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1. EXECUTIVE SUMMARY

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared by nghenvironmental on behalf of Silverton Wind Farm Developments Pty Ltd (the Proponent) to assess the potential environmental impacts associated with the development of a wind farm north of Silverton, in western New South Wales. The Silverton Wind Farm would be developed by Silverton Wind Farm Developments Pty Ltd, a special purpose vehicle created for a joint venture development of the Proposal between Epuron and Macquarie Capital.

The Proposal is to be assessed as a Part 3A Major Project, under the NSW Environmental Planning and Assessment Act 1979. The Proposal is considered Critical Infrastructure under this Act as it is a power generator with capacity to generate in excess of 250 megawatts. The proponent is seeking project approval for the construction and operation of works associated with Stage 1 of the proposed development and concept approval for all construction and operational works associated with Stage 2.

This assessment:

- Describes the proposed wind farm
- Identifies statutory assessment and approval requirements in relation to the Proposal
- Identifies and assesses the environmental impacts of the Proposal, with a focus on key issues identified by stakeholders (including the Department of Planning, local and state government agencies and the local community)
- Identifies measures to manage risks and avoid or mitigate potential impacts.

1.2 PROPOSAL OUTLINE

The Proposal would involve the construction and operation of a large-scale wind farm in the western region of NSW. The Proposal includes:

- Up to 598 wind turbines, each with three blades mounted on a tubular steel tower and a generator transformer inside or adjacent to each tower
- Electrical connections between wind turbines and the site substations using a combination of underground cable and overhead concrete, timber or steel pole power lines
- Site substations to convert from reticulation voltages (22–66kV) to medium voltages (66–220kV) for connection with the transmission switchyard
- An onsite transmission switchyard that includes high voltage transformers and switchgear for connecting the output of the wind farm to offsite transmission lines
- A new 24km transmission line connecting the transmission switchyard with TransGrid's existing Broken Hill substation (20km off site)
- A new 305km transmission line connecting the transmission switchyard with SP-Ausnet's existing Red Cliffs substation in Victoria (301km off site)
- Onsite control and maintenance buildings, including storage facilities for equipment, materials and spares and workers facilities building
- Internal access tracks, hardstand areas and other associated infrastructure required for the construction, installation and maintenance of the wind farm
- Minor upgrades to site access via the Silverton Road, Eldee Station Road and Daydream Mine Road.

Additional temporary construction infrastructure would be required during the construction and refurbishment or decommissioning phases.

A number of wind turbines are currently under consideration for the site. In general, different characteristics of turbine types require different turbine layouts. For the purpose of this EA, one turbine layout has been proposed, which shows both the Stage 1 and Stage 2 works areas.

This Proposal provides flexibility to incorporate detailed design and environmental constraints in the final location of equipment. The final turbine selection would be determined following a competitive tender process pending project approval.

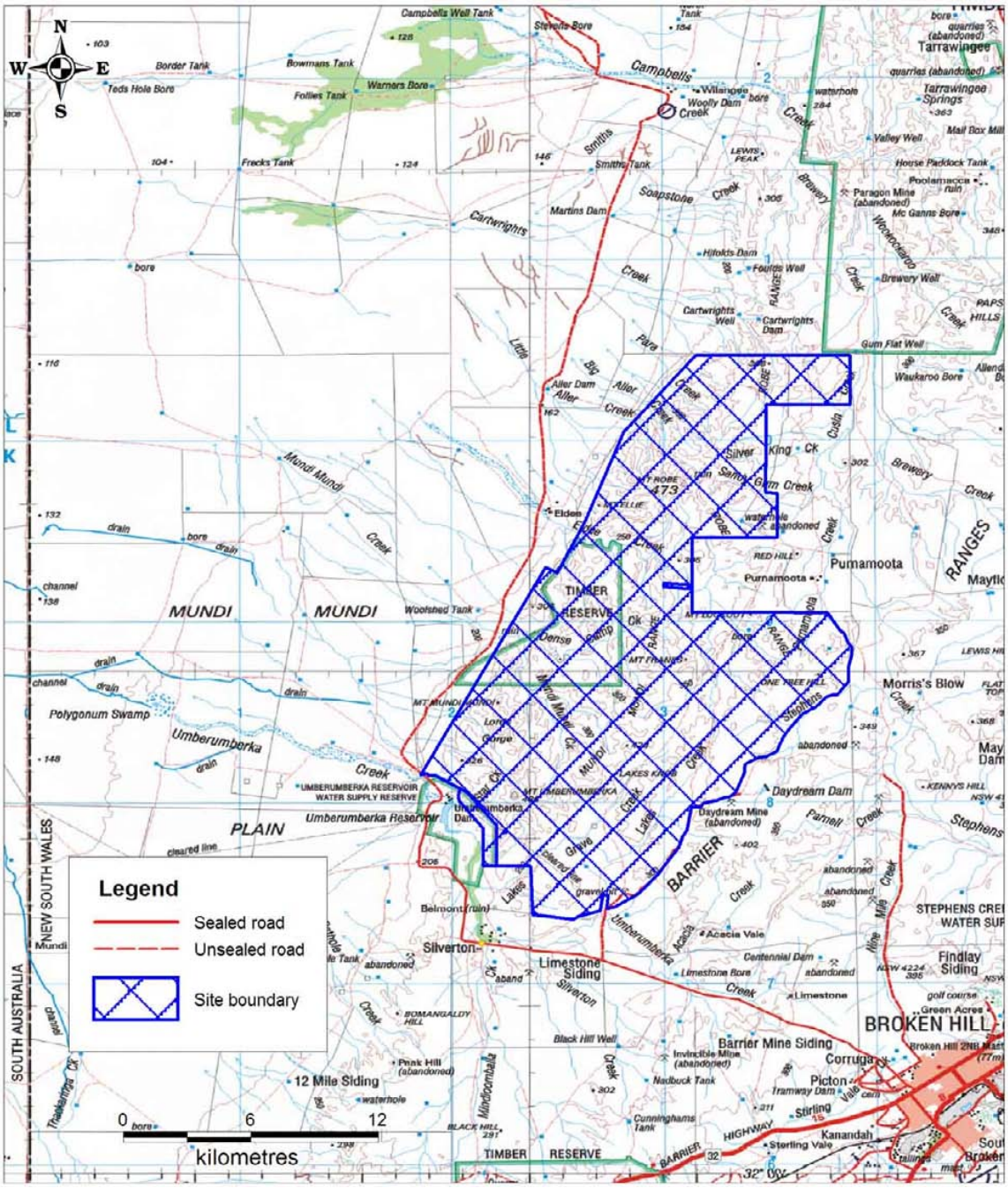

Figure 1.1 Site location shown in blue cross-hatching

Project benefits

Silverton Wind Farm Developments is committed to developing the Silverton Wind Farm in a way that minimises adverse local impacts and maximises the benefits of the Proposal to the local community and broader population.

The Proposal would reduce the current dependency on the consumption of fossils fuels for electricity and would therefore reduce the impacts of climate change resulting from the emission of greenhouse gases. Within the electricity sector in NSW, approximately 90 per cent of electricity is generated by fossil fuel power stations, primarily coal-fired power stations. Greenhouse gas emissions from electricity generation in New South Wales grew by 44 per cent between 1990 and 2002 (NSW Government 2004).

Based on a 598 turbine layout, the Proposal would offer the following broad benefits:

- Production of approximately 3,500,000 MWh of renewable electricity per annum, sufficient for the average consumption of around 437,500 homes
- Reduction in greenhouse gas emissions of approximately 3.5 million tonnes of carbon dioxide (equivalent) per annum, the equivalent of taking 700,000 cars off our roads
- Savings in water consumption of approximately 4,600 million litres per annum of potable water (this is the amount of water required to produce the same amount of electricity from coal-fired power stations)
- Annual savings in pollution from coal-fired power stations of up to 18,760 tonnes of sulphur dioxide, 8,365 tonnes of nitrogen oxides and 535,000 kilograms of particulates
- Establishment of a community fund to assist in funding community and environmental projects that provide benefits to the Silverton community
- Improvement in local infrastructure in the Silverton area
- Protection and improved management of sensitive local biodiversity including the tawny rock dragon and a previously unrecorded spinifex ecological community creating biodiversity benefits on site
- Provision of 3,988 full time equivalent (FTE) regional jobs and injection of approximately $701 million into the regional economy
- Improved security of electricity supply through diversification.

The Silverton Wind Farm if installed today would be the largest wind farm operating anywhere in the world. It is an infrastructure investment providing a level of renewable energy production on par with the massive Snowy Hydro Scheme. The Silverton Wind Farm is a landmark Proposal which clearly demonstrates the future of energy supply in Australia and around the world – it is the coming of age of the renewable energy industry in Australia.

1.3 COMMUNITY SUPPORT AND CONSULTATION

Studies throughout NSW have shown that residents are concerned about global warming and are aware of the alternatives available. The studies have illustrated that respondents understand what a wind turbine is and how wind farms appear in the landscape. Respondents in surveys are generally supportive of wind farms. Moreover when it comes to the location of wind farms, respondents support having wind farms in their immediate locality and a majority would still approve of a wind farm within one kilometre of their home.

Community consultation in the Broken Hill area shows there is widespread community support for the Proposal and strong interest from businesses and industry locally. Consultation with neighbours and local residents of the Silverton Wind Farm site has identified key issues and concerns of the local community. Results of a questionnaire indicate the top three issues in order of priority to be: visual impact, flora and fauna, and construction and operational noise levels. These and other issues identified by the local community are addressed in this EA, together with a specific section evaluating impacts on community wellbeing. A secret ballot held by the Silverton Village Committee revealed that a strong majority of Silverton residents were in favour of the development.

1.4 OUTLINE OF ASSESSMENT

Key issues were identified in consultation with stakeholders (including the community, local councils, agency representatives and the consent authority) and formalised in the Director-General's Requirements for the preparation of the Environmental Assessment. Investigation of these issues forms the major part of this Environmental Assessment. These issues were investigated via specialist reports and by desktop assessment.

Specialist investigations were carried out in the key areas of:

- Visual impacts
- Noise impacts
- Biodiversity impacts
- Indigenous heritage impacts
- Non indigenous heritage impacts
- Aviation hazard impacts
- Communication impacts
- Socio-economic impacts
- Traffic and transport impacts

These investigations are appended to the EA in full and are summarised in the body of the EA. They characterise the potential visual, noise, indigenous and non indigenous heritage, biodiversity, socio-economic and traffic and transport impacts of the Proposal and outline mitigation measures required to accompany the Proposal to manage the identified impacts.

Additional issues were considered by desktop assessment and consultation. These included:

- Electromagnetic fields (EMFs)
- Hydrological impacts
- Cumulative impacts
- Lifestyle impacts
- Farming and grazing impacts
- Resource impacts
- Film and art
- Fire and bushfire impacts
- Mineral exploration impacts
- Community wellbeing
- Tourism impacts
- Health and safety impacts
- Physical impacts
- Land value

The desktop assessments and consultation undertaken indicate that potential impacts are manageable with the implementation of specific mitigation measures.

1.5 RESULTS OF ASSESSMENT

For all impacts identified in this assessment, mitigation strategies have been developed and incorporated in the planning and design of the Proposal and in binding commitments made by the Proponent and outlined in this report.

No impacts were identified which, after these mitigation strategies have been implemented, are considered unacceptable impacts. The overall environmental, economic and social benefits of this Proposal are considered to outweigh the mitigated impacts identified.

The results of the assessments are provided in the body of this report, with the specialist reports in full included in the appendices. The following issues are highlighted due to their significance:

Visual

- The wind farm would be viewed from a number of surrounding view locations, including a small number of residences, lookouts and road corridors. A total of 55 view locations were assessed, however the larger part of the landscape surrounding the proposed wind farm comprises a generally unoccupied semi desert landscape
- The wind farm would have an overall moderate impact on the surrounding landscape character
- The wind farm would have an overall moderate visual impact on people travelling through, visiting and residing in areas surrounding the Proposal. The visual assessment identified a very small number of view locations that may have a high visual impact
- This potential visual experience of individuals residing in proximity to, or visiting the local area of the proposed wind farm could be either positive or negative depending on the personal opinions of the viewer. Research carried out in Australia and overseas suggests that the majority of people visiting or residing close to wind farms do not believe that wind turbines are a negative feature in the landscape and are unlikely to negatively impact tourism
- Development of the transmission line between Broken Hill and Red Cliffs would have a low cumulative impact on the landscape character and a low cumulative impact on people travelling through and residing along the route of the transmission line
- The transmission lines between the wind farm and Broken Hill would have an overall low impact on the surrounding landscape character and low visual impact.

Noise

- Construction noise is manageable with the implementation of mitigation measures
- Operational noise modelling indicated that compliance with the relevant noise criteria can be achieved using the layout and the turbines proposed
- Additional noise modelling of the final layout based on the turbine selected will be carried out to confirm relevant noise criteria are likely to be met.

Biodiversity

- No threatened plant species or Endangered Ecological Communities (EECs) were identified within areas that would be affected by Stage 1 works
- While it is not listed as an EEC, the occurrence of porcupine grass/red mallee/gum coolibah/hummock grassland/low sparse woodland on site is considered to be significant and has been treated as a constraint in the layout proposed
- The EEC *Acacia loderi* shrublands may occur within the Stage 2 wind farm envelope and would require further field surveys

- The transmission line to Red Cliffs features two EECs: *Acacia loderi* shrublands (approximately 1.8 per cent of the transmission route) and Sandhill pine woodland (listed under a Preliminary Determination). One threatened species, bitter quandong (*Santalum murrayanum*), was observed. Mitigation strategies have been developed for these areas
- Eight threatened fauna species were identified within the Stage1 wind farm site: pied honeyeater, painted honeyeater, redthroat, pink cockatoo, little pied bat, slender mallee blue-tongue lizard, marble-headed snake-lizard and tawny rock dragon and appropriate mitigation is incorporated into the turbine layout
- Constraints mapping was prepared concurrent with Proposal site planning to minimise impacts on areas with high conservation values for Stage 1 and the Broken Hill transmission line
- The final site layout has been assessed to minimise biodiversity impacts. Mitigation measures centre on avoiding or minimising impacts to the identified constraints, implementing weed, sediment/erosion and feral goat controls, considering the design of all infrastructure to minimise potential for collisions, design and implementation of an adaptive management monitoring program to monitor collision impacts
- Significant biodiversity benefits will arise from the establishment of a goat management program which is included as part of this Proposal. This will substantially reduce the existing impacts of goats on sensitive vegetation on the site. For example, the area of vegetation to be removed as a consequence of the development of the stage one area of the wind farm (82.7Ha) would be offset by the implementation of a goat management program over the stage one area site (4,918.4Ha). This would ensure that statutory requirements to improve or maintain the environmental values of the site are achieved
- Further detailed biodiversity assessment would be undertaken for Stage 2 and for the Red Cliffs transmission line.

Indigenous heritage

- The field survey and assessment was undertaken in partnership with Broken Hill Local Aboriginal Land Council (BHLALC)
- Aboriginal objects in the form of stone artifacts were recorded in a number of locales
- The survey identified that the Stage 1 area contained an extensive distribution of aboriginal objects
- The majority of recorded sites in the proposal area are low or very low density stone artifact distributions, assessed to be of low archaeological significance. In addition, a number of Aboriginal object locales have been identified which are assessed to be of low/moderate, moderate or high archaeological significance
- Aboriginal object locales assessed to be of moderate or high significance with mitigation recommended have relevant mitigation stated in the draft Statement of Commitments.

Non indigenous heritage

- Non indigenous heritage items were identified at a number of locations
- Impacts associated with construction and decommissioning of the proposed turbines range from increased traffic levels through to ground disturbance in discrete locations
- Research has revealed that there is high potential for historical features associated with mining and pastoral activities for the area covering Stage 2 of the wind farm site
- Direct impacts can be avoided to all heritage items within the proposal area and specific measures are included in the Draft Statement of Commitments.

Economic benefits

- The Proposal would provide 3,988 FTE jobs and inject up to $701 million into the regional Australian economy and approximately $60 to 90 million into the local economy
- The Proposal would provide a community fund for local community and environmental projects

— More localised community economic benefits include the offer by the Proponent to provide solar water heating and solar powered electricity in line with government grants, at no cost to residents of Silverton.

Renewable energy generation

— The Proposal would generate approximately 3,500,000 MWh of renewable electricity per annum, sufficient for the average consumption of approximately 437,500 NSW homes

— Reduction in greenhouse gas emissions of approximately 3.5 million tonnes of carbon dioxide (equivalent) per annum, the equivalent of taking 700,000 cars off our roads

— Savings in water consumption of approximately 4,600 million litres per annum of potable water (this is the amount of water required to produce the same amount of electricity from coal-fired power stations)

— Annual savings in pollution from coal-fired power stations of up to 18,760 tonnes of sulphur dioxide, 8,365 tonnes of nitrogen oxides and 535,000 kilograms of particulates.

1.6 ENVIRONMENTAL MANAGEMENT AND IMPACT MITIGATION

This Environmental Assessment includes the proposed methods of mitigating potential adverse impacts of the Proposal. These specific mitigation measures are included in a draft *Statement of Commitments* which is attached to this EA and to which the Proponent would commit if the Proposal is approved for development.

Environmental management principles that would be applied during the construction, operation and decommissioning of the Proposal are outlined in this Environmental Assessment.

The implementation of all mitigation measures would be by way of a Project Environmental Management Plan (PEMP), comprising a Construction Environmental Management Plan (CEMP) and an Operation Environmental Management Plan (OEMP). The PEMP would include performance indicators, timeframes, implementation and reporting responsibilities, communications protocols, a monitoring program, auditing and review arrangements, emergency responses, induction and training and complaint/dispute resolution procedures. The monitoring program would clearly identify any residual impacts after mitigation. Adaptive management would ensure that improvements were consolidated in the updated environmental management plans.

1.7 CONCLUSION

This Environmental Assessment (EA) documents the likely and potential environmental, social and economic impacts that may result from the proposed Silverton Wind Farm.

The Proposal has sought to balance the opportunities presented by the site with the constraints revealed by the studies undertaken. The Proponent is committed to realising a development which provides a clear net community benefit.

The Proposal has incorporated the environmental constraints identified in an iterative manner throughout the project design to ensure adverse impacts are minimised and benefits are maximised. The Proposal incorporates measures to proactively address identified environmental risks throughout the construction, operation and decommissioning of the wind farm. These measures would be incorporated in a Project Environmental Management Plan and its associated Construction and Operation Environmental Management Plans.

Benefits of the Proposal have been identified at the global, regional and local scale. While operational, the Proposal would provide a greenhouse gas emission-free source of locally generated electricity. Approximately 3,500,000 MWh of energy would be produced (sufficient for the average consumption of up to 437,500 homes), resulting in a greenhouse gas emission reduction of approximately 3.5 million tonnes of carbon dioxide (equivalent) per annum, the equivalent of taking 700,000 cars off the road.

The Proposal would directly address a New South Wales listed Key Threatening Process, Anthropogenic Climate Change, by reducing the proportion of the electricity demand supplied by burning fossil fuels.

This provides additional benefits to water use and pollution generation that accompany coal-fired power generation. Furthermore, the impacts of human-induced climate change are particularly relevant in Australian agricultural production environments, lending support to the appropriateness of the development for the region.

On balance the local and global environmental, economic and social benefits of the Proposal are considered to outweigh residual adverse impacts identified on or near the site.

The Proponent is committed to ensuring the measures developed in this Proposal are best practice and is committed to working with stakeholders to ensure the best possible result is achieved for the Silverton Wind Farm site. This not only has immediate benefits for the site and locality that would house the wind farm; it would also set a high standard for the development of wind energy resources in the state and the country.

2. INTRODUCTION

2.1 ABOUT THIS REPORT

This Environmental Assessment has been prepared by nghenvironmental on behalf of Silverton Wind Farm Developments Pty Ltd to assess the potential environmental, social and economic impacts associated with the Silverton Wind Farm.

This Environmental Assessment (EA):

- Describes the proposed wind farm
- Outlines the benefits of the wind farm Proposal
- Identifies statutory assessment and approval requirements in relation to the Proposal
- Identifies and assesses the environmental impacts of the Proposal, with a focus on key issues identified by key stakeholders
- Identifies measures to avoid or mitigate potential impacts and manage risks.

The EA draws together a number of specialist studies undertaken to assess the Proposal, covering visual, noise, traffic, indigenous and non indigenous heritage, biodiversity (flora and fauna) and economic impacts. The findings of these studies have been incorporated into the EA, with the specialist studies included as Appendices to this EA. Mitigation has been built into the design of the Proposal as well as the Statement of Commitments in Chapter 9.

The EA is intended to meet the assessment requirements of the Part 3A provisions of the *Environmental Planning and Assessment Act 1979* and the Major Projects State Environmental Planning Policy 2005. The Concept Approval Application was lodged with the NSW Department of Planning (DoP) for the Proposal in 2007. Since this time, the completion of specialist studies and further investigation has led to several Proposal modifications. The Proposal as described in this EA supersedes the description in the Concept Approval Application.

Broadly speaking, the development can be separated into four components:

- Site area – Stage 1
  (Stage 1 turbine locations and all related construction, operation and maintenance infrastructure including site access)
- Site area – Stage 2
  (All remaining turbine locations and all related construction, operation and maintenance infrastructure including site access)
- Transmission line corridor – Site to Broken Hill (NSW) – Stage 1
  (Initial grid connection including 24km power line from Site to Broken Hill in NSW)
- Transmission line corridor – Site to Red Cliffs (Vic) – Stage 2
  (Final grid connection including 300km power line from Site to Red Cliffs in Victoria).

The proponent is seeking project approval for the construction and operation of works associated with Stage 1 of the proposed development and concept approval for all construction and operational works associated with Stage 2 including the transmission line from Broken Hill to Red Cliffs.

Following a declaration by the Minister for Planning on 27 February 2008, the Proposal would be considered Critical Infrastructure under the *Environmental Planning and Assessment Act 1979* as it has the capacity to generate in excess of 250 megawatts. The designation follows an assessment of the power generation needs of NSW.

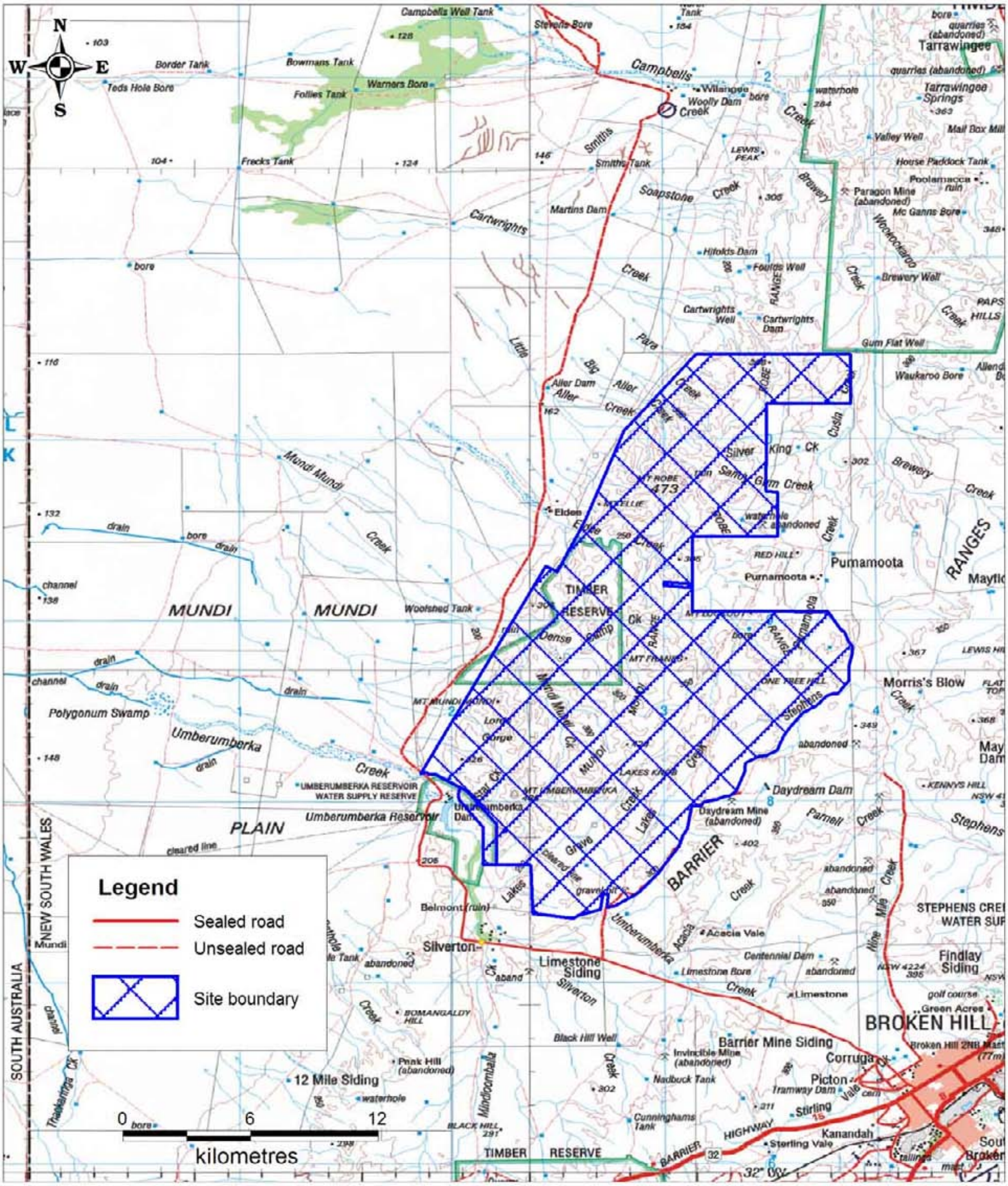

Figure 2.1 Site location shown in blue cross-hatching

2.2 OVERVIEW OF THE PLANNING PROCESS

The *Environmental Planning and Assessment Act 1979* (EP&A Act) is the primary statute for environmental planning and development control in NSW. The EP&A Act establishes three principal types of statutory planning instruments: State Environmental Planning Policies (SEPP), Regional Environmental Plans (REP) and Local Environmental Plans (LEP).

Part 3A of the *EP&A Act 1979* came into force on 1 August 2005. Part 3A integrates the assessment and approval regime for all Major Projects that need the approval of the Minister for Planning, previously dealt with by Parts 4 and 5 of the EP&A Act. The associated State Environmental Planning Policy (Major Projects) 2005 defines wind power developments with a capital cost of $30 million or more as Major Projects. The proposed Silverton Wind Farm would have a capital cost in excess of $30 million and would therefore be considered a Major Project under Part 3A.

Under Part 3A, the Minister may authorise the Proponent to apply for an approval of a concept plan for a project. In addition, a single application may be made for approval of a concept plan and approval to carry out any part or aspect of the project. For more complex projects, DoP convenes a Planning Focus Meeting of state agency and local government representatives to consider the scope and level of assessment of key issues. The Director-General of DoP then issues the Proponent with requirements for the Environmental Assessment, indicating the issues to be addressed, the level of assessment required and any consultation requirements. The Director-General's requirements may also require the Proponent to include a statement of the commitments to which the Proponent would commit to manage the environmental impacts of the Proposal.

After an Environmental Assessment has been prepared and accepted by the Director-General, the report is placed on public exhibition for at least 30 days during which time submissions from the community are accepted. Following the consultation period, the Director-General may require the Proponent to respond to the comments, revise the Proposal or revise the Statement of Commitments.

In relation to this Proposal, and consistent with Part 3A reforms, this Environmental Assessment report was preceded by an issues scoping exercise to identify and prioritise issues related to the Proposal.

On 14 and 15 November 2007, a Planning Focus Meeting was held onsite and attended by representatives from the NSW Department of Planning (DoP), Department of Environment and Climate Change, Department of Lands, Western Catchment Management Authority (CMA), Lower Murray Darling Catchment Management Authority (CMA) Department of Primary Industries (Minerals), Country Energy, NSW Roads and Traffic Authority (RTA), Broken Hill City Council, TransGrid, as well as representatives of the Proponent and **ngh**environmental.

The Major Project Application for the Proposal was lodged with the NSW Department of Planning (DoP) on 24 December 2007.

On 23 January 2008 the Minister for Planning authorised the submission of a concept plan and on 13 February 2008 the Director-General's Requirements were issued.

Following a declaration by the Minister for Planning on 27 February 2008, the Proposal would be considered Critical Infrastructure under the Environmental Planning and Assessment Act 1979 as it has the capacity to generate in excess of 250 megawatts.

2.3 THE PROPONENT

The Silverton Wind Farm would be developed by Silverton Wind Farm Developments Pty Ltd as a joint venture between Epuron and Macquarie Capital. Silverton Wind Farm Developments Pty Ltd is the joint venture special purpose vehicle created by the two companies for this development.

Epuron Pty Ltd (formerly Taurus Energy Pty Ltd) is a NSW-based renewable energy company established in 2002 primarily to develop wind energy projects in NSW. In 2005, Taurus Energy Pty Ltd became the Australian subsidiary of Epuron GmbH, a significant international group of companies that develop, finance, build and operate major renewable energy projects. Epuron is itself a subsidiary of Conergy AG, which is listed on the Frankfurt Stock Exchange in Germany.

Epuron and its principals have many years of experience in the development of renewable energy projects. In addition to this Proposal for the Silverton Wind Farm, Epuron has recently lodged a Development Application for the proposed Gullen Range wind farm near Goulburn. Epuron has previously gained development consent for three wind farm projects in NSW: one to the Snowy River Council (Snowy Plains wind farm, approved 2005) and two to the Department of Planning as Part 3A assessments (Cullerin wind farm and Conroy's Gap wind farm, Southern Tablelands of NSW, both approved 2007). Accordingly, Epuron is the most experienced wind farm developer in NSW. Epuron has a strong pipeline of new renewable energy projects in the early stages of development.

Macquarie Group Limited is a diversified international provider of banking, financial, advisory and investment services, headquartered in Sydney, Australia. In Australia and New Zealand, Macquarie is a market leader in investment and financial services. In Asia, Macquarie offers a full range of investment, financial market and advisory products and services and in Europe, the Middle East, Africa and the Americas, Macquarie focuses on particular business areas in which its expertise delivers value to clients. Macquarie has grown substantially since its beginnings in Australia in 1969, and more recently has reported successive years of record profits and growth since 1992. Macquarie now employs more than 13,500 people in 25 countries.

Macquarie Capital is one of the seven operating groups within Macquarie Group Limited. It includes corporate advisory, wholesale structuring, underwriting, specialist funds management, private equity, specialised equipment financing, institutional stockbroking and equities research capabilities.

The joint venture brings together Macquarie's strength and experience in financing and managing large-scale infrastructure and Epuron's expertise in wind power development.

2.4 REGIONAL CONTEXT OF THE PROPOSAL

The Silverton Wind Farm is proposed to be located in the Barrier Ranges, with its south western boundary approximately 3.5 kilometres north of Silverton and approximately 25 kilometres northwest of Broken Hill. The site boundary is approximately 20 kilometres from the South Australian border.

Site infrastructure (turbines, tracks, electrical connections, maintenance facilities etc) would be concentrated on the Mundi Mundi Range in the southern portion of the site and Mount Robe Range in the northern portion of the site. These ranges are made up of metamorphic and deformed sedimentary rocks that formed northeast and northwest trending ridges up to 300 metres above the level of the surrounding Mundi Mundi Plains (NSW DECC 2003). The proposed wind farm is located within the Broken Hill Complex Bioregion. This bioregion is located in the far west of NSW with the eastern portion located within the Murray-Darling Basin. The area of the proposed turbine site is currently managed by four lessees that hold leases issued for grazing by the NSW Department of Lands under the *Western Lands Act 1901*. These lessees currently graze a mixture of sheep and goats within their property boundaries.

Silverton is the nearest settlement. Silverton was established in 1880 as a mining town. The municipality was formed in 1886 but was subsequently taken off the NSW register in 1899, leaving the NSW State Government in administrative control of the town. With the discovery of the Broken Hill ore body, the majority of the residents of Silverton relocated to Broken Hill. Today Silverton has a population of 89 (ABS Census 2006) and is predominately a tourist town. It features art galleries, eateries and a number of other tourist attractions including the Silverton Hotel.

The nearest major town is Broken Hill, approximately 25 kilometres southeast of the turbine site. Broken Hill was founded in 1883 by Charles Rasp, with the municipality of Broken Hill incorporated in 1888 and declared a city in 1907 (BCC 2004). Broken Hill was historically a mining town buoyed by the discovery of the Broken Hill ore body (silver/lead). The economic significance of mining to the area decreased in the later part of the twentieth century. However, tourism and mining continue to be significant contributors to Broken Hill's economy and the legacy of mining continues to be a major attraction that drives the tourism industry.

The wind farm Proposal involves the installation of transmission lines between the wind farm site and Broken Hill, as well as from the wind farm site to Red Cliffs. The majority of the transmission line would be located in the Local Government Area of Wentworth, NSW with the remaining section of the transmission line in the unincorporated area. The Wentworth Shire is located within the Lower Murray-Darling Basin region in a semi-arid area. The LGA totals 26,170 square kilometres in area and has a population of 6,779 (ABS 2006). The landscape of the LGA is generally dry, however Australia's two longest rivers, the Murray and the Darling, maintain a dominant influence on the environment, economy, social life and culture (Wentworth 2004). Extensive dry land farming and grazing account for 96 per cent of the total land use within the Shire (Wentworth 2004).

The power line easement corridor is characterised by a number of farming and grazing properties owned by private land holders. A small section of the transmission route (<two kilometres) would be located in Victoria, within the Mildura Rural City Council LGA. Separate approval would be sought for works within Victoria.

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3. DESCRIPTION OF THE PROPOSAL

3.1 GENERAL DESCRIPTION

The Proposal would involve the construction and operation of a large-scale wind farm in the western region of NSW. The Proposal includes:

- Up to 598 wind turbines, each with three blades mounted on a tubular steel tower and a generator transformer inside or adjacent to each tower
- Electrical connections between wind turbines and the site substations using a combination of underground cable and overhead concrete or timber pole power lines
- Site substations to convert from reticulation voltages (22–66kV) to medium voltages (66–220kV) for connection with the transmission switchyard
- An onsite transmission switchyard that includes high voltage transformers and switchgear for connecting the output of the wind farm to offsite transmission lines
- A new 24 kilometre transmission line connecting the transmission switchyard with TransGrid's existing Broken Hill substation (20km offsite)
- A new 305 kilometre transmission line connecting the transmission switchyard with SP-Ausnet's existing Red Cliffs substation in Victoria (301 kilometre offsite)
- Onsite control and maintenance buildings, including storage facilities for equipment, materials and spares and workers facilities building
- Internal access tracks, hardstand areas and other associated infrastructure required for the construction, installation and maintenance of the wind farm
- Minor upgrades to site access via the Silverton Road, Eldee Station Road and Daydream Mine Road.

Additional temporary construction infrastructure would be required during the construction and refurbishment or decommissioning phases.

An initial wind turbine layout has been prepared for the site (Figure 3.5). A number of alternative wind turbines are being considered for the site. A list of wind turbines being contemplated is included in Table 3.1. The final wind turbine selection would be carried out through a competitive tender process pending development approval.

Project staging

This application defines the Proposal into two stages.

Stage 1 involves the construction of the first 120 wind turbines (Figure 3.6) and associated infrastructure. This stage includes the transmission switchyard and high voltage transmission line corridor from the site to Broken Hill. All environmental assessments have been completed in detail for this stage and the results are provided in this EA.

Stage 2 involves the staged construction of up to 478 additional wind turbines (Figure 3.5) and associated infrastructure. This stage includes expanding the transmission switchyard, constructing additional site substations and constructing the high voltage transmission line from site to Red Cliffs in Victoria. Final assessment of biodiversity, indigenous and non indigenous heritage impacts for this stage are ongoing. This EA provides a Statement of Commitments that explains how biodiversity and indigenous and non indigenous heritage impacts would be avoided, mitigated or managed for this stage.

Additional biodiversity and heritage assessment work is currently underway in portions of this Stage 2 area to complete the assessment of those portions to the standard required for full Project Approval. This work may be completed and submitted to the Department of Planning prior to determination of Stage 1, in which case the proponent may request the inclusion of these portions for determination at the same time as the determination of Stage 1 Project Approval.

The full description of the land on which the project is proposed is presented in Attachment 14.9.

