8 ASSESSMENT OF ADDITIONAL ISSUES

Beyond the key issues identified by the Department of Planning in the Director General's Requirements, additional areas of impact were identified using a risk analysis model. This model considers the nature of the potential impact (i.e., is it temporary, reversible, likelihood of secondary impacts), the receiving environment and the likelihood of the impact occurring.

Table 8-1 Risk analysis of remaining issues

The risk rating ranges from 1 to 5: *1 = low anticipated impact / sensitivity / likelihood of occurrence*

5 = high anticipated impact / sensitivity / likelihood of occurrence

DISCUSSED IN THIS SECTION:	IMPACT AREA	NATURE OF IMPACT	SENSITIVITY OF RECEIVING ENVIRONMENT	LIKELIHOOD OF OCCURRENCE	RISK RATING
8.1	Hydrology	4	4	3	48
8.2	Soils and Landforms	4	3	3	36
8.3	Mineral Exploration	2	2	2	8
8.4	Land Values	4	3	2	24
8.5	Economic[29]	3	3	5	45
8.6	Community Wellbeing	3	3	2	18
8.7	Lifestyle	2	4	2	16
8.8	Tourism	2	3	3	18
8.9	Agricultural	1	1	4	4
8.10	Health and Safety	5	2	2	20
8.11	Historic heritage	2	1	1	2
8.12	Climate and Air Quality	2	2	2	8
8.13	Resource	2	2	5	20
8.14	Cumulative	3	3	4	36

[29] Economic Impacts as a result of the proposal are considered a positive impact.

8.1 HYDROLOGY (WATER, WATER QUALITY AND WATER-TABLE IMPACTS)

8.1.1 Existing environment

Surface water

Coppabella Hills and Marilba Hills Precincts are located within close proximity of one another, in terms of catchment hydrology, and are combined in this discussion. They both occur within the mid Murrumbidgee Catchment north of the Murrumbidgee River, which is the largest river in the vicinity of the two Precincts. The Murrumbidgee River catchment is a major component of the Murray-Darling Basin, joining the Murray River at Balranald, with an area of 84,000 square kilometres. The Murrumbidgee catchment has a diverse range of landscapes, and significant agricultural, social and conservation values. As discussed in Wasson *et al.* (1998), erosion and sedimentation in the catchment are primarily generated from channels and stream bank erosion rather than erosion from unchannelled hillslopes. The study concluded that post 1830, only about 5% of the total sediment in the study area had been derived by unchannelled slopes; the remainder had come from channel incision and bank erosion. Further, the results indicated that to control the downstream effects of erosion, conservation efforts should be focussed on gullies and channel banks, Wasson *et al.* (1998). It should be noted that although the study site was not located in the vicinity of the three Precincts it was located on the Southern Tablelands and Wasson *et al.* (1998) state the results of the study are applicable to the wider area.

Coppabella Hills and Marilba Hills Precincts are located within the Jugiong Creek and Illalong Creek sub catchments of the mid Murrumbidgee catchment. The major creek within these catchments is Jugiong Creek. There are a number of small creeks that flow into Jugiong Creek which is the primary exit point for water in these sub-catchments to flow into the Murrumbidgee River. The Murrumbidgee flows in a general east to west direction.

Jugiong Creek, a tributary of the Murrumbidgee River is located approximately 1.8 kilometres to the north of the closet portion of the Coppabella Hills Precinct. Coppabella Hills Creek is located to the south of the Coppabella Hills Precinct adjacent to Whitefields Road. Stony Creek, a small tributary of Jugiong Creek, runs in a general north – south direction within the Coppabella Hills Precinct.

Illalong Creek is located approximately 690 metres to the north of the closet portion of the Marilba Hills Precinct. Conroys Creek is located within the Marilba Hills Precinct which flows into the Bogolong Creek.

There are a number of creeks located within the Coppabella and Marilba precincts. Only higher order creeks would be permanent however, for the purposes of this assessment, it has been assumed that water would flow in all creeks and unnamed drainage lines during certain hydrologic conditions. These creeks that were identified using topographic maps are presented in Table 8-2: below.

Table 8-2: Creeks located within the Coppabella and Marilba Hills precincts with the potential to be impacted

Creek name	Precinct	Potential impact
Coppabella Creek	Coppabella Hills	Access tracks
Jugiong Creek	Coppabella and Marilba Hills	Transmission easement
Balgalal Creek	Coppabella Hills	Transmission easement
Stony Creek	Coppabella and Marilba Hills	Access tracks and transmission easement
Bushrangers Creek	Coppabella Hills	Access tracks and transmission easement
Bald Hill Creek	Coppabella Hills	Access tracks
Deep Stony Watercourse	Coppabella Hills	Access tracks
Two Mile Creek	Coppabella Hills	Transmission easement
Blind Creek	Marilba Hills	Access tracks and transmission easement
Conroys Creek	Marilba Hills	Transmission easement
Garry Creek	Marilba Hills	Access tracks
McCullums Creek	Marilba Hills	Access tracks and transmission easement
Woolgarlo Creek	Marilba Hills	Transmission easement
Burnt Hut Creek	Marilba Hills	Transmission easement
Dunderaligo Creek	Marilba Hills	Transmission easement
Back Creek	Marilba Hills	Transmission easement

There are also a number of unnamed drainage lines that traverse the landscape of the Coppabella and Marilba Hills precincts with the potential to be impacted by the proposal.

An existing causeway across Jugiong Creek may need to be traversed by large and oversized vehicles, if this route is included in the preferred haulage route. Increased traffic during construction would occur, even if this is not selected in the haulage route, as contractors access and leave the site during construction and operation.

The local drainage system within these precincts is defined as “waters’ in accordance with Section 120 of the POEO Act.

Water supply

Yass (2007) identified that the Yass Dam has a capacity of 850ML and services Yass, Bowning and Binalong. Yass (2007) indicates pressures on water supplies within the LGA due to a combination of population growth and drought. As detailed in Section 8.12.1, rainfall for the general area has been below average for six of the last seven years, confirming drought conditions.

Liaison with Yass Valley Council indicated that generally, water supplied from the Yass Dam was directed to Yass and surrounding villages, however, an upgrade to this dam is expected to be completed prior to construction of this project and remains an option for consideration. At the time of writing the Yass LGA was under level one, permanent water restrictions. Residents living outside of the villages rely on their own supplies; supply is likely to include rainwater tanks, onsite dams and groundwater extraction bores. It is considered that residents living outside of the villages have critical water supply issues in this current drought.

Water in the Harden LGA is primarily sourced from the Murrumbidgee River and is managed by the Golden Fields County Council. A pipeline runs from the village of Jugiong to Harden. Initial consultation with representatives from the Golden Fields County Council indicated that the pipeline could offer a potential source of water for the proposal. The potential for Golden Fields County Council to supply water to the proposal would depend on a range of factors including recent climatic conditions prior to the request for water the total amount of water required for the proposal and the duration of water supply required. Should the Proponent wish to investigate the potential for using this water as a source of water for the proposal consultation and negotiations with Golden fields County Council would be required.

Liaison with Harden Shire Council indicated that residents had in the past been able to connect to this water supply pipe. It is understood that residents who live on properties outside of the near vicinity of the pipe are likely to be on their own supply similar to residents outside Yass and surrounding villages.

There are no statements of joint intent issued by the healthy rivers commission in the Murrumbidgee catchment area.

Groundwater

A number of registered groundwater bores are located within the general area of each precinct.

As discussed above, it is likely that residents within the local vicinity of the development area are likely to have their own supply of water for both domestic and agricultural use. It is likely that a number of properties extract water from groundwater bores.

Yass (2007) describes that most groundwater within the Yass LGA is suitable for domestic, agricultural and limited industrial uses. Further, increased development in rural areas may impact the quantity and quality of groundwater to existing users and the environment, Yass (2007). In 2004, an embargo was placed on new groundwater extraction licenses due to concerns that groundwater in the Yass catchment was unsustainable.

The Department of Water and Energy indicated that the vast majority of groundwater registered bores located in the area, both within the Yass Valley and Harden LGAs would be extraction bores for irrigation purposes (pers. comm. M. Mitchell, DWE 17 Dec 2008).

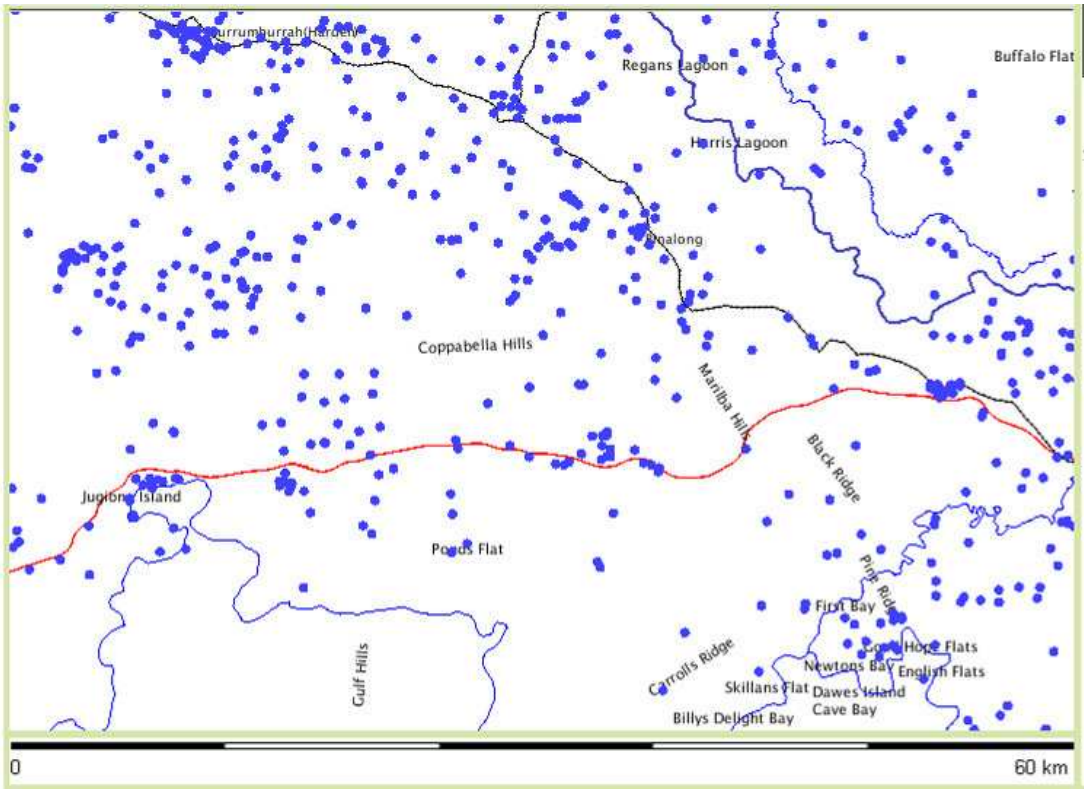


Figure 8-1: Groundwater bores located within the general vicinity of the precincts (DECC 2008)

8.1.2 Impact assessment - construction and decommissioning

It is considered that the volume of water required for Proposal would be similar across all three precincts. The following estimates of the volume of water required are based on daily usage rates expected during the construction period of the proposed wind farm. Please note these estimates have been based on the construction of all 182 proposed turbines over a construction period of 24 months.

Table 8-3: Estimated water usage required for the Proposal

Activity	Estimated volume (litres)	Expected duration	Expected total for construction (mega litres)
Site facilities	10,000 (per week)	Entire construction phase	1.04
Turbine footings	50,000 (per footing)	182 turbines	9.1
Water Cart (dust suppression)	60,000	One water cart running each day of construction, two water carts per turbine footing.	9.3

Surface water

Water bodies located within close proximity of the precincts are likely to be sensitive to input from pollutants, including sediment, hydrocarbons and nutrients. Excavation, soil stockpiling and haulage form the primary risks with regard to protecting the water quality in the catchment from sediment input. The transport of chemicals, the requirement to batch concrete and use hydrocarbons onsite (in vehicle

refuelling as well as in machinery such as the substation and nacelles), represents a spill risk, as detailed below.

Excavation activities, including road construction and track upgrades and the excavation of footings for turbines, crane pads, control buildings and substation, as well as soil stockpiling would be located away from natural drainage features where possible. However a number of Creek and drainage line crossings would be required to be constructed. Table 8-2 identifies Creeks within the development envelope that have the potential to be impacted by the construction of access tracks and transmission easements. There is also the potential for impact indirectly by sediment or pollutant laden run-off during large rainfall events to affect local drainage lines. As detailed in Section 8.2, there will large amount of earthworks including stockpiling associated with the Proposal. It is considered that stockpiles and other areas undergoing earthworks have the potential to generate sediment laden run off during periods of rain fall. Dust and soil sediments may be transported off site as run-off as a result of heavy vehicles using access tracks during construction.

There is potential for construction materials, such as alkaline concrete wash and hydrocarbons to be discharged from construction sites and during transport. Chemicals are found in concrete products, soil additives used for stabilisation and other purposes, concrete-curing compounds, fuels and building material wastes. When used or stored improperly, these chemicals can become mixed with stormwater and carried by sediment and runoff from construction sites. Staff amenities would also be required onsite, producing biological waste[30].

The input of any of these substances can cause eutrophication of surrounding waters, affecting water quality required for stock and domestic use, and lead to the degradation of aquatic habitats and the environmental services associated with them, such as water filtration, aeration) could also occur from the use of fertiliser (during site remediation), and nutrient release from sediments as a result of erosion and release of turbid waters during construction.

Water courses that have potential to be impacted at Coppabella Hills and Marilba Hills are lower order streams. The construction and maintenance of proposed creek crossings has the potential to impact on water quality and hydrologic regimes.

While works adjacent to and within creeks pose a serious risk to local water ways without controls, impacts are manageable, through the design, implementation and monitoring of specific controls during the construction phase and associated site remediation. The development footprint of the Proposal (the sum of all areas to be directly affected by tracks, footings or stockpile and compound sites) has been calculated as:

Coppabella Hills:	1.47 % of the site	((116.22 ha / 7907 ha) x 100)
Marilba Hills:	3.60 % of the site	((149.17 ha / 4140.0 ha) x 100)

The small percentage of direct impact, the buffer distances able to be achieved around drainage lines and the high degree of manageability, suggest that impacts to water quality would be able to be managed effectively. Potential impacts would be managed through the preparation and adoption of a Sediment Erosion and Control Plan. This plan would identify details and design specifications of sediment and

[30] At this stage it is difficult to identify the exact quantity of chemicals that would be required during the construction phase. This information would become evident prior to the construction phase. The Proponent commits to identifying all chemicals (including quantities and physio-chemical properties) required for construction activities and preparing an appropriate management plan to manage these chemicals. The appropriate vehicle for this is considered to be the Construction Environmental Management Plan.

erosion controls and would be prepared in general accordance with *Managing Urban Stormwater – 'Soils and Construction'* guidance document.

Groundwater

The Proposal area is currently under a groundwater embargo that would restrict the extraction of groundwater for construction purposes. Thus, should the Proponent propose to extract groundwater for use during construction or decommissioning, they would have to purchase this water off an already licensed user. Additionally, should an agreement be reached with a licensed user the Proponent would likely compensate the user such that this impact would unlikely be significant.

There is also the potential for groundwater dependant ecosystems (GDEs) to be impacted during the construction phase of the Proposal. Draft information obtained from the Department of Water and Energy identified three main types of GDEs within the Murrumbidgee catchment, Karst, Wetlands and Springs. Results of the draft study identified the presence of two GDEs, Karsts, at Talmo and Taemas. Both these locations are outside of the development envelope but within the vicinity of the Proposal. `These are presented in Figure 8-2 below.

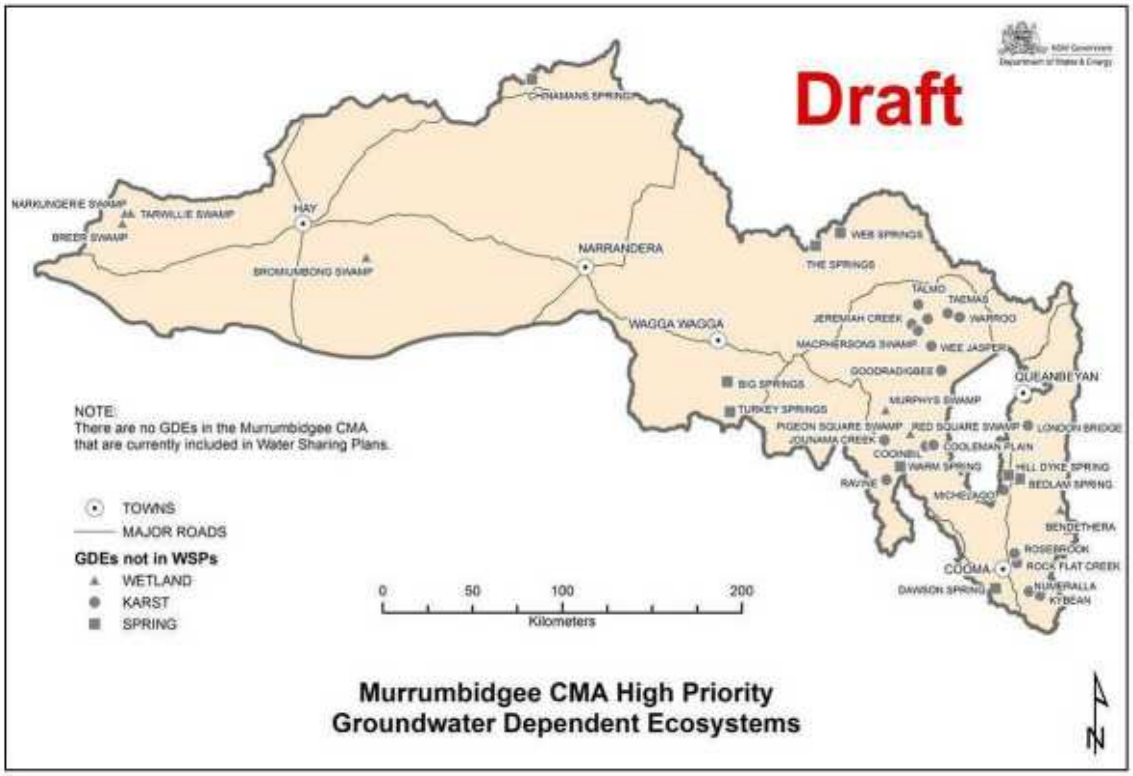


Figure 8-2: GDE's within the Murrumbidgee CMA, (data sourced from DWE)

Should groundwater extraction be required, appropriate approvals would be sought from the Department of Water and Energy prior to the extraction of groundwater. Additionally, studies would be undertaken by an appropriately qualified geotechnical engineer to ensure that unacceptable impacts to groundwater are avoided.

Blasting may be required, to anchor turbines (this will be determined by detailed geotechnical investigations, prior to construction). Should controlled blasting be required, it would be carried out in

accordance with all relevant statutory requirements. The Proponent would investigate the potential to affect groundwater prior to blasting works being undertaken.

