3.3 Wind Farm Infrastructure

It is not yet known which model of wind turbine will be used for the Project as final turbine selection will occur through a competitive tender process pending development approval. However, in terms of generation capacity, the wind turbines under consideration for this Project vary in the range from between 1.8 and 3.3 MW. By way of example the Suzlon S88, 2.1 MW machine (as installed at the Capital Wind Farm, east of Lake George, New South Wales (NSW)) is typical of the type of wind turbine that could be used. See **Figure 8.14** and **8.15**, **Volume 2** (also found in **Appendix 6**) for a benchmark comparison between the Project and the Suzlon S88, 2.1 MW wind turbines at the Capital Wind Farm. **Image 3.1** below displays a picture of a typical wind turbine, detailing the component parts.

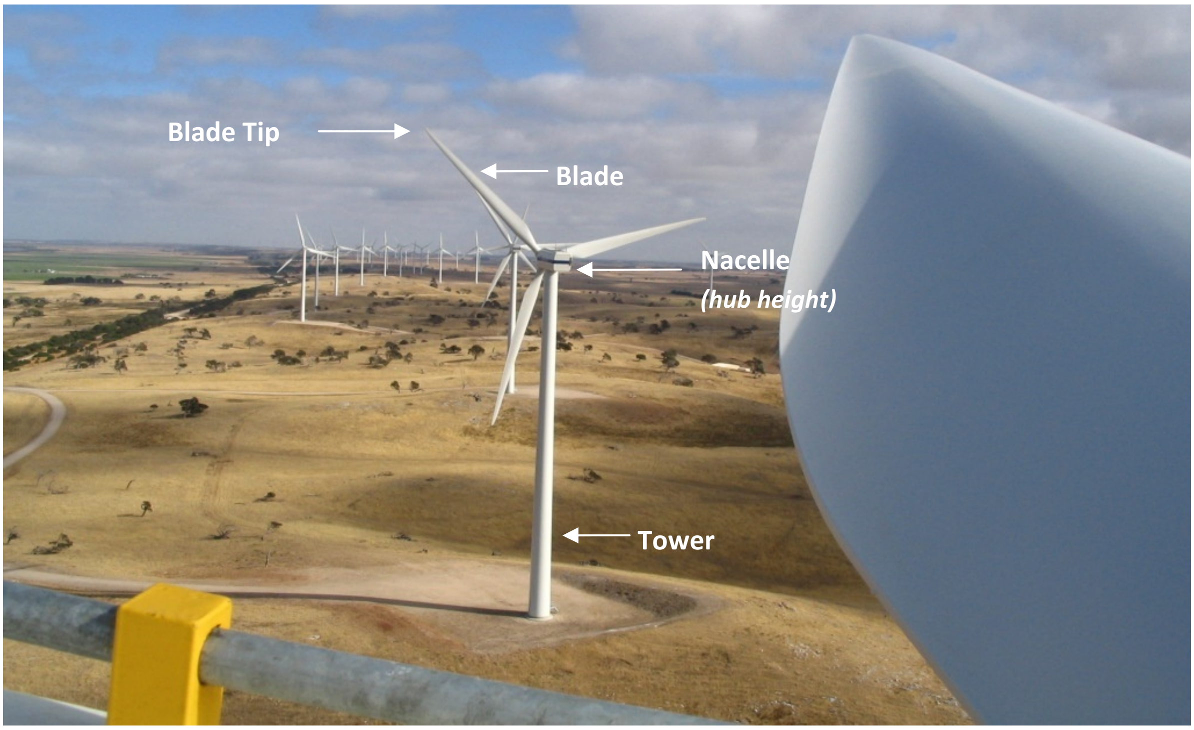

Image 3.1 Components of a wind turbine

3.3.1 *Turbine Rotor*

The turbines used for the Project will be three-bladed, semi-variable speed, pitch regulated machines with rotor diameters between 88 and 104 m and a swept area of 6,083 to 8,490 square metres (m^2). Typically turbines of this magnitude begin to generate energy at wind speeds in the order of 4 metres per second (m/s) (14.4 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 kph). Wind turbine blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub, and include lightning rods for the entire length of the blade. The blades typically rotate at about 12 revolutions per minute (rpm) at low wind speeds and up to 18 rpm at higher wind speeds.

3.3.2 *Towers*

The supporting structure is comprised of a reducing cylindrical steel tower fitted with an internal ladder or lift. The largest tower height under consideration is 101.5 m with an approximate diameter at the base of 4.5 m and 2.5 m at the top. However it is important to note that the rotor diameter suitable for this wind turbine is 100 m and therefore falls within the maximum proposed blade tip height of 152 m. Alternative tower heights of 80, 85, 94 and 100 m are also under consideration however this is not an exhaustive list since new models and certified designs are continually entering the market place. The tower will typically be manufactured and transported to site in three to five sections for on-site assembly.

3.3.3 *Blade Tip*

The blade tip will comprise the highest point of the wind turbine when in a vertical position. Given the turbines under consideration, a blade tip height of 152 m is considered to be the maximum.

3.3.4 *Nacelle*

The nacelle is the housing constructed of steel and fibreglass that is mounted on top of the tower and can be 10 m long and 4 m high and 4 m wide. It encloses the gearbox, generator, transformers, motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the wind turbine.

3.3.5 *Footings*

Three types of foundation for the turbines will be considered pending geotechnical investigation of the ground conditions at the Project site.

Slab (gravity) foundations would involve the excavation of approximately 450 cubic metres (m^3) of ground material to a depth of approximately 2 m. Approximately 200 m^3 would, if suitable, be used as backfill around the turbine base. Remaining excavation material will be used for the on-site road infrastructure, where necessary. A slab foundation would involve installation of shuttering and steel reinforcement, followed by the pouring of concrete. (Refer to **Image 3.2** for an example of a gravity footing).

If slab plus rock anchor foundations are required, the construction of the foundation for each machine would involve the excavation of approximately 300 m^3 of ground material to a depth of approximately 2 m. Slab plus rock anchor foundations require shuttering and steel reinforcement, drilling of rock anchor piles up to a depth of approximately 20 m, concrete pour, after which the rock anchors are stressed and secured once the concrete has cured sufficiently.

Alternatively, if a single mono-pile foundation is required (rock anchor), approximately 50 m^3 of ground material would be removed by a rock drill to a depth of approximately 10 m, of which 30 m^3 would, if suitable, be used as back fill. If a mono-pile foundation is used, a tubular section with tower connection flange attached is inserted in the hole and concrete is then poured in situ. (Refer to **Image 3.2** for an example of a rock anchor footing).

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

Detailed geotechnical surveys will be carried out during pre-construction work to determine the necessary foundation type per turbine. It is feasible that more than one type of turbine foundation may be required for the Project, following the assessment of the individual turbine locations. New turbines are continually coming on to the market and it is possible that minor variations to these typical dimensions could occur prior to final turbine selection. Impact assessments undertaken for the Project assume the use of the largest foundation footprint for all turbines, i.e. slab plus rock anchor.

3.3.6 *Crane Hardstand and Assembly Areas*

Site access roads would have areas of hardstand (approximately 50 by 25 m) adjacent to each wind turbine for use during component assembly and by cranes during installation. The clearing of native vegetation for the construction of access roads and hardstand areas will be avoided where possible. If clearing is found to be unavoidable, this will be appropriately managed and carried out as described in **Chapter 20** Statement of Commitments. The roads would be surfaced with local stone to required load-bearing specifications. The nature and colour of surface stone would be selected to minimise visual impact prior to construction. The roads and hardstand areas would be maintained throughout the operational life of the Project and used principally for the periodic maintenance of the wind turbines. **Image 3.3** below shows a typical hardstand area adjacent to the wind turbine footing.