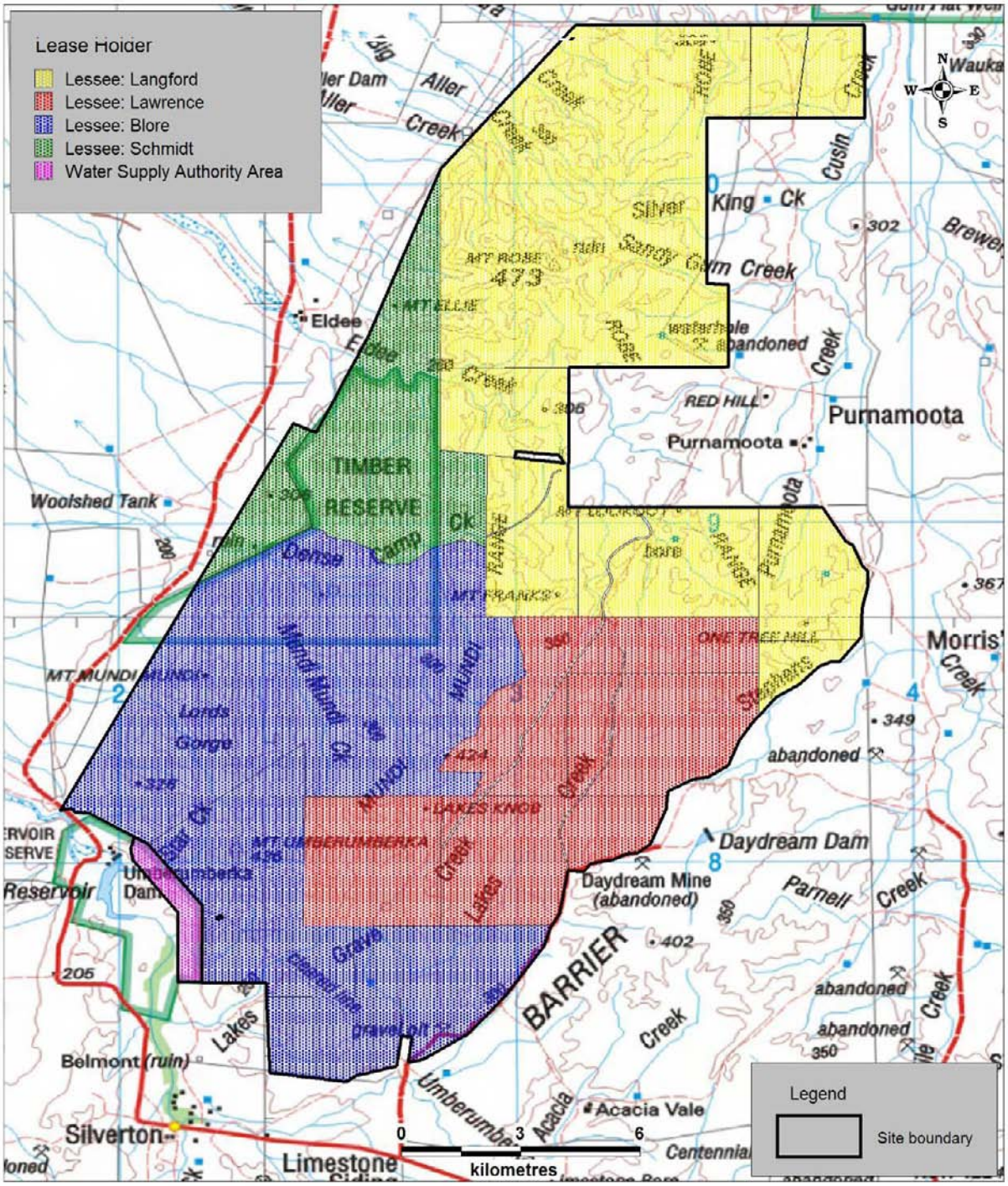


Figure 3.1 Site boundary and existing lease holdings

The majority of the site is currently held under four western lands leases. The site is entirely on land owned by the Crown.

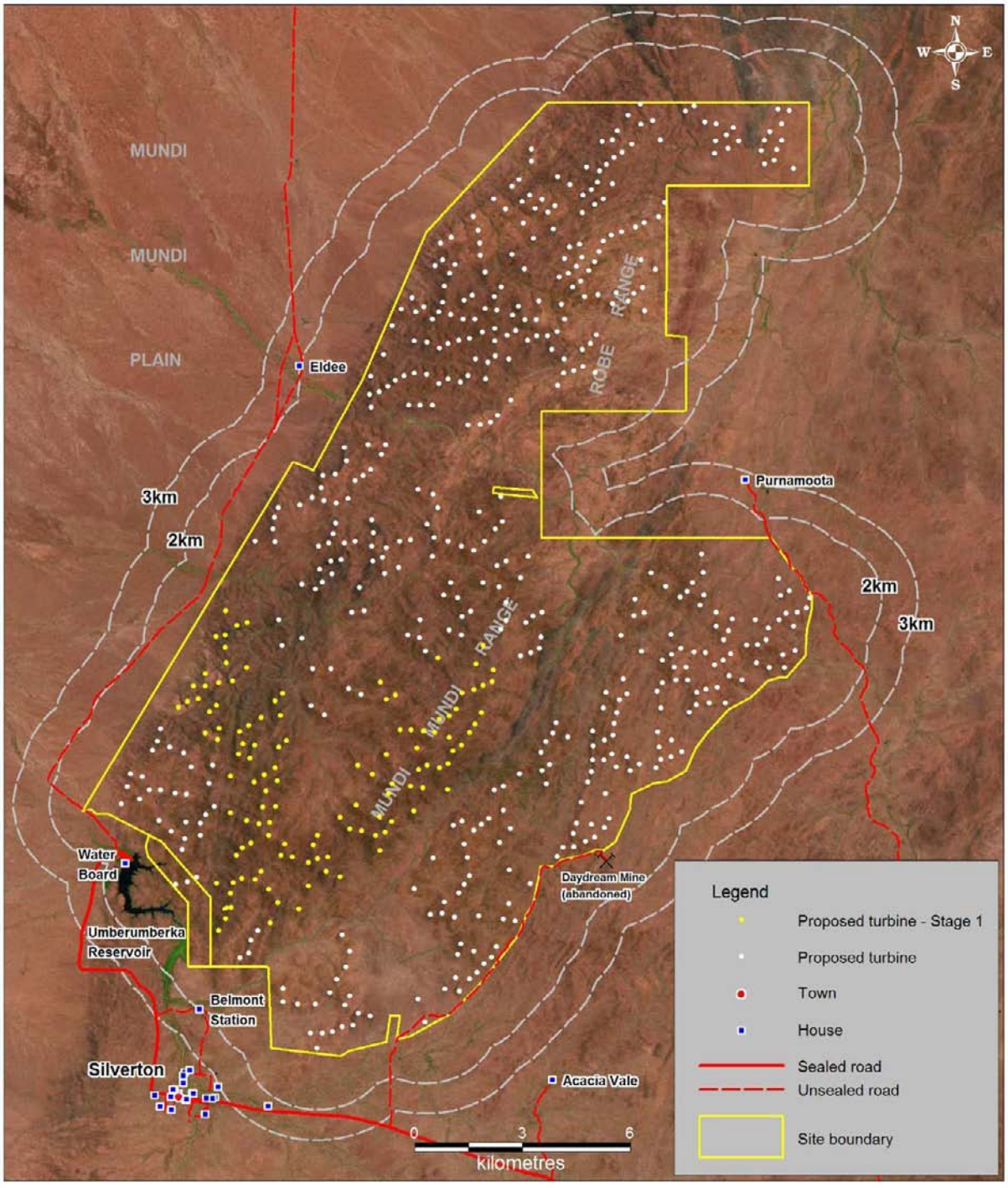


Figure 3.2 House locations near site showing distance from wind turbines

Five houses are located within three kilometres of the site, with approximately 22 additional houses located within the Silverton township.

3.2 WIND TURBINE INFRASTRUCTURE

3.2.1 Wind turbines – general description

Wind turbines

The wind turbines currently under assessment have a diameter of 77 to 110 metres and a hub height in the range of 78 to 105 metres. Examples of turbines currently under consideration are outlined in Table 3.1. New turbines are continually coming onto the market; therefore it is possible that minor variations to these typical dimensions could occur prior to final turbine selection.

The maximum tip height proposed for the site is 155 metres above ground level. Any turbine selected would meet this overall tip height limit.

Wind turbines can be fixed speed or variable speed machines. That is, the turbine blades would either rotate at a constant speed (when operating) or a variable speed depending on wind speeds. Variable speed machines have better performance over a wider range of wind speeds, provide higher quality power to the electricity grid and help reduce wind turbine noise levels at low speeds, however they are more expensive to install.

Each wind turbine would be a three bladed type of the 'up-wind' design (facing up into the wind and in front of the tower). This design facilitates the reduction of noise impacts.

Wind turbine blades are typically made of glass fibre reinforced with epoxy or plastic (fibreglass) attached to a steel hub, and include lightning rods for the entire length of the blade. Blades are manufactured in one piece and are therefore the longest element transported to and around site.

The rated power capacity of the site would depend on final turbine selection and transmission connection capacity.

Figure 3.3 Typical wind turbine (82m rotor installed on an 80m tower)

(Photo courtesy REpower Systems AG)

Nacelle

The nacelle is the housing at the top of the tower enclosing the generator, gearbox 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 a winch or 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 a tubular steel or tubular steel and concrete tower, tapering from around five metres at the base to around three metres at the top. Exact dimensions would depend on the wind turbine design selected. The tower is constructed in multiple sections, each section bolted together via an internal flange. Within the tower are the power and control cables, and access ladder to the nacelle (with safety climb system).

Lattice towers would not be used as wind turbine generator towers in the development.

Access tracks, hardstands and footings

The tower would be seated in a reinforced concrete footing and would require removal of rock and subsoil at the base of each turbine. Various designs of footing are under consideration, based around a gravity footing (where subsoil geology is less stable) and a rock-bolted footing (where subsoil geology provides good bedrock). A combination of these footing designs may be used on the site depending on the geology at each turbine location.

Each wind turbine would require track access and cabling access to allow construction and connection to the site substation. Access tracks would typically be six metres wide (wider at bends) and be all weather graded tracks. Hardstand areas required beneath each turbine would typically be 22 metres by 40 metres (approximately 900m^2) however are subject to final turbine selection and crane requirements.

Hardstands would be left in situ after construction to provide for ongoing maintenance and repairs if necessary. Access tracks would also be left in situ.

Generator transformer

Each wind turbine generator would produce power at typically 690V and up to 1,000V. This is then transformed at each wind turbine to between 22kV and 66kV for reticulation around the site to the nearest site substation. The generator transformer for each wind turbine would be located either within the base of the tower, in the nacelle or adjacent to the tower as a small pad-mount transformer, 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

Civil Aviation Safety Authority (CASA) guidelines for aviation warning lighting for a group of wind turbines require that sufficient wind turbines should have red obstacle beacons to indicate the extent of the group. The interval between beacons should not exceed 900 metres. Accordingly, if CASA considers that the project is likely to be a hazard to aircraft it may require aircraft warning lights. Requirements would be discussed and agreed with CASA once the final detailed turbine layout is selected. For a more detailed discussion on the requirement for night lighting, refer to Section 7.13.

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 a wind speed of around three to five metres per second (11 to 18 kilometres per hour) and gradually increase in production to their maximum capacity, usually at around 12 to 15 metres per second (44 to 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 anemometre mounted on the nacelle, and would restart once wind speeds drop again to a suitable level.

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

It should be noted that noise and shadow flicker are not expected to be an issue, as these impacts have been avoided or minimised in the design process. However, this ability within the control system would allow adjustment of wind turbine operation modes for unforeseen outcomes.

3.2.2 Wind turbine selection

Background to turbine selection

Wind farms are a highly capital-intensive business, with around 90 per cent of the long-term costs associated with construction and financing. Likewise, revenues are directly linked to energy production, which is basically fixed by the turbine selection and siting carried out in the design phase. For this reason, to keep generation costs down and to ensure the Proposal's financial viability, it is essential that the appropriate wind turbine is selected for a site, and that a competitive approach is used between manufacturers to minimise the capital costs of the project.

At this stage, the specific wind turbine model and manufacturer has not been selected for this Proposal. Various international wind turbine manufacturers have products available that are suitable for the Australian market and for this site. These wind turbine suppliers include Clipper Wind (US), Vestas (Denmark), REpower (Germany), Suzlon Energy (India), GE Wind (US), Goldwind (China), Mitsubishi (Japan), Nordex (Germany) and Siemens (Germany). These suppliers are constantly bringing new turbines to market.

While all the turbines under consideration meet the general description in Section 3.2.1, each wind turbine model is different in its design parametres, and each manufacturer also offers a number of similar wind turbine models optimised for different wind speed conditions. Even small changes in wind speeds or minor modifications to turbine locations can impact a turbine's suitability for a site and energy production at a site.

Accordingly, the final turbine selection can only be carried out under a competitive tendering process once this project application has been determined and the conditions of approval are known.

Wind turbines under consideration

Table 3.1 identifies the wind turbines currently under consideration for this Proposal, together with key parametres of these turbines.

In general, different characteristics of turbine types require different turbine layouts; however, to simplify the environmental assessment of the Proposal a single layout has been developed that reflects the characteristics of a large range of turbine types.

Table 3.1 Wind turbines under consideration

Turbine supplier	Turbine model	Turbine capacity	Blade diametre
Clipper Wind	C89	2.5 MW	89 m
Clipper Wind	C93	2.5 MW	93 m
Clipper Wind	C96	2.5 MW	96 m
Clipper Wind	C99	2.5 MW	99 m
GE Wind	2.5xl	2.5 MW	100 m
GE Wind	1.5sl/sle	1.5 MW	77 m
GE Wind	1.5xle	1.5 MW	82.5 m
Goldwind	77	1.5MW	77m
Mitsubishi	MWT92	2.4 MW	92 m
Mitsubishi	MWT95	2.4 MW	95 m
Nordex	N90	2.5 MW	90 m
Nordex	N100	2.5MW	100 m
REpower	MM82	2.0 MW	82 m
REpower	MM92	2.0 MW	92 m
REpower	3.3M	3.3 MW	104 m
Siemens	SWT83	2.3 MW	82.4 m
Siemens	SWT93	2.3 MW	93 m
Siemens	SWT101	2.3MW	101m
Siemens	SWT107	3.6 MW	107 m
Suzlon	S88	2.1 MW	88 m
Vestas	V80	2.0 MW	80 m
Vestas	V82	1.65 MW	82 m
Vestas	V90	1.8 MW	90 m
Vestas	V90	3.0 MW	90 m

Every turbine has slightly different characteristics in terms of site suitability, physical size, energy production and noise impacts. Further, some manufacturers provide different blade diametres for what is essentially the same machine. For example, REpower provides a nearly identical wind turbine with either 82m or 92m blades (MM82 or MM92 respectively). It is therefore possible to locate a combination of similar machines on the same site to provide the best overall outcome.

Requests for Proposal (RFP) from wind turbine manufactures has been sought by the Proponent to shortlist the turbines under consideration. Final wind turbine selection would be carried out based on commercial considerations within the consent conditions stipulated by the Department of Planning. In particular, final assessment of noise impacts would be prepared prior to construction based on the final turbine selection and layout. The Proponent would ensure that noise predictions for the final turbine selection and layout meets the SA EPA Guidelines for non-involved houses or the WHO Guidelines for involved houses, as appropriate (refer to Section 7.3).

Selection of representative wind turbines

The majority of issues identified with respect to this development would not be impacted by specific turbine selection. The final turbine selection could, however, have a material impact on some issues; therefore a representative turbine has been selected to complete the analysis of these issues.

Representative turbines have been used for preparation of:

- Optimised wind turbine layouts
- Estimates of energy production and greenhouse gas reduction calculations
- Photomontages and Zone of Visual Influence for the visual impact analysis
- Noise propagation assessment for the Noise Assessment.

This EA and the related specialist studies consider scenarios based on turbines that provide representative impacts.

The noise assessment is based on the REpower MM92, which has noise characteristics typical of modern wind turbines and therefore offers a good approximation of the likely noise impacts of the Proposal. The MM92 is considered indicative and representative of the range of turbines under consideration. The analysis demonstrates that it is possible to achieve the noise limits set by the SA EPA Guidelines and WHO Guidelines as appropriate.

Additional noise modelling of the noisiest turbine (V90–3MW) of the turbines under consideration, and for which data is available, was undertaken to present worst case impacts of the project. This analysis shows mitigation would be required if this turbine was used on the proposed layout. To address the issue of noise impacts from physically larger turbines, a sensitivity analysis related to changes in hub height was undertaken and demonstrates increase in physical size does not significantly effect noise propagation from wind turbines.

The majority of turbines under consideration for this Proposal are expected to meet the noise requirements for the full complement of 598 turbines. If turbines are selected which would exceed the noise requirements, the number of turbine location will be reduced or noise management techniques used to ensure noise requirements are met. Accordingly, the Proponent has modelled noise impacts using a turbine which represents the 'most likely' noise impact rather than the 'worst case' noise impact. Whichever wind turbine is selected for the Proposal, the Proponent would ensure that the wind farm complies with the noise requirements stipulated.

The estimates of energy production (and therefore greenhouse gas reduction) are based on the Siemens SWT93 wind turbine which has an energy yield performance near the middle of the range of turbines under consideration, and therefore offers a good approximation of energy yield (and therefore greenhouse gas reduction).

The visual assessment is conducted using a model turbine with a 100 metre high tower and a 100 metre blade diametre. This equates to a tip height of 150 metres which exceeds the majority of turbines under consideration. This is therefore considered to be representative of the larger turbines and therefore is representative of potential worst case visual impacts.

3.2.3 Wind turbine layouts

Preparation of wind turbine layouts

The Proponent has prepared a wind farm layout that identifies 598 potential wind turbine locations. This layout reflects the typical spacing required for wind turbines currently under consideration. This layout was prepared by wind energy consultants Garrad Hassan Pacific Pty Ltd and modified by the Proponent to take into account known site constraints.

To prepare this layout, the Proponent provided Garrad Hassan with key site parametres and constraints, including:

- Site boundary
- Aerial photography of the site (for production of vegetation maps)
- High resolution topography of the site (1m contours)
- Wind speed data collected onsite and offsite
- Location of residences in the vicinity of site
- Information on general constraints within the site (including biodiversity and heritage constraints, boundary and residence proximity constraints)
- Operating parametres of selected representative wind turbines.

Garrad Hassan then prepared an optimised wind turbine layout that could accommodate the turbines under consideration using a variety of specialised software packages including WaSP and Windfarmer™, as detailed below:

- Preparation of wind speed correlation at onsite monitoring mast (comparison of measure period with long-term Bureau of Meteorology and CSIRO wind monitoring sites) to determine likely long-term wind speed characteristics at the monitoring locations
- Preparation of a wind speed profile across the site based on this long-term wind speed and the site physical parametres (topography, vegetation)
- Optimisation of wind turbine location based on the wind speed profile to maximise wind energy production while meeting all constraints (including biodiversity, heritage, noise limits on neighbouring residences, electromagnetic interference and proximity constraints)
- Calculation of likely long-term average wind energy production at each turbine.

The wind speed profile across the site is shown in Figure 3.4. This demonstrates the significant variability of wind speed across the site, which would help to explain the requirement to carefully select the appropriate turbine for the site.

Designing and presenting a specific layout for each turbine under consideration would result in multiple layouts which, while broadly similar in terms of impact, would be overly complex for the purposes of assessment. A single wind turbine layout was developed which is broadly suitable for all wind turbines under consideration to give a clear representation of the Proposal and its impacts for this EA.

Turbine layout optimisation was carried out using Siemens SWT93 wind turbine, which is representative of turbines under consideration. Turbine spacing was modified to consider typical turbine spacing required for the turbines under consideration. Minor adjustments to the optimised layout were then carried out to take into consideration site constraints, access and related issues. Figure 3.5 and Figure 3.6 show the proposed turbine layout.

Depending on final turbine selection, it is possible that not all turbine locations proposed would be used to ensure that the wind farm continues to meet all consent conditions (e.g. noise constraints). Also, final wind turbine and equipment locations may be adjusted prior to construction as outlined in Section 3.3.

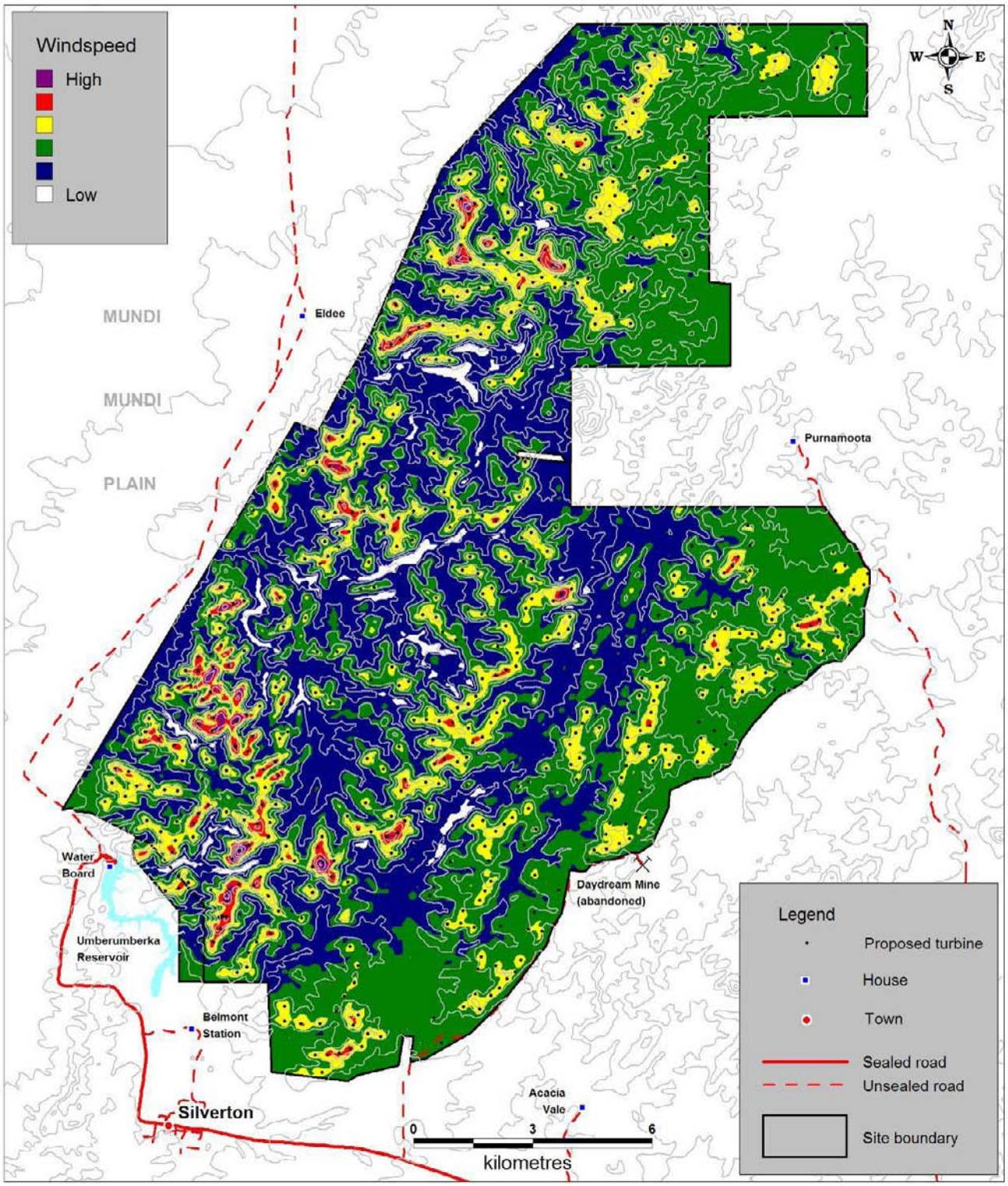


Figure 3.4 Wind speed profile across the site

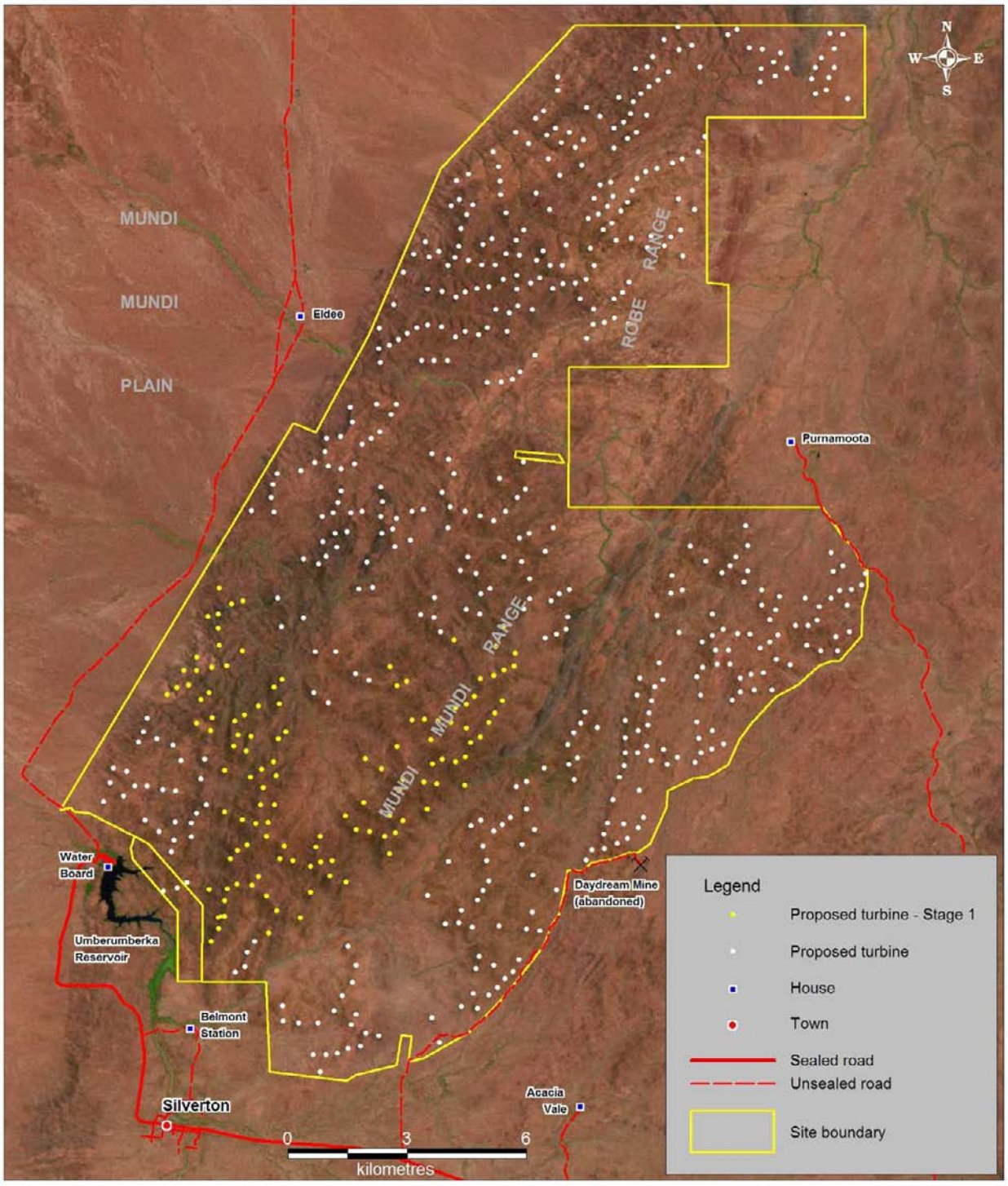


Figure 3.5 Indicative wind turbine layout (598 turbines)

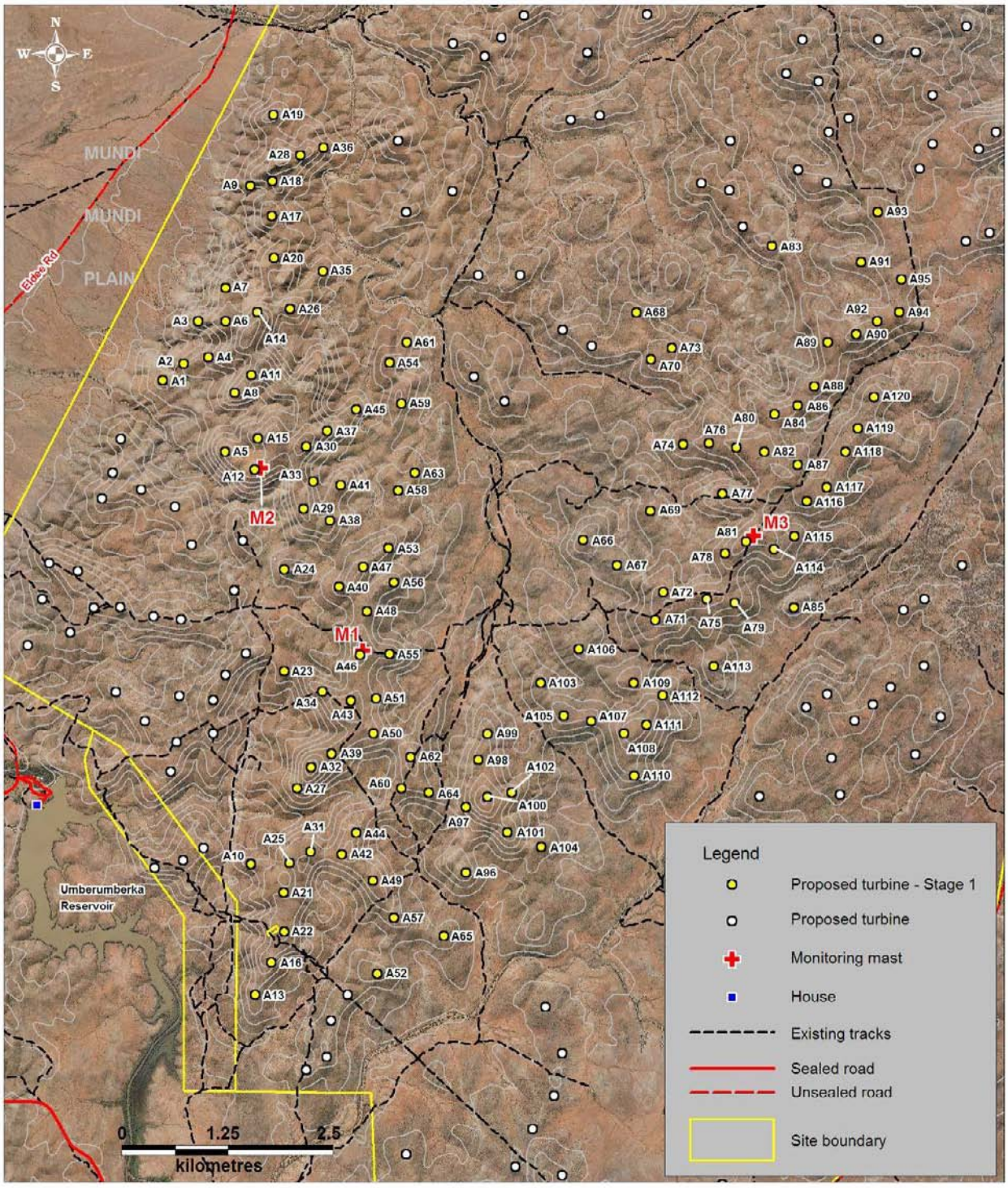


Figure 3.6 Indicative wind turbine layout – Stage 1 development area (120 turbines)

3.2.4 Electrical connections

Introduction

To export power from the proposed wind farm, it is necessary to electrically connect each wind turbine to the NSW electricity grid. Proposed electrical works would include:

- Onsite power reticulation cabling (underground and overhead) at 22–66kV to connect wind turbines to the site substations
- A number of site substations to step the voltage up from reticulation voltages (22–66kV) to medium voltage (66–220kV) for connection to the transmission switchyard
- Onsite medium voltage feeders (overhead) at 66–220kV to connect the site substations to the transmission switchyard
- Onsite control and communications cabling
- An onsite control building housing control and communications equipment
- A transmission switchyard to connect the site to the national electricity grid
- 220kV transmission line to connect transmission switchyard to TransGrid's Broken Hill 220kV substation (including necessary upgrades to TransGrid's system)
- 220–500kV transmission line to connect the transmission switchyard to SP-Ausnet's Red Cliffs 220kV substation in Victoria (including upgrades to SP-Ausnet's system).

Onsite electrical reticulation

Within each wind turbine, or in the adjacent pad-mount transformer, the power voltage is stepped up from generation voltage to 22–66kV for reticulation around the site.

Each wind turbine must be connected at reticulation voltage and then connected to the site substation or directly to the transmission switchyard. These connections are made using a combination of overhead and underground cabling.

In general, overhead cabling offers benefits onsite as it minimises ground disturbance and is lower cost, however there are practical limitations in installing overhead cabling on ridges where turbines are present. Therefore it is typical to use underground cabling on ridgelines where turbines are installed, and to use overhead cabling to bring power from turbine clusters back to the site substations or transmission switchyard.

Cable trenches would, where reasonable, be dug within or adjacent to the onsite tracks to minimise any related ground disturbance. Short spur connections would come off main cable runs that would approximately follow the main road access routes onsite.

Overhead cabling would use concrete, wood or steel pole designs with single or double circuit on each pole as required.

The routes for power reticulation would be finalised taking into account the ease of excavation of cable trenches or tower installation, and with an effort to minimise impacts on areas with sensitive biodiversity or heritage, to minimise clearing of trees and to minimise erosion issues resulting from construction.

Site substations

A number of site substations are required to convert power from reticulation voltages (22–66kV) up to medium voltage of 66k–220kV, suitable to connect into the transmission switchyard. Each site substation would include transformers and all necessary ancillary equipment such as control cubicles, voltage and current transformers, and circuit breakers for control and protection of the site substation. The transformers are likely to be of the oil-cooled variety, and therefore may contain considerable quantities of oil. Provision would be made in the design of the substation for containment of any oil that may leak or spill.

The 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, and would have an earth grid extending outside of the boundary of the security fence.

Site substations would be substantially smaller than the transmission switchyard. It is likely that each site substation would take up an area of approximately 100m x 100m. Alternatively, a larger number of smaller transformer yards may be used, which each could be as small as 20m x 40m.

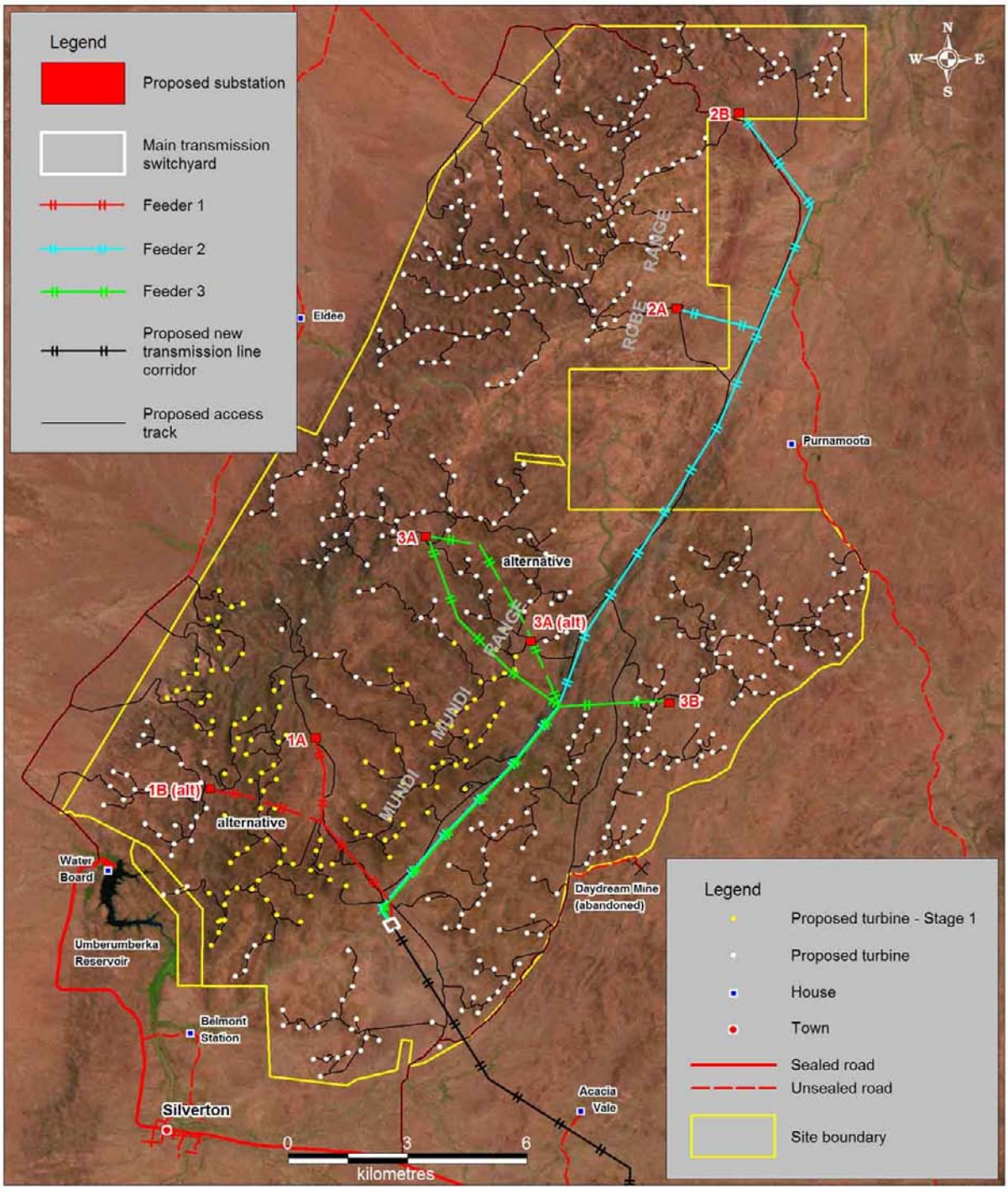


Figure 3.7 Indicative site substation and medium voltage feeder locations

Site substations could be located in the areas indicated in Figure 3.7. These locations have been identified on the basis of the wind turbine layout. Final locations would be selected to minimise environmental disturbance of the site, to reduce cabling lengths and therefore reduce costs and environmental impacts, to minimise stock management issues for current farm use and to reduce visual impacts and ground disturbance of the site. In general, site substations are located in flatter areas.

