Prepared for
Taurus Energy

Proposed Development of a 30MW Wind Farm at Cullerin, New South Wales

Project Application

prepared by
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1 EXECUTIVE SUMMARY

This Project Application outlines the scope of the construction, operation and decommissioning/recommissioning phases of the Cullerin wind farm proposal. It identifies and prioritises the associated potential environmental impacts. The Project Application has been prepared by **ngh**environmental on behalf of Taurus Energy Pty Ltd.

The proposal would be assessed under Part 3A of the *Environmental Planning and Assessment Act 1979* which provides a consolidated assessment and approval regime for Major Projects. Following the submission of the Project Application and issuing of the Department of Planning Director-General's requirements, a detailed Environmental Assessment Report would be prepared. The Project Application and Environmental Assessment Report also draw upon the input of local and state government agencies. A Planning Focus Meeting involving government representatives was held at the proposal site on 10 November 2005 to identify key issues which need to be addressed in the assessment.

The Cullerin site is located on private grazing land, approximately 30 kilometres west of Goulburn, on the NSW Southern Tablelands. The development sites carry mixed native-exotic pasture, with fragmented areas of woodland.

The proposal would involve the construction and operation of up to 16 wind turbines on ridge crests, each with three blades up to 46 metres long mounted on a tubular steel tower up to 80 metres high. The wind farm would have a maximum capacity of up to, but not exceeding, 30 megawatts. Underground and overhead cabling would be used to connect the turbines. Two options are currently being considered for the location of the substation and connection to the grid.

The project is expected to inject $10 million into the local economy; $5 million during construction and $5 million during the operational phase. It would supply sufficient energy in a typical year to meet the annual needs of up to 10,000 'average' NSW homes and reduce greenhouse gas emissions by up to 80,000 tonnes per year.

Moderate to high priority issues associated with the proposal are outlined in this Project Application and include noise impacts, bushfire hazard and impacts on visual values, flora and fauna, archaeological values, land and property values, land use and development opportunities, services and infrastructure and the cumulative impacts of wind farms, locally and regionally. These higher priority issues would be assessed in detail in the Environmental Assessment Report to be prepared for the project. This Project Application outlines a series of specialist studies to be undertaken as part of the assessment process, covering biodiversity, archaeological, noise and visual issues.

Lower priority issues are those where impacts are expected to be small or readily manageable using a range of mitigation measures. These issues include construction noise, safety and impacts on local hydrology, soils and land uses. Lower priority issues would also be defined and assessed in the Environmental Assessment Report, and a series of detailed mitigation measures and commitments identified to ensure that impacts on natural and human values are minimised or avoided.

The Project Application also outlines a community consultation plan incorporating two Open House sessions which would allow for informal communications between the public and the proponents/assessment personnel, regular presentations on key issues and specialist studies, and information displays. Community consultations would also include media publicity and statutory requirements for public exhibition and opportunities for public comment.

2 INTRODUCTION

2.1 Purpose of this document

This Project Application has been prepared on behalf of Taurus Energy Pty Ltd. Taurus Energy proposes to develop a wind farm for the purpose of electricity generation at Cullerin, approximately 25 kilometres west of Goulburn, New South Wales. The wind farm would be located on private property within and adjacent to agricultural areas (Figure 2.1).

This Project Application details the scope of the construction, operation and decommissioning / recommissioning phases of the proposal and prioritises the potential environmental impacts associated with it. Potential environmental impacts associated with the proposal have been categorised into **moderate to high** and **low** priority issues. Issues identified as moderate to high priority would be comprehensively investigated and assessed in the Environmental Assessment Report, as directed by the Director General's Requirements. A list of these issues and strategies that Taurus Energy currently plans to undertake to address them are discussed in Section 4 of this report. Low priority issues are anticipated to generate low level impacts. These are identified and mitigation measures to address these issues are detailed in Sections 5 and 6.

2.2 Statutory context

On the first of August, 2005, Part 3A of the *Environmental Planning and Assessment Act 1979* commenced. The new Part 3A consolidates 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 Act. The new Part 3A applies to wind power developments with a capital cost of $30 million dollars or greater, defining these developments as Major Projects.

The proposed Cullerin wind farm would have a capital cost in excess of $30 million dollars and therefore is likely to be a Major Project, under Part 3A of the Act. Taurus Energy contacted the Department of Planning formally on September 8, 2005, introducing the Cullerin proposal and seeking advice on the assessment process. Under the instruction of the Department of Planning, this document seeks to categorise the potential impacts of the proposal in terms of moderate – high and low priority issues. Taurus Energy seeks the Director General Requirements for the required Environmental Assessment Report of those issues assessed by the Minister to be of moderate to high priority.

It is understood that upon validation of this document, after attendance of the Planning Focus Meeting, the Department of Planning will issue the Director General Requirements within 28 days.

Although they are no longer the consent authority, Taurus Energy have consulted with Upper Lachlan Shire Council (R. Davies, K. Reedy, J. Bell; 10 August, 2005) in order to better appreciate the local issues associated with development of wind farms in the locality.

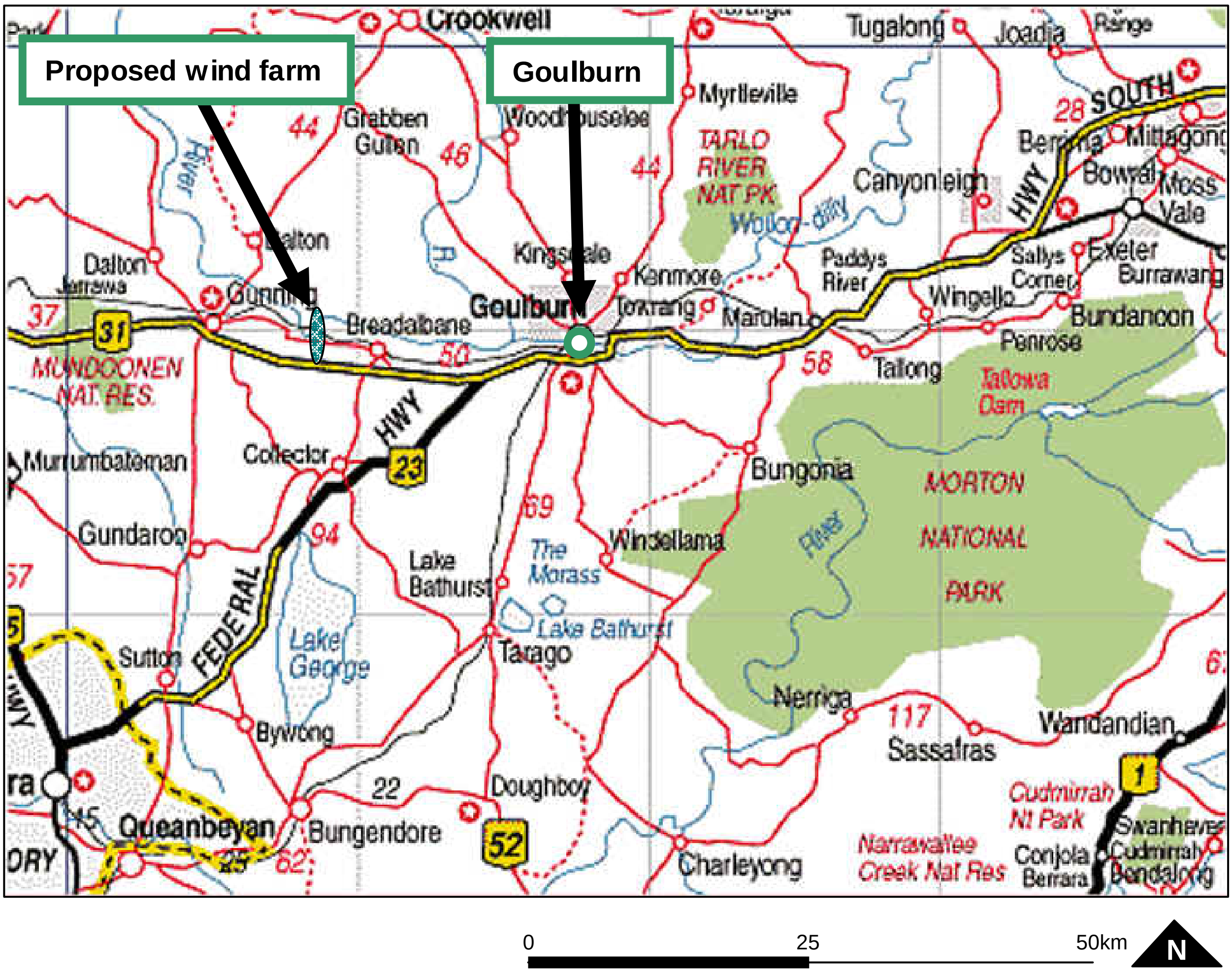

Figure 2.1 Location of the proposed Cullerin wind farm

3 SCOPE OF PROPOSED WORKS

3.1 Project justification

Cullerin Range Wind Farm offers several benefits to the environment and local community:

- This project will inject $10 Million into the local economy ($5 Million during construction and $5 Million during the operational phase);
- The wind farm will provide sufficient electricity in a typical year to meet the annual needs of up to 10,000 'average' NSW homes;
- The project will reduce greenhouse gas emissions by up to 80,000 tonnes per year of carbon dioxide for the life of the project, helping to reduce the impact of climate change (this figure is based on the expected generation of the wind farm, which is still under assessment, and a state average greenhouse gas emissions factor for electricity generation. In practice, it is likely that coal fired generation is the most likely generation plant to be reduced, therefore this emissions factor would appear conservative);
- The proposal will include an annual funding allocation for environmental measures both on and offsite. Taurus Energy will make an annual funding commitment (amount to be determined) which will be set aside into a community fund to be managed for community benefits. The structure of the fund is to be determined, and would involve management by the local Council or local community representatives. The purpose of the fund is to provide additional monies for community needs, whether they be weed management, landcare works, provision of local services (e.g. libraries, swimming pools), road improvements, community parklands etc.; and
- The project provides an opportunity to increase tourism, if this is desired by the community.

State and Federal governments have been shown to support wind farms for their ability to produce renewable energy while reducing greenhouse gas emissions. The Cullerin Range Wind Farm proposal is fully self-funding, producing no drain on the public purse. The project maximises use of existing resources (wind, power line, road access) while being remote from high population centres, thereby minimising adverse social impacts.

This wind farm would have a minimal impact on capital investment in other forms of power generation. It would provide up to 30 Megawatts into the NSW electricity system which has a peak generating capacity of over 14,000 Megawatts. It cannot be guaranteed that the wind farm would be generating during times of peak generation requirements, therefore it is unlikely to reduce investment in peak generating capacity. However, it would marginally reduce the use of existing coal generators, reducing coal consumption for each Megawatt-hour produced by the wind farm.

3.2 General description

This section describes the wind farm project in detail, and provides the scope of works involved during the construction, operation, and decommissioning phases.

The proposal would generate a maximum 30MW and would involve the construction, operation, and decommissioning of:

- Up to 16 wind turbines, each with three blades up to 46m long mounted on a tubular steel tower up to 80m high;
- Electrical connections between wind turbines using a combination of underground cable and overhead concrete pole power lines;
- A substation and transmission connection linking the wind turbines to the existing Country Energy 132kV transmission system located adjacent to the site;
- Access roads around the site, and minor upgrades to access via Old Sydney Road, for installation and maintenance of wind turbines;

- An onsite control room and equipment storage facilities.

The project description is based on the current status of planning. In particular, any site layouts are based on the current proposal which may change due to unexpected issues arising in relation to ongoing biodiversity assessment; archaeological assessment; geology; wind regime; wind turbine availability; and transmission connection design issues.

Figures 3.1 to 3.3 illustrate the site location, landholdings, existing house locations, proposed turbine locations, civil works and electrical connections of the proposed development.

These figures show multiple turbine locations. The optimal locations will be selected prior to submission of the Environmental Assessment Report.