Image 3.3 Typical hardstand area adjacent to a rock anchor footing

3.3.7 *Monitoring Masts*

There are currently two temporary wind monitoring masts installed, one located on-site and the other close to the Project site (60 and 40 m high respectively), recording wind data for Project development and planning.

Approximately four permanent wind monitoring masts, up to 100 m high, are proposed to be installed on-site. Locations for these masts are yet to be determined and will be influenced by the final wind turbine selection. These permanent masts may incorporate the existing temporary structures and provide information for the performance monitoring of the wind turbines. The wind monitoring masts would be of a guyed, narrow lattice or tubular steel design. **Image 3.4** below shows both typical tubular and lattice wind monitoring mast designs.

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

3.4 Electrical Infrastructure

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

- Up to 125 wind turbine generator transformers;
- The establishment of a 100 by 100 m collector substation with 33 kV-to-132 kV transformers, circuit breakers and isolators;
- Approximately 64 km of 33 kV entrenched underground cables;
- Approximately 14 km of 33 kV overhead electrical interconnection cables;
- Approximately 4 km of underground or overhead electrical interconnection cables (decision as to whether this infrastructure will be located under or above ground will be subject to detailed design);
- Approximately 68 km of underground control cables (4 km may be underground or overhead); and,
- Establishment of a 30 by 6 m operation facilities building to house control and communications equipment.

3.4.1 *Generator Transformer*

The wind turbine generators typically produce electricity at nominally 0.69 kV which is stepped up to 33 kV by the transformer located in either the nacelle, the base of the tower or close to the base of the tower on a concrete pad. **Image 3.5** below shows an example of a transformer located outside of the tower.

The generator transformer may be oil-filled or a dry type depending on the wind turbine. Where oil-filled transformers are used, appropriate measures will be incorporated to prevent any oil loss reaching local water courses. The volume of oil used for generator transformers is in the order of 1,000 litres (L). The output from each of the turbines will be directed via 33 kV cables that link to the 33/132 kV collector substation.

Image 3.5 Transformer adjacent to wind turbine

3.4.2 *Collector Substation*

The collector substation location has been chosen to minimise access distance and electrical losses, and to reduce its visibility from surrounding public viewpoints (see **Figures 3.1** to **3.6**). The collector substation will be 2 km from 'Boco', the nearest inhabited dwelling. Following construction, and if warranted, small areas of tree planting could be undertaken to screen any part of the collector substation that are visible from the surrounding country to reduce visual impact. Access to the collector substation site for construction purposes will be via the new internal access road off Avon Lake Road. Post-construction access would be along the same route or alternatively via Boco Road, which links to the internal road network via the Snowy River Way.

The collector substation will include two 150 megavolt ampere (MVA) transformers to step-up the voltage from 33 kV to 132 kV, together with ancillary equipment. It will occupy an area approximately 100 by 100 m and will be surrounded by a 2 m high security fence, surmounted by strands of barbed wire. The collector substation arrangement will include an array of busbars, circuit breakers, isolators, various voltage and current transformers and a static compensator-capacitor as agreed with Country Energy. A buried earth grid will extend one metre beyond the fence on all sides. The ground surface within the collector substation enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. As the transformer may contain upwards of 80,000 L of oil, provision will be made in the design for primary and secondary containment of any oil that may leak or spill from the transformers or associated components. This would involve constructed concrete bunds around each transformer and a spill oil retention basin or oil/water separator outside the collector substation compound. The 1 ha area includes a provision for a 20 m buffer of land surrounding the equipment.

Consideration was given to the establishment of two internal collector substations. However studies indicated that although both options would have similar electrical protection requirements, a single collector substation approach both reduces the land use requirement (and therefore impact area) but in addition offered greater operational flexibility by allowing for full power transfer between the two transformers. Therefore a single collector substation design results in a lower cost, lower land use and a better level of network reliability so is the preferred and proposed option.

3.4.3 *Overhead and Underground Cables*

The electrical cables from the Sherwins Cluster will comprise of underground cabling (with the two connections across the Snowy River Way and Avon Lake Road proposed to be either under or above ground), and will connect directly to the collector substation. The Yandra, Springfield and Boco Clusters are over a kilometre or greater from the substation and a double-circuit overhead power line from each Cluster operating at 33 kV is proposed to connect the combined output of the turbines to the substation. These double-circuit 33 kV overhead lines will run approximately east-west for distances up to 6 km. Where feasible the lines to the Springfield and Yandra Clusters will be attached to the same poles and along the same easement leading into the collector substation. The respective routes will be located so that they will not be generally visible from much of the surrounding countryside and to minimise the clearance of trees (see **Figures 3.1** to **3.6**). **Image 3.6** shows a typical overhead line construction that could be implemented in this Project.

Image 3.6 Double-circuit overhead 33 kV power line

The underground cable routes will generally be between the turbines and follow the route of the internal access roads (refer to **Image 3.7** below). The final route will minimise vegetation clearing and avoid potential erosion and heritage sites and will also depend on the ease of excavation, ground stability and cost. Markers may be placed along the route of the underground cables, if agreed by the participating landowners. Placement of these cables below ground will result in minimal visual impact.

Control cables will interconnect the wind turbine generators and the operation facilities building. Computerised controls within each wind turbine will automatically control start-up, speed of rotation and cut-out at high wind speeds. Recording systems will monitor wind conditions and energy output at each of the turbines. Remote monitoring and control of the Project will also be possible. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the groups of turbines and above ground between the Yandra, Springfield and Boco Clusters and the facilities building located at the collector substation location within the Sherwins Cluster. Above ground control cables would be strung from the poles of the internal 33 kV overhead lines located between the Clusters.

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

Image 3.7 Laying underground electrical cable within road network

3.4.4 *Operation Facilities Building*

A facilities building approximately 30 by 6 m will be constructed at the same location as the collector substation. The general location has been chosen to minimise the length of overhead lines and underground cables and also to minimise the visibility of the facilities building and substation. The building will house instrumentation, electrical and communications equipment, routine maintenance stores, a small work area and staff amenities.

The structure is proposed to be a slab-on-ground construction with steel frame, metal or brick walls and a sheet-steel roof or alternatively a transportable type building constructed on piers. It will be of sturdy construction, suitable for the weather conditions it will be exposed to and will be compatible with the rural environment. Roof drainage will collect rainwater for domestic use. A septic or composting toilet system, which complies with Council requirements, will be installed to treat the small amount of waste water produced.

The design of the collector substation, electrical installations and operation facilitates building will be developed in conjunction with Country Energy and comply with relevant technical, electrical and planning standards.

3.5 Site Access Works

3.5.1 *Site Entry*

The Project locality can be reached via the Monaro Highway at Nimmitabel via the existing arterial roads of Springfield Road, Avon Lake Road, and the Snowy River Way.

The deep gullies which join the MacLaughlin River provide an access constraint within the Project site resulting in the proposed layout comprising four Clusters of turbines which require separate access points to the public road network.

Existing access roads are shown in **Figures 3.1** to **3.6** and can be classified in to three broad categories:

- National Highways: Monaro Highway, which is maintained by the Roads and Traffic Authority, would provide access from Canberra to Springfield Road immediately south of Nimmitabel;
- Regional Roads: Snowy River Way (also referred to as Ando Road) which is maintained by Bombala Council and connects the Bombala area to the Snowy Mountains via Dalgety and Berridale;
- Local Roads: All other roads which are maintained by the Council (either Bombala or Cooma-Monaro Shire). This includes Springfield Road which will be the major access to the Project site from Nimmitabel; and
- The Roads and Traffic Authority (RTA), Bombala and Cooma-Monaro Councils have ongoing maintenance and improvement programmes for the roads and bridges under their control.