Bushfire Asset Protection Zones (APZs) would also be calculated for each site substation once its final location and size is confirmed.

Medium voltage feeders

Onsite medium voltage cabling (overhead) at 66–220kV is required to connect the site substations to the transmission switchyard.

Overhead cabling would use concrete pole, wood pole, steel pole or steel lattice tower designs as appropriate for different parts of the site. Towers would be single or double circuit as required.

The routes for power reticulation would be finalised taking into account the ease of excavation of cable trenches or tower installation, and with an effort to minimise impacts on areas with sensitive biodiversity or heritage, to minimise clearing of trees and to minimise erosion issues resulting from construction. Indicative routes based on a three-feeder design are shown in Figure 3.7

Control and communications cabling

In addition to the power reticulation cabling, control and communications cabling is required from the control building to each wind turbine, and to its site substation. This control cabling would be installed using the same method and route as the power cabling above, that is, strung from the same poles as overhead lines or dug in the same cable trench as underground cables.

Control cables would consist of twisted pair cables, multi-core cables or optical fibres and would be used for central and remote control of individual wind turbines, substation controls, monitoring of weather data and equipment, and communications to offsite control centres where required.

Transmission switchyard

A transmission switchyard is required to connect the medium voltage feeders linking the turbines to the national electricity grid. This switchyard would include high voltage circuit breakers, busses and related switchgear and all necessary ancillary equipment such as control room and amenities, control cubicles, voltage and current transformers, and circuit breakers for control and protection of the substation.

The switchyard 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, and would have an earth grid extending outside of the boundary of the security fence.

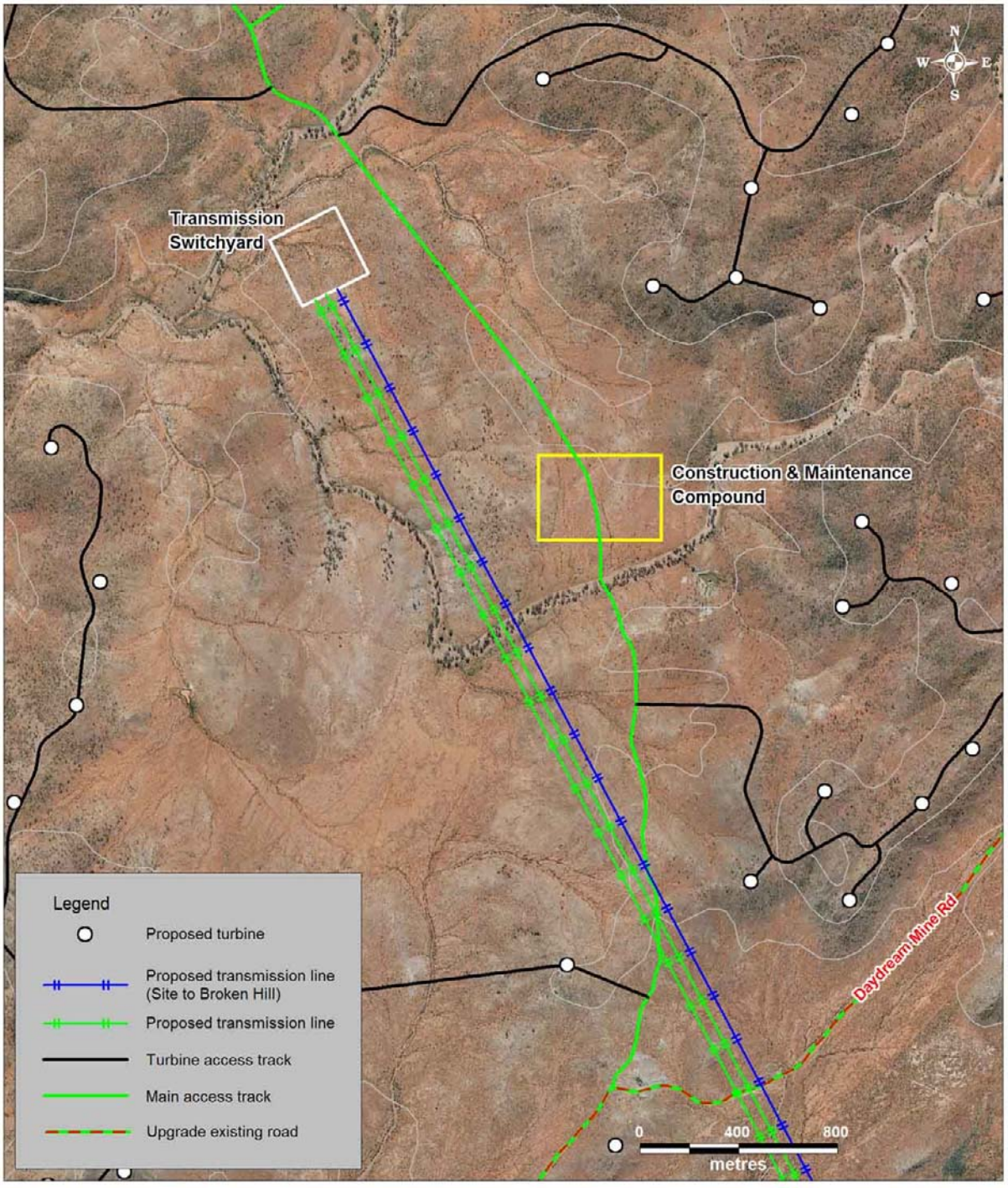


Figure 3.8 Transmission switchyard and control building locations

Figure 3.9 Coffs Harbour 330/132kV substation under construction

(courtesy TransGrid)

Figure 3.10 Indicative control building

The transmission switchyard would be located onsite, taking up an area of approximately 300m x 300m. This is typical for high voltage switchyards of this kind (eg the Coffs Harbour 330/132kV substation, Figure 3.9, occupies an area of approximately 160m x 100m, however the larger Armidale 330kV substation occupies an area of 300m x 300m). The final switchyard layout would be determined during the final electrical design that provides final requirements for transformer, high-voltage switch gear, earthing, and protection systems. Geotechnical considerations and cost are other factors that will contribute to the final substation layout.

It would be located in the area indicated in Figure 3.8. This location has been selected to minimise environmental disturbance of the site, to reduce cabling lengths and therefore reduce costs and environmental impacts, to minimise stock management issues for current farm use and to reduce visual impacts and ground disturbance of the site.

Indicative bushfire Asset Protection Zones (APZs) would be calculated based on the exact final size of the switchyard, vegetation type and slope. The transmission switchyard may include additional large power transformers to increase from medium voltages to transmission voltages. The transformers are likely to be of the oil-cooled variety, and therefore may contain considerable quantities of oil. Provision would be made in the design of the transmission switchyard for containment of any oil that may leak or spill. Other equipment in the substation includes circuit breakers, current and voltage transformers, disconnectors and isolators, and high voltage busbars.

Transmission line routes

The wind farm would connect to the national grid.

The initial transmission line connection would involve construction of 24 kilometres of 220kV transmission line from the transmission switchyard to TransGrid's existing 220kV Broken Hill substation (20 kilometres of this route is offsite). This would then allow power to be exported from site along TransGrid's existing Broken Hill to Buronga transmission line. Assessment of the power transfer ability of this line indicates that the existing Broken Hill to Buronga line is rated to approximately 430MVA (summer night time normal rating) and 478MVA (winter night time normal rating) (Dr. Parker, Manager System Planning and Analysis, TransGrid, pers comms) and therefore is adequate to accommodate the output of the first stage of the proposal. The preferred route is outlined in Figure 3.12.

A second transmission line connection would involve construction of 305 kilometres of 220kV and possibly up to 500kV transmission line from the transmission switchyard to SP-Ausnet's existing 220kV Red Cliffs substation in Victoria. Two circuits are required; therefore this transmission line could be a double circuit transmission line or two single circuit power lines as appropriate. Approximately 301km of this line would be offsite, of which 300 kilometres would be in NSW. This would allow power to be exported from site to Red Cliffs substation and then into NSW, Victoria and South Australia. An indicative route which follows the existing transmission line is outlined in Figure 3.13. The final corridor would be confirmed in consultation with relevant landholders.

Both connections involved construction of new high voltage power lines as well as upgrades to existing substations at Broken Hill, Red Cliffs and additional substations upstream.

Initial system studies prepared by the Proponent's consultants, E-Connect and Worley-Parsons, have confirmed that sufficient connection capacity could be expected from these transmission connections to allow full export of the site's capacity.

Depending on turbine selection, a final transmission line connection may be required from site directly into South Australia. This transmission line would operate at 275kV and most likely connect into the Davenport, Canowie, Robertstown or Monash substations in South Australia and if required would be the subject of further approval. A step-up transformer would be required at the transmission switchyard onsite.

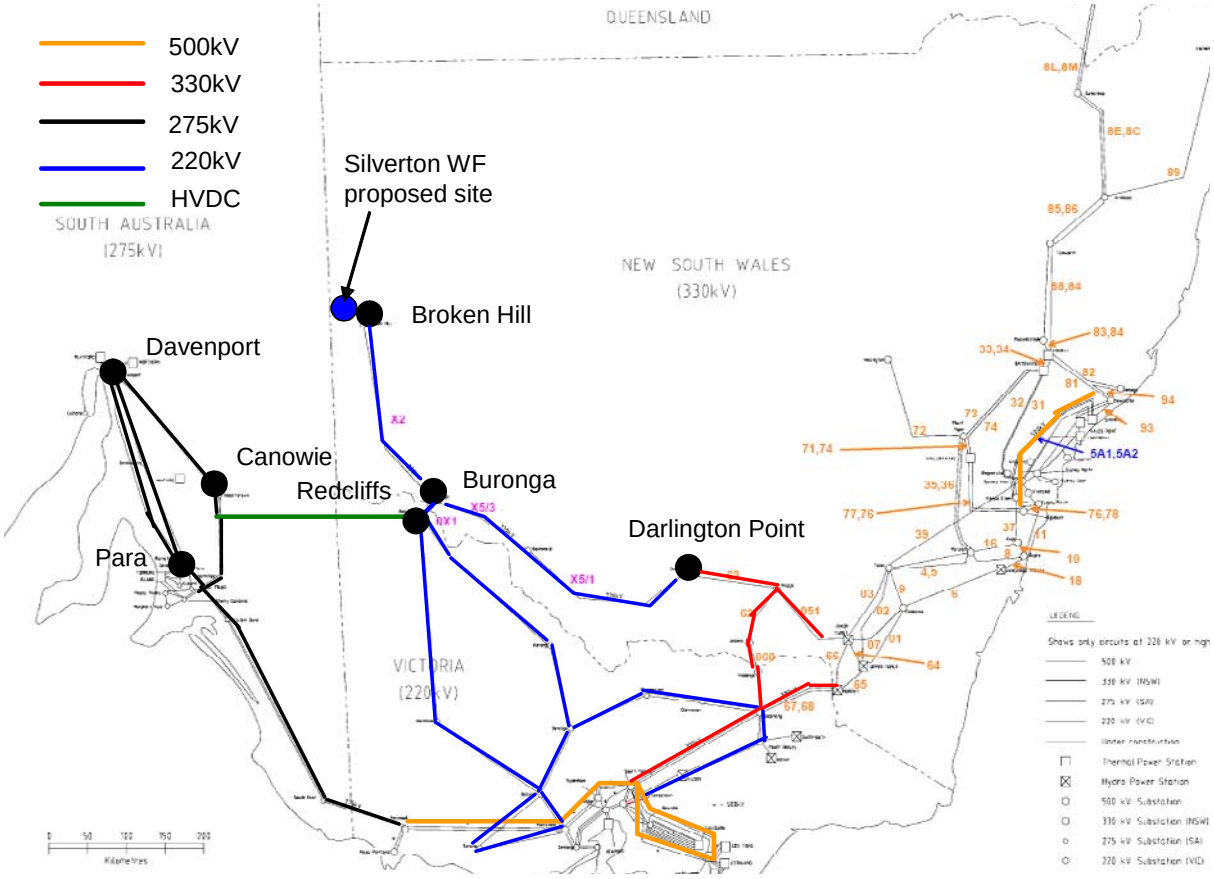


Figure 3.11 National electricity grid showing potential connection locations

Figure 3.14 and Figure 3.15 indicate typical transmission line requirements for power lines operating at these voltages. While these figures focus on steel lattice construction, steel or concrete pole construction would have similar characteristics.

The Proponent would secure sufficient easements to allow construction and maintenance of the power lines in accordance with appropriate industry guidelines.

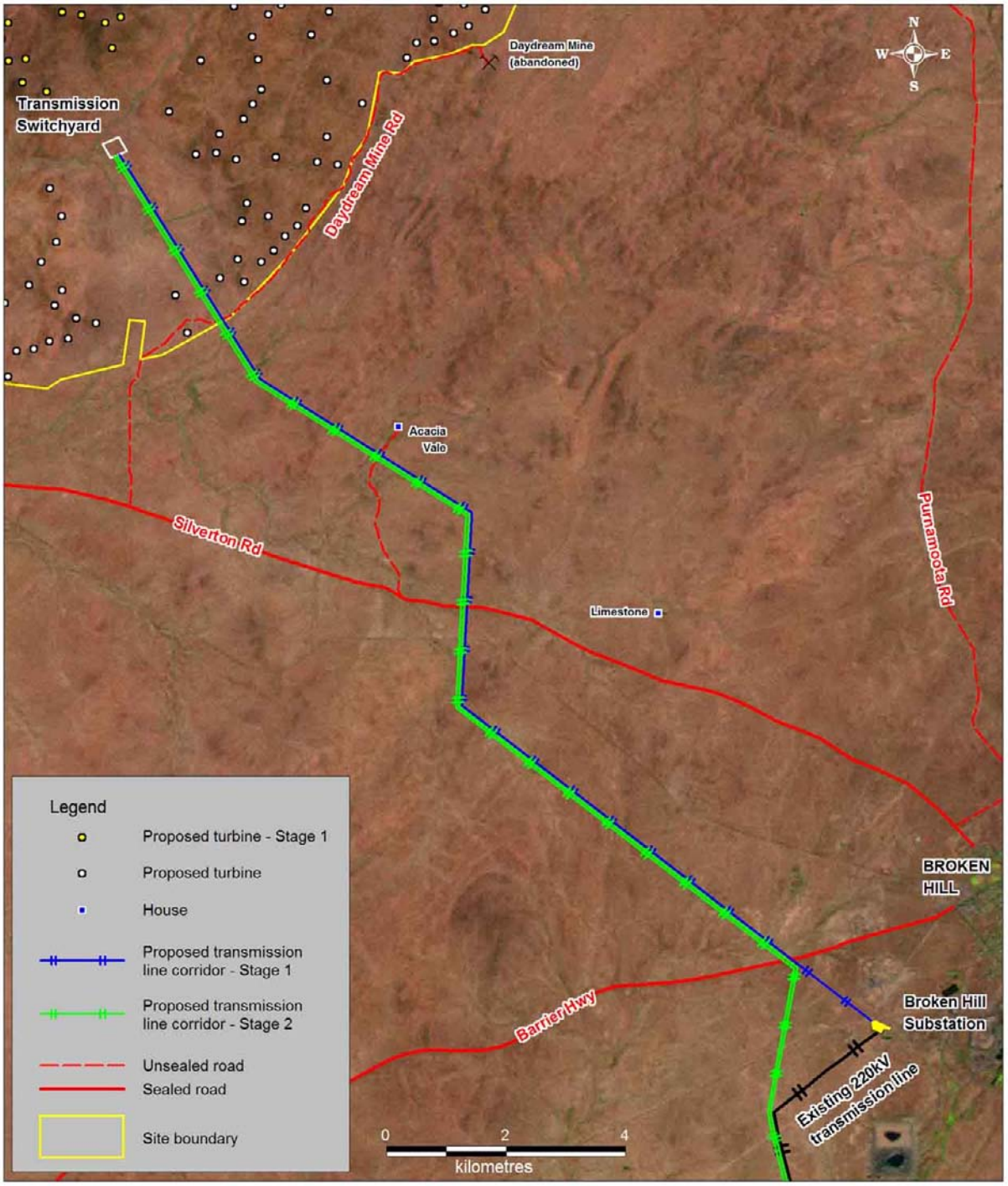
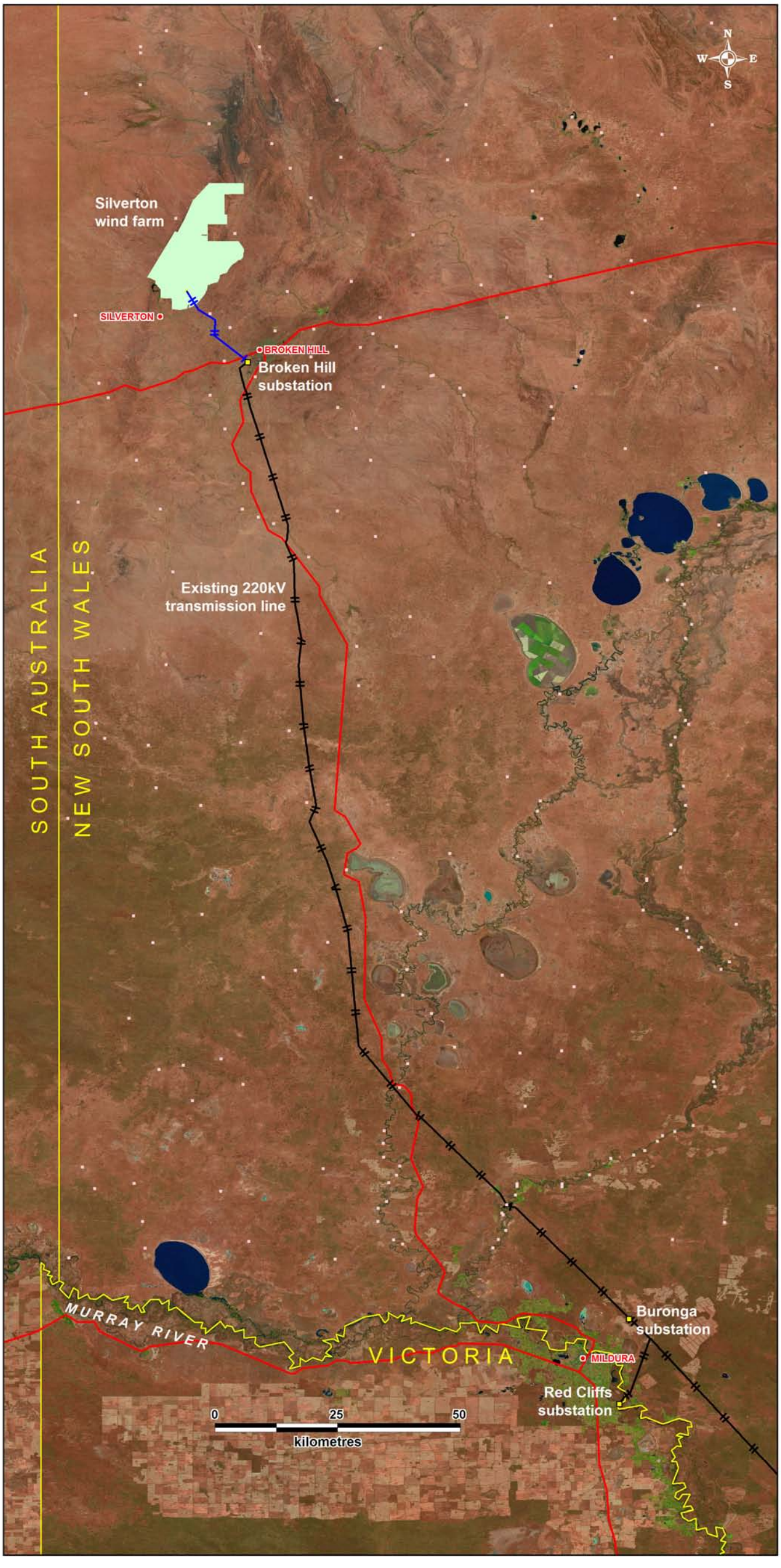


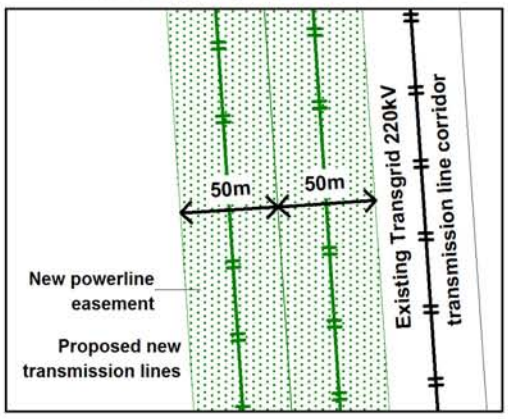
Figure 3.12 Electricity transmission line corridor – site to Broken Hill

Figure 3.13: Electricity transmission line corridor – site to Red Cliffs



Inset - Location within Australia

Inset - Detail of proposed corridor



Legend

- Town
- Homestead
- Substation
- Road
- Stage 1 - proposed powerline Site to Broken Hill
- Existing 220kV transmission line
- Site boundary

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Table 3.2 Typical transmission tower height and easement parametres

Voltage	Circuit type	Tower type	Easement width (m)	Tower height (m)	Source	State
500	Double	Lattice	70	55	TransGrid	NSW
500	Double	Lattice	80	63	SP Ausnet	Vic
500	Single	Lattice	65	42	SP Ausnet	Vic
330	Double	Steel pole	60	43	TransGrid	NSW
330	Double	Lattice	60	40	TransGrid	NSW
330	Single	Lattice	60	30	TransGrid	NSW
330	Single	Lattice	60	37	SP Ausnet	Vic
275	Double	Lattice	50	48	SP Ausnet	Vic
275	Double	Lattice	50	53	ElectraNet	SA
275	Single	Lattice	50	45	ElectraNet	SA
275	Single	Twin stobie pole	50	25	ElectraNet	SA
220	Double	Lattice	40	47	SP Ausnet	Vic
132	Double	Lattice	45	33	TransGrid	NSW
132	Double	Lattice	40	44	ElectraNet	SA
132	Single	Lattice	40	37	ElectraNet	SA
132	Single	Single stobie pole	30	24	ElectraNet	SA
132	Single	Twin wood pole	45	16	TransGrid	NSW

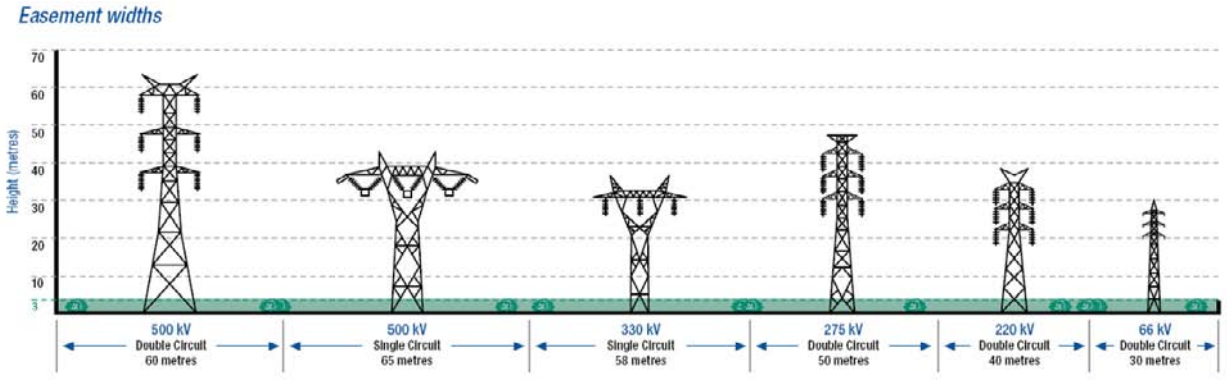

Figure 3.14 Typical transmission line parametres

(courtesy SP-Ausnet)

Figure 3.15 Typical transmission line configurations

Clockwise from top left: 66kV single circuit steel pole; 132kV single circuit double wood pole; 220kV single circuit steel tower; 132kV double circuit steel tower.

Interaction with TransGrid, Vencorp, SP-Ausnet and NEMMCO

The Proponent has submitted a Grid Connection Application and seeks to finalise a Grid Connection Agreement with TransGrid in relation to the Broken Hill connection. This application was prepared on the basis of the proposed connection arrangements and in accordance with the National Electricity Code. This Grid Connection Agreement would include all technical requirements for safe connection of the wind farm to the NSW electricity grid at Broken Hill.

When commissioning the transmission lines appropriate procedures would be in place to ensure continuity of electricity supply to customers during the commissioning of the wind farm. Sections of the Broken Hill and Red Cliffs substations may need to be de-energised to allow safe installation of switchgear and the new power line/s from the wind farm, however this would not involve reduction of power supply to customers.

The Proponent has submitted connection enquiries and is liaising with VenCorp and SP-Ausnet on the submission of similar Grid Connection Applications with Vencorp and SP-Ausnet in relation to the Red Cliffs connection.

Relevant stakeholders including Country Energy, TransGrid, SP-Ausnet, Vencorp and NEMMCO would continue to be consulted in the preparation of the related Grid Connection Agreements. The Grid Connection Application process is being implemented in parallel with the Development Application to avoid delays prior to construction.

3.2.5 Site civil works, roads and access

Access route

Access to the site would be from Broken Hill via Silverton Road as indicated in Figure 3.16.

The majority of vehicles are expected to access site via new site access tracks built from the Daydream Mine Road. Using this indicative route as the primary access would reduce construction and ongoing traffic through the township of Silverton and is therefore preferred. There remains an option to access the northern part of the site using the existing Purnamoota road and upgrading it as required.

Some areas of the site can only be reasonably accessed via Silverton and from the west of site. This traffic would, by necessity, transit via Silverton. Accordingly, the number of vehicles accessing site via this route would be minimised.

Access tracks

Onsite access tracks for construction and operation would generally be unsealed formations up to six metres in width or up to 12 metres in width where passing lanes are required. Tracks are required to the base of each wind turbine location, the transmission switchyard and the location of each site substation and other buildings.

Figure 3.16 shows an indicative track layout based on the current turbine layout and preliminary design principles. In general, this indicates a main access track along each ridgeline, with side tracks taken to each wind turbine location by the shortest reasonable route.

Particular care has been shown to the road design near the area of sensitive spinifex habitat identified towards the south of the site. Figure 3.17 identifies the initial access track proposed, together with the modified access track to minimise disturbance to this sensitive habitat. A number of turbines were removed from this area to minimise direct impacts and, with appropriate management techniques, the remaining turbines can be accessed with minimal disturbance to sensitive habitat.

At each wind turbine base, a firm hardstand area would be required to provide a level and stable base for cranes necessary for construction. New gates and possibly new or realigned fences may also be required to protect stock during the construction phase.

Once the construction has finished, any tracks not used for normal grazing practice or turbine maintenance would be rehabilitated. Both hardstand and access tracks would be maintained onsite to allow maintenance and repairs to the wind turbines.

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

- Minimise the number and length of necessary access tracks
- Locate access tracks along the route of existing tracks
- Locate access tracks to minimise clearing of native vegetation
- Locate access tracks to minimise impact on sensitive biodiversity or heritage areas
- Construct access tracks with due regard to erosion, sediment control and drainage.

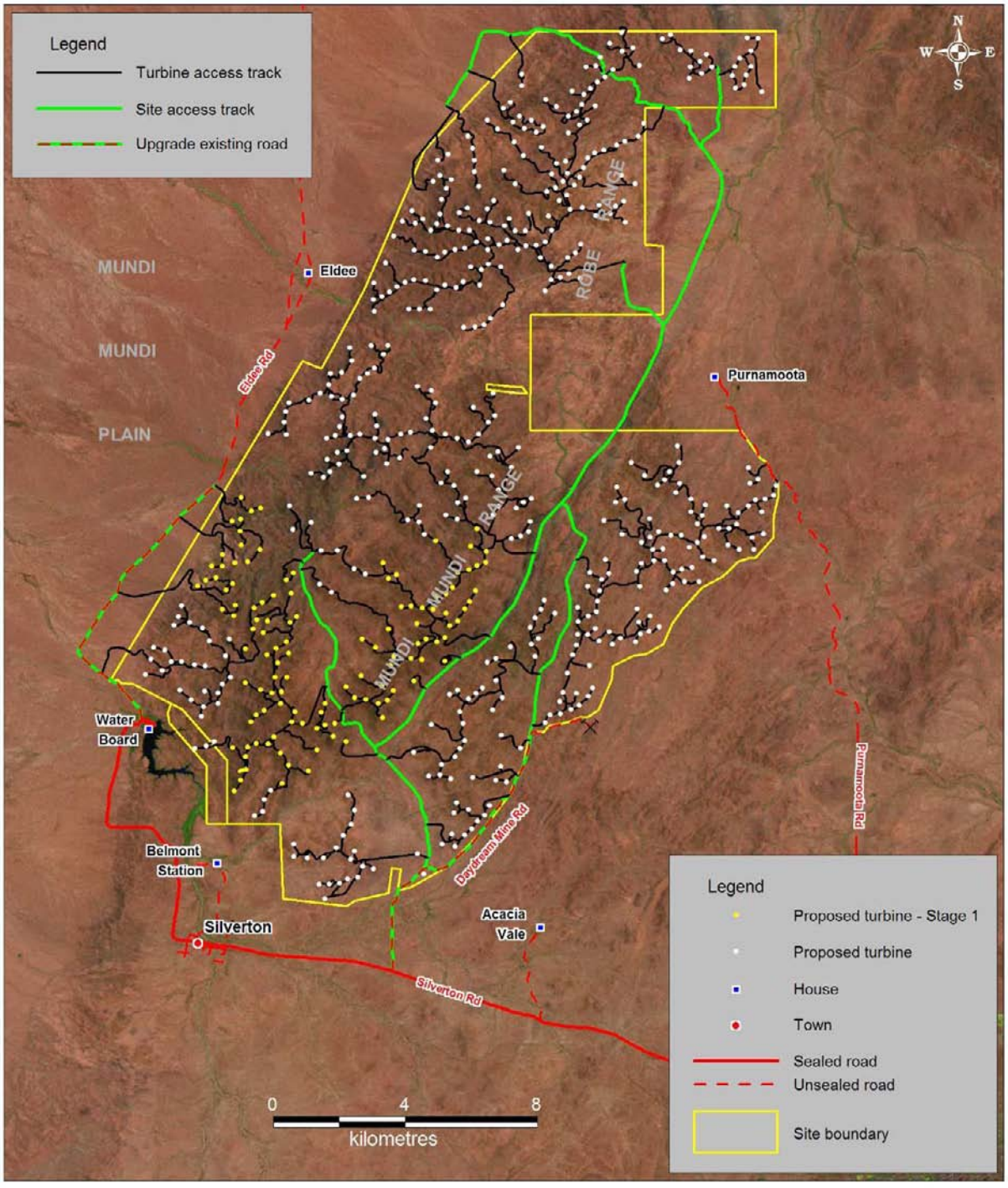

Figure 3.16 Proposed site access and indicative turbine access routes

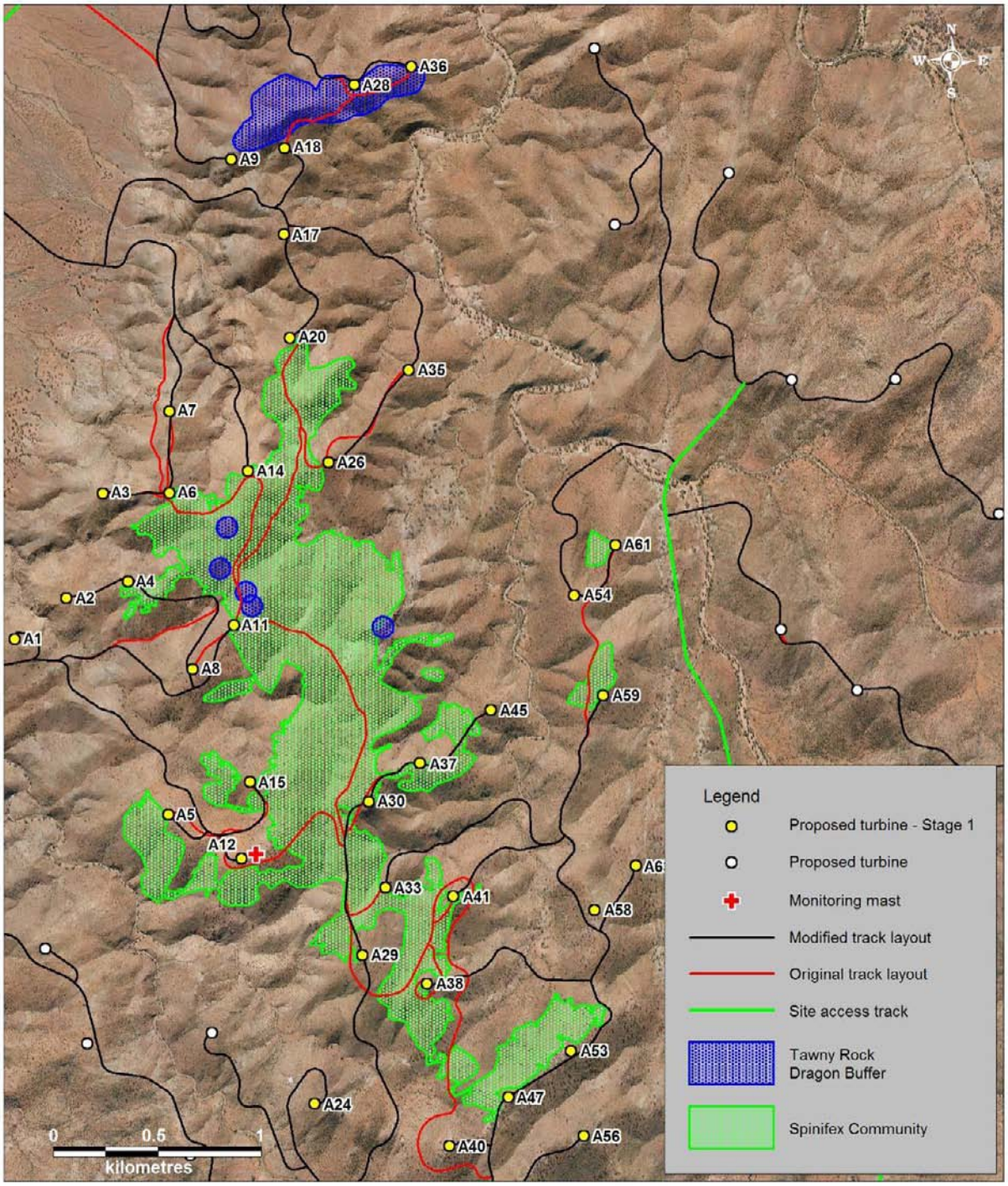

Figure 3.17 Site access in areas of sensitive vegetation

Vehicle management

Every effort would be made to ensure vehicles:

- Are minimised in size, length and number
- Travel with appropriate regard to other road users
- Travel at times that minimise traffic noise impacts to surrounding residents.

During construction, light vehicles would generally operate within one hour before and after construction work times onsite. However, the delivery of turbines to the site via oversize vehicles may occur at night, outside normal construction hours, in order to ensure safe passage during low traffic conditions.

A Traffic Management Plan (TMP) would be prepared to properly manage traffic impacts in accordance with Section 7.6. It would be developed in consultation with the RTA to ensure that the measures are adequate to address potential safety and asset degradation impacts. Traffic management is discussed in more detail in Section 7.6.