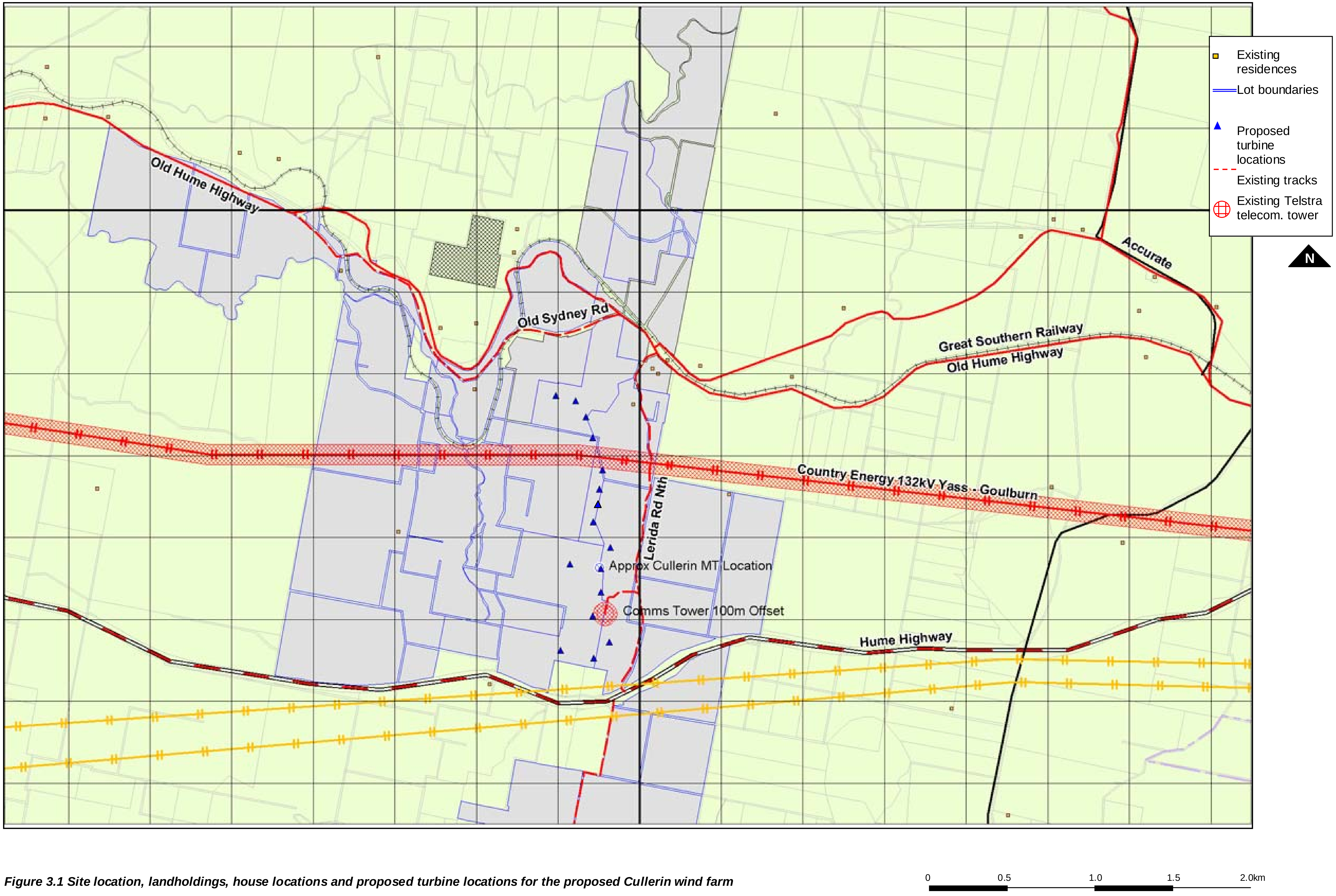

Figure 3.1 Site location, landholdings, house locations and proposed turbine locations for the proposed Cullerin wind farm

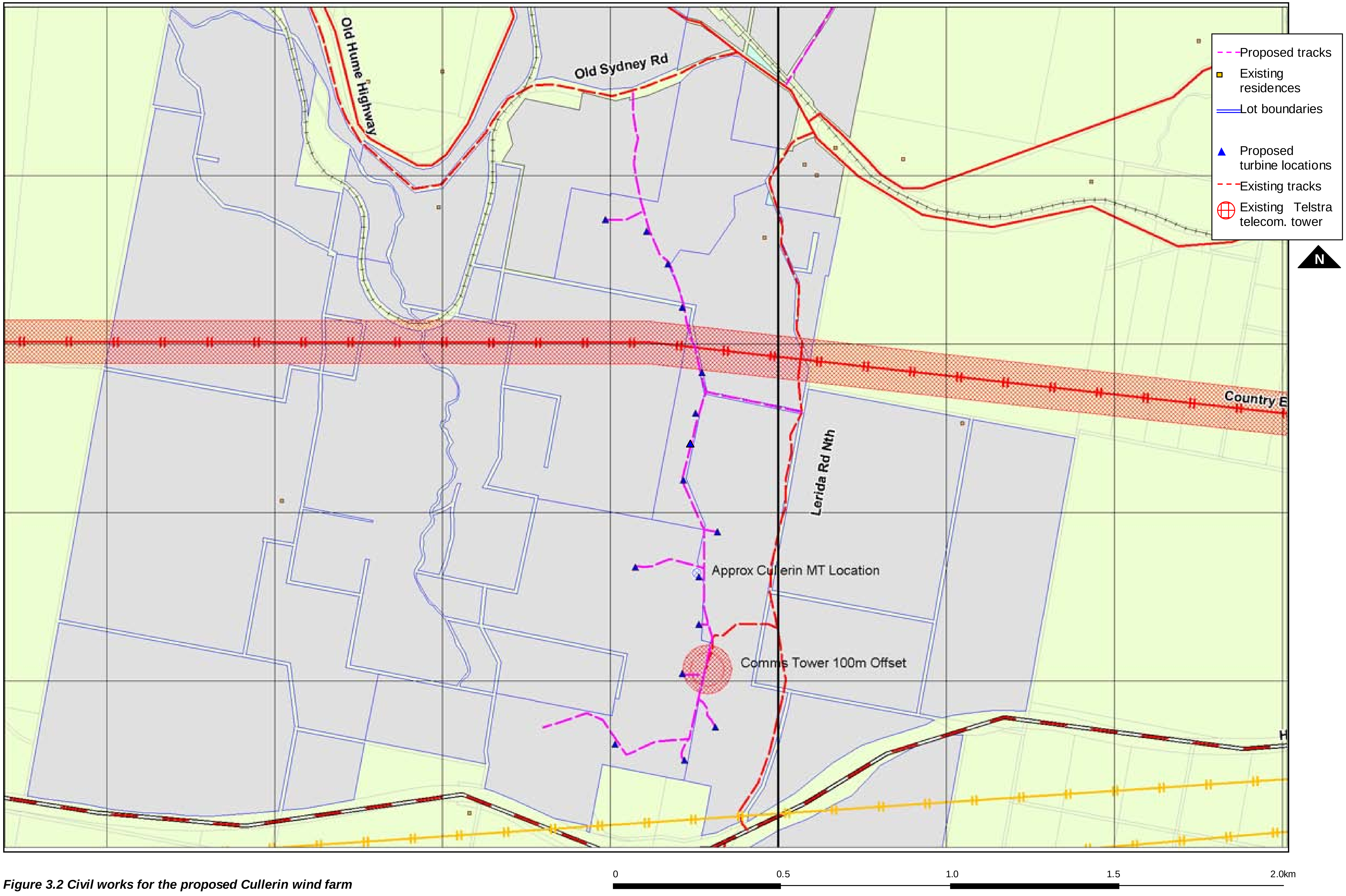

Figure 3.2 Civil works for the proposed Cullerin wind farm

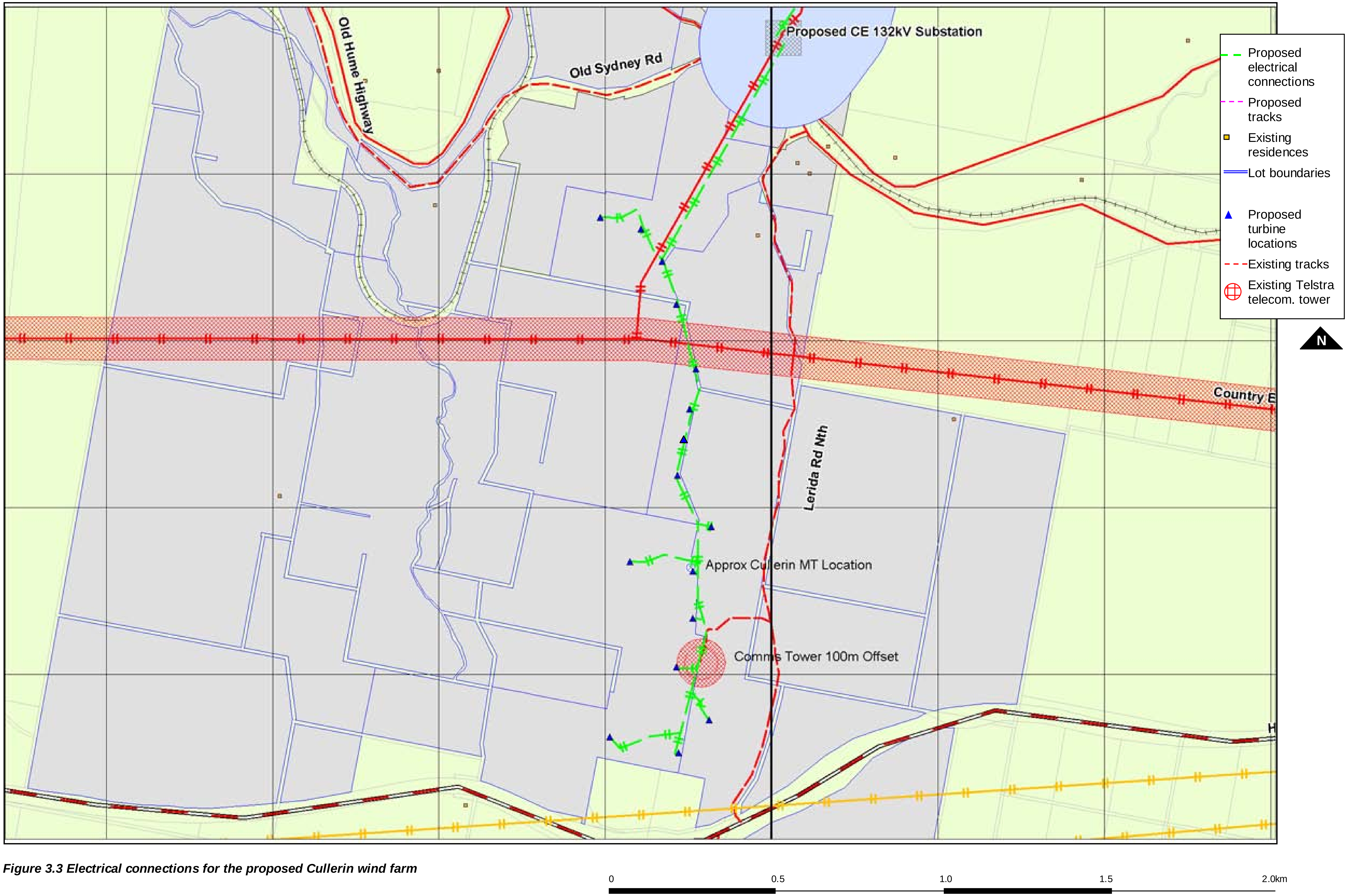

Figure 3.3 Electrical connections for the proposed Cullerin wind farm

3.3 Wind farm infrastructure

3.3.1 Wind turbines and wind monitoring equipment

3.3.1.1 Wind turbines

Each wind turbine would have a capacity of between 1.5MW and 3.0 MW, and provide sufficient power to supply between 500 and 1000 homes.

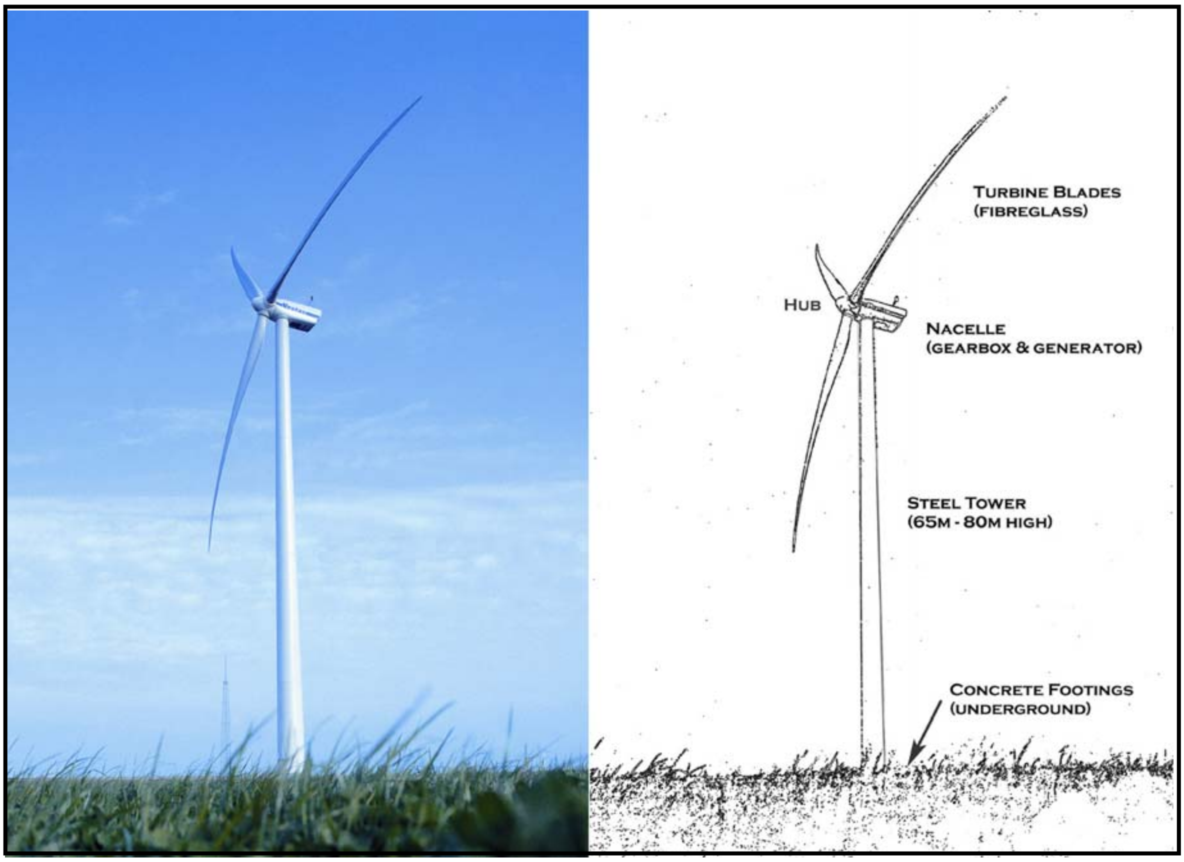

Figure 3.4 A typical wind turbine.

