tonnes
Aggregate	46%	441 tonnes	127,008 tonnes
Water*	7%	67 kL	19,296 kL
TOTAL:	100%	958 tonnes	275,904

*Based on the assumption that water has the density of 1000 kg per m^3

Water Supply

The operational phase of the wind farm will require relatively small volumes of water and will be supplied primarily from rain water collected from facility roof drainage. Should additional water be required, it will be sourced from local water sources and delivered by truck to the site.

It is proposed that concrete for the turbine foundations be either provided from a portable source or a purpose built batching plant (with sufficient capacity to allow an entire foundation to be constructed in one pour). Accordingly, approximately 67 kL of water will be needed for each foundation.

Water used in concrete needs to be relatively free of impurities which may adversely react with the cement. As such, water required by construction activities will need to be of a quality commensurate with potable water.

A water truck has a typical capacity of 16 kL. Thus to provide 67 kL to site will require approximately 4 trucks.

It is anticipated that in total 28,000 kL of water would be required for the turbine foundations and 31,000 kL for dust suppression (assuming 2 water trucks per day for 300 days). That equates to a total of about 59,000 kL of water for the construction phase. If this water was entirely sourced from external sources the total number of truck movements required would be 3,687 in each direction.

The sourcing of treated water would help to minimise the amount of water sourced from the local environment. The erosion and sediment control measures will mitigate the potential for the construction and operational aspects of the wind farm impacting on the areas surface water and/or groundwater quality or quantity.

16.6 Wastes

Waste generated from the Liverpool Range Wind Farm is predicated to be minimal and will be confined to the construction and decommissioning stages of the project. During the operational stage, there will be very limited waste generated.

A key strategy of the construction and decommissioning works is to avoid and minimise waste from the construction site, reuse and recycle waste where possible and dispose appropriately of waste which cannot be managed in any other way. This is the application of the Waste Hierarchy which states that:

- Strategies which try to avoid products becoming waste are generally preferable to
- Strategies which seek to find a use for waste, which are in turn generally preferable to
- Strategies for disposal which should be used as a last resort.

The proponent would prepare a Waste Management Plan (WMP) as part of the Construction Environment Management Plan (CEMP). The WMP would identify all potential waste streams associated with the project. The WMP would also outline methods of disposal of waste at appropriately licenced facilities.

16.6.1 Assessment

Table 16-8 below identifies the waste streams generated by the project and includes examples and management strategies.

Table 16-8 - Waste Streams for the Liverpool Range Wind Farm

Waste Stream	Generation Process	Example of Waste Type	POEO Classification	Management Strategy	Waste Storage	Approximate Quantity
Office Waste	General office activities	Paper, plastics, packaging, cartridges, polystyrene	General Solid (non-putrescible)	Provide separated recycling and non-recyclable bins onsite.	A mixed recycling bin would be provided and located within the site office compound.	Negligible*
Office Waste	General office activities	Food	General solid (putrescible)	Provide separate waste bins on site for food waste. Regular collection of this waste will be undertaken with the collected waste disposed of at an appropriately licensed facility.	A food scraps bin would be provided and located in the site mess room.	Negligible*
Packaging	General construction activities	Timber pallets, plastic, steel strapping, cardboard	General Solid (non-putrescible)	Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non-recyclable materials.	A recycling bin would be provided and located within the designated lay down area.	Negligible*
Construction Activities	Excavation and earthworks	Excess spoil	General Solid (non-putrescible)	Reuse onsite, if unable to re-use on site dispose of at appropriately licensed land fill.	Any excess material would be stockpiled on site.	Negligible*
Construction Activities	Vegetation clearing	Excess cleared vegetation	General Solid (non-putrescible)	Non weedy material would be mulched and used during rehabilitation.	Any excess material would be disposed of at an appropriately licensed facility.	Negligible*
Construction Activities	Vegetation clearing	Excess cleared vegetation	General Solid (non-putrescible)	Weedy vegetation would be sprayed and bagged to avoid potential proliferation.	This material would be disposed of at an appropriately licensed facility.	Negligible*
Construction Activities	Construction materials	Formwork, reinforcing steel, PVC conduits, cables	General Solid (non-putrescible)	Ensure this waste is not mixed with any other waste. Provide separated bins onsite.	This material would be stockpiled on site and removed by an appropriately licensed waste contractor.	Negligible*
Construction Activities	Construction materials	Cable reels	General Solid (non-putrescible)	All cable reels would be stored on site and returned to the manufacturer.	Cable reels would be stored on site within the lay down area.	Zero waste. All reels returned to manufacturer.

Waste Stream	*Generation Process*	*Example of Waste Type*	*POEO Classification*	*Management Strategy*	*Waste Storage*	*Approximate Quantity*
Construction Activities	Concrete Truck Wash out	Concrete laden water	Liquid waste	Washout waster would be contained within a concrete wash out bay. This water has a high pH and high turbidity. The water component of the waste water is left within settling ponds to evaporate. The resulting waste is concrete sludge.	A dedicated concrete wash facility would be located in the close vicinity of each turbine. Concrete sludge would be re-used for road base aggregate or disposed as inert waste to an appropriately licensed land fill.	<~4 ML of water evaporated on site. Negligible amounts of concrete sludge generated.
Construction Activities	Sewage	Sewage	Liquid waste	Sewage waste generated onsite would be stored within toilet tanks.	The sewage would be collected and transported by a transport company licensed to transport sewage waste.	Negligible*
Construction Activities	Use of chemicals	Empty drums and storage containers	Classification dependant on chemical stored	Drums and containers would be stored in an appropriately bunded hardstand area.	This material would be disposed of at an appropriately licensed facility.	Negligible*
* Negligible – Refers to a quantity of waste that is small or unimportant to the point where it is not worth considering. In the context of this project it is considered to be less than 1 ML in total.						

Where possible, waste generated by the project will be recycled or reused on site. For example, excavation spoil and crushed rock from the construction of construction compounds, access tracks and turbine foundations will be reused for the base layer for access tracks on the site where possible. Dust covers and wooden cable drums used for transporting turbine blades and wiring would be reused. Packaging materials will be stored for recycling at the on-site construction compound. All wastes would be removed by contractors and maintenance staff. No local garbage service is expected to be required.

There will be very limited to nil dangerous sharps or toxic waste from the project. The majority of waste described above would be classified as general solid waste (non-putrescibles) in accordance with the POEO Act. Sanitary wastes would also be generated within the ancillary facilities and site compound during the construction period. This waste would be classified as general solid waste (putrescibles) in accordance with the POEO Act.

16.6.2 Mitigation Measures

The proponent would prepare a Waste Management Plan (WMP) to be included within the CEMP. It would include but not be limited to the following:

- The scope for reusing and recycling waste materials;
- Provision for recycling would be made onsite;
- Wastes would be disposed of at appropriate facilities;
- Toilet facilities would be provided for onsite workers and sewage from contractors pump out toilet facilities would be disposed at the local sewage treatment plants or other suitable facility agreed to by Council;
- Excavated material would be used in road base construction and as aggregate for foundations where possible. Surplus material would be disposed of in appropriate locations on site (on agreement with the landowner), finished with topsoil, and revegetated.

16.7 Property Values

There is a view within some parts of the community that wind farms can adversely affect surrounding property values. Other than wider market conditions, there are a number of contributory factors potentially influencing differences between perceived and actual property values surrounding wind farms. These include its agricultural productivity, personal perceptions, location, allowable land uses, proximity to town centres, lifestyle circumstances and amenity considerations.

In 2009, the NSW Valuer-General released the findings of a study into the potential impacts of wind farms on surrounding land values. The report, “Preliminary Assessment of the Impact of Wind Farms on Surrounding Land Values in Australia”, assessed eight wind farms located in NSW and Victoria and considered available market data mainly through the analysis of property sale transaction data. The findings of the study found that:

- Wind farms do not appear to have negatively affected surrounding property values in most cases. Forty (40) of the 45 sales investigated did not show any reductions in value. Five (5) properties were found to have lower than expected sale prices (based on a statistical analysis). While these small number of price reductions correlate with the construction of a wind farm further work is needed to confirm the extent to which these were due to the wind farm or if other factors may have been involved;
- Results also suggest that a property’s underlying land use may affect the property’s sensitivity to price impacts. No reductions in sale price were evident for rural properties or residential properties located in nearby townships with views of the wind farm;
- The results for rural residential properties (commonly known as 'lifestyle properties') were mixed and inconsistent; there were some possible reductions in sale prices identified in some locations alongside properties whose values appeared not to have been affected. Consequently, no firm conclusions can be drawn on lifestyle properties;
- Overall, the inconclusive nature of the results is consistent with other studies that have also considered the potential impact of wind farms on property values; and
- Further analysis (with additional data and expansion of the study area to other states) may yield more comprehensive results. Notwithstanding this, further studies are also likely to be limited by the availability of sales transaction data.

The Valuer Generals study also considered previous studies which have analysed property sales transaction data relating to other local and international wind farms. The studies vary in size and methodology. While some studies have found slight negative impacts, the larger more comprehensive studies have generally found no statistical evidence of reductions in value associated with the development of a wind farm.

In 2007, a NSW Land and Environment Court decision found that property value impacts are not relevant considerations in the assessment of wind farms (or any other development). In Taralga Landscape Guardians v. Minister for Planning and RES Southern Cross Pty Ltd, in considering a request for compensation of nearby landowners in relation to a potential reduction in property value, Chief Justice Preston found that:

- *If the concept of blight and compensation, as pressed by the Guardians, were to be applied to this private property (a proposition which I reject) then any otherwise compliant private project which had some impact in lowering the amenity of another property (although not so great to warrant refusal on general planning grounds when tested against the criteria in S79C of the Act) would be exposed to such a claim.*
- *Creating such a right for compensation would 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 S5(a)(ii) for "the promotion and co-ordination of the orderly and economic use and development of land.*

Furthermore, a specific individual case for a property neighbouring a proposed wind farm in South Gippsland Shire has recently been put forward as supporting decreased property values. It appears however from public statements made by the Shire CEO that this individual case had specific circumstances around historic premium lifestyle land value compared to neighbouring properties and the agreed rate reduction was based on proximity of proposed temporary construction infrastructure (concrete batching plant), which may only attract a lower rate during the wind farm construction period only.

17 Draft Statements of Commitment

17.1 Environmental Management Plan

A management plan will be implemented for all mitigation measures. This will comprise of a Construction Environmental Management Plan (CEMP) and an Operation Environmental Management Plan (OEMP). Both plans would include performance indicators, timeframes, implementation and reporting responsibilities, communication protocols, a monitoring program, auditing and review arrangements, emergency responses, induction and training and complaint/dispute resolution procedures. Adaptive management would ensure that improvements were consolidated in the updated plans.