Water supply

The total amount of water required to develop the Coppabella Hills and Marilba Hills Precincts is estimated to be around 16.23 Mega litres. The majority of this water is required in concrete batching to provide footings for turbines, control buildings and substations. Water will also be required onsite for dust suppression and in case of fire.

There are a number of options being considered for sourcing water for the construction phase of the project. Surface water could be supplied from either Jugiong creek or Lake Burrinjuck, however, test results may be required to determine the suitability of the water for construction purposes. In both cases a temporary allocation would need to be purchased from an existing license holder. Direct access to the water supply would also need to be arranged, which would involve necessary occupancy agreements through state water or a landowner and work approvals through the Department of Water and Energy.

Groundwater is another option available through the use of ground bores. As the site area currently has an embargo on ground water an allocation would need to be purchased. As the project is considered a Major Project under Part 3A of the NSW Environmental Planning and Assessment Act 1979, a ground bore could be drilled should a suitable location be found.

The Goldenfields Water County Council (GWCC) maintains a pipeline that supplies water from Jugiong to Harden. Initial contact with GWCC revealed that while this is not the general practice it has not been ruled out as an option. The pipeline runs approximately 10 kilometres west of the Coppabella Hills Precinct. A purchase and allocation agreement would be negotiated between the Proponent and GWCC.

The Yass Dam is expected have an upgrade completed by the anticipated time of construction. The Proponent will liaise with council closer to the construction phase to determine if this is still an option for sourcing water.

Water would be reused where possible to reduce the total amount required. No waste-water would be discharged into creeks or drainage lines. No sewerage or septic would be installed for the construction phase; portaloos would be available to construction staff during this phase. Water used for dust suppression, would be controlled such that the smallest volume possible is administered to minimise water requirements and the potential for run off.

8.1.3 Impact assessment - operation

Water tanks may be installed to collect rain water from the control building, in order to supply water for maintenance staff facilities. No additional water connections are anticipated. A septic system may be installed in the control building. These would meet Council (Yass or Harden, as appropriate) standards.

The operation of the wind farm would require minimal traffic on roads/tracks, which would have been upgraded to accommodate heavy loads during the construction phase. The increase in compacted areas as a result of the track upgrades may potentially increase the amount and turbidity of runoff around these tracks. All access tracks would be maintained in accordance with the OEMP, including appropriate permanent sediment and erosion controls.

Infrastructure including the substation and turbines would be designed to prevent any leakage of fuels or lubricants, even in high rain fall events (eg Stormceptor type system).

The NSW DECC provides NSW water quality objectives (WQO) and river flow objectives (RVO) for surface waters within NSW. The NSW water quality objectives *are the agreed environmental values and long-term goals for the NSW's surface waters* (DECC 2009). These goals identify:

- The community's values and uses for our rivers, creeks, estuaries and lakes (i.e. healthy aquatic life, water suitable for recreational activities like swimming and boating, and drinking water); and
- A range of water quality indicators to help us assess whether the current condition of our waterways supports those values and uses (DECC 2009)

The River Flow Objectives:

> *are the agreed high-level goals for surface water flow management. They identify the key elements of the flow regime that protect river health and water quality for ecosystems and human uses* (DECC 2009).

The Proposal area for both precincts is located within the Murrumbidgee River and Lake George catchment. The Proposal has the potential to impact the Murrumbidgee River, classed as a major regulated river, Burrinjuck Dam, classed as a major storage and a number of uncontrolled streams, including Jugiong and Illalong creeks.

River quality and objectives for the Murrumbidgee and Lake Catchment are presented in Table 8-4 below. Water quality objectives are presented in Table 8-5Table 8-4.

Table 8-4: River quality objectives for Murrumbidgee and Lake George Catchments

Environmental value	River quality objectives	Water body	Classification
Protect pools in dry times	Protect natural water levels in pools of creeks and rivers and wetlands during periods of no flows	Jugiong and Illalong creeks	Uncontrolled stream
Protect natural low flows	Protect natural low flows	Jugiong and Illalong creeks	Uncontrolled stream
Minimise the effect of weirs and other structures	Minimise the impact of instream structures	Jugiong and Illalong creeks	Uncontrolled stream
Protect important rises in water levels	Protect or restore a proportion of moderate flows ('freshes') and high flows	Jugiong and Illalong creeks	Uncontrolled stream
Maintain wetland and floodplain inundation	Maintain or restore the natural inundation patterns and distribution of floodwaters supporting natural wetland and floodplain ecosystems	Burrinjuck Dam	Major water storage
Mimic natural drying in temporary waterways	Mimic the natural frequency, duration and seasonal nature of drying periods in naturally temporary waterways	Burrinjuck Dam	Major water storage

Environmental value	River quality objectives	Water body	Classification
Manage groundwater for ecosystems	Maintain groundwater within natural levels and variability, critical to surface flows and ecosystems	Burrinjuck Dam	Major water storage
Maintain natural flow variability	Maintain or mimic natural flow variability in all streams	Jugiong and Illalong creeks	Uncontrolled stream

Table 8-5: Water quality objectives for Murrumbidgee and Lake George Catchments

Environmental value	Water quality objectives	Water body	Classification
Aquatic Ecosystems	Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Visual amenity	Aesthetic qualities of waters	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Secondary contact regulation	Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Primary contact regulation	Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Livestock water quality	Protecting water quality to maximise the production of healthy livestock	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Irrigation water supply	Protecting the quality of waters applied to crops and pasture	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Homestead water supply	Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream
Drinking water-groundwater	Refers to the quality of drinking water drawn from	Murrumbidgee River	Major regulated river

Environmental value	Water quality objectives	Water body	Classification
	the raw surface and groundwater sources before any treatment	Jugiong and Illalong creeks	Uncontrolled stream
Aquatic foods	Refers to protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.	Murrumbidgee River Jugiong and Illalong creeks	Major regulated river Uncontrolled stream

Water quality objectives detailed above are *not intended to be applied directly as regulatory criteria* (DEC 2006). However it is considered prudent that the Proposal consider these objectives when defining measures for the mitigation of potential impacts associated with the Proposal.

The guiding principle of the development with regards to water quality is to have a neutral or beneficial impact. The objectives presented in the tables above describe protection, maintaining or improving water quality within the catchment. The mitigation measures outlined in Section 8.1.4 have been prepared so as to achieve the "neutral or beneficial impact'. It is considered that these mitigation measures are consistent with the WQOs and RVOs.

8.1.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
42	Deterioration of water quality (Surface Water)	Minimise risk	Infrastructure placement, including turbines, tracks, substations, control buildings, stockpiles, and site compounds and turnaround areas, would not be sited within 40 metres of a major drainage line or water course	Detailed design	CEMP	x	x
43	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	The Proponent would prepare a Sediment / Erosion Control Plan (SECP) as a sub plan of the Construction Environmental Management Plan. This plan would include the following provisions: • Sediment traps would be installed wherever there is potential for sediment to collect and enter waterways • Stockpiles generated as a result of construction activities would be bunded with silt fencing, (mulch bunds or similar) to reduce the potential for runoff from these areas • On the steeper slopes check banks would be installed across the trenchline, as appropriate, following closure of the trench. These would discharge runoff to areas of stable vegetation • Stabilisation and site remediation would be undertaken as soon as practicable throughout and post construction. • Soil and water management practices would be developed as set out in Soils and Construction Vol. 1 (Landcom 2004)	Construction	CEMP	x	x
44	Deterioration of water quality (Surface Water)	Minimise risk	Design water crossings to minimise impact on existing banks, water flow and animal passage.	Construction	CEMP	x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
45	Water supply	Minimise risk	Undertake liaison with representatives of Golden Fields County Council regarding the potential supply of construction water	Construction	CEMP	X	X
46	Deterioration of water quality (Surface Water)	Minimise risk	All vehicles onsite would follow established trails and minimise onsite movements	Construction Operation	CEMP OEMP	X	X
47	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spills	Construction Operation	CEMP OEMP	X	X
48	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintenance or re-fuelling of machinery would be carried out on hard-stand in accordance with industry standards for fuel transfer	Construction	CEMP	X	X
49	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Design of concrete batch plants would ensure concrete wash would not be subjected to uncontrolled release. Areas of the batching would be bunded to contain peak rainfall events and remediated after the completion of the construction phase. Waste sludge would be recovered from the settling pond and used in the production of road base manufactured onsite. The waste material would be taken from the batching plant to be blended in the road base elsewhere onsite.	Construction	CEMP	X	X
50	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Carry out dust suppression as required through either watering or chemical means (environmentally friendly polymer based additives to water).	Construction Decommissioning	CEMP	X	X
51	Deterioration of water quality	Achieve neutral or	A Site Restoration Plan (SRP) would be prepared as part of the Construction Environmental Management Plan. This would set out	Construction	CEMP	X	X

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
	(Surface Water)	beneficial water quality impact	protocols for restoration works including: • Site preparation • Stabilisation • Revegetation • Monitoring	Decommissioning			
52	Deterioration of water quality (Surface and Ground Water)	Minimise risk	A Spill Response Plan would be prepared as part of the CEMP and OEMP including: • Identify persons responsible for implementing the plan if a spill of a dangerous or hazardous chemical/waste would occur • Identify all chemicals required for the Proposal, including physio-chemical properties, risks posed to water quality objectives and appropriate methods of storage of these chemicals. • Locate Material Safety Data Sheets (MSDS) for all chemical inventories at on site and readily available • Comply with manufacturers recommendations in relation to application and disposal where chemicals are used • Report any spill that occurs to the Construction Manager regardless of the size of the spill • Establish clearly defined works and refuelling areas • Spill protocols in this plan would dictate when the EPA would be notified • Chemical / fuel storage areas would be identified, and be bunded to prevent loss of any pollutants • Hydrocarbon spill kits would be stored at the site. A	Construction Operation Decommissioning	CEMP OEMP	X	X

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
			number of site staff are to be trained in the use of the spill kits				
53	Deterioration of water quality (Surface and Ground Water)	Minimise Risk	The Proponent would notify the NSW DECC EPA in the event of any spill that had the potential to pollute waters.	Construction Operation	CEMP OEMP	X	X
54	Protection of ground water	Minimise risk	Undertake investigations, as part of the geotechnical investigation, to ensure that the project would have no material adverse effect on groundwater/aquifers as a result of blasting activities.	Pre-construction	CEMP	X	X
55	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Monitor bunded infrastructure to ensure that volume of oil could be fully contained in the event of leak	Operation	OEMP	X	X
56	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintain septic systems, if installed, to meet appropriate Australian standards	Construction Operation Decommissioning	CEMP OEMP	X	X

8.2 SOILS AND LANDFORMS

8.2.1 Existing environment

The State of Environment Report for the Yass Valley Shire (2006-2007), has identified that soil erosion is a serious environmental issue throughout the LGA. The SoE identifies that erosion has occurred across the Yass Valley as a result of clearing for agriculture, poor land management practices, overstocking and flooding events.

The Harden SoE (2004) identified that surveys indicated about 420 kilometres of gully erosion and about 50 kilometres of streambank erosion were present in the shire, as well as extensive areas of severe to minor sheet erosion.

Soils landscapes vary across each Precinct of the Proposal. Soil landscapes of the Coppabella Hills and Marilba Hills Precincts have been described in Hird (1991) which identified that soils within the three Precincts have erosion potentials including high to extreme. A brief description of the landscape at each Precinct is presented below.

A search of the contaminated land record, managed by the NSW DECC (DECC 2009a) identified one site within the Yass Valley LGA and one site within the Harden LGA of known contamination. The first site is a service station located within the township of Yass and the second site is a railway site within the township of Harden. There are no records on the public register of known contamination within or nearby any of the three precincts. It is understood that land use history within the precincts is a mixture of farming (grazing). Farming operations have the potential to contaminate land through activities such as sheep and cattle dips and diesel refuelling. Due to the historical land use of the precincts (farming) and the close involvement of the landowners in the development of the sites, the potential for contamination to be present and disturbed by construction activities is considered to be low.

Coppabella Hills Precinct

The landscape within the Coppabella Hills Precinct is generally steep with granite rock outcrops. As described in Table 8-6, Oak Creek, Cockatoo, Binalong and Canowindra soil landscapes occur within the development envelope. With the exception of Canowindra, soils across the Coppabella Hills Precinct have erosion potentials ranging from high to extreme. Gullying on the slopes and foothills of the Precinct is clearly evident, Figure 8-3.

Erosion gully in the foothills of the Coppabella Hills Precinct

Erosion on side slope within Coppabella Hills Precinct

Figure 8-3: Examples of erosion within Coppabella Hills Precinct

Marilba Hills Precinct

The landscape within this Precinct is moderately steep with less rock outcropping than the Coppabella Hills Precinct. As described in Table 8-6, Oak Creek, Cockatoo, Barrenjack, Conroys Creek, Binalong and Canowindra soil landscapes occur within the development envelope. With the exception of Canowindra, soils across the Coppabella Hills Precinct have erosion potentials ranging from high to extreme.

Gullying is less evident, although slumping is occurring in some areas; a consequence of tree clearing causing excessive water to permeate between the soil horizons. This is being addressed on some properties by planting timber belts to intercept ground water.

Sparsely vegetated landscape of Marilba Hills

Marilba Hills

Figure 8-4: Examples of erosion within Marilba Hills Precinct

A brief description of the applicable soil landscapes is presented in Table 8-6 below.

Table 8-6: Soil landscapes of the Proposal area. All information obtained from (Hird 1991).

Soil landscape	Description	Erosion potential	Soil salinity	Precinct
Murringo (mu)	Murringo occurs in association with Young granite. On crests and side slopes moderately deep gradationally textured and duplex red soils. Yellow earths and yellow podzolic soils occur on foot slopes with yellow soldic soils in some drainage lines. Occurs in undulating to rolling low hills with slope gradients generally between 5% and 25%.	Non-clacic brown soils and red earths of side slopes have a moderate erosion potential.	No salting evident	Coppabella Hills
Oak Creek (oc)	Oak Creek is described as shallow soils formed on steep hills. Shallow siliceous sands and shallow sandy Red Earths occur on crests and side slopes with minor red and yellow sandy podzolic soils on lower slopes. Oak Creek soils are located on steep hills of elevations varying from 600-750 metres with slope gradients of 30-50%. Siliceous sands that occur on the crests and side slopes are described as having an extreme erosion hazard with the sandy earths of the remainder of the unit having a high erosion hazard.	Siliceous sands that occur on the crests and side slopes are described as having an extreme erosion hazard with the sandy earths of the remainder of the unit having a high erosion hazard.	No salting evident	Coppabella Hills Marilba Hills
Cockatoo (ct)	Cockatoo soil landscapes are found on small rocky hills. The soils are shallow to moderately deep, brightly coloured red and yellow gradationally textured soils with weak to occasionally moderate structure. Cockatoo soils are located on rolling low hills and hills with local relief between 60-150 m and gradients varying between 10-30%.	Soils of the Cockatoo landscape are described as having a high erosion potential.	Not Present	Coppabella Hills Marilba Hills
Barrenjack (bj)	Barrenjack soils are formed on steep hills. The soils are shallow stony, sandy to loamy soils on crests and side slopes. Stony red and yellow Podzolic soils on colluvial footslopes with alluvial soils. These soils are located on steep hills and mountains, local relief varies between 200-400 metres with slope gradient between 30-50%.	Shallow loams of the Barrenjack landscape have an extreme erosion potential with the remainder of the unit having a very high erosion hazard.	No salting evident	Marilba Hills
Conroys Creek (cy)	Occurs as a valley in the vicinity of Burrinjuck dam. Acid yellow duplex soils with deep massively structured and bleached A2 horizons on mid and lower slopes. Lithosols and Red and Yellow earths are found on upper slopes with yellow Solodic soils on footslopes and in drainage lines. This landscape exists as valleys between hill formations.	Soils of the Conroys Creek landscape unit have been described as having a moderate to high erosion potential.	Patchy	Marilba Hills

Soil landscape	Description	Erosion potential	Soil salinity	Precinct
Binalong (bi)	Moderately deep, bright yellowish brown gradationally or occasionally duplex textured, weakly to moderately structured occur on crests and side slopes. Yellow podzolic soils occur on the lower slopes. Local relief within the unit varies between 30-90 metres with slope gradients between 3-10%.	Lithosols and Stoney earths of the crests and side slopes have extreme and very high erosion potential, respectively. Podzolic soils of the foot slopes have high erosion potential.	No salting evident	Coppabella Hills Marilba Hills
Canowindra (cd)	The primary soils are non-calcic Brown soils. Yellow and brown Solodic soils occur in some drainage lines, with shallow red podzolic soils sometimes found on crests and upper slopes. Red earths also occur on higher crests. Local relief varies from 20-60 metres with gradients between 2-8%.	All soils in this soil landscape group are described as having a moderate erosion potential.	Moderate	Coppabella Hills

8.2.2 Impact assessment - construction and decommissioning impacts

Construction of turbine footings and crane pads would be located on the crests within each Precinct. Access roads would be constructed over all areas of the landscape; crests, side slopes and foothills. The majority of civil construction works would be located on soils documented as having high to extreme erosion potential, and therefore managing potential erosion, associated landform stability and sediment mobilisation impacts are serious issues during the construction and decommissioning phases.

It is anticipated that access tracks would be constructed at a nominal width of approximately 6 metres; however some sections would be required to be 12 metres wide to allow turn around bays and over taking areas. In addition to access tracks, the construction of turbine footings and crane pads need to be level, which in undulating and steep terrain, would likely require a large amount of earthworks. Due the engineering specifications, construction of access roads, turbine footings and crane pads would likely require considerable 'cut and fill' resulting in a substantial amount of material to be stockpiled. Generally these stockpiles are located in the vicinity of the earth works, along the edge of the tracks or near the footings and pads. These stockpiles create a larger impact area than the specific works which they are associated with. Thus stockpiling material would impact the areas in the immediate vicinity of infrastructure locations that are not subject to direct earth works. Off site migration of sediment laden run off could potentially originate from stockpiles and areas of extensive earthworks during rainfall events. Although this has the potential to impact receptors off site, impacts are considered manageable, as discussed in Section 8.1.

Soil compaction would occur, as hardstands and tracks are created and as work progresses across each Precinct. This would reduce the permeability of the soil, increasing run off.

A range of chemicals would be required during the construction phase; 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. They can also cause soil contamination, affecting plant growth. The Proponent would prepare a spill response plan that would identify procedures to respond to chemical spills that have the potential to impact the surrounding environment. The DECC would be notified if a spill was considered to present a significant risk of harm to humans or the environment.

During the construction works, there is the potential for existing contamination to be disturbed. The three precincts are located on private property that has a land use history of farming (grazing). Farming operations are a potential source of contamination, likely resulting from activities including sheep and cattle dipping, diesel refuelling and historical use of pesticides. Live stock dips and refuelling areas (if any) are likely to be located on flatter terrain at the base of ridges. It is considered unlikely that these operations would occur on the side slopes and tops of the ridges, where most of the proposed development would occur. Further, the side slopes and ridges which dominate the landscape of the development envelope are likely to be used for grazing, thus reducing the likelihood of potentially contaminating activities. The use of pesticides has been predominately in cropping areas. Again the likelihood of pesticide use is small on the side slopes and ridges.