A typical 90m diameter wind turbine installed using an 80m tower.

Each wind turbine would be a three bladed type of the “up-wind” design, that is, facing up into the wind and in front of the tower. The wind turbine would have a diameter of 70 to 92 metres and a hub height of 60 to 80 metres, with the blade tip at its apex 100 to 126 metres above ground level. Blades would be made of fibreglass attached to a steel hub, and would include lightning rods for the entire length of the blade.

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 is also noise insulated to minimise noise emissions from mechanical components.

Tower

The tower is a tubular steel tower of up to 80 metres high, tapering from around 4 - 5 metres at the base to around 2 - 3 metres at the top. Exact dimensions will depend on the wind turbine design selected. The tower is constructed in up to four 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).

Footings

The tower would be seated in a reinforced concrete footing. Two designs of footing are under consideration, 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.

Transformer

Each generator would produce power at up to 1,000V. This is then transformed at each wind turbine to either 22,000V or 33,000V for reticulation around site. The 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. The transformer would be either a dry-type transformer, or would be suitably bunded.

Wind turbine model selection

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 also help to improve wind turbine noise performance at low wind speeds. However, they are more expensive to install.

It is likely that variable speed machines would be used in this wind farm, with a rotational speed in the range of 5 to 25 revolutions per minute (RPM) depending on wind conditions. This rotational speed is slower than the existing New South Wales wind farms at Blayney and Crookwell which operate at a fixed speed of 25-30 RPM.

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.

At this stage, the specific wind turbine model and manufacturer has not been selected. Final wind turbine selection would be carried out based on commercial considerations within the consent conditions stipulated by the Department of Planning.

Wind turbine layout

The proposed wind turbine locations shown on Figure 3.1 are indicative only; this layout has not been finalised. A preferred layout will be included after further investigations and environmental assessment have been carried out as it will be necessary to adjust the final placement of wind turbines, taking into account geology, final wind profiles, construction issues, local heritage, flora and fauna issues; some of the indicated locations may be removed, while others may be added within the overall limit of 16 turbines proposed.

3.3.1.2 Wind turbine 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 around 3 – 5 metres per second (11 – 18 kilometres per hour) and gradually increase in production to their maximum capacity, usually at around 12 – 15 metres per second (44 – 54 kilometres per hour). Once at this maximum capacity, the wind turbine would control its output by altering the pitch of the wind turbine blades. Under high wind conditions in excess of 25 metres per second (90 kilometres per hour) the wind turbine would automatically shut down to prevent damage. It would continue measuring the wind speeds during this state via an anemometer mounted on the nacelle, and would restart once wind speeds drop 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 or shadow flicker under certain conditions, these conditions can be pre-programmed into the control system and individual wind turbines automatically shut down whenever these conditions are present. For example, the noise control systems can be programmed such that if the wind is blowing from a certain direction at a certain wind speed, the wind turbines can be switched off. Likewise, wind turbines can be switched off at a certain time of day during a period of the year when the sun angles may cause shadow flicker on nearby properties.

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

3.3.1.3 Ongoing wind monitoring equipment

Taurus Energy has established a 65m high lattice tower wind monitoring mast to assess wind speeds at the site. It is proposed to continue operation of this mast to allow ongoing performance monitoring of the site. Data from this mast is also used for the acoustic noise assessment.

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

3.3.2 Electrical connections

The onsite electrical works would include:

- Onsite power reticulation cabling (underground and overhead) at either 22,000V or 33,000V between wind turbines and the substation
- Onsite control and communications cabling
- An onsite Control and Facilities Building housing control and communications equipment
- A Site Substation to step the voltage up from reticulation voltage to transmission voltage of 132,000V.

3.3.2.1 Onsite electrical connections

Within each wind turbine, or in the adjacent pad-mount transformer, the power voltage is stepped up from generation voltage to either 22,000 Volts (22kV) or 33,000V (33kV) for reticulation around the site. The selection between these voltages is a commercial consideration; power line easements, cable trench design, and reticulation routes are identical.

Power reticulation cabling

Each wind turbine must be connected together at reticulation voltage, and then connected to the Site Substation. These connections are to be made via a combination of overhead lines and underground cabling:

- Underground cabling is proposed between wind turbines along each ridge, to minimise visual impacts of the proposal.
- Overhead lines are proposed between the southern wind turbine group and the substation to minimise impacts in crossing Old Sydney Rd, the Old Hume Hwy, and the Great Southern Railway, and to reduce costs.

Overhead 22kV or 33kV lines would require an easement of 20 metres, and would be located to minimise clearing of trees, and to reduce visibility from neighbouring houses. Powerlines would be mounted on single wood or concrete poles approximately 17 - 20 metres high, spaced approximately 150 – 300 metres apart (depending on terrain), and coloured to blend in with the surroundings.

Underground cables would require a trench of approximately 1 – 1.5 metres deep and 0.5 – 1 metre wide. Cable trenches would, where possible, be dug within the onsite roads to minimise any related ground disturbance.

Underground lines are three to four times more expensive than overhead powerlines, and have a greater environmental impact through disturbance to soil required for digging trenches. An overhead line would also have a higher connection capacity allowing for the joint use of the asset with the approved Gunning Wind Farm proposed by Delta Electricity to the north of the site.

The routes for power reticulation would be finalised taking into account the ease of excavation of cable trenches, 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.

Control cabling

In addition to the power reticulation cabling, control and communications cabling is required from the Control and Facilities Building to each wind turbine, and to the 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.

3.3.2.2 Control and facilities building

A control building would be built onsite to house instrumentation and control equipment and communications equipment. This building would also house routine maintenance stores, a small work area, and amenities for staff.

A telephone connection to the Control and Facilities Building would be required to allow remote monitoring and control of the wind farm. This connection could consist of multiple buried telephone lines or a satellite connection.

The building would be of concrete slab on ground construction with steel frame, metal or brick walls, a non-reflective sheet steel roof, and would include rainwater storage tank for domestic use. An onsite septic system or composting toilet system would be installed to treat waste water produced.

The Control and Facilities Building would be located and coloured to be in keeping with the surrounding environment, and with consideration to the length of lines and control cabling necessary.

3.3.2.3 Site substation and 132kV Connection

A substation is required to convert power from onsite reticulation voltage of 22kV or 33kV to a transmission voltage of 132kV suitable to connect into Country Energy's transmission system. It would also include all necessary ancillary equipment such as control cubicles, voltage and current transformers, and circuit breakers for control and protection of the substation.

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 approximately 1 metre outside of the boundary of the security fence.

The substation would include a 30 – 40MVA power transformer. This transformer is 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 which may leak or spill.

Two locations have been considered for the substation:

Location A – Onsite, near the point where the existing 132kV line crosses the main ridge.

Location B - Onsite, on property to the north of the Great Southern Railway where a common substation could be considered with the proponent of the Gunning Wind Farm.

These locations have 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.

It is likely that minor alterations would be required to the existing transmission line to allow connection of the new cabling. This may include the construction of new concrete power poles at the connection point. In addition, if Location B is proposed for the site substation, approximately 1.5km of new 132kV overhead power line would be required to connect the substation to the existing 132kV transmission line.

In both cases, the substation would be located onsite and approval is being sought under this application. The location will be determined prior to submission of the Environmental Assessment Report.

3.3.3 Site access work

3.3.3.1 Access route

Access routes to the site are expected to use the existing Hume Highway and Old Hume Highway. The most likely route is via the Hume Highway, to Lerida Rd North, onto Old Sydney Rd and then through a new access track onto the northern end of the site. A possible additional route is via the Old Hume Highway, onto Old Sydney Rd, and then onto the site. Crossings of the Great Southern Railway are still to be determined; it is possible that a back route on the northern side of the railway line would be used.

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 which minimise traffic noise impacts to surrounding residents

3.3.3.2 Access tracks

Onsite access tracks for construction and operation would be unsealed formations up to 5m in width, and are required to the base of each wind turbine location and the location of the Substation and Control and Facilities Building.

A main access track would be located approximately as indicated in Figure 3.2 which shows proposed new tracks or track upgrades in magenta. From this main access track, side tracks would be taken to each wind turbine location. At each wind turbine base, a firm hardstand area would be required to provide a level and stable base for cranes necessary for construction.

Once the construction has finished, any tracks not used for normal farming practice would be spread with recovered topsoil and allowed to grow over or planted with appropriate grasses.

Every effort would be made to:

- Minimise the number and length of necessary access tracks
- Locate access tracks along the route of existing farm tracks
- Locate where clearing of existing native vegetation would be minimised
- Locate where impact on sensitive biodiversity or heritage areas would be minimised

- Construct with due regard to erosion, sediment control and drainage

3.3.4 Other site services

Telephone connections are proposed at the Control and Facilities Building, both for remote operation of the wind farm, and for use of operating staff at the site.

Standard 240 Volt / 415 Volt power would also be installed at the Control and Facilities Building.

Water for ongoing domestic use by maintenance and operation staff would be provided via a rainwater tank and rooftop collection system at the Control and Facilities Building. This building would also have a composting toilet or septic system for staff use.

Operating staff would be responsible for removal of all other wastes at the site; no waste management services would be required.

3.4 Staging of works

The works establishment of the wind farm can be considered as occurring in three phases. These include construction, operation and decommissioning of the wind farm. A description of activities under these headings follows.

3.4.1 Phase 1: Construction of the wind farm

The construction phase of the wind farm would include such activities as:

- Transport of people, materials and equipment to site
- Civil works for access track construction, footings and trenching for cables
- Establishment and operation of concrete batching plant and/or rock crushing equipment onsite, if required
- Installation of wind turbines using large mobile cranes
- Construction of substation and onsite power reticulation lines and cables
- Temporary site offices
- Restoration and revegetation of site on completion

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

Wind turbine construction can be relatively fast once the footings are prepared, with wind turbines installed at a rate of 2 – 4 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 grid connection works would be carried out in parallel.

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

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

3.4.1.1 Wind turbine construction and installation

Installation of the wind turbine blades would require establishment of a level (<1% gradient) and stable hardstand area at the base of each wind turbine. This hardstand area would support cranes used for the major component lifts, and could have an area of up to 30 metres by 30 metres. It is also necessary to have a delivery area for the various components adjacent to the hardstand area, in most cases it is expected that the access road could be used as this delivery 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 which are 80-90m in diameter. 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 parameters. 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.

3.4.1.2 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.

3.4.1.3 Concrete batch plant

It is likely that pre-mix concrete will be brought to site from local batch plants.

However, a portable concrete batch may be required to supply concrete onsite. This would involve an level area of up to 50 metres by 75 metres onsite to locate the loading bays, hoppers, cement and admixture silos, concrete truck loading hardstand, water tank, and stockpiles for aggregate and sands. The site would include an in-ground water recycling / first flush pit to prevent dirty water escaping onto the site, and would be fully remediated after the construction phase.

The batch plant would be located on an existing clear and level area of the site, to be determined.

Sands and aggregate would be sourced from excavation of footings, where possible, or from existing sand and gravel pits within the local area. Every effort would be made to source clean sands and aggregates to prevent transport of weeds to site.

In the event that an on-site batch plant is proposed, water would most likely be trucked in from off site. It is possible that, depending on water levels, water from existing dams on the property could be used to supplement water cartage.

3.4.2 Phase 2: Wind farm operation

Once installed, the wind farm would operate for an economic life in the order of twenty to thirty years. The economic life would depend on various considerations including the increasing costs of maintenance; requirements for major repair work; and cost and efficiencies of possible replacement wind turbines.

During the operation phase, 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, a site monitoring program would be established to determine additional impacts of the wind farm. The monitoring program would measure noise emissions from the operational wind farm as well as biodiversity impacts, given the paucity of information available on the impact of wind farms on Australian birds and bats. As well as provide information able to be used to minimise the operational impacts of the Cullerin Wind Farm on birds and bats, it would be a source of information for other wind farms in Australia.

3.4.2.1 Routine maintenance

The wind farm operates unattended. To maintain the wind farm operating in a safe and reliable manner, it would require regular inspection and operation on an as needs basis. This would generally be carried out using standard vehicles.

In addition, regular maintenance is required, generally at 3, 6 and 12 monthly intervals. This does not require 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.

3.4.2.2 Major repairs

It is possible that major unexpected equipment failures could take place during the life of the wind farm. While wind turbines and electricity connections are designed for a 20 - 30 year life, failures can occur due to a number of factors including lightning strike (either onsite on the wind turbines or offsite on the transmission line) and design or manufacturing flaws to key components (such as transformers or gearboxes).

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, although helicopters may sometimes be used for one-off replacements.
- Replacement of wind turbine generators or gearboxes would 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

3.4.2.3 Site monitoring program

Monitoring of the wildlife impacts of the wind turbines would occur at regular intervals during the initial phase of operation. This could be carried out using a standard vehicle and would not require any additional works or infrastructure.

3.4.3 Phase 3: Wind farm decommissioning / recommissioning

The life of the wind turbines is 30 years at which point the wind turbines would be replaced, overhauled or removed from the site.

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, all other equipment would be removed from site. No concrete batching plant or materials delivery would be required, therefore the decommissioning period would be significantly shorted and with significantly less truck movements than the construction phase.