3.2.6 Wind monitoring equipment

The Proponent is currently maintaining a number of tall wind monitoring masts across the site to assess wind speeds at proposed turbine locations. Following construction, permanent wind monitoring masts would be required at the site to assist the control and operation of the wind farm. These would be static guyed lattice or tubular towers with remotely operated wind monitoring equipment at multiple heights on each mast.

Pending final wind turbine placements, it may be necessary to maintain the existing wind monitoring masts, move the existing wind monitoring masts to different locations within the site, replace the wind monitoring mast with a shorter or taller wind monitoring masts, or install additional wind monitoring masts to assist with control and operation of the site.

These masts would be located within the development envelope assessed in the various studies reported in this document. Accordingly, the scope of works includes all monitoring masts required for the site.

3.2.7 Site construction and maintenance facilities

The proposed location of the construction compound and wind farm maintenance facility is indicated in Figure 3.18.

A control building would be built onsite to house instrumentation, control equipment and communications equipment. The control building would be located in or adjacent to the transmission switchyard or adjacent to the maintenance facility, and is expected to be a joint facility for control of the substation as well as the wind farm. It is likely that the operations centre within this facility would be manned 24 hours to allow early response. Appropriate facilities would be provided for 24 hour operations.

A maintenance workshop would be established to provide ongoing maintenance and workshop facilities for storage of components and equipment. Smaller control facilities, including potentially workshops and stores, may be located in the vicinity of each of the site substations as indicated in Figure 3.7.

Maintenance facilities buildings would provide a work area for staff, meeting rooms, canteen and other amenities for permanent and visiting staff. These buildings would be located in the vicinity of the main maintenance workshop.

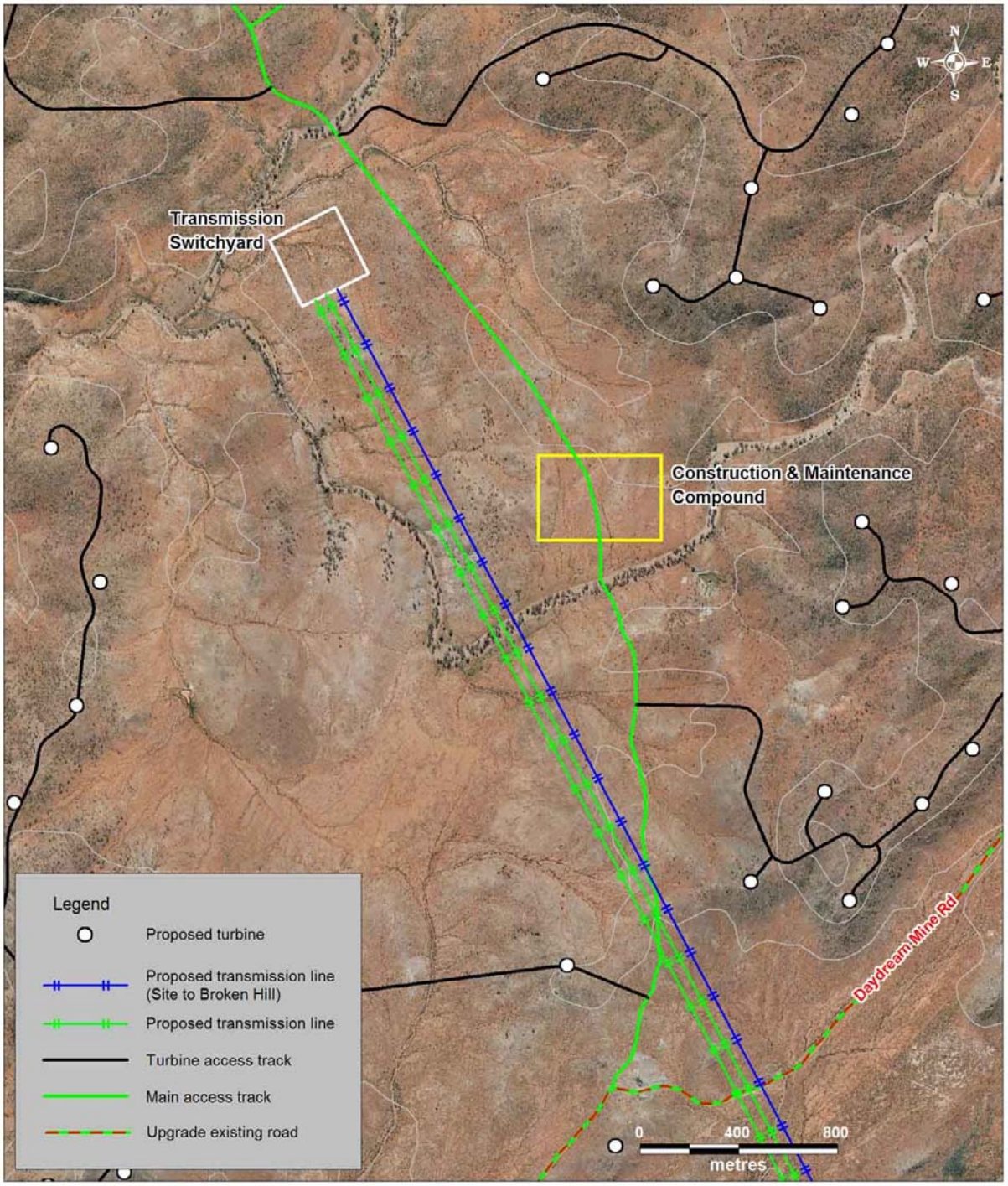

Figure 3.18 Site construction compound and maintenance facility

The control and amenities buildings are expected to be of concrete slab on ground construction with steel frame, metal or brick walls, a non-reflective sheet steel (colourbond) roof, and would include rainwater collection and storage for domestic use. A composting or septic toilet system would be installed for staff use. It is likely that the buildings would be air-conditioned.

Standard 240V/415V power would also be installed at each building.

All buildings would be built in accordance with the relevant Australian building codes.

3.2.8 Tourism facilities

The option to encourage tourists and interested parties to visit a particular location to discover information about the wind farm presents the people of Silverton and the landholders with a number of opportunities.

Experience at other wind farms indicates that tourists and motorists are likely to be interested to find out more about the wind farm. Appropriate information signage would therefore be erected at carefully selected locations.

Tourism and visitor facilities could be developed at suitable locations should the community or landowners wish this to happen. Details of the type and location of any facilities would be confirmed in consultation with local residents. Possible locations include the Mundi Mundi Lookout west of Silverton, Eldee homestead as well as various locations along the Daydream Mine Road and the Silverton Road.

It is expected that direct access would be provided to tourists to one of the turbines easily accessed from the Day Dream Mine Road. A turbine close to the public road would provide an 'up-close' experience to tourists without encouraging the public to venture further onto leaseholder land. The nature and location of any interpretive information is to be decided when the turbine to be accessed is identified.

3.2.9 Other site services

Temporary power (11–22kV), telephone and internet services would be required for the construction phase. In addition, a permanent power supply (11–22kV) would be required for the transmission switchyard and site substations to allow backup supplies to the substation in the event of an outage on the main transmission lines. Power would also be required for the control and maintenance facilities.

Communications to the control buildings, construction and maintenance facilities would be required. This connection could consist of multiple buried telephone lines, broadband cable, microwave or a satellite connection. It is possible that a microwave link may be required for substation control. If so, this would be subject to a license application to the Australian Communications and Media Authority.

Arrangements would be made for the removal of all wastes at the site.

3.3 MODIFICATIONS TO EQUIPMENT LOCATIONS

The equipment locations incorporated in this Proposal have undergone a preliminary review to determine that the layout is reasonably suitable for construction and would comply with likely consent conditions and environmental constraints. As presented in Section 3.2.3, rather than present a turbine layout for each turbine model under consideration a single layout has been presented which has identified an indicative location for each turbine. Minor relocation of equipment may be required prior to construction, however, as a result of a number of factors including:

- Final turbine selection
- Final wind speed and energy yield analysis
- Additional environmental constraints identified through any ongoing site investigations
- Constraints identified in relation to site constructability or cost minimisation
- Constraints identified in relation to turbine suitability assessment
- Constraints identified after the results of final engineering and geotechnical investigations are completed.

Following final turbine selection and completion of further technical investigations (including geotechnical and final noise modelling), turbine locations will be finalised.

In a recent NSW Land and Environment Court ruling (Taralga Landscape Guardians v. Minister for Planning NSWLEC 2007) the Court found in relation to relocation of wind turbines in that circumstance "… that a 250 metres relocation of any of the elements is not unreasonable." While this finding could be perceived to be site specific, it accepts the principle in relation to equipment relocation and provides some guidance as to acceptable relocation distances.

It is recognized that in accordance with the *Environmental Planning and Assessment Act (1979)* any equipment relocation is required to be broadly consistent with the Proposal as outlined, and that otherwise an application for modification of the Development Consent would be required.

Minor relocation of wind turbines is likely in accordance with the factors outlined above, and would also require minor relocation of tracks and electrical connections as well as possibly relocation of site substations.

The Proponent considers that in relation to this Proposal:

- Relocation of wind turbines and other equipment of up to 250 metres would have negligible effect on visual impacts of the Proposal and is broadly consistent with the Proposal
- Relocation of wind turbines and other equipment in excess of 250 metres may or may not have a material effect on visual impact of the Proposal and therefore whether it is consistent with the Proposal would be considered by the Proponent on a case by case basis
- Relocation of wind turbines and other equipment is broadly consistent with the Proposal where the principle acceptability limit criteria outlined in the South Australia EPA Noise Guidelines for Wind Farms (February 2003) is achieved at neighbouring (non-involved) residences as outlined in Section 7.3.1
- Relocation of the Transmission line corridor from Site to Broken Hill for the purpose of improving visual impact to nearby residences is broadly consistent with the Proposal
- Relocation of any equipment in a way which does not notably increase impacts to native vegetation, biodiversity, indigenous heritage or non-indigenous heritage (considered as a whole) is broadly consistent with the Proposal.

3.4 CONSTRUCTION FACILITIES AND STAGING OF WORKS

The works establishment of the wind farm can be considered as occurring in four phases. These include construction, operation, refurbishment and decommissioning of the wind farm. A description of activities is presented below.

3.4.1 Phase 1: Wind farm construction

The construction phase of the wind farm would include construction activities as detailed below.

- Transportation of people, materials and equipment to site
- Construction of temporary site offices and facilities
- Civil works for access track construction, footings and trenching for cables
- Establishment, operation and removal of concrete batching plants
- Potential use of rock crushing equipment onsite, if required
- Potential use of blasting in foundation excavation, if required
- Construction of substations and onsite power reticulation lines and cables
- Installation of wind turbines using large mobile cranes
- Temporary site storage
- Restoration and rehabilitation of disturbed onsite areas on completion of construction works.

Construction would commence with the upgrading of roads and other site civil works, including preparation of hardstand areas, and laying of cables. This would be followed by construction of concrete footings, which must be cured prior to erection of the wind turbines.

Wind turbine erection can be relatively fast once the footings are prepared, with approximately two to five wind turbines installed per week. 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 with the civil works.

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

On completion of construction, the site would be rehabilitated where possible and all waste materials removed from the site. Any temporary road realignments would be restored.

Wind turbine construction and installation

Installation of the wind turbine blades would require establishment of a level (<1 per cent gradient) and stable hardstand area at the base of each wind turbine. This hardstand area would support cranes used for the major component lifts. It is also necessary to have a delivery area for the various components adjacent to the hardstand area.

Installation of the wind turbine blades would also require cleared areas at the base of each wind turbine to manoeuvre the wind turbine blades. Generally, the three blades are connected to the hub on-ground, and the whole wind turbine lifted as one piece. There is some scope to avoid damage to or removal of native vegetation during this stage by careful positioning of the blades to avoid trees and shrubs. This would be carried out wherever possible.

The wind turbines would be anchored using large concrete gravity footings or smaller concrete footings bolted to rock, as determined by geological parametres. Some blasting of rock may be required to excavate footings, dependent on the geological properties of the rock and design of the footing. Should controlled blasting be required, it would be carried out in accordance with all relevant statutory requirements.

Rock crusher

Materials excavated during the construction of wind turbine footings may be able to be reused as road base for the road surface upgrades. For this purpose, it is possible that a mobile rock crusher would be used onsite.

Concrete batching plants

Portable concrete batching plants would be required to supply concrete onsite and therefore form part of this Proposal. Up to six batch plant locations would be required to minimise the distance between the batching plant and the foundations being poured. Batching plant equipment may be relocated between the sites as the works progress to different areas of the site.

The concrete batching plants would require a level area of approximately 150 metres by 150 metres to locate the loading bays, hoppers, cement and admixture silos, concrete truck loading hardstand, water tank, and stockpiles for aggregate and sands. Each batching plant location would include an in-ground water recycling/first flush pit to prevent dirty water escaping onto the site, and would be appropriately remediated after the construction phase.

The batching plants would require a license to be issued by DECC (under the *Protection of the Environment Operations Act 1997)*, given that the batching plant capacity would exceed the license threshold of 150 tonnes per day. License conditions specified by DECC are likely to include operational protocols and monitoring.

Figure 3.19 indicates likely batching plant locations that are proposed to be located adjacent to site substations, however final batching plant locations would be confirmed prior to construction.

The criteria for batch plant locations is related to:

- Minimising overall travel distance from batch plant to turbine/substation locations
- Avoiding sensitivity environmental areas
- Suitable access and turning areas for delivery trucks and mixing trucks
- Adequate space for stockpiling materials

Sands and aggregate would be required for the construction of turbine footings, hardstands and tracks. Without having completed the detailed design, it is expected that sand and aggregate would be sourced from excavation of footings where possible, or from existing approved sand and gravel pits within the local area. Local contractors are confident that the quantities required would easily be sourced locally. Every effort would be made to source clean sands and aggregates to prevent transport of weeds to site. If additional quarries for the supply of sand or gravel are necessary these will require appropriate approvals, permits and licenses.

Discussions with Country Water have indicated sufficient water is available through the Broken Hill water supply system to cater for the project needs. It has been estimated that approximately 200 kilolitres per day of water would be required for the construction of the concrete footings for the turbines, control rooms and the substations. In addition, water or chemical treatment may be used on site access tracks in times of high wind to assist with dust suppression. Water for concrete manufacture and dust suppression would be sourced from the Umberumberka Reservoir via a temporary pipeline or by water truck to the concrete batching plants.

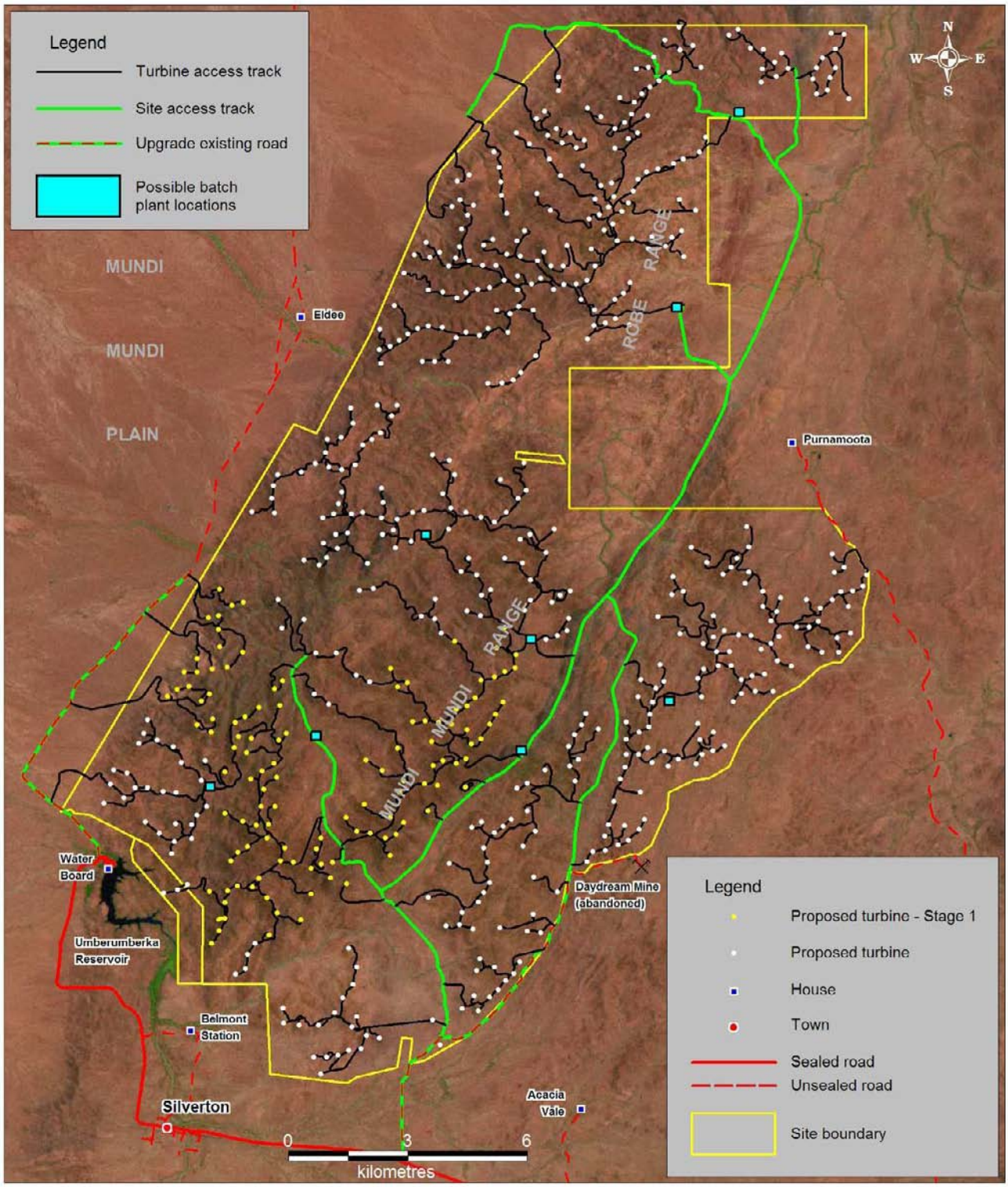

Figure 3.19 Likely concrete batch plant locations

3.4.2 Phase 2: Wind farm operation

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

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 vehicles.

In addition, regular maintenance is required, generally at three, six and twelve monthly intervals. As a guide, each turbine requires about seven 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 equipment failures could take place during the life of the wind farm. While wind turbines are designed for a 20 to 30 year life, failures can occur due to a number of factors including lightning strike (either onsite to wind turbines or offsite to the transmission line) and damage to key components (such as transformers or gearboxes). Failure can also occur on other equipment including that located in the site substations and transmission switchyard.

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

Site monitoring program

A post-construction site monitoring program would be established to determine impacts of the wind farm during the initial phase of operation. The Operation Environmental Management Plan will contain details of the site specific monitoring programs required and would assess key issues such as biodiversity, noise compliance and visitation numbers.

Further details of the monitoring and adaptive management mechanisms are included in Section 9.3.

3.4.3 Phase 3: Wind turbine refurbishment

The life of a modern wind turbine is typically 20 to 30 years at which point individual wind turbines would be refurbished, replaced, overhauled or removed from the site. Individual turbines may also fail at shorter lives for various reasons.

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.

The existing substations and cabling would be largely reused. It is also possible that the existing footings and towers could also be reused, subject to the designs of turbine 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 development consent under this application.

3.4.4 Phase 4: Wind turbine decommissioning

Should a turbine fail and it is not commercially viable to replace the turbine, the turbine would be decommissioned.

Decommissioning would involve similar road access arrangements to construction, and would require access for large cranes and transport vehicles to dismantle and remove the turbines. All underground footings and cable trenches would remain in situ and made safe, and all other equipment would be removed from site. The decommissioning period is likely to be significantly shorter and with significantly fewer truck movements than the construction phase.

It should be noted that the scrap value of turbines and other equipment is expected to be sufficient to cover the majority of the costs of their dismantling and site restoration.

3.4.5 Construction hours

Given the location of the site and distance from adjacent houses, it is proposed that normal construction hours would be waived for this project. The Traffic Management Plan would consider any impacts to residents from such a waiver.

It is likely that the majority of installation work would occur during daylight hours. However, some work (eg delivery or erection of turbines where feasible or permissible) may occur overnight due to logistic reasons. Turbine lifts, for example, can only be carried out during lighter wind periods and it is possible that night-time work would be required in this instance.

Also, given the location of the site, it is possible that some workers would operate on a longer shift basis, which would require working weekends.

3.5 SITE DISTURBANCE AND IMPACT AREA

The proposed wind farm requires the construction of a number of elements including turbines, turbine foundations, underground and overhead power lines, switchyard, substations, control building 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 restored following the completion of the construction program.

Table 3.3 presents the estimated area of the site impacted by the Proposal based on the proposed turbine layout. Some of these impacts would be for the duration of the wind farm operation and some are temporary impacts during the construction phase. In total, approximately two per cent of the site would suffer disturbance as a result of the Proposal, and some of these areas would be able to be rehabilitated after the construction phase.

Table 3.3 Development envelope

Description	Quantity or length	Estimated dimensions (m)	Estimated total area (hectares)
Transmission switchyard	1	300 x 300	9
Site substations	7	100 x 100	7
Control & communications building	1	25 x 40	0.1
Maintenance facility	1	60 x 50	0.3
Construction compound*	1	500 x 350	17.5
Concrete batching plants*	6	150 x 150	13.5
Turbine footing	598	15 x 15	13.5
Access and crane stand*	598	22 x 40	52.6
Access tracks and spur roads onsite*	380km	12 m width	456
External site access*	75km	12 m width	90
		Total affected area	659.5Ha
		Total site area	31,860Ha
		Percentage affected	2.07%

* Includes areas of existing disturbance (i.e. existing tracks) and areas that would be subsequently remediated and is accordingly a worst case.

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4. PROJECT JUSTIFICATION

4.1 PROJECT BENEFITS

Silverton Wind Farm Developments is committed to developing the Silverton Wind Farm in a way that minimises adverse local impacts and maximises the benefits of the Proposal to the local community and broader population. Based on a 598 turbine layout, the Proposal would offer the following broad benefits:

- Production of approximately 3,500,000Wh of renewable electricity per annum, sufficient for the average consumption of around 437,500 homes
- Reduction in greenhouse gas emissions of approximately 3.5 million tonnes of carbon dioxide (equivalent) per annum, the equivalent of taking 700,000 cars off our roads
- Savings in water consumption of approximately 4,600 million litres per annum of potable water (this is the amount of water required to produce the same amount of electricity from coal-fired power stations)
- Annual savings in pollution from coal-fired power stations of up to 18,760 tonnes of sulphur dioxide, 8,365 tonnes of nitrogen oxides and 535,000 kilograms of particulates
- Establishment of a community fund to assist in funding community and environmental projects that provide benefits to the Silverton community
- Improvement in local infrastructure in the Silverton region
- Protection and improved management of sensitive local biodiversity including the tawny rock dragon and a previously unrecorded spinifex ecological community
- Provision of 3,988 FTE regional jobs and injection of approximately $701 million into the regional economy
- Improved security of electricity supply through diversification.

4.2 THE VIABILITY OF WIND POWER

4.2.1 International wind power development

Wind power technology has evolved rapidly through a research and development stage in the 1980s, rapid expansion and consolidation in the industry in the 1990s and is now a mature, advanced mainstream energy technology. As the technology has developed, the cost of wind power has been reduced. In some regions, wind farms are already competitive with energy sources such as fossil fuels.

Wind farms are an increasingly important source of electricity generation worldwide. Internationally, by the end of 2007, the total capacity of wind energy was more than 94,000MW, which amounts to over four times the total capacity of power generation in New South Wales. Approximately 67 per cent of this has been installed in the last five years (GWEC 2008) and the global wind industry has been growing at the staggering rate of nearly 30 per cent per year for the last ten years (GWEC, 2008).

On global terms, the installed capacity of wind energy is predicted to reach 149.5 GW by 2010, which is roughly twice the installed capacity at the end of 2006 of 74.2GW (GWEC, 2007). The annual cumulative growth would be 19.1 per cent during the period 2006 to 2010.

According to a statement released 1 February 2007 by the European Wind Energy Association (EWEA), the EU cumulative wind power capacity increased by 7,588MW or 19 per cent to 48,545MW in 2006, representing a wind turbine manufacturing turnover of some €9 billion. China has the potential to be world's biggest wind energy market by 2020, recently doubling its current wind energy target for 2020 to 20,000MW (Hydro Tasmania 2006). In the USA, 2,400MW of new capacity was installed in 2006 and another 5,244MW in 2007, representing a percentage growth of 26.8 and 45.3 per year respectively.

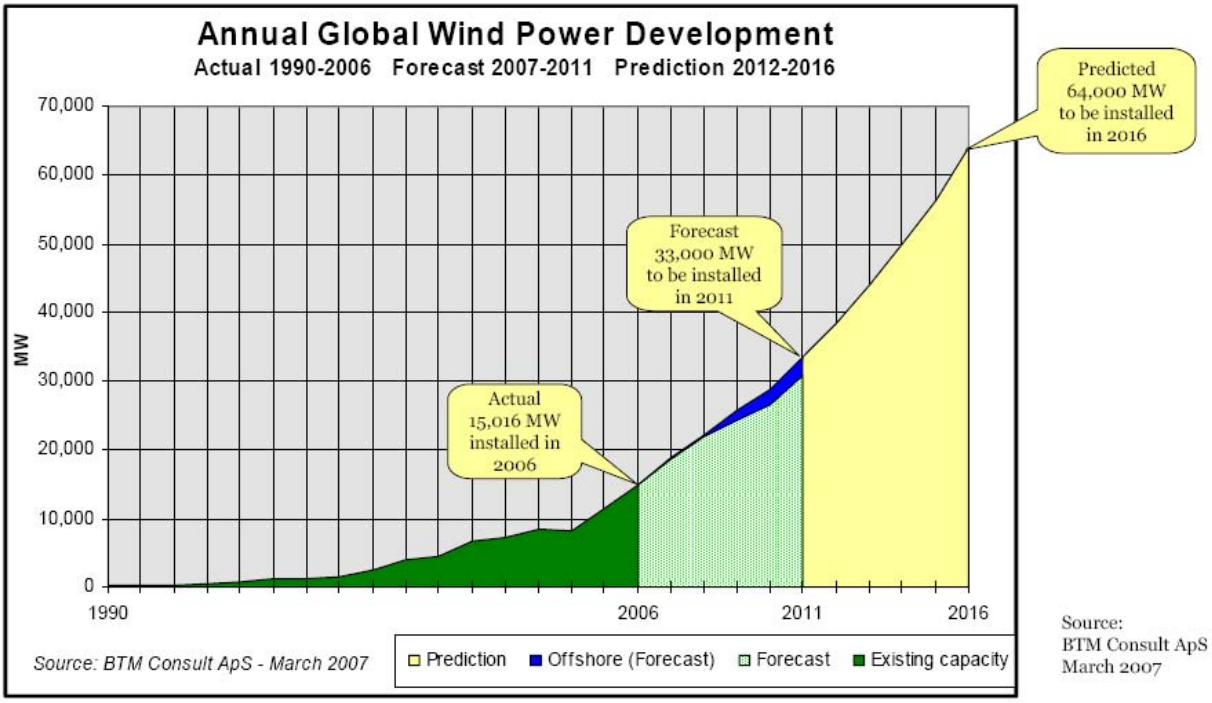

Figure 4.1 Annual global wind power development

(BTM Consult ApS, 2007)

In many countries, even with already strong growth, governments are implementing policies to further accelerate the adoption of wind and other renewables for electricity generation. In a media statement in December 2005 referring to the United Kingdom, the United Kingdom's Energy Minister, Malcolm Wicks, stated:

> *"As an island nation, we would be foolish not to exploit to the full all the natural resources that affords. Research from Oxford University recently confirmed that Britain has the best wind resource in Europe, providing most energy during peak daytime and winter periods. I am wedded to increasing the amount of energy we source from this and other forms of renewables. This year, there's been record growth in the industry and our drive to reach our 10 per cent target by 2010 is undiminished."*

The European Wind Energy Association (EWEA) summarises many of the drivers for increased government support for wind as part of a balanced energy policy:

> *Wind energy is a significant resource; it is safe, clean and abundant. Unlike conventional fuels, wind energy is an indigenous supply permanently available in virtually every nation in the world, delivering energy security benefits of eliminating fuel costs and long-term fuel price risk, and avoiding the economic, political and supply risks of dependence on imports from other countries. Wind power has no resource constraints; the fuel is free and endless. (EWEA 2005)*

The Global Wind Energy Report 2006 reviews the recent and substantial forecast growth in the wind industry around the world.

> *Wind Energy is becoming an established, mainstream power source in a rapidly growing number of countries, and that growth will, and must, continue, as we seek to stave off the effect of global climate change and create true energy security. (GWEC, 2007)*

Table 4.1 Installed wind power capacity (GWEC 2007 and WWEA 2006)

Region	Installed capacity 2007 (MW)	Installed capacity 2007 in %	Installed capacity 2006 (MW)	Installed capacity 2006 in %
Europe	57,136	60.7	48,563	65.4
Americas	19,199	20.4	13,542	18.3
Asia	16,091	17.1	10,659	14.4
Australia/Pacific	1,158	1.2	1,000	1.3
Africa	528	0.6	369	0.6
World	94,112	100	74,133	100

Table 4.2 Top 20 countries by installed capacity:

Rank	Country/region	Additional capacity installed in 2007 (MW)	Percentage increase in capacity in 2007 (%)	Total capacity installed at end 2007 (MW)
1	Germany	1,667	8.1	22,247
2	USA	5,244	45.3	16,818
3	Spain	3,522	30.3	15,145
4	India	1,730	27.6	8,000
5	China	3,449	132.4	6,050
6	Denmark	3	0.1	3,125
7	Italy	603	28.4	2,726
8	France	888	56.6	2,454
9	United Kingdom	427	21.7	2,389
10	Portugal	434	25.3	2,150
11	Canada	386	26.4	1,846
12	The Netherlands	210	13.5	1,746
13	Japan	139	10.0	1,538
14	Austria	20	2.1	982
15	Greece	125	16.8	871
16	Australia	7	0.9	824
17	Ireland	59	7.9	805
18	Sweden	217	38.0	788
19	Norway	8	2.5	333
20	New Zealand	151	88.3	322

Source: Global Wind Energy Council press release 6 February 2008

4.2.2 Wind power in Australia

In Australia, the cost of wind energy is more than the cost of coal-fired electricity at the wholesale level. In the past, wind farms have become economically viable as a result of the introduction of the Federal Government's Mandatory Renewable Energy Target (MRET). MRET required electricity retail companies to purchase a percentage of their power from renewable energy sources.

While the existing MRET of 10 per cent renewable electricity by 2010 is approaching full subscription, following recent elections, the new Federal Government announced its commitment to expand the renewable energy target to 20 per cent by 2020. This would require in the order of 45,000GWh of new renewable energy generators to be built across Australia by 2020. To deliver on this commitment, the Government is working in cooperation with the states and territories through the Council of Australian Governments (COAG) to implement an expanded national Renewable Energy Target (RET) that will bring the MRET and existing and proposed state and territory targets into a single national RET scheme. On the 2 July 2008, the COAG Working Group on Climate Change and Water released a consultation paper on key design issues for the expanded RET scheme, seeking comments from interested stakeholders. The Federal Government currently intends to implement the proposed legislative changes by mid-2009.

In mid 2007, NSW State Government introduced new legislation to parliament called the Renewable Energy (NSW) Bill as part of the Government's Greenhouse Policy to encourage additional generation of renewable energy. The NSW renewable target is also referred to as NRET and requires 10 per cent of electricity to be sourced from renewable energy by 2010 and 15 per cent by 2020. Once operational, the NSW RET scheme will be absorbed into the National RET scheme. However, the proposed legislative changes have confirmed that all projects approved under the existing state-based schemes will be eligible under the expanded RET scheme. The proposed Silverton Wind Farm would provide renewable energy, which is expected to be eligible for Renewable Energy Certificates under either the State or Federal Government's scheme. The full costs of these schemes have already been taken into account by electricity retail companies in power prices set by them. Therefore the wind farm would not increase prices for NSW residents or businesses. In fact, it would reduce the costs of production by reducing transmission losses to the region.

Many people in Australia do not acknowledge the government support that coal-fired generators have received over many years, and believe that schemes such as MRET or NRET are unwarranted. Renewable energy targets were established in legislation to assist the development of this new industry in Australia, and to reduce greenhouse gas emissions from power generation. By doing so, these renewable targets (and wind farms) would provide a base for cheaper and cleaner power into the future.

4.2.3 Viability of this project

The Silverton Wind Farm would be developed by a private company. Accordingly, it is necessary for the project to provide an adequate financial return. The commercial viability is driven primarily by capital costs and the related cost of financing such projects. While the energy in the wind is free, the energy produced must make sufficient return to cover the high upfront costs of building the wind farm.

In the case of this Proposal, the commercial viability is supported by the scale of the Proposal, the ability to construct in stages, the existing transmission line connections and the very good wind speeds that have been measured on the site.

A number of elements included in this Proposal, such as the installation of power lines underground, result in increased costs to the Proponents, and these higher costs have been accepted where they result in a project that is still commercially feasible.

4.3 COMMUNITY SUPPORT FOR WIND FARMS

4.3.1 Government policy objectives

The Proposal would promote renewable energy generation and thereby limit greenhouse gas emissions associated with energy production and is in line with Federal and State Government promotion of renewable energy, including:

- The Commonwealth Government support for renewable energy provision through the National Greenhouse Strategy (NGS), the existing Mandatory Renewable Energy Target (MRET) and the planned expanded national Renewable Energy Target (RET)
- The NSW Government has also demonstrated support for a greater uptake in renewable energy through the announcement of the NSW Renewable Energy Target in November 2006. This target proposes that 15 per cent of NSW's electricity should come from renewable energy by 2020
- The NSW Government has demonstrated their support for large electricity generation projects through the designation of projects in excess of 250MW as Critical Infrastructure under the *Environmental Planning and Assessment Act 1979*
- The NSW Government supports renewable energies through programs of the Sustainable Energy Development Authority (SEDA), which has been incorporated into the Department of Energy, Utilities and Sustainability (DEUS), the NSW Greenhouse Gas Abatement Scheme and the NSW Greenhouse Office
- Increased consumer demand for electricity generated from renewable sources is apparent in the national 'Green Power' accreditation program, which sets environmental and reporting standards for renewable energy products offered by electricity suppliers.

State and Federal Governments have been shown to support wind farms for their ability to produce renewable energy while reducing greenhouse gas emissions. This support is in line with broader community attitudes towards power generation, greenhouse gas emissions, climate change and renewable energy generation.

4.3.2 National Telephone Survey

A telephone survey of 1027 participants was carried out in August 2003 by the Australian Research Group Pty Ltd on behalf of the Australian Wind Energy Association (ARG 2003). This report found strong support for renewable energy, and wind farms in particular:

- 94 per cent of respondents thought that a target to increase the contribution of clean energy from renewable sources was a good (32 per cent) or very good (62 per cent) idea. Less than three per cent considered the current target to be too high or much too high
- 80 per cent of respondents said they would be more likely (53 per cent) or much more likely (27 per cent) to think John Howard was doing a good job as Prime Minister if he increased the amount of electricity generated by non-polluting means such as solar or wind energy
- The majority of respondents are prepared to pay more for cleaner energy. A substantial majority of respondents (76 per cent) said that they were prepared to pay five per cent more on electricity bills for 10 per cent more clean energy when faced with the option of having cheap electricity at any cost
- The renewable energy sector has substantial community support. 88 per cent of respondents want the Government to increase support to the renewable energy sector compared with only 26 per cent wanting to see an increase in support to the fossil fuel sector
- Very strong support exists for building wind farms. 95 per cent support (27 per cent) or strongly support (68 per cent) building wind farms to meet Australia's rapidly increasing demand for electricity
- 91 per cent think it is more important to build wind farms for electricity than avoid building them in rural Australia

— Greenhouse pollution is an issue of considerable concern. Fifty-nine per cent would be more likely or much more likely to think that John Howard was doing a good job as Prime Minister if he signed the Kyoto Protocol

— For 71 per cent of respondents, reducing greenhouse pollution outweighs protecting industries that rely on reserves of fossil fuel.

Interestingly, respondents residing in the city were as likely as those in regional/outer metro areas to support building wind farms; however, city respondents were more likely than regional/outer metro respondents to **strongly** support this electricity option (72 per cent and 64 per cent respectively). The clear majority (91 per cent) of respondents indicated that building pollution-free wind farms for electricity is more important than avoiding building wind farms in rural Australia (4 per cent).