The key information that will be monitored is detailed in the CEMP and the OEMP. The CEMP is an overarching plan. It will provide the environmental management details for the construction phase of the project and applies to all activities undertaken by those involved in the construction. The CEMP will provide a framework for the management and control of activities in regards to environmental aspects and the key risks identified e.g. through an environmental work statement. As a result it will also form a basis to ensure measure compliance and ensure that non-compliance is identified. The CEMP will also describe how contractors will control the environmental aspects during construction and the review methodology, it will provide a framework in which environmental quality and performance outcomes can be measured against and substantiated. The CEMP will include the following key information and sub-plans:

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

The OEMP is similar to the CEMP except it is for the operation of the wind farm. The OEMP will monitor the following key information that will each have a sub-plan:

- Operational noise management;
- Landscape management;
- Bird and bat management;
- Weed and pest management;
- Safety management
- Telecommunication interference; and
- Decommissioning.

A hierarchy will be created to ensure project compliance, this will involve the: owners representative, operations manager, operations site supervisor, health safety quality manager, environmental representative consultant and the relevant agency. The hierarchy will ensure that reporting is conducted to the appropriate stakeholder and that any action required is implemented. Such reporting will include compliance reporting, compliance monitoring and audit, incident reporting, audit and improvement and compliance and corrective actions.

Compliance tracking will be undertaken periodically during operation and will be formally reported to DoPI. Reporting will involve a pre-operation compliance report, periodic environmental management reports and periodic evaluation and adaptive management reports.

In addition the OEMP will be formally reviewed periodically after the commencement of operation and periodically thereafter to ensure it is up to date and that changes to procedures and practices have been implemented according to the plan.

Both OEMP and CEMP will be required to be approved by the Director General. An independent audit will be undertaken by an independent person or team commissioned by the owner as part of the environmental audit process.

17.2 Statement of commitments

Under the Director General's Requirements, the proponent is required to provide a Statement of Commitments on how they propose to implement measures for environmental mitigation, management and monitoring for the project.

Avoidance and mitigation measures have been developed for the design, construction, operation and decommissioning phases of the project within this EA.

The commitments in this section have been developed into a comprehensive set of environmental impact avoidance and mitigation measures which incorporate:

- specific recommendations contained in the specialist reports; and
- additional measures identified during the preparation of this Environmental Assessment (in consultation with the community and government agencies).

In general, these issues will be incorporated and addressed in the proposed CEMP and OEMP.

To avoid duplication in this section, mitigation measures are located under the most appropriate heading only and are not repeated in subsequent sections.