The scrap value of turbines and other equipment is expected to be sufficient to cover the costs of their dismantling and site restoration.

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. Again, the scrap value of turbines and other equipment is expected to be sufficient to cover the costs of their dismantling and site restoration. The existing substation and cabling could be reused, and it is possible that the existing footings could also be reused. This would allow a significant cost saving for a subsequent project, and it is therefore likely that recommissioning the wind farm could be commercially appropriate.

In light of the long life span of the project, approval for the decommissioning or recommissioning of the wind farm is not being sought in this application.

3.5 Rehabilitation guidelines

The proposed works would involve excavation and construction activities, would increase traffic on unstable surfaces. This would increase the potential for spread of weeds and erosion and potentially an adverse impact on water quality.

All disturbed areas would be stabilised as soon as practicable, following the construction period. In particular, sloping sites and sites where vegetation has been disturbed would require immediate rehabilitation. In general, rehabilitation would follow four stages:

1. Site Preparation:

Site preparation aims to provide the best possible conditions for plant root growth (Parr-Smith et al. 1998). This is achieved by improving soil and subsoil texture by softening and aeration, providing adequate water and nutrients and removing competition from weed species.

Topsoil would be separated from underlying subsoil as it is excavated. All excavated material would be placed on a geotextile fabric or already disturbed surfaces, to prevent damage to vegetation. The topsoil would be respread over the disturbed area to act as a seed bank, providing nutrients for the proposed plantings and/or seeding.

Sods of native vegetation would be carefully removed, stored and cared for, requiring regular watering and replacement as soon as possible. A root base at least 15cm deep is required, sods would not be so large that they require more than one person to lift, and the above ground growth of shrubs would be trimmed to allow the root mass to support new growth. If sods cannot be replaced within a week, they will require nursery-like conditions to preserve them.

2. Stabilisation:

Stabilising the disturbed areas would prevent erosion, reduce the impact of frost, wind, water runoff and raindrop action and would provide a final surface for revegetation.

Stabilisation would occur immediately after the completion of construction or progressively as sections are completed. Disturbed areas would be stabilised using organic erosion control matting or mulch.

3. Revegetation:

Revegetation is the process of establishing plants on a stabilised site (Parr-Smith et al. 1998). The sites would be revegetated progressively as works are completed with species appropriate to each site.

4. Monitoring:

On-going monitoring and maintenance is required following rehabilitation. This step can require a greater level of resources than the initial establishment of native vegetation, depending on the response of the ecosystem to the actions described above. It is an essential step as techniques that work well at one site may prove inadequate at another site, leaving soil denuded and vulnerable to erosion. Maintenance would involve replacement of dead or missing plants, protection from grazing animals if necessary, removal of weeds and watering through dry periods until the system has reached a predetermined stable state. Mulch may need to be replaced when it breaks down or where there is insufficient plant groundcover.

4 MODERATE TO HIGH PRIORITY ISSUES

Although largely unknown at this stage, these issues are considered potentially able to generate moderate to high level impacts and are therefore of greater priority in terms of investigation and mitigation of impacts. They will require additional investigation/consultation and will be dealt with more fully in the **Environmental Assessment Report**.

4.1 Summary of moderate to high priority issues

The sources of impact and proposed strategy for investigation is described for each item of moderate to high priority, in Table 4.1, below.

Table 4.1 Issues of moderate to high priority.

Issue	Sources of impact	Strategy
Bushfire Risk	• Potential for wind turbines to start or influence the pattern of bushfire. • Potential to impact bushfire-fighter access.	Further investigation / consultation with Council and RFS.
Flora	• Clearing of vegetation during construction and maintenance. • Impact on composition of vegetation community. • Potential for spread of weeds through soil disturbance during the creation of access tracks, footings and underground cable routes. • Impact on threatened species or endangered ecological communities.	Further investigation via biodiversity assessment including desktop literature review and onsite field work.
Fauna	• Loss or modification of habitat. • Impact on threatened, significant and migratory species (collision hazard to mobile species). • Direct impact of construction and operation on fauna (including threatened and domestic species) for example blade flicker and noise.	Further investigation via biodiversity assessment including desktop literature review and onsite field work.
Visual	• Loss of visual amenity • Impact on scenic character • Cumulative Impacts (including the additional infrastructure of the Gunning Wind Farm and other proposals in the area).	Further investigation via visual assessment involving community consultation.
Community cohesion	• Potentially divisive development.	Further investigation via community consultation. Implementation of a community consultation plan.
Archaeology	• Potential to impact Aboriginal heritage values and items.	Further investigation via archaeological assessment including desktop literature review and onsite field work. Subsurface work would only be undertaken if required.

Issue	Sources of impact	Strategy
Services and Infrastructure	• Potential to impact roads, bridges, rail crossings, electricity infrastructure. • Potential for positive contribution (access to the site may be improved as a result of the development, provision of new substation may allow future network improvements for properties in the area).	Further investigation via consultation with the Upper Lachlan Council and the Road and Traffic Authority (RTA).
Traffic	• Turbines may distract drivers (either by their movement or as other motorists pullover to view the development). • Increased traffic may be a safety risk in the local area.	Further investigation via consultation with the Upper Lachlan Council and RTA.
Acoustics	• Operational noise may impact residences nearby.	Further investigation via acoustic assessment including modelling and mapping.
Aircraft and tele-communication impacts.	• Television, radio and telecommunications may be impacted. • Turbines may cause a collision hazard.	Further investigation and liaison with telecom providers and Civil Aviation Safety Authority (CASA) and Air Services Australia.

4.2 Proposed investigation strategies

For several areas, a plan has been outlined for further investigation by **ngh**environmental. The investigations currently proposed are outlined below for biodiversity, archaeology and community impacts. For the remaining issues, investigation would be guided by the Director General's Requirements for the EAR and would involve liaison with relevant authorities.

4.2.1 Biodiversity Assessment

The biodiversity assessment would target mammals, birds (woodland and wetland species), amphibians and reptiles by direct searches and habitat assessment and flora via the 'random meander' method and vegetation mapping. All of these groups have species listed within the *NSW Threatened Species Conservation Act 1995* (eg. Koala, Regent Honeyeater, Blue-billed Duck, Green and Golden Bellfrog, Striped Legless Lizard, and two species of Diuris orchid) and several listed Endangered Ecological Communities may be relevant.

Field work would be completed over a period of three to four days by three people. A specialist report would be prepared that would include the results of investigations, a literature review of threatened species with potential to be impacted, and mapping of vegetation communities and habitats (including significant vegetation communities and habitats).

Fauna survey techniques proposed during the assessment would include:

- General diurnal observation, recording herpetofauna, bird censusing, and incidental sightings of fauna;
- Elliot and cage trapping, over a minimum period of 3 nights (approximately 200 trap nights), in representative habitat types;
- Recording of bats ultrasonic calls for analysis over a period of 3 nights for a minimum of 0.5 hrs/night;
- Nocturnal call playback for owls and Yellow-bellied Gliders (Masked Owl and Barking Owl) will be completed at the site;
- Amphibian nocturnal streamside searches (one person hour will be completed over a 200 meter length at gullies (where they occur within the study area). If wet weather occurs during the survey period it may be possible to obtain more data on frogs by traversing tracks within the sites and recording frogs moving on these;
- Foot based spotlighting will be completed, searching for nocturnal arboreal and scansorial vertebrate fauna; and
- Scat searches and animal sign would be completed along tracks for predator scats and for 20 minute duration among vegetation in each habitat type at each site.

The approach of the botanical assessment would follow the method known as the 'random meander' method documented by Cropper (1993). Species occurrence and abundance would be documented for each vegetation community. Vegetation communities would be described and mapped.

4.2.2 Archaeology

The Aboriginal Heritage project would be conducted in accordance with the requirements of the NSW DEC Aboriginal Cultural Heritage Standards and Guidelines Kit (NPWS draft 1997). In addition the study will be undertaken following the new requirements for Community Consultation – Interim Guidelines for Aboriginal Community Consultation-Requirements for Applicants. Accordingly, the study would include:

- Consultation requirements including Notification and Registration of Interests (written notification to five nominated groups, any groups or individual who elect to register and via an advertisement in the local paper) and Preparation of Assessment (submission to any registered stakeholders of the proposed methodology);

- Consultation with relevant Aboriginal organizations;
- A review of heritage listings and relevant literature;
- A synthesis of local and regional archaeology;
- The construction of a predictive model of Aboriginal site location;
- A comprehensive field survey of the zones of proposed impact conducted in accordance with the NSW DEC Aboriginal Cultural Heritage Standards and Guidelines Kit (NPWS draft 1997);
- An analysis of the survey and results;
- A significance assessment of cultural heritage sites located within the study area;
- Consultation in regard to management issues and options;
- An assessment of whether or not further archaeological investigations are required;
- Recommendations for the mitigation and management of cultural heritage based of the results of the investigation, significance assessment and a consideration of the impacts of the proposed activities;
- Provision of a draft document to registered Aboriginal stakeholders; and
- The preparation of any necessary Part 6 (NPW Act) applications.

4.2.3 Visual Assessment

A visual assessment report would be completed, considering the wind turbines themselves and associated infrastructure, including transmission lines, roads and substations. The impacts would be assessed through site investigations, photomontages and information gained from stakeholders. The methodology used to determine the visual impacts has been adapted from the Bureau of Land Management in the US known as the BLM method which identifies ratings for visual quality, visual sensitivities and distance zones and was used from the visual assessment at Snowy Plain. This method enables an objective assessment of visual impacts associated with the proposal.

The Visual Assessment will be completed by:

- Review of existing literature;
- Review of topographical maps and aerial photographs;
- Preparation and review of turbine photomontages from key locations with respect to visual impact;
- Visiting the site and adjacent areas; and
- Engaging the community through workshops to document the community's and stakeholder's values of the visual amenity and visual quality of the local and regional area and their perception of the wind farms;

The Visual Impact Assessment will be determined by:

- Identifying the scenic quality by categorising the landscape setting, existing land uses, and identifying the landscape character;
- Identifying important views to the wind turbines and associated infrastructure from surrounding areas including roads, freeways, railway and neighbouring residences. A selection of these points would be used for preparation of photomontages.
- Identifying the type of user of the surrounding areas, therefore determining the scenic sensitivity and the duration of exposure to the proposal;
- Identifying the degree of change introduced by the project and subsequent contrast to the existing landscape; and
- Recommending mitigations to minimise visual impact were necessary.

4.2.4 Community consultation plan

A community consultation plan has been drafted and would be implemented concurrently with the specialist studies. Table 4.2 outlines the approach of the community consultation.

Table 4.2 Community consultation plan

Stakeholder / Process	Method of Consultation
Owners / occupiers Includes all land holders / occupiers that may have wind turbines occurring on their land (details obtained from Upper Lachlan Council).	‣ Contact landholders and occupiers in person by phone or meeting: o Discuss details of the proposed work. o Discuss environmental assessments and onsite meetings that will occur. o Provide with means to communicate concerns / issues (Taurus and ngh phone number, address, website). ‣ Send formal consultation letter, to contain: o Details of the proposed work. o Plan for environmental assessments and onsite meetings. o Copy of the consultation process plan. o Means to communicate concerns / issues (Taurus, ngh, Council contact name, phone number, address, website). ‣ Invite to all Open House* sessions.
Nearby land owners and occupiers (details obtained from Upper Lachlan Council).	‣ Send formal consultation letter, to contain: o Details of the proposed work. o Plan for environmental assessments and onsite meetings. o Copy of the consultation process plan. o Means to communicate concerns / issues (Taurus, ngh, Council contact name, phone number, address, website). ‣ Invite to all Open House* sessions.
Aboriginal community Local Aboriginal Land Councils contacted during Archaeological investigations Liaison with DEC	‣ Consultation would be conducted in accordance with the requirements of the NSW DEC Aboriginal Cultural Heritage Standards and Guidelines Kit (NPWS draft 1997) and in addition would be undertaken following the new requirements for Community Consultation – Interim Guidelines for Aboriginal Community Consultation- Requirements for Applicants. ‣ Notification via local newspapers, to contain: o Details of the proposed work. o Inclusion of interested parties in the field assessment.

* see further explanation, *Section 4.2.4.1*.

Stakeholder / Process	Method of Consultation
Wider community	‣ Notification via local media (radio and newspapers, local newsletters), to contain: o Details of the proposed work. o Environmental assessments and onsite meetings that will occur. o Provide with means to communicate concerns / issues (Taurus and ngh phone number, address, website). o Dates and purpose of Open House* sessions.
Local Council Upper Lachlan Council Richard Davies (Environmental Services), Ken Reedy (Director of Works), John Bell (General Manager).	‣ Initial Meeting held to introduce proposal and obtain comments relevant to the proposal. ‣ Invite to all Open House** sessions. ‣ Summary of comments from sessions will be provided to Council. ‣ Invite to onsite Planning Focus meeting. ‣ Liaison to keep abreast of proposal changes and findings of assessments.
Open House* sessions Owners / occupiers, Nearby land owners and occupiers, Wider community, Council	‣ First Open House*: o Outline proposal and assessment process. o Invite the community to outline concerns / issues. o Provide means to communicate concerns / issues (Taurus Energy, **ngh**environmental, Council: contact names, phone number, address, website). ‣ Second Open House*: o Update on proposal and assessment process. o Provide results of specialist studies and how these have shaped the proposal. o Invite the community to outline concerns / issues. o Provide means to communicate concerns / issues (Taurus Energy, **ngh**environmental, Council: contact names, phone number, address, website).