Bombala Council has a continuing programme for the reconstruction and sealing of the gravel section of Snowy River Way. Reconstruction is currently taking place from the western end of the gravel section near Boco Road towards the locality of Ando for a distance of 3 km.

There are no current proposals for major road improvements on the other access roads under consideration.

The currently favoured access points for the four Clusters are shown in **Figures 3.1** to **3.6** and described below:

- Yandra Cluster: The major access point is from Yandra Road via the access road to "Benbullen" which departs Yandra Road at 1.5 km from Springfield Road;
- Springfield Cluster: The access point under consideration is from Brechnoch Road, approximately 13 km from Nimmitabel, this is in relation to siting the temporary site office, construction compound and a concrete batching plant facility adjacent to Brechnoch Road and subsequently reducing transport distances during the construction phase. An alternative access point off Springfield Road is located approximately 16 km from Nimmitabel, along an existing laneway entry known locally as "Dummy Lane";
- Sherwins Cluster: Access points being considered are at 22.5 km from Nimmitabel on Avon Lake Road and on both sides of Snowy River Way (Ando Road) at approximately 28 km from Nimmitabel; and
- Boco Cluster: Access will be from the same internal access road from Avon Lake Road as required for the Sherwins Cluster, to avoid unnecessary impacts to the Riparian corridor along the MacLaughlin River that would otherwise result from the upgrade of the Boco Road.

Note: 25 km of the arterial road access likely to be used for construction activities are unsealed. This has implications for water usage and dust suppression and is discussed later in this chapter.

All entrances to the Project site from the existing arterial roads will be designed to allow long vehicles to safely exit from or re-enter without disrupting traffic. Further consultation will be undertaken with Council and the RTA to confirm the final design. Further details relating to safe access considerations are discussed in **Chapter 12**, Traffic and Transport.

3.5.2 *On-site Access Roads*

Other access consists of new on-site roads between turbines, also comprising hardstand and turning head areas. The on-site roads will follow existing farm tracks where possible that traverse the ridgelines and plateaus. All roads leading from the arterial roads and all on-site access roads are likely to require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation.

As indicated in **Section 3.2** depending on final turbine selection and crane availability, new internal access roads will consist of either a 12 or 6 m wide design. The 12 m wide design is applicable for a track-mounted 'crawler' crane whereas the 6 m wide design is suited for a more mobile tyre-mounted crane. If a 6 m design is constructed it will incorporate passing bays up to 12 m wide located at intervals of approximately 1 km to allow for the safe passage of vehicles.

Currently crawler cranes are more common within the Australian market place and therefore the assessments undertaken within this EA are based around the greatest impact arising from a 12 m wide design for Layout Option 1. However tyre-mounted cranes are beginning to enter the market and if available will be considered for this Project.

Construction of the internal road network will require earth works that are beyond the limits of the permanent road impact within the Study area. This is required to level areas of steep gradient to a design suitable for safely transporting Project components into position. Detailed civil designs have been prepared for Layout Option 1 that include impacts associated with permanent road, hardstand and turning head areas in addition to the area considered the extent of the earth works. Designs have been carried out for both a 12 m and 6 m (with passing bays) road, hardstand and turning head network and a thorough assessment of these impacts is included in **Chapter 10** Flora and Fauna.

If a 12 m wide road design is considered appropriate for construction, then up to 6 m of road width will be rehabilitated after the infrastructure has been installed (post construction phase). If a 6 m road design is constructed then no rehabilitation would occur to the road after the infrastructure has been installed (post construction phase).

The roads will be surfaced with compactable, engineered base material with suitable drainage. Materials will be sourced locally where possible and in consultation with the local Councils. Measures will be taken to minimise the risk of the spread of weeds and disease from materials brought in for construction purposes.

The required on-site access for the four Clusters are shown in **Figures 3.1** to **3.6** and described below:

- Yandra Cluster: Approximately 6 km of the existing roads will require full or partial upgrade, whilst a further 17 km of new internal on-site access will be required;
- Springfield Cluster: Approximately 1.5 km of the existing Brechnoch Road will require a partial upgrade and approximately 200 m of the existing laneway entrance (Dummy Lane) will require a full upgrade, if required. A further 11 km of new internal on-site access will be required;
- Sherwins Cluster: No existing roads will require upgrade, although 25 km of new internal on-site access will be required; and

- Boco Cluster: Approximately 1 km of existing farm track will require a full upgrade, with a further 17 km of new internal on-site access required.

3.5.3 *Internal Link Road*

A link road from the Sherwins Cluster and collector substation site to the Boco Cluster is proposed as the main access point for construction activity to occur between to two sites. Transport distances, the requirement to upgrade the Boco Road and the impact on the Riparian corridor along the MacLaughlin River were the primary drivers for identifying this route as an alternative. The link road forms the steepest section of the road network however detailed civil designs have considered gradient of the slope, potential ecological and ground water impacts, and the requirement to cross the MacLaughlin River at a single point on the valley floor where there is an existing causeway. As a result, the proposed route is approximately 2.5 km long with an average gradient of 6 %.

The existing causeway on the link road under investigation will require reconstruction to provide sufficient width and suitable approach gradients for construction traffic. The causeway if reconstructed would also need to meet the requirements of the Department of Water and Energy (DWE) for watercourse crossings under the *Water Management Act 2000*. These requirements include provisions for the passage of fish as required by the NSW Department of Primary Industries (Fisheries). In its existing form the causeway has one 0.75 m diameter pipe culvert for low-flows which is considered to be insufficient. The guidelines for fish passage require culverts to have a large opening which will provide light penetration through the structure. The existing outlet is above the natural stream level, which would prevent the upstream passage of fish in low flow conditions.

A reconstructed crossing would be designed and certified by a suitably qualified engineer in accordance with the "Guidelines for controlled activities Watercourse Crossings" (NSW DWE Feb 2008) and contain the following elements:

- Box culvert or culverts with wet cells to provide for low level flows. These culverts would have an invert level below the existing pipe at stable stream bed level;
- Elevated dry cells to accommodate higher flows. The invert of these cells could be at the existing causeway level;
- The deck or road surface at a level which would allow approach gradients at less than 14 % with vertical curves accordance with Austroads rural road geometry;
- An available minimum deck width of 4.5 m on a straight alignment;
- Road approach alignment to allow for long vehicles transporting wind turbine blades approximately 50 m long; and
- Minimum disturbance of existing banks and streambed.

It is envisaged that this structure would be constructed at the existing crossing with slight widening on the upstream side. Evidence of flood levels at the causeway and at the crossings downstream indicate that it would be uneconomical to provide a high level structure and that the structure should be designed with a deck level below the high flood level and at a level approximately 1 to 2 m above the existing causeway level.

The construction of a road link as proposed will have significant environmental and Project benefits:

- Travel distances from Nimmitabel to the Boco Cluster will be reduced by 7.0 km by the construction of approximately 2.6 km of additional internal road from the proposed substation to the Boco Cluster;
- Upgrading works on Boco Road can be significantly reduced as the existing causeways are of an acceptable standard for light traffic;
- The reconstruction of the causeway across the MacLaughlin River at 2.85 km will not need to be upgraded for large vehicles;
- The improvements to the existing stream crossing within the property of Boco will restore the passage of fish species at all water levels in this section of the MacLaughlin River; and
- The passage of heavy vehicles past the residences (Sherwood, Riverside and Boco) on Boco Road will be eliminated.

3.5.4 *General vehicle movements*

Access to turbines located at the end of a spur on a ridge generally requires a T or Y-section of road (referred to as a turning head) close to the hardstand area to allow semi-trailer trucks to turn around. These are graded the same as the proposed internal access roads and are typically 30 to 40 m in length.