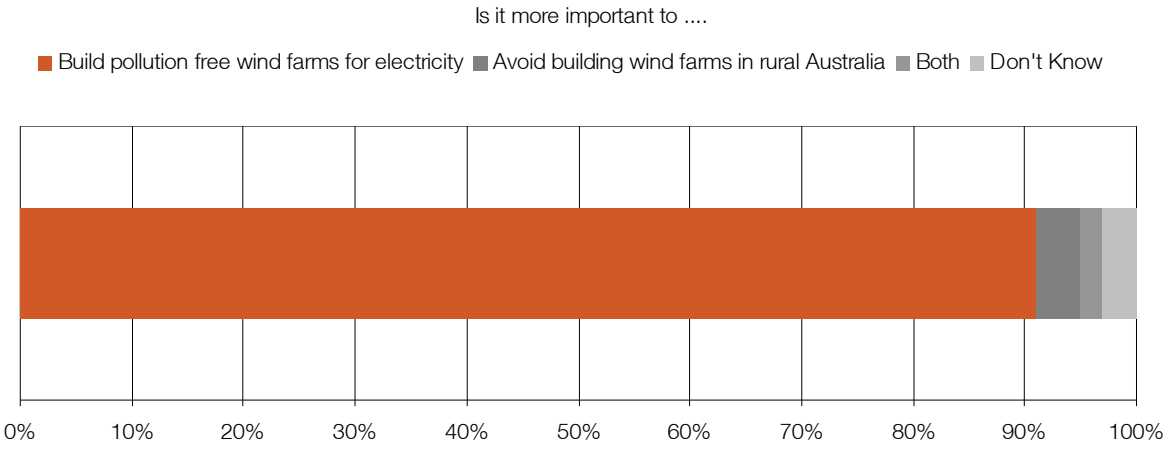

Figure 4.2 Community support for building wind farms

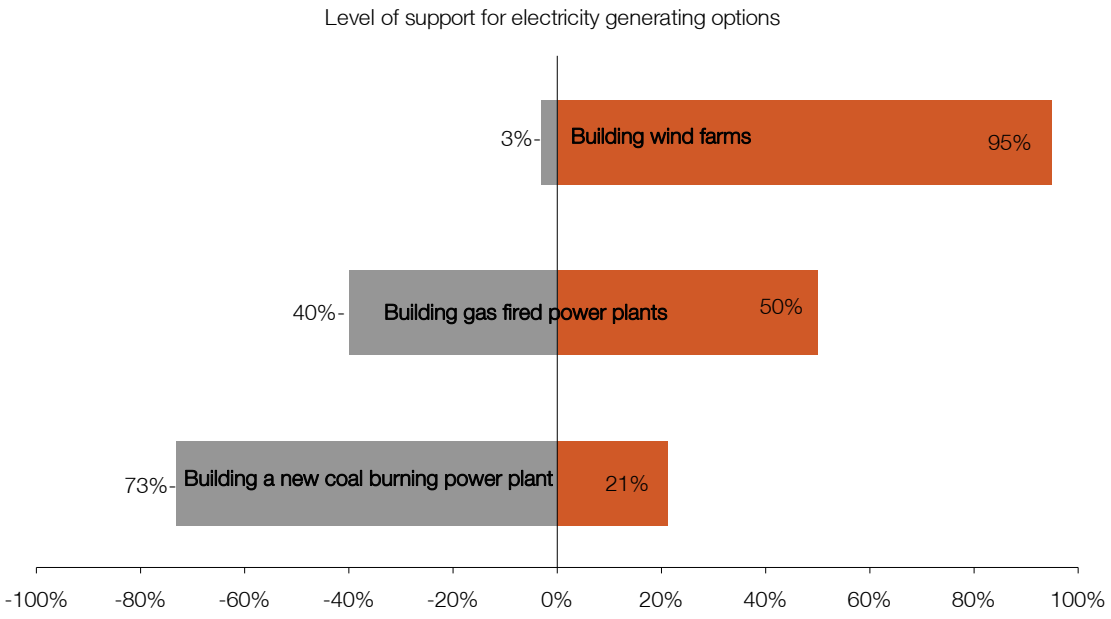

Figure 4.3 Community support for electricity generating options

Silverton village wind farm ballot

The Silverton Village Committee held a secret ballot to determine whether the people of Silverton supported the wind farm Proposal. As reported in the Barrier Daily Truth on Saturday 15 March 2008, 36 respondents voted in favour and 20 voted in opposition with two ballot papers not returned. The Committee Secretary is quoted as stating: 'We now know the mood of the town. We can move forward and work with whoever we need to work with for a positive outcome for Silverton.'

4.3.3 NSW Southern Tablelands Survey 2007

A recent random phone survey of 300 residents of the Goulburn/Crookwell/Yass region was undertaken by REARK Research (on behalf of Epuron) in July 2007 to determine the community perception of wind farm developments in the Southern Tablelands.

The Silverton Wind Farm is not located within the area surveyed. However, this survey appears significant in that it shows the perspective of a community that has a long track record with development of wind farms, and is experienced with the issues and benefits associated with wind farms.

The survey matched the demographic profile of the area based on the census records and had a sampling precision of 5.7 per cent at the 95 per cent confidence level.

The outcomes from this study show:

- 80 per cent of respondents are concerned, right now, with the threat of global warming and its impact on the environment; 16 per cent said they were unconcerned
- Nine in ten respondents had seen a wind turbine, and more than eight in ten had seen the Crookwell wind farm. Awareness of wind turbines was very high
- 90 per cent of respondents were aware of announcements of wind farms to be built in the Southern Tablelands
- 89 per cent of respondents were in favour of wind farm projects being developed in the Southern Tablelands; 5 per cent were opposed
- 83 per cent of respondents stated: 'I would be happy to see a wind farm built on farm land near where I live'
- When respondents were asked regarding the acceptability of a wind farm near where they lived, 87 per cent supported a wind farm within 25 kilometres, and 71 per cent of respondents favoured a wind farm within one kilometre of their home
- In considering multiple wind farms in their local rural area, three out of four respondents accepted two 'typical' wind farms (15 to 80 turbines), and two out of three respondents accepted three typical wind farms in their local area.

This study shows the adult residents in the survey area are concerned about global warming and are aware of the alternatives available. The study also shows respondents know and understand what a wind turbine is and how wind farms appear in the landscape. Respondents are generally supportive of wind farms.

Moreover, when it comes to locating wind farms, respondents are supportive (rather than averse) to having wind farms in their immediate locality, and a majority still approve of a wind farm within one kilometre of their home.

It is suggested that respondents feel the creation of wind farms is positive and this study shows that many are prepared to embrace wind farms in their local area.

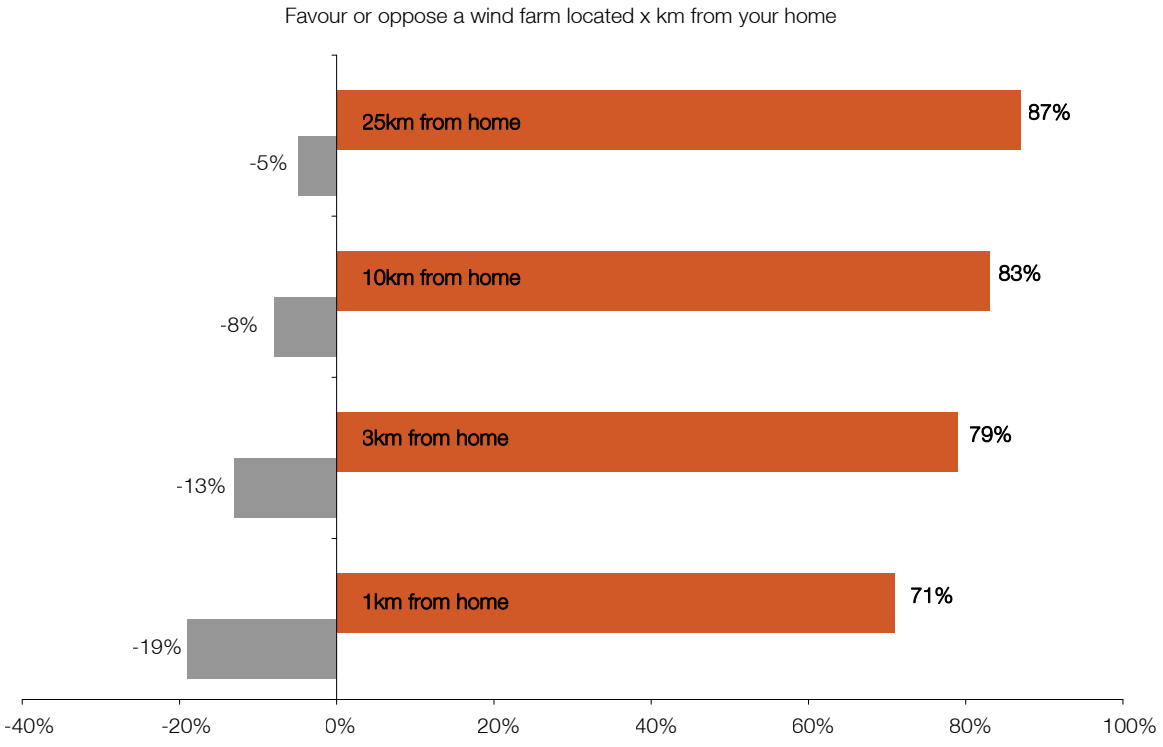

Figure 4.4 Community support for wind farms located near their home

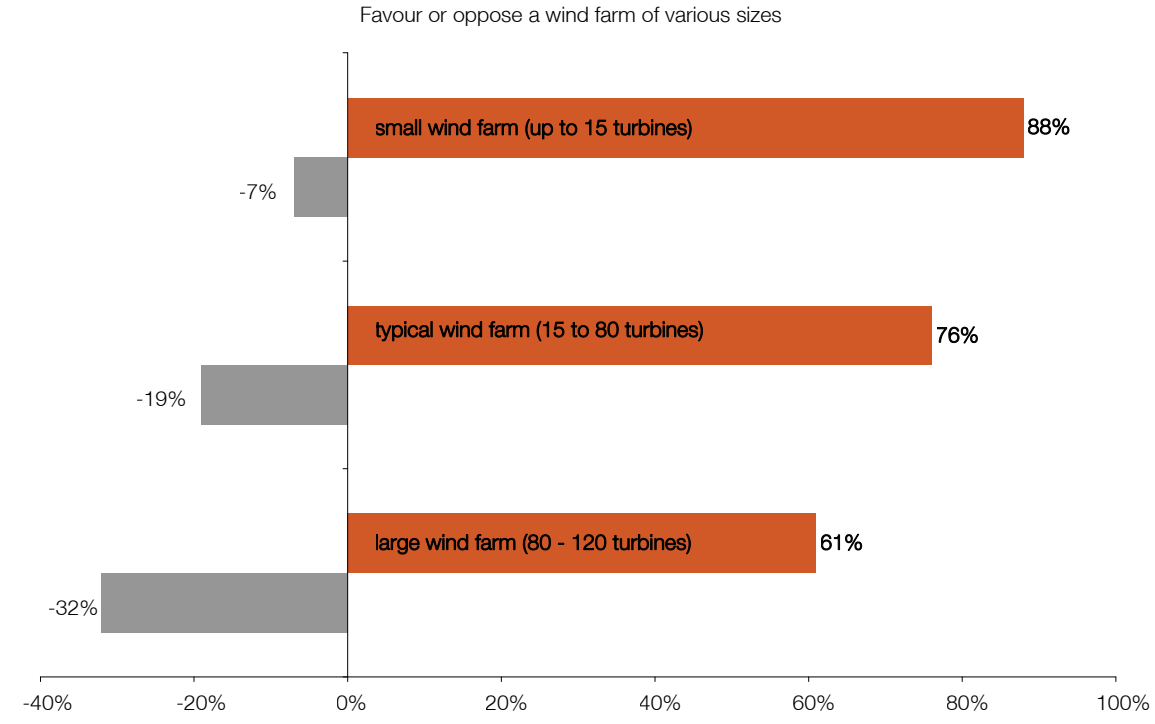

Figure 4.5 Community support for wind farms of various sizes

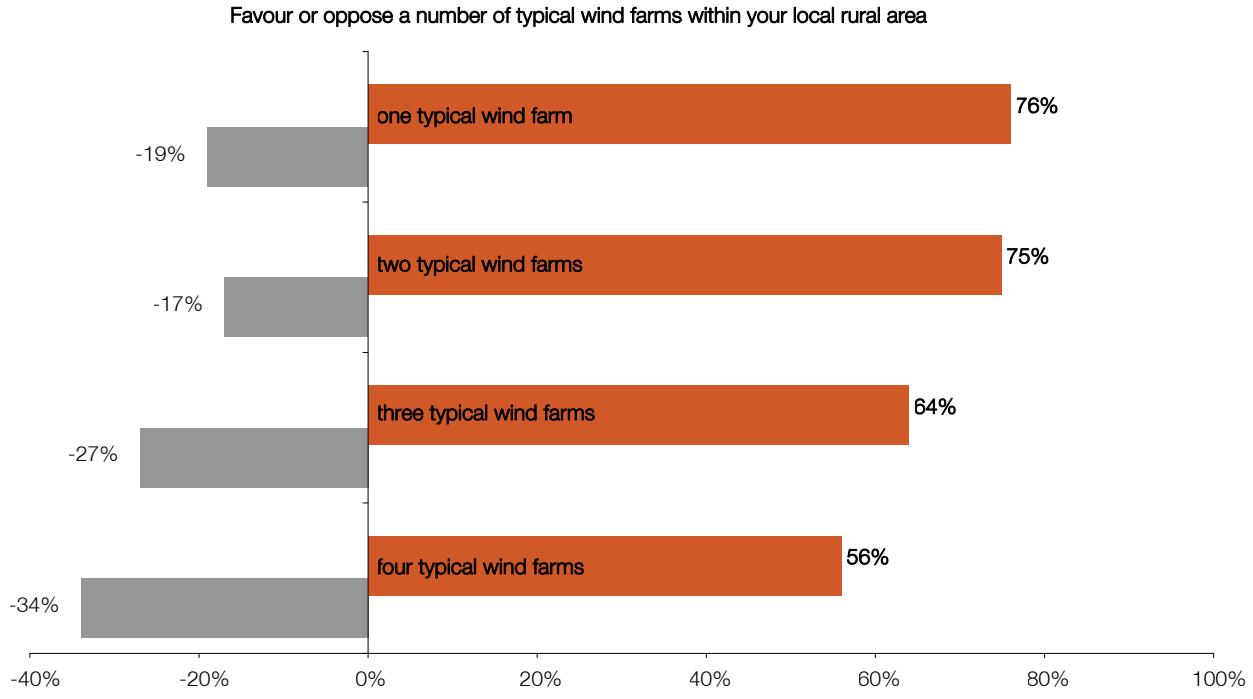

Figure 4.6 Community support for multiple wind farms within their local area

4.4 REGIONAL AND GLOBAL BENEFITS

4.4.1 Public electricity generation from renewable resources

Energy production of Silverton Wind Farm

The Proponent has prepared an initial power generation calculation for a range of wind turbines currently under consideration. This calculation is based on Windographer™ software, which allows analysis of industry standard weather monitoring data (including wind speeds and directions as well as air temperature, pressure and humidity). Windographer™ also provides a large range of wind turbine output parametres for assessment, and allows predictions of wind speeds at various hub heights depending on the turbines selected.

On the basis of these studies, energy production estimates (on a sent-out basis) for the Silverton Wind Farm are in the range of 6.5 to 10GWh per turbine per annum. This calculation is based on a predicted typical year, with variations around this average in the order of 10 to 20 per cent likely for any single year.

The final site capacity is based on the output per wind turbine multiplied by the number of wind turbines installed. The number of wind turbines is limited to the maximum number proposed (598 turbines); however a smaller number of turbines may be installed depending on the site transfer capacity confirmed as a result of final grid connection studies. By way of example, if we consider the REpower 3.3M, its nameplate capacity is 3.3MW. If the site transfer capacity is found to be 1,000MW, this would limit the number of REpower 3.3M machines to 303 machines. However, the energy output per machine of this turbine is in the upper end of the range proposed, therefore the energy production of the site could be higher from this turbine than a larger number of smaller turbines.

Accordingly, the overall site energy generation capacity is impacted by the site transfer capacity. Studies to date suggest that a site transfer capacity of at least 1,000MW is available based on the transmission connection strategy outlined in Section 3.2.4. Based on this minimum site transfer capacity, the Proponent's analysis suggests a site generation capacity of 3,000 to 4,000GWh per annum.

Predictions used in this report are therefore presented on the basis of a mid-range figure of 3,500 GWh per annum. Further figures in this report are based on this production estimate.

Domestic electricity consumption in NSW was 7,399 kWh on average in 1999, growing from 6,983 kWh on average in 1990 (DEUS 2000). We have used a figure of approximately 8,000 kWh on average for 2007 based on ABS figures.

On this basis, production of electricity from the Silverton Wind Farm of 3,500,000 MWh per annum would equate (on an annual average basis) to the annual electricity use of approximately 437,500 average NSW homes.

Life cycle assessment and embodied energy

Wind power is a clean form of energy, which during operation produces no carbon dioxide (CO2) emissions. While some emissions of these gases would take place during the design, manufacture, transport and erection of wind turbines, enough electricity is generated from a wind farm within a few months to totally compensate for these emissions. When wind farms are dismantled, they leave no legacy of pollution for future generations (AWEA 2006a).

The Danish Wind Turbine Manufacturers Association prepared a life cycle analysis (LCA) of wind turbine manufacture that investigated the manufacturing, construction, installation, operation and decommissioning impacts of wind turbines. This particular study investigated a 600kW onshore and 1.5 MWoffshore wind turbine, and found in both cases an energy payback period of less than four months (when scrapping of the equipment is taken into account). Given the lifetime of a typical wind farm is 20 to 30 years, this means that the wind turbines generate approximately 60 to 90 times the energy used in their construction over their life (DWTMA 1997).

Vestas have prepared a report on the Life Cycle Assessment of the V90 (3.0MW) turbine (Vestas, 2006) calculating the energy balance for an onshore V90 (3.0MW) is 6.6 months. The energy balance (or payback) is the duration the turbine is required to operate until the energy required to manufacture, operate, transport, dismantle and dispose the turbine is paid back.

Need for new power generation in NSW

Wind farms are an economically viable means of generating electricity and have many environmental benefits when compared to currently available alternatives. In New South Wales, a combination of hydro-power generators and coal-fired generators supply the population's power needs. Even with the considerable scale of the Snowy Mountains Hydro-Electric Scheme, coal-fired and gas-fired power generators supply around 90 per cent of New South Wales electricity consumption and this percentage is increasing.

The proposed Silverton Wind Farm would not cause one of NSW's 2,640 MW coal-fired power stations to be permanently closed down. However, every megawatt-hour of electricity produced from the proposed wind farm would mean a megawatt-hour of electricity is not required from fossil fuel power stations. This in turn reduces fossil fuel required to provide power, which reduces greenhouse gas emissions.

On a regional level, wind farms address the increasing demand for electricity in New South Wales, the loss of efficiency during transport (by generating electricity more locally) and provides renewable and clean source of electricity to the region.

Growth in electricity demand will soon exceed electricity supply during peak times. According to TransGrid's Annual Planning Statement 2007, scheduled demand projections show that additional generation would be required to manage peak periods by summer 2008/9. Accordingly, New South Wales requires additional electricity generators to be built to meet this demand, and to avoid power outages and blackouts.

The role of wind farms in NSW in meeting peak demand is under investigation, with preliminary studies indicating at least 15% of installed wind capacity may be relied upon at times of peak demand. The development of the Silverton wind farm would greatly diversify the distribution of wind farms in NSW, leading to increased reliability of wind generation during peak demand periods.

Interaction with the electricity network

Wind power provides a reliable and dependable electricity production. While on a day-to-day basis wind power output fluctuates with wind speed, on an annual basis output variation is small, and generally within 10 to 20 per cent of the long-term average. This is in contrast with hydro power, for example, where output of some power stations can drop to zero output during drought years.

The hourly fluctuations in wind speed, and therefore wind power output, are not significant in relation to the existing fluctuation of loads within the electricity system. Figure 4.7 shows NSW Regional Reference Price (RRP) and electricity demand over a 24-hour period in February 2008. Figure 4.8 shows NSW electricity demand over a 12-month period. These figures show a daily variation of approximately 6,000MW or more than five times the maximum possible output available from the proposed wind farm. The existing electricity system in NSW is more than strong enough to cope with output fluctuations of the wind farm.

New modelling technologies being implemented by NEMMCO allow the prediction of wind farm output to be built into the National Electricity Market (NEM) system models. This allows NEMMCO to operate the system on a daily basis with detailed knowledge of likely wind farm outputs at any point in time. Accordingly NEMMCO is able to compensate for variations in wind outputs in operating the NEM on a daily basis.

Transmission benefits

In addition to their own electricity production, wind farms also reduce transmission line losses that arise from long distances that power must be transmitted to supply regional locations. This reduces the overall cost of power supply in New South Wales, and further reduces greenhouse gas emissions.

Well-located wind farms also better use existing transmission line infrastructure, providing better use of assets and, in some cases, reducing or removing the need to build new transmission line to supply customers.

In the case of this Proposal, Silverton Wind Farm is to be connected to a region of the NEM which corresponds to the intersection point of three regions – NSW, Victoria and South Australia. The flow of power at the interconnection points of the regions is dependant on the total load and generation within each region. The historical direction of power flow has predominately been from South West NSW into Central and Western Victoria through a very long 330/220kV system stretching west from Wagga Wagga.

The Silverton Wind Farm would initially connect to the Broken Hill 220kV substation and supply the Broken Hill load. Any power in excess of the requirements of Broken Hill would be transferred by the existing Broken Hill – Buronga X2 transmission line. Once this power line is nearing capacity a new 220kV power line connection would be built from Silverton to Red Cliffs in Victoria. Conceptual studies for the project indicate that at full capacity the Silverton Wind Farm is likely to meet load requirements of western NSW and northern Victoria. In particular, loads in the following areas are expected to be fully or partially met:

Substation draft 2007/08	Marginal loss factor
Broken Hill	1.1736
Red Cliffs	1.1579
Kerang	1.1306
Horsham	1.1014

(Source: NEMMCO)

A loss factor of 1.1736 for Broken Hill means that for each MWh of electricity consumed at Broken Hill an additional 0.1736 (17 per cent) losses are created on powerlines servicing that consumption.

The impact on losses resulting from the Silverton Wind Farm would be affected by multiple factors including the stage of the project; the physical arrangement of powerlines; the wind speed (and therefore power output) at each point in time; as well as the electricity market status in NSW, VIC and SA.

Initial loss calculations in the concept study found:

- Based on an export capacity of 260MW, peak losses on the X2 power line between Silverton wind farm and Buronga are estimated at 6.3 per cent
- Peak losses between Silverton wind farm and Red cliffs when operating at an export capacity of 1010MW are estimated at 7.2 per cent
- These peak loss calculations show losses substantially below the existing marginal loss factors outlined above.

The Proposal includes significant transmission infrastructure that would bring long-term economic benefits to NSW and improve supply reliability in Broken Hill.

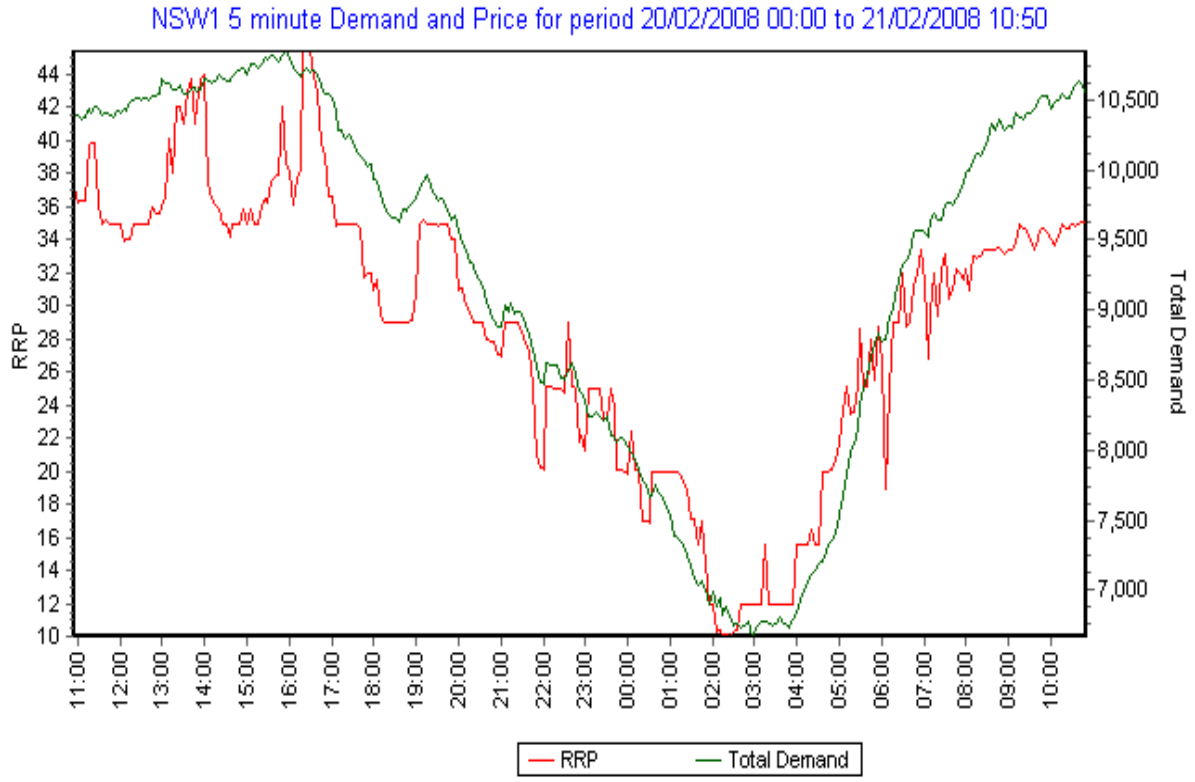

Figure 4.7 Daily variation in NSW electricity demand (20 February 2008)

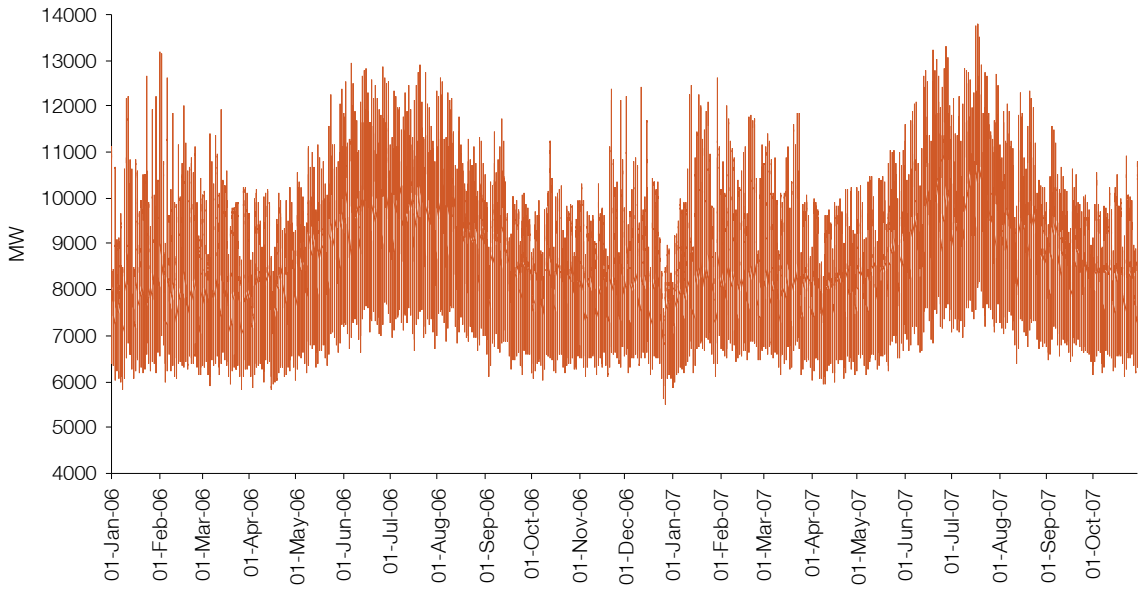

Figure 4.8 Annual variation in NSW electricity demand (2006/07)

4.4.2 Greenhouse gas emission reduction

Climate change

There is increasing evidence that greenhouse gas emissions result in the warming of the earth's surface and have associated adverse impacts on weather patterns and natural ecosystems. According to the David Suzuki Foundation:

Rising average temperatures do not simply mean balmier winters. Some regions will experience more extreme heat, while others may cool slightly. Flooding, drought and intense summer heat could result. Violent storms and other extreme weather events could also result from the increased energy stored in our warming atmosphere. (DSF 2006)

The foundation goes on to list the following general impacts of climate change:

- **Extreme weather**: Climate change will increase the potency of storms, floods, droughts and other weather disasters
- **Water impacts**: Climate change will seriously affect water resources around the world, which will in turn affect food supply, health, industry, transportation and ecosystem integrity
- **Imperilled ecosystems**: Ecosystems around the world will be damaged by climate change. (In Australia, particularly sensitive ecosystems include the Great Barrier Reef and the alpine areas including the Snowy Mountains)
- **Global meltdown**: Alpine glaciers, arctic ecosystems and ice sheets are all at risk of succumbing to climate change, with global impacts
- **Health**: Climate change threatens the health of future generations through increased disease (such as malaria), fresh water shortages, worsened smog and more
- **Economic risks**: Rapid climate change poses incalculable economic risks for the future, which far outweigh the economic risks of taking action today.

In relation to this last point, the insurance industry is one of the first to notice these direct economic impacts. According to the David Suzuki Foundation, before 1988 the global insurance industry never had claims for more than US$1 billion in any single natural disaster. Yet between 1988 and 1996, 15 such events occurred and a number of insurance companies closed down in the wake of these disasters.

According to the Munich Reinsurance Corporation of Canada, “Economic losses caused by natural catastrophes are likely to bring home the effects of climate change more and more dramatically as time goes by.”

In addition, the cost to business of adapting to climate change will be significant, and the longer this adaptation is delayed the more significant and more severe will be the impact.

Greenhouse gas reduction from this project

According to the Australian Greenhouse Office, stationary (ie non-transport) energy supply is the largest and fastest growing sector in terms of greenhouse gas emissions in Australia. The stationary energy sector accounted for 48 per cent of total emissions in 2002. Emissions from electricity generation make up nearly 70 per cent of stationary energy emissions. Between 1990 and 2002, emissions from electricity increased by 53 Mt CO2-e, an average of 2.9 per cent per year (AGO 2005). Therefore in Australia, 33 per cent of total greenhouse gas emissions are produced during the generation of electricity.

Within the electricity sector in NSW, approximately 90 per cent of electricity is generated by fossil fuel power stations, primarily coal-fired power stations. Greenhouse gas emissions from electricity generation in New South Wales grew by 44 per cent between 1990 and 2002 (NSW Government 2004).

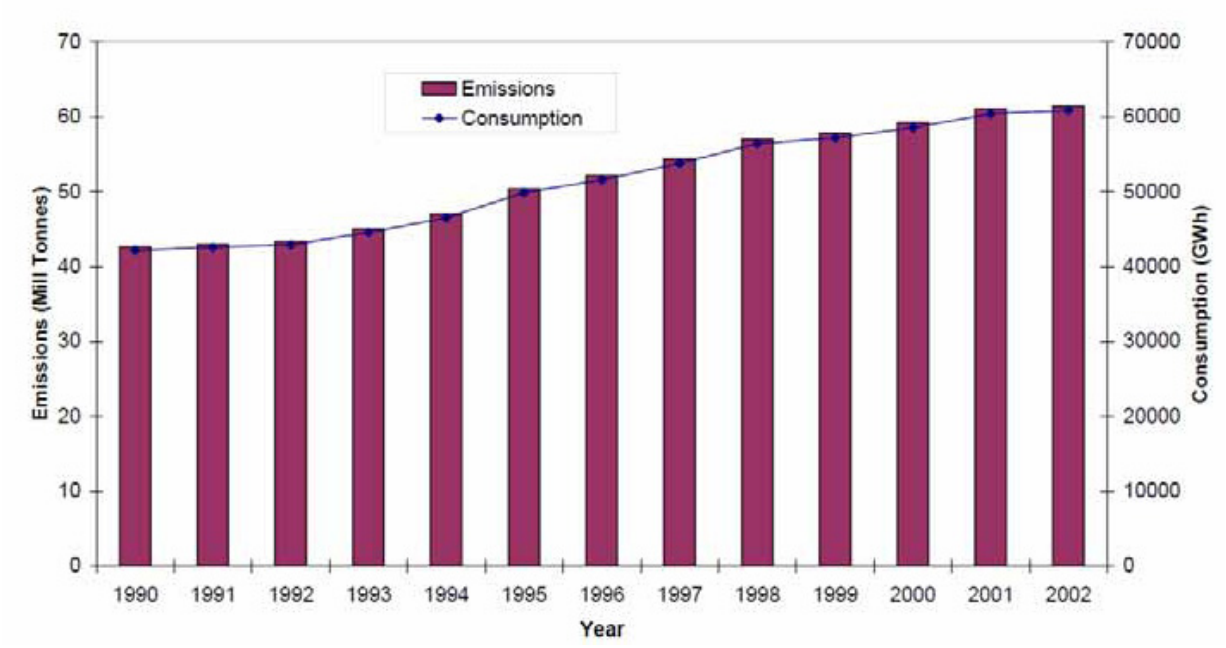

Figure 4.9 Greenhouse gas emissions from NSW power stations

(NSW Government 2004)

The nature of the NSW power system and the dominance of coal as the fuel source, means that fossil fuel power stations are also the ‘marginal generator’. The zero fuel cost of renewable energy (such as smaller hydro, biomass and wind power) means that these renewable energy sources are dispatched whenever generation is available, and coal-fired power stations are reduced or increased in output to match the overall system generation with the required load. Although the Snowy Hydro is capable of supplying a very large amount of power, it can generally only do this for very short periods in order to maintain the water levels in its dams.

Accordingly, each megawatt-hour of electricity generated by a renewable energy generator (e.g. the Silverton Wind Farm) would reduce coal-fired generation by approximately one mega watt. This may not mean that existing coal-fired power stations are shut down, but it does mean that less coal is burnt in these power stations and therefore greenhouse gas emissions are reduced.

The most recent greenhouse gas emissions coefficient for the NSW electricity system is the NSW Annual Pool Value for 2006 of 0.969 tonne CO2e/MWh (NSW Greenhouse Office 2005). Total NSW greenhouse gas emissions (tCO2e) have been growing rapidly in recent years as shown in Figure 4.9

Table 4.3 NSW electricity system greenhouse gas coefficients

Year	Total NSW population	Total NSW emissions (tCO2-e)	Total NSW sent out generation (MWh)	Annual pool value tCO2- e/MWh
2003	6,678,400	63,431,793	66,800,866	0.950
2004	6,752,100	65,979,036	67,276,401	0.981
2005	6,812,300	65,896,606	69,341,455	0.950
2006	6,869,400	70,010,515	72,222,646	0.969

Source: NSW Greenhouse Office 2005, GGAS newsletter, December 2006 and December 2007

This means that for each megawatt-hour of electricity consumed in the NSW electricity pool, approximately 1,000 kilograms of greenhouse gases are emitted, primarily from coal-fired power stations.

The proposed wind farm would represent a renewable, non-greenhouse gas producing method of electricity generation to meet increasing demand. Every megawatt-hour of electricity generated by the wind farm would reduce generation elsewhere in the system by approximately the same amount. This would reduce emissions from electricity generation by over one tonne of CO2-equivalent per MWh, as well as reducing losses within the electricity transmission system.

This means that for each megawatt-hour of electricity generated by the proposed wind farm, the emission of at least 1,000 kilograms of greenhouse gases is avoided. For comparison, a typical vehicle using ten litres of petrol per 100 kilometres and driving 20,000 kilometres per annum would have a greenhouse gas emission of approximately 250g/km, or an annual emission of around five tonnes (Australian Government 2006).

Section 4.4.1 outlines the expected energy production of the Silverton Wind Farm, which is expected to be approximately 3,500,000MWh per annum in a typical year.

The wind farm would reduce greenhouse gas emissions by up to 3.5 million tonnes of CO2e per annum, or a cumulative effect of 70 million tonnes of CO2e over the first 20 years of the wind farm operations.

This is the equivalent reduction in greenhouse gas emissions of taking 700,000 typical cars off our roads for the life of the wind farm.

Reduced impacts of climate change

Climate change is a scientifically proven result of human-induced greenhouse gas emissions, leading to an increased instability of climatic systems, significantly changed weather patterns worldwide and a general warming of the globe.