Table 17-1 Draft Statement of Commitments

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
1	General	Revisions to approved development	No material increase in impact	Ensure that any minor changes, including micro-siting up to 100 m in any direction, to the proposed development do not create any material increase in overall environmental impact. In the event of any significant or material changes to the wind turbine layout, an updated noise assessment and visual impact assessment will be submitted as required prior to construction.	Design	DP&I
2	General	Loss or modification of habitat	Mitigate impact	Implement a Construction Environmental Management Plan (CEMP) and an Operational Environmental Management Plan (OEMP) in accordance with the Best Practice Guidelines for Wind Energy Projects (Auswind, 2006).	Construction	CEMP OEMP
3	Visual	Deterioration of visual amenity at surrounding residences	Mitigate impact	Prior to the commencement of construction consult with any residence within 2 km of a wind turbine regarding visual impacts. Consider appropriate mitigation measures, if required, including an offer for vegetative screening. The Proponent would write to the owner of each residence outlining the offer to consult and process. A site visit would determine the extent and type of mitigation required. If vegetative screening is required, species selection would be determined in consultation with landholders using specialist advice. An offer for vegetative screening would remain in place for a period of 1 year after project construction, to allow residence time to either adjust or to decide that landscape filtering or screening is warranted. Planting would be completed within 2 years of completion of project construction.	Post Construction	CEMP OEMP
4	Visual	Deterioration of visual amenity Blade glint	Mitigate impact	Ensure turbines are supplied with appropriate surface finish and colour, as recommended by the manufacturer, to minimise glint and reflected sunlight.	Design	CEMP
5	Visual	Deterioration of visual amenity	Avoid Impacts	Avoid use of advertising, signs or logos mounted on turbine structures, except those required for safety purposes.	Design	CEMP
6	Visual	Deterioration of visual amenity	Mitigate impact	Minimise activities that may require night time lighting, and if necessary use low intensity lighting designed to be mounted with the light projecting inwards to the site to minimise glare at night.	Construction & Operation	CEMP OEMP
7	Noise	Construction noise	Minimise Impact	In general, construction activities associated with the project that would generate audible noise in excess of the requirements of the Interim Construction Noise Guidelines at any residence would be undertaken during the daylights hours of: Monday – Friday: 7am – 6pm Saturday: 8am – 1pm	Construction	CEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				Sunday and public holidays:Not currently proposed These working hours have been proposed to allow reasonable efficiencies of effort to achieve maximum productivity and to minimise the overall construction duration but should not be restricted to daylight hours. Variations to these hours may be required subject to weather, safety and seasonal impacts. • Any construction activities outside of the standard construction hours will only be undertaken in the following circumstances; a) Construction activities that generate noise that is: a. no more than 5dB(A) above rating background level at any residence in accordance with the ICNG (Table 2 of the ICNG); and b. no more than the noise management levels specified in Table 3 of the ICNG at other sensitive receivers; or b) for the delivery of material required outside those hours by the NSW police Force or other authorities for safety reasons (section 10.11.2); or c) where it is required in an emergency to avoid the loss of life, property and/or to prevent environmental harm; works as approved through the out-of-hours work protocol outlined in the Construction Noise and Vibration Management Plan as part of the Construction Environmental Management Plan.		
8	Noise	Construction noise	Minimise Impact	Apply all feasible and reasonable work practices regarding construction machinery including the use of temporary acoustic barriers, the use of silencers, improved vehicle noise control and the use of 'quiet work practices' (such as reducing or relocating idling machinery).	Construction	CEMP
9	Noise	Construction noise	Mitigate Impact	Implement a community consultation process to ensure adequate community awareness and notice of expected construction noise.	Construction	CEMP
10	Noise	Construction noise	Minimise Impact	Locate fixed noise sources such as crushing plant at the maximum practical distance from the nearest dwellings and where possible use existing landforms to block line of sight between equipment and the dwelling.	Construction	CEMP
11	Noise	Operational noise	Compliance	Ensure final turbine selection and layout complies with the SA EPA Noise Guidelines of 35 dB(A) or background plus 5 dB(A) (whichever is higher) for all non-involved residential receivers, other than those which have entered into a noise agreement with the Proponent in accordance with the SA EPA Noise Guidelines.	Detailed design	OEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
12	Noise	Operational noise	Compliance	Ensure final turbine selection and layout complies with the World Health Organisation Guidelines for Community Noise requiring 45 dB(A) or background plus 5 dB(A) (whichever is higher) for all involved residential receivers and all non-involved residential receivers who have entered into a noise agreement with the Proponent in accordance with the SA EPA Noise Guidelines.	Detailed design	OEMP
13	Noise	Operational noise	Compliance	Prior to construction, prepare and submit to the DP&I a noise report providing final noise predictions based on any updated background data measured, the final turbine model and turbine layout selected, to demonstrate compliance with the relevant guidelines for all residences.	Detailed design	OEMP
14	Noise	Operational noise	Mitigate impact	If operational monitoring identifies an exceedance through a complaint hotline or other means that is investigated, consideration would be given to providing mechanical ventilation or other mitigation (to remove the requirement for open windows), building acoustic treatments (improving glazing) or using turbine control features (including the consideration of turning turbines off) to manage excessive noise under particular conditions.	Operation	OEMP
15	Noise	Operational noise	Compliance	Develop and implement an operational noise compliance testing program. The compliance program will commence 3 months before construction commencement and continue on a permanent basis for 2 years post commissioning. Permanent noise loggers will be installed at selected receivers for the duration of the compliance program, with noise data regularly downloaded and any potential exceedances noted for detailed analysis. The selected house locations will comprise of all houses within 2km of a turbine and selected representative houses within 2-5km.	Operation	OEMP
16	Ecology	Loss or modification of habitat	Avoid, minimise, offset	Where areas of native vegetation and habitat cannot be avoided, microsite infrastructure to minimise impacts (includes road widening and powerline easement).	Detailed design	CEMP
17	Ecology	Loss or modification of habitat	Mitigate impact	Align access roads and underground electrical cabling along existing tracks where possible to minimise the number of easements and vegetation removal and the spread of weeds.	Detailed design	CEMP
18	Ecology	Loss or modification of habitat	Mitigate impact	Construct underground electrical reticulation and overhead powerlines along access road infrastructure where possible to minimise the number of easements and the potential for avian collisions	Detailed design	CEMP
19	Ecology	Loss or modification of habitat	Avoid, minimise, offset	Prepare and implement an Offset Plan, to offset the quantum and condition of native vegetation to be removed, in order to achieve a positive net environmental outcome for the project. Offset areas would reflect the actual footprint of the development (i.e. foundation areas and new tracks) not the maximum impact areas	Prior to construction	CEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				(which include easements and existing tracks). The Offset Plan would be prepared in consultation with OEH, prior to construction.		
20	Ecology	Loss or modification of habitat	Avoid, minimise, offset	Implement a post-construction bird and bat monitoring program to determine the impacts of the project on bird and bat populations	Prior to construction	OEMP
21	Ecology	Weed Control	Avoid Impacts	The CEMP would include appropriate weed control protocols. Such measures may include washing machinery after entering affected areas during wet periods and spraying road ways, where required, to ensure the spread of weeds is restricted during construction and throughout the ongoing operation of the project.	Construction	CEMP
22	Heritage	Disturb identified area	Avoid Impact	Protect identified Aboriginal and European sites that need to avoided during construction.	Detailed design & construction	CEMP
23	Heritage	Inadvertent disturbance of Aboriginal heritage sites or objects	Avoid Impact	All relevant staff and contractors should be made aware of their statutory obligations for heritage under NSW NPW Act (1974) and the NSW Heritage Act (1977), which may be implemented as a heritage induction.	Construction	CEMP OEMP
24	Aircraft Hazards	Potential hazard	Minimise Impact	Liaise with all relevant authorities (CASA, Airservices, and Department of Defence) and supply location and height details once the final locations of the wind turbines have been determined and before construction commences.	Detailed design	CEMP
25	Aircraft Hazards	Potential hazard	Minimise Impact	Consult with the landowners and appropriate licensed contractors to discuss alternate measures for aerial spreading in areas affected by the turbines	Operation	OEMP
26	Communication	Deterioration of signal strength	Avoid impact	Locate wind turbines to avoid existing microwave link paths that cross the site or liaise with the owners of such links to relocate services to avoid potential impacts from turbines.	Detailed Design	CEMP
27	Communication	Deterioration of signal strength	Avoid impact	Ensure adequate television reception is maintained for neighbouring residences as follows: • Undertake a monitoring program of houses within 5km of the wind farm site to determine any loss in television signal strength if requested by the owners. • In the event that after construction television interference (TVI) is experienced by existing receivers within 5km of the site, investigate the source and nature of the interference. • Where investigations determine that the interference is cause by the wind farm, establish appropriate mitigation measures at each of the affected	Operation	OEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				receivers in consultation and agreement with the landowners. Specific mitigation measures may include: • Modification to, or replacement of receiving antenna • Provision of a land line between the effected receiver and an antenna located in an area of favourable reception • Improvement of the existing antenna system • Installation of a digital set top box or In the event that interference cannot be overcome by other means, negotiating an arrangement for the installation and maintenance of a satellite receiving antenna at the Proponents cost.		
28	EMF	Radiation exposure from EMFs	Avoid Impact	Powerlines would be located in accordance with the minimum distances set in Country Energy's Procedural Guideline – Easement Requirements.	Detailed Design	CEMP
29	Shadow flicker	Safety & nuisance	Compliance	Appropriate mitigation measures will be negotiated and implemented, where necessary, including potentially limiting hours of operation on selected turbines or pre-programming the control system of individual wind turbines to automatically shut down while these conditions are present.	Operation	OEMP
30	Shadow flicker	Safety & nuisance	Compliance	Shadow flicker effects on motorists would be monitored following commissioning and any remedial measures, if required, to address concerns would be developed in consultation with the RMS.	Operation	OEMP
31	Traffic	Safety and asset protection	Minimise Impact	The Proponent would develop and implement a Traffic Management Plan (TMP) in consultation with roads authorities to facilitate appropriate management of potential traffic impacts. The TMP would include provisions for: • Scheduling of deliveries and managing timing of transport • Identifying the number of trips per day • Undertaking community consultation before and during all haulage activities • Designing and implementing temporary modifications to intersections, roadside furniture, stock grids and gates • Managing the haulage process, including the erection of warning and/or advisory speed signage prior to isolated curves, crests, narrow bridges and change of road conditions • Designation of a speed limit as required to be placed on roads that would be used primarily by construction traffic	Construction	CEMP OEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				• Preparation of a Transport Code of Conduct to be made available to all contractors and staff • Identification of a procedure to monitor the traffic impacts during construction and work methods modified (where required) to reduce the impacts • Provision of a contact phone number to enable any issues or concerns to be rapidly identified and addressed through appropriate procedures • Reinstatement of pre-existing conditions after temporary modifications to the roads and pavement along the route.		
32	Traffic	Safety and Asset protection	Minimise Impact	Engage a licensed haulage contractor with experience in transporting similar loads, responsible for obtaining all required approvals and permits from the RMS and Councils and for complying with conditions specified in those approvals. This would include the use of escorts for oversize and over-mass vehicles in accordance with RMS requirements	Construction	CEMP
33	Traffic	Safety and Asset protection	Minimise Impact	Prepare road dilapidation reports covering pavement and drainage structures in consultation with roads authorities for the route prior to the commencement of construction and after construction is complete. Repair any damage resulting from the construction traffic (except that resulting from normal wear and tear) as required during and after completion of construction at the Proponent's cost or, alternately, negotiate an alternative for road damage with the relevant roads authority.	Construction	CEMP
34	Traffic	Potential disruption to other road users	Mitigate Impact	Provide a 24hr telephone contact during construction to enable any issue or concern to be rapidly identified and addressed.	Construction	CEMP
35	Bushfire	Bushfire risk	Minimise Impact	Prepare a Bushfire Management Plan as part of the Construction Environmental Management Plan. The Rural Fire Service and NSW Fire Brigade would be consulted in regard to the plans adequacy to manage bushfire risks during construction, operation and decommissioning. The plan would as a minimum include: • Details of flammable materials and ignition sources brought onto the site, such as hydrocarbons, to be handled and stored as per manufacturer's instructions. • During the construction phase, appropriate fire fighting equipment would be held onsite for use when the fire danger is very high to extreme, and a minimum of one person on site would be trained in its use. The equipment and level of training would be determined in consultation with the local RFS.	Construction Operation Decommissioning	CEMP OEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				• Substations would be bunded with a capacity exceeding the volume of the transformer oil to contain the oil in the event of a major leak or fire. The facilities would be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater). • Workplace health and safety protocols would be developed to minimise the risk of fire for workers during construction and operation. • Fire extinguishers would be stored onsite in the control building and within the substation building. • Shut down of turbines would commence if components reach critical temperatures or if directed by the RFS in the case of a nearby wildfire being declared (an all-hours contact point would be available to the RFS during the bushfire period). Remote alarming and maintenance procedures would also be used to minimise risks. • Overhead transmission easements would be periodically inspected to monitor regrowth of encroaching vegetation.		
36	Hydrology	Deterioration of water quality (Surface Water)	Minimise Impact	Ensure infrastructure, including turbines, tracks, substations, control buildings, stockpiles, and site compounds and turnaround areas, is not sited within 20-40 metres of a major drainage line or water course, where practical.	Detailed design	CEMP
37	Hydrology	Deterioration of water quality (Surface Water)	Avoid Impact	Prepare a Sediment & Erosion Control Plan as part of the Construction Environmental Management Plan. Soil and water management practices would be developed as set out in Soils and Construction Vol. 1 (Landcom 2004)	Construction	CEMP
38	Hydrology	Deterioration of water quality (Surface Water)	Minimise Impact	Ensure all vehicles onsite follow established trails and minimise onsite movements, where possible.	Construction Operation	CEMP OEMP
39	Hydrology	Deterioration of water quality (Surface and Ground Water)	Minimise Impact	Design concrete batch plants to ensure concrete wash would not be subjected to uncontrolled release. Bunded areas of the batching plant to contain peak rainfall events and remediate after the completion of the construction phase. Waste sludge would be recovered from the settling pond and used in the production of road base manufactured onsite. The waste material would be taken from the batching plant to be blended in the road base elsewhere onsite.	Construction	CEMP
40	Hydrology	Deterioration of water quality (Surface and Ground Water)	Minimise Impact	As soon as practical, stabilise exposed or clear areas to minimise erosion and sedimentation that can potentially pollute and dam watercourses in the area.	Construction	CEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
41	Hydrology	Deterioration of water quality (Surface and Ground Water)	Minimise Impact	A Spill Response Plan would be prepared as part of the CEMP and OEMP.	Construction Operation Decommissioning	CEMP OEMP
42	Soils and Landforms	Erosion of disturbed land	Mitigate Impact	At the conclusion of the construction period, where practical, the disturbed areas of the site would be rehabilitated to a level suitable for the ongoing agricultural use of the land. The topsoil removed for construction activities would be stockpiled and reused for the rehabilitation of the areas around the turbine foundations, lay down and hardstand areas and along the access tracks.	Construction	CEMP
43	Soils and landforms	Contamination	Minimise Impact	Consult with involved property owners in relation to areas of land potentially contaminated by past land use and manage impacts in these areas to avoid affecting any areas of contamination.	Detailed design	CEMP
44	Soils and landforms	Soil quality	Minimise impact	The Proponent would prepare a protocol in the instance that contamination is found. Should contamination or potential contamination be disturbed during excavation works, the area would be assessed by appropriately qualified consultants and OEH would be notified if warranted.	Construction	CEMP
45	Soils and landforms	Soil loss or stability of landform loss	Minimise Impact	Concrete wash would be deposited in an excavated area, below the level of the topsoil, or in an approved landfill site. Where possible, waste water and solids would be reused onsite.	Construction	CEMP
46	Soils and landforms	Soil loss or stability of landform loss	Minimise Impact	Access routes and tracks would be confined to already disturbed areas, where practical. All contractors would be advised to keep to established tracks.	Construction	CEMP
47	Mineral Exploration	Conflict with mineral exploration	Avoid Impact	Liaise with the current mineral license holder providing a final turbine and infrastructure layout, prior to the construction phase.	Pre-construction	CEMP
48	Economic	Effect on local community	Maximise positive impact	Liaise with local industry representatives to maximise the use of local contractors and manufacturing facilities in the construction and decommissioning phases of the project.	Construction	CEMP
49	Economic	Effect on local community	Maximise positive impact	Liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works and to the extent practical coordinate with local events.	Construction	CEMP
50	Economic	Effect on local community	Maximise positive impact	Make available employment opportunities and training for the ongoing operation of the wind farm to local residents where reasonable.	Operation	OEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
51	Economic	Community Fund	Continue consultation to maximise benefit	The proponent will continue consultation on a possible format for a community enhancement program • At least 6 months prior to the commencement of operations, call a meeting of the Community Consultation Committee and consult with Council(s) with respect to establishment of the community fund; • Prior to the commencement of operation of the project, establish that community fund as required and publically announce the administration processes and current funding commitments of the fund; and, • Regularly make publicly available the details of the fund including its administration processes, funds made available, funding commitments and outcomes.	Operation	OEMP
52	Agriculture	Impact on current land use	Minimise Impact	Stock would be restricted from works areas where there is a risk stock injury or where disturbed areas are being stabilised.	Construction	CEMP
53	Agriculture	Impact on current land use	Minimise impact	Develop, implement and monitor the effects of a Site Restoration Plan. The plan would aim to stabilise disturbed areas as rapidly as possibly. The Plan would consider: • Appropriate stabilisation techniques across the precincts • Suitable species for re-seeding (native species would be given preference due to their superior persistence and for conservation purposes) • Monitoring for weed and erosion issues.	Construction Decommissioning	CEMP
54	Agriculture	Impact on current land use	Minimise impact	Ensure that the switchyard and substation is appropriately fenced to eliminate stock ingress.	Operation	OEMP
55	Agriculture	Impacts on current activities	Minimise impact	If aerial agriculture activities are demonstrated to be materially disrupted on any property immediately adjacent to the site due to the operation of turbines, the Proponent would consult with the affected landowner and implement appropriate mitigation measures where necessary taking into consideration the history of aerial agriculture activities. This could include funding the cost difference between the pre-wind farm aerial agricultural activities and a reasonable alternative method.	Operation	OEMP
56	Health and Safety	Safety of persons or stock	Minimise Impact	A detailed Health and Safety Plan would be prepared, as a sub plan of the Construction Environmental Management Plan, identifying hazards associated with construction works, the risks of the identified hazards occurring and appropriate safeguards would be prepared prior to the commencement of construction works. The Plan would include, but not be limited to:	Construction	CEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				• Inductions for all contractors requiring site access. • Ensure all staff are appropriately qualified and trained for the roles they are undertaking.		
57	Health and Safety	Safety of persons or stock	Minimise Impact	Appropriate safety measures will be implemented in accordance with good industry practice and relevant legislation to ensure risk to the general public is mitigated, including clear marking of hazards and restricting access to public where required	Construction and Decommissioning	CEMP
58	Climate	Air quality	Minimise Impact	A cost benefit analysis would be completed on differing potential mitigation options for dust suppression, for inclusion in the CEMP.	Construction	CEMP
59	Climate	Air quality	Minimise Impact	Undertake ongoing visual dust monitoring and suppression (if required) during the construction phase. Monitoring would regularly assess the effectiveness of dust suppression activities. Monitoring would regularly assess the effectiveness of dust suppression activities.	Construction	CEMP
60	Climate	Air quality	Minimise Impact	Dust levels at stockpile sites would be visually monitored. Dust suppression would be implemented if required. Stockpiles would be protected from prevailing weather conditions.	Construction	CEMP
61	Climate	Air quality	Minimise Impact	Should a complaint relating to dust by a resident be received, monitoring at the boundary of the construction site would be undertaken using dust gauges. The Proponent would assess the dust gauges and undertake additional mitigation measures, where required.	Construction	CEMP
62	Climate	Air quality	Minimise Impact	Should blasting be required, it would be carried out in accordance with all relevant statutory requirements and residences within 1km of blasting activities would be informed prior to blasting	Construction	CEMP
63	Climate	Air quality	Minimise Impact	Dust filters would be installed on silos, where required	Construction	CEMP
64	Resources	Waste generation	Minimise waste and maximise recycling of materials	The Proponent would prepare a Waste Management Plan to be included within the Construction Environmental Management Plan. It would include but not be limited to the following: • The scope for reuse and recycling would be evaluated • Provision for recycling would be made onsite • Wastes would be disposed of at appropriate facilities • Toilet facilities would be provided for onsite workers and sullage from contractor's pump out toilet facilities would be disposed at the local sewage treatment plants or other suitable facility agreed to by Council • Excavated material would be used in road base construction and as	Construction Operation	CEMP OEMP