Alternatively, semi-trailer trucks can reverse back out of an access route, provided the Project site safety regulations permit, or entrances made wider (bell-mouth) to allow manoeuvring.

Hardstand areas equal 50 by 25 m with additional area equal to 15 by 15 m to accommodate the turbine foundation and roads up to 12 m wide during the construction phase are proposed as maximum impacts. These dimensions would be sufficient to allow for passing and turning vehicles unless obstructed by a component such as a blade laid down on the hardstand awaiting assembly. In such an instance semi-trailer trucks could either turn around in the adjacent turning head, or continue to the next turbine hardstand area to turn around. Construction contractors generally avoid double-handling of components and as such manage the delivery and installation process under a just-in-time management process, thereby reducing the number of components laid down on site at any one time.

The proposed dimensions are sufficient for two cranes per turbine site to lift the components from the semi-trailer trucks, and for the trucks to drive on past to a suitable turning point, as described above.

3.5.5 *Ancillary Roads and Remediation*

Generally in the pre-approval phase of a wind farm a development is designed at a high level with respect to basic civil engineering design parameters, primarily because the final infrastructure design can change during the consenting process and the cost of undertaking detailed civil design and geotechnical surveys is prohibitive without the security of Planning Consent. Sites are therefore designed to the best knowledge that is available at the time, whilst incorporating avoidance, mitigation and management measures determined by means of the key assessments under taking prior to submission to the relevant authority. Though with regard to the Project, detailed civil designs have been undertaken with respect to the Project components that create the greatest impact (the road, hardstand and turning head areas) to provide accurate information in the assessment of the Project.

However once approvals are obtained, activities are undertaken to reach financial close. Key to this is the selection of a preferred wind turbine supplier and construction contractor which in turn will have specific requirements for road design. For example, each turbine is uniquely different requiring bespoke turning radii, access and exit gradients and crane requirements. As such, it is not until the surveyor of the construction contractor walks the Project site and incorporates the conditions of approval that detail design of the roads and hardstands can be submitted to the turbine supplier for approval. In consideration of the above it is important that some flexibility in design is maintained during the consenting process (refer to **Section 3.8**).

Some additional roads or tracks may also be required for construction of the internal overhead transmission line and for access to erosion control sites. The erosion control sites will benefit from the use of excess rock excavated from turbine footings and will be chosen based on the availability of excess material, the need for erosion repair, and minimising the distance for material transport.

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

3.6 Utility Services

The Project will be connected to Country Energy's 132 kV transmission network and when not generating will draw a minor amount of electricity from that source. The development of the external 132 kV overhead electrical interconnection will be undertaken separately from the Project (see **Section 3.11**).

A telephone connection to the proposed operation facilities building involving multiple telephone lines will also be provided to enable remote monitoring and control of the Project.

Mobile telephone coverage is available on most of the ridgelines and plateaus with limited service available on the valley floor. Although the Project will not rely on this form of communication, it can be assumed that members of the construction, operation and maintenance teams will communicate using both mobile telephones and radios.

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

3.7 Resource Requirements

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

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

Gravel and sands can be sourced locally. There are two known quarries within the area with no ceiling on their annual output and the closest of these is located within 5 km north of Nimmitabel. Both quarries provide basalt based materials which are of the same geology as that comprised across the Project site. Both gravel and sand will be required to mix the high strength concrete to pour the wind turbine foundations. Gravel will also be required to dress the turbine sites, see **Image 3.5** above, and provide a low resistivity apron around the collector substation.

Water requirements will be met by an existing 91 mega litre (ML) spring-fed dam located within the Project site. Water will be used in both concrete batching plant facilities, and road construction and dust suppression activities along both new and existing roads. It is estimated that in the order of 10.5 ML of water would be required to produce the quantity of concrete required for gravity footings for Layout Option 1, and as such can be considered the maximum amount of water required for use in concrete batching. By way of comparison, it is estimated that only 3.5 ML of water would be required if standard rock anchors were used for all footings in Layout Option 1.

A current embargo on water usage rights within the MacLaughlin River catchment restricts water supply for activities classified as 'Industrial Use'. Under this heading, the supply of water for use in concrete batching plants is restricted. However, following discussions with the NSW Office of Water (NOW) (the licensing authority) regarding the nature of the Project, NOW have indicated that despite the embargo water from this dam would be permitted for use in the concrete batch plant facilities. Landowner consent has been obtained and it is proposed that a replacement licence application should be lodged with the NOW to seek an amendment to the existing licence (10SL55662) from the current permitted purposes of pisciculture, stock and domestic use, to include 'Industrial Use'. It is important to note that with this amended purpose, there will be no increase in water entitlement under the licence. This process will allow for sufficient water to be sourced from the dam to meet the requirements of the concrete batching plant. It is proposed that the licence will revert back to its original purpose at the completion of the Project.

In addition, approximately a further 13.5 ML of water would be required for road construction and dust suppression activities. This would provide sufficient volume for all new and upgraded internal road construction and dust suppression activities, including those associated with the 25 km of unsealed arterial road. These activities are not embargoed and as such require the Proponent to apply for a permit to the NOW. This will be undertaken pending Development Approval.

The owners of the dam, under their current licence conditions, have the rights to establish a water pump facility to transfer water from the dam to storage tanks located to the east and west of their property; four location options are shown in **Figures 3.1** to **3.6**. This is primarily to provide water for stock purposes. It is likely two water tanks up to 125,000 L will be installed by the landowner, and both the Proponent and landowner have agreed that, pending Development Approval and the process outlined above, this system can be used and/or upgraded to provide the daily quantities of water required for construction purposes. Moreover, the location of the proposed storage tanks have been integrated in to the road layout design of both Yandra and Springfield Clusters to minimise transport distances during the construction phase.

Road base material will be required for construction of access roads to turbine sites and the substation. Part of the road base requirement may be sourced from material extracted from turbine footings with the remainder imported to the Project site. Where additional material is required, local supplies of the same geological type can be sourced from the two quarries indicated above. Supply constraints are not considered an issue as both quarries have long term permits to quarry and have no annual ceiling on their output.

Given the scale of the Project it is anticipated that there will be no waste material exported from the site during construction. Top soil cleared from surfaces during the construction phase will be used for remediation, and rock excavated for turbine footing preparations will be used for road base, back fill for foundations and/or erosion control purposes as far as practicable. Ancillary waste, such as packaging, associated with component and stock pile deliveries will be disposed of according to local Council requirements and form part of the Construction Environmental Management Plan.

3.8 Potential Design Layout Variations

Alterations may be required to the Project layout which could result in the minor relocation of infrastructure (wind turbines, access tracks, cabling, etc) prior to construction. Considerations such as final turbine selection, ongoing energy yield analysis, unforseen environmental constraints, constructability/cost-reduction and pre-construction engineering investigations can impact on the final design and affected area of the Project.

As recently highlighted in the Gullen Range Wind Farm's EA, the NSW Land and Environment Court (Taralga Landscape Guardians v. Minister for Planning NSWLEC 2007) found, in relation to the relocation of wind turbines:

> *"… that a 250 m relocation of any of the elements is not unreasonable."*

Although site-specific, it provides a precedent by which minor alterations to the proposed Boco Rock Wind Farm layouts may occur prior to construction. Furthermore, as indicated in the Gullen Range EA, the *EP&A Act* allows for the relocation of equipment so long as it remains broadly consistent with the proposal as outlined, otherwise an application for the modification of the Development Consent would be required.

In respect of the points outlined above and the Project site-specific avoidance, mitigation and management actions described in the subsequent chapters, it is proposed that an allowance to reposition the wind turbines and other infrastructure up to 100 m radius from the submitted layouts, subject to conditions of approval is issued. Moreover, it is proposed that no additional Development Consent is required where it can reasonably be shown that such repositioning in accordance with the parameters above would not materially affect or notably increase impacts as a whole, and remains broadly consistent with the Project.