Recent research by the CSIRO for the NSW Government shows the likely impacts of climate change to NSW may include (NSW Government 2004):

- A 70 per cent increase in drought frequency by 2030, leading to less rain and less water for farms, cities, power stations and rivers
- Major costs to farmers of managing impacts such as reduced water availability, increased hail damage and the spread of tropical pests
- Increased risks to buildings and infrastructure from storms, bushfires, floods and lightning strikes
- Higher insurance premiums, more restricted insurance coverage and the withdrawal of cover from the highest risk areas
- An increase in the number of extremely hot days each year
- Extinctions of threatened animals and plants
- Threats to human health from heat stress, mosquito-borne diseases and injuries from storms and floods.

Various scientists have assessed the likely impacts of climate change in Australia, captured in a report titled 'Climate Change: An Australian Guide to the Science and Potential Impacts', prepared for the Australian Greenhouse Office 2003 (AGO 2003). This incorporated major contributions from CSIRO, Griffith University, Sydney University, Australian National University, Monash University and others.

The climate change report highlights current scientific expectation of the impacts of climate change in Australia. Vulnerabilities of New South Wales include floods, droughts and forest fires. Projected adverse impacts on Australian agriculture, as a consequence of reduced local production capacity and increased production in positively affected northern hemisphere countries are particularly relevant to agricultural economies in rural NSW. Section 4.3 of the report outlines the largely negative impacts in Australia of climate change on pastoral activities, on cropping and agriculture, on fisheries, on forestry, on drought, and on pests, parasites and pathogens. It goes on to discuss the effects on sustainability of the industry in the presence of global markets (AGO 2003).

4.4.3 Energy security

In addition to broad environmental benefits, the development of wind energy in Australia has security implications as a stable and renewable energy source. Wind farms offer a diversification of the existing electricity supply infrastructure, which helps to mitigate risks of power station failures, potential acts of terrorism and price risks from fossil fuels that are tied strongly to international energy prices.

A single coal-fired power station in NSW can generate up to 2,640MW, or approximately 20 per cent of the total NSW generation capacity. Any kind of outage or failure of such a power station, whether cause by fault or terrorism, would have a significant impact on the operations on the electricity system and thereby the economy as a whole. In addition, fossil fuel prices are currently being pushed to record levels. For example, the price of oil has more than tripled since 2001, reaching an all-time high of almost US$100/barrel in November 2007. The prices for fossil fuel energy used for power generation, in particular gas, are strongly linked to international markets.

Gas is recognised as the likely fuel of choice for future NSW power generation capacity. According to ABARE, there are currently proposals for 13 new power stations in NSW, with operational dates up to 2013 and a total capacity of 6,064 MW. Eleven out of the 13 of these projects are gas-fired power stations, with the remaining power stations coal-fired and making up 32 per cent of new capacity (ABARE 2005). The supplemental use of wind power, with its free fuel cost, helps to decouple electricity prices from international oil and gas markets.

Corin Millais as CEO of the European Wind Energy Association summarised the situation:

Wind power has zero fuel price risk, zero fuel costs and extremely low operation and maintenance costs. In addition, wind provides total protection from carbon costs, and zero geo-political risk associated with supply and infrastructure constraints or political dependence on other countries. Wind power has no resource constraints; the fuel is free and endless. Unlike conventional fuels, wind is a massive indigenous power source permanently available. Wind power stations can be constructed and deliver power far quicker than conventional sources. (Millais 2006)

In addition, climate change is also likely to reduce security within the electricity network. Research carried out by CSIRO on behalf of the NSW Government notes four potential risks of climate change (NSW Government 2004):

- Increased risks of storm, lightning and bushfire damage to electricity infrastructure
- Reduced water availability for cooling inland power stations
- Increased peak electricity demand for air-conditioning due to the increased number of extremely hot days
- Reduced operational capacity of electricity networks at times of high temperatures, making more investment necessary to expand capacity to cater for a given level of demand.

This wind farm would help to reduce climate change, and would provide a distributed power station to serve the regional community. It would have a positive effect on energy security.

4.4.4 Regional environmental benefits

Water use in power stations

Many fossil fuel-fired power stations use significant amounts of potable water in their operations, primarily for cooling water (which is evaporated in cooling towers) and for boiler make-up water.

Any reduction in the use of fossil fuel-fired power stations would lead to a reduced demand on Australia's finite sources of potable water. This in turn would free up water for more productive uses, and is also likely to have longer term benefits to river quality and thereby water quality and potentially aquatic ecosystems.

The major NSW coal-fired power stations have the following potable water requirements per annum:

Table 4.4 Water consumption in NSW coal-fired power stations

Company	Power station	Potable water consumption
Macquarie Generation	Liddell (Hunter River/Lake Liddell)	25,000 ML/y
Macquarie Generation	Bayswater (Hunter River/Lake Liddell)	36,000 ML/y
Eraring Energy	Eraring	1,500 ML/y
Delta Electricity	Wallerawang and Mt Piper (Fish River & Cox's River)	22,000 ML/y
Delta Electricity	Munmorah and Vales Point	1,000 ML/y
TOTAL		**85,500 ML/y**

Source: company websites

This is equivalent to approximately 15 per cent of Sydney's annual water consumption.

Based on an annual energy generation from these power stations 64,209GWh (ABARE 2005), this equates to approximately 1.316 kilolitres per megawatt-hour generated.

Accordingly, where the Silverton Wind Farm displaces NSW power generation, it would have the potential to reduce water consumption in NSW by 4,600 million litres of potable water per annum.

Pollution from fossil fuel-fired power stations

The generation of electricity from fossil fuels also releases significant levels of contaminates and pollutants into the atmosphere, both through airborne and waterborne releases.

In his overview of worldwide wind generation, Paul Gipe & Associates state:

> *"Every megawatt-hour produced by a wind turbine offsets the emission of 0.5 to 1 tonne of carbon dioxide from conventional sources. Wind generation also offsets up to seven kilograms per megawatt-hour of sulfur oxides, nitrogen oxides and particulates from the fuel cycle for coal, including mining and transport, 0.1 kilogram per megawatt-hour of trace metals, such as mercury, and more than 200 kilograms per megawatt-hour of solid wastes from coal tailings and ash. The amount of pollutants offset depends upon the mix of fossil fuels, nuclear power and hydro-electricity used in the existing fuel cycle. Wind generation offsets more air pollutants from utilities dependent on coal than those burning natural gas.* (Gipe 1999)."

In Australia, the National Pollutant Inventory identifies the emissions from electricity supply sector, primarily fossil fuel-fired power generation. These are shown in Table 4.5, which highlights that the industry is a major emitter of heavy metal compounds, carbon monoxide, oxides of nitrogen and sulfur dioxide.

Table 4.5 National Pollutant Inventory 2005–06, electricity supply sector

Substance	Total emissions (kg/year)	Emissions to air (kg/year)	Emissions to land (kg/year)	Emissions to water (kg/year)
Acetaldehyde	14,000	14,000		
Ammonia (total)	95,000	47,000		48,000
Antimony & compounds	1.4	1.4		
Arsenic & compounds	190	190		
Benzene	130	130		
Beryllium & compounds	53	53		
Boron & compounds	430,000	430,000		
Cadmium & compounds	79	79		
Carbon monoxide	9,000,000	9,000,000		
Chromium (III) compounds	880	870		10
Chromium (VI) compounds	46	46		
Cobalt & compounds	87	87		
Copper & compounds	510	510		
Cumene (1-methylethylbenzene)	240	240		
Cyanide (inorganic) compounds	7,000	7,000		
Cyclohexane	180	180		
Ethylbenzene	250	250		
Fluoride compounds	1,300,000	1,300,000		
Formaldehyde (methyl aldehyde)	120,000	120,000		
n-Hexane	180	180		
Hydrochloric acid	8,600,000	8,600,000		
Lead & compounds	830	830		
Manganese & compounds	1,500	1,500		
Mercury & compounds	340	340		
Nickel & compounds	950	950		
Oxides of Nitrogen	140,000,000	140,000,000		
Particulate Matter 10.0 um	4,700,000	4,700,000		
Polychlorinated dioxins and furans	0.0074	0.0074		
Polycyclic aromatic hydrocarbons	370	370		
Selenium & compounds	9,600	9,600		
Sulfur dioxide	250,000,000	250,000,000		
Sulfuric acid	2,500,000	2,500,000		
Toluene (methylbenzene)	2,300	2,300		
Total Volatile Organic Compounds	1,100,000	1,100,000		
Xylenes (individual or mixed isomers)	400	400		
Zinc and compounds	630	630		

These figures are total emissions over all power stations in NSW. Ref (http://www.npi.gov.au)

These figures are total emissions over all power stations in Australia. The emissions do not occur because a power station exists; they occur because of the use of fossil fuels while the power station is operating. Any reduction in fossil fuel use would also reduce the level of pollutants released each year into the environment.

Table 4.6 Power station emissions per unit, Macquarie Generation

	Bayswater Power Station	Liddell Power Station
Coal consumed	7,029,587 tonnes	5,436,503 tonnes
Non-coal fuel consumption		
Biomass co-firing		21,468 tonnes
Coal replaced by biomass		18,774 tonnes
Coal replaced since August 1999		289,879 tonnes
Electricity from biomass since August 1999		565,595 MWh
Annual average production from biomass		70,699 MWh
Oil firing		
Boiler start-up	4,405 tonnes	8,588 tonnes
Liddell Supplementary Fuels Program		15,136 tonnes
Air emissions		
Sulfur dioxide	5.36 kg/MWh	4.56 kg/MWh
Oxides of nitrogen (expressed as NO2)	2.1 kg/MWh	2.39 kg/MWh
Particulate matter	0.033 kg/MWh	0.15 kg/MWh
Carbon dioxide	931 kg/MWh	953 kg/MWh
Water diverted (Hunter River)		48,641 ML

Source: Macquarie Generation 2007

By way of an example, in the financial year 2006–07, Macquarie Generation's Bayswater coal-fired power station consumed over seven million tonnes of coal and 4,000 tonnes of fuel oil to produce 14,310GWh of electricity. The per megawatt-hour emissions of sulfur dioxide, oxides of nitrogen, carbon dioxide and particulate matter are shown in Table 4.6.

Based on these figures, the Proposal would prevent the atmospheric emission of:

— 15,960 to 18,760 tonnes of sulfur dioxide

— 7,350 to 8,365 tonnes of nitrogen oxides

— 115,500 to 525,000 kilograms of particulates.

4.5 LOCAL ENVIRONMENTAL, ECONOMIC AND SOCIAL BENEFITS

4.5.1 Local environmental benefits

Through the development of this Proposal, a number of significant species were identified onsite. In particular, the porcupine grass/red mallee/gum coolibah/hummock grassland/low sparse woodland identified onsite is a previously undescribed community. These areas are identified in Figure 3.17.

This community provides potential habitat for two threatened species; the marble-headed snake-lizard and slender mallee blue-tongue lizard.

The Proponent is committed to protecting and enhancing this area of habitat. Wind turbine locations have been removed and access tracks minimised in this area. The Proponent would establish a management plan for this area to reduce existing impacts caused principally by introduced species (feral goats and rabbits).

4.5.2 General benefits to community

The local community would gain a marginal benefit from those global and regional benefits contained in Section 4.4, in particular:

- Reduced greenhouse gas emissions
- Reduced impacts of climate change
- Improved environmental performance and sustainability of power generation
- Viable source of electricity to help meet growing demand
- Increased energy security.

A significant part of the regional and local economy is based on or around agricultural pursuits. In addition, the area receives very low rainfall and high ambient temperatures, therefore is more susceptible to climatic variations. The negative economic impacts of climate change are likely to be felt much more considerably in the local area than in urban areas of NSW, therefore the benefits of this Proposal are also likely to be significantly weighted in favour of the local community.

A number of specific benefits are also available to the local community.

4.5.3 Jobs, investment and economic benefit

Over the life of the wind farm it would inject approximately $701 million into the regional economy from the wind farm construction and operations (SGS Economics and Planning, Appendix 7).

This economic injection would come from:

- 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 lessees and the Crown
- Provision of ongoing local jobs in operating and maintaining the wind farm.

It is estimated that the Proposal would provide around 3,988 FTE jobs in regional Australia. This equates to 2,040 FTE jobs created during the construction period and 1,948 FTE jobs during the operational phase of the wind farm.

The Broken Hill region has suitable trades and skills to take on similar or additional work in relation to turbine delivery and construction. In particular, many of the trades existing within the Broken Hill region are suitable for wind farm construction, operation and maintenance.

In another area in NSW where wind farms are being constructed, the Southern Tablelands, a consortium has established facilities to construct the large steel turbine towers required for this Proposal. A consortium involving Ainsworth Engineering, Vale Engineering, Rigby Jones, Edwards Construction and Southern Steel Group, supported by Bluescope Steel, are currently finalising plans to commence tower manufacture in Goulburn. There is no reason why similar initiatives could not be established in Broken Hill and result in a large number of jobs and additional economic benefits to NSW.

In addition to these direct benefits, the Proposal provides an opportunity to increase tourism, if this is desired by the community. This also would increase use of local services on an ongoing basis. This wind farm would be the largest in Australia and one of the largest in the world for many years to come, and is expected to offer an ideal opportunity to support additional tourism within the Broken Hill region.

4.5.4 Regional infrastructure benefits

The infrastructure required for development of the wind farm would also provide a significant local benefit to the community, as discussed below.

Road upgrades. Road upgrades required for this Proposal would also provide the community additional benefits. The assessment has identified that a number of locations may require road upgrade work which, in some cases, includes sealing of roads that could otherwise be rendered impassable by seasonal rains. The areas are more fully described in the traffic and transport report. Road upgrades would provide the local community with safer, improved roads. These upgrades also provide ease of access to properties and reduced vehicle maintenance costs.

Road maintenance. The Proponent would maintain the roads necessary for the operation and maintenance of the wind farm for the duration of the wind farm's life. This would provide improved road infrastructure to the local residents.

Transmission line upgrade. The Proposal includes construction of a major new transmission line between Broken Hill and Red Cliffs. This transmission line provides the potential to operate as a backup power supply to Broken Hill, improving reliability and reducing costs to Country Energy of operating its existing backup power station in Broken Hill. This removes the need on Country Energy to fund a substantial upgrade of the existing backup supplies, reducing the costs of power to regional NSW.

Payments to Western Lands. The Minister for Lands, Tony Kelly, has reportedly given a commitment that any monies raised by the Department of Lands from lease payments made in relation to the Proposal would stay in the Western Division. This increases the funding pool available to the Department of Lands for investment within the Western Lands division, thereby providing broader regional infrastructure and land management benefits.

4.5.5 Silverton community fund

As part of this Proposal, the Proponent has committed to establish the Silverton Community Fund – a program to broaden the benefits of the wind farm within the local Silverton community. The fund would be established to provide for local environmental benefits and community facilities that benefit the Silverton community.

The intent of the Proponent is that these funds are spent on community facilities within the local area (i.e. within ten kilometres of the wind farm). Potential projects could include:

- Event sponsorship
- Tourism promotion
- Land care including weed and pest management on community land
- Local sporting facilities
- Local public infrastructure such as fence upgrades
- Community parklands (e.g. Penrose Park)
- Academic and vocational scholarships
- Rural fire service support
- Local heritage management.

Funding would be determined on an as needs basis during the life of the wind farm, and would be set aside for specific community projects and initiatives. The Proponent expects that at least $20,000 – $30,000 per annum will be spent in the community, however does not want to limit itself to that and proposes to fund meaningful projects to the benefit of the community. Funding would not replace existing government funding, however could be used to support government funding.

The structure of the fund and its management would be determined in consultation with the local community, and in particular the Silverton Village Committee, the Penrose Park Trust and the Silverton Commons Trust.

Solar Silverton

In addition to the community fund, the Proponent would offer solar water heaters, solar power systems (sometimes called PV or photovoltaic) and energy efficiency packages for residences surrounding the site and in the Silverton village.

The Solar Silverton program would commence at start of construction of the wind farm and be completed within two years of completion of construction. Under the program, the Proponent would offer residents within ten kilometres of the wind farm the clean energy package.

As a result, residents would benefit from energy cost reductions and also an improved property value for their home. In addition, the solar facilities would provide a visible example of Solar Silverton.

Due to the heritage qualities of Silverton, not all houses would be suitable for the installation of solar energy equipment. The Proponent would work with residents to ensure heritage issues are taken into consideration in designing and locating solar systems.

1. Energy Efficiency Package

This package would include energy efficient lights, three star (AAA) shower roses, tap aerators and flow restrictors as well as detailed information on efficient use of the energy in the home and Green Power. This would be offered at no cost to the homeowner.

2. Solar Water Heating Package

A range of solar water heaters would be offered, providing options for the homeowner to reflect varying numbers of residents at each house. The homeowner would select the appropriate system for their residence from a list of products available.

Silverton Wind Farm Developments would source the products and arrange to install the system. After installation, the homeowner would benefit from significantly lower energy bills for the life of the product, as well as a significant environmental benefit.

3. Solar Power (Photovoltaics)

A one kilowatt (peak) solar photovoltaic (PV) system would be offered to residents who have committed to reduce their energy requirements by installing the Energy Efficiency Package and Solar Water Heating Package.

Solar photovoltaic systems have very high one-off costs and low to negligible operating costs. The Proponent would source photovoltaic systems and arrange to install the systems at no cost to the homeowner.

Please note it is possible for the Proponent to offer these solar energy systems where Government rebates apply. The systems are being offered on the basis of existing Government support levels of up to $8,000 per kilowatt (for a one kilowatt photovoltaic system) and up to $1,800 per system (for a solar water heater). Therefore, the offer is made on the basis that the residence complies with the requirements of these programs. Should the support mechanism change, in terms of the rebate being withdrawn or a feed-in tariff introduced, then the basis of the program will be amended to ensure the program still provides real community benefits and the maximum benefit for every dollar provided under the program.

4.6 CONSIDERATION OF ALTERNATIVES

4.6.1 Comparison with other forms of electricity generation

Wind is one of the cheapest forms of renewable energy available in Australia, which can be demonstrated by its dominant share of the MRET target.

Wind farms offer significant environmental benefits over fossil fuel power stations. During the operational life of a wind farm, it would produce:

- No greenhouse gas emissions
- No air or waterborne pollutants such as nitrous oxides, sulfur oxides, heavy metals or particulates
- No water use
- No waste products (nuclear or otherwise) that require long-term disposal.

Wind power is also a relatively safe technology. In over 20 years of electricity generation with more than 100,000 machines installed worldwide, no member of the public has ever been injured in the operation of a wind farm. Since the early 1970s, the wind energy industry has experienced 14 worker fatalities worldwide, directly or indirectly during wind farm construction or related accidents. All these deaths could have been prevented if today's safe work practices had been adopted (AusWEA 2004).

According to the construction, forestry, mining and energy union (CFMEU), mining is the most dangerous occupation in Australia. Coal miners, for example, have a one in 28 chance of being killed over their 40-year working life. Figures obtained from the International Labour Organisation (ILO) show that miners account for 1 per cent of the global work force yet at the same time contribute to seven per cent of global work fatalities (Westwick-Farrow Pty Ltd, 2006).

4.6.2 Selection of wind farm location

Background to site selection

Appropriate sites for wind farms of any scale are very rare in New South Wales. Appropriate locations for wind farms are found where:

- Wind speeds are not only high but consistent
- Vegetation cover is low and not sensitive
- Land is rural/agricultural use
- Housing in the immediate vicinity is relatively sparse
- High voltage transmission lines are available on or near site
- Reasonable road access is available to site
- Relevant landowners are interested in allowing wind turbines on their land.

While many believe that coastal winds are stronger, in New South Wales the most suitable sites occur at various locations along the Great Dividing Range, which helps to accelerate the more consistent westerly winds at levels close to the ground.

Epuron, one of the joint venture partners developing this Proposal, has investigated various regions around NSW for their wind farm potential. Epuron has one of the most extensive wind data sets available in NSW through its combination of wind-monitoring towers and wind-modelling studies.

In relation to this specific Proposal, the Proponent has installed four onsite monitoring masts and procured the data from a nearby offsite monitoring mast to confirm the quality of wind speeds onsite. A further six monitoring masts are planned for installation across the site.

The Silverton site

In November 2006, the NSW Government announced a new target to increase the amount of renewable energy supplied in NSW from 10 per cent to 15 per cent of consumption. It was considered that this new target would require a major increase in wind energy use and led to the Proponent assessing the potential of the Broken Hill area to host a new wind farm.

Initial assessment of the Silverton area indicated that the site has:

- High and consistent wind speeds
- Sparse vegetation that would not materially interfere with wind flows
- Extremely low population density (fewer than 27 houses within ten kilometres of the wind farm)
- Existing electricity transmission line near site (220kV Broken Hill–Buronga)
- Excellent regional infrastructure located in Broken Hill.

4.6.3 Scale of the proposed wind farm

Wind farms are generally comprised of multiple wind turbine generators. Generally, the more wind turbines located in a wind farm, the higher its energy production and the lower its capital cost per unit of energy generated.

Table 4.7 NSW wind farm proposals

Project, project location	Proponent (status)	Project capacity (MW)	No. of turbines	New power lines to connect to grid
Crookwell 1 WF, near Crookwell	Eraring Energy (Operational)	4.8MW Built 1997	8	66kV substation on site
Blaney Wind Farm, near Bathurst	Eraring Energy (Operational)	9.9MW Built 2000	15	66kV substation on site
Kooragang Wind Turbine, near Newcastle	Energy Australia (Operational)	0.6MW Built 1997	1	Powerline on site
Hampton Park, near Hampton	Hampton Wind Park Company (Operational)	1.32MW Built 2001	2	11kV powerline on site
Cullerin WF, near Goulburn	Epuron (Under construction)	30MW	15	132kV substation on site
Capital WF, near Bungendore	Renewable Power Ventures (Under Construction)	126MW	63	330kV substation on site
Snowy Plains WF, near Berridale	Epuron (DA approved)	30MW	15	Substation on site
Conroy's Gap WF, near Yass	Epuron (DA approved)	30MW	15	<4km aerial
Woodlawn WF, near Tarago	Wind Energy JV (DA approved)	50MW	25	Not specified
Taralga WF, near Taralga	RES Southern Cross (DA approved)	186MW	62	Not specified, >30km high voltage
Gunning WF, near Gunning	Delta Electricity (DA approved)	64MW	32	14km, 132kV, aerial
Crookwell 2 WF, near Crookwell	TME (DA approved)	92MW	46	330kV substation, on site
Liverpool Ranges WF, near Murrurundi	Macquarie Generation (DA Approved)	8MW	4	Substation on site

Project, project location	Proponent (status)	Project capacity (MW)	No. of turbines	New power lines to connect to grid
Box Hill WF, near Guyra	Allco Wind Energy (DA approved)	Up to 21MW	10	No details available
Black Springs WF, near Oberon	Wind Corporation (Aust) (Proposed)	18.9MW	9	Substation on site
Kyoto Energy Park, near Scone	Pamada (Proposed)	85 – 120MW	Up to 47	Substation and overhead lines
Ben Lomond, near Guyra	Ben Lomond Wind Farm (Proposed)	Up to 205MW	98	132kV substation on site
Glen Innes WF, near Glen Innes	Glen Innes Wind Power (Proposed)	44 – 66MW	22	substation on site
Gullen Range WF, near Gunning	Gullen Range Wind Farm Pty Ltd (proposed)	Up to 278MW	Up to 84	330kV substation on site
Silverton Wind Farm, near Broken Hill	Silverton Wind Farm Developments (Proposed)	>1000MW	598	Several 220kV substations on site with staged development of power lines to grid

Sources: Company websites, media releases and published environmental impact statements

Most wind farms currently proposed in New South Wales are greater than 50 megawatts, with more than 25 wind turbines each. As demand for renewable energy increases, proposals are increasing in size. For example, the proposed Gullen Range Wind Farm could see a single project generate >250 megawatts in the NSW Southern Tablelands.

The Silverton Wind Farm is clearly of a different scale to these other proposed wind farms. The Silverton site provides a rare opportunity to develop a wind farm on a scale comparable with a coal-fired base load power station. The scale of the Silverton Wind Farm increases the long-term environmental and economic benefits available from the Proposal and accordingly is part of making the best use of the opportunity presented and maximises the value to NSW.

The effective upper limit on the size of this site is defined by transmission line and connection limitations within the national electricity market in western NSW/north western Victoria. Current estimates are that this capacity is in the order of 1,000 to 1,500MW, however detailed design that is well underway would determine the final, technically appropriate upper limit on power generation at the site. This is determined through the selection of turbines, design of transmission lines and design of network connection assets currently under consideration.

4.6.4 Size of the proposed wind turbines

Wind turbines come in various sizes, from small ten kilowatt wind turbines used for individual houses to five megawatt wind turbines used offshore in Europe that can supply up to 2,000 houses each. These large turbines can have blade diametres and hub heights of well over 110 metres each, with tip heights of up to 180 metres.

There is a trade-off between the number of wind turbines and the size of wind turbines to provide commercial volumes of electricity from a site. The smaller the wind turbine, the larger the number of wind turbines required for a viable project.

Increasing the size and reducing the number of wind turbines has a number of benefits:

- Increased clean energy generation from a site
- Reduced overall visual impact (see Section 7.2)
- Reduced environmental impacts of construction through fewer footings, hardstands, road areas etc
- Reduced cost of wind power per unit of output.

The Proponent proposes to use large wind turbines, with each wind turbine having a hub height of approximately 80 to 100 metres and with the blade tip at its apex up to 155 metres above ground level. This size turbine maximises the environmental and economic benefits to NSW without significantly increasing local environmental or social impacts.

4.6.5 Electricity transmission connection options

A number of routes have been assessed for the initial transmission line to Broken Hill. The proposed route is designed to reduce visual impacts for visitors to Silverton by reducing the area along the Silverton Road where the transmission line can be seen. The final transmission line route would be determined subject to detailed site conditions and ongoing landowner discussions.

The currently proposed transmission line route to Red Cliffs broadly follows the existing transmission line corridor, thereby reducing the additional impacts of building a new access track for the new transmission lines. This corridor also reduces additional visual impacts as the area is already disturbed through the existing transmission line. Modifications may be made along this route to take into account issues raised by individual landowners/lessees.

Alternate connection points for the final transmission lines remain under consideration. While Red Cliffs in Victoria currently appears the most likely connection point, additional points of connection under consideration include Buronga in New South Wales and Robertstown, Davenport and Canowie in South Australia.

The final connection point would be determined based on specialist studies currently being undertaken by Worley Parsons as well as through negotiations with the various network service providers.

4.7 MODIFICATIONS TO THE SILVERTON WIND FARM PROPOSAL

This section demonstrates how the results of specialist investigations and community feedback from the consultation activities have reshaped the proposal.

The location of individual wind turbines onsite and elements of the construction, operation and decommissioning phase are being informed by a range of specialist studies. These include wind speed parametres, noise and visual assessment (from residences and nearby recreational areas), indigenous and non indigenous heritage and flora and fauna values (including threatened species and communities, vegetation cover, migratory species and habitat values of the site).

The location of equipment has also been guided by community feedback through the extensive public consultation program undertaken. The final Proposal has been designed to reduce adverse impacts within identified social and environmental parametres while taking advantage of the landscape features that could most effectively contribute to the supply of greenhouse gas emission-free sustainable energy generation.

In particular, the following improvements have been made since the initial concept was developed and following feedback at the information day in November 2007:

- Site access has been extensively modified to minimise traffic through and around the Silverton township. To the extent practical, traffic would access site via new access points off the Daydream Mine Road
- The transmission switchyard location has been identified. To the extent practical, all facilities buildings would be located within this same general vicinity, reducing traffic disturbance and visual impact to the public and nearby landholders
- The power line route from the proposed wind farm to Broken Hill has been refined following feedback from the local community and to reduce visual impacts to people travelling between Broken Hill and Silverton.
- Wind turbines and access tracks have been moved to avoid sensitive reptile habitats onsite, particularly in relation to the tawny rock dragon
- Wind turbines have been removed and access tracks have been moved to avoid sensitive vegetation habitats onsite, particularly in relation to the spinifex areas that are expected to be declared an endangered ecological community (see Figure 3.17).

- Cultural heritage items of interest onsite have been identified and buffers put in place to avoid disturbance to these locations, which mainly relate to mining heritage
- No infrastructure would be placed on the Mundi Mundi Plains and attention would be paid to minimise impacts in relation to the existing Mundi Mundi homestead site
- Construction would be undertaken with full provision of information on particular issues for individual residents, including suitable notice and procedures in relation to significant traffic movements and/or any necessary blasting
- The concept of a Silverton Community Fund has now been incorporated into this Proposal to broaden the benefit of this Proposal within the local community. In particular, the inclusion of the Solar Silverton program would provide direct benefits to surrounding residents
- A commitment to offer visual screening to affected landowners in the vicinity of the wind farm has been incorporated into the final Proposal
- The Proponent is working with the Silverton community to identify ways to maximise benefits to Silverton, including those brought by increased tourism, resulting from the wind farm.

4.8 REVERSIBILITY OF THE PROPOSAL

The EA outlines the measures that would be implemented to protect the environment and minimise both environmental and social impacts of the Proposal.

The Proposal would not substantially alter the vegetation, soil or water quality on the site. In the short term, mitigation measures would be required during construction to ensure that the spread of weeds, soil erosion and water quality decline are not exacerbated by the Proposal and in particular that water quality impacts of the Proposal are neutral or positive. Impacts on fauna contain a greater degree of uncertainty, requiring monitoring to characterise the impacts of the operational wind farm and an adaptive management program. With the effective implementation of the goat management plan there should be a notable improvement in biodiversity values across areas of the site.

Impacts on the visual landscape would be ongoing during the operational phase of the wind farm. However, visual and noise impacts would be minimal during decommissioning and absent following the removal of the wind farm.

Decommissioning of the wind farm would involve the removal of all above ground infrastructure from the site. The concrete footings and access trails would remain, but all other soil disturbance would be rehabilitated and revegetated where appropriate. The landforms, land use and visual character of the site would then be largely returned to its pre-existing state.

5. PLANNING CONTEXT

5.1 STATE GOVERNMENT LEGISLATION AND POLICY

5.1.1 Critical Infrastructure

On 26 February 2008, the NSW Premier Morris Iemma announced that proposals to build new power stations with a capacity to generate at least 250 MW would be declared Critical Infrastructure under the *Environmental Planning and Assessment Act 1979* (EP&A Act). The declaration is intended to secure the energy future of the state and to allow for sustainable economic development.

The Silverton Wind Farm Proposal qualifies as Critical Infrastructure under this declaration as it has a capacity to generate in excess of 250MW.

5.1.2 Part 3A approval process

The Proponent sought the Minister for Planning's opinion that the Proposal be considered a Major Project and assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The Director General responded in a letter dated 24 October 2007 that the Proposal would be considered a Major Project under Part 3A. The approval process applying to Major Projects under Part 3A and the Major Projects State Environmental Planning Policy is described in Section 2.2.

Part 3A integrates the assessment and approval regime for all Major Projects that require the approval of the Minister for Planning and do not require authorisations under the:

- *Fisheries Management Act 1994* (sections 201, 205 or 219, stop work orders)
- *Heritage Act 1977* (Part 4 or section 139)
- *National Parks and Wildlife Act 1974* (section 87, consent under section 90, interim protection and stop work orders)
- *Native Vegetation Act 2003* (section 12)
- *Rivers and Foreshores Improvement Act 1948* (Part 3A)
- *Rural Fires Act 1997* (section 100B)
- *Water Management Act 2000* (sections 89, 91)
- *Threatened Species Conservation Act 1995* (interim protection and stop work orders)
- *Protection of the Environment Operations Act 1997* (environment protection notices)
- *Local Government Act 1993* (orders under section 124).

As such, requirements identified within the above mentioned Acts have not been considered as part of this assessment.

5.1.3 Concept development

The Major Project Application for the Proposal was lodged with the NSW Department of Planning (DoP) on 24 December 2007.

On 23 January 2008 the Minister for Planning authorised the submission of a concept plan and on 13 February 2008 the Director-General's Requirements were issued.

Accordingly, this EA and application is being submitted in the context of this being an application for concept approval for the whole development, plus an application for project approval of the initial stage of the development.

Broadly speaking, the development can be separated into four components:

- Site area – Stage 1
  (Includes Stage 1 turbine locations and all related construction, operation and maintenance infrastructure including site access)
- Site area – Stage 2
  (Includes all remaining turbine locations and all related construction, operation and maintenance infrastructure including site access)
- Transmission line corridor – Site to Broken Hill (NSW) – Stage 1
  (Initial grid connection including 24km power line from site to Broken Hill in NSW)
- Transmission line corridor – Site to Red Cliffs (Vic) – Stage 2
  (Final grid connection including 300km power line from Site to Red Cliffs in Victoria).

This EA provides a full assessment of all impacts in relation to Stage 1 development (items 1 and 3 above).

This EA also provides detailed assessment of the majority of impacts in relation to Stage 2 development (items 2 and 4 above). For Stage 2 development, additional detailed biodiversity, indigenous and non indigenous heritage assessments are proposed to be carried out prior to construction. Details of this proposed assessment and treatment of its results are outlined in the Statement of Commitments.

This Proposal has now been declared Critical Infrastructure. This places a significantly higher impetus to developing the Proposal as quickly as practical. To that end, the Proponent considers there is significant merit in reducing delays to Stage 2 of the Proposal by granting project approval to both stages of the Proposal, subject to finalising biodiversity, indigenous and non indigenous heritage assessments as outlined in the Statement of Commitments.

5.1.4 Director-General's Requirements

The Director-General's Requirements that outline the form and content of the Environmental Assessment report are attached to this document (Attachment 1). Table 5.1 summarises the requirements and where they are addressed in this report.

Table 5.1 Director-General's Requirements (DGRs)

This table outlines the DGRs, issued by the DoP on 13 February 2008 and where each item is addressed in this EA.

Director-General's Requirements	Addressed
General requirements	
Executive summary	Section 1
Glossary	Section 11
Detailed description of Stage 1 of the Proposal including construction operation and decommissioning, detailed descriptions of locations and dimensions of Proposal components, AHD and grid coordinates of turbines, details of grid connections	Section 3
Timeline indicating staging (including decommissioning)	Section 3
Consideration of relevant statutory provisions and guidelines	
Consideration of relevant statutory provisions (including DoP draft NSW Wind Energy Environmental Impact Assessment Guidelines 2002, Auswind's Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia 2006)	Section 5
Assessment of key issues (outlined below) with mitigation measures required to reduce impacts to acceptable levels	Section 7
Draft Statement of Commitments	Section 9.2
Certification by the authors of the EA	Section 12
Key issues	
Strategic justification	Section 4
Visual amenity impacts	Section 7.2

Director-General's Requirements	Addressed
Noise impacts	Section 7.3
Flora and fauna (biodiversity)	Section 7.4
Water quality	Section 7.5
Traffic and transport	Section 7.6
Aboriginal heritage	Section 7.7
Non indigenous heritage	Section 7.8
Socioeconomic	Section 7.9
Land use issues	Section 7.10
Farming and grazing	Section 7.11
Mineral exploration	Section 7.12
Aircraft hazard	Section 7.13
Fire and bush fire	Section 7.14
Electromagnetic fields	Section 7.15
Communications	Section 7.16
General environmental risk analysis	Section 8
Consultation	Section 6
Appropriate and justified level of consultation with agencies and community	Section 6

5.1.5 Protection of the Environment Operations Act 1997

This Act is administered by the Department of Environment and Climate Change (DECC), Environmental Protection Authority (EPA) branch. Activities listed in Schedule 1 of this Act (which include concrete batching facilities with a capacity of exceeding 30,000 tonnes per year) require a licence. It is anticipated that the temporary concrete batch plant would exceed this amount and would require a licence to be issued by DECC.

Previously, wind farms that supply or are capable of supplying more than 30MW of electrical power have required a licence. Under recent amendments, wind farms over 30MW no longer require a licence.

The EPA can issue licences that are designed to control the potential air, noise, water and waste impacts of an activity. Licences are ongoing but subject to review at least once every five years and can be varied, suspended or revoked. Impacts and mitigation measures related to air and water quality as well as noise amenity are described in this EA, Sections 7.3.3, 7.5.2 and 8.6.

5.1.6 Western Lands Act 1901 and Crown Lands Act 1989

The proposed wind farm site is located on Crown land currently held under grazing leases issued under the *Western Lands Act 1901*. The Department of Lands acts as landowner on behalf of the Crown.

These existing Western Lands leases are for grazing, tourism and film-making purposes. The *Western and Crowns Lands Amendment (Special Purpose Leases) Act 2008* was passed in June 2008 to amend the *Western Lands Act 1901* and the *Crown Lands Act 1989* to allow the granting of special purpose leases in parallel with the existing grazing leases. The proposed wind farm would be granted a special purpose lease by the Department of Lands and this requires the consent of the existing Lessees, who would receive remuneration from the wind farm operator.