SoC	Issue	Impact	Objective	Mitigation tasks	Project phase	Auditing
				aggregate for foundations where possible. Surplus material would be disposed of in appropriate locations on site (on agreement with the landowner), finished with topsoil, and revegetated.		
65	Environmental Management	Quality Assurance	Compliance	Appoint a representative as a key contact for all environmental management issues.	Construction Operation	CEMP OEMP
66	Environmental Management	Quality Assurance	Compliance	Site induction for all workers and visitors to include maps of all sensitive areas and availability of CEMP and OEMP on site.	Construction Operation	CEMP OEMP
67	Environmental Management	Quality Assurance	Operational monitoring and Compliance	Will implement a compliance and monitoring programme against permit conditions.	Operation	OEMP
68	Community Consultation	Project Information	Inform Community	Appoint a community liaison office to be available for consultation by the community and to provide information to the community about the status of the project.	Construction Operation	CEMP OEMP
68	Community Consultation	Project Information	Community liaison	Continue with the Community Consultation Committee as required during various stages of the project life cycle.	Construction Operation	CEMP OEMP

18 Conclusion

This Environmental Assessment has investigated and assessed the likely impacts that would result from the proposed Liverpool Range Wind Farm, a project capable of generating around 846 MW of renewable energy.

The project has incorporated the environmental constraints identified during the assessment process and demonstrated how these constraints were applied to the design of the wind farm to arrive at the most appropriate site layout. It has also outlined the measures that will be taken to avoid and if necessary address the environmental risks and issues that have been identified for the construction, operation and decommissioning stages. These measures have been converted into a statement of commitments.

The Proponent has prepared detailed studies by independent consultants on the key issues of:

- Landscape and Visual Impact Assessment;
- Operational and Construction Noise;
- Biodiversity Assessment (Flora and Fauna); and
- Indigenous and Cultural Heritage (Archaeology).

Additional studies were conducted in relation to communications, traffic and transport, aviation, existing landscape and community issues such as economic, health and safety and community benefits.

A strategic justification for the project outlined the following benefits at the local, regional and global scales:

- In full operation, it would generate more than 2,724,700 MWh of electricity per year - sufficient for the average consumption of around 340,600 homes.
- It would improve the security of electricity supply through diversification of generation locations.
- It would reduce greenhouse gas emissions by approximately 2,634,800 tonnes of carbon dioxide equivalent (CO_2e) per annum.
- It would contribute to the State and Federal Governments' target of providing 20% of consumed energy from renewable sources by 2020.
- It would contribute to the NSW Government's target of reducing greenhouse gas emissions by 60% by the year 2050.
- It would inject funds of up to $1,272 million into the Australian economy.
- It would create local employments opportunities of up to 829 jobs during construction and up to 78 permanent jobs during the operational lifetime of the project.

The conclusion of the individual key issue assessments is that the proposed Liverpool Range Wind Farm can be constructed with minimal impact to the existing environment.

The success of the project in meeting the environmental requirements of "maintain or improve" relies on the effective implementation of both the Construction and Operational Environmental Management Plans. The Proponent is committed to ensuring the measures developed in these plans are best practice to ensure the best possible outcome for the Liverpool Range Wind Farm as well as the local and wider communities.

19 Glossary and Acronyms

Abbreviation	Description
AA	Airservices Australia
ABARE	Australia Bureau of Resource Economics
ABS	Australian Bureau of Statistics
ACMA	Australian Communications and Media Authority
AEMO	Australian Energy Market Operator
ALA	Aircraft Landing Area
An	Annum
APZ	Asset Protection Zone (for bushfire compliance)
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ARTC	Australian Rail Track Corporation
AusWEA	Australian Wind Energy Association (previously Auswind)
BA	Biodiversity Assessment
CANRI	Community Access to Natural Resource Information
CAP	Catchment Action Plan
CASA	Civil Aviation Safety Authority
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
dB(A)	Decibels (A weighted)
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation (now OEH)
DECC	NSW Department of Environment and Climate Change (now OEH)
DECCCW	NSW Department of Environment, Climate Change and Water (now OEH)
DEH	Commonwealth Department of Environment and Heritage, now the Department for Environment and Water Resources
DEUS	NSW Department of Energy Utilities and Sustainability (now OEH)
DEWR	Commonwealth Department for Environment and Water Resources, formerly the Department of Environment and Heritage
DGRs	NSW Department of Planning and Environment's Director General's Requirements.
DP&E	NSW Department of Planning and Environment (previously DP&I)
DP&I	NSW Department of Planning and Infrastructure (now DP&E)
DPI	Department of Primary Industries
EA	This Environmental Assessment report
EEC	Endangered Ecological Community
EMF	Electromagnetic fields
EMP	Environmental Management Plan

Abbreviation	Description
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPA	Environmental Protection Agency
EPBC Act	Federal Environmental Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
FM Act	Fisheries Management Act
GBDLA	Green Bean Design Landscape Architects
GHG	Greenhouse Gas
GWh	gigawatt-hour
ha	hectare (unit of area 100m x 100m)
HBT	Hollow-bearing tree
HF	High Frequency
ICN Guideline	DECC Interim Construction Noise Guideline 2009
IPCC	Intergovernmental Panel on Climate Change
kg	kilogram
kL	Kilolitres
km	kilometre
kV	kilovolt
LAeq	Equivalent Sound Power (A weighted)
LALC	Local Aboriginal Land Council
LCA	Landscape Character Area
LEP	Local Environmental Plan
LGA	Local Government Area
LSALT	Lowest Safe Altitudes
LVIA	Landscape and Visual Impact Assessment
m	meter
m/s	meters per second
mG	milligauss
ML	Megalitres
MRET	Mandatory Renewable Energy Target
MTOW	Maximum Take-off Weight
MW	megawatt
MWh	megawatt-hour
NEM	National Electricity Market
NES	National Environmental Significance
NPI	National Pollutant Inventory
NRET	NSW Renewable Energy Target
OEH	Office of Environment and Heritage
OEM	Original Equipment Manufacturer
OEMP	Operational Environmental Management Plan
OLS	Obstacle Limitation Surface

Abbreviation	Description
PEA	Preliminary Environmental Assessment
POEO Act	Protection of the Environment Operations Act 1997
Proponent	Epuron Pty Ltd
REP	Regional Environmental Plan
RET	Renewable Energy Target
RFS	Rural Fire Service
RMS	Roads and Maritime Service
SA EPA Guidelines	South Australian Environment Protection Authority Environmental Noise Guidelines: Wind Farms (2003)
SEPP	State Environmental Planning Policy
SKM	Sinclair Knight Merz
SoC	Statement of Commitments
tCO2e	Tonne of carbon dioxide equivalent
TMP	Traffic Management Plan
TSC Act	Threatened Species Conservation Act 1995
TVI	Television Interference
V	volt
VHF	Very High Frequency
W	watt
WHO	World Health Organisation
WTG	Wind Turbine Generator

20 Preparation of Environmental Assessment

This Environmental Assessment was prepared and authored by Epuron and the content is not false or misleading. Specific sections were drawn from specialist consultants' reports as detailed in Table 20-1 below.

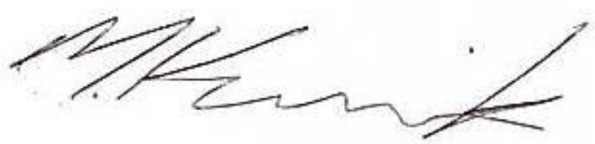
Table 20-1 Preparation of the Environmental Assessment

Section	Description	Author
9	Visual Assessment	Andrew Homewood Green Bean Design Landscape Architects
10	Operational and Construction Noise	Gustaf Reutersward SLR Consulting Pty Ltd
11	Ecology	Nick Graham-Higgs NGH Environmental Pty Ltd
12	Aboriginal and European Heritage	Julie Dibden NSW Archaeology Pty Ltd

Brian Hall and Michael Kurnik of Epuron constitute the document's primary authors. The information contained in this document is neither false nor misleading. All information is considered by the authors to be correct at the time of writing.