The Proponent would prepare a protocol to be actioned in the event of disturbance of any areas considered to be contaminated. This protocol would be included in the CEMP and outline the process to be followed if contamination was identified as result of civil construction works.

Acid Sulfate Soils (ASS) are not mapped as occurring within the three precincts. Acid sulfate soils occur in about 40,000 square kilometres of Australia's coastal zone, including parts of every state and the

Northern Territory (Sammut 2000). Further, Sammut (2000) point out that in general, iron sulfide layers are expected to be located in areas where the surface elevation is less than five metres above mean sea level.

The Candowindra soil group was identified as having moderate salting evident. The Canowindra soil group is located on the crests and upper slopes within the Coppabella precinct and there is the potential of works disturbing these soils. The remainder of the soil groups anticipated to be present within each precinct had low potential for salts.

Blasting may be required, to anchor turbines (this will be determined by detailed geotechnical investigations, prior to construction). Should controlled blasting be required, it would be carried out in accordance with all relevant statutory requirements.

Construction impacts are expected to be temporary within each Precinct. As construction would occur within a specific time and area, the potential for impact, would be limited to discrete locations. Additionally, the application of mitigation measures would reduce the potential for cascading impacts (such as transport of sediment in drainage lines and resultant impacts offsite).

Decommissioning impacts are considered to be minor relative to construction. It is considered that mitigation measures detailed below would allow for the appropriate management of soils during the decommissioning phase.

8.2.3 Impact assessment - operation

The operation of the wind farm is likely to require minimal traffic, as discussed in Section 7.10. By this time, the roads/tracks that would have been upgraded to accommodate heavy loads during the construction phase. No soil or landform impacts are anticipated to be generated during the operational phase.

8.2.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
57	Landform stability	Minimise risk	The Proponent would undertake geotechnical investigations in the area of the proposed turbines to determine ground stability.	Pre - construction	DoP	X	X
58	Contamination	Minimise risks	Consult with involved property owners in relation to areas of land potentially contaminated by past land use and manage impacts in these areas to avoid affecting the any areas of contamination.	Pre - construction	CEMP	X	X
59	Soil quality	Minimise risks	Subsoil would be separated from topsoil for rehabilitation purposes. Topsoil from the excavation sites would be stockpiled and replaced. On steep slopes, topsoil would be stabilised. Any excess subsoil would be removed from the site and disposed of at an appropriate fill storage site.	Construction	CEMP	X	X
60	Soil quality	Minimise impact	Avoid compaction of soil resulting from vehicle access and laying of materials particularly during saturated soil conditions, and remediate as necessary	Construction	CEMP	X	X
61	Soil quality	Minimise impact	The Proponent would prepare a protocol in the instance that suspected contamination is unexpectedly found. Should contamination or potential contamination be disturbed during excavation works, the area would be assessed by appropriately qualified consultants. The DECC would be notified if warranted.	Construction	CEMP	X	X
62	Soil loss or stability of landform loss	Minimise risks	Concrete wash would be deposited in an excavated area, below the level of the topsoil, or in an approved landfill site. Where possible, waste water and solids would be reused onsite.	Construction	CEMP	X	X
63	Soil loss or stability of landform loss	Minimise risks	Access routes and tracks would be confined to already disturbed areas, where possible. All contractors would be advised to keep to established tracks.	Construction	CEMP	X	X

8.3 MINERAL EXPLORATION IMPACTS

8.3.1 Existing environment

Geologically, the area proposed for the Yass Valley Wind Farm lies in the eastern Lachlan Fold Belt, an area consisting of Palaeozoic age sequences (Ordovician to Permian) overlain in part by Cainozoic age basalts and sediments. Over 580 metallic mineral occurrences are known within the area defined in the Goulburn 1:250 000 map sheet area. Historically, the area has produced significant amounts of gold and base metals, as well as tungsten. The area also hosts important industrial mineral resources; including coarse aggregate, sand, iron oxide and limestone.

The Department of Primary Industries has indicated during the consultation process that the impact of the Proposal on mineral exploration and mining is a key concern. There is one current exploration license within the wind farm that has the potential to be impacted. Exploration License 3559 (EL 3559) is located across the north east portion of the Coppabella Hills Precinct and north western portion of the Marilba Hills Precinct. The NSW DPI suggest that while the construction of the wind farm may not physically prevent exploration from being undertaken within the area, it could be a disincentive to explorations if it restricts or precludes the mining of any resources that may be discovered.

EL 7248 is currently held by Taronga Mines Limited. Exploration leases entitle the holders to carry out exploration and prospecting for minerals within the specified areas. Lease boundaries are indicated on Figure 8-5 and overlap a portion of both Coppabella Hills and Marilba Hills Precincts. The exploration lease is for Group 1 minerals which include a number of metallic minerals.

The Proponent has undergone consultation with representatives of Taronga Mines. During a phone conference on 20 February 2009, the Taronga mines representative acknowledged that they were aware of the Proposal and that part of the proposed development envelope was within the boundary of the Taronga Mines Exploration license area. Further, the representative of Taronga mines indicated that in the current economic climate, the company had no immediate plans to act on the exploration license in the following six months.

Taronga mines indicated that they did not require any further information with regards to the Proposal and indicated that they would like the Proponent to consult with them in six months time.

There are no operating mines within the development envelope. Bogo quarry is located to the south east of the Marilba precinct. It is understood that Bogo Quarry extracts coarse aggregate, and subject to approvals may operate a concrete batching plant in the future. Should the proposed Bogo quarry batching plant gain approval and begin operation, this would establish an alternate source of concrete that could potentially be used during construction.

Representatives from Glenella Quarry Pty Ltd (owner/operators of Bogo Quarry) met with the Proponent on 27 February 2009 to discuss both proposals. Of particular interest to the Proponent is the capacity of the proposed batching plant and the likely timeframe of its development and operation. Both issues were consistent with the requirements of this proposal. The proximity of the quarry to the proposed development envelope provides that there is an opportunity for the quarry to supply base materials for road construction and rehabilitation as well as concrete for turbine foundations if the batching plant be approved.

8.3.2 Impact assessment - construction and decommissioning impacts

Potential sterilisation of the mineral resource and inhibition of an active or future exploration program would be the key mineral resource concern posed by the Proposal. The Proposal has the potential to impact on one current exploration area. The Coppabella and Marilba precincts are located within a portion of Exploration Licence (EL) 7248. Final turbine and infrastructure layouts would be provided to the license holder and DPI.

There is a potential for any planned exploration works to be impacted. This may occur during the construction phase, when infrastructure is developed and would depend on the size and location of the infrastructure, including the substation, turbines footings, control building and access roads, as well as the unknown quality, quantity and location of the mineral resource. Although there is a potential for the construction of the wind turbines to impact the potential for exploration, the construction phase is of relatively short duration. It is considered that future exploration project schedules could be managed in relation to the planned timeframe for construction.

8.3.3 Impact assessment - operation

In principle, there is no reason why the exploration of minerals could not occur around the operational wind turbines as the direct footprint of the wind farm infrastructure is less than 0.5 per cent EPL site area. The Proposal would not prevent access to the Coppabella precinct or ground based exploration of minerals except in the vicinity of infrastructure where there may be safety, structural, operational or engineering limitations. In this context, it is possible that the operational wind farm may impede the exploration of minerals within the exploration lease area, in close proximity to infrastructure such as turbines and substations. This may be due to restrictions on the manoeuvrability of exploration machinery, localised sensitivity of magnetic and gravity remote sensing methods and occupational health and safety considerations. However, the access roads constructed for the proposed wind farm would likely facilitate future exploration works via the creation of easier access as well as making a greater portion of the exploration lease area more accessible. Impacts to manoeuvrability and occupational health and safety considerations would be reversed at the end of the project's life, allowing exploration of all areas except for those discussed above; including substation, turbines and control building footings. This combined area is small in relation to the lease area and as stated in relation to construction and decommissioning impacts, the impact is considered to be justified.

It is understood that mineral exploration can also be achieved aerially by low flying planes and ground penetrating radar. The operation of the wind farm would limit the opportunity for this exploration method to be achieved.

While only one Exploration Lease occurs within the development envelope at this time, if a mineral deposit is discovered then an application for a Mining Lease can be made. There is no certainty that a discovery would be made or a Mining Lease would be granted and accordingly the amount of potential lost mining revenue cannot be known in advance. In comparison to the exploration lease area, the relatively small land area that would be sterilised and the level of reversibility of the Proposal suggest that this impact is justifiable; the temporary loss of these areas for mining would be offset by the utilisation of a renewable resource during the project's life. The benefits of the wind farm Proposal would extend to involved property owners (via lease agreements), Yass Valley Wind Farm and its shareholders as well as the end users of the renewably generated electricity.

This combined area is small in relation to the lease area and as stated in relation to construction and decommissioning impacts, the impact is considered to be justified.

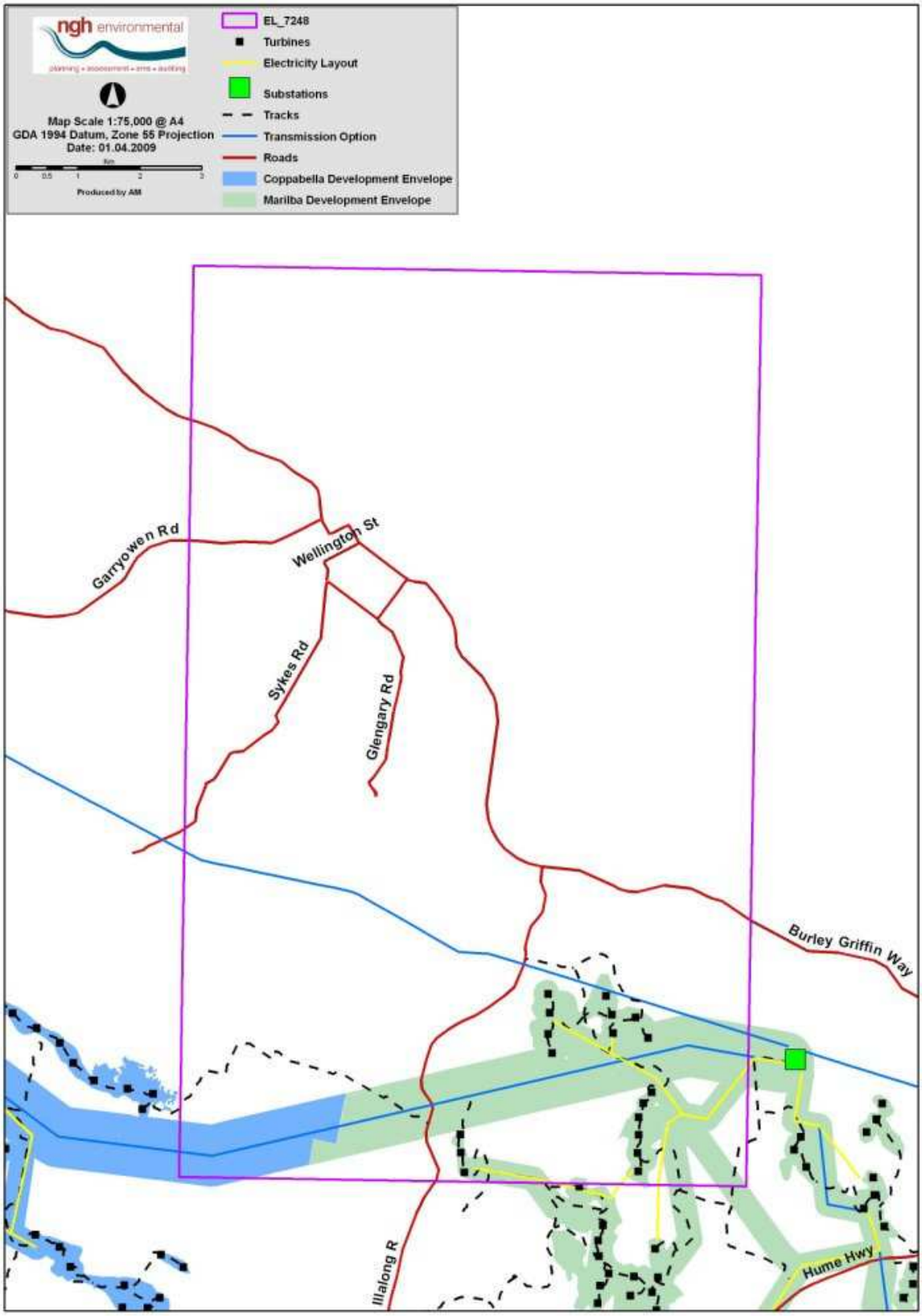


Figure 8-5: Mining leases in the vicinity of the Yass Valley Wind Farm Proposal (supplied by NSW Department of Primary Industries)

8.3.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
64	Conflict with mineral exploration	Minimise conflict	The Proponent would liaise with the current mineral lease holder providing a final turbine and infrastructure layout, prior to the construction phase	Pre-construction	CEMP	X	X
65	Conflict with mineral exploration	Minimise conflict	The Proponent would liaise with continue to liaise with Taronga Mines. This consultation would be ongoing between the Proponent and Taronga Mines.	Pre-construction / Construction	CEMP	X	X
66	Conflict with mineral exploration	Minimise conflict	The Proponent would provide a point of contact to the current mineral lease holder	Pre-construction	CEMP	X	X
67	Conflict with mineral exploration	Minimise conflict	The Proponent would liaise with the involved land owners and current mineral lease holders prior to rehabilitation, to ensure that any project access roads that they may wish to retain are retained. Several of these access roads are likely to be of benefit both to routine agricultural activities as well as to exploration activities onsite	Construction	CEMP	X	X

8.4 LAND VALUE IMPACTS

8.4.1 Existing environment

Local determinants of land value

Land values are influenced by prevailing and permitted land uses, economic conditions, access and proximity to markets and workplaces, demand for lifestyle and a range of other dynamic factors. While public perception of wind farms can be highly variable and subjective (SRSC 2005), there is the potential for a section of the market to be negatively affected by perceived or actual visual or noise impacts, or by changes to compatible land uses as a consequence of wind farm development.

Permitted land uses: agriculture and residential subdivision

The proposed Yass Valley Wind Farm is located in an area where agricultural capacity has traditionally been the largest determinant of land prices. The land surrounding the precincts within the Yass Valley LGA is zoned No. 1(a) Rural Agricultural Zone, used for extensive sheep and cattle grazing. The land surrounding the western portion of the Coppabella Hills Precinct (located within the Harden Shire LGA) is zoned 1(a) Non-urban "A" under the Interim Development Order (IDO) No. 1 – Shire of Harden. There are major shifts occurring in agriculture in the region, driven by declining international agricultural markets, extended droughts and the introduction of new farming methods. Linked to these changes, rural subdivision applications are being made in the Yass Valley and Harden Shire Councils as agriculturalists capitalise on increasing property values. There is also increasing demand for rural subdivision lots, increasingly valued for their rural character and lifestyle values, rather than agricultural productivity.

Information provided by Yass Valley Council identified that there are three approved subdivisions within the vicinity of the proposal. The approved subdivisions are located west and south west of Bowning and near Bookham Figure 8-6.

Yass Valley Council have provided the following information on these approved subdivisions:

- DA 5.2003.379.1, 8 lots (8 – 160 hectares), consent granted in 2004 (non involved)
- DA 5.2005.251.1, 8 lots (8 – 159 hectares), consent granted in 2006 (involved)
- DA 5.2003.380.1, 3 lots (48 – 134.1 hectares), consent granted in 2004 (non involved)
- DA 4.1997.113.1, 2 concessional lots (3.5 and 9.2 plus the residual lot), consent granted in 2006 (non involved)

The size of the smaller lots indicates that agricultural productivity would not be the prime land use. One subdivision is being marketed as an eco-village.

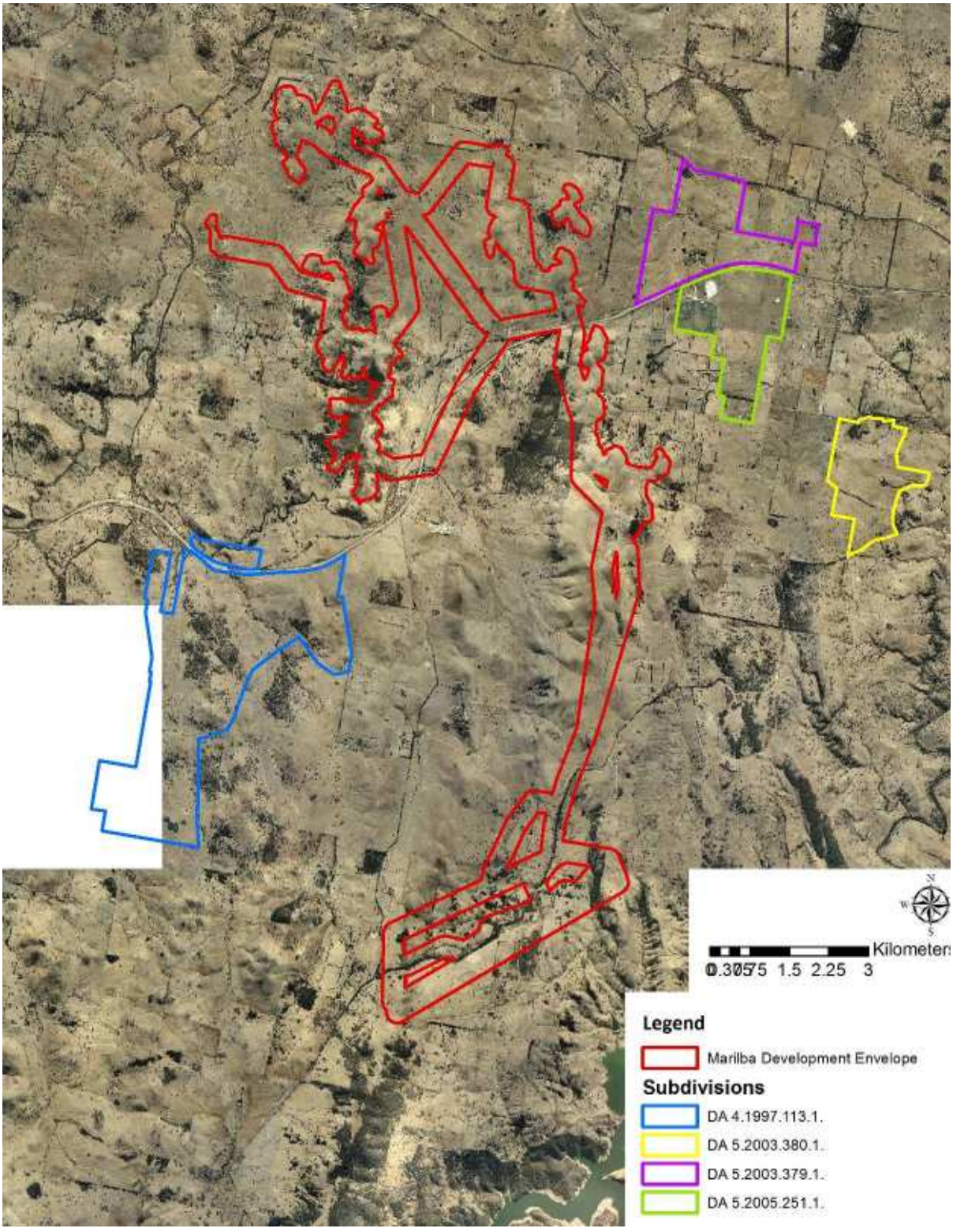


Figure 8-6 Relevant subdivisions in Yass LGA and their proximity to the Marilba Hills Precinct

Information provided by Harden Shire Council identified that there are two approved subdivisions in the vicinity of the Coppabella Hills precinct. One is a four Lot subdivision located on Burley Griffin Way. It is estimated that the closet point of this subdivision to a proposed turbine is 8.5 kilometres to its north-north-east. The other approved subdivision is a three lot rural subdivision located north of the Coppabella Hills precinct along Garry Owen Road. It is estimated that the closet portion of the approved subdivision to the nearest proposed turbine is 4.5 kilometres.