Therefore, wind farm tenure would be provided by a special purpose lease, existing grazing leases would continue under the Western Lands Act and current land use would remain largely unaffected.

5.1.7 Water Management (Water Supply Authorities) Regulation 2004

There are a number of Special Catchment Areas defined under the *Water Management (Water Supply Authorities) Regulation 2004* which need to be considered as part of the environmental assessment process. This regulation identifies that a person must not erect any building or structure, carry out any work or alter or extend any building, structure or work without the consent of Country Energy. Silverton Wind Farm Developments has been consulting with Country Energy, (Country Water) regarding the required consent under this regulation.

5.1.8 Native Vegetation Act 2003

The objectives of the *Native Vegetation Act 2003* are to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State. Property Vegetation Plans (PVPs) can be administered under Part 4 *Native Vegetation Act 2003* and require approval from the Minister. Through consultation with the Lower Murray-Darling CMA, it is understood that one property along the transmission route from site to Red Cliffs (Coombah Station) has a PVP. There is the potential for the proposed transmission line to run through this PVP, although at this stage definite boundaries of the PVP have not yet been identified.

5.1.9 DoP draft NSW Wind Energy Environmental Impact Assessment Guidelines 2002

These guidelines identify important factors to be considered when undertaking environmental assessments of wind farm projects. Key recommendations relate to consultation, site selection, project justification as well as specific impact areas such as noise, visual amenity and aerial fauna.

The DoP guidelines have been considered in the preparation of this EA.

5.1.10 Auswind's Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia 2006

The guidelines were developed to establish the process for identifying, developing and implementing wind energy projects, recognising that each project will 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.

5.1.11 Ecologically Sustainable Development (ESD)

Ecologically sustainable development (ESD) involves the effective integration of social, economic and environmental considerations in decision-making processes. In 1992, the Commonwealth and 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.

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 that 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
- 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
  - Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms that 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 impact assessment of the proposed Silverton Wind Farm. Potential impacts associated with the Proposal have been considered and mitigated where risk is present. Where uncertainty remains, measures have been suggested to address the uncertainty.

The majority of the potential impacts of the Proposal are likely to be localised to the development area and would not diminish the options regarding land and resource uses and nature conservation available to future generations. Parametres such as the site's soil, hydrology and native vegetation have been valued in terms of their broader contribution to the catchment and catchment processes. The reversibility of the Proposal has been specifically addressed in Section 4.8 and is considered to be an advantage of this type of development.

The impacts of the Proposal on biodiversity have been assessed in detail in the attached Biodiversity Assessment (summarised in Section 7.4) and management strategies incorporated into the Draft Statement of Commitments.

The aims, structure and content of this EA have incorporated these ESD principles. The Draft Statement of Commitments in Section 9.2 provides an environmental management commitment to these parametres. Based on the social and environmental benefits accruing from the Proposal 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 ESD definitions.

5.2 COMMONWEALTH LEGISLATION

5.2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The 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

— 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 that includes:

— World heritage properties

— Wetlands of international importance (ramsar wetlands)

— Commonwealth listed threatened species and ecological communities

— Commonwealth listed migratory species

— Nuclear action

— Commonwealth marine areas

— Commonwealth land.

The Act aims to ensure the conservation and recovery of flora and fauna species and communities at a state and national level. Schedules 1 and 2 of the EPBC Act identify species and communities that are endangered, vulnerable or presumed extinct. Schedule 3 of the EPBC Act outlines key threatening processes.

Wind farm site

A search for Matters of National Environmental Significance based on the wind farm site (including a 50 kilometre buffer) was undertaken using the Commonwealth Government's Protected Matters Search Tool, 21 December 2007. 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 Commonwealth Government's Protected Matters Search Tool is provided in full in Appendix 3.

In summary, the report indicates the following matters for consideration:

- **One wetland of international significance:** Lake Pinaroo is located approximately 350km from the proposed development. There would be no potential for impact on this wetland directly. Avian movement corridors are considered within Section 3 of the attached Biodiversity Assessment
- **Six threatened species:** Purple-wood wattle, thick-billed grasswren, plains-wanderer, Australian painted snipe, eastern long-eared bat and Murray cod. The potential for these species to be adversely affected by the Proposal is considered in Section 3 of the attached Biodiversity Assessment
- **Seven migratory species:** White-throated needletail, great egret, cattle egret, Latham's snipe, painted snipe, rainbow bee-eater and fork-tailed swift. The potential for these species to be adversely affected by the Proposal is considered in Section 3 and Appendix C of this Biodiversity Assessment. No World Heritage Properties, National Heritage Places, Commonwealth Marine Areas or Threatened Ecological Communities were returned by the search
- **Places on the Register of the National Estates (RNE):** There are 44 places listed on the RNE within a 50km radius of the site. None occur within the Stage 1 site boundaries.

Transmission line corridor

A search for Matters of National Environmental Significance based on the proposed power line route was undertaken using the Commonwealth Government's Protected Matters Search Tool, 22 January 2008 (provided in full in Appendix 4).

In summary, the report indicates the following matters for consideration:

- **Eight wetlands of international significance:** Banrock Station Wetland Complex, Coorong and Lakes Alexandria and Albert Hattah-Kulkyne Lakes, Lake Pinaroo and Riverland
- **One threatened Ecological community**: Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions
- **Twenty-one threatened species:** Purple-wood wattle, *Atriplex infrequens, Austrostipa metatoris,* club spear-grass, mossgiel daisy, winged pepper-cress, menindee nightshade, slender darling-pea, yellow swainson-pea. Thick-billed grasswren, swift parrot, mallee fowl, black-eared miner, red-lored whistler, regent parrot (eastern), Australian painted snipe, mallee emu-wren, southern bellfrog, eastern long-eared bat, Murray hardyhead, Murray cod
- **Thirteen migratory species:** White-bellied sea-eagle, white-throated needletail, mallee fowl, black-eared miner, rainbow bee-eater, great egret, cattle egret, sharp-tailed sandpiper, Latham's snipe, painted snipe and fork-tailed swift
- Places on the Register of the National Estates (RNE): There are 65 places listed on the RNE.

A Biodiversity Constraints Technical Report has been prepared for Stages 1 and 2 of the proposed Silverton Wind Farm and power line route. This addressed likely flora and fauna constraints by way of desktop assessment and on ground verification of vegetation mapping and threatened species searches (attached in full, Appendix 4). Key constraints include avoiding or minimising impact to EECs in good condition, minimising clearing of other native vegetation, minimising impact to fauna habitat attributes and to threatened species of flora and fauna. Based on desktop

assessment, extrapolation of information obtained in a comprehensive investigation of the Stage 1 area and a field survey of the power line route, these results indicate that constraints are able to be managed with the implementation of mitigation measures. Further investigation would be needed to validate the desktop assessments, evaluate all threatened species with potential to be adversely affected and refine the mitigation measures. This is discussed more fully in Section 7.4.

Referral to the Department of Environment, Water, Heritage and the Arts.

While the Proposal was not considered to require referral as a potential 'controlled action' to the Department of Environment, Water, Heritage and the Arts, to obtain certainty a referral is being made for the Proposal on the basis of potential impact to Commonwealth-listed threatened species, communities and migratory species.

5.2.2 Department of the Environment, Heritage, Water and the Arts, Supplementary Significant Impact Guidelines 2.1.1: Wind Farm Industry Sector 2008

The purpose of these guidelines is to assist operators in the wind farm industry to decide whether or not actions 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 7.4.

5.2.3 Bilateral agreements

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. One of the aims of the agreement is to minimise duplication of environmental impact assessment processes, ensuring a coordinated approach for actions requiring approval from both the Commonwealth and the State.

While it is not considered that the Proposal represents a 'controlled action', as defined by the EPBC Act, an EPBC referral has been completed for the Proposal as a precautionary measure as detailed in Section 5.2.1. No other matters pertaining to this Proposal are relevant to the bilateral agreement.

5.3 LOCAL GOVERNMENT INSTRUMENTS AND POLICIES

The Silverton Wind Farm site is located within the unincorporated area administered by the NSW Department of Lands, Western Division; as such local government instruments are not applicable to works within this area.

Specific electricity transmission infrastructure would be located within the borders of the Broken Hill City Council Local Government Area (LGA) and the Wentworth LGA in the south.

Land to be used within the boundaries of the Broken Hill LGA is zoned 1 (a) General Rural under the Broken Hill Local Environment Plan 1996. The development of the transmission line on land which is covered under this zone would be permissible with development approval.

Land within the Wentworth LGA that would be affected by the transmission line is primarily zoned 1 (a) General Rural Zone under Wentworth Local Environmental Plan 1993. While critical infrastructure projects are not subject to zoning prohibition, it is noted that the development of electricity transmission infrastructure would be permissible with development consent in land zoned 1 (a) General Rural Zone.

A small section of the transmission route, 1.3 kilometres, would be located in Victoria, within the Mildura Rural City Council LGA. The proposed works are permissible under the local environmental plans. Separate approval would be sought for works within Victoria. Correspondence confirming this aspect of the Proposal is permissible under Victorian legislation is provided (Attachment 2).

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6. CONSULTATION

6.1 GOVERNMENT CONSULTATION

6.1.1 Initial meetings

The Proponent met with the consent authority, the NSW Department of Planning, formally in August 2007 to introduce the Proposal and to seek advice on the assessment process. The NSW Department of Planning participated in the onsite Planning Focus Meeting with other agencies, described below. The Proponent and nghenvironmental have had ongoing correspondence with the NSW Department of Planning and other relevant agencies throughout the assessment process.

6.1.2 Planning Focus Meeting (PFM)

A Planning Focus Meeting (PFM) for the Proposal was held on 14 and 15 November 2007. Staff from the Proponent, nghenvironmental, NSW Archaeology and Bega Duo Designs were on hand to introduce the Proposal, provide input and answer questions. Agency participants included:

- Neville Osborne (Department of Planning)
- Daniel Stokes and Andrew Bell (Department of Lands)
- Harvey Johnson Mark Fletcher and Dennis Harvey (Department of Environment and Climate Change)
- Robert Barnes (Department of Primary Industries)
- Louise Turner (Western Catchment Management Authority)
- Noel Hayward and Claire Wilkinson (Lower Murray Darling Catchment Management Authority)
- Frank Zaknich and Peter Oldsen (Broken Hill Shire Council)
- Adrian Ray (Country Energy)
- Joe Sulicich (Roads and Traffic Authority)
- David Trethewey TransGrid

Additionally, agencies invited but unable to attend the PFM included:

- Civil Aviation Safety Authority
- Department of Defence
- Country Water
- Wentworth Shire Council.

Participants met in Broken Hill on 14 November 2007 for a presentation on the Proposal. Participants were transported to the site via the Mundi Mundi Lookout, where the general location of the proposed turbine site was identified to the participants. The participants then proceeded to the site of wind monitoring mast 1. During this stop, archaeologist Julie Dibden gave a brief presentation on the archaeological investigations that had been completed to date. On the following day, the participants were taken to the southern portion of the site that was accessed from Daydream Mine Road. Due to the size of the site, it was considered impractical to attempt to see a large portion of the site in detail. As such, site inspections were concentrated in areas of the proposed Stage 1 works. Additionally, an attempt was made to have inspections located on ridge tops to facilitate extended views of the turbine site.

At each stop, the Proponent gave an overview of likely infrastructure placement (the number of turbines and their placement was only indicative, pending the results of specialist studies). The Part 3A assessment process, under the *Environmental Planning and Assessment Act 1979*, and the purpose of the Planning Focus Meeting was described to the attendees. The minutes of the PFM are included in Attachment 3 and were circulated to all attendees.

6.1.3 Director-General's Requirements

The Director-General's Requirements outlined in Table 5.1 were developed by the Department of Planning based on input from a number of agencies and stakeholders, many of whom attended the planning focus meeting and site visit. The input agencies and stakeholders include:

- Department of Environment and Climate Change
- Department of Lands
- Department of Primary Industries
- Department of Water and Energy
- Roads and Traffic Authority
- Broken Hill City Council
- Wentworth Shire Council
- Mildura Rural City Council
- Lower Murray Darling Catchment Management Authority
- Western Catchment Management Authority
- NSW Rural Fire Service
- Civil Aviation Safety Authority
- Airservices Australia
- Department of Defence
- Relevant Aboriginal Communities
- Relevant holders of mineral exploration licences
- The local community, including the Silverton Village Committee.

This input included both formal advice and informal feedback from the Planning Focus Meeting.

6.2 COMMUNITY CONSULTATION

The Proponent has informed and consulted with the local community during the planning and development of the Proposal. The development of the Silverton Wind Farm was made known to the public early in its development with a launch by the Proponent and the release of an animated simulation of the wind farm. This followed initial background assessment, early studies, information gathering and discussions to determine that a wind farm at the site was a serious proposition. At the time of the announcement, the detailed development of the wind farm was in its early stages. The announcement was aimed at maximising the community and stakeholder input into the development of the Proposal.

6.2.1 Community Consultation Plan

A Community Consultation Plan was prepared by nghenvironmental for the Proposal (Attachment 4). It began by developing the objectives of consultation, which were:

- To ensure the community is fully informed about the Proposal
- To provide multiple opportunities for the community to receive information and provide feedback about the Proposal
- To incorporate the feedback into the design of the wind farm where possible
- To provide multiple opportunities for ongoing dialogue with the community.

The format of this plan included:

- A profile of the community of the Broken Hill/Silverton area
- Consultation objectives
- Issue management
- Project-based activities
- Documentation of activities undertaken (to be completed post-consultation).

The plan was used to guide consultation during the development of the Proposal. Not all activities suggested were undertaken. The intention of the plan was that it be adapted as community feedback was received so that consultation activities were a pragmatic response to the issues raised by the community.

Key consultation activities included attendance at a Silverton Village Committee meeting, an open house session attended by a range of specialist consultants working on the wind farm, follow-up phone calls and correspondence, a further meeting for residents of Silverton and site surrounds, release of media statements, interviews with local media outlets including the Barrier Daily Truth and Barrier Miner and ABC Broken Hill, newspaper advertisements and in person.

6.2.2 Implementation of the Community Consultation Plan

While much of the consultation process focused on informing the community about issues relating to the Proposal, activities to engage the community in two-way dialogue were also undertaken and, where possible, community feedback informed the development by being incorporated into the design of the wind farm. Examples included the open house forum and phone conversations and face-to-face meetings with community stakeholders.

From the early stages of the Proposal, the Proponent has carried out extensive face-to-face meetings with landholders and residents of Silverton and Broken Hill. These meetings had the aim of explaining the scope of the Proposal and the process, and addressing concerns and discussing opportunities that were raised.

Open house

The open house session for the Proposal was held on 28 November 2007 at the Silverton Municipal Chambers. A community newsletter preceded the event, which was also advertised in the local media (newspaper and radio). The event ran from 2:00pm to 7:00pm. Representatives from the Proponent (four representatives), nghenvironmental (two representatives), acoustic consultants Heggies (one representative) and visual impact consultant URS (one representative) were present to discuss the Proposal specifics (including general questions about wind farms and wind farm development), the environmental planning process, biodiversity, noise and visual impacts. A summary of the work completed to date was distributed as well as a feedback form. Photomontages and noise modelling of the latest turbine layout were posted on the walls of the hall.

62 people registered their attendance on the day. It is estimated that, in total, approximately 75 people attended. Observations made on the day are presented below.

- The majority of people who registered their attendance at the open house reside in Broken Hill, with a significant number from Silverton
- A large number of people were interested in the business and work opportunities presented by the wind farm
- Some attendees noted that the wind farm presented opportunities for Silverton township
- Several people were interested in the flora and fauna work, particularly the process for determining species at risk and monitoring collision impacts
- Several people wanted to know if the Proposal had already been approved or was a 'done deal'. The submission timeline and opportunities for community input were of interest
- A number of people were concerned with the potential visual impacts that may result from the construction of the wind farm
- A number of people were concerned with the potential noise impacts that may result from its construction and operation
- A community alliance has been formed (Breaking Wind Alliance). This alliance opposes the construction of the wind farm
- Several people were concerned about the 'life' of the wind farm and also whether the turbines would be left onsite once operations at the wind farm have ceased.

Twelve community feedback forms were received via post. An example of the feedback form is presented in Attachment 5. The community feedback forms offered the community an opportunity to comment on the proposed wind farm through answering a number of questions. Generally the feedback forms indicated the following.

- The majority of respondents would take visitors to the Mundi Mundi Lookout
- Views and historic values were the highest community values with regards to the local area
- Most people indicated that they use the area for recreation
- The majority of people who completed forms were local residents
- Potential visual impact was considered the biggest impact on the respondents
- A number of people are concerned with environmental damage to the area including loss of visual amenity, historic land value and health issues.

Open house follow-up meeting

Following the results of the expert studies, the wind farm layout was revised to take into account constraints identified through biodiversity, indigenous and non indigenous heritage, noise, visual impact and community consultation.

To further ensure the views and hopes of the residents of Silverton had been fully represented to the Proponent, a letter was sent to the Silverton Village Committee, the Penrose Park Trust and the Silverton Common Trust. This letter requested that the secretary of each of these groups seek the views of their members on any areas of concern or opportunities they felt the Proposal offered to the village or its members. The letter offered a further meeting in Silverton with any interested parties.

At the Silverton Village Committee meeting, Silverton representatives decided to request a resident-only meeting with the Proponent. Accordingly, the Proponent wrote to the residents of the 27 homes within 10 kilometres of the site inviting them to such a meeting.

Secret ballot

At the March 2008 Silverton Village Committee meeting there was the announcement of the result of a secret ballot on the wind farm run by the Silverton Village Committee with no direct input from the Proponent. This secret ballot identified that:

- 36 residents do want the wind farm to proceed
- 20 residents do not want it to proceed.

Silverton village meeting

This meeting on 26 March at the Municipal Chambers in Silverton was attended by 22 local people, including representatives from the Department of Lands, the two village trusts and the Village Committee, which hosted the event, plus three representatives of the Proponent.

Following the revisions to the wind turbine layout, which was based on identified constraints, new photomontages were created for the wind farm and these were printed up into large format and put on display at the meeting.

At the open house session in November, a number of residents had asked if it would be possible to have free or reduced-price electricity as a form of mitigation for Silverton residents. The Proponent explained that it could not do this for two reasons: 1) it was not a retailer and 2) free electricity might not encourage energy efficient habits. However the Proponent took the concept on board and at the meeting the Proponent provided written information on a community fund and on the company's Solar Silverton offer of solar water heating, solar power and an energy efficiency audit for eligible residents within 10 kilometres of the wind farm.

The question and answer format discussed a number of concerns and opportunities, some of which had been previously raised and addressed through avoidance, minimisation or mitigation in the final design. The Proponent was able to explain how many of the previously raised concerns had been addressed in the progression of the development. These included site access, construction traffic, noise, environmental impacts from construction and fire management.

Key issues raised at the meeting included:

- Traffic impacts
  - To tourism traffic during construction
  - Speed limits and the impact on residents of Silverton travelling to and from Broken Hill
  - On Silverton from construction traffic including dust suppression
- Water
  - The possibility of a water treatment plant for Silverton
  - Removing siltation in the Umberumberka Reservoir
- Tourism
  - Impacts to tourism ventures in Silverton during construction
  - Options for providing tourism information
  - Infrastructure impacts from increased tourism (e.g. requirement for parking and toilets)
- Transport
  - Possibility of transporting components to Broken Hill by rail
- Communication
  - Investigation of improved mobile phone communications from Telstra.

- Timing
  - Timeframe to commencement of construction and duration of construction
- The following additional submissions were made:
  - A briefing paper on Penrose Park was presented to the Proponent regarding use of the facility for construction workers
  - A bridge over a creek on the Common was suggested and a briefing requested by the Proponent
  - Electricity for the village at three-phase rather than two-phase was requested.

A key aspect of the meeting was to gather ideas on the uses for a community fund and to encourage thinking on the benefits Silverton community might wish to see as a result of the wind farm. Coordinating through the heritage adviser to the village and being prepared separately, it is hoped that further submissions will be presented to the Proponent.

The Proponent would work with the community to progress these issues, many of which would be further developed in the Environment Management Plan (EMP) and in ongoing dialogue with the community about capturing the opportunities and benefits presented by the wind farm.

Details of the Solar Silverton initiative and proposed Community Fund presented to the attendees at the meeting are presented in Attachment 6.

Consultation with individuals and the community is ongoing.

Agfair 2008

Representatives of the Proponent set up an information stand at Agfair on 2 May and 3 May, 2008 at the racecourse at Broken Hill. The event was large scale and attendance was in the thousands. Information available on the stand included a large scale map of the proposed wind farm, photomontages of the proposed wind farm from a range of locations, an updated newsletter outlining the Proposal, and forms for members of the community to register their interest in the Proposal. The stand was well visited with significant enthusiasm for the development.

Newsletters

The first newsletter introduced the Proposal in October 2007 and provided the detail known at that time about the proposed wind farm and advising of opportunities for contacting the Proponent. It was distributed to all residents within ten kilometres of the site and stakeholders beyond who had or might have had an interest in the Proposal.

The second newsletter in November 2007 provided updated information about the wind farm and invited the community to attend the open house session to be held locally. It had the same distribution as the first plus other individuals and groups subsequently identified or made known to the Proponent.

The third newsletter in early May 2008 provided information on the final proposed layout and key facts about the Proposal. This was handed out at Agfair and sent to the updated distribution list.

A copy of all newsletters, media releases and results of the open house session are included as attachments (Attachment 6).

Media articles

A number of articles in the local, state and national media were published throughout the Proposal development period. The majority of these articles expressed view points by individuals, community groups or other stakeholders. These articles maintained the awareness of issues surrounding the wind farm, and the Proponent responded where appropriate via media interviews.

Accordingly, it is considered that the local and broader community is very well informed of the nature of this development, and appears generally supportive of the Proposal.

6.2.3 Keeping the community informed

In addition to this direct contact, media releases, newsletters and letters have been distributed to the broader community. The Proponent has been featured regularly on Broken Hill-based media, both radio and newspapers.

It is considered that the dissemination of information to the local community has been positive. This assessment is based on the positive result of the Silverton Village Committee secret ballot that was also publicly reported (see Attachment in Community Consultation Report). The Silverton Village Committee publicly stated that, having gauged the views of the residents, it would engage with the Proponent to maximise the benefits of the wind farm for the people of Silverton. The Proponent has embraced this proactive approach by the Silverton Village Committee and would continue to engage directly with the Committee to ensure benefits for the Silverton community. The Proponent also notes that while the majority of Silverton residents are in favour of the wind farm, a small number of residents are undecided or against the Proposal and the Proponent will continue to liaise with all parties to work towards avoiding, minimising or mitigating impacts and maximising local opportunities.

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7. ASSESSMENT OF KEY ISSUES

7.1 SCOPING AND PRIORITISATION OF ISSUES

Recent reforms to the Environmental Planning and Assessment Act 1979 and associated planning instruments (Part 3A) provide for improvements to efficiency in the assessment and approval process, by allowing assessments to focus on key issues.

Key issues are those with the potential to produce significant environmental or human impacts. They have been identified with respect to this Proposal in the Director-General's Requirements (refer to Section 5.1.4). The impact assessment process this EA documents is focussed on these key issues. Table 7.1 summarises the key issues and the investigation strategies employed to investigate them. Section 7 summarises the methodologies, results and mitigation measures recommended by these investigations for each key issue individually.

Table 7.1 Categorisation of key impact areas related to the Proposal

Issue	Investigation strategy
Visual amenity	Specialist report including photomontages of turbine layout
Noise (operational)	Specialist report including modelling and mapping
Biodiversity	Specialist report including flora, fauna
Hydrology (water quality)	Desktop review and consultation
Traffic and transport	Specialist report
Indigenous heritage	Specialist report
Non indigenous heritage	Specialist report
Economic	Specialist report
Land values	Desk review and consultation
Farming and grazing	Desk review and consultation
Mineral resource	Desktop review and consultation
Aircraft hazard	Desktop review and consultation
Fire and bushfire	Desktop review and consultation
Electric and magnetic radiation	Desktop review and consultation
Communications	Desktop review and consultation

Where specialist reports were undertaken, these are appended to the EA.

Section 8 discusses separately additional issues identified using the risk analysis methodology (see Section 8, Table 8.1).

Section 9 summarises all mitigation measures to which the Proponent would commit, together with the environmental management framework proposed for their implementation.

7.2 LANDSCAPE AND VISUAL IMPACT

7.2.1 Approach

A Landscape and Visual Impact Assessment (LVIA) was completed by URS and Green Bean Design for the Proposal.

The objective of the LVIA was to determine the potential visual impact of the Silverton Wind Farm, transmission lines and associated infrastructure on people living and working, or visiting and travelling the area surround the Silverton Wind Farm.

The LVIA involved a comprehensive evaluation of the visual character of the landscape in which the proposed wind farm and associated structures would be located, and an assessment of the potential visual impacts that may result from the construction and operation of the wind farm, taking account of appropriate mitigation measures.

The LVIA also assessed the potential visual impact on a number of potential receptor categories including residents, tourists as well as the film and art industry. The potential impacts on the film and art industries have been discussed separately in Sections 8.3.

The general methodology adopted for the LVIA included the following activities:

- Desktop study addressing visual character and receptor locations within the surrounding area
- Fieldwork and photography
- Assessment of landscape impact
- Assessment of visual impact
- Preparation of photomontages and illustrative material.

A desktop study was undertaken to initially identify an indicative view catchment for both stages of the proposed wind farm and associated structures. The desktop study referenced 1:100,000 scale topographic maps as well as aerial photographs and satellite images of the proposed development site and surrounding area.

Topographic maps and aerial photographs were also used to identify the locations and categories of potential visual receptors for verification during the fieldwork stage of the assessment. The desktop study also identified some preliminary physical characteristics of the surrounding landscape including features such as the site context, drainage, vegetation, landform and elevation.

A field work program was undertaken as part of the LVIA. Details of the field work undertaken include:

- Two separate inspections over an eight-day period to determine the potential extent of visibility of the wind farm and associated structures and confirm the surrounding landscape characteristics
- Attendance at an open house forum for community consultation
- Verification and confirmation of various receptor locations from which the wind farm and associated structures could potentially be visible
- Preparation of a written and photographic record for each receptor location assessed.

The potential impact of the Proposal on the character of the surrounding landscape would result primarily from the relatively capability of the landscape to accept human modifications and alterations without the loss of landscape character or deterioration of visual amenity. This overall capability (also known as the visual absorption capability of the landscape) may result primarily from the combination of two factors:

- The degree of potential screening that could be provided by the existing physical characteristics of the landscape (i.e. landform, rock form or vegetative cover)
- The nature and degree of perceptual factors that may influence interpretation and appreciation of the landscape (i.e. scale, line, pattern and colour).

The potential visibility of the wind farm from surrounding receptor locations would result primarily from the extent to which any particular structure of the wind farm may be visible and may be determined from a combination of factors including:

- The category and type of situation from which receivers may view the wind farm (examples of receptor categories include residents, tourists and motorists)
- The potential number of receivers with a view towards the proposed wind farm from any one view location
- The distance between the receiver and the proposed wind farm
- The duration of time the receiver may view the proposed wind farm from any static or dynamic view location.

The overall potential visual impact of the Proposal at individual receptor locations would result primarily from a combination of the potential visibility of the wind farm and the visual absorption capability of the landscape between, and surrounding, the receptor and the wind farm.

7.2.2 Assessment

An underlying rationale for the visual assessment is that if receivers are not normally present at a particular view location, such as scrub pasture or desert areas, then there is likely to be a nil visual impact at that location. Conversely, if one or more turbines are highly visible to a large number of people, or from a sensitive receptor location, then the impact is likely to be high. Although this rationale can be applied on a broad scale, the LVIA also considers, and has determined, the potential visual impact for individual receptor locations that may have a higher degree of sensitivity to the wind farm development, including the potential impact on individual residential dwellings.

Wind farm site

Background

The southern extent of the proposed wind farm development area is located approximately 3.5 kilometres north of Silverton. Silverton is registered as an historic place on the Register of the National Estate and is accessed via a sealed road approximately 23 kilometres to the west-northwest of Broken Hill. Silverton contains a small number of diverse buildings and structures which, for the most part, are physically disconnected from each other by the previous removal or demolition of earlier structures.

The main buildings remaining in, and around, Silverton include:

- Residential structures
- Silverton Hotel
- Municipal Chambers
- War Memorial Youth Camp
- Silverton Gaol Museum
- Churches and Masonic Temple (vacant)
- Silverton Public School (closed in 1970).

A small number of tourist orientated businesses operate in and around Silverton including:

- Art galleries
- Coin Carvery and Opal Shop
- Tea Rooms and Silverton Hotel
- Barrier Ranges Camel Safaris
- Daydream Mine.

Recreational areas within the vicinity of Silverton include Penrose Park and the Umberumberka Reservoir picnic area. Penrose Park contains a number of camping and visitor facilities and hosts the annual St Pat's Races Recovery Picnic Day.

The Silverton heritage walking track has a view of Silverton and the abandoned Umberumberka Mine. The track crosses a former railway line and reaches a highpoint around 260 m AHD. A number of designated rest points and lookouts along the route of the walking track have views towards the southern end of the Mundi Mundi Range.

There are two dedicated lookouts within the vicinity of the proposed wind farm development area: the Mundi Mundi Lookout and a small lookout area to the side of the exit road from the Umberumberka Reservoir visitor area. Both lookouts have extensive views to the west over the Mundi Mundi Plain. Access to the Umberumberka Reservoir lookout is restricted to between 8.30am and 3.30pm.

The LVIA identified nine landscape units surrounding the proposed wind farm development and include:

- The Mundi Mundi Plain
- Mundi Mundi and Robe Ranges
- Umberumberka Reservoir
- Silverton
- One Mile and Umberumberka Creek catchments
- Daydream Mine and Purnamoota
- Nine Mile Creek
- Broken Hill urban development
- Broken Hill industrial fringe.

A detailed description and assessment of the landscape units is included in the LVIA report, Appendix 1 and a summary of the landscape Units, Visual Amenity and Visual Absorption Capability presented below. Figure 7.1 identifies the nine landscape units.

Summary of Landscape Units

The majority of the Landscape Units are generally medium to large in scale, offering distant and open views in a number of directions toward and beyond the Silverton Wind Farm site.

Some areas within the landscape exhibit a smaller and more intimate scale and generally occur within the undulating landform of the Barrier Ranges where steep hill sides and hidden gullies reduce landscape scale and offer varying degrees of enclosure.

The majority of the Landscape Units have a simple pattern and structure which is exhibited over a broad area of the landscape, and largely defined by pastoral grazing and agricultural land use, although complexity in structure and pattern increases around urban and industrial areas.

Beyond the main urban areas, where colour is defined by various built structures, colour is largely determined by exposed rock outcrops, soils and vegetation found in the surrounding landscape. On a broad scale, dominant colours in the landscape reflect the semi arid desert tones of red and orange soils together with a mixed colour of minerals and rocks. Surrounding vegetation provides a range of colours including various hues of green, grey, blue and purple. The clarity and intensity of colours can vary with the quality of light.

Summary of visual amenity

Overall the visual amenity of the landscape character surrounding the Silverton Wind Farm is considered to be moderate. There are some areas that exhibit higher degrees of visual amenity, notably when viewed from elevated receptor locations such as the Mundi Mundi lookout and the Sculpture Park, and relates largely to the spatial relationship and visual opportunities presented by the extent of large scale open spaces against rising and undulating landforms.

Summary of visual absorption capability

Overall the landscape surrounding the Silverton Wind Farm development has been determined to have a moderate visual absorption capability, which tends to slightly increase around areas of more concentrated modifications to the landscape, such as the urban areas of Broken Hill and within Silverton. Landscape Unit 1 – The Mundi Mundi Plain, and Landscape Unit 2 – Mundi Mundi and Robe Ranges tend to have a low visual absorption capability, which generally results from the inherent large scale and open characteristics of the landscape combined with the general absence of vegetation to provide potential screening opportunities.

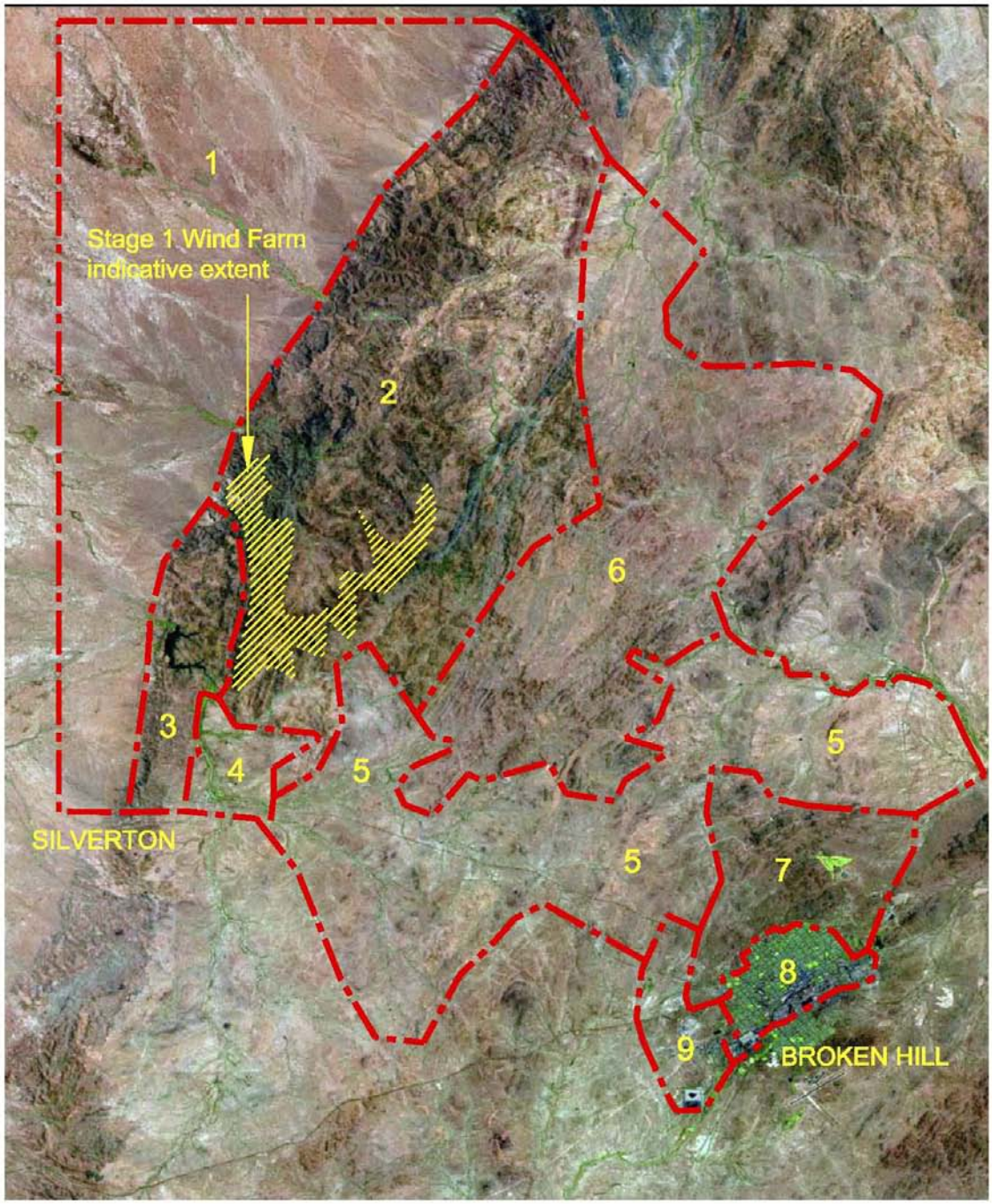

Figure 7.1 Visual impact landscape units

Impact assessment – construction

The construction of the turbines would be completed sequentially across the wind farm site. The LVIA concentrated on the visual impact of the Proposal post construction. Additional visual impact would be present during construction and decommissioning albeit temporarily.

Large and heavy vehicles en route to the site, road works on specified access roads, the potential for dust generation as well as turbine assembly onsite, would be visible to passing traffic and local residents in some locations. The construction of access tracks that would be used during both the construction and operation phases of the proposed wind farm would also have the potential to impact the visual amenity of the area. The construction of access tracks has been planned in consultation with key stakeholders and has been designed, among other issues, to minimise the potential visual impact of these tracks.

The majority of these impacts are considered to be temporary. The areas that would be affected are covered in the visual assessment for the operational phase, summarised below.

Impact assessment – operation

The operational phase of the of the wind farm would present potential visual impacts to receivers at 55 view locations. The initial stage of the wind farm involves the construction of 120 wind turbines, although all 120 turbines are unlikely to be visible from any single receptor location. The entire wind farm would include the construction of up to 598 wind turbines, although again all the turbines are unlikely to be visible from any single receptor location due to the distance and topography across the site.