Brian Hall
Epuron (Senior Project Manager)

Michael Kurnik
Epuron (Assistant Project Manager)



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Attachment 1 – Detailed Site Maps

Attachment 2 – Involved Landowner Parcels

Lot/DP	Lot/DP	Lot/DP	Lot/DP	Lot/DP
1/1045523	1/363100	1/864461	108/750744	117/750763
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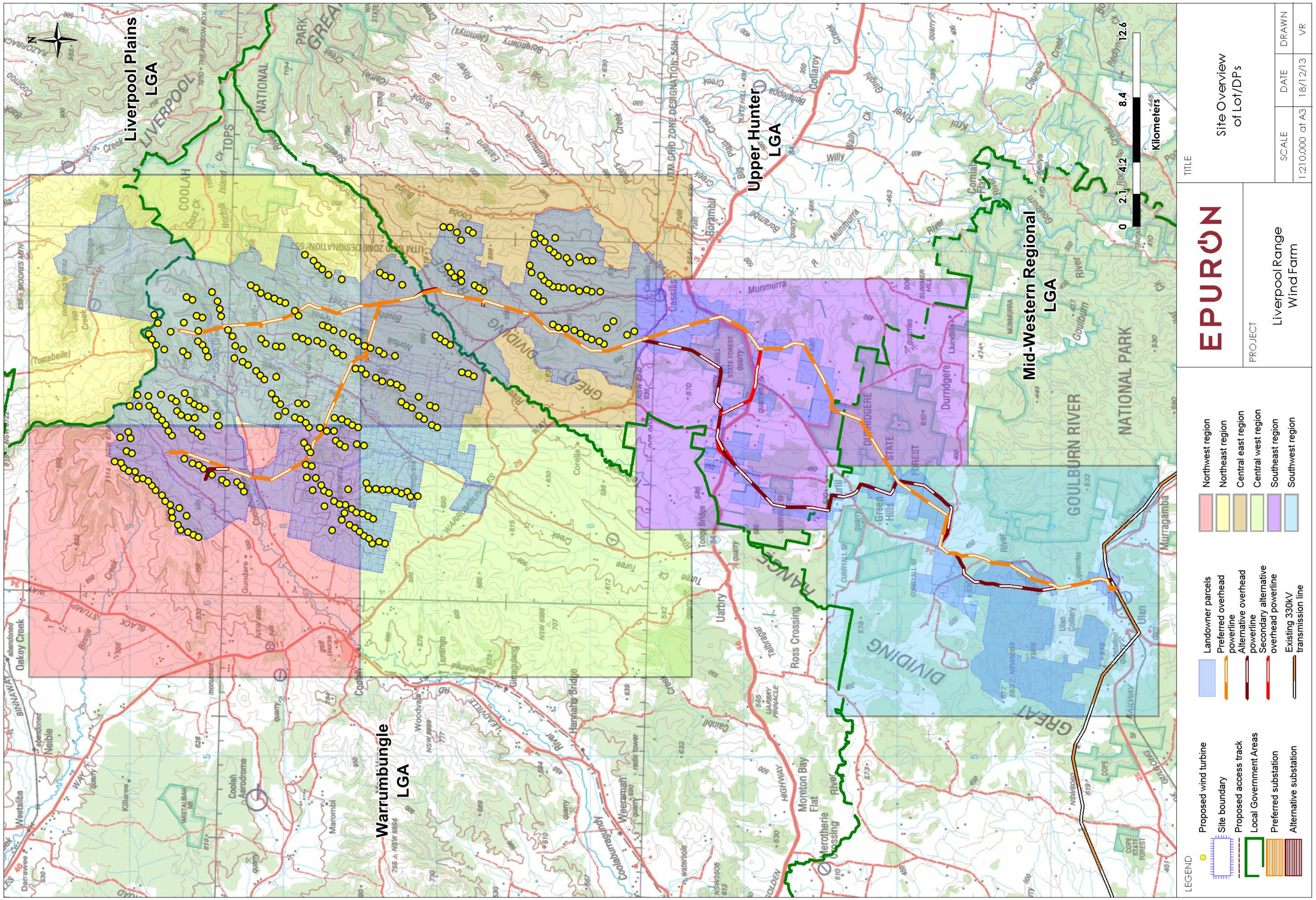

Figure 1.Site overview of Lots/DPs.

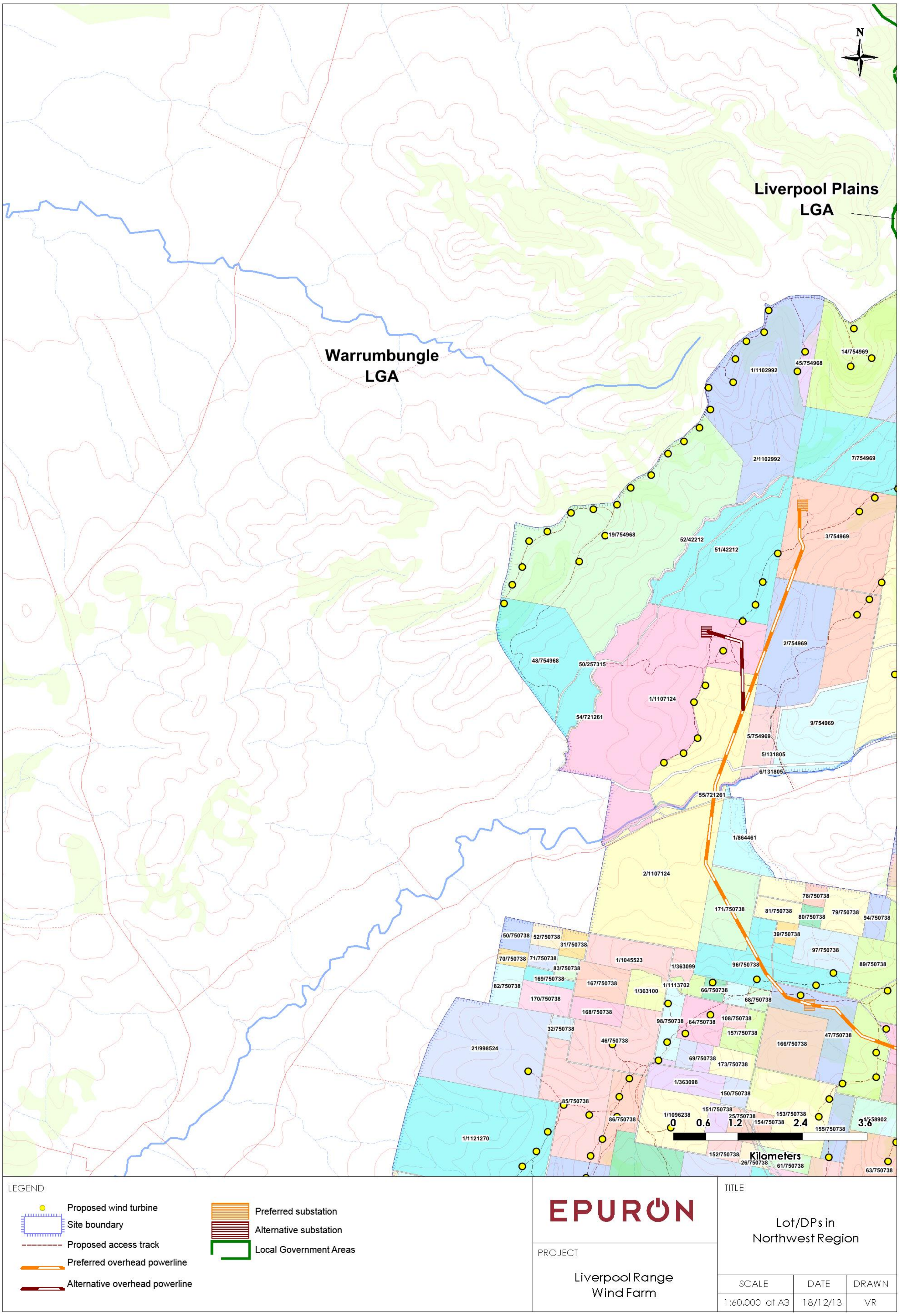

Figure 2.Lot/DPs in Northwest Region.

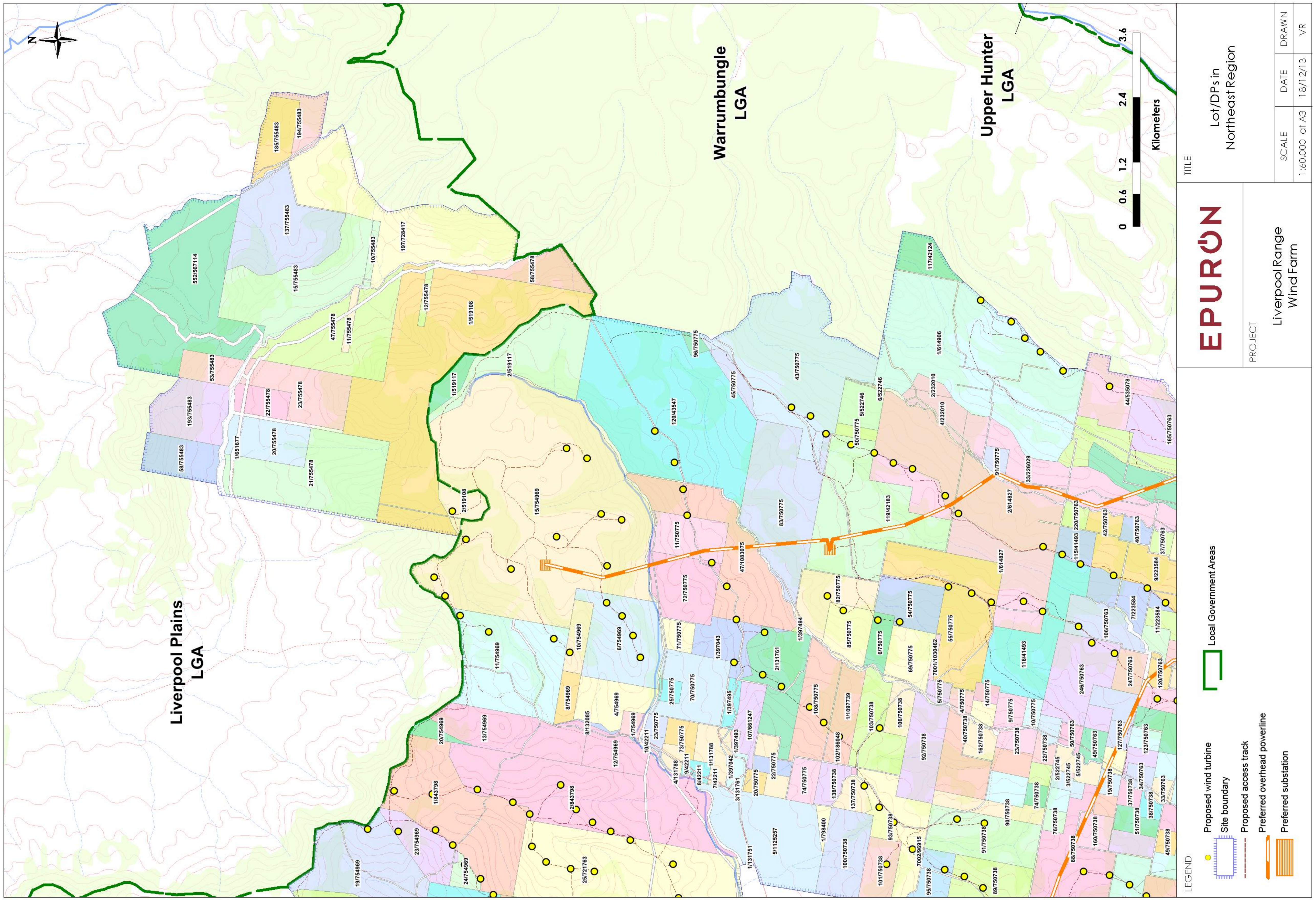

Figure 3.Lot/DPs in Northeast Region.