3.9 Wind Farm Development Phases – Development Approval to Operation

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

3.9.1 *Anticipated Project Timeline*

Approval is sought for the final positioning of up to 125 turbines and associated infrastructure within a radius of 100 m of the locations indicated in **Figures 3.1** to **3.6**. The Proponent is applying for

Development Approval to allow for substantial construction to begin within 24 months of the date of Consent. The actual timing of construction will principally be driven by the length of time taken to obtain other permits and authorisations, attaining Board approval/project financing for commencement and the long lead times for wind farm components. An indicative Project timeline is presented in **Table 3.3** below. Staging of the development is also a consideration and some of those factors which may lead to a staged approach are discussed below in **Section 3.9.2**.

The following provides a guide to the anticipated activities subject to Development Approval for the Project.

Table 3.3 Anticipated Project timeline

		2009		2010				2011				2012				Onwards	2031/32
		Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4		
Wind Farm related activities	Wind Farm Development Approval																
	Detailed Design and Contract Development																
	Preconstruction Works																
	Construction Works																
	Commissioning (in line with NER *)																
	Operation																
	Maintenance																
	Decommissioning or Equipment Replacement																
	Upgrade of Existing 66 kV line																

** National Electricity Rules*

3.9.2 *Construction Staging and Considerations*

The following section provides context into aspects that could have a bearing on a staged construction process and as such the Proponent is seeking flexibility in approval conditions to allow for a staged development, subject to Development Approval. These considerations are to be taken with respect to the proposed electrical connection option outlined in **Section 3.11** below.

Project scale: The Project comprises of four discrete Clusters and is estimated to be constructed over a period of 18 to 24 months. Within this time period it is anticipated that activities will occur mainly within one or two of the Project Clusters at any one time. This is subject to commercial considerations and the Conditions placed on the development following Development Approval.

The Proponent requests that, dependent on obtaining Development Approval for the connecting power line, the Project could be either commissioned in stages or as a whole wind farm.

Grid connection: The power generated from the Project will connect into two Country Energy owned lines east of the Project site, currently comprising of a 132 kV line and a 66 kV line. Country Energy are in the process of upgrading the 66 kV line to a double-circuit 66/132 kV to meet their own licensing requirements with respect to security of supply to the South Coast region. The timing of this upgrade is expected to occur in parallel with the anticipated construction timeline for the Project shown in **Table 3.3** above.

Unexpected setbacks to this upgrade could delay the generation output from the Project. In this instance, and subject to obtaining Development Approval for the connecting power line, the Proponent requests that the Project could be commissioned in stages. In this instance, approximately 120 to 130 MW of the overall capacity of the Project could be connected into the existing 132 kV line.

Conservation Outcomes: To minimise impacts of the proposal on sensitive lifecycle stages of endangered species identified in areas of the Project site (i.e. mating, laying and incubation periods), development windows may be constrained. This is discussed in more detail in **Chapter 10** Flora and Fauna with respect to the Grassland Earless Dragon known to be located within the Sherwins and Springfield Clusters

3.9.3 *Detailed Design and Contract Development*

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

Project environmental commitments, including undertakings arising from the impact assessment, consent conditions and any licensing conditions will be compiled and used to prepare the Project Environmental Management Plans (EMP's) as outlined in **Chapter 20** Statement of Commitments (SoC). The Project EMP's would also be incorporated into the contract specifications for the required construction works and equipment supply to ensure compliance and achieve the Project environmental objectives.

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

The Contractor will also be required to produce a Contractor Environmental Management Plan to address its component of the Project works.

3.9.4 *Pre-construction Works*

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

- Detailed site investigation including geotechnical investigations involving a series of trial pits and/or boreholes;
- Upgrading the surfaces of local roads and access roads where required;
- Widening the junctions or corners of local roads, entrance/access points where required;
- Widening the existing gateways, or inserting new gateways as necessary along fence lines;

- Stripping and careful storage of existing soil from the areas which would be affected by construction activities, including the tower bases, the collector substation location, access road areas, crane hardstand and assembly areas;
- The construction of a secure site compound, with Project owner and subcontractors field offices (portables), parking bays, and toilet facilities (temporary);
- Erection of signage on roads;
- Enabling works for the locating of a mobile concrete batching plant (temporary);
- Enabling works for the locating of a rock crushing plant (temporary, if required);
- Environmental survey and refinement (if necessary) of the EMP in line with the Draft SoC, Health and Safety Plan, Traffic Management Plan and any other documentation as required under the planning authorisation;
- Survey of critical boundaries and pegging of infrastructure locations;
- Detailed cultural heritage and flora/fauna surveys across entire site (if required);
- Preparation of works procedures and Project Implementation Plan; and
- Engineering design works and submission for Building Rules Consent.

3.9.5 *Construction Works*

Construction activities include activities that cross over with pre-construction works and comprise site establishment, earth works for access roads, footings and crane hardstand areas, erection of up to 125 wind turbines, approximately four permanent wind monitoring masts, a collector substation, above and below ground cabling and temporary site facilities. Construction activity is likely to occur over a period of approximately 18 to 24 months with restoration following the completion of works.

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

Updates on the progress of construction works and relevant impacts will be provided during the construction period.

Site Establishment and Temporary Site Infrastructure: Site works will require the erection of temporary infrastructure such as a portable field office, toilet facilities, construction compound and parking bays (refer to **Image 3.8** below). This infrastructure will be typical of that used at construction sites; however it will not include full accommodation facilities.

Image 3.8 Typical temporary site office

Two preferred areas for the temporary site office, toilet facilities and construction compound and parking bays have been considered (**Table 3.4**). One is located off Springfield Road, adjacent to Brechnoch Road, the second located close to the intersection of the Snowy River Way and Avon Lake Road (see **Figures 3.1** to **3.6**). The temporary site office facilities will be approximately 40 by 100 m and the construction compound approximately 150 by 200 m, with a combined area of approximately 3.4 ha. The area will be fully fenced with sufficient access to allow vehicle movement, stockpiling of materials, and office facilities. The selection criteria for identifying these locations were with respect to the following:

- Flat accessible location to the arterial roads to allow for vehicle movement to all Clusters;
- Minimising the ecological impact – avoidance of Endangered Ecological Communities (EEC's), avoidance of mapped hollow bearing trees, away from recorded Threatened Species, avoidance of major creeks and the MacLaughlin River;
- Minimising traffic and transport activity during construction;
- Minimising visual impact from publicly accessible locations; and
- Minimising noise impacts at receptor locations.

Pending Development Approval, a construction contractor will be appointed to the Project. If alternative locations for these temporary facilities are sought then the same selection criteria will be considered to determine suitable locations.

Table 3.4 Summary of preferred site office and construction compound locations

No.	Location	Site Features
1	Along Brechnoch Road	An area of flat land comprising non-native vegetation, existing access from the arterial roads, close to turbine Clusters, 800 m from nearest dwelling (associated landowner).

No.	Location	Site Features
2	Intersection of the Snowy River Way and Avon Lake Road	An area of flat land comprising heavily grazed vegetation, existing access from the arterial roads, close to turbine Clusters, 2.8 km from nearest dwelling (associated landowner). Used recently as a storage compound by Bombala Council during the upgrade to the Snowy River Way road.