4.2.4.1 Open House sessions

It is proposed that at least two Open House sessions will take place. The first would introduce the proposal to the community, in its initial form and invite comments. The second session would deliver the results of the specialist studies and their impact on the shape of the proposal. Both sessions will aim for a two way dialogue between the proponents and the community.

An Open House is an effective means to initiate a local presence and dialogue with residents and other stakeholders. It can be helpful in avoiding the stress and heat of a public meeting, allowing a flow of stakeholder dialogue throughout the event rather than a more constrained discussion that can potentially be hijacked by the most vocal individuals. While there remains a potential for this to occur with an open house, it is easier to manage given the more diffuse flow of traffic. Furthermore, there is potential for a larger proportion of stakeholders to voice their individual concerns with the relevant representatives in a less confrontational situation, allowing interested parties to find out about issues at their own pace without the pressure of speaking before a large group of people. This is achieved by fostering small group and one-on-one discussions. It also allows the presentation of issues and information to be tailored to individual queries.

•

* see further explanation, *Section 4.2.4.1*.

The recording of public input from an open house can be difficult due to its loose structure. It is also staff intensive. These issues would be addressed by using an array of recording tools; butcher's paper for community members to write on, structured forms for them to fill in, and by taking comments directly using a laptop. People would be encouraged to comment via one of these methods.

The venue for the open house needs to be accessible (including disabled access), and would need to be open for several hours covering a period from mid-afternoon (~3.00 pm) to early evening (~7.00 pm) to allow the greatest attendance. Display information would need to be prepared and fact sheets with general information on wind farms and the proposal would be useful for people to take away. Community members would be notified of the timing of the events via local newspaper articles and local radio. Owners and adjoining neighbours would be invited to attend via written invitation. The involvement of the local council would be encouraged.

The format of the open house would include;

Station 1:- consists of two people from Taurus Energy.

Provide proposal details and general information on wind farms. This would be provided on a one to one basis, plus a half hour small group workshop on the hour every hour. It would include posters showing the site, examples of wind farms etc.

Station 2:- consists of two people from nghenvironmental.

Would provide information on a one to one or small group basis. Would focus on the

planning process, specialist environmental studies being undertaken including biodiversity and heritage (results if available), provide information on noise and potential mitigation strategies, discuss likely impact of the proposal as a result of its footprint, plus impacts associated with the operation of the facility (focus on biodiversity, heritage, acoustic environment).

Station 3:- consists of one person from Scenic (visual assessment).

Would provide information on a one to one or small group basis. Would discuss results of visual assessment. Would include graphic presentation, visual catchment, and impact on local visual environment.

Station 4:- Registration/comments (nghenvironmental)

This would require a person at a desk to register people as they enter and manage obtaining comments by either encouraging the participants to fill in forms, write ideas on butcher's paper (provided at each station), or dictate comments for insertion onto a laptop.

5 LOW PRIORITY ISSUES

It is considered that the proposal has the potential to generate a range of environmental impacts. As directed by the Department of Planning, potential impacts have been considered under the headings of **low priority** issues and **moderate to high priority** issues.

This section demonstrates the rationale for the identification of low priority issues and discusses the measures that Taurus Energy would implement to mitigate these impacts (summarised in the *Statement of commitments, S*ection 6). It is anticipated that the issues identified as low priority will not require further investigation in the Environmental Assessment Report and can be managed by way of the discussed environmental safeguards.

Issues that the proponent has identified as low priority are summarised in Table 5.1.

Table 5.1 Summary of low priority issues

Issue	Sources of impact
Climate and air impacts	‣ Dust and emissions generated during excavation, road works, transport of machinery. Impacts would be greatest during construction and decommissioning ‣ Local climate may be affected by the increase in turbulence caused by the wind turbines. Impacts would be ongoing ‣ Greenhouse gas emissions The proposal would make a positive contribution to the reduction in greenhouse gas emissions by providing an alternative electricity sourced from fossil fuels
Soils and landforms	‣ Soil disturbance from vegetation clearing ‣ Erosion from excavation works ‣ Soil compaction from the transport of heavy equipment
Construction noise	‣ Operation of equipment ‣ Transportation of equipment and materials to and from the site
Hydrology (water quality and water-table impacts)	‣ Mobilisation of sediment and pollutants generated during excavation, road works, transport of machinery ‣ Risk of oil leaks during operation and maintenance
Landuse	‣ Permissibility of the development on the site selected, under local government legislation and planning instruments ‣ Impact on onsite and adjacent land uses during the construction, operational and decommissioning phases
Economic impact	‣ Property prices may be impacted by the infrastructure ‣ Local employment would be created during construction - net economic gain to the local community
Services and Infrastructure	‣ Access to the site may be improved as a result of the development ‣ Provision of new substation may allow future network improvements for properties in the area
Tourism	‣ Impact on the number and type of visitors to the area
Safety	‣ Potential to generate electromagnetic fields ‣ Potential to cause injury
Removal of infrastructure	‣ Ability to finance removal of infrastructure ‣ Environmental rehabilitation of site

5.1 Climate and air quality impacts

5.1.1 Existing environment

The site and immediate area ranges from approximately 700 – 850m, with development proposed to be focused on ridges. Data obtained from the Bureau of Meteorology weather station at Goulburn indicate that the highest mean maximum temperature occurs in January (28.1°C) and the lowest mean minimum occurs in July (1.3°C). Although the local topography of ranges and plateaus can result in localised climatic conditions, temperatures onsite are expected to fall within this range.

The mean annual rainfall in the Goulburn area is recorded as 687.8mm, between 1961-1990. However, rainfall in the Goulburn area has been lower than average over three of the last four years (Australian Capital Territory Government 2004). The annual totals for the last four years are as follows: 776.2mm (2000-01), 595.1mm (2001-02), 481.4mm (2002-03) and 453.2mm (2003-04). Highest monthly rainfall historically occurs from May to June. Lowest monthly rainfall historically occurs from November to April.

Goulburn is one of a small number of inland areas of New South Wales that has been targeted for the development of wind farms, due to the reliably high wind speeds recorded on ridges in the area. Davy and Coppin (2003) analysed wind speeds at several sites in South East Australia, including Goulburn. They noted anomalous calms recorded late at night and early in the morning for Goulburn, attributed to the stable atmospheric conditions at night and the sheltered position of monitoring stations. Summer showed the largest potential for wind generation capacity, with lowest seasonal capacity in autumn.

Climatic data for Goulburn therefore indicates that diurnal conditions in summer can be dry and hot with high wind speeds. This could be expected to produce dusty conditions, particularly in drought where heavily grazed paddocks are prone to wind erosion.

5.1.2 Potential impacts and mitigation measures

5.1.2.1 Dust and emissions

Dust and emissions would be generated during excavation works, road works and the transport of machinery. Impacts would be greatest during construction and decommissioning / recommissioning phases. Impacts would be temporary, occurring during a 3-6 month construction period. Similarly, the area that would be impacted would not be great in extent (works areas indicated on Figures 3.2 and 3.3).

The impacts of the proposal are considered manageable with regard to air quality and climate. Specific activities that would be undertaken and their potential environmental impacts are listed below. The identified impacts would be restricted to the construction and decommissioning / recommissioning phases of the wind farm. Mitigation strategies that would be employed during these phases to manage the potential for adverse environmental impacts are outlined in Table 5.2.

Table 5.2 Potential impacts from dust and emissions with mitigation strategies

Activities	Mitigation
Disturbance to vegetation to establish a hardstand area at the base of each turbine. Removal of vegetation may increase wind erosion and airborne dust. Pasture would not be cleared however, compaction would kill individual plants, increasing the potential for erosion.	‣ Landforms would be stabilised and rehabilitated as soon as practicable after works (see Section 3.5 for rehabilitation principles). ‣ Turbine placement would, where possible, avoid impacts to mature trees.

Activities	Mitigation
Blasting activities to establish turbine footings. Blasting may be required, pending the results of geotechnical investigation, to adequately secure the footings. One house occurs approximately 500m from where blasting may be required. This landowner is involved with the proposal.	• Nearby residences would be informed prior to blasting. • Should controlled blasting be required, it would be carried out in accordance with all relevant statutory requirements.
A concrete batching plant may be installed onsite. Dust from dry materials and emissions from mixing machinery may occur as a result of the plant. These would be minor and not located near residences.	• The batching plant would not be located near residences. • Dust levels at stockpile sites would be visually monitored. Dust suppression (eg. water sprays) will be implemented if required. • Product stockpiles will be protected from prevailing weather conditions. • Loads of dry materials will be covered where appropriate. • Dust filters will be installed on silos. • Only machinery compliant with emission standards will be used. • Machinery and vehicles will not be left running or idling when not in use.
Rock crushing to convert excavated materials to road base. The operation of mobile rock crushing equipment may generate dust and vehicle emissions.	• As above
Excavation of footings for wind turbines and for the control room and substation.	• Excavation would only be commenced during stable, dry weather conditions, operational requirements permitting.
Construction of trenches to house underground cables.	• Excavation would only be commenced during stable, dry weather conditions, operational requirements permitting. • Subsoil would be separated from topsoil for rehabilitation purposes. All topsoil from the excavation sites would be stockpiled and replaced to its original depth for seeding and fertilising. On steep slopes, topsoil would need to be stabilised using, for example, jute matting. Any excess subsoil would be removed from the site and disposed of at an appropriate fill storage site. • On the steeper slopes check banks would be installed across the trenchline, approximately 50 metres apart, following closure of the trench. These would discharge runoff to areas of stable vegetation.
Installation of vehicle tracks and upgrades to existing tracks. This would result in some clearing and compaction of vegetation on the existing road verge.	• Excavation would only be commenced during stable, dry weather conditions, operational requirements permitting. • Landforms would be stabilised and rehabilitated as soon as practicable after works.

Activities	Mitigation
Dust generated by vehicle traffic on dirt roads.	• Should dust generation be of a high level during the transport of machinery near residences, watering of sections of the route would be undertaken to reduce dust.
Vehicle emissions both onsite and enroute to the site.	• Vehicles and motorised equipment would be maintained so that emissions are minimised.

5.1.2.2 Local climate

Local climate may be affected to a minor degree by the increase in turbulence caused by the wind turbines, while the wind farm is operational. Modelling and experimentation on real wind turbines has shown that the mixing effect of thermal layers has very little effect on temperature during the day (Baidya, *et al.* 2004). Recordings taken below wind turbines and averaged over a 24 hour period were observed to be greater than existing ground level wind speeds by approximately 0.6 metres/second and to raise temperatures by approximately 0.7^{o}C (Baidya, *et al.* 2004).

Wind speed impacts have been suggested as being confined to a distance from each turbine equivalent to 10 times the vertical height of the turbine (SEDA 2002). For the turbines considered (126m from the ground to blade-tip), an effect up to 1.25km from each turbine may be expected, attenuating with distance from the turbines. As the local topography is undulating (see cover photo and contours of Figures 3.1-3.3) the horizontal distance from each turbine would be less than this amount.

The turbines would turn slowly in low wind conditions and faster with increasing wind speeds; hence they would enhance not counter natural wind conditions. The anticipated change in wind speed and temperature at the ground level is not considered large enough to impact vegetation or be in conflict with the continued agricultural use of the land. This impact would be ongoing but minor and is not considered by this report to require mitigation.

5.1.2.3 Greenhouse gases

The proposal would make a contribution to the reduction in greenhouse gas emissions by providing an alternative to electricity sourced from fossil fuels. This constitutes the chief environmental benefit of the proposal. Benefits to long-term climate change may be afforded by the development of non greenhouse gas emitting energy sources. During the operational life of the wind farm, the development would supply electricity for approximately 10,000 homes. This would reduce greenhouse gas emissions by approximately 60,000 – 80,000 tonnes of carbon dioxide per annum.

5.2 Soils and landforms

5.2.1 Existing environment

The CANRI database (Department of Natural Resources, accessed October 2005) shows that the site is situated on stable land forms, suitable for cultivation. Areas considered to have severe limitations occur to the north and south of the site. These areas would not be impacted by works.

The Soil Landscapes of the Goulburn 1:250,000 mapsheet (Soil Conservation Service of NSW 1991) shows that the site consists of two soil units; ‘**mi’** (Midgee) and ‘**wy’** (Wyangala) (Figure 5.1).