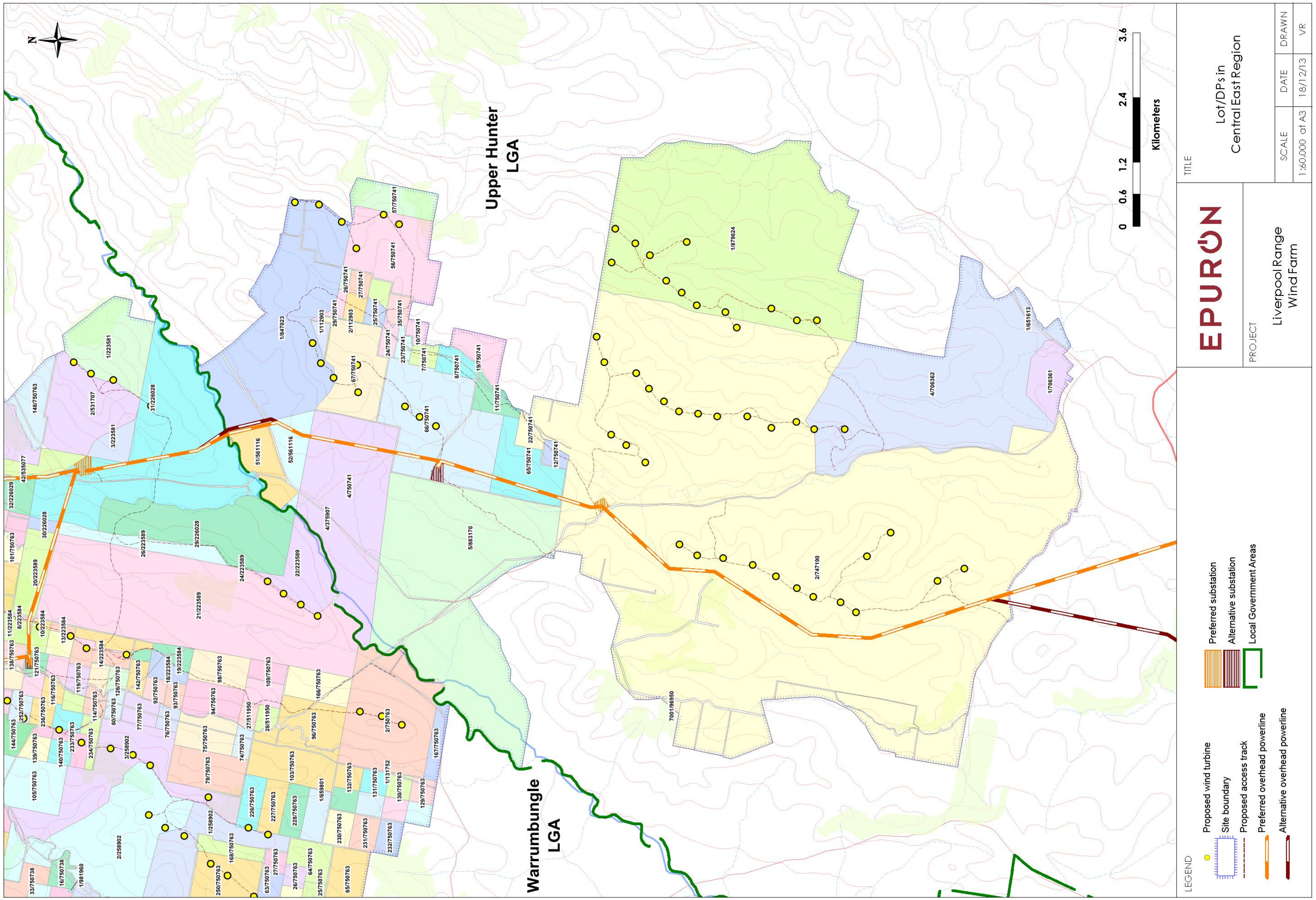

Figure 4.Lot/DPs in Central East Region.

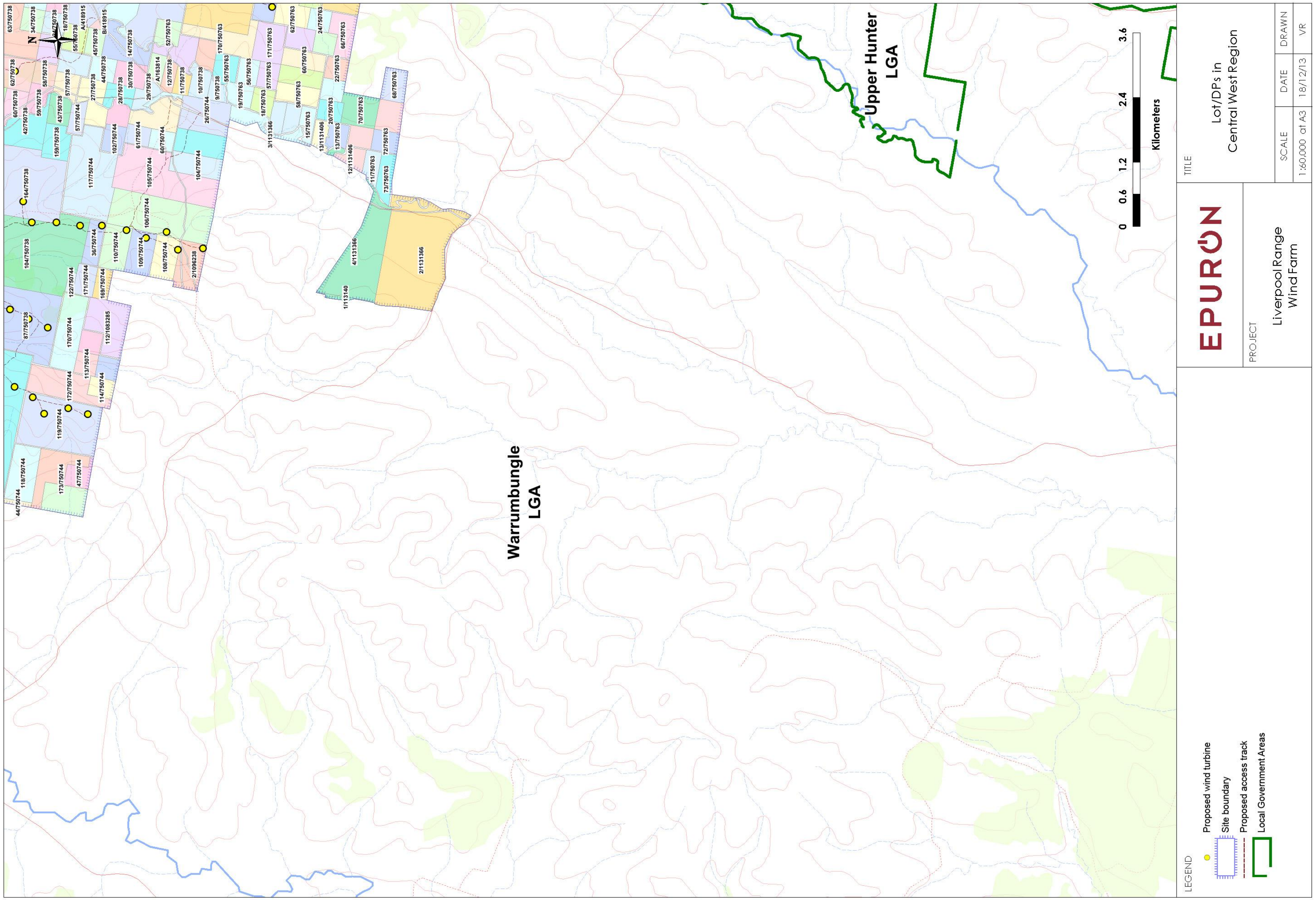

Figure 5.Lot/DPs in Central West Region.

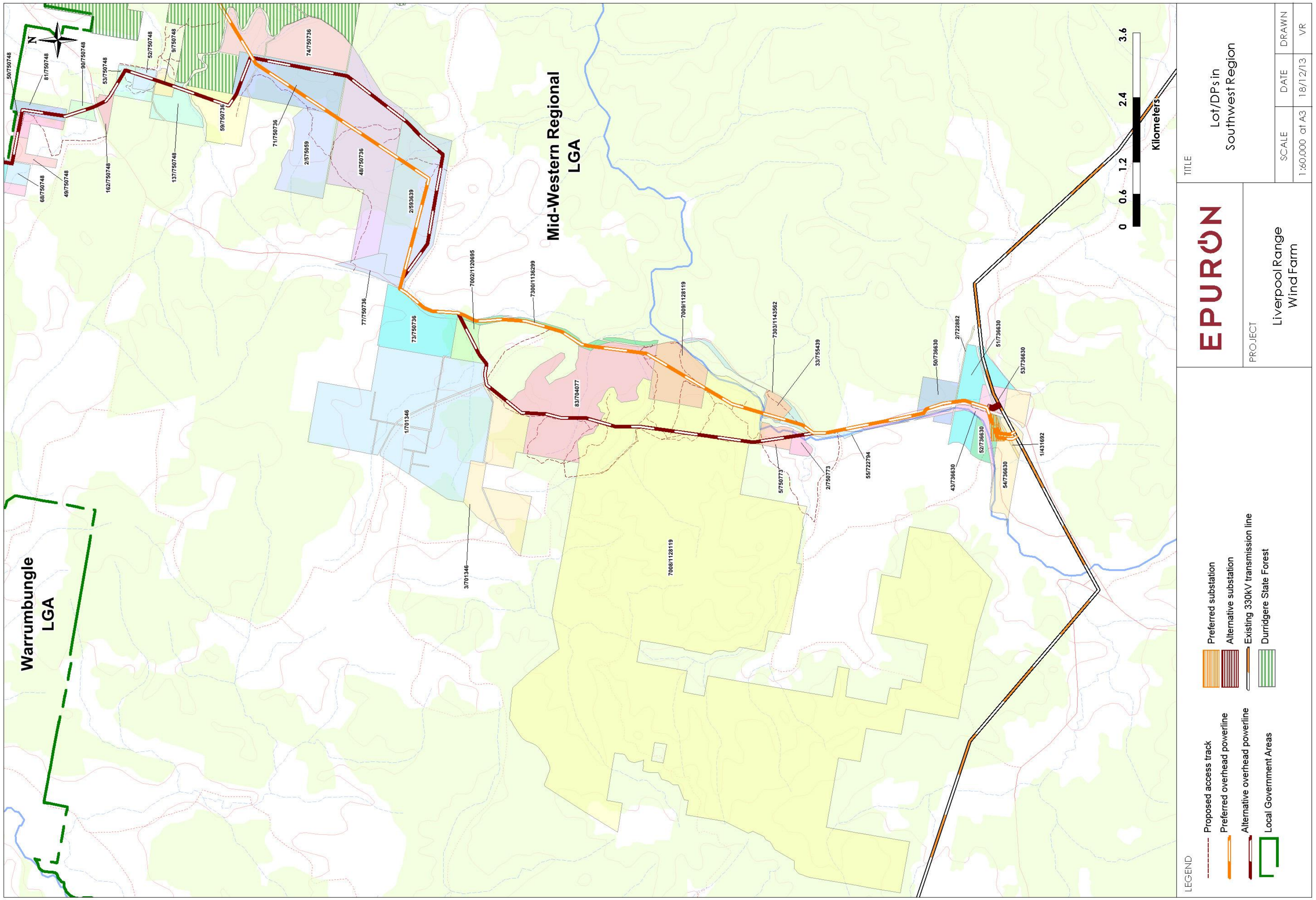

Figure 7.Lot/DPs in Southwest Region.