There is also potential for further concessional lot applications in the surrounding district. In addition to traditional farmers, 'hobby farm' or 'lifestyle' residents are present in the local area particularly along Black Range Road, near to the Marilba Hills Precinct.

Commutable proximity to the larger population centres of Canberra and Sydney is likely to be an important factor in the trend smaller subdivisions; increasing numbers are settling in the Yass district and commuting to work in Canberra. The potential for subdivision in the area increases the importance of land value impacts. While agriculture and wind farms are demonstrably highly compatible, recreational and aesthetic land uses have a higher subjective component. There is speculation within the local community that the Proposal would reduce land values (B.Marshall pers. obs. Yass Valley Wind Farm Open House, 10 Dec 2008).

Land value studies and wind farms

The impact of wind farms on land values has been raised as a key concern by several individuals during the community consultation process. However, it is a difficult question to definitively address. There are examples of successful residential estates being developed near wind farms in Australia; an informal study of the Salmon Beach estate near the Esperance wind farm in Western Australia showed a strong trend of increasing house prices (AusWEA 2004). However, the interplay of multiple land value determining factors undermines any direct comparisons.

Henderson and Horning Property Consultants (2006) undertook a study into local property values around the Crookwell 1 wind farm, the closest operational wind farm to the proposed Yass Valley Wind Farm (although significantly smaller in turbine number and size). The study was undertaken in relation to the potential impact of the Cullerin wind farm (located between Gunning and Goulburn on the Hume Highway) but has land use factors comparable to the proposed Yass Wind Farm. Henderson and Horning's study explored the effects of a wind farm on local land values, with recourse to the impacts resulting from other wind farm developments, in Australia and overseas. Henderson and Horning's Land Value Assessment is sourced below, with additional studies, to provide a background to the effects of wind farms on land value.

United States Sterzinger et al. 2003

The United States report (Sterzinger *et al.* 2003) was an empirical review where data from 10 wind farm sites was collected and subjected to a statistical regression analysis to determine price changes in three ways:

- How property values changed over the entire period of the study for the view shed and comparable region;
- How prices changed in the view shed before and after the projects came on-line; and
- How property values changed for both the view shed and comparable community but only for the period after the project came on-line.

This study concluded that:

> *"there is no support for the claim that wind development will harm property values"*

and was qualified with a statement that more data would need to be analysed as it becomes available.

United Kingdom ref RICS 2004

The United Kingdom perceptual study gauged professional property opinions about the impact wind farm development had on both residential and agricultural land values. It received 405 responses of which 81 indicated they had dealt with residential transactions affected by wind farm development. The report concluded the main negative impact on property values are visual impact, fear of blight and the proximity of a property to a wind farm. Seventy-two percent of the sample believed wind farm development had no impact or a positive impact on agricultural land values. Sixty percent believed wind farms decreased the value of residential properties where the wind farm was in view. The perceived negative impact was recorded to continue but becomes less severe two years post completion.

United Kingdom Dent and Sims 2007

A recent study (Dent and Sims 2007) looked at 919 residential property transactions at three locations in Cornwall, within 5 miles of wind farms. The results were analysed and local estate agents were interviewed to understand the underlying reasons for any variation in property prices.

The results were generally inclusive, with terrace and semi-detached houses within a mile of a turbine significantly lower in price than similar houses located further away. Detached houses and all property greater than a mile from a turbine showed no clear linear relationship between physical distance and transaction price. Upon investigation with local real estate agents it became clear that the lower prices of terraced and semi-detached houses within 1 mile of a turbine were ex-defence housing properties and were less desirable, confounding any conclusion about wind farm effects.

The study concluded that the relationship between property price and distance from turbines was inconclusive however, it suggested that factors other than wind farms had a more significant effect on property prices. It also concluded that the 'threat' of a wind farm may have a more significant impact than the actual presence of one. This finding agrees with perception studies undertaken by Warren *et al.* (2005) which found exaggerated perceptions of wind farms are often dispelled by actually living near a wind farm (Elliott 1994; Redlinger *et al.* 2002; SEDD 2002; Braunholtz 2003; SEI 2003a, cited in Warren *et al.* 2005).

Victoria Australia Smith et al 2004

In Victoria Australia, the Bald Hills Wind Farm Panel Inquiry examined the issues of property devaluation for neighbouring properties in a similar manner; property valuers and real estate agents provided submissions and appeared before the Panel Inquiry as expert witnesses. The Panel Inquiry report concluded that:

> *"All that appears to emerge from the range of submissions and evidence on valuation issues is the view that the effect of wind energy facilities on surrounding property values is inconclusive, beyond the position that the agricultural land component of value would remain unchanged. On this there appeared to be general agreement."*

Crookwell, Australia Henderson and Horning 2006

The Crookwell wind farm was developed in 1998. Sales transactions over a 15 year period were searched (1990 to 2006). Properties that surround the development and have some direct impact from a valuation perspective were investigated (principally aesthetic influences including, visual, noise and shadow effects).

The context of the study was a general trend of larger properties being sold and broken up into smaller lots commencing in the late 1990's, with very few sales occurring in the period prior to the development of the wind farm. This trend is an example of the changing nature of land use in the area, from commercially operating grazing land to a more passive rural residential use. Market forces appear to value the rural residential amenity above that of the agricultural productive capacity of the land.

It is clear that the underlying agricultural productive capacity of the land and the surrounding property subject to the wind farm is not in any measured way affected by the development of the Crookwell wind farm, meaning there has been no reduction in values. Indeed the property subject to the development enjoys additional revenue (leasing agreements) and additional benefits including improved access, erosion control and passive wind protection for stock from the sub stations and turbine tower structures. Henderson and Horning concluded, the revenue stream from the wind farm plus the underlying agricultural production from the land may well outbid the subdivision potential for the site. This is premised on the rental income from the turbines being at market value.

The Land Value Assessment report concluded that further research would be required to determine what value the market would place on the wind farm revenue streams however, it is suggested that the capitalisation rates would be similar to other infrastructure improvements like mobile communication towers and signage investments. Therefore the wind farm development has the potential to slow down the process of productive agricultural land changing to rural residential uses in the short to medium term with the shift caused by the additional income generated from the wind farm revenue making the agricultural use of (involved properties) more viable.

Additional to agricultural land values, there is also the potential of wind farm development to impact land values determined by recreational land uses. No literature on recreational land values and wind farm impacts was able to be identified, to assist with this aspect of the impact assessment. Impacts to lifestyle and tourism have however, been investigated separately in Section 8.7 and 8.8.

8.4.2 Impact assessment - construction and decommissioning impacts

During the construction and decommissioning phases of the wind farm, a temporary increase in traffic loads, as well as increased noise and visual impacts would occur. These impacts would be temporary and would not be anticipated to be reflected in the land value of the site or land values in the area.

When the site is decommissioned, it could continue to be used for extensive agricultural activities or could be subdivided or used for more intensive uses, as dictated by prevailing markets and the interests of the land owners. Disturbed soil, excluding access tracks which the landowners may wish to retain, would be stabilised and rehabilitated. Underground structures including the concrete footings used to anchor turbines and buildings would remain onsite, but occupy a small proportion of the development envelope (refer to Section 3.6). These features may have a minor impact on land use however, the lease agreements during the life of the project are intended to compensate the landowner for this. This impact would not be anticipated to be reflected in the land value of the site or land values in the area.

8.4.3 Impact assessment - operation

The operational impacts of the development are considered to have the greatest bearing on land value. While the lease agreements are intended to compensate the involved landowners for impacts during the life of the project, the development may potentially affect the land values of the surrounding properties that are in some way affected by the development; those with a view of the site or near enough to experience operational noise. For the Coppabella Hills and Marilba Hills Precincts, future land uses may include agriculture and residential subdivision. The population density is currently sparse and provided

that visual and noise impacts are adequately mitigated in the design and construction of the Proposal (as per Sections 7.2 and 7.3) no significant impacts are anticipated, based on the available literature discussed above.

Operational traffic impacts would be negligible during the operational phase and, if anything, access improvements may positively affect local land values.

The conclusions of the studies considered in this section, applied to the Coppabella Hills and Marilba Hills Precincts, suggest that:

- The agricultural productive capacity of land affected by wind farm Proposals (including the development envelope itself as well as surrounding properties) is not anticipated to be affected by the development of the wind farm.
- The revenue stream from the wind farm and associated benefits (such as improved access) plus the underlying agricultural production capacity of the sites directly affected may well outbid the subdivision potential of the sites, slowing down the process of productive agricultural land changing to rural residential uses in the short to medium term.
- The evidence suggests that having a view of the wind turbines would not adversely affect the land values of surrounding properties. Any negative perceptions that this is the case are likely to decrease two years post construction.
- The wind farm may dampen a sensitive section of the property buying market however, this effect is balanced by other influences such as demand for land and housing within a commutable distance from larger centres, Canberra, Melbourne and Sydney and the creation of a development-oriented or green energy aesthetic.
- As the site would be returned to its current appearance at the end of the project's life, the potential impacts to land values are reversible in the long-term.

The are four subdivision in the Yass Valley LGA and two in the Harden LGA that have the potential to impacted during operation of the wind farm. Due to the location of these sub-divisions, refer to

Figure 8-6, potential noise and visual impacts to residents and future residents of these sub-divisions is considered the main potential impact of the development. Potential visual and noise impacts are assessed in detail in Section 7.2 and Section 7.3. Additionally, potential impacts to land values has been discussed above.

While the wind farm cannot be developed without the risk of some land value impact on surrounding properties during the construction and operational phases, it is considered by this assessment that on balance the benefits of the Proposal are sufficient to outweigh this risk. The risk is not dissimilar to that posed by other large scale infrastructure developments undertaken to meet increasing energy demands.

No mitigation is considered to be required for the potential impacts to land values. As a large component of this issue is related to visual, noise, community, lifestyle and tourism impacts, measures outlined in Section 8.6 for mitigation of impacts to the community are considered sufficient to address this issue.

8.5 ECONOMIC IMPACTS

8.5.1 Existing environment

The proposed Yass Valley Wind Farm would be located primarily within the Yass Valley Local Government Area (LGA). The exception is the Coppabella Hills Precinct, a portion of which is located within the Harden Shire LGA.

Key statistics pertaining to the two LGAs are provided in Table 8-7.

Table 8-7 Key statistics for the LGA

	Yass (2006)	Harden (2006)
Size of shire: Area of sq km.	3970	1861
Population		
Number	13,135 (2006)	3,582 (2006)
% Growth since 2001	34%	-4%
Medium age 2006 (yrs)	39	44
Median Family Income ($AUSD)	1377	903
Top Industries (number of people employed)		
Sheep, beef, cattle and grain farming	534	354

Central government administration	445	N/A
School education	271	85
Road and freight	N/A	60
Cafes and restaurants	249	N/A
Public order and safety services	158	N/A
Fruit and tree nut growing	N/A	50
Meat manufacturing	N/A	41

Source: Australian Bureau of statistics

The Yass Valley Shire is largely agricultural. Extensive grazing of sheep and cattle are the predominant land uses. In recent years many new agricultural industries are emerging including cool climate wines, alpaca studs, miniature cattle studs, olives and berries, Yass (2006). The major industry sectors within the Yass Valley Shire are agriculture, retail trade and tourism, which reflect the predominately rural nature of the area, Yass (2006). Bowning and Binalong are the closest villages to the three Precincts and provide limited services (groceries, accommodation). Yass, the major centre of the Yass Valley LGA is located approximately 20-30 kilometres east of the three Precincts and has a population of approximately 6000 residents (Tourism NSW 2008). The Yass Valley LGA features historic buildings, wineries, rural villages, antiques and art galleries along with Burrinjuck Water State Park (Yass 2008), valued by locals and visitors alike.

The Harden Shire Council is known for its rich agricultural base including cereal cropping, horticulture and grazing, Harden (2008). Land within the Harden Shire LGA has the highest dryland wheat production within NSW. The predominate industry within the Shire is agriculture, the second largest industry is transport. The Harden shire is strategically located at the junction of the major transport routes, the Hume and Olympic highways as well as the Burley Griffin Way, Harden (2008).

Relevant to both LGAs, the drought has put increasing pressure on agricultural enterprises. Increasing growth in the Yass Valley also places water resources and other services under greater demand.

8.5.2 Impact assessment- construction and decommissioning

The Yass Valley Wind Farm would provide temporary employment opportunities during construction and decommissioning. Increased demand for services in the local area, most likely during the construction phase, would also accompany the development, as contractors seek accommodation and utilise other services in the local area. It is estimated that between $150 and $250 million could be spent within the region as a result of the wind farm over its life.

There is an opportunity for local contracting and manufacturing services to be contracted during site development. These may include concreting, earthworks, steel works and electrical cabling. As well, other service-related employment would follow, with the provision of food, fuel, accommodation and other services to contractors. Based on a construction phase spanning 24-36 months, employment would likely increase by 505 FTE jobs across the local area. It is considered that construction, property and business services, retail trade and wholesale trade would make up most of the employment growth. Precise

economic benefits would vary depending on final site design, turbine suppliers, timing of works and other details. Currently there are no facilities capable to manufacture turbine components (nacelles and blades) in Australia. There may be the potential to manufacture towers in Australia.

There are a number constraints related to the potential socioeconomic impacts described. These include supply-side constraints; primarily the supply of labour and the capacity of local business to service new contracts together with the quality of local housing and other physical and social infrastructure and amenities needed to attract and retain workers.

As the construction and decommissioning phases of the projects would take place over a considerable time period (estimated to be 24-36 months for construction and approximately 12 months for decommissioning), there is potential to adversely impact current grazing activities on the sites that would be developed and for the additional heavy vehicle traffic on public roads to interfere with other economic activities, for example, scenic drives, field days and other tourist related activities. It is anticipated that grazing impacts would be confined to involved land holders. Involved land holders would be compensated by the Proponent for allowing the infrastructure to be constructed on individual properties. It is considered that this compensation would off-set impacts on grazing. These impacts are discussed specifically in *Sections 8.8 Tourism Impacts*, and *8.9 Agricultural Impacts.*

8.5.3 Impact assessment - operation

Wind farms are an economically viable means to generate electricity (refer to *Section 9 Strategic Justification*). The Proposal would be privately funded. There would be no ongoing financial expenses to the community or any government agency. Economic inputs would involve employment opportunities for the local, regional and national work force.

The operational phase of the project is anticipated to create 40[31] full time equivalent jobs over a 30-year period. At this time the project may be decommissioned or recommissioned.

[31] This figure is based on a paper written by MacGill (2007) that states O&M jobs created are 0.09 * MW capacity

8.5.4 Mitigation Measures

Mitigation measures relating to the economic aspect of the Proposal centre on the maximisation of economic benefits to the wider community.

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
68	Affect on local community	Maximise positive impact of Proposal	Liaise with local industry representatives to maximise the use of local contractors and manufacturing facilities in the construction and decommissioning phases of the project.	Construction	CEMP	X	X
69	Affect on local community	Maximise positive impact of Proposal	Liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works and to the extent practical coordinated with local events	Construction	CEMP	X	X
70	Affect on local community	Maximise positive impact of Proposal	Liaise with Yass Valley and Harden Shire Councils and the Department of State and Regional Development to provide information to assist in attracting people to the local area to facilitate meeting the expected demand for human resources for both construction and operation of the Proposal	Construction Operation	CEMP	X	X
71	Affect on local community	Maximise positive impact of Proposal	Make available employment opportunities and training for the ongoing operation of the wind farm to local residents where reasonable	Operation	OEMP	X	X

8.6 COMMUNITY WELLBEING

8.6.1 Existing environment

Wind farms have been seen as divisive developments in terms of local communities. To investigate the potential for adverse impact to the community, this section considers the current makeup of the local community, indicators of community well being, documented responses by communities to wind farm developments, and specific responses of the local community to the Yass Valley Wind Farm Proposal.

The make-up of the local community can be seen as being comprised of families that have been in the area for several generations and newer residents attracted by work opportunities or by the rural lifestyle. By virtue of the increased transient population alone, the tree-change (or sea change) demographic shift can result in a loss of sense of community (Gurran *et al.* 2005).

The greater Southern Tablelands region has, over the last several years, had several wind farms proposed and developed. Criticisms have been levelled at the general planning process relating to consultation and community funds. Further, it is understood that in general, Yass Valley Shire Council does not support wind farms within their local government area, (pers. comm. S.Jurcevic, Yass Valley Shire Council 2008). It is understood that frustration has been observed in other communities within the Southern Tablelands area related to the developers, type of development and the assessment and consent process for both state and council approved developments (Twyford Consulting 2007).

Indicators of wellbeing and issues of concern

Community wellbeing is related to the quality of the natural and urban surroundings, socio-economic position, the availability of services and perceptions of safety (Yass Valley Shire Council State of the Environment Report 2004). One measure of 'community' is the willingness of individuals to be involved in volunteer organisations such as the Bush Fire Brigade, Meals on Wheels, the Country Women's Association and farmers' associations. The additional element of people who have long associations with the area can strengthen the fabric of the local community. These features are present in the local community.