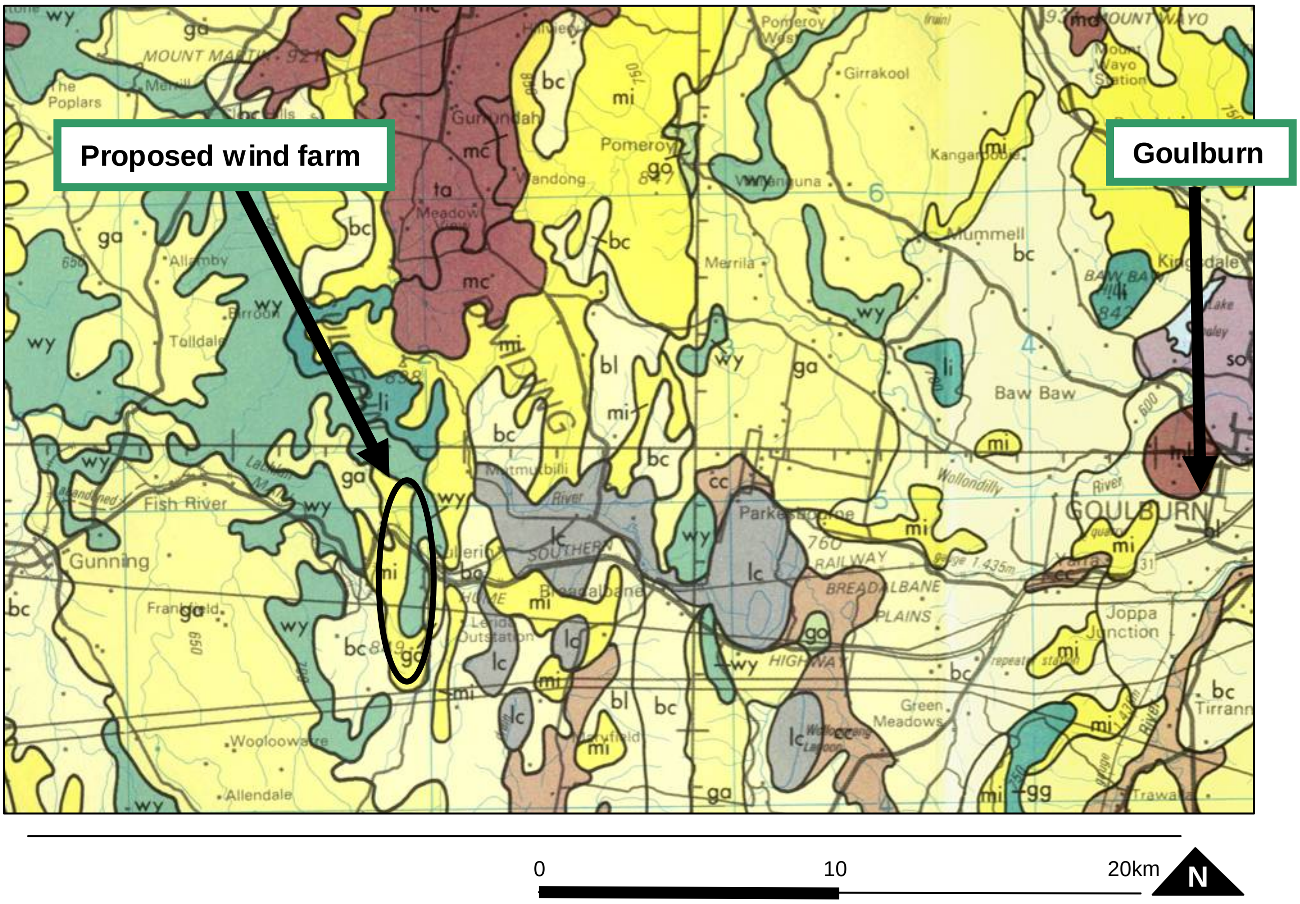

Figure 5.1 Soil types for the local area

‘**mi’** (Midgee) occurs on the west and south of the site. Landscapes are rolling to low hills on Ordovician and Devonian and Silurian metasediments. Soils are commonly acid stony yellow earths and yellow podsolic soils on side-slopes and crests, in association with lithosols, red podzolic soils and red earths with soloths on lower slopes. This soil unit is known for widespread minor to moderate sheet erosion. Gullying of drainage lines also occurs (Soil Conservation Service of NSW 1991).

‘**wy’** (Wyangala) occurs on the east of the site. Landscapes are rolling granitic low hills and hills with tors and boulders. Siliceous sands, red earths and red duplex soils occur on side-slopes. Yellow duplex soils occur on footslopes and in some drainage lines. Gully erosion is common in drainage lines. Sheet erosion can occur following drought or bushfire and occasional salting occurs in low lying areas (Soil Conservation Service of NSW 1991).

The soils mapping data is patchy for the area however, extensive areas of sodic soils have been indicated near Goulburn (EPA 2004). Sodic soils are those soils with an Exchangeable Sodium Percentage (ESP) greater than 6. When wet, these soils are highly dispersive, adversely impacting soil structure and subsequently landform stability and plant growth. The effect of ESP on soil dispersion is also influenced by organic matter content, clay mineralogy (Australian Soil Classification 2003).

5.2.2 Potential impacts and mitigation measures

Soil compaction and erosion could occur during excavation works, road works and the transport of machinery. Impacts would be greatest during construction and decommissioning / recommissioning phases. Impacts would be temporary, occurring during a 3-6 month construction period. Similarly, the area that would be impacted would not be great in extent (works areas indicated on Figures 3.2 and 3.3).

The impacts of the proposal are considered manageable with regard to soils and landforms. Specific activities that would be undertaken, and their potential environmental impacts are listed below. The identified impacts would be restricted to the construction and decommissioning / recommissioning phases of the wind farm. Mitigation strategies that would be employed during these phases to manage the potential for adverse environmental impacts are outlined in Table 5.3.

Table 5.3 Potential impacts to soils and landforms with mitigation strategies

Activities	Mitigation
Disturbance to vegetation to establish a hardstand area at the base of each turbine. Removal of vegetation may increase wind erosion. Turbines would be positioned to avoid mature trees. Pasture would not be cleared however, compaction would kill individual plants, increasing the potential for erosion.	‣ Landforms would be stabilised and rehabilitated as soon as practicable after works. ‣ Turbine placement would avoid impacts to mature trees, where possible.
Transport of heavy equipment. Soil compaction would occur as a consequence of the transport of heavy equipment. Compaction can reduce the biotic soil binding mechanisms provided by bacteria and micro invertebrates and leave surface layers of soil more susceptible to wind and water erosion. In lower slope positions, compaction of saturated soils may cause slumping, affecting slope stability and water quality. In the main, areas to be compacted would be confined to already established tracks.	‣ Tracks would be graded to enhance stability. ‣ Routes would be confined to already disturbed areas, where possible.
Blasting activities to establish turbine footings. Blasting has potential to impact on the stability of landforms.	While the soils onsite are prone to erosion, they are not considered to be unstable and therefore the impacts of blasting on landforms and their stability is anticipated to be low.
Excavation of footings for wind turbines and for the control room and substation. Works would cause gross soil disturbance, create stockpiles and thereby represent a high risk of erosion and mobile sediment generation. These works would occur in discrete areas and could be managed to avoid erosion during and following construction works.	‣ Excavation would only be commenced during stable, dry weather conditions, operational requirements permitting. ‣ Subsoil would be separated from topsoil for rehabilitation purposes. All topsoil from the excavation sites would be stockpiled and replaced to its original depth for seeding and fertilising. On steep slopes, topsoil would need to be stabilised using, for example, jute matting. Any excess subsoil would be removed from the site and disposed of at an appropriate fill storage site. ‣ On the steeper slopes check banks would be installed across the trenchline, approximately 50 metres apart, following closure of the trench. These would discharge runoff to areas of stable vegetation.

Activities	Mitigation
Vehicle and machinery operation. Hydrocarbon spills during refuelling of equipment are a risk during the construction, operation and decommissioning / recommissioning phases.	‣ Site storage areas would be identified, and be bunded to prevent loss of any pollutants. ‣ Hydrocarbon spill kits would be stored at the site. ‣ Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spill. ‣ Maintenance or re-fuelling of machinery would be carried out in hard-stand areas (ie. existing or proposed road surface or hard-stand areas beneath turbines, not on areas that either contain native vegetation, or would be revegetated). ‣ Where chemicals are utilised, their application and disposal would comply with manufacturers recommendations.
Rock breaker and gravel storage. Compaction would result from the rock-breaking equipment and stockpile sites. These would be temporary.	‣ Landforms would be stabilised and rehabilitated as soon as practicable after works.
Concrete batching plant operation. Concrete would be made onsite, to be used in the footings of the turbines and onsite buildings. Concrete wash can impact upon the chemical fertility of the soil.	‣ Concrete wash would be deposited in an excavated area, below the level of the topsoil.

5.3 Construction noise

5.3.1 Existing environment

The site proposed for the development is bounded by a highway to the south and agricultural land to the east, west and north. Several residences are located within one kilometre of the site (Figure 3.1). Existing background noise includes relatively constant noise from the highway, periodic use of agricultural machinery and local traffic.

According to the Environment Protection Authority's Noise Control Guideline for Construction Site Noise, L_{10} noise levels must not exceed the background level by more than 10 dB(A). This restriction applies to projects with a construction period of between 4 and 26 weeks; the construction period of the Cullerin wind farm is likely to fall within this range. The Guideline also states that variations should be made according to local conditions.

Depending on weather conditions, turbine installation can occur at a rate of 2-3 turbines per week, suggesting a two month installation period. Additional time is required beforehand (for civils construction, site preparation, preparation and pouring of footings etc) and after (for site rehabilitation). This total period could be in the order of 6 - 9 months, pending weather conditions and staging of works.

The EPA Guideline identifies noise-sensitive locations as residential premises, schools, hospitals, places of worship, parks and wilderness areas. Apart from the transport of machinery, which can be routed to avoid sensitive locations, the works would be not occur within close proximity of residential areas, schools etc. Several residences occur within one kilometre of the site and may be within audible distance of construction works. The EPA Guideline applies time restrictions for noise emissions; Monday to Friday - 7am to 6 pm, Saturday – 7 am to 1 pm if inaudible on residential premises, otherwise 8am to 1pm. These measures would be applied in relation to rock breaking and blasting works and other construction noise.

5.3.2 Potential impacts and mitigation measures

Two types of noise would be associated with the development; noise generated during construction and noise generated during operation of the wind farm. The latter will be addressed by way of a specialist report to model and assess the areas that would be impacted by operational noise (refer to *Section 4 Summary of moderate to high priority issues*, Table 4.1). The former is anticipated to be manageable with respect to impacts to the public and is discussed below.

Table 5.4 Potential impacts of construction noise with mitigation strategies

Activities	Mitigation
Noise generated by construction and installation of the wind farm. Potential sources of noise and vibration include drilling equipment, excavation and earthmoving machinery, concreting and rock crushing equipment and power tools. These activities would occur during a 3-6 month construction period.	• Works would comply with the Environment Protection Authority's construction noise criteria for working times and emission levels. • Machinery would use appropriate and effective exhaust mufflers and compressor silencers. • Noise complaints would be responded to rapidly using monitoring equipment. If EPA Guideline restrictions are being exceeded, appropriate noise reduction strategies would be employed, such as the re-orientation or re-positioning of machinery, re-scheduling of noisy activities, installation of temporary noise barriers, improved vehicle noise control, reduced work times and the use of 'quiet work practices' (such as reducing or relocating idling machinery).The need for, and the timing and location of the proposal would be well publicised and explained to improve community tolerance of noise emissions.
Noise generated by heavy vehicles enroute to the site. It is estimated that 160-240 large vehicle movements are expected to occur over a three month period (a maximum of 20 heavy or oversized vehicle movements in any one day).	• As above, and • A traffic management plan will be prepared with input from RTA and NSW Police.

5.4 Hydrology (water quality and water-table impacts)

5.4.1 Existing environment

The site is situated in the Lachlan catchment. The Lachlan River is the largest in the area. It is located approximately one kilometre north of the development site. Several tributaries of the Lachlan River come closer to the development (approximately 250m) however, construction would be focussed on ridges and therefore no water body would be directly impacted by the proposed development. Rivers and wetlands may be impacted indirectly through run-off. Measures would be implemented to control run-off.

Wetlands are marked as occurring approximately 2.5km to the east and 2km to the west of the main ridgeline proposed for development. Many of these are seasonal. The potential impact of the wind farm on birds, as well as other fauna, will be comprehensively investigated in a biodiversity survey.

5.4.2 Potential impacts and mitigation measures

Impacts to water quality would primarily relate to the transport of equipment and vehicles within close proximity to drainage lines and the generation of mobile sediment and potentially pollutants, during construction. Water table impacts are not anticipated.

In total, approximately three kilometres of new track would be installed. Minor upgrades to existing tracks may also occur. Increased compacted areas would increase the amount and turbidity of runoff, to a minor extent. While traversing these tracks, there is potential for the leakage of fuels or other hydrocarbons which could find their way in to drainage lines.

Dust, mobile sediment and vehicle emissions generated during transport, excavation and blasting works may also find their way into drainage lines. This could lead to elevated levels of sediment and turbidity in stormwater discharged and therefore reduce water quality. Where water pools, increased nutrients can rapidly reduce the oxygen content with toxic effects to aquatic environment and biota that inhabit them.

Additionally, there is a risk that construction materials such as alkaline concrete wash would be discharged from the construction sites. Chemicals are found in paints, acids for cleaning surfaces, cleaning solvents, concrete products, soil additives used for stabilisation and other purposes, concrete-curing compounds, fuels as well as other sources. When used or stored improperly, these chemicals can become mixed with stormwater and carried by sediment and runoff from construction sites. Eutrophication of surrounding waters could also occur from the use of fertiliser (during revegetation), and nutrient release from sediments as a result of erosion and release of turbid waters during construction.

The impacts of the proposal are considered manageable with regard to water quality. Specific activities that would be undertaken, and their potential environmental impacts are listed below. Mitigation strategies that would be employed to manage the potential for adverse environmental impacts are outlined in Table 5.5.