Attachment 3 – Residence Coordinate

Residence ID	Easting	Northing
B12-2	759,392	6,4411364
B5-6	759,412	6,475,153
B5-7	759,494	6,475,275
B6-8	759,315	6,473,604
B6-9	759,330	6,473,411
B6-10	759,459	6,474,801
B6-11	759,597	6,472,970
C11-2	763,803	6,447,924
C11-3	763,827	6,447,931
C12-1	761,007	6,443,118
C12-2	763,029	6,443,367
C12-3	764,051	6,440,189
C12-1	764,054	6,440,167
C12-2	764,926	6,442,030
C12-3	764,985	6,441,431
C13-1	761,882	6,436,371
C13-2	761,940	6,439,124
C13-3	761,951	6,439,124
C13-1	763,838	6,439,665
C13-2	763,876	6,438,764
C13-3	763,901	6,439,711
C13-4	764,142	6,438,093
C13-6	764,317	6,436,297
C13-7	764,439	6,439,522
C14-1	762,706	6,434,717
C14-2	764,674	6,431,931
C15-1	764,883	6,425,917
C2-3	764,134	6,490,350
C2-4	764,191	6,490,559
C4-1	761,908	6,482,895
C4-2	762,190	6,481,915
C4-3	762,238	6,481,795
C4-4	762,874	6,481,513
C4-5	762,878	6,482,423
C4-6	762,958	6,482,067
C4-7	762,958	6,482,433
C4-8	763,965	6,482,463
C4-9	764,371	6,480,560
C5-1	760,070	6,475,843
C5-2	760,190	6,475,987

Residence ID	Easting	Northing
C5-3	760,755	6,479,176
C5-4	760,800	6,477,141
C5-5	761,379	6,479,642
C5-6	761,460	6,477,801
C5-7	762,771	6,476,691
C5-8	762,926	6,476,796
C5-9	763,840	6,479,921
C5-10	764,398	6,479,612
C6-1	760,542	6,473,529
C6-2	762,522	6,472,569
C6-3	763,886	6,471,207
C6-4	764,351	6,470,201
C7-1	764,232	6,469,712
C7-2	764,972	6,468,258
D10-1	765,303	6,451,599
D10-2	766,900	6,452,324
D10-4	767,015	6,451,874
D10-5	768,202	6,451,763
D10-6	768,302	6,451,187
D10-7	769,156	6,451,460
D11-1	765,386	6,445,145
D11-2	768,385	6,447,807
D11-3	768,613	6,448,262
D11-4	769,745	6,445,682
D12-1	765,053	6,441,167
D12-2	765,435	6,440,364
D12-3	765,480	6,441,020
D12-4	765,685	6,440,863
D12-5	766,125	6,440,950
D12-6	766,142	6,443,760
D12-7	766,159	6,443,727
D12-8	766,264	6,441,160
D12-9	766,276	6,442,860
D12-10	766,548	6,440,352
D12-11	767,268	6,443,112
D12-12	767,324	6,442,270
D12-13	767,438	6,443,075
D12-14	767,614	6,442,820
D12-15	767,856	6,443,309
D12-16	768,076	6,443,334

Residence ID	Easting	Northing
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D12-18	768,326	6,442,034
D12-19	768,374	6,441,914
D12-20	768,793	6,444,903
D12-21	769,013	6,443,991
D12-22	769,786	6,444,587
D13-1	766,454	6,436,196
D13-2	766,505	6,439,870
D13-3	767,059	6,436,571
D13-4	767,104	6,436,627
D13-5	767,667	6,436,290
D13-6	767,721	6,436,001
D13-7	768,039	6,435,990
D13-8	768,118	6,437,797
D13-9	769,780	6,436,434
D13-10	769,815	6,435,656
D14-1	765,278	6,431,951
D14-2	765,347	6,431,575
D4-1	765,422	6,484,412
D4-2	765,727	6,484,644
D4-3	766,088	6,484,562
D4-4	766,362	6,484,106
D4-5	766,906	6,481,291
D4-6	768,370	6,481,475
D4-7	769,558	6,484,285
D4-8	769,576	6,484,342
D4-9	769,800	6,482,050
D6-1	769,184	6,472,228
D6-2	769,411	6,471,608
D6-3	769,414	6,471,866
D7-1	765,177	6,468,242
D7-2	767,488	6,468,138
D7-3	768,296	6,469,155
D7-4	768,469	6,469,763
D7-5	769,535	6,469,184
D7-6	769,644	6,469,327
D7-7	769,734	6,466,440
D8-4	769,927	6,463,730
D9-2	769,985	6,455,781
E1-1	773,391	6,496,054

Residence ID	Easting	Northing
E10-1	771,187	6,453,754
E10-2	771,623	6,450,598
E10-3	771,845	6,452,199
E10-4	771,874	6,452,975
E10-5	771,929	6,452,506
E11-1	770,139	6,449,472
E11-2	771,514	6,449,094
E11-3	771,545	6,449,122
E11-4	772,077	6,447,142
E11-5	772,087	6,445,815
E11-6	772,918	6,447,441
E11-7	772,943	6,448,492
E11-8	773,425	6,447,854
E11-9	773,560	6,447,498
E12-1	774,711	6,440,138
E12-2	774,714	6,440,068
E2-1	774,854	6,493,728
E3-2	774,634	6,485,402
E3-3	774,826	6,485,037
E4-1	773,390	6,484,129
E4-2	773,466	6,484,080
E4-3	773,492	6,484,278
E4-4	773,616	6,482,725
E4-5	774,406	6,484,563
E4-6	774,681	6,484,593
E5-1	773,065	6,475,200
E5-2	773,092	6,475,057
E5-3	774,485	6,478,428
E5-4	774,532	6,478,237
E5-5	774,556	6,478,244
E5-6	774,620	6,478,043
E6-1	771,386	6,473,570
E6-2	773,187	6,474,948
E7-1	770,093	6,466,051
E7-2	770,164	6,465,993
E8-1	770,133	6,464,104
E9-1	770,377	6,455,246
E9-3	771,809	6,455,318
E9-4	772,890	6,459,717
F11-1	777,113	6,448,701

Residence ID	Easting	Northing
F12-1	775,479	6,440,651
F12-2	775,637	6,444,355
F12-3	777,933	6,442,759
F2-1	775,382	6,493,341
F2-2	776,225	6,493,044
F2-3	776,258	6,492,638
F2-4	776,417	6,492,338
F2-5	776,525	6,492,461
F6-1	779,283	6,470,731
F6-2	779,289	6,470,778
F6-3	779,360	6,470,786
F6-4	779,804	6,470,050
F7-1	775,970	6,469,502
F7-2	776,035	6,469,752
F7-3	776,084	6,469,736
F7-4	776,870	6,467,660
F7-5	777,002	6,467,659
F7-6	777,255	6,468,058
F8-1	777,698	6,464,852
F9-1	775,364	6,456,611
F9-2	779,611	6,455,812
F9-3	779,714	6,455,866
F9-4	779,892	6,456,264
F9-5	779,898	6,456,207

Residence ID	Easting	Northing
F9-6	779,913	6,456,165
F9-7	779,942	6,456,248
G10-1	780,504	6,453,557
G10-2	780,694	6,453,578
G10-3	780,764	6,453,747
G10-4	780,852	6,453,776
G10-5	780,994	6,453,869
G10-7	781,115	6,453,948
G10-8	781,147	6,453,997
G2-1	780,254	6,492,574
G2-2	781,560	6,492,081
G2-3	781,848	6,491,865
G4-1	781,170	6,482,977
G6-1	781,085	6,470,560
G6-2	782,538	6,471,887
G6-3	783,765	6,473,517
G9-1	782,075	6,455,530
G9-2	782,098	6,456,061
G9-3	782,953	6,455,739
H6-1	785,415	6,474,126
H6-3	786,868	6,470,984
H7-1	785,125	6,465,108
H8-1	787,952	6,462,116
H9-1	785,676	6,459,623

Attachment 4 – Turbine Coordinates

Turbine ID	Easting	Northing	AHD
C3-1	764,267	6,485,655	858
C3-2	764,424	6,485,998	880
C3-3	764,606	6,486,331	902
C3-4	764,734	6,486,809	940
C5-1	764,362	6,474,877	870
C5-2	764,716	6,476,944	850
C5-3	764,609	6,475,171	850
C6-4	763,962	6,473,880	825
C6-5	763,851	6,473,510	816
C6-6	763,858	6,474,324	842
C6-7	764,167	6,474,538	846
D2-1	768,529	6,489,772	1020
D2-2	768,577	6,490,200	1040
D2-3	768,774	6,490,528	1040
D2-4	769,109	6,490,703	1060
D2-5	769,193	6,491,105	1069
D2-7	769,725	6,489,975	1036
D2-8	769,873	6,490,338	1040
D3-10	767,316	6,488,442	879
D3-11	767,619	6,488,667	940
D3-12	767,905	6,488,924	940
D3-13	768,103	6,489,262	940
D3-15	768,071	6,489,664	961
D3-16	768,706	6,485,319	777
D3-17	768,942	6,485,623	780
D3-18	769,077	6,486,050	799
D3-2	765,070	6,486,992	918
D3-20	769,364	6,486,587	800
D3-3	765,517	6,487,338	919
D3-4	765,671	6,486,432	900
D3-5	765,928	6,487,403	960
D3-6	766,153	6,486,914	920
D3-7	766,371	6,487,494	949
D3-8	766,621	6,487,807	878
D3-9	767,004	6,488,042	872
D4-1	767,243	6,482,687	711
D4-2	767,611	6,482,866	770
D4-4	767,804	6,483,810	790