The Yass Valley Shire Council prepared the 2006-2011 Yass Valley Council Social Plan (Yass 2006).The aim of the plan is to *identify the key social and cultural needs of the community and respond to these needs in partnership with other government and non government service providers* (Yass 2006). Key indicators that enhanced the wellbeing of the Yass Valley community as detailed in Yass (2004) included:

- Drinking water quality was good overall
- There were no major noise problems
- The rate of annual growth in the ratio of employed persons to resident population went from – 0.9% in 1996 to +0.2% in 1998, and remained positive at the time of the 2001 Census
- An additional 207 places in the Shire were recognised for their heritage value in the Local Environment Plan

Issues for community wellbeing identified during the State of the Environment 2004 reporting period were:

- The Shire's population continued to grow in number and age (accommodation for the ageing population was noted as a concern)

- Limited tertiary courses are offered through a local campus of the Illawarra Institute of TAFE (no other tertiary courses are offered in the local government area)
- Local health services for residents was noted as a concern;
- Although infrastructure assets are considered to be in fair condition, the sewage treatment plant requires an upgrade
- Limited public transport is available to many residents in the Shire

The Social Plan identified ten action plans *corresponding to key strategic directions that represent the broader needs of the community*. The impacts of ongoing drought heighten the existing levels of stress within people of the predominately agricultural community and have clear links to stress and adverse health impacts. The key strategic directions formulated by the Social plan are reproduced below:

1. Enhancing Community Capacity
2. Enhancing Community Infrastructure
3. Improving Transport
4. Supporting our Children
5. Supporting our Youth
6. Preparing for an Ageing Population and Supporting Older People
7. Encouraging Greater Participation in Learning, Education and the Workforce
8. Enhancing Culture, Heritage, and the Environment
9. Improving the Community's Health and Wellbeing
10. Creating a Safe Environment

Similar to Yass Valley Shire Council, Harden Shire Council has prepared a Social Plan 2006-2010, (Harden 2006). The communities of Galong and Jugiong are located in close proximity to the west portion of the Coppabella Hills Precinct. Harden (2006) identified that the three main issues for local residents of the Galong community were, activities, village presentation and transport. A number of recommendations were presented including minor road upgrades, public area beautification projects and improvement to the community hall to recreate it as the centre of community life for families and children.

The Jugiong community identified community strengths including, but not limited to the following:

- Proximity to the Hume highway
- Community spirit
- Numerous community assets

Harden (2006) identified that the Jugiong community thought that an increase in tourist numbers would be positive for the community.

It is recommended that, to address the potential for the Yass Valley Wind Farm Proposal to be divisive and generate stress within the community, adversely affecting community wellbeing, that the Social Plan priority actions be used as a guide when considering community well-being mitigation measures.

Community responses to wind farms

Warren *et al.* (2005) observed that the move from centralised power generation to decentralised use of renewable sources raises novel and challenging issues for planning, land use and social engagement. Their study of wind farms in Scotland and Ireland investigated the nature of community views about wind farms.

The study found that aesthetic perceptions (whether positive or negative) are the strongest single influence on individuals' attitudes towards wind farms and that proximity to wind farms is not a reliable indicator of perception in the long-term. Surveys showed that people with anti-wind farm views perceived turbines as noisier and more intrusive than those in favour of wind turbines, regardless of the actual recorded levels (Krohn and Damborg 1999, cited in Warren *et al.* 2005). The study observed that opposition arises in part from exaggerated perceptions of wind farms that living near a wind farm dispels (Elliott 1994; Redlinger *et al.* 2002; SEDD 2002; Braunholtz 2003; SEI 2003a, cited in Warren *et al.* 2005). More positive feelings about wind farms were recorded closer to the wind farm site than further away (Warren *et al.* 2005).

Eltham *et al.* (2008) identified that a communities attitude for a wind farm change over time. The study found a small increase in the percentage of people supporting the wind farm subject to the study, after living with the development, who had initially been opposed. Additionally, Eltham *et al*. (2008) pointed out that changes in opinion were also identified between the recalled opinions for an increase in residents finding the wind turbines visually attractive and the increase in residents considering the secure form of energy that wind energy provides to be a valuable asset.

Warren *et al.* (2005), state that a consistent picture of public attitudes to wind power is emerging from surveys and case studies in Europe. Large majorities are strongly in favour of wind farms, their opinions formed by personal experience, in contrast to a minority in opposition whose opinions are formed not by experience but by misinformation and prejudice. This does not discount the real issues associated with community impacts, those being landscape aesthetics and the speed, scale and uncoordinated nature of the wind farm developments (Warren *et al.* 2005).

Public attitudes are critically influenced by the nature of the planning and development process; the more open and participatory, the greater the level of public support (Birnie et al. 1999; Khan 2003, cited in Warren et al. 2005). Additionally, Gross (2007) describes outcomes that are perceived to be unfair can result in protests, damaged relationships and divide communities particularly when decisions are made which benefit some sections of the community at the perceived expense of others. Thus, the notion of 'winners' and 'losers' within the community can also influence community perceptions towards wind farms, Gross (2007).

Community perceptions towards wind farms in the Southern Tablelands

A specialist report, *Report on Community Perceptions of Wind Farms in the Southern Tablelands, New South Wales* was prepared for the Proponent in October 2007 and incorporated the areas around the proposed Yass Valley Wind Farm of. The study was commissioned by the Proponent to facilitate the collection of a bench mark measure of attitudes of local residents towards the construction of a wind farm in their local community. The study area was a collection of rural localities situated in the Goulburn – Crookwell – Yass region within the southern highlands of NSW, and thus is considered to be directly geographically relevant. The survey was undertaken by ERM in conjunction with REARK Pty. Ltd., a consulting firm that specialises in public opinion and market research surveys. The methodology for the public opinion survey is detailed below.

- The study was conducted by telephone in a prescribed geographic area defined by post codes and locality names (including the areas surrounding the proposal)
- Sample source was derived from the electronic white pages listing of residential numbers within the defined area
- The sample size for the survey was defined at 300. The report indicated that 50% of the sample of 300 would have a sampling precision of 50±5.7%. Further details of the sample statistics are detailed in ERM (2007), presented in Attachment 9.
- The respondent for this survey was defined as a randomly selected adult resident within the residence called using the closest birthday technique
- The telephone study was undertaken with the assistance of a Computer Assisted Telephone Interviewing (CATI) system. Field work was undertaken by appropriately qualified personnel
- A questionnaire was developed for the purposes of this study. The questionnaire is presented in ERM (2007), Attachment 9. The field work was conducted during the evening and concluded in early August, 2007
- The data collected was analysed and presented in the form of tabulated results within ERM (2007)

Prior to the commencement of the survey, the level of knowledge held by the community with regards to wind farms and associated infrastructure was a relative unknown. The outcomes of the study undertaken as adapted from ERM (2007) are presented below.

- Eighty percent of respondents are concerned with the threat of global warming and its impact on the environment. Conversely, 16% of respondents indicated that were not concerned
- General awareness of wind turbines was very high. Almost all of respondents had claimed that they had seen a wind turbine and 9 in 10 claimed to have actually seen a turbine. Further, in excess of 8 in 10 respondents had seen the current wind farm located at Crookwell
- Approximately 90% of respondents were aware of announcements relating to wind farms
- Eighty-nine percent of respondents were in favour of wind farm projects to be developed in the southern tablelands with 5% opposed. Of the 89%, 83% stated *''I would be happy to see a wind far, built on farm land near where I live''*
- Eighty-seven percent of respondents supported the development of a wind farm within 25 kilometres of their house, with 71% supporting a wind farm within 1 kilometre of their house
- With respect to the construction of multiple wind farms, 75% accepted two 'typical' wind farms (15 to 80 turbines) in their local rural area, with 17% opposed

The study concluded that generally adult residents in the survey area are concerned about global warming and are aware of alternatives available. Additionally, the respondents were generally aware of wind turbines and how wind turbines appear within the landscape and are generally supportive. Survey results further indicated that respondents were generally not adverse to the development of wind farms in the immediate locality. The survey also indicated that 89% of the respondents indicated that they were in favour of the development of a wind farm within the southern highlands. In addition, over 9 in 10 respondents agreed that '*wind energy is a good alternative energy source*'. The survey also found that the community had no clear preference between a few clusters, close together, or spread out at reasonable intervals along the highway (ERM 2007).

Based on the results of the survey undertaken by ERM in 2007, it would appear that the community within the southern tablelands are generally supportive of wind farms. The survey also indicated that the community was aware of announcements relating to wind farm development in the region.

A poll conducted recently in the Upper Lachlan Shire Council LGA (LG Elections 2009) aimed to identify the community's perspectives with relation to wind farms. The question posed to the community was: Do you support the continuing development and construction of wind farm turbines in the Upper Lachlan Council area?. A total of 4,727 votes were counted during the poll with 70.04% (3,311) voting 'yes' to the question posed as detailed above with 29.96% (1,416) of respondents voting 'no'. The results of this poll support the supposition that general public perceptions of wind farms in the Upper Lachlan LGA are positive.

8.6.2 Impact assessment - construction

Impacts relevant to construction centre around transport and traffic issues, as well as this being a defining stage in the development of a large scale project which some people may have misgivings about. The construction of the wind farm would generate a level of community disruption, not necessarily related to actual construction impacts but rather to this phase marking the beginning of a Proposal that people have strong views about. As discussed above, adverse impacts arise for a number of reasons:

- The development represents a large outside force over which the individual feels little control
- The development process takes the power of consent out of the hands of local representatives, being decided at the state (and sometimes federal) level
- The development is of a nature that would be highly visible, relatively novel and may not be avoidable (in a visual context) during day to day activities
- The development is of a nature which focuses monetary benefits on a relatively small number of directly involved property owners, often creating resentment and inequity

The construction phase may be the trigger for feelings of resentment about the development. The long-term effects of stress can compound over time. As cited above, several studies have now documented that this trend appears to abate with time. That is, exaggerated perceptions are often dispelled post construction, by the direct experience of a wind farm.

The proposed road upgrades would contribute positively to community wellbeing, by enhancing local infrastructure. The provision of local jobs it would contribute to the socio-economic aspect of wellbeing directly.

8.6.3 Impact Assessment – operation and decommissioning

The Proposal would not act to exacerbate existing community issues in the affected LGAs, as summarised above. In terms of infrastructure, employment and tourism, the Proposal would have benefits, as discussed in more detail in *Sections 7.10 Traffic and Transport, 8.5 Economic Impacts, 8.8 Tourism Impacts.*

No additional mitigation measures are considered to be required for operational impacts.

8.6.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
72	Community wellbeing	Provide accurate information	Dissemination of accessible and independent information on wind farm impacts	Pre-construction	CEMP	X	X
73	Community wellbeing	Provide accurate information	Biodiversity monitoring information collected during the operation of the wind farm would be made publicly available	Operation	OEMP	X	X

8.7 LIFESTYLE IMPACT

8.7.1 Existing environment

For local residents and visitors alike, rural land use and large land holdings in the area create a landscape amenable to recreation (horse-riding, walking, fishing, boating) and one in which many people seek to retire or 'escape' from a more urban environment. Yass (2006) identifies that people from both Sydney and Canberra are moving into the Yass Valley LGA *to benefit from the rural lifestyle while having the advantages of access to employment opportunities and a major retail centre, Canberra.*

The western portion of the Coppabella Hills Precinct is located within the Harden Shire Council LGA. Harden was historically a railway centre which created significant employment until post-World War Two. The declining need for rail services impacted the area, Harden (2006). The Harden LGA is now predominately an agricultural area with a number of agricultural support industries. However, correspondence with Council representatives has indentified two approved Development Applications for small subdivisions within the proposed Coppabella Hills Precinct. Similar to the Yass LGA, it is expected that the lifestyle values of the Harden LGA are not purely related to agriculture and transport.

There are two approved subdivisions in the vicinity of the proposal area. These are discussed in Section 8.4.1.

8.7.2 Impact assessment - construction and decommissioning

Construction noise, the generation of dust from vehicles and the increased traffic flow during construction and decommissioning may impact on the lifestyle values of the locality in the short term. Impacts would be experienced by nearby properties as well as properties on the haulage route. For local residents, this may create an ongoing nuisance for the period of construction and then cease. For visitors to the area, this nuisance may dominate a short vacation or weekend away. The close proximity to the Hume Highway means that haulage on minor roads would be limited (refer to *Section 7.10 Traffic and Transport* for a more detailed discussion).

Impacts would attenuate rapidly with distance from the work sites and haulage routes. These impacts would be temporary, occurring over a 24 - 36 month period (not continuous in any one location), and would be regulated by occupational health and safety and noise and pollution restrictions. Due to the temporary duration of the impacts and relatively low population density, this is not expected to generate an unacceptable level of impact.

The two approved subdivisions located in the vicinity of the Coppabella Hills precinct within the Harden LGA are located approximately 4.5 km and 8.5 km away from the nearest proposed turbine. The lots sizes within these two subdivisions range from 40 ha up to 384 ha. There is the potential for residents and future residents of these subdivisions to have views of the proposed wind farm. It is unlikely that these subdivisions would be impacted by noise during either the construction or operational phase of the proposed wind farm.

8.7.3 Impact assessment - operation

A different set of impacts relate to the operational phase of the wind farm. While the operational wind farm would not preclude nearby residential or recreational land uses, the perceived visual, noise, health and land value impacts may adversely affect the experience of those seeking the quiet, rural character of the area. These impacts are expected to attenuate with distance from the site. Time can also lessen the

perceived adverse impacts of a wind farm, as actual experience replaces initial exaggerated perceptions (cited in Warren *et al.* 2005).

Specialist reports have quantified and evaluated the visual, noise and land value impacts of the Proposal (refer to Appendix 1, 2.1, 2.2 and Section 8.4 respectively). Health impacts have been evaluated in Section 8.10. On the basis of these assessments, the impact on the life style values of the site is expected to be manageable by specifically managing visual impact, operational noise impact, community wellbeing impacts, tourism impacts and health and safety impacts, as detailed in Sections 7.2, 8.6 and 8.10 of this report.

No additional mitigation is proposed for lifestyle impacts.

8.8 TOURISM IMPACTS

8.8.1 Existing environment

The Yass Valley Wind Farm would be located between the local service centres of Yass, Binalong, Bookham and Bowning. These towns and their surrounds have historic appeal, retaining buildings and other historic features of interest to locals and tourists alike. Tourist accommodation is located within these villages. The rail network passes through Binalong. The three Precincts are not located near any formalised tourist drives however, the Hume Highway, a major thorough fare passes close to the Coppabella Hills and Marilba Hills Precincts. The local road network is used by local and tourist traffic alike.

Binalong, Bookham and Bowning have a rich cultural history (Yass 2008). One of Australia's most famous poets, A.B. 'Banjo' Patterson was raised on a station outside of Binalong. The visitors guide points out a number of tourist attractions within the shire including historical buildings, wineries, limestone caves, quality antiques and arts and craft.

The Yass Valley Development Corporation was formed to assist in the promotion of the benefits of the Yass Valley including tourism. The development corporation is responsible for the promotion of visitor services, events ands and general tourism promotion within the Shire. Visitor numbers within the Yass LGA dropped in the period 2005/2006 due largely to the national petrol price increases, however numbers increased again in the period 2006/2007 (Yass 2007a).

There are a number of annual events that cater for tourists in the Yass Valley Shire LGA. A number of these events are located in the vicinity of the three Precincts and have the potential impacted as part of the Proposal. These events, adapted from Yass (2008) are presented in the table below. There are also a number of events in the township of Yass which have been omitted from this table.

Table 8-8 Annual tourism attractions

Event name	Location	Date
Bookham Sheep Show and Fair	Bookham	April
Binalong Memorial Swimming Pool Market Day	Binalong	October
Wee Jasper Naturally	Wee Jasper	February and August

8.8.2 Impact assessment - construction and decommissioning

Key construction impacts centre on construction traffic along haulage routes, and associated visual, noise and dust impacts. Safety and transport issues are discussed and mitigated within *Section 7.10 Traffic and Transport.* Visual, noise and climate and air quality impacts are discussed separately in Sections 7.2, 7.3 and 8.12.

Additional to mitigation measures discussed for these specific areas, there is potential to minimize the disruption of the construction phase, through liaison with tourist operators.

8.8.3 Impact assessment - operation

Operational impacts, from a tourism perspective, centre on the visual impacts of the development. The number and type of visitors to the area is not anticipated to be impacted by the operational wind farm. The development is not incongruous with the production-based economy of the general area.

The development may generate increased tourism if it is promoted as a tourist destination (pull over area with information or potentially tours of the site). The level of promotion that the development receives would be determined as a separate matter to this development application. It would not be instigated by the Proponent but would be supported by the Proponent if it appeared to be something that the involved landowners, local community and the Yass Valley and Harden Shire Councils desired. Promotion of the development is not part of this Proposal.

8.8.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
74	Affect on local activities	Minimise disruption	Co-ordinate construction activities with local tourist operators. The Proponent would liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works	Pre-construction	CEMP	x	x
75	Affect on local activities	Maximise benefits	The Proponent would work with the involved landowners, the community and both Yass Valley and Harden Shire Councils to allow for the development of the wind farm as a tourist attraction, if this option becomes desirable to these three parties.	Operation	OEMP	x	x

8.9 AGRICULTURAL

8.9.1 Existing environment

Agriculture is the main land use in the Yass Valley, occupying approximately 73% of the total land area (Yass 2007) or about 290,913 hectares. Agriculture in the region is dominated by wool production. Approximately five million kilograms of wool are produced annually from 331 properties (Capital Region Development Board 2005). A sideline industry has developed in fat lambs for the meat industry using Merino-Border-Leicester cross. Yass Valley LGA is diversifying its rural products; many new agricultural industries are emerging including wine, alpaca studs, olives and berries. The close proximity of Canberra to the Yass Valley LGA is assisting the establishment of these new enterprises (Yass Valley Council 2006a). The shift from grazing to cropping and mixed farming is a recent trend and may be related to the recent drought conditions; this trend has been recognised as having implications for land degradation as the land capability is not suited to long-term cultivation (Sheppard 2006).

In general, the precincts are comprised of cleared ridges, slopes and flats containing scattered trees and forest remnants. The pasture is a mixture of native and exotic species.

The context of climate change is relevant to a discussion on the future of agricultural land use. General warming in the region is likely to reduce the capacity of the land. Pittock (2003) observed that a significant proportion of Australian exports are agricultural products sensitive to changes in climate, water availability, carbon dioxide, fertilisation, and pests and diseases. As well as direct impacts, agricultural profits could be affected by a projected increase in agricultural production in mid to high latitude northern hemisphere countries (Pittock 2003). Development of land with uses that are compatible with agricultural activities, such as wind power, therefore have potential to provide increased economic security to rural industries. As well, they provide a substitute for carbon emission producing electricity production that is stable (not dependent on other countries) and renewable.

There is potential for wind power to become a new rural industry, providing a significant new income stream for rural communities at a time when traditional land uses are under pressure (Warren *et al*. 2005). Agriculture has been identified as having a significant role to play in carbon offsetting by a CSIRO report commissioned by the Agricultural Alliance on Climate Change, which includes farming and green organisations, ABC (2007). The report states that farmers could make an extra $3 billion a year by helping to produce clean energy and by offering carbon offsets to polluters. The Climate Institute states this is a key step needed to cut greenhouse gases. These points are particularly relevant to the Yass area where agricultural endeavours have been greatly impacted by recent drought and where anticipated climate change projections indicate a continuation of this trend.

The Proposal would provide a drought resistant supplementary income stream for involved land holders, compatible with current grazing practices.

8.9.2 Impact assessment - construction and decommissioning

Adverse impacts affecting the agricultural use of the three Precincts and surrounding properties would be greatest during the construction and decommissioning phases of the development. They would centre on restrictions to stock access and potential to affect grazing land (direct loss of land, due to footings and tracks, and potential degradation of land, through erosion and sedimentation, pollution and weed ingress).