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

Signage will be erected on the Monaro Highway and other critical locations from the outset of construction, directing all vehicles associated with the construction site to the Project site office. Sightseeing traffic will be managed towards safe, prominent viewpoints where they may view the Project, but not in a way that would jeopardise the safety of sightseers or the progress of construction. Additional signage would be located near to the Project site, providing information about the turbines, the companies involved in the Project and essential safety information and telephone numbers. The need for a pull-off bay for sightseers' cars will also be assessed. Negotiations with the Cooma-Monaro Shire and Bombala Councils, NSW RTA and other affected parties will be initiated to determine final signage locations and various works required.

Ancillary Construction Activities: On-site Concrete Batch Plant/Rock Crusher: Up to two concrete batching plants are proposed to supply concrete for the wind turbines foundations.

An on-site batching plant facility would occupy an area of approximately 50 by 100 m and likely consist of a trailer-mounted concrete mixer, cement bins, sand and aggregate stockpiles and a storage container for various equipment and tools. Sufficient area will be required for the use of front-end loaders, delivery of materials and entry and exit of vehicles. A batch plant would be powered by a diesel generator and have a production capacity of approximately 40 cubic metres per hour (m^3/h). **Image 3.9** below shows a typical mobile concrete batching plant facility.

Five locations have been identified for concrete batch plants within the Project site, which are summarised in **Table 3.5**. The selection criteria for identifying these locations were with respect to the following:

- Minimising the ecological impact – avoidance of EEC's, avoidance of mapped hollow bearing trees, away from recorded Threatened Species, avoidance of major creeks and the MacLaughlin River;
- Minimising traffic and transport activity during construction;
- Minimising visual impact from publicly accessible locations;
- Minimising noise impacts at receptor locations; and
- Close to an accessible water source.

Pending Development Approval, a construction contractor will be appointed to the Project. If alternative locations for these temporary facilities are sought then the same selection criteria will be considered to determine suitable locations.

Table 3.5 Summary of preferred concrete batch plant locations

No.	Location	Site Features
1	Along Brechnoch Road	An area of non-native vegetation, existing access from the arterial roads, close to turbine Clusters, set back from publicly accessible areas, 800 m from nearest dwelling (associated landowner), close to the available water source.
2	Along Yandra Road	An area of non-native vegetation, existing access from the arterial roads, close to turbine Clusters, set back from publicly accessible areas, 1.8 km from nearest dwelling (associated landowner), close to the available water source.
3	Within the Yandra Cluster	An area of non-native vegetation, new access road to be built, close to turbine Clusters, set back from publicly accessible areas, 1.8 km from nearest dwelling (associated landowner), close to the available water source.
4	Substation location	An area of native vegetation, new access road to be built for substation, close to turbine Clusters, set back from publicly accessible areas, 1.8 km from nearest dwelling (associated landowner).
5	Intersection of the Snowy River Way and Avon Lake Road	An area of flat land comprising heavily grazed vegetation, existing access from the arterial roads, close to turbine Clusters, 2.8 km from nearest dwelling (associated landowner). Used recently as a storage compound by Bombala Council during the upgrade to the Snowy River Way road.

The location of concrete batching plants will be determined at the construction planning stage and will be strategically sited to minimise impact on the local area.

Image 3.9 Temporary on-site concrete batching plant

Under the *Protection of the Environment Operations Act 1997* 'Concrete Works' are considered a scheduled activity requiring a Licence from the Department of Environment and Climate Change (DECC) if the capacity of production of concrete exceeds 30,000 tonnes per year. A licence for its operation will be applied for to the DECC following Development Approval.

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

During construction, site access roads are constructed at a width of up to 12 m to allow for passing construction traffic, large mobile cranes, and other long and wide loads. Once the Project is operational, the access roads will be reduced in size to 6 m in width, acknowledging that traffic from this point onwards will principally involve commercial vehicles. The crane hardstand and assembly areas will be sized at approximately 50 by 25 m.

Dust suppression is a key consideration during the construction and use of roads. A permit will be sought from the NOW for the extraction of the required quantity of water to enable the construction and dust suppression of up to 79 km of new and upgraded internal access roads and up to 25 km of unsealed arterial roads that are likely to be used for site access.

Subject to Development Approval, the Proponent will seek from the NOW permission for a temporary licence to be issued to extract the quantity of water required for road construction and dust suppression purposes from the on-site dam.

Footing Construction: If gravity foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 450 m^3 of ground material to a depth of approximately 2.5 m. Shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish approximately 0.5 to 1 m below ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete. Given the limited output capacity of the concrete batch plants foundation designs can incorporate cold joints and construction joints. These can limit foundation pours to around 250 m^3, thereby allowing increased workmanship, less demand on the batching plant and a contingency plan in the event of plant breakdown, delays to material supplies or detrimental weather events (discussed below in more detail).

If rock anchor foundations are required, the construction of the foundation for each wind turbine would involve the excavation of approximately 100 m^3 of ground material to a depth of approximately 2.5 m. The rock anchor cores are drilled into the bed-rock prior to concrete pour, and are up to a depth of approximately 20 m. The rock anchor tendons are grouted into place, stressed and secured once the concrete has cured sufficiently. Steel forms shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish at ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete.

Prolonged cold temperatures can cause heat loss from the limestone hydration process during foundations pours. If concrete loses too much heat there is a risk of plastic cracking and loss of durability within the concrete. This can be controlled to a degree by additives to the concrete mixture. The preferred approach is to avoid pouring concrete during prolonged periods of cold weather.

With hot temperatures, the concrete can be affected by water loss through evaporation and can dry out too quickly. Additives can again control the extent of this, however pouring concrete during the evening or when the temperatures are lower is preferred. Alternatively a tent can be erected over the base area to provide protection to the concrete pour.

On-site Electrical Reticulation: Either prior to or during turbine base construction, the underground site electrical system would be installed. This would involve the cutting or excavation of trenches to a depth of up to 1.2 m for the laying of the underground cabling that links the turbines. All trenches would be marked with warning tape and backfilled once the cables were in-situ.

The majority of the underground cabling will be located adjacent to the access roads. The general procedure for the laying of underground cables will be as follows:

- Preparation work, including installation of gates/temporary removal of fences as required;
- Use of an excavator or rock saw to dig a trench (0.45 m wide by 1.2 m deep);
- Material excavated is stored adjacent to the trench for subsequent back-filling;
- Laying of bundled cables within a bed of protective sand;
- Backfilling and compaction of previously excavated material in layers by use of a vibration plate compactor, all in accordance with Engineering Specifications;
- Placement of tape warning of the presence of electrical cables at the required depth; and
- On completion the cable route may be marked with small marker posts and the surrounding vegetation will be allowed to regrow.

Collector Substation Compound: A location for the on-site collector substation has been selected (**Figures 3.1** to **3.6**). The total compound area will be in the order of 100 by 100 m incorporating a 20 m Asset Protection Zone (APZ) area extending from the boundary of the installed equipment. The yard will be surfaced with compacted quarry rubble to form a hardstand area. Reinforced concrete footings will then be constructed to support electrical infrastructure and buildings. Infrastructure required within the yard includes a 33/132 kV transformer, switchgear, power conditioning equipment and operation facilities building. **Image 3.10** below shows a typical collector substation deign during construction.

Image 3.10 Transformer foundation (foreground) and electrical substation and switchgear infrastructure (background)

Turbine Erection: The turbine components would be delivered to the Project site on semi-trailers. The method of construction would involve the use of a small mobile crane (up to 100 tonne) for the ground assembly operation. A larger 600-1,000 tonne crane together with the small mobile crane, would be required to erect the turbines once ground assembly is complete. Erection is likely to take approximately 2-3 days per turbine. Depending on the configuration, the crane may require up to 2 days to disassemble and remobilise to a new site. **Image 3.11** shows the sequential stages undertaken during the installation of a wind turbine.