Turbine ID	Easting	Northing	AHD
D4-5	767,868	6,483,146	780
D4-6	768,013	6,484,128	763
D4-8	768,340	6,484,770	780
D5-1	764,872	6,475,454	850
D5-10	766,415	6,476,470	950
D5-11	766,603	6,476,812	913
D5-12	767,367	6,475,892	848
D5-13	767,143	6,477,146	869
D5-14	767,808	6,474,713	840
D5-15	767,303	6,477,485	878
D5-16	767,320	6,478,205	866
D5-17	768,108	6,477,995	890
D5-18	767,644	6,477,650	879
D5-19	768,151	6,478,599	883
D5-2	765,079	6,475,815	851
D5-21	768,879	6,478,264	880
D5-22	768,975	6,478,651	888
D5-23	769,784	6,478,362	889
D5-3	765,379	6,476,318	914
D5-4	765,798	6,474,962	891
D5-5	765,881	6,475,371	890
D5-6	766,101	6,475,679	930
D5-7	765,853	6,476,132	933
D5-8	766,284	6,477,441	870
D5-9	766,371	6,476,094	942
D6-1	765,620	6,474,610	840
D6-10	767,421	6,474,554	839
D6-11	765,461	6,474,258	788
D6-2	766,913	6,471,836	729
D6-3	766,934	6,471,367	728
D6-4	767,127	6,472,425	732
D6-5	767,243	6,472,045	731
D6-6	767,271	6,472,790	755
D6-7	767,361	6,473,248	770
D6-8	767,356	6,473,655	780
D6-9	767,419	6,474,100	781
E2-3	770,714	6,490,065	1049
E2-4	770,774	6,490,770	1059

Turbine ID	Easting	Northing	AHD
E2-5	771,102	6,490,217	1032
E3-10	771,597	6,487,787	920
E3-11	771,893	6,488,024	980
E3-12	772,155	6,488,316	1000
E3-13	772,519	6,488,535	1000
E3-14	772,795	6,488,857	980
E3-15	772,771	6,489,554	1002
E3-16	773,462	6,488,920	980
E3-17	773,523	6,489,630	1040
E3-18	772,809	6,490,126	1003
E3-19	773,547	6,488,078	940
E3-20	773,313	6,487,417	978
E3-21	773,094	6,487,107	979
E3-22	772,491	6,487,064	972
E3-23	772,199	6,486,798	980
E3-24	772,073	6,486,348	960
E3-25	772,026	6,485,906	940
E3-26	773,631	6,486,533	960
E3-27	773,174	6,486,241	960
E3-28	772,938	6,485,936	960
E3-29	772,768	6,485,595	898
E3-30	772,611	6,485,236	860
E3-4	770,832	6,485,440	815
E3-5	770,876	6,487,368	846
E3-6	771,061	6,485,729	880
E3-7	771,164	6,487,616	899
E3-8	771,289	6,486,039	860
E4-1	772,157	6,480,467	910
E4-10	774,793	6,481,632	902
E4-11	771,536	6,484,335	800
E4-12	772,157	6,484,436	840
E4-2	772,939	6,480,332	920
E4-3	773,216	6,480,602	924
E4-5	773,621	6,480,883	917
E4-7	774,529	6,481,346	910
E4-8	774,691	6,480,596	920
E5-1	770,127	6,476,095	863
E5-10	771,190	6,477,293	917
E5-11	771,379	6,477,732	889
E5-12	771,399	6,478,445	889

Turbine ID	Easting	Northing	AHD
E5-13	771,407	6,475,263	805
E5-14	771,566	6,475,625	845
E5-15	771,718	6,478,669	888
E5-17	771,777	6,475,943	880
E5-18	771,935	6,479,013	898
E5-19	771,956	6,476,318	912
E5-2	770,076	6,478,547	890
E5-20	772,028	6,476,797	920
E5-21	772,056	6,479,383	897
E5-23	772,438	6,479,983	892
E5-24	772,999	6,479,156	880
E5-26	772,920	6,478,645	890
E5-3	770,307	6,475,342	799
E5-4	770,314	6,476,427	901
E5-6	770,565	6,476,714	910
E5-7	770,391	6,478,774	900
E5-8	771,190	6,476,835	916
E6-1	771,426	6,470,084	727
E6-10	772,837	6,472,109	780
E6-11	772,835	6,470,561	750
E6-13	773,075	6,472,419	780
E6-14	773,408	6,471,305	779
E6-17	773,994	6,472,394	780
E6-18	774,197	6,472,718	770
E6-2	771,559	6,470,459	734
E6-20	774,309	6,473,134	780
E6-21	774,422	6,473,676	780
E6-22	774,655	6,474,088	789
E6-24	774,874	6,474,745	810
E6-25	770,232	6,474,872	770
E6-4	771,949	6,470,953	760
E6-5	772,167	6,471,265	770
E6-7	772,707	6,470,195	732
E6-9	772,689	6,471,761	793
E7-6	774,748	6,467,705	660
E7-7	774,913	6,468,081	660
E7-8	774,999	6,468,488	649
F3-10	776,773	6,485,385	960
F3-11	777,019	6,485,678	980
F3-12	777,148	6,488,678	1004

Turbine ID	Easting	Northing	AHD
F3-14	777,496	6,488,887	1037
F3-18	777,646	6,487,456	1040
F3-19	777,710	6,485,668	1004
F3-24	778,247	6,486,603	1080
F3-25	778,198	6,488,290	1048
F3-27	778,566	6,485,399	1019
F3-28	778,673	6,485,773	1024
F3-29	778,726	6,488,547	1072
F3-3	776,102	6,486,364	920
F3-35	779,706	6,486,038	1020
F3-37	779,894	6,486,420	1080
F3-4	776,009	6,485,046	860
F3-5	776,352	6,486,655	902
F3-6	776,415	6,485,184	880
F3-7	776,484	6,487,872	920
F3-8	776,788	6,488,401	964
F4-10	777,151	6,481,564	928
F4-12	776,663	6,480,221	896
F4-14	777,770	6,483,715	920
F4-2	775,083	6,481,896	906
F4-22	779,135	6,484,253	940
F4-24	779,511	6,479,984	950
F4-25	779,625	6,480,335	950
F4-26	779,634	6,484,412	1000
F4-28	779,809	6,480,692	946
F4-29	779,960	6,481,127	979
F4-3	775,463	6,482,426	910
F4-31	778,650	6,484,175	911
F4-33	775,913	6,483,306	905
F4-34	776,709	6,483,257	930
F4-4	775,685	6,482,767	900
F4-5	776,474	6,482,738	920
F4-7	776,704	6,480,627	930
F4-8	776,875	6,481,267	930
F4-9	777,331	6,483,435	939
F5-1	775,203	6,475,050	770
F5-10	776,862	6,477,556	908
F5-14	777,048	6,477,913	920
F5-15	777,023	6,475,273	830
F5-16	777,032	6,478,516	920

Turbine ID	Easting	Northing	AHD
F5-17	777,294	6,475,612	820
F5-18	777,199	6,478,879	920
F5-19	777,534	6,476,242	830
F5-2	775,234	6,475,426	780
F5-20	777,322	6,479,313	909
F5-24	777,743	6,476,858	890
F5-25	777,922	6,477,194	871
F5-26	778,065	6,477,548	847
F5-27	778,687	6,479,123	905
F5-29	779,012	6,479,376	917
F5-7	776,086	6,476,221	830
F5-8	776,274	6,476,641	867
F5-9	776,583	6,476,889	844
F6-10	776,175	6,473,575	780
F6-11	776,408	6,473,879	780
F6-12	776,572	6,474,450	810
F6-13	776,727	6,474,836	820
F6-14	777,417	6,470,211	666
F6-7	776,059	6,472,837	760
F7-1	776,773	6,469,273	642
F7-2	776,986	6,469,585	670
F7-3	777,188	6,469,907	670
F8-1	777,133	6,460,050	650
F8-10	779,953	6,463,534	640
F8-2	777,290	6,460,358	649
F8-3	777,514	6,460,741	640
F8-4	777,725	6,461,179	630
F8-6	777,849	6,461,730	627
F8-7	777,904	6,462,206	630
F8-8	778,103	6,462,544	620
F8-9	779,629	6,463,172	640
F9-1	776,846	6,459,250	628
F9-2	777,031	6,459,541	640
F9-3	777,425	6,457,733	610
F9-4	777,662	6,457,241	600
F9-5	777,890	6,459,054	640
F9-6	778,329	6,458,606	640
G4-2	780,169	6,481,590	1007
G4-3	780,212	6,484,775	1000
G4-4	780,494	6,481,880	1009

Turbine ID	Easting	Northing	AHD
G4-5	780,657	6,482,236	1010
G5-10	782,252	6,478,146	880
G5-12	782,644	6,478,708	880
G5-4	781,047	6,476,314	780
G5-6	781,337	6,477,178	870
G5-8	781,690	6,477,602	864
G5-9	781,943	6,477,891	880
G6-3	780,682	6,472,379	735
G6-4	781,163	6,473,079	840
G6-6	781,283	6,473,492	850
G6-7	781,492	6,473,813	858
G7-1	780,312	6,467,072	740
G7-10	783,615	6,468,558	770
G7-11	784,103	6,468,825	780
G7-12	784,240	6,468,049	730
G7-14	784,066	6,467,762	711
G7-15	784,426	6,469,246	763
G7-16	784,471	6,469,700	772
G7-2	780,477	6,467,375	740
G7-3	780,675	6,467,650	740
G7-4	780,934	6,468,523	757
G7-6	781,209	6,468,977	767
G7-7	781,448	6,468,539	761
G7-8	781,481	6,469,214	780
G7-9	781,848	6,469,371	761
G8-1	780,148	6,463,809	636
G8-10	780,769	6,462,832	646
G8-11	781,000	6,463,107	659
G8-12	781,295	6,463,343	660
G8-14	781,493	6,463,939	671
G8-15	781,972	6,464,084	679
G8-16	782,137	6,461,473	640
G8-17	782,273	6,459,982	582
G8-18	782,275	6,460,354	590
G8-19	782,430	6,461,682	650
G8-2	780,277	6,460,830	638
G8-20	782,552	6,462,222	650
G8-21	782,790	6,462,499	651
G8-22	783,015	6,462,789	652
G8-23	783,485	6,463,093	661
G8-24	783,709	6,463,358	669
G8-25	783,351	6,463,802	661
G8-26	783,736	6,462,401	650
G8-27	783,974	6,463,734	661
G8-3	780,383	6,460,362	630
G8-4	780,486	6,461,281	640
G8-5	780,490	6,461,838	634
G8-6	780,584	6,462,549	641
G8-7	780,542	6,462,189	640
G8-9	782,495	6,460,832	570
G9-28	780,253	6,460,030	603
G9-29	780,247	6,459,465	610

Attachment 5 – Letter Confirming Part 3A Position

Attachment 6 – Director General's Requirements and Supplementary Director General's Requirements

Attachment 7 – Project Consultation Plan

Attachment 8 – Consultation Material

Appendix A – Landscape and Visual Assessment

Appendix B – Noise Assessment

Appendix C – Biodiversity Assessment

Appendix D – Aboriginal and European Heritage

Appendix E – Traffic and Transport Assessment

Appendix F – Telecommunications Impact Assessment

Appendix G – Decommissioning and Rehabilitation Plan

Appendix H - Addressing the Terms of Reference (TOR) for Matters of National Environmental Significance (MNES) for the proposed Liverpool Range Wind Farm and Transmission Line