During construction and decommissioning, stock may need to be excluded from the works area and, in some cases, restricted from access roads, to minimise the risk of collisions. There are likely to be

temporary speed limits enforced to mitigate the risk. The impact of exclusion of stock would be high Coppabella Hills and Marilba Hills which involve very large land holdings and multiple affected agricultural enterprises.

During the construction phase, soil disturbance through the construction and upgrading of tracks, laying electrical cables, excavate footings and create hardstand areas would remove pasture currently available for grazing (refer to the impact area calculations in Section 3.6). In many cases, this impact would be temporary, as disturbed areas would be rehabilitated before the completion of the construction phase (crane hard stand areas, access tracks not required during the operational phase and underground cable trenches). During decommissioning, further areas would be restored to their pre-existing capacity (access and spur tracks not required by the landowner, electricity easements). During the restoration activities, stock access would be periodically restricted while vegetation is re-established. The total amount of land not able to be returned to pre-project agricultural capacity is a minor proportion of the total impact area (access tracks, the footings of turbines, control building and substation).

Potential for indirect impacts is present where soil compaction, erosion, turbid runoff, weed ingress, pollution from chemical spills is not managed adequately. Impacts such as erosion, turbid runoff and weed ingress have the potential to spread, affecting much greater areas of land. Unmitigated, these impacts would reduce the productivity of the affected areas. These impacts are highly manageable, however.

Noise and dust generated during the construction and decommissioning are manageable and considered to represent negligible impacts for agricultural activities, given the mitigation proposed (detailed in Sections 7.3 and 8.12).

Construction impacts are therefore considered to be largely temporary and manageable. Affected land owners would be compensated for the loss of the development footprint by way of the lease arrangements they enter into with the Proponent.

There is an opportunity to improve the native composition of the site and production capacity in some areas onsite. The ongoing expenses of resowing exotic species as well as the resultant loss of soil condition and ingress of weeds are good reasons to investigate the sustainability of using native species rather than replacing them with exotics during site restoration. The precincts retain varying degrees of native understorey, a result of soil type, stocking rate and improvement practices. The rehabilitation and encouragement of native grasses onsite could have production and conservation benefits and should be explored as a potential offset to clearing during the construction phase of project development. Revegetation of disturbed and weedy areas with productive native species, excluding stock from unstable areas as well as management of the timing and intensity of grazing, could be implemented during and following site development to benefit landform stability, native vegetation diversity and may create more drought tolerant pastures.

8.9.3 Impact assessment - operation

Grazing practices

The operational wind farm is not anticipated to affect the way that involved landowners or neighbouring landowners currently manage their agricultural activities. Nor is it anticipated to affect the production capacity of the land, apart from a minor loss of the available grazing area taken up directly by the foot print of the Proposal. The operational wind farm provides a benefit to involved landowners, a supplementary drought resistant income stream throughout the life of the project.

Wind energy organisations promote the capability to graze stock right to the base of wind turbines without ill effect (Union of Concerned Scientists 2005). Given the number of wind farms and duration of their operation on grazing land and the lack of data available to indicate adverse impact, it is assumed that the turbines would have minimal impact on livestock grazing onsite and nearby. 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; *AusWEA* undated (b); British Wind Energy Association undated). There is no evidence to suggest that this would be drawn out or adversely impact animal welfare or agricultural productivity.

Agricultural flying

The use of aeroplanes and helicopters for agricultural purposes such as crop dusting, spraying and fertilising occurs throughout the Southern Tablelands and in the region of the three Precincts. This is significant to the safety of aircraft operating in the vicinity of wind turbines and the potential limitation of aerial operations due to the presence of turbines.

Agricultural operations involving low level flying can only occur in good conditions (high visibility) in accordance with the aviation regulations. It is considered that these conditions would be conducive to wind turbines being readily observable. Pilots who are engaged in low level flying and agricultural operations are required to undertake a risk assessment for each flight. This would identify specific hazards such as trees and powerlines. Wind turbines would be treated no differently. Therefore the operation of agricultural aircraft in the vicinity of wind turbines does not represent an unacceptable risk and is considered safe provided that normal operational procedures are followed.

The location of wind turbines may provide a potential limitation on the aerial application of fertiliser or spraying in the immediate location of a turbine. CASA has no regulations for the minimum distance that agricultural pilots can fly from objects such as wind turbines. The pilot is responsible for assessing the risks with each job. As the turbines are located on ridges predominately used for grazing, spraying activities associated with crops is unlikely. Additionally the turbines are located on involved landowners properties who have consented to the project.

Any turbines located adjacent to property boundaries would have a restricted impact on the ability to conduct aerial operations on neighbouring lands. Therefore it is considered unlikely that the presence of turbines would significantly effect aerial spraying in the vicinity of the three Precincts.

8.9.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
76	Impact on current land use	Minimise disruption	Stock would be restricted from works areas where there is a risk stock injury or where disturbed areas are being stabilised.	Construction	CEMP	x	x
77	Impact on current land use	Minimise impact	Develop, implement and monitor the effects of a **Site Restoration Plan.** The plan would aim to stabilise disturbed areas as rapidly as possibly. The Plan would consider: • Appropriate stabilisation techniques across the precincts • Suitable species for re-seeding (native species would be given preference due to their superior persistence and for conservation purposes) • Monitoring for weed and erosion issues	Construction and Decommissioning	CEMP	x	x
78	Impact on current land use	Minimise disruption	Liaison would be undertaken with neighbouring landowners and landowners adjoining access roads, to provide information about the timing and routes to be used during construction and decommissioning. This could be in the form of advertising and provision of a contact point for further inquiries. The aim would be to reduce the risk of interference with agricultural activities on affected roads and road verges.	Construction	CEMP	x	x
79	Impact on current land use	Minimise impacts	Ensure that the switchyard and substation is appropriately fenced to eliminate stock ingress.	Operation	OEMP	x	x

8.10 HEALTH AND SAFETY

8.10.1 Existing environment

There are a number of hazards associated with the construction, operation and decommissioning of wind farms, including construction activities, construction noise, shadow flicker and the stability of turbines. These issues are assessed below. Note that operational noise impacts and electromagnetic fields are discussed separately in Sections 7.3 and 7.9, respectively.

8.10.2 Impact assessment- construction and decommissioning

Construction activities

Hazards inherent with wind farm construction activities relate to the size and movement of infrastructure (large rotating blades at a great height), high voltage electricity and high wind speeds. The risks are similar to working on other large infrastructure, such as tall buildings and transmission lines. According to Gipe (2008) two members of the public have been killed by wind turbines since 1975. One was a parachutist another was a crop duster that hit a guy wire of a wind monitoring tower. Additionally, Gipe (2008) identifies that 32 construction, operation and maintenance staff has been killed since 1975. Industry practice has improved over this time and many dangerous activities have been eliminated or reduced (SEDA 2004). Employee safety is managed through the application of standard work place practices, such as restraints, fall arrest systems, protective clothing and procedures that enable infrastructure to remain stationary during specific activities. Emergency response protocols and equipment and reminders of the requirement for workers to take responsibility for their safety are able to address a large component of potential risks.

Construction works would take place over a 24-36 month period for all three Precincts, utilising main and local roads. Considering traffic flow to and from the site, the maximum daily rate of traffic at any point in the project's road network is approximately 250 vehicles per day (refer to Appendix 6). As the Precincts are spread over several locations, there would be a number of individual turbines sites and sections of road works. As such, construction impacts at any one location are unlikely to be continuous.

The safety issues associated with construction traffic have been discussed in Section 7.10. Access routes have been selected which, with the implementation of recommended environmental safeguards, would minimise risks to workers, the public and stock during the construction phase.

Hazards and associated risks that construction staff would be exposed to as a result of the Proposal are considered manageable through the implementation of a Site Occupational Health and Safety Plan.

8.10.3 Impact assessment- operation

Shadow Flicker

Shadow flicker is the name given to describe the effect caused by the shadow created as the sun passes directly through the rotating blades of a turbine at a stationary viewpoint. Due to their height, wind turbines can cast shadows on the areas around them. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. For a particular position, shadow flicker will only occur during periods when the suns rays pass directly through the swept area of the turbine blades to the viewpoint. The extent of the shadow flicker is dependent on the time of day, geographical location, meteorological conditions of the site and local vegetation.

The effect of 'chopping the light' attenuates with distance and is not considered, by modellers of shadow flicker (Danish Wind Industry Association 2003) to be noticed beyond 500-1000m from a turbine. The operational wind turbines are not anticipated to produce a flicker frequency high enough to pose a health risk. Comparable turbines have been rated 0.45 to 0.95 Hz, significantly below critical levels of 8-30 Hz for public health.

A detailed analysis of the potential for shadow flicker and blade glint to affect dwellings has been carried out and the full report is presented in the Visual Assessment, Appendix 1. Modelling of the shadow flicker was conducted at each precinct using specialist industry software, assessing the largest turbine (maximum tip height) proposed for the project to represent the worst case impact scenario. The calculated number of annual hours at each of the nearby houses where shadow flicker may be experienced is presented below in Table 8-9. A reduction of the theoretical maximum number of hours was assumed based on the long term observation of cloudy days.

In NSW there are no guidelines on which to assess shadow flicker generated by wind turbines. To carry out the shadow flicker assessment, the Victorian Planning Guidelines [1] that limit the duration of shadow flicker to a maximum of 30 hours per year and 30 minutes in one day, have been sourced. The South Australian Planning Bulletin suggests that shadow flicker is insignificant once a separation of 500m between the turbine and house is exceeded. However, a conservative distance of 1 km has been used for this assessment.

Table 8-9 Calculated hours of shadow flicker predicted for nearby residences.

Residence no.[32]	Precinct	Theoretical maximum shadow flicker (hrs/year)	Actual (reduced) shadow flicker (hrs/year)	Maximum shadow flicker (mins/day)	Compliance with Victorian planning guidelines
M18	Marilba Hills	7	2.1	21	Yes
C25	Marilba Hills	0	N/A	0	Yes

The results show compliance with the Victorian Guidelines of 30hrs/year and 30 mins/day at all nearby residences.

Blade glint will be avoided by the use of non-reflective coatings on the turbine blades.

Flicker vertigo is an imbalance in brain cell activity caused by exposure to low frequency flickering or flashing of a light or sunlight seen through a rotating propeller (Rash 2004). It can result in nausea, dizziness, headache, panic, confusion and – in rare cases – loss of consciousness. Flicker vertigo is usually associated with a light flashing sequence, or flicker frequency, of between approximately 4 hertz (cycles per second) and 20 hertz (Rash 2004, NASA 2001).

Shadow flicker frequencies of between 8-30 hertz can trigger epileptic seizures for photosensitive epileptics. Less than 5% of cases involve photosensitive epilepsia, and only a portion of these photosensitive cases have experienced a seizure triggered by flickering light (Epilepsy Association of Australia).

Flicker frequency of rotating propellers, including wind farm rotors, is derived by multiplying the hub rotation frequency by the number of blades. Based on the rotation speed of the 3 bladed wind turbines

[32] Residence number codes supplied as Appendix 1.

proposed for the project, the maximum shadow flicker frequency would be 1 cycle per second (1 hertz), well outside the frequency range associated with flicker vertigo or photosensitive epilepsy.

The proposal is therefore unlikely to represent a health risk to local residents in relation to flicker vertigo or photosensitive epilepsy.

Stability of Turbines

The stability of turbines is an issue often raised by the local community. Fear that component parts may detach and fall from the turbines can create distress to nearby landowners. The wind turbines, at up to 150 metres in height, would represent a hazard if inadequate anchorage resulted in a turbine falling over or if a blade were to detach during operation and fall to the ground. Ice may also be propelled from the blades in extremely cold conditions. However, the likelihood of these events occurring further than 210m from a turbine has been calculated as 1:10,000,000 (Taylor and Rand 1991, cited in SEDA 2004).

Due to the size of component parts, objects are not likely to fall far from the turbine, in the rare event of malfunction. Three hundred metres has been suggested as the upper buffer distance required to ensure no buildings or populated areas are within range (SEDA 2004). SEDA (2004) also notes that this would always be less than the buffer required to meet visual and noise criteria.

Modern wind turbines are extremely safe and reliable, with a history of independent certification and compliance of over 25 years. Wind turbines supplied by the leading global manufacturers (including those identified in Table 3-2) are designed and built to high industry standards, such as the International Electrotechnical Commission (IEC). Type Certification of particular wind turbine models is provided by independent certification authorities that specialise in wind turbines such as Det Norske Veritas (DMV), Germanischer (GL) and TUV Rheinland (TUV). The Type Certification process establishes the safety and reliability of the design and the validity of its supporting calculations, including the assumptions and inputs on which the certificates are based.

The wind turbine foundations are designed to meet the requirements and loads for the particular wind turbine model, as well as the site specific geotechnical, seismic and climatic conditions. The design and construction of the wind turbine foundations would be in accordance with the Australian Standard for concrete structures (AS3600).

> *"Wind energy is one of the safest energy technologies. It is a matter of record that no member of the public has ever been injured during the normal operation of a wind turbine, with over 25 years operating experience and with more than 70,000 machines installed around the world"*
>
> (British Wind Energy Association 2007)

Complex noise effects on health

Wind turbines and the noise produced from these generators is a relatively new and complex concept. Large changes have been made to turbine design affecting noise propagation over recent years. The complex nature of the noise from wind turbines has motivated recent research on the possibility of adverse health effects from wind turbine noise. There are numerous conflicting papers dealing with this issue yet to date there is no clear evidence to suggest that wind turbine noise causes any physical health problems. Adopting a precautionary approach to this potential impact, a review of these studies is presented below.

A British General Practitioner conducted a study of 42 people suffering adverse affects and *living within 2km of wind turbines*. Despite the small sample size, anecdotal survey style (this paper has not been

published or formally peer reviewed), Dr. Harry made several points of interest for wind farm development:

- The noise produced by wind turbines is complex (intermittent, involving low frequency sound, complicated by other factors) and therefore, the responses produced can also be complex
- The kind of symptoms experienced can act to reinforce each other; sleep disturbance, tiredness, anxiety, head aches and migraines, depression. Having one family member who experiences any or all of these symptoms is likely to affect the well being of other family members, who may not experience adverse noise effects directly
- People most susceptible are those with noise sensitivity; children, the elderly, those with existing stress or depression
- Attitudes to wind turbines and to the amenity value of the landscape and 'peace and quiet' values also appeared to affect the level of adverse impact
- The vibrational component and the visual reinforcement of the moving turbines can compound the effects
- There can be a disincentive for affected people to report symptoms due to the effect it may have on their ability to sell a house near a turbine, generating a 'catch 22' for sufferers

The Swedish Environmental Protection Agency commissioned a report on noise from wind turbines conducted by E. Pedersen from Halmstad University. The aim of the report was to review all present knowledge on perception and annoyance of noise from wind turbines in residential areas as well as recreational areas. The report was to form a base for further discussions on regulation and guidelines for noise from wind turbines in Sweden. The results of the review came to the following conclusions:

- Annoyance from wind turbines is to a degree correlated to noise exposure, but is also influenced by the turbines' visual impact on the landscape;
- Wind turbine noise does not directly cause any physical health problems; and
- Regulations regarding noise from wind turbines for different countries in Europe were inconsistent. The recommended levels, where stated absolutely, varied from 40 – 55 dBA during the day and 35 – 45 dBA during the night when recorded from outside a dwelling. Countries such as France and Scotland recommend that wind farm noise be limited to between 3 – 5 dBA above background noise.

The World Health Organisation (WHO Guidelines for Community Noise, 1999) has developed guideline values for community noise that present noise levels where the lowest adverse effects may occur as a result of noise including temporary or long term deterioration in physical, psychological or social functioning. The available knowledge of the adverse effects of noise on health is sufficient for the WHO to develop guidelines on the following:

- Annoyance
- Speech intelligibility and communication interference
- Disturbance of information extraction
- Sleep disturbance
- Hearing impediments

The most significant and relevant of these in relation to wind farms is the noise levels that could impact the ability of nearby residents to sleep. The WHO guidelines on noise levels that do not result in sleep disturbance is 45dBA measured outside the residence. This is above the criteria levels of the SA noise guidelines of 35dBA that the wind farm must comply with for non-involved landowners.

Early identification of the noise problems and mitigation of its effects may be the best approach to avoiding potential health problems. The Proponent commits to monitoring and mitigating noise exceedences in accordance with the SA EPA Guidelines. Visual impact is discussed in Section 7.2. Community level impacts are discussed in Sections 8.6 and 8.7.

The health hazards associated with the operational phase of the wind farm are assessed as being low. Standard vehicles would be used to during maintenance visits. The control building would be Council approved. Procedures would be put in place to ensure a safe working environment is maintained.

8.10.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
80	Safety of persons or stock	Minimise risks	A detailed **Health and Safety Plan (H&SP)** would be prepared, as a sub plan of **the Construction Environmental Management Plan**, identifying hazards associated with construction works, the risks of the identified hazards occurring and appropriate safeguards would be prepared prior to the commencement of construction works. The Plan would include, but not be limited to: • Inductions for all contractors requiring site access. • Ensure all staff are appropriately qualified and trained for the roles they are undertaking	Construction	CEMP	x	x
81	Safety of persons or stock	Minimise risks	Site fencing would be installed where there is a risk to the safety of the general public (i.e. when the trench is left open for extended periods)	Construction and Decommissioning	CEMP	x	x
82	Safety and Asset protection	Minimise Risk	Establish procedures to ensure that soil is not carried onto the Hume Highway on the wheels of construction traffic	Construction	CEMP	x	x
83	Safety / nuisance to persons or stock	Minimise risks	If shadow flicker is found to be a nuisance to residents, conditions would be pre-programmed into the control system and individual wind turbines automatically shut down whenever these conditions are present	Operation	OEMP	x	x
84	Safety of persons or stock	Minimise risks	Shadow flicker effects on motorists would be monitored following commissioning and any remedial measures to address concerns would be developed in consultation with the RTA and the Department of Planning	Operation	OEMP	x	x
85	Safety of persons	Minimise risk	Establish a turbine maintenance program in accordance with industry standards.	Operation	OEMP	x	x

8.11 HISTORIC HERITAGE

8.11.1 Approach

An assessment of the non-Indigenous heritage status of the proposed Yass Valley Wind Farm is included in the archaeology and heritage report prepared by New South Wales Archaeology Pty Ltd.

This Non-Indigenous component has referred to literature relating to the European occupation, a review of Parish maps and a field inspection aimed at locating historical items, features or potential archaeological sites.

The NSW Department of Urban Affairs and Planning and the NSW Heritage Office have produced guidelines for preparing archaeological and heritage assessments as set out in Heritage Assessments 1996. Where relevant this report has been prepared in accordance with these guidelines and those most recently defined as a result of the 1998 amendments to the *NSW Heritage Act 1977*.

8.11.2 Existing Environment

Searches have been conducted for previous heritage listings in and around the study area; these searches have included all of the relevant heritage registers for items of local through to world significance. Details of these searches are provided in the archaeology and heritage report. The results are summarised briefly below:

Australian Heritage Database

This database contains information about more than 20 000 natural, historic and Indigenous places.