Table 5.5 Potential impacts to site hydrology with mitigation strategies

Activities	Mitigation
Generation of mobile sediment. Blasting, excavation and vehicular traffic may result in increased levels of sediment in nearby waterways.	‣ All vehicles onsite would follow established trails and minimise onsite movements ‣ All bridges used would be assessed prior to works to ensure that they are able to bear the projected loads of the laden vehicles. ‣ Sediment traps would be installed wherever there is potential for sediment to collect and enter waterways. ‣ Excavation would only be commenced during stable, dry weather conditions, operational requirements permitting. ‣ On the steeper slopes check banks would be installed across the trenchline, approximately 50 metres apart, following closure of the trench. These would discharge runoff to areas of stable vegetation. ‣ Stabilisation and rehabilitation of disturbed ground would be carried out as soon as practicable after works. ‣ Stockpile sites would be identified and turbid water discharged from these treated by a combination of silt fencing and temporary mulching/seeding.
Generation of pollutants. There is a risk that pollutants from vehicles and machinery (fuels and other hydrocarbons), concrete batching, rehabilitation works (fertilisers, herbicides) may be leaked and transported via runoff into nearby waterways.	‣ Site storage areas would be identified, and be bunded to prevent loss of any pollutants. ‣ Hydrocarbon spill kits would be stored at the site. ‣ Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spill. ‣ Maintenance or re-fuelling of machinery would be carried out in hard-stand areas (ie. existing or proposed road surface or hard-stand areas beneath

Activities	Mitigation
	turbines, not on areas that either contain native vegetation, or would be revegetated). ‣ Where chemicals are utilised, their application and disposal would comply with manufacturers recommendations.
Impacts to the water table.	‣ Not applicable.

5.5 Land use

5.5.1 Existing environment

The development occurs across four land titles. This land is used for agricultural grazing of sheep. Residential houses occur within 250m of the ridgeline where the development would be focussed (refer to Figure 3.1). Tourism to the area is also a consideration, particularly as the development has an impact on the visual landscape and is located within 300m of the Hume Highway, a major route between regional centres.

The zoning of the land is 1 (a) Rural Zone. The development is permissible under the Local Environmental Plan.

5.5.2 Potential impacts and mitigation measures

Impacts pertaining to land use fall under four headings: impacts to agricultural use, impacts to residential use, impacts to recreational use and impacts to land value. (Visual impact assessment, considering the range of values associated with the landscape, will be conducted to comprehensively address the visual impacts of the proposal).

5.5.2.1 Agricultural impacts

Impacts to agricultural use would be greatest during the construction and decommissioning/ recommissioning phases of the development. During these periods, stock would need to be excluded from the works area. Rehabilitation of the site would also require restricted stock access while vegetation is re-established on disturbed areas. This is considered to be a minor impact. Land owners are compensated for this loss by way of the lease arrangements they enter into with Taurus Energy.

Operational impacts are not anticipated to impact upon the agricultural use of the site. A ‘settling in period’ is likely to occur during which livestock become accustomed to the turbines (I. Newton, Wind Farm Manager, Eraring pers. comm. Jan 2005). Evidence to date published by *AusWEA* (the Australian wind energy association) and the British Wind Energy Association, drawn from rurally located wind farms in Europe, suggests that livestock become accustomed to the wind turbines after a short period. There is no evidence to suggest that this would be drawn out or adversely impact animal welfare or agricultural productivity.

No mitigation measures beyond the liaison with onsite landowners to restrict stock access to the construction zones during the period of construction and decommissioning / recommissioning is considered to be required.

5.5.2.2 Residential and recreational impacts

While the development would not preclude nearby residential or recreational land uses, the impacts of noise and visual impact require thorough investigation and where possible quantification. (Acoustic and visual assessment will be comprehensively investigated as part of the Environmental Assessment Report).

5.5.2.3 Tourism impacts

Tourist activities promoted in the area include historic buildings (Post Office, Town Hall, St Peter and St Paul's Catholic Cathedral, the Old Goulburn Brewery, Goulburn Rail Heritage Centre), museums, memorials and galleries (the Goulburn Steam Museum, Rocky Hill War Memorial, Goulburn Regional Art Gallery, Fibre Design Textile Gallery) and nature-based recreation (Wollondilly Walking Trail, Heritage Walking Tour, Bungonia State Recreation Area, Pejar Dam).

Attractions such as the Big Merino underscore the production based culture of the area and the civic pride in their pioneering past.

The number and type of visitors to the area is not anticipated to be impacted by the development of a wind farm on the Cullerin Range. The development is not incongruous with the production-based economy of the area and is not situated near nature-based recreation activities. The level of promotion that the development receives (for example, whether viewing platforms are installed for visitors) will depend on the response of the local community during the community consultation process, which will be implemented by Taurus Energy and nghenvironmental.

5.5.2.4 Land value impacts

Finally, the development may potentially affect the land values of the land in the immediate area where the development is sited as well as the locality. The reasons may be related to the visual or acoustic impact of the development, anticipated changes to compatible land uses and impacts to local infrastructure. Prediction and quantification of land value impacts is problematic. These associated impacts are often not supported by empirical evidence or local studies and can be largely a factor of public perception. Public perception of wind farms is variable, with wind farms seen as attractive or offensive, depending on the viewer (SRSC 2005).

Overseas studies have cited both increases and decreases in land value as a result of wind farm developments and the reasons for the change can be difficult to isolate. An AusWEA review found no adverse impact on land values. They cited a USA study of 10 wind farm developments which found that for the majority, wind farm developments performed better than comparable properties; in Esperance Western Australia one out of 15 properties examined reduced in value (cited as being due to other factors). To date, no conclusive evidence allows the conclusion that land values will be adversely impacted. Local anecdotal evidence suggests that the Crookwell I and Blayney wind farms in the Goulburn areas have had no bearing on land value (I. Newton, Wind Farm Manager, Eraring pers. comm. Jan 2005).

Due to the importance of this issue to the community, it will be investigated in more detail in the EAR.

5.6 Economic impact

5.6.1 Existing environment

Gunning is located approximately five kilometres west of the site and is the nearest town. Traditionally, Gunning’s economy is reliant on wool production, regarded as one of the major centres of fine wool in Australia. Goulburn, approximately 25km to the east, is the regional centre with a population in 2001 of 21,400 (over 75% of the regional population is located in Goulburn). The locality offers visitors an historic rural experience, featuring heritage buildings, country wares and a developing café culture in Goulburn and the smaller townships (SGS Economics and Planning Pty. Ltd. 2003).

The main employment sectors for Goulburn Mulwaree, considered to be indicative of Upper Lachlan, are shown in Figure 5.2. Agriculture, followed by retail trade, are the dominant employers in the region.

5.6.2 Potential impacts and mitigation measures

Wind farms are an economically viable means to generate electricity and whilst providing several potential environmental benefits, when compared to currently available alternatives. Potential for gains exist in the provision of local employment. Local people and contractors would be selected where they can demonstrate the capacity to undertake the works in an effective, efficient and price-competitive manner. Other economic benefits would result in the provision of services to workers; such as accommodation, food, fuel etc. Economic benefits will vary depending on final site design, turbine suppliers, timing of works, and other details. Taurus estimates that up to $10 million could be spent within the region as a results of the wind farm and over its life, broadly split with approximately $5 million during the construction phase and $5 million during the operation phase.

The project would be privately funded by Taurus Energy. There would be no ongoing financial expenses to the community or to the Upper Lachlan Shire Council. The development would be of direct economic benefit to landowners who enter into leasing arrangements with Taurus Energy. Wind farm development has not been shown to adversely impact property prices in New South Wales, as discussed above.

A feature of wind farm developments is that the distribution of benefits can be limited to a small number of landowners, while the impacts (particularly the ongoing visual impact and specific noise impacts) can have a much larger sphere of influence. The proponents are currently considering several options to provide additional benefits to the larger community. This would be a topic of the community consultation process.

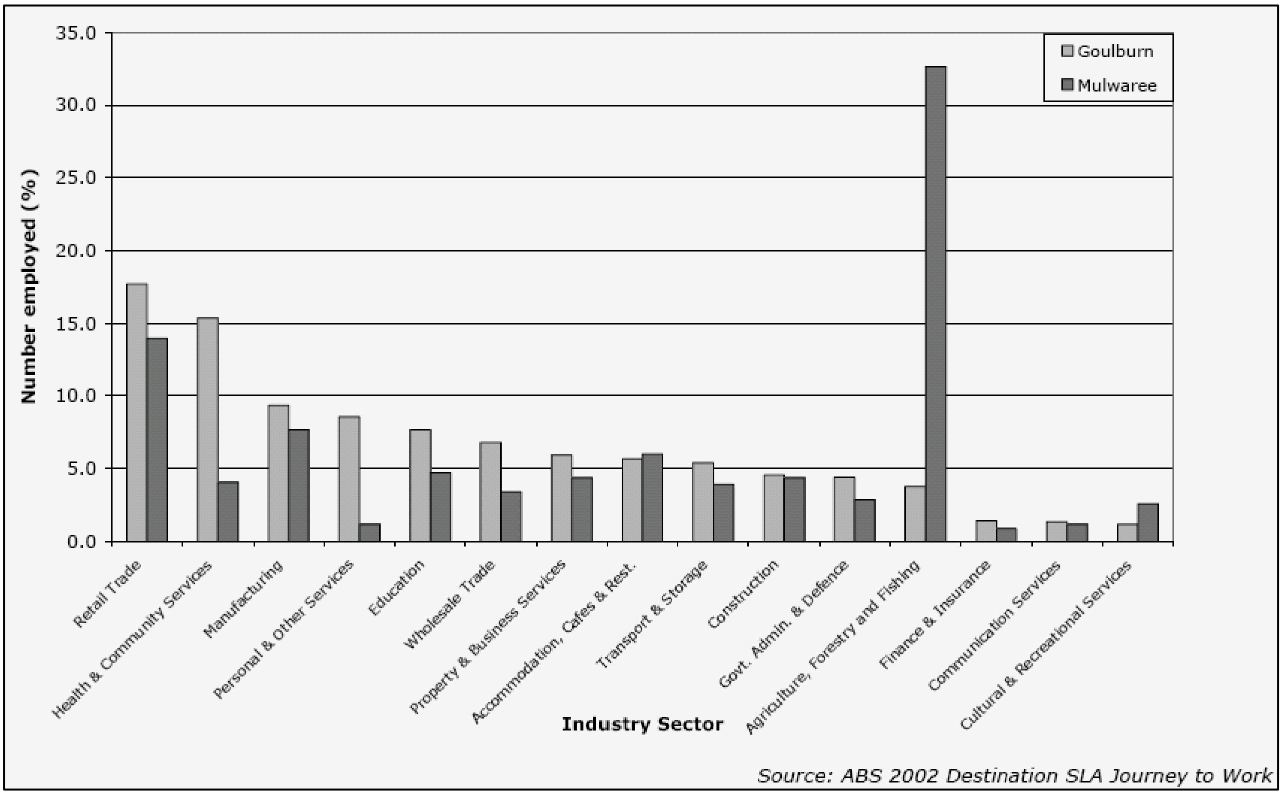

Figure 5.2 Employment break down for the Goulburn region

5.7 Safety

5.7.1 Existing environment

Workers would be required to install and maintain the proposed wind farm development. Construction works would take place over a 3-6 month period. Considering traffic flow to and from the site, 160-240 large vehicle movements are expected to occur over a three month period. Works would be spread over several locations, including individual turbines sites and sections of road works. Construction impacts at any one location would not be continuous.

5.7.2 Potential impacts and mitigation measures

Construction sites can create a public safety hazard and therefore, risks must be mitigated. During the construction and decommissioning / recommissioning phases, there is a risk to workers and to motorists, due to the construction works required and the large volume of heavy vehicles. Occupational Health and Safety procedures and traffic management investigations would be implemented to reduce these risks.

During the operational phase of the development, there is potential to generate health risks such as through exposure to noise, electromagnetic fields and shadow flicker. These impacts are considered to be manageable by implementation of mitigation strategies, discussed below.

Operational noise

Noise levels, particularly where they occur continuously and affect sleep patterns, can be harmful to humans and is cited by the World Health Organisation (WHO) as one of the most serious effects of environmental noise. WHO guidelines recommend that sound levels during sleep should not exceed 30 dB(A) for continuos background noise, and that individual noises events exceeding 45 dB(A) should be avoided (WHO 2004).

The noise levels generated by an operational wind farm are particular to the turbine design, local topography and weather conditions. This will be the subject of a specialist study which will model anticipated noise levels, based on existing background noise (obtained from noise loggers placed at several locations around the proposed site). Noise levels attenuate with distance. It is anticipated that turbine locations can be chosen that keep noise levels within acceptable levels at sensitive locations, such as residences. In accordance with the South Australian EPA Wind Farm Environmental Noise Guidelines, 2003, the limits at local residences are background noise plus 5dB(A) or 35dB(A), whichever is the higher limit. Construction noise is considered to be a lower priority issue and is discussed in Section 5.3.

Electromagnetic fields

Electromagnetic fields are generated by operating electrical equipment, such as transmission lines, substations, and the wind turbines themselves. Transmission lines and electrical devices generate 50/60 Hz electric and magnetic fields in their vicinity. They can have acute and chronic impacts. While electric fields can be reduced by shielding and with distance, magnetic fields can only be reduced with distance.

Acute impacts: The development would generate electromagnetic fields around electrical infrastructure. The transmission lines would generate greater EMFs than the wind turbines. Due to the location of lines and the amount of voltage both within and at either end of a transmission line, the electric and magnetic fields will be different. For example, an 33kV line may be ‘unbalanced’ in terms of load and located closer to the ground than a 132kV line and may therefore generate higher EMFs. High voltage lines can produce magnetic field exposure to those standing beneath them of up to 80 milligauss (mG) however, this is far less than the 1000mG limit recommended for 24 hour exposure (National Health and Medical Research Council Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields).