Image 3.11 A range of typical turbine erection photographs

Overhead Power Line: A 132 kV double-circuit overhead power line will be required to transport the electricity from the Project site to a substation (to be assessed under a separate approvals process, refer to **Section 3.11**). The power line poles will be supported by reinforced concrete piers to a depth determined by an engineer, taking into account the local geotechnical conditions. The poles will be concrete, steel or wooden, approximately 25 m in height as determined by Country Energy. If concrete or steel poles are selected, it is common practice for these to be painted a dark green to reduce their visual impact.

3.9.6 ***Commissioning***

Pre-commissioning checks will be carried out on the high voltage electrical equipment prior to connection to the Country Energy transmission network. The connection to the grid, as discussed in **Section 3.11** is dependent on the associated transmission works. When the Project electrical system has been energised, the wind turbines will be commissioned and put into service.

3.9.7 ***Operation***

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

3.9.8 ***Servicing and Maintenance***

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

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

3.9.9 *Refurbishment*

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

Any material change to the Project layout, or significant changes to the turbine technology, will be referred to the Department of Planning as an amended proposal. It would also be subject to the regulations and guidelines of the day. Refurbishment requires the transportation and installation equipment and facilities, similar to that used during initial construction.

3.9.10 *Decommissioning*

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

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

The underground cables are buried below ploughing depth and contain no harmful substances. They would be left in the ground and only recovered if economically and environmentally viable. Terminal connections would be cut back to below ploughing levels.

All decommissioning work would be the responsibility of the Project owner and is a provision within the lease arrangement. Experience in Denmark and The Netherlands shows that sale of the scrap metal and other valuable items salvaged from the turbines and electrical components would more than meet the cost of decommissioning.

3.9.11 *Fire management*

A fire management plan is an important part of both wind farm planning and the community consultation process. All aspects of the Boco Rock Wind Farm Project will adhere to the *Rural Fire Service (RFS), Planning for Bushfire Protection*, and will be in consideration of the *Auswind Best Practice Guidelines (Fire Management Guidelines) 2006* (see **Chapter 16** Fire and Bushfire).

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

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

- Adherence to all regulations;
- Installation of access tracks at least 5 m wide (7 m for corners) and with appropriate vertical clearance and suitability for all weather conditions;
- Provision of appropriate fire-fighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions;
- Maintaining provision for mobile telephone and UHF radio communications;
- Provision of on-site identification of individual turbine locations and access gates for fire-fighting services, and an undertaking to provide local rural fire service groups with access to gates;
- Consideration of total fire ban days in regard to hours within which construction takes place;
- Providing the RFS with:
    - A construction works schedule;
    - Maps of final turbine layout and identification information for individual turbine sites;
    - Access road plans and locations of access gates;
    - Security information such as location of locked gates and restricted access areas;
    - Location of any additional water supplies installed for construction activities; and
    - Location of potential landing pads for fire-fighting aircraft or helicopters.

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

3.10 Summary

The Boco Rock Wind Farm will comprise one of two potential design layouts; one consisting of 125 wind turbines and the other 107 wind turbines, both spread over 17 different properties, with a maximum blade tip height of 152 m. The output from the Project is limited by the rating of the transmission lines in the area, thereby constraining output to approximately 270 MW.

The Project will connect into two Country Energy owned lines located to the east via a new 132 kV double-circuit line, which is subject to a separate approvals process.

The Proponent requests that consideration is given to a micro-siting allowance of 100 m during the detailed design phase, and that the Project, if necessary, can be built and commissioned in stages.

Pre-construction works involve final site surveys (for heritage and ecology), geotechnical investigations and preparation activities. Construction works involve the grading and surfacing of access tracks and turbine footprints, and the installation of the Project and connection infrastructure as well as temporary works facilities, including storage areas. Land that is disturbed but is not part of the land-take for the life of the Project, will be reinstated.

Operation of the Project is controlled remotely, with the majority of site visits required being that by maintenance staff. At the end of the term of the Project the facility may either be refurbished or decommissioned. Decommissioning will involve the removal of all above-ground infrastructure and the reinstatement of the ground to a pre-construction condition.

3.11 Overview of Connection of the Project to the Electricity Grid

To harness the energy produced by the Project, new transmission lines will be required to connect it to the existing electricity grid. To meet this requirement the construction of new double-circuit 132 kV overhead transmission lines would be required to connect the Project with two existing Country Energy lines located approximately 25 km east of the Project site. **Image 3.12** shows a typical transmission line construction and alternate pole designs that could be implemented in this project.

The proposed transmission line would become part of Country Energy's network, and as such Country Energy would be the ultimate owner and operator of the new infrastructure. Country Energy is therefore considered to be the Proponent for the proposed transmission line for the purposes of the *EP&A Act*. Design and construction of the transmission line is to be undertaken by the Project Proponent, Boco Rock Wind Farm Pty Ltd (a wholly owned subsidiary of Wind Prospect CWP Pty Ltd), in accordance with Country Energy guidelines, specifications and requirements.

Country Energy will assess and determine the electricity transmission line in accordance with its statutory obligations as a determining authority under Part 5 of the *EP&A Act* and clause 228 of the *EP&A Regulations*.

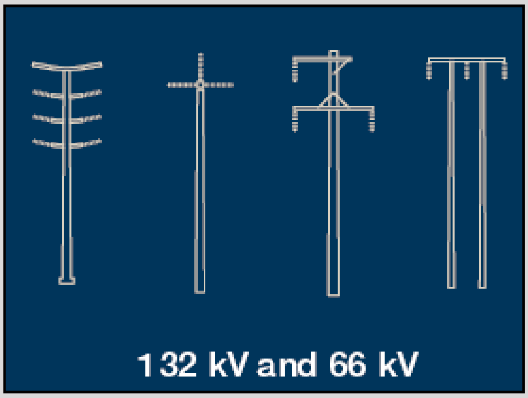

Image 3.12 Overhead 132 kV power line and typical alternate designs

It is expected that the approvals process for the transmission connection will consist of the following general stages:

- Preparation of a 'Route Options Study' (Completed)
- Preparation of a 'Review of Environmental Factors' for the determining authority (Underway);
- Approval by determining authority, which in this case will be Country Energy; and
- Implementation in accordance with the necessary controls.

An overview of the transmission line connection is provided below to explain the associated infrastructure so that all stakeholders are able to understand the full context of the development.

3.11.1 *Proposed Transmission Connection Works*

Country Energy has been approached regarding the connection of the Project to their high voltage transmission system to the east of the proposed development. A Connection Application has been lodged by the Proponent and a written response has been received from Country Energy indicating the necessary requirements for connection. Further electrical studies are currently underway to determine the connection configuration.

Country Energy has indicated that the combination of the existing 132 kV and the planned upgrade to the 66 kV network to a 66/132 kV rating will have sufficient capacity to accept the output from the Project without augmentation to other existing transmission lines or substations.

Connection of the Project would involve:

- The construction of a double-circuit, overhead 132 kV line and is anticipated to be constructed using a single pole design. Based on Country Energy's requirements for 132 kV, single pole, long span transmission lines, the transmission line easement would be 40 to 45 m in width. Depending on the final route selected, the transmission line length would be in the order of 25 km. Assuming a maximum easement width of 45 m and a maximum length of 25 km, the footprint of the easement would be up to 112.5 ha; and
- The construction of a single substation at the point of connection (switching substation) and feeder line connections to both existing lines to enable effective connection of the new 132 kV double-circuit transmission line. The switching station will consist of an outdoor high voltage enclosure containing circuit breakers, isolators and other necessary equipment. Assuming a maximum compound area of 200 by 200 m, the footprint of the switching substation would be up to 4 ha.

A new easement will be required on all properties affected by the transmission line. Landowners in the locality have been approached and preliminary agreement has been reached. Further discussions and formal consent by each landowner will form part of the separate approvals process for the transmission connection.