The database includes places in, and places under consideration for any one of these lists:

- the World Heritage List
- the National Heritage List
- the Commonwealth Heritage list
- the Register of the National Estate

A search of the database (11th December 2008) revealed that there are 4 items listed on the Register of the National Estate in or near the Binalong/Burrinjuck area. None of these items are located within or directly adjacent the Yass Valley Wind Farm precincts.

State Heritage Inventory

The *NSW heritage databases* contain over 20,000 statutorily-listed heritage items in New South Wales. This includes items protected by heritage schedules to local environmental plans (LEPs), regional environmental plans (REPs) or by the State Heritage Register.

A search of this database (27th November 2008) revealed that there are 7 items that are listed as being present in the Binalong/Burrinjuck region. None of these items are located within or directly adjacent the Yass Valley Wind Farm precincts.

National Trust of Australia (NSW) Register

The National Trust of Australia (NSW) is a non-government Community Organisation which promotes the conservation of both the built and natural heritage (for example, buildings, bushland, cemeteries, scenic

landscapes, rare and endangered flora and fauna, and steam engines may all have heritage value). The Trust has approximately 30,000 members in New South Wales.

Following its survey and assessment of the natural and cultural environment, the Trust maintains a Register of landscapes, townscapes, buildings, industrial sites, cemeteries and other items or places which the Trust determines to have heritage significance and are worthy of conservation. Currently there are some 11,000 items listed on the Trust's Register. They are considered to be 'Classified'.

A search of the National Trust of Australia (NSW) Register (11th December 2008) revealed that there is one item in the vicinity of the Yass Valley Wind Farm proposal area that is currently listed with the National Trust. The item is outside the Wind Farm precincts.

The historical themes relevant to the proposal area have been listed in the archaeological and heritage report. An historical theme is a way of describing a major historical event or process that has contributed to the history of NSW. Historical themes provide the background context within which the heritage significance of an item can be understood. Themes have been developed at National and State levels, but corresponding regional and local themes can also be developed to reflect a more relevant historical context for particular areas or items.

There is an enormous array of themes and hence potential site types that might occur in and around the Yass Valley Wind Farm precincts. Nonetheless, many of these correspond to heritage items in urban contexts. Given that there are no known historical villages or towns within the proposal areas it is unlikely that most of these themes will be represented within the proposed turbine envelopes and other areas of direct impacts. There is however potential for sites associated with agriculture, such as fences, ploughlands, sheds and water tanks. More generally there is the potential for roads, tracks and paths.

Given that the majority of impacts associated with the proposed wind farm are located on exposed ridge tops, the potential for evidence of early settlement, such as homesteads and huts, is relatively low. The most likely site types to be encountered are sections of old fences and roads. There is also a limited potential for evidence of small mining ventures.

During the field survey three potential non-Indigenous heritage items were recorded in and adjacent areas of proposed impacts. These recordings include a section of wooden fence (Marilba SU4/H1); a small stone feature, possibly a hut platform (Marilba SU28/H1) and an area of ploughland (Coppabella SU24/H1). The potential heritage items recorded during this survey have been assessed against the State Heritage Register criteria and have been guided by the NSW Heritage Office update *Assessing Heritage Significance* (2001) and the Heritage Council of NSW update *Levels of Heritage Significance* (2008). A statement of significance for each item is provided in the archaeology and heritage report. The three potential heritage items are assessed to be of insufficient significance to warrant heritage listing. They cannot be linked to people or events of historical importance and they present limited research potential, aesthetic qualities or other values that might be associated with an item of heritage significance. It is however recommended that limiting the extent of impacts to these items should be undertaken if feasible.

8.11.3 Impact assessment - construction and decommissioning

The construction of the Yass Valley Wind Farm will result in physical impacts to any potential heritage items which may be located within direct impact areas. Given that the three items identified do not warrant heritage listing these impacts are assessed to be low.

8.11.4 Impact assessment - operation

It is considered unlikely that there would be any impact to non-Indigenous sites during the operation of the wind farm.

8.11.5 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
86	Disturbance to a non-Indigenous potential heritage item	Minimise disturbance	The Proponent would limit the extent of impacts to the three identified heritage items.	Construction and decommissioning	CEMP	x	x

8.12 CLIMATE AND AIR QUALITY

8.12.1 Existing environment

The physical impacts discussed below relate to climate and air quality. *Hydrology and Soils and Landforms* were investigated separately as higher priority issues, *Sections 8.1 and 8.2.*

Climate

The proposed Yass Valley Wind Farm development envelope would occupy a total area of approximately 1,400 hectares, with turbine infrastructure located predominantly on elevated ridges addition to access tracks on the side slopes and foothills.

Data obtained from the Bureau of Meteorology the nearest weather station at Lake Burrinjuck, accessed November 2008, indicate that the highest mean maximum temperature occurs in January (29.4°C) and the lowest mean minimum occurs in July (3°C). The mean annual precipitation in the Burrinjuck area is recorded as 919.1mm, between 1908 and 2008. However, precipitation in the Burrinjuck area has been lower than average for six of the last seven years. The annual precipitation totals for the last seven years are as follows: 765.4mm (2001), 653.7mm (2002), 992.2mm (2003), 772.9mm (2004), 892.9 (2005), 358.1 (2006) and 827.8 (2007). Highest monthly rainfall historically occurs from June to August with the lowest monthly rainfall historically occurring from January to March. Climatic data for the Yass area 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. Although the local topography of ranges and plateaus can result in localised climatic conditions, climatic conditions onsite are expected to be similar to that described.

The Southern Tablelands of inland New South Wales has been targeted for the development of wind farms in recent years, 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 on the Southern Tablelands. Summer showed the largest potential for wind generation capacity, with lowest seasonal capacity in autumn.

Air quality

The two precincts are predominately used for agricultural operations. Agricultural activities can produce periodic adverse affects on air quality during activities such as sowing pasture, harvesting or slashing pasture. During drought conditions particularly, large areas of bare ground may occur after intensive grazing, fire or periods of low rainfall. This may increase wind erosion with resultant increases in dust levels.

The State of the Environment (SoE) report for the Yass Valley Council for 2006/2007 identified that 55 substances were emitted into the air in the Yass Valley LGA as reported to the National Pollutant Inventory in 200-2005. Further, air emission in the Yass Valley LGA is impacted by increased transport and use of domestic solid fuel heaters (Yass 2007). Yass (2007) states that air quality in the LGA is generally good but can reduce in winter due to solid fuel heater emissions.

There was no air quality monitoring undertaken in the reporting period or the Harden 2004 State of Environment Reporting period however, this LGA is expected to be more affected by poor air quality, due to greater level of broad acre farming.

Receptors which may be considered sensitive to air quality impacts during and following the development of the proposed wind farm include residences, places of work, and tourist destinations. These are sparsely distributed in the vicinity of the precincts.

8.12.2 Impact assessment - construction and decommissioning

Climate

No climatic impacts are anticipated to be generated during the construction or decommissioning phases. Dust and erosion mitigation are discussed below and in *Section 8.2 Soils and Landforms.*

Air Quality

Dust and emissions are likely to be generated during clearing, excavation, blasting (if required), concrete batching, rock crushing (if required), road works and during the transport of infrastructure and materials to each Precinct. It is considered that any impacts likely to occur would be greatest during the construction and decommissioning phases, both temporary phases, likely to last between 24 - 36 months. In addition, the works area would not be static for this period, it would move as infrastructure is progressively installed and therefore the impact would not be experienced continuously at any one place during these phases.

The precincts and location of nearby residential properties are identified in Figure 3-7: House locations (houses within 5km) – Both Precincts

. The distance between the proposed activities and the receptors as well as the potential for mitigation suggest that air quality impacts during construction and decommissioning would not be high. The impacts of the Proposal during the construction and decommissioning phases are considered manageable with regard to air quality. Mitigation strategies that would be employed during these phases to manage the potential for adverse air quality impacts are presented, below. It is considered that these mitigation measures would be effective in reducing the potential generation of dust resulting from activities associated with the Proposal.

8.12.3 Impact assessment - operation

Climate

Local climate impact

The local climate may be affected to a minor degree by the increase in turbulence caused by the operational wind turbines. 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 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, (maximum of 150 metres from the ground to blade-tip), an effect up to 1.5km from each turbine may be noted (attenuating with distance from the turbines). As the local topography is undulating, the horizontal distance from each turbine may be less than this amount in actuality.

The turbines would turn slowly in low wind conditions and faster with increasing wind speeds; hence they would amplify rather than counter natural wind conditions. The anticipated change in wind speed and

temperature at 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 negligible.

Broad climate impact

The Proposal would make a positive 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, as discussed in detail in Section 4 of this document.

For each megawatt-hour of electricity consumed in the NSW electricity pool, approximately 1,000 kilograms of greenhouse gases are emitted, primarily from coal fired power stations. The Yass Valley Wind Farm would represent a renewable method of electricity generation to meet increasing demand of non-greenhouse gas producing electricity generation. Therefore every megawatt-hour of electricity generated by the wind farm could prevent approximately one megawatt-hour of electricity being generated at a coal-fired power station.

Reduction in greenhouse gas emission directly contributes to combating the adverse impacts associated with climate change including:

- The increase in extreme weather events
- Increased demand for water and associated impacts on natural systems
- Economic impacts associated with changing land capability

Adverse impacts noted specifically for Australian agricultural communities include an increase in floods, droughts and forest fires. As a consequence of reduced local production capacity in conjunction with increased production in positively affected northern hemisphere countries, the economic impact of climate change is particularly relevant to agricultural economies (AGO 2003) such as the Yass region.

No adverse climate change impacts related to the operational phase of the wind farm would result.

Air Quality

The operation of the wind farm would require minimal traffic on roads/tracks that would have been upgraded to accommodate heavy loads during the construction phase. Additionally, none of the wind farm infrastructure would generate emissions that would impact air quality. Therefore, negligible air quality impacts are anticipated to be generated during the operational phase of the wind farm.

8.12.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
87	Air quality	Minimise risks	A cost benefit analysis would be completed on differing potential mitigation options for dust suppression, for inclusion in the CEMP.	Construction	CEMP	x	x
88	Air quality	Minimise risks	Dust levels at stockpile sites would be visually monitored. Dust suppression would be implemented if required. Stockpiles would be protected from prevailing weather conditions	Construction	CEMP	x	x
89	Air quality	Minimise risks	Undertake ongoing visual dust monitoring and suppression (if required) during the construction phase. Monitoring would regularly assess the effectiveness of dust suppression activities. Monitoring would regularly assess the effectiveness of dust suppression activities.	Construction	CEMP	x	x
90	Air Quality	Minimise risks	Should a complaint relating to dust by a resident be received, monitoring at the boundary of the construction site would be undertaken using dust gauges. The Proponent would assess the dust gauges and identify additional mitigation measures, where required.	Construction	CEMP	x	x
91	Air quality	Minimise risks	Should blasting be required, it would be carried out in accordance with all relevant statutory requirements and residences within 1km of blasting activities would be informed prior to blasting	Construction	CEMP	x	x
92	Air quality	Minimise risks	Dust filters would be installed on silos, where required	Construction	CEMP	x	x

8.13 RESOURCE IMPACTS

8.13.1 Existing environment

Life cycle analysis: wind turbine

Life cycle analysis (LCA) is based on careful accounting of energy and material flows associated with a system or process. It is a way to quantify and analyse the resource impacts of a process or project. This approach covers the whole project life cycle, from the extraction of raw materials to the disposal of materials at the completion of projects. LCA is particularly relevant for renewable technologies, where it is often argued that the energy used to produce the technology is not 'paid back' during the lifetime of the technology (Schleisner 2000). LCA estimates of energy and emissions based on the total life cycle of materials used for a project, i.e. the total amount of energy consumed in procuring, processing, working up, transporting and disposing of the respective materials (Schleisner 2000).

In Schleisner's (2000) analysis of two wind farms in Denmark, the energy 'payback' time was modelled to be 0.26 years for a wind farm on land. That is, in approximately 3 months, the energy produced by the wind farm had 'paid back' the energy consumed in producing, installing and decommissioning that wind farm. It was found that 94% of the materials used for construction of a wind turbine could be recycled (Schleisner 2000). Additionally, the value of the materials able to be sold for reuse can be used to offset the cost of decommissioning the wind farm and rehabilitating disturbed areas to pre-existing or better condition.

Matinez *et al* (2009) completed a study of the Life Cycles of wind turbines based on an energy efficiency of 200 equivalent full load hours. The study points out that relative payback times for energy used in the production and disposal of materials comprising the wind turbine 0.40 year or 2% of a 20 year lifetime. Additionally, the pay back time for contamination caused by its manufacture, start up, operation and decommissioning is less than 3.1% of a 20 year lifetime.

In 2004 Vestas Wind Systems, a Danish wind turbine manufacturer, commissioned a lifecycle analysis (LCA) of the V80 2.0 MW turbine (Elsam Engineering A/S, 2004). The study investigated the manufacturing, construction, installation, operation and decommissioning impacts of the wind turbine. The study was site specific and investigated turbines in the Tjæreborg wind farm on the west coast of Denmark. The results of the V80 LCA found that a total of 3,635,850 kWh of energy was consumed in the lifetime of each turbine (Elsam Engineering A/S, 2004). Based on this figure it was found that the Tjæreborg wind farm had an energy payback period of 7.7 months (when disposing and recycling of the equipment is taken into account).

A life-cycle assessment has been conducted by Vestas for a Vestas V90-3.0MW wind turbine. Vestas divided the life-cycle into four phases: production, transportation, operation and disposal. This assessment looked only at the turbines and did not consider associated infrastructure such as transmission lines, substation and control building.

The study identified that the greatest consumption of energy and resources occurred during the production phase. Raw materials required include iron ore for the construction of steel components and their casings as well as crude oil to make the epoxy materials used in blade construction. These resources are limited and considered non-renewable. In contrast, energy consumption during the transportation, operation and disposal phases was relatively minor.

During the operational phase (based on a 20-30 year life-span and taking into account the maintenance required over this period) the costs of construction and decommissioning begin to be offset by the

operational capacity of the turbines. Disposal encompasses the fuels required to dismantle and transport the turbines as well as the disposal of materials.

Using a functional unit of 1 kW hour as a basis for comparison, Vestas provide the following comparisons between phases of the 3MW wind turbine life-cycle and CO_2 emissions between other energy producing power stations (tables below).

Table 8-10 Break down of the energy consumed during phases of the life cycle of a Vestas V90-3MW.

A Vestas V90-3MW turbine is expected to generate 157,800MWh during a 20 year lifetime, repaying energy required to produce the turbine in approximately 6.6 months. Energy required to produce, transport, operate and dispose of the turbine has been converted to MWhs to facilitate comparison with total energy produced.

Phase	Onshore vestas v90-3mw
Production phase	7,795.00 MWh
Transport phase	74.00 MWh
Operation phase	14.00 MWh
Disposal phase	*-3,572.00 MWh
Total	4.311 MWh

** the negative figure indicates the value of the material for reuse or recycling.*

Table 8-11 Comparison of CO2 emissions produced per kilowatt hour

Using energy output (kWh) to compare emissions, the wind turbine produces a small fraction of the CO_2 emissions of coal or gas-fired power stations.

Generation method	CO_2 produced
Onshore Vestas V90-3MW turbine	8 grams per kWh
Gas-fired power station	467 grams per kWh
Coal-fired power station	826 grams per kWh

Hence, by comparison to major electricity generating methods employed in Australia, wind farms rate favourably based on:

- CO_2 emissions generated per kilowatt hour of energy produced
- Potential to reuse and recycle component parts
- Energy payback time in comparison to the life span of the project

8.13.2 Impact assessment - construction and decommissioning

It is considered that the majority of resource use and waste generation would occur during the construction and decommissioning phases.

Use of resources

The construction of the proposed wind farm, including associated infrastructure, would require the use of various resources, such as concrete and other masonry products (footing, slabs, hardstand areas, building elements), materials associated with the operation of machinery, and motor vehicles (fuels and lubricants) and other construction materials (metals, glass, plastics). These materials are not currently depleted or restricted in supply however; increasing scarcity and environmental impacts are becoming apparent from the use of fossil fuels, mineral resources and other non-renewable resources. As such, the Proposal is unlikely to place significant pressure on the availability of local or regional resources.

Additionally, research cited above indicates that embedded energy within wind turbines is 'paid back' within a relatively short time frame. Research reviewed indicated that payback times varied up to one year post commissioning of the wind farm.

Recycling of materials at the end of the life of the wind farm would create another opportunity for a positive impact resulting from the Proposal. The life cycle analysis of the Vestas 3 MW wind turbine identified that recycling of parts post decommissioning of turbines would have the net effect of -3572.0 MWh based on the value of material for reuse or recycling.

Generation of waste

Solid waste is one of the major pollutants caused by construction. Waste would be generated by a number of different activities occurring during the construction phase including:

- Vegetation clearing
- Material from packaging
- Building materials
- Scrap metals
- Excess soil material
- Plastic and masonry products

It is considered that waste generated as a result of the construction phase, detailed above would be classified as building and demolition waste within the class *general solid waste (non putrescibles)* in accordance with the POEO Act.

Sanitary wastes would also be generated within the ancillary facilities (site compound) during the construction period. This waste would be classified as *general solid waste (putrescibles)* in accordance with the POEO Act.

Table 8-12 identifies the potential waste streams and proposed management options for each stream.

Table 8-12: Likely waste streams and associated management options

Waste stream	Generation process	Example of waste type	POEO classification	Management strategy	Waste storage
Office Waste	General office activities	Paper, plastics, packaging, cartridges, polystyrene	General Solid (non-putrescible)	Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non recyclable materials.	A mixed recycling bin would be provided and located within the site office compound
Office Waste	General office activities	Food	General solid (putrescible)	Provide separate waste bins on site for food waste. Regular collection of this waste will be undertaken with the collected waste disposed of at an appropriately licensed facility.	A food scraps bin would be provided and located in the site mess room
Packaging	General construction activities	Timber pallets, plastic, steel strapping, cardboard	General Solid (non-putrescible)	Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non recyclable materials.	A recycling bin would be provided and located within the designated lay down area
Construction Activities	Excavation and earthworks	Excess spoil	General Solid (non-putrescible)	Reuse onsite, if unable to re use on site dispose of at appropriately licensed land fill.	Any excess material would be stockpiled on site
Construction Activities	Vegetation clearing	Excess cleared vegetation	General Solid (non-putrescible)	Non weedy material would be mulched and used during rehabilitation.	Any excess material would be disposed of at an appropriately licensed facility.
Construction Activities	Vegetation clearing	Excess cleared vegetation	General Solid (non-putrescible)	Weedy vegetation would be sprayed and bagged to avoid potential proliferation.	This material would be disposed of at an appropriately licensed facility.
Construction Activities	Construction materials	Formwork, reinforcing steel, PVC conduits, cables	General Solid (non-putrescible)	Ensure this waste is not mixed with any other waste. Provide separated recycling bins onsite for recyclable material. Provide general waste bins for non recyclable materials.	This material would be stockpiled on site and removed by an appropriately licensed waste contractor

Waste stream	Generation process	Example of waste type	POEO classification	Management strategy	Waste storage
Construction Activities	Construction materials	Cable reels	General Solid (non-putrescible)	All cable reels would be stored on site and returned to the manufacturer	Cable reels would stored on site within the lay down area
Construction Activities	Concrete Truck Wash out	Concrete laden water	Liquid waste	Washout waster would be contained within a concrete wash out bay. This water has a high pH and high turbidity. The water component of the waste water is left within settling ponds to evaporate. The resulting waste is concrete sludge.	A dedicated concrete wash facility would be located in the close vicinity of each turbine. Concrete sludge would be re-used for road base aggregate or disposed as inert waste to an appropriately licensed land fill
Construction Activities	Sewage	Sewage	Liquid waste	Sewage waste generated onsite would be stored within toilet tanks.	The sewage would be collected and transported by a transport company licensed to transport class C waste
Construction Activities	Use of chemicals	Empty drums and storage containers	Classification dependant on chemical stored	Drums and containers would be stored in an appropriately bunded hardstand area.	This material would be disposed of at an appropriately licensed facility.