It is considered that the potential visual impact could be both a positive or negative impact depending on the receiver who is viewing the farm.

The LVIA identified and assessed a total of 55 potential receptor locations and included views from:

- Residences
- Public lookouts
- Film locations
- Tourist facilities and destinations
- BBQ and recreational areas
- Road corridors.

The visual impact assessment presented in Table 7.2 has been created from the LVIA presented in Appendix 1 and includes each of the 55 receptor locations that have been assessed. The criteria used to determine the potential visual impact of the Proposal are detailed in the LVIA report in Appendix 1.

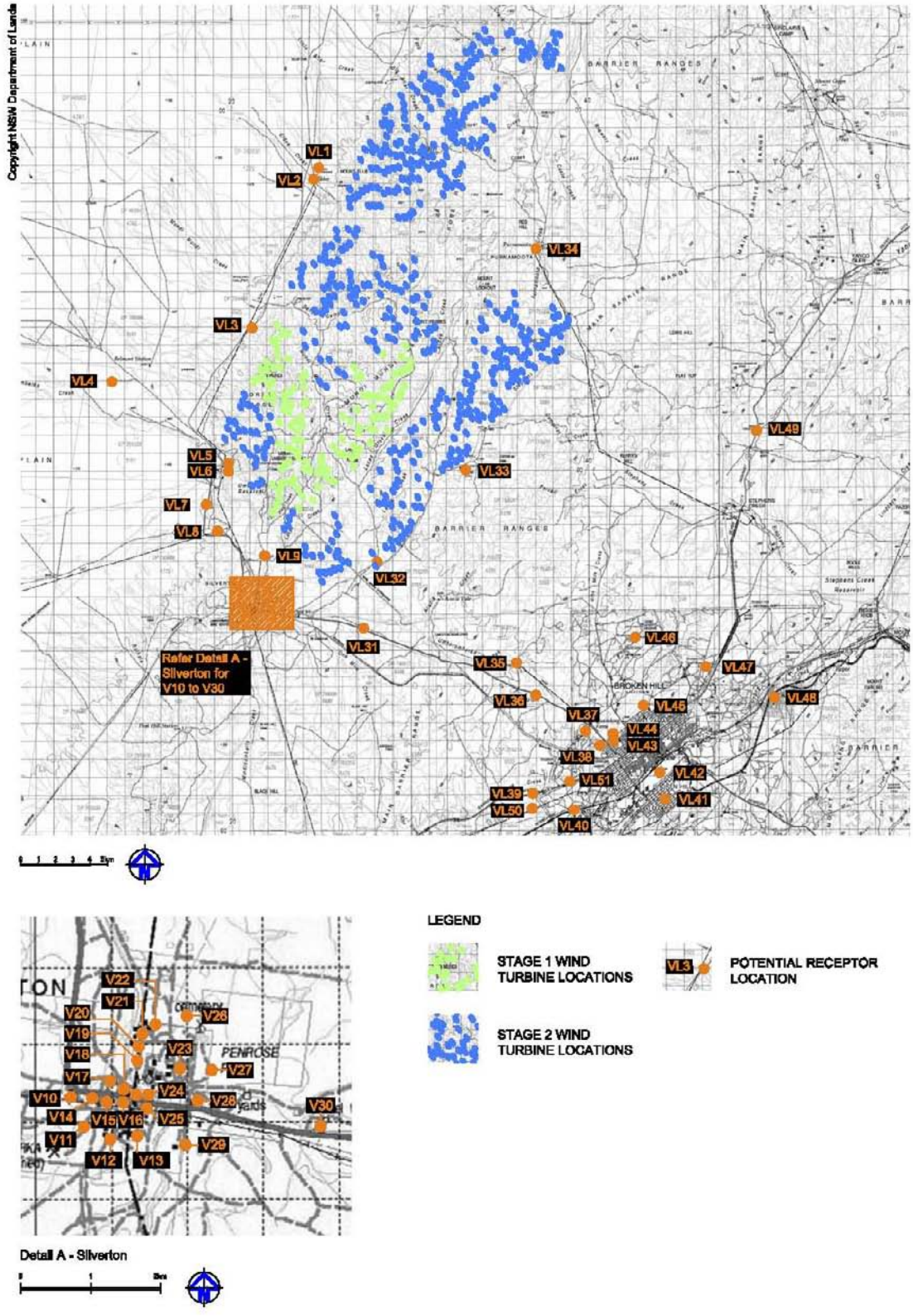

Figure 7.2 View locations

Table 7.2 Visibility Matrix for operational impacts

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
1	Occasional film location and working woolshed.	Open and extensive views from exterior areas surrounding Eldee woolshed toward series of hills along western edge of Barrier Range. Views take in Eldee Station buildings and tree lines along Eldee Creek.	9.2km (Long)	2.1km (Short)	Very Low	Stage 1 n/a Stage 2 Moderate to Long Term	Below	Nil	Low
2	Residents, employees and guests	View east from homestead and guest accommodation toward series of hills along the west edge of the Barrier Range.	8.4km (Long)	2.0km (Short)	Very Low	Stage 1 n/a Stage 2 Long Term	Below	Nil	High*
2a	Employees and visitors	Views from various areas within the Eldee Station property that extend along the west edge of the Mundi Mundi Plain and within the Barrier Ranges.	Varies depending on location within property	Varies depending on location within property boundary	Very Low	Moderate to Long Term	Below	Low*	Medium
3	Motorist	View north east or south west from vehicles travelling to, or beyond, Eldee Station on section of unsealed road for approximately 10km north of the Umberumberka Reservoir. Road corridor takes in views along the west edge of the Barrier Range and across the Mundi Mundi Plain.	1.1km (Short)	0.9km (Very Short)	Very Low	Very Short Term	Below	Low	Low
4	Occasional filming location.	Open and extensive views east from red clay pan surrounding film location across Mundi Mundi Plain toward west edge of Barrier Ranges.	7.9km (Long)	6.9km (Long)	Very Low	Moderate Term	Below	Low	Low

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
5	Visitors at Umberumberka reservoir car park and amenities building.	View north and east from lower car park and amenities building across portions of reservoir and dam. Views generally contained by landform rising to the east of the reservoir and by tree planting around the car park area.	2.5km (Medium)	1.3km (Short)	Low to Moderate (1)	Varies – likely Short to Moderate Term	Below	Low*	Low*
5a	Visitors to reservoir BBQ picnic area.	View south east from BBQ picnic area across water body toward hills beyond is partially screened by trees around the reservoir.	2.5km (Medium)	1.1km (Short)	Low to Moderate (1)	Varies – likely Short to Moderate term	Below	Low*	Low*
6	Residential	View south and east from residence across water body to hills fringing reservoir.	2.5km (Medium)	1.5km (Short)	Very Low	Moderate to Long	Below	Low	Medium
7	Motorist	View east to north east from road corridor toward hills south of reservoir, as well as views west to north west across the Mundi Mundi Plain.	3.7km (Medium)	2.7km (Medium)	Low to Moderate (1)	Very Short to Short term	Below	Low	Low
8	Visitor	Extensive and open views from the Mundi Mundi lookout west across the Mundi Mundi Plain. Views to the north, north east and south of the lookout are generally contained by undulating hills in the south portion of the Mundi Mundi Range and low hills to the west and south of Silverton.	3.2km (Medium)	3.2km (Medium)	Low to Moderate	Short to Moderate term	Below	Low	Medium
9	Residential	View north to north east from homestead generally contained within vicinity of homestead by undulating landform and vegetation.	2.5km (Short)	1.8km (Short)	Very Low	Moderate to Long term	Below	Low	Low

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
9a	Farm worker	Views from various locations within Belmont Station extend over Mundi Mundi Plain and Barrier Range pasture country.	Wide variance depending on location within property boundary	Wide variance depending on location within property boundary	Very Low	Moderate to Long Term	Below or Level	Low	Low
10	Residential	View north to north east from residence toward the south portion of the Mundi Mundi Range.	5.6km (Medium)	4.7km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium
11	Residential	View north to north east from residence toward the south portion of the Mundi Mundi Range.	5.9km (Medium)	4.8km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium
12	Residential and galleries	View north from residential and gallery buildings on elevated ground to the south of Silverton. Views extend over Silverton toward the south portion of the Mundi Mundi Range.	6.0km (Long)	4.5km (Medium)	Low to Moderate	Short to Moderate term	Below	Medium*	Medium*
13	Residential and gallery	View north from residential and gallery buildings on elevated ground to the south of Silverton. Views extend over Silverton toward the south portion of the Mundi Mundi Range.	5.8km (Medium)	4.2km (Medium)	Low to Moderate	Moderate to Long term	Below	Medium*	Medium*
14	Residential	View north from residence toward south portion of the Silverton Wind Farm site.	5.5km (Medium)	4.5km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium
15	Silverton Hotel	View north from building and courtyard generally screened by external fence and adjoining structures.	5.5km (Medium)	4.4km (Medium)	Low to Moderate	Short to Moderate term	Below	Low*	Low*

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
16	Shop and residential	View north from building is generally contained within the main street through Silverton. Views toward the proposed Silverton Wind Farm are partially obstructed by buildings on the opposite side of the road.	5.5km (Medium)	4.2km (Medium)	Very Low	Moderate	Below	Low*	Low*
17	Residential and artist studio	View from north of building and studio toward south portion of the proposed Silverton Wind Farm.	5.2km (Medium)	4.2km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium
18	Gallery, shop and residence	Indirect view from shop frontage area, with no view toward the proposed Silverton Wind Farm site within gallery space.	5.3km (Medium)	4.1km (Medium)	Low to Moderate	Moderate to Long term	Below	Low*	Low*
19	Residential	View north to north east from residence toward Silverton Wind Farm generally blocked by a combination of vegetation and surrounding structures. Potential view north to north east toward Silverton Wind Farm from exterior residential areas including access track to residence.	4.9km (Medium)	3.7km (Medium)	Very Low	Moderate to Long term	Below	Low*	Medium*
20	Residential	View north to north east from residence toward Silverton Wind Farm generally blocked by a combination of vegetation and surrounding structures. Potential view north to north east toward Silverton Wind Farm from exterior residential areas including access track to residence.	4.7km (Medium)	3.6km (Medium)	Very Low	Moderate to Long term	Below	Low*	Medium*

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
21	Residential	View north to north east from residence toward Silverton Wind Farm generally blocked by a combination of vegetation and surrounding structures. Potential view north to north east toward Silverton Wind Farm from exterior residential areas including access track to residence.	4.6km (Medium)	3.4km (Medium)	Very Low	Moderate to Long term	Below	Low*	Medium*
22	Residential	View north from residence toward Stage 1 partially screened by a combination of vegetation and surrounding structures.	4.4km (Medium)	3.2km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium*
23	Visitor (camping or recreational) Resident – caretaker	View north from within most sections of Penrose Park are generally screened by internal tree planting and structures. Views from the north portion of Penrose Park toward Stage 1 and Stage 2 turbine locations.	4.9km (Medium)	3.3km (Medium)	Very Low to Low (with seasonal variation)	Moderate to Long term	Below	Low	Low
24	Visitor – community events, or camping and recreational	View toward the proposed Silverton Wind Farm from rear of buildings generally blocked by surrounding structures and vegetation along creek lines.	5.3km (Medium)	3.8km (Medium)	Very Low	Short to Long term (visitation varies)	Below	Nil	Nil
25	Visitor or staff	View north from building and courtyard generally contained within the main streetscape area.	5.5km (Medium)	3.9km (Medium)	Low to Moderate	Short to Moderate term	Below	Low	Low
26	Visitor	View north and north east from cemetrey toward Stage 1 and Stage 2 turbine locations.	4.2km (Medium)	2.9km (Medium)	Very Low to Low	Very Short to Short term	Below	Low	Low

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
27	Residential	Generally extensive and open view north and north east from adjoining residences. Medium distance views extent to Stage 1 and Stage 2 wind turbine locations, with potential for views from residence. Residence to north offers some screening of views for residence to the south.	5.0km (Medium)	2.9km (Medium)	Very Low	Moderate to Long term	Below	Medium*	High*
28	Residential	View north from residence toward creek line and scrub pasture beyond. Potential intermittent views toward Silverton Wind Farm from north of residence.	5.4km (Medium)	3.2km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium*
29	Residential	View north from residence toward south portion of Stage 1, with potential views to upper portions of some Stage 2 turbines.	6.0km (Medium)	3.7km (Medium)	Very Low	Moderate to Long term	Below	Low	Medium*
30	Residential and Visitors to Camel Farm	View north from residence toward creek line and pasture. Potential views toward Stage 1 and Stage 2 turbines.	5.9km (Medium)	2.2km (Short)	Very Low	Moderate to Long term	Below	Low	Medium
31	Motorist	View north west from Silverton Road corridor for around a 10km section of road.	Distance varies 7.7km (Long)	Distance varies 2.2km (Short)	Low to Moderate (4)	Very Short term	Below	Low	Low
32	Motorist	Indirect view toward Stage 1 wind turbines from access track running north east toward Day Dream Mine. Very short distance view toward a small number of Stage 2 wind turbines located adjacent to the track to the Day Dream Mine.	5.0km (Medium)	0.2km (Very Short)	Low to Moderate (with seasonal visitation)	Very Short to Short term	Below	Low	Medium*
33	Visitor and staff	Views west to north west toward Stage 1 wind turbines from car park and mine surface areas are partially blocked by undulating landform. Generally direct and very short distance views to a small number of Stage 2 wind turbines located to the east of the Mundi Mundi Range.	5.2km (Medium)	0.7km (Very Short)	Very Low to Low (with seasonal visitation)	Short to Moderate term	Below	Low	Medium*

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
34	Residential	Views toward Stage 1 wind turbines from residence are generally screened by landform rising to the west of the residence. Indirect and medium distance views toward Stage 2 wind turbines to the south from exterior areas around the residence, as well as very short distance views from sections of the Purnamoota access track.	9.0km (Long)	2.8km (Medium)	Very Low	Moderate to Long term	Below	Nil	Medium*
34a	Property owner, farm worker	Views from various locations within Purnamoota Station extend over Barrier Range pasture country.	Wide variance depending on location within property boundary	Wide variance depending on location within property boundary	Very Low	Moderate to Long Term	Below or Level	Low	Low
35	Residential	Views north west from Limestone property are partially restricted by undulating landform to the west and north west of the residence. Distant to long distance views are available from various locations around the residence with some limited screening potential provided by existing trees surrounding compound area to the west of the residence.	14.3km (Distant)	9.5km (Long)	Very Low	Moderate to Long term	Below	Low	Low
36	Motorist or visitor for sunset views	View north west from the Silverton Road corridor (west bound) to the south of the Limestone property.	16.4km (Distant)	11.5km (Long)	Low to Moderate (4)	Very Short to Short term	Below	Low	Low
37	Residential and employees	View north west from residence and commercial buildings generally screened by landform and vegetation.	19.7km (Distant)	15.0km (Distant)	Very Low	Moderate to Long term	Below	Nil	Nil

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
38	Residential	View from residences on Brown Street extend north to north west across scrub pasture and surrounding open landscape.	20.8km (Distant)	16km (Distant)	Very Low	Moderate to Long term	Below	Nil	Nil
39	Motorist	View north to north east along Barrier Highway road corridor toward Barrier Ranges. Distant views toward Silverton Wind Farm are generally indirect from road corridor and potentially blocked by areas of undulating landform.	21.1km (Distant)	15km (Distant)	High (2)	Very Short term	Below	Low	Low
40	Various	Indirect views north west toward the Silverton Wind Farm site from sections of the Broken Hill railway line and various areas within the industrial area to the west and south west of the Broken Hill town centre. Views are generally screened by a combination of low undulating landform and structures within the industrial area.	22.6km (Distant)	17.5km (Distant)	Low to Moderate	Moderate to Long term	Below	Nil	Nil
41	Various	Views within residential and commercial urban development south of the Broken Hill mullock heap. Views toward the Silverton Wind Farm are generally blocked by surrounding development and landform.	25.8km (Distant)	20.7km (Distant)	High	Moderate to Long term	Below	Nil	Nil

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
42	Visitors and staff	Open and extensive views from top of the central mullock heap (including restaurant and miners memorial) extending north west over Broken Hill to distant horizon. Very distant views toward the Silverton Wind Farm site are likely to be influenced by prevailing atmospheric conditions.	24.6km (Distant)	19.6km (Distant)	Low to Moderate	Moderate to Long term	Generally below but potentially level and higher to turbines beneath RL340m.	Low	Low
43	Visitors and employees	Extensive and open views north west from hilltop location around TV transmitter station toward distant horizon across low scrub and pasture landscape. The Pinnacles are visible to the south west.	21.5km (Distant)	16.5km (Distant)	Very Low	Moderate to Long term	Below	Low	Low
44	Residential	View north west from residence across open landscape toward Limestone property and beyond.	21.0km (Distant)	16.0km (Distant)	Very Low	Moderate to Long term	Below	Low	Low
45	Visitors	Views from the White Rocks Reserve extend north to north west across open and generally level scrub pasture. Immediate views to the south extend over buildings along the southern fringe of Broken Hill.	21.4km (Distant)	16.5km (Distant)	Very Low	Short to Moderate term	Below	Low	Low
46	Visitors	Extensive and open views across the landscape are available as a 360 degree panoramic from the Sculpture Park hill top location. Distant view to north west horizon line and Silverton Wind Farm site on the distant Mundi Mundi and Robe Ranges.	18.5km (Distant)	14.0km (Distant)	Very Low to Low (3)	Short to Moderate term	Below	Low	Low

Potential receptor location	Category of potential receptor	Direction and context of view toward the Silverton Wind Farm	Approx view distance to Stage 1	Approx view distance to Stage 2	Relative number of viewers	Period of view	View elevation	Stage 1 visual impact	Stage 2 visual impact
47	Visitor	View north west from the top of Round Hill, located off the Silver City Highway north east of Broken Hill. Open and extensive views available as 360 degree panorama over Broken Hill and surrounding landscape. View north west toward Silverton Wind Farm partially obscured by landform around Sculpture Park and Living Desert Reserve.	22.7km (Distant)	18.3km (Distant)	Very Low	Very Short to Short term	Below to Level	Low	Low
48	Various	Residential and commercial areas with views toward the proposed Silverton Wind Farm blocked by surrounding development and landform.	26.8km (Distant)	22.7km (Distant)	Low to Moderate	Moderate to Long term	Below	Nil	Nil
49	Motorist	View north west to west from Silver City Highway corridor north of Broken Hill. Indirect views toward the Silverton Wind Farm site are generally blocked undulating landform between the road corridor and the proposed Silverton Wind Farm area.	Varies, generally >20km (Distant)	Varies, generally >12km (Distant)	Very Low to Low	Short to Moderate Term	Below	Nil	Low
50	Residential	Residential receptor south of the Barrier Highway road corridor.	21.2km (Distant)	16.1km (Distant)	Very Low	Moderate to Long term	Below	Nil	Nil
51	Residential	Residential receptor off Barrier Highway. Views toward proposed Silverton Wind Farm blocked by landform.	21.3km (Distant)	16.2km (Distant)	Very Low	Moderate to Long term	Below	Nil	Nil

Visibility Matrix Notes:

Annual Average Daily Traffic Count – (RTA 2005) have been referred to for the estimation of relative number of viewers along road corridors, and for potential visitation to Silverton and the Sculpture Park. Visitation numbers were requested from, but were not provided by, Broken Hill City Council.

(1) Unincorporated road west of Umberumberka Reservoir – Less than 50 (total in both directions). (2) Barrier Highway west of Broken Hill – 999 (total in both directions).

(3) Nine Mile Road at Sculpture Park – 60 (total in both directions). (4) Silverton Road – 210 (total in both directions).

** denotes visual impact adjusted from visibility matrix criteria to account for receptor sensitivity or magnitude of impact. Visual impacts may be adjusted to higher or lower visual impacts. Relative number of viewers estimated per day.*

An assessment and determination of the potential visual impact for the wind farm development on the 55 receptor locations indicated that for the combined Stages 1 and 2:

- Eight of the 55 view locations have been determined to have a NIL visual impact
- 26 of the 55 view locations have been determined to have a LOW visual impact
- 19 of the 55 view locations have been determined to have a MEDIUM visual impact
- Two of the 55 view locations have been determined to have a HIGH visual impact.

Receptor locations 2 and 27, determined to have a high visual impact within the Visibility Matrix (Table 7.2), include a homestead to the west of the Mundi Mundi Range (receptor location 2) and residential dwellings located to the east of Penrose Park (receptor location 27). Although each receptor location may experience a high visual impact, neither receptor will experience views toward all the Stage 1 and 2 turbines, with the majority of turbines screened by the rising landform along the east and west edge of the ranges.

The residential dwellings (receptor location 27) to the east of Penrose Park have limited existing screening opportunities and are likely to have direct views toward a number of the wind farm turbines. As well as views from the immediate vicinity of the residences, there may also be opportunities for views toward the wind turbines from some areas within the residential dwellings, although exterior views from within residential dwellings were not inspected or assessed during the fieldwork.

The homestead, including visitor accommodation, to the west of the Mundi Mundi Range (receptor location 2) will experience short distance and direct views toward a number of turbines located along the west portion of the wind farm site. Views toward some of the wind turbines are likely to occur from areas within and immediately surrounding the residential dwellings.

A total of 13 residential receptor locations within, and surrounding Silverton, that were determined to have a Low visual impact resulting from the Stage 1 wind farm, have been determined to have a Medium visual impact following the Stage 2 development. The Medium visual impact generally results from an increase in the total number of turbines that may be visible from individual receptor locations together with the proximity of residences and a group of Stage 2 turbines located between the south portion of Stage 1 and the Day Dream Mine access road. Although this receptor location has been determined High for Stage 2, the majority of Stage 1 and Stage 2 turbines will not be visible from this receptor location.

Lighting

The Silverton Wind Farm may require obstacle marking and lighting at night time and during periods of reduced visibility to meet Civil Aviation Safety Regulations, and will be subject to the advice and endorsement of the Civil Aviation Safety Authority.

Potential visual impacts associated with obstacle marking and lighting at night time have not been extensively researched or tested in New South Wales, although some research has generally concluded that although night time lighting mounted on wind turbines may be visible for a number of kilometres from a wind farm site, the actual intensity of the lighting appears no greater than other sources of night time lighting, including vehicle head and tail lights. Previous investigations have also suggested that replacing the more conventional incandescent lights with light emitting diodes (LED) may help to minimise the potential visual impact of the lights.

Potential light sources

The main potential light sources associated with the Silverton Wind Farm will include:

- Control and auxiliary buildings
- Substations
- Wind turbines.

In addition to the standard level of lighting required for normal security and safety, lighting may also be required for scheduled or emergency maintenance around control buildings, substations and wind turbine areas.

As the visibility of the Stage 1 and 2 substations and control rooms will be largely contained by surrounding landform, it is unlikely that light spill from these light sources will be visible from the majority of surrounding receptor locations including surrounding residences within Silverton.

No lighting is likely to be required for the Stage 1 and 2 transmission line between the Silverton Wind Farm and the existing Broken Hill substation or for the duplication of the 220kV line between Broken Hill and the terminal station at Red Cliffs in Victoria.

Potential receptors and impact

The categories of potential receptors that may be impacted by night time lighting generally include residents and motorists, but may also include people visiting locations for sunset views including the Mundi Mundi Lookout and the Sculpture Park, although day time and night time visitation to the Sculpture Park is restricted.

The majority of residential receptors within, and around, Silverton will have views toward relatively small and discontinuous groups of wind turbines generally along the south portion of the wind farm site, and therefore are only likely to have views toward a relatively small number of safety lights from any one receptor location.

Residential receptors with generally unobstructed views toward a greater number of turbines are likely to view a greater number of safety lights, and may include individuals at receptor locations 2 and 27, previously identified as high visual impact receptor locations. Irrespective of the total number of visible safety lights, safety lighting is more likely to be noticeable from exterior areas surrounding residences rather than from within residences where at night time room lights tend to reflect and mirror internal views in windows or curtains may be drawn that block the view altogether.

Whilst safety lighting will be visible to motorists, principally travelling northwest to west along the Silverton Road, the duration of visibility would tend to be very short and partially screened by undulating landform along some sections of the road corridor.

Night time lighting associated with the wind farm is unlikely to have a significant visual impact on the majority of receptor locations, including residential receptor locations in areas surrounding the proposed wind farm, and will be negligible for most receptor locations.

Transmission line route (Site to Broken Hill)

Background

The LVIA prepared for the section of transmission line between the wind farm and Broken Hill includes a detailed assessment of the potential visual impact, and is detailed in Appendix 1 and summarised as follows:

A total of 11 receptor locations were identified as part of the transmission line visual assessment. The categories of potential receptors that may be impacted as a result of the construction of the transmission line include:

- Residences
- Visitors to tourist facilities and destinations (eg The Sculpture Park)
- Motorists
- Rail passengers.

Impact assessment – construction

The characteristics and construction methods of the proposed power line have been detailed in Section 3.2.4.

Construction machinery, hardware, stockpiles and potential dust generation visible during construction activities have the potential to impact on visual amenity. However, these would confined to the construction phase. A number of the proposed mitigation strategies identified in Section 7.2.3 would assist to minimise visual impacts.

Impact assessment - operation

An assessment of the visual impact for each receptor location determined that:

- 0 of the 11 receptor locations have been determined to have a NIL visual impact
- 11 of the 11 receptor locations have been determined to have a LOW visual impact
- 0 of the 11 receptor locations has been determined to have a MEDIUM visual impact
- 0 of the 11 receptor locations have been determined to have a HIGH visual impact.

Around 22 kilometres of the Stage 1 220kV transmission line will not be directly visible from receptor locations around Silverton or from the Silverton Road.

The transmission line visibility will increase as the line approaches and crosses over road corridors, including Silverton Road and the Barrier Highway, although the duration of view from motor vehicles travelling along these roads is likely to be very short term and the resulting visual impact low.

Figure 7.3 Existing 220kV line, Broken Hill to Buronga

Figure 7.3illustrates the existing 220kV transmission line extending from Broken Hill to a switching station at Buronga, as viewed when travelling south on the Silver City Highway between Broken Hill and Mildura. The panorama illustrates a single line of pylons visible above a generally horizontal horizon line with little or no undulation in foreground on background views.

Figure 7.4 Typical landscape of Silverton Road corridor

Figure 7.4 illustrates the landscape viewed toward the general area where the transmission line will cross the Silverton Road corridor, and illustrates the gently undulating nature of the landscape which continues toward the more elevated sections of the Mundi Mundi and Robe Ranges. The undulating landscape will tend to disrupt views toward portions of the pylons and screen potential long distance views along the length of the transmission line.

Potential views toward the transmission line may occur from a small number of residences on the urban fringe west to north west of Broken Hill but will generally be within the context of the industrial nature of the local area.

The potential extent and level of transmission line visibility will also be determined by the final layout and location of support structures; however the majority of the pylons are unlikely to be viewed wholly above the skyline from the majority of receptor locations, including elevated locations such as the Sculpture Park. Further conclusions are presented in the LVIA, Appendix 1.

Transmission line route (site to Red Cliffs)

Background

The Stage 2 transmission line assessment has been based on the alignment of the existing transmission line. While unlikely, the final Stage 2 transmission line route may vary from the existing route and may not be visible within the same viewshed as the existing transmission line.

The final components of the proposed transmission line are subject to detail electrical design and approvals from regulatory bodies.

The main visible components will include:

- A supporting structure (pylon or tubular pole)
- Insulator
- Conductors.

The cumulative visual impact of the Stage 2 transmission line will depend on the final alignment and the type of structures (pylons or poles) to be installed.

Indicative alignment – Stage 2 Silverton Wind Farm to Broken Hill substation

The final alignment for this section of the Stage 2 transmission line is subject to further detail design, however it is assumed that the majority of the Stage 2 route will duplicate Stage 1 alignment between the Silverton Wind Farm and the Broken Hill substation.

The Stage 2 transmission line will also extend to the proposed Stage 2 substations, and are unlikely to be visible from surrounding residential or public road areas.

Indicative alignment – Broken Hill substation to Red Cliffs terminal station

The final alignment for this section of the Stage 2 transmission line is subject to further detail design and environmental studies, however it is assumed that the majority of the transmission line will duplicate the existing alignment between the Broken Hill substation and the terminal station at Red Cliffs in Victoria.

The existing transmission line is approximately 293 kilometres long and extends in a general south to south east direction following the Silver City Highway between Broken Hill and Buronga.

The categories of potential receptors within the view catchment of the proposed transmission line include:

- Residential
- Motorists
- Tourists and recreational users

Other significant crossing locations, travelling south from Broken Hill include:

- The Darling River
- The Murray River
- Kings Billabong Nature Reserve (managed by Parks Victoria).

Impact assessment – construction

The final transmission line route has not yet been finalised. On that basis, the visual assessment, has assumed that the proposed transmission line will duplicate the current transmission line.

Generally it is considered that the cumulative impact resulting from the construction of the additional transmission line is unlikely to be significant for the majority of residences that currently view the existing transmission line. Stockpiles and potential dust generation from construction activities also have the potential to impact on visual amenity.

As discussed, the majority of views towards the existing transmission line from the Silver City and Sturt Highways are distant and indirect. Due to the dynamic and sequential progressive nature of the transmission line construction, potential impacts to visual amenity are considered to be low and from many areas negligible.

Residential Views

For the purposes of the Concept Approval, residential views have been considered in a number of discrete groups relative to their position in the landscape along the existing transmission line route, and broadly consist of residences:

- To the south west of Broken Hill
- Off the Silver City Highway (including pastoralist homesteads)
- Either side of the Darling River corridor
- To the north and east of Gol Gol
- To the south of the Red Cliffs terminal station.

The table below lists the general occurrences of residences together with the context of view and preliminary comments relating to the potential nature and extent of cumulative landscape and visual impacts.

Table 7.3 Summary of residential view locations

Residential location	View context	Comments
Residences around south west Broken Hill	Very low number of potential residential receptors to the south west of Broken Hill around existing industrial area and Silver City Highway corridor. Existing views generally extend across large scale open spaces. Potential for generally distant views toward existing transmission line.	Views toward the existing transmission line generally occur within a large scale and open landscape offering distant and extensive views. Views within the locality include the industrial area to the south and west Broken Hill including views to mining operations and existing electrical infrastructure. It is likely that the cumulative impact of an additional transmission line would not be significant for these residential locations.
Homesteads off Silver City Highway	Very low number of potential residential receptors from around twenty homesteads/farms set back from the east and west of the Silver City Highway corridor. Existing transmission line extends over scrub and pasture areas but does not appear to pass over, or within a close (less than 1km) distance to homestead or residences.	A preliminary assessment has been carried out as a desktop study and field inspections. Homesteads and residences are generally not visible from the Silver City Highway. Potential for short distance views for a very low number of viewers from within properties toward the existing transmission line from general pasture areas or access tracks. It is likely that the cumulative impact of an additional transmission line would not be significant for these residential locations.
Darling River	Very low number of potential residential receptors located on both sides of the Darling River in the vicinity of the transmission line crossing. Views generally contained within and along the river corridor, but occasionally extending north and south across agricultural land.	A preliminary assessment has been carried out as a desktop exercise as residences are generally not visible from local roads. The existing transmission line will potentially be visible from a small number of residences on either side of the river, and the final level of visibility will be subject to the final alignment adopted.
North and east Gol Gol	Very low number of potential residential receptors with views from the edge of Gol Gol across agricultural, orchard and vineyard areas.	Medium distance views across generally open agricultural landscape, with occasional individual and grouped trees. It is likely that the cumulative impact of an additional transmission line would not be significant for these residential locations.
Red Cliffs terminal station	Very low number of potential residential receptors west of Red Cliffs township (along Wonega, Woorlong and Woomera Avenues) to the south of the terminal station with local views across Kings Billabong Wildlife Reserve.	Views toward the proposed transmission line would be within the context of the electrical infrastructure of the Red Cliffs terminal station. It is likely that the cumulative impact of an additional transmission line would not be significant for these residential locations.

Motorists

The existing transmission line crosses a number of roads including:

- Silver City Highway (three crossing points between Broken Hill and Mildura)
- High Darling Road (one crossing point)
- Low Darling Road (one crossing point)
- Wentworth to Pooncarie Road (one crossing point)
- Arumpo Road – TransGrid Switching Station (one crossing point)
- Sturt Highway (one crossing point).

There are five designated rest areas on the Silver City Highway between Broken Hill and Mildura, including the roadhouse located at Coombah.

The Seven Tree rest area, approximately 200 kilometres south of Broken Hill, is the only rest area with a potential distant view (around three kilometres) west toward the existing transmission line.

The majority of views toward the existing transmission line from the Silver City Highway corridor are distant and indirect, although the transmission line converges toward the highway and crosses at three locations. As the majority of views are from moving vehicles the cumulative visual impact of an additional transmission line is not likely to be significant.

Similarly, views toward the existing transmission line from the Sturt Highway corridor are generally distant and indirect, although the transmission line converges toward the highway and crosses at a single location. As the majority of views are from moving vehicles the likely cumulative visual impact of an additional transmission line is not likely to be significant for motorists.

The transmission line will also cross a number of minor roads, including the Upper and Lower Darling Roads and the Arumpo Road, as well as many access tracks over private property and farms.

In the context of the generally open and rural/agricultural nature of views, the cumulative impact of an additional transmission line will be unlikely to have a significant impact on the potentially very low number of motorists travelling along minor roads.

Recreational users

The existing transmission line extends over the Murray River as it approaches the terminal station at Red Cliffs in Victoria, and passes through the southern portion of the Kings Billabong Nature Reserve.

Although there is a boat ramp facility located in the general vicinity of the existing power line as it crosses the river, the majority of public facilities and activities within the nature reserve appear to be located three to four kilometres north of the existing transmission line corridor, and depending on the final alignment, the transmission line is unlikely to be visible from existing designated picnic or walking tracks. The site of the historic pumping station (the Psyche Pumps) is approximately 4 kilometres north of the existing transmission line.

Recreational use also includes charter boat trips along the Murray River and boat use in general for other recreational purposes. The Murray River floodplain, extending either side of the existing transmission line corridor, is predominantly tree covered, and tends to restrict views toward the transmission line to around a 300 to 500 metre length from sections of the river as it passes by the existing transmission line.

The LIVA concluded that the development of the transmission line between Broken Hill and Red Cliffs would have a low cumulative impact on the landscape character and a low cumulative impact on people travelling through and residing along the route of the transmission line. Additionally, the greater extent (around 80 per cent) of the transmission line would be located through a generally undeveloped rural landscape area with a very low population density. Further conclusions are presented in the LVIA, Appendix 1.

Photomontages

A series or photomontages have been prepared by Garrad Hassan Pacific Pty Ltd to illustrate the Silverton Wind Farm post construction. Eight photomontages locations have been selected to illustrate the Silverton Wind Farm from surrounding areas.

The photomontages locations are illustrated in LVIA Appendix 1, and include:

- Receptor Location 2 from Eldee Station Homestead (Stage 2 only)
- Receptor Location 4 from clay pan film location on Belmont Station (Stage 2 only)
- Receptor Location 7 from road to Umberumberka Reservoir (Stage 2 only)
- Receptor Location 8 from Mundi Mundi Lookout (Stage 1 and Stage 2)
- Receptor Location 15 from Layard Street, Silverton (Stage 1 and Stage 2)
- Receptor Location 19 from east of residences, north Silverton (Stage 1 only)
- Receptor Location 31 from Silverton Road (Stage 1 and Stage 2)
- Receptor Location 46 from Sculpture Park, north of Broken Hill (Stage 2 only).

The photomontages were generated through the following steps:

- A digital terrain model (DTM) of the Silverton Wind Farm site is created from a terrain model of the surrounding area (usually digital contours)
- The site DTM is loaded in the Garrad Hassan Pacific Pty Ltd WindFarmer software package
- The layout of the wind farm, and three dimensional representation of the wind turbine is configured in WindFarmer
- The location of each viewpoint (photo location) is configured in WindFarmer – the sun position for each viewpoint is configured by using the time and date of the photographs from that viewpoint
- The view from each photomontage location is then assessed in WindFarmer. This process requires accurate mapping of the terrain as modelled, to that as seen in the photographs. The photographs, provided by Green Bean Design, taken from each photomontage location are loaded into WindFarmer, and the visible turbines superimposed on the photographs
- Adjustments are made to the combined image for fogging due to haze or distance, as well as screening by vegetation or obstacles
- The final image is converted to JPG format and imported to the final figure.

A detailed summary of the photomontages is included in the LVIA Appendix 1 and selected photomontages are presented in Figure 7.5.

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Figure 7.5: Selected photomontages of Silverton Wind Farm (Stages 1 and 2).

Silverton Road, Daydream Mine Entrance

Silverton Crossroads

Mundi Mundi Lookout

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