The ridgeline would not be accessed by the general public and only periodically by maintenance staff, hence opportunity for exposure to EMFs will be low. Onsite, underground cabling would be used where practicable; this reduces the amount of EMF. The turbines and substation would be located as far as practicable from residences.

Chronic impacts: NHMRC Interim guidelines evaluated the evidence to date on chronic exposure and stated that to date, chronic low-level exposure to 50/60 Hz fields has not been established to increase the risk of cancer (p.14, NHMRC 1989). However, as a precautionary measure, all EMR generating infrastructure will be sited as far as practicable from residences.

Shadow flicker

Shadow flicker is produced by the shadow cast by moving turbine blades when the sun is at a low angle (morning and evening). The flickering can cause a nuisance, or if between 8-30 Hz can be a health hazard (Epilepsy Association of Australia). The operational wind turbines are not anticipated to produce a flicker frequency high enough to pose a health risk. Comparable turbines have been rated 0.45 to 0.95 Hz, well below critical levels of 8-30 Hz for public health. The effect of ‘chopping the light’ attenuates with distance and is not considered, by modellers of shadow flicker (Danish Wind Energy Association) to be noticed beyond 500-1000m from a turbine.

If shadow flicker is found to be a nuisance to residents or motorists, conditions can be pre-programmed into the control system and individual wind turbines automatically shut down whenever these conditions are present. This issue will be discussed with the RTA as part of the traffic investigations in the Environmental Assessment Report.

Table 5.6 Potential impacts to public safety with mitigation strategies

Activities	Mitigation
Health impacts to workers and the general public during construction and decommissioning / recommissioning of the wind farm. Risk of injury during construction works. Risk of injury during transport of equipment to the site. Risk of injury to the public. Risk of injury to stock.	‣ Workplace health and safety protocols would be developed to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities. ‣ The safety of the workforce would be managed by strict safety procedures, good design of site tracks, and regular maintenance. If an incident occurs, communications to ambulance or medical services would be via phone or radio. ‣ Traffic management will be investigated within the Environmental Assessment report to ensure that roads and bridges are adequate to handle the loads required and to identify strategies to reduce the risk to other motorists during the construction and decommissioning phase. ‣ Site fencing would be installed where work staff consider that there is a risk to the safety of the general public (ie. when the trench is left open for extensive periods).
Health impacts to workers and the general public during the operation of the wind turbines. In emergencies the turbines must be able to be shut down. Trespasses and stock must be kept away from infrastructure.	‣ Start-up and shutdown (including safety shutdowns) are fully automated, with manual interruption available via onsite control systems and remote computer. ‣ The substation area would be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress.
Specific health issues that may be associated with the operation of the wind farm. Noise, electromagnetic fields and shadow flicker have all been suggested as posing risks to public health during the operational phase of the wind farm.	‣ Noise modelling and investigation of the operational wind farm will be undertaken as part of the Environmental Assessment Report to ensure that the noise levels are within State prescribed guidelines and do not pose a health risk during the operation and construction phases. ‣ Electromagnetic fields (EMF): *Acute impacts* The ridgeline would not be accessed by the general public and only periodically by maintenance staff, hence opportunity for exposure to EMFs will be low. Onsite, underground cabling would be used where practicable; this reduces the amount of EMF. The turbines and substation would be located as far as practicable from residences. The National Health and Medical Research Council (NHMRC) Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields will be adhered to (24 hour exposure: 1000mG, occupational exposure: 5000mG). *Chronic impacts* NHMRC Interim guidelines evaluated the evidence to date on chronic exposure and stated that to date, chronic low-level exposure to 50/60 Hz fields has not been established to increase the risk of cancer (p.14, NHMRC 1989). However, as a precautionary measure, all EMR generating infrastructure will be sited as far as practicable from residences. ‣ Shadow flicker:

Activities	Mitigation
	If shadow flicker is found to be a nuisance to residents or motorists, conditions can be pre-programmed into the control system and individual wind turbines automatically shut down whenever these conditions are present. This issue will be discussed with the RTA as part of the traffic investigations in the Environmental Assessment Report.

5.8 Removal of infrastructure

The lease agreements for the placement of the wind turbines are 20-30 years, with an option to extend; the turbines may be maintained or replaced during a potential recommissioning phase. Therefore, the date of turbine removal is uncertain.

The value of the wind turbines in scrap metal is considered by the proponent to be adequate to pay for their removal and site rehabilitation. To ensure that the site is rehabilitated adequately, the following prescriptions would be incorporated into the development:

- Wind turbines, substation, control building, and the associated above ground electricity infrastructure are to be removed and the site restored once the wind farm is decommissioned.
- Individual wind turbines not used to generate electricity for a continuous period of 12 months would be removed unless extenuating circumstances apply.
- Written evidence would be provided to the Director General, that the lease agreement(s) with the site landowners have adequate provisions to meet the decommissioning requirements, that the site be restored to a similar condition as existed before the development.

Due to the importance of this issue to the community, it will be investigated in more detail in the EAR.

6 PRELIMINARY STATEMENT OF COMMITMENTS

Under the Part 3A reforms, proponents are required to provide a Statement of Commitments on how they propose to manage the project to minimise and avoid impacts. In order to minimise and avoid potential environmental impacts arising from the identified low priority issues, Taurus Energy commits to implementing the following 42 environmental safeguards.

These safeguards are a summary outline; detailed mitigation and avoidance measures addressing all impact areas would be included in the EAR. Wherever possible, the commitments would be specific, related to particular work sites, quantified, timeframed and auditable. Detailed mitigation measures and work practices would be incorporated in a project Environmental Management Plan (EMP), and would draw on relevant material in the Department of Planning conditions database, the Guidelines for the Planning, Construction and Maintenance of Tracks (DLWC 1994), the Alpine Rehabilitation Manual (Parr-Smith and Polley 1998) and other guidelines and protocols as appropriate.

6.1 Outline of Statement of Commitments

In order to mitigate against the potential environmental impacts discussed in Section 5, Taurus Energy commit to implementing the following 42 environmental safeguards:

1. Landforms would be stabilised and rehabilitated as soon as practicable after works, following the rehabilitation guidelines, Section 3.5.
2. Turbine placement would avoid impacts to mature trees, where possible.
3. Works would comply with the Environment Protection Authority's construction noise criteria for working times and emission levels.
4. Machinery would use appropriate and effective exhaust mufflers and compressor silencers.
5. Noise complaints would be responded to rapidly using monitoring equipment. If EPA Guideline restrictions are being exceeded, appropriate noise reduction strategies would be employed, such as the re-orientation or re-positioning of machinery, re-scheduling of noisy activities, installation of temporary noise barriers, improved vehicle noise control, reduced work times and the use of 'quiet work practices' (such as reducing or relocating idling machinery).The need for, and the timing and location of the proposal would be well publicised and explained to improve community tolerance of noise emissions.
6. Nearby residences would be kept fully informed prior to any blasting that would be undertaken.
7. Excavation would only be commenced during stable, dry weather conditions, operational requirements permitting.
8. Subsoil would be separated from topsoil for rehabilitation purposes. All topsoil from the excavation sites would be stockpiled and replaced to its original depth for seeding and fertilising. On steep slopes, topsoil would need to be stabilised using, for example, jute matting. Any excess subsoil would be removed from the site and disposed of at an appropriate fill storage site (the potential to dispose of soil and rocks onsite will be considered after more detailed onsite investigations).
9. On the steeper slopes check banks would be installed across the trenchline, approximately 50 metres apart, following closure of the trench. These would discharge runoff to areas of stable vegetation.
10. Should dust generation be of a high level during the transport of machinery near residences, watering of sections of the route would be undertaken to reduce dust.
11. Vehicles and motorised equipment would be maintained so that emissions are minimised.

12. Tracks would be graded to enhance stability.
13. Routes would be confined to already disturbed areas, where possible and the number of vehicle movements would be minimised.
14. Site storage areas would be identified, and be bunded to prevent loss of any pollutants.
15. Hydrocarbon spill kits would be stored at the site.
16. Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spill.
17. Maintenance or re-fuelling of machinery would be carried out in hard-stand areas (ie. existing or proposed road surface or hard-stand areas beneath turbines, not on areas that either contain native vegetation, or would be revegetated).
18. Where chemicals are utilised, their application and disposal would comply with manufacturers recommendations.
19. The concrete batching plant, if required, would not be located near residences.
20. Concrete wash would be deposited in an excavated area, below the level of the topsoil.
21. Dust levels at stockpile sites would be visually monitored. Dust suppression (eg. water sprays) will be implemented if required.
22. Product stockpiles will be protected from prevailing weather conditions.
23. Loads of dry materials will be covered where appropriate.
24. Dust filters will be installed on silos.
25. Machinery and vehicles will not be left running or idling when not in use.
26. All bridges used would be assessed prior to works to ensure that they are able to bear the projected loads of the laden vehicles.
27. Sediment traps would be installed wherever there is potential for sediment to collect and enter waterways.
28. Stabilisation and rehabilitation of disturbed ground would be carried out as soon as practicable after works.
29. Stockpile sites would be identified and turbid water discharged from these treated by a combination of silt fencing and temporary mulching/seeding.
30. Workplace health and safety protocols would be developed to minimise the risk of fire for workers during construction and during maintenance in the control room and amenities.
31. The safety of the workforce would be managed by strict safety procedures, good design of site tracks, and regular maintenance. If an incident occurs, communications to ambulance or medical services would be via phone or radio.
32. Traffic management will be investigated within the Environmental Assessment report to ensure that roads and bridges are adequate to handle the loads required and to identify strategies to reduce the risk to other motorists during the construction and decommissioning phase.
33. Site fencing would be installed where work staff consider that there is a risk to the safety of the general public (ie. when the trench is left open for extensive periods).
34. Start-up and shutdown (including safety shutdowns) are fully automated, with manual interruption available via onsite control systems and remote computer.
35. The substation area would be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress.

36. Onsite, underground cabling would be used where practicable; this reduces the amount of EMR.
37. The turbines and substation would be located as far as practicable from residences.
38. All EMR generating infrastructure will be sited as far as practicable from residences.
39. If shadow flicker is found to be a nuisance to residents or motorists, conditions can be pre-programmed into the control system and individual wind turbines automatically shut down whenever these conditions are present
40. Wind turbines, substation, control building, and the associated above ground electricity infrastructure are to be removed and the site restored once the wind farm is decommissioned.
41. Individual wind turbines not used to generate electricity for a continuous period of 12 months would be removed unless extenuating circumstances apply.
42. Written evidence would be provided to the Director General, that the lease agreement(s) with the site landowners have adequate provisions to meet the decommissioning requirements, that the site be restored to a similar condition as existed before the development.

6.2 Implementation of environmental mitigation measures

After identification and investigation of all issues considered to have potential to generate environmental impacts (in the **Environmental Assessment** Report), a more comprehensive Statement of Commitments would be developed. This would be an outcome orientated table detailing:

- The environmental objectives for each environmental component (ie. air, soil, water, biodiversity, social components etc.)
- Measurable tasks that would be undertaken to meet each objective
- Who would complete each task and how it would be completed
- The timing of the task, and
- Any auditing or environmental management plan related to the objective.

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8 AUTHORS

Authors	**Experience**
Nicholas Graham-Higgs Bachelor of Applied Science	Nick has worked as an environmental planning consultant since 1992, specialising in environmental impact assessment and natural resource management. His work demands an in-depth knowledge of current planning and environmental legislation coupled with a comprehensive understanding of development-related impacts, especially those relating to the provision of recreational facilities. Nicholas has acquired his knowledge in this field over the last 17 years, during which he has worked with a number of land management organisations within and outside Australia. Much of the work undertaken has been within sensitive areas, including major works for infrastructure development; the augmentation of water supplies at Perisher Range and Adaminaby, environmental assessment for a wind farm on the Snowy Plains, near Kosciuszko National Park.
Brooke Marshall Bachelor of Natural Resources (Hons)	Since joining **ngh**environmental, Brooke has prepared impact assessment reports relating to road construction, water pipeline installation, river modification and prescribed burning activities. These reports have included threatened floral and faunal species assessments requiring research, fieldwork and GIS components. She has also prepared REFs and EMPs for alpine areas. Recent projects involve wind farm environmental impact assessment and natural values strategic assessment, both projects were in the Snowy River Shire. Brooke is currently focusing on environmental impact assessment, biodiversity assessments and wildlife management issues. Brooke has carried out comprehensive faunal surveys on the south coast including at Moruya, Moruya Heads, Boydtown, Eden and Pambula. She has experience with cage and Elliot traps, hair tubes, spotlighting, scat and sign searches and bird / reptile / amphibian transects, anabat recording and has assisted harp trapping of microchiropteran bats. Brooke has designed surveys to locate den trees and monitor the utility of habitat for a fragmented population of Yellow-bellied Gliders. The latter work was carried out in collaboration with DEC Parks and Wildlife, Merimbula and the results were compiled in a report which recommended management actions to improve the viability of this population.
Andrew Durran Bachelor of Engineering (Elec), Masters of Business Administration (Technology Management)	Research and report writing, Section 3. An electrical engineer specialising in development of renewable energy projects. Director for Taurus Energy in relation to Cullerin Wind Farm.

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