POEO: *Protection of Environment Operations Act* 1997

A key strategy of construction and decommissioning works would be to avoid and minimise waste from the construction site, reuse and recycle waste where possible and dispose appropriately of waste which cannot be managed in any other way. This is the application of the Waste Hierarchy which states that:

1. Strategies which try to avoid products becoming waste are generally preferable to
2. Strategies which seek to find a use for waste, which are in turn generally preferable to
3. Strategies for disposal which should be used as a last resort

The Proponent would prepare a Waste Management Plan (WMP) as part of the CEMP. The WMP would identify all potential waste streams associated Proposal. The WMP would also outline methods of disposal of waste at appropriately licensed facilities.

8.13.3 Impact assessment - operation

Resources required during the operational phase include fuel for construction and maintenance vehicles, lubricants for oil changes in the turbines and replacement parts if required that may consist of metal and plastic based products. The discussion and safeguards above apply equally to this phase, although resource requirements and wastes are anticipated to be much lower. All wastes would be removed by contractors and maintenance staff. No local garbage service would be required.

8.13.4 Mitigation measures

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
93	Waste generation	Minimise waste and maximise recycling of materials	The Proponent would prepare a **Waste Management Plan** to be included within the **Construction Environmental Management Plan**. It would include but not be limited to the following: • The scope for reuse and recycling would be evaluated • Provision for recycling would be made onsite • Wastes would be disposed of at appropriate facilities • Toilet facilities would be provided for onsite workers and sullage from contractor's pump out toilet facilities would be disposed at the local sewage treatment plants or other suitable facility agreed to by Council • Excavated material would be used in road base construction and as aggregate for footings where possible. Surplus material would be disposed of in appropriate locations on site (on agreement with the landowner), finished with topsoil, and revegetated	Construction Operation	CEMP OEMP	x	x

8.14 CUMULATIVE IMPACTS

8.14.1 Existing environment

Cumulative impacts, for the purpose of this assessment, relate to the combined potential effects of different impact areas of the proposal (i.e. construction traffic combined with visual impact) as well as the potential interaction with other proposals in the local area (e.g. the combined effects of multiple adjacent wind farms or other large infrastructure projects, during construction, operation and decommissioning).

The Goulburn / Yass region has high wind speeds and good access to electricity and transport corridors. Therefore, there is potential for other wind farms or similarly large scaled infrastructure to be proposed and developed in the future. In the Goulburn / Yass region (16,175 km^2, one wind farm is operational (Crookwell I), two have commenced construction (Capital and Cullerin) and four additional projects have been granted Planning Approval (Woodlawn, Crookwell II, Taralga and Gunning). In the Yass area, one wind farm has been approved (Conroys Gap).

This proposal would involve the construction of up to 152 turbines over two precincts: Coppabella Hills (up to 86 turbines), Marilba Hills (up to 66 turbines). Carroll's Ridge Precinct would be the subject of a separate EA (up to 30 turbines). The approval of all three precincts of the proposed Yass Valley Wind Farm would represent a 69.5% increase in the total number of turbines developed or approved for development within the region.

Cumulative impacts can occur concurrently or sequentially. They are assessed in this section under the broad headings of visual impacts, noise impacts, biodiversity impacts, air hazard impacts, traffic impacts, economic and resource impacts, social impacts and climate and air quality impacts.

8.14.2 Impact assessment

Visual

It is considered that the potential visual impact associated with the construction of one precinct would be less than if two or three precincts were constructed. For the purposes of this assessment, consideration of potential cumulative impacts associated with the construction of all three precincts (up to 182 turbines) has been adopted.

There are a number of wind farms either approved, under construction or proposed in the southern tablelands of NSW. The construction of the proposed Yass Valley Wind Farm would result in a large increase in the total number of turbines approved or proposed in the southern tablelands. This large increase in the total number turbines has the potential to increase the cumulative visual impact of the Yass wind farm. Currently, the closest approved wind farm is Conroy's Gap which is flanked by the Marilba Hills precinct.

The proposed Yass Valley Wind Farm is located in close proximity to the Hume Highway. Currently the Cullerin Range wind farm (under construction) and the Conroy's Gap wind farm (planning approved), are the only other wind farms located in the direct vicinity of the Hume Highway, east of the Yass proposal. The Cullerin Range wind farm site (15 turbines) is visible from the Hume Highway and is located between 45 and 60 minutes east of the current proposal. The Conroy's Gap wind farm is located adjacent to the Marilba Hills precinct and is visible from the Hume Highway. The construction of the proposed Yass Valley Wind Farm would represent a cumulative visual impact to users if the Hume Highway. It is considered that the distance between Cullerin and the proposed Yass Valley Wind Farm in addition to individual mitigation

measures applied on a precinct specific basis would reduce the severity of this potential cumulative impact.

Noise

Cumulative noise impacts were considered in the modelling completed for the noise impact assessment. All layouts displayed in the noise impact assessment have considered the cumulative impacts of nearby wind farm developments and have shown that compliance is achievable. Cumulative noise impacts are expected to be within guideline limits for operational noise from the wind farm.

Biodiversity

The key impact of wind farms, with respect to cumulative impacts, is the potential to generate continuing losses of some species with low reproductive rates (such as Wedge-tailed Eagles and Eastern Bentwing Bats), and thereby create a 'mortality sink' with potential to affect populations at a regional level (Jonzen et al. 2005). Mitigation strategies are included in this proposal to address this risk.

The impacts of the wind farm on biodiversity values would combine with existing impacts resulting from land clearing, agricultural activities, weeds and hazards. It is important to recognise that the district has experienced extensive losses to ecosystem integrity and stability. Woodland and grassland communities in particular, which coincide with prime agricultural land, and riparian and wetland communities have been heavily impacted. It is likely that many woodland flora and fauna species have become locally extinct, and many are in continuing decline. There is a time lag, or 'extinction debt', operating which will mean that decline and extinction will continue for many species for decades to come, regardless of management responses. Further impacts on lowland environments are expected from soil and water salinisation, soil erosion and sedimentation, weed invasion and spread, disruption to river hydrology due to farm dam construction and water extractions and habitat fragmentation and clearing resulting from residential sub-division and building.

To address cumulative biodiversity impacts, this EA includes mitigation measures to reduce impacts on areas of higher conservation significance and to offset the area to be disturbed by the proposal. Offsets are considered to be required, where impacts cannot be avoided, in order to achieve a 'maintain or improve' environmental outcome. The approach taken by this assessment is to offset the quantum of habitat loss associated with the proposal, based on the finalised infrastructure layout. The broader environmental benefits of establishing renewable energy sources have not been considered in the assessment or offset plan. Therefore, coupled with measures to offset habitat loss, the contribution of the proposal to reducing the adverse environmental impacts of fossil fuel based electricity generation is anticipated to constitute an overall 'improve' outcome.

Ongoing monitoring of operational biodiversity impacts, such as collisions, would be undertaken in collaboration with both precincts, as well as other regional wind farms. This commitment addresses the need to build local knowledge of actual impacts of wind farms in the region and address them in a co-ordinated manner. Specific Statements of Commitment are stated in Section 7.4 of this EA.

Traffic impacts

There is the potential for an increase in traffic, primarily associated with the construction phase to combine with existing road traffic on the Hume Highway and surrounding roads. It is planned that construction of the wind farm would occur sequentially, one precinct at a time, thus reducing the severity of the potential impact. Traffic impacts are considered to be primarily associated with the construction period and therefore would be temporary in nature.

The Hume Highway is a state highway that acts as the main inland transport corridor for people travelling between Sydney and Melbourne. It is considered that impacts to motorists using the Hume Highway would be manageable as the road is designed to cater for a large volume of traffic. Smaller roads that would be utilised for access would be subject to increased traffic volumes during the construction phase. With the adoption of the mitigation options identified these impacts are also considered manageable.

Economic and resource impacts

The potential for positive cumulative economic effects of the proposal is very real during the construction of the project. Particularly, if a number of wind farms are constructed within the region at the same time, there would be potential to increase the skills of the local work force and to establish industry relating to the manufacture of a proportion of project infrastructure. Liaison will continue with local economic development bodies to ensure this potential is maximised.

Social impacts

Public perception studies have shown that more realistic and positive perceptions accompany actual physical experience of wind farms; fear of the unknown can exaggerate perceptions of visual and noise impacts particularly (Warren et al. 2005).

While it is certain that not all members of the community will view the proposed development of wind farms favourably, in some communities, investment in clean energy production can become a point of pride to residents. During wind farm community consultation in Berridale, NSW for the Snowy Plains Wind Farm, many participants spoke with pride about the Snowy Hydro Scheme and the appropriateness of similar clean energy developments in their shire (B. Marshall pers. obs 2005). The southern tablelands region looks well placed to become a leader in the Australian wind industry. The results of the NSW Southern Tablelands Survey 2007 (REARK Pty Ltd 2007, refer to Section 4.2.2) indicate that support for renewables is high.

Adverse cumulative impacts post construction may result from the altered perception of the character of the area. For lifestyle, recreational and tourist land uses, this impact is keener. These impacts have been discussed in Sections 8.7 and 8.8.

Climate and air quality impacts

During construction, there is potential for cumulative exhaust and dust generation, if other wind farms or other large scale infrastructure projects occur concurrently. These impacts are highly manageable on a project by project basis. Measures in Section 8.12 would assist in ensuring that the impacts of this proposal would be managed appropriately.

The cumulative impact of additional wind farms in the region would have positive impacts for NSW in terms of the provision of non-fossil fuel sourced electricity to meet increasing demand. In terms of addressing increasing greenhouse gas emissions, this is a net benefit of the proposal.

9 STRATEGIC JUSTIFICATION

This section provides a strategic assessment of the justification for the project in the context of its local and regional setting. It also outlines the suitability of the project, and indicates where this is discussed in more detail throughout the report, as well as describing the considered alternatives.

The justification for the Coppabella Hills and Marilba Hills Precincts of the Yass Valley Wind Farm development is based on the following forecasts;

- In full operation, it would generate 1200 GWh of electricity per year -sufficient for the average consumption of 150,000 homes
- It would improve the security of electricity supply through diversification
- It would reduce greenhouse gas emissions by approximately 1,160,000 tonnes of carbon dioxide (equivalent) per annum
- It supports the strategic direction of the region, as outlined in the Sydney-Canberra Corridor Regional Strategy
- It would contribute to the NSW Government's target of providing 15% of consumed energy from renewable sources by 2020
- It would contribute to the NSW Government's target of reducing green house gas emissions by 60% by the year 2050
- It would create local employment opportunities and inject funds of up to $334 million into the Australian economy

Apart from these main objectives, ancillary benefits and opportunities would also accrue. These include local community, infrastructure, tourism and biodiversity benefits.

9.1 PRIMARY JUSTIFICATION

9.1.1 Electricity generation capacity

In order to determine the likely energy generated by the proposed wind farm, a thorough wind energy assessment was undertaken based on an indicative turbine layout. This analysis calculated the amount of energy produced by the project in a typical annual wind regime. Various on-site losses, such as in cabling and from substation operations, were then subtracted to produce an estimate of the sent-out electricity generation for a typical year.

Additional investigations were carried out by the Proponent on a wider range of turbines using the wind turbine analysis tool Windographer™. This analysis has produced a range of energy yield estimates based on the turbine layouts indicated in Figures 3-10 to 3-12.

On the basis of these studies energy production estimates (on a sent-out basis) for the proposed Yass Valley Wind Farm are in the range of 5.5 to 8.5 GWh per turbine per annum, depending on final turbine selection and turbine layout. This calculation is based on a predicted typical year, with variations in the order of 10-20% likely for any single year. Predictions used in this report are therefore based on an average figure of 7.0 gigawatt-hours (GWh) per turbine per year.

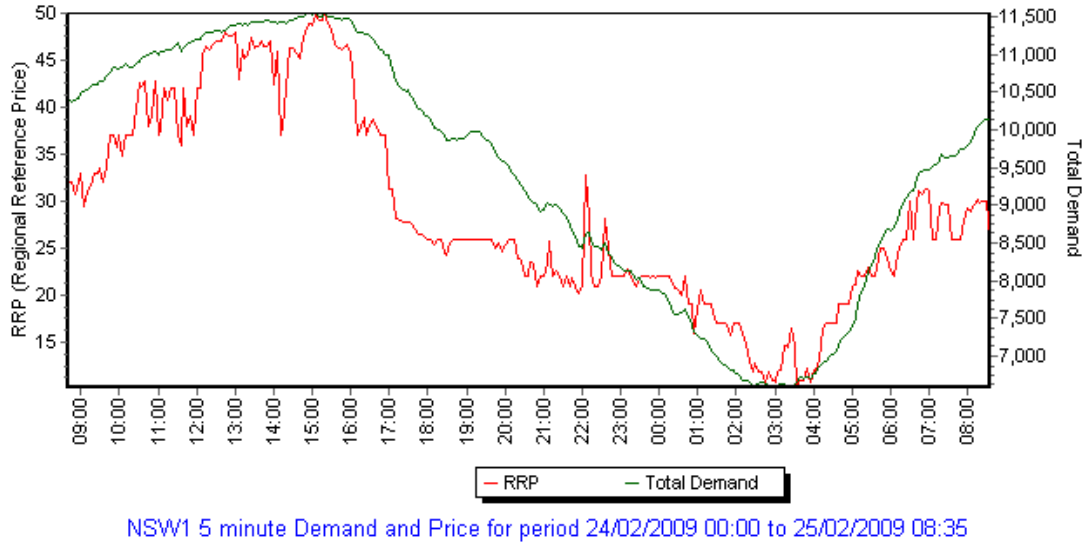
In 1999 the average domestic electricity consumed in NSW was 7,399 kWh, growing from the 1990 average of 6,983 kWh (DEUS 2000). A figure of 8,000 kWh on average is applied in this report based on

ABS figures. On this basis the wind farm is expected to produce electricity in the order of 1200 GWh per annum, equivalent to the average consumption of 150,000 homes. Further figures in this report are based on this production estimate.

9.1.2 Security through diversification

The reliability of electricity supply is a measurement of the total time customers are without electricity each year against the total time that electricity was demanded. The NSW electricity supply is currently rated as being 99.7% reliable. The Government's goal is to achieve 99.98% by 2016 (NSW Government, 2006). A reliance on coal-power stations to achieve this goal may be limited.

Figure 9-1 below shows electricity demand in NSW over a 24 hour period on February 25 2009. The graph shows a daily variation of approximately 5,000 MW.



Source: NEMCO Live Market Data, **www.nemmco.com.au**, accessed 25/02/09

Figure 9-1: Daily variations in NSW electricity demand (25th February 2009)

Coal fired power stations are limited in their ability to vary their output and match the daily fluctuations in energy demand. Efforts to flatten out the demand curve to match supply include reduced cost electricity being offered to consumers when demand is lower. In general, energy generated from renewable technologies, such as solar and wind, are more flexible with their output and can follow the short-term variations in demand (Needham, 2008).

Energy generated from the Coppabella Hills and Marilba Hills Precincts would fluctuate daily with variations in the wind speed on-site. These variations would not impact on the daily demands within the electricity system.

TransGrid and NEMMCO require modelling of the existing network (in accordance NEM rules) to demonstrate that the wind farm would not adversely affect the performance of the network under normal or fault conditions. The proposed wind farm is located in close proximity to the substation at Yass, one of the strongest nodes in TransGrid's network. Preliminary investigations have revealed that the

network in this area is strong and stable under most fault conditions and would able to handle fluctuations in power output from the wind farm.

The development of these Precincts would offer diversification to the existing electricity supply infrastructure, which helps mitigate the risks of power station failures. A single coal fired power station in NSW can generate up to 2,640MW, or approximately 20% of the total NSW generation capacity. An outage or failure of such a power station would have a significant impact on the operations on the electricity system and thereby the economy as a whole

9.1.3 Need for renewable energy

Life Cycle Assessment and Embodied Energy

Life cycle analysis (LCA) is based on careful accounting of energy and material flows associated with a system or process. It is a way to quantify and analyse the resource impacts of a process or project. LCA is particularly relevant for renewable technologies, where it is often argued that the energy used to produce the technology is not 'paid back' during the lifetime of the technology. A detailed LCA is presented in Section 8.13.

A study commissioned by Vestas Wind Systems in 2004 revealed that the energy 'pay-back' for the Tjæreborg wind farm was 7.7 months (when scrapping of the equipment is taken into account). When considering the turbine itself it found that the Vestas V90 3.0MW machine produced 8 grams of carbon dioxide per kWh over its lifecycle. In comparison a Gas-fired power station produces 467 grams per kWh and a coal-fired power station produces 826 grams per kWh.

Contribution to reducing greenhouse gas emissions

During its operational phase, the Yass Valley Wind Farm would generate electricity without producing greenhouse gases. The Life Cycle Analysis discussed in Section 8.13 demonstrates that while there are some GHG emissions associated with the manufacturing, construction and decommissioning of wind turbines, this amount is negligible compared to the amount of clean renewable energy produced. At this stage it is not possible to determine the exact reduction in GHG emissions, however, some assumptions can be derived.

By providing additional energy to the grid, the project would reduce the need for this same amount of energy to be produced at a coal power station. This would in turn reduce the amount of GHGs emitted that are currently associated with this amount of electricity.

As derived in Section 4.3.4, 967 kilograms of GHGs are emitted for every megawatt-hour of electricity produced by power stations for the National Electricity Market. In theory for every megawatt-hour of electricity generated by the proposed wind farm, the emission of at least 967 kilograms of greenhouse gases is avoided.

If the amount of energy is 1430 GWh p.a, then the amount of GHGs avoided would be 1,368,000 tonnes per year. This value is estimated based on the current dominance of coal power stations in the NSW pool. It doesn't account for change to the NSW Pool Coefficient, or change to the future mix of electricity generators.

The employment of other renewable energy technologies would also result in similar GHG reductions. However, as demonstrated in Table 9-1 and Table 9-2, wind technology has a higher sent-out capacity and lower capital and operating costs than other technologies. Therefore the most feasible way to reduce GHG emissions from energy generation is presently via wind farms.