Access to each pole location and along the line is required during the construction and operation of the transmission line. Access requirements to the transmission line during construction and operation would largely be catered for through using a combination of the existing road network, internal (farm) vehicle tracks and the transmission line easement itself.

Considering the low volume of expected vehicle traffic during construction and operation, combined with the presence of large areas of existing cleared grazing land along the proposed transmission line route, the establishment of a vehicle access track would require only minimal, if any, civil works.

Large sections of the proposed route traverse existing farmland comprising a mix of grazed native and non-native grasses. These sections are likely to not require clearing for the establishment of the transmission line. Furthermore, these areas are currently trafficable by normal four-wheel-drive-vehicles and are likely to not require clearing or any civil works to facilitate vehicle access for either construction or ongoing operation, however this remains subject to final route selection and detailed design

Some clearing of vegetation that has the potential to interfere with transmission line conductors or access to infrastructure may be required. Country Energy has developed vegetation clearing guidelines for power line easements. The key points of these guidelines are as follows:

- A clearing zone corresponding to the width of the easement is required along the length of the transmission line route;
- The easement width and clearing zone shall allow for conductor blow out; and
- All vegetation types except grasses shall be removed from the clearing zone, except as follows:
  - Low growing species shall be retained at river or creek crossings;
  - In deep valleys where the conductors will be well above the maximum height of the prevailing vegetation and the clearance space will never be compromised, all vegetation shall be retained (except where it impedes construction access);
  - Low growing species may be retained for the first five metres of the corridor adjacent to main roads to provide a visual buffer zone; and
  - Stumps shall be retained where there is the possibility of erosion.

The connection will be carried out in accordance with Country Energy's normal procedures for maintenance works involving interruptions to supply.

The output of the Project will be directed to primarily supply the population of Cooma and the larger electrical load centres to the north, however supplies will also flow to the local area and to the substations at Bega and Bombala for further distribution.

3.11.2 *Identification of Potential Transmission Line Development Corridors*

As the first step in the environmental planning process for the transmission line identification, potential transmission line development corridors were established (**Table 3.6** and **Figure 3.7**). These corridors comprised broad areas that were anticipated to provide feasible options for a transmission line route. The planning process for the Project has involved initial consultation with landowners that have the potential to be affected by the proposed transmission line connection. As a result of this process, a number of landowners who are opposed to transmission line infrastructure and easements on their land were identified which in turn has shaped the assessment corridors.

The potential transmission line development corridors identified were used as a starting point for an environmental constraints and route options identification study.

Table 3.6 Potential transmission line development corridors

Corridors	Description
Southern Corridor	Runs in a general easterly direction along the MacLaughlin River valley from the Project collector substation.
Northern Corridor A	Runs initially in a general easterly direction along the MacLaughlin River valley as for the Southern Corridor before turning northwards along the valley of Boco Creek (a tributary of the MacLaughlin) then eastwards parallel to Springfield Road.

Corridors	Description
Northern Corridor B	Runs initially west then northwest from the Project collector substation to Avon Lake Road then northwards to Springfield Road, then runs parallel to Springfield Road.

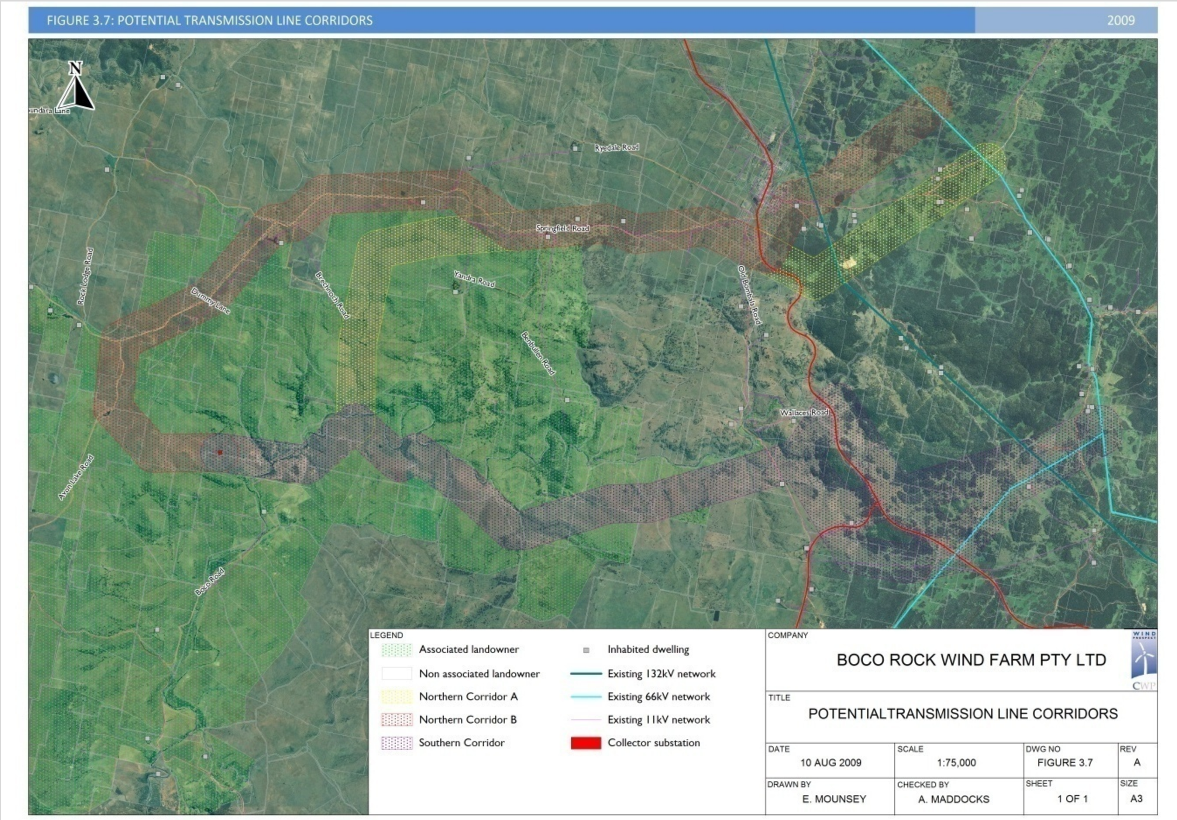

Figure 3.7 Potential transmission line corridors

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

3.11.3 *Summary of Environmental Constraints*

The results of the qualitative desktop assessment indicated that the Northern Corridor B option is least favourable for transmission line development. Of the remaining two corridor options, Northern Corridor A is anticipated to present the greatest number of constraints for development resulting in the Southern Corridor as the most favourable of the potential transmission line development corridors.

Detailed field surveys will commence along the Southern Corridor to identify a suitable transmission line route and determine whether or not ecological impacts can be satisfactorily avoided, mitigated and/or managed. These assessments will form part of a Review of Environmental Factors (REF) in accordance with Country Energy's specifications and subject to Part 5 of the *EP&A Act*. A summary of the ecological constraints of the preferred Southern Corridor are provided in **Chapter 10** Flora and Fauna.

An anticipated timeline of the transmission line development is provided in **Table 3.7** below.

Table 3.7 Anticipated timeline of transmission line development

		2009		2010				2011			
		Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Transmission line related activities	Route Option Refinement										
	Define Connection Point										
	Review of Environmental Factors										
	Approval from Country Energy										
	Detailed Design and Contract Development										
	Full System Studies										
	Full Network Compliance Studies										
	AEMO Registration										
	Preparation of Connection Agreement										
	Preconstruction Works										
	Construction Works										
	Commissioning										
	Upgrade of Existing 66 kV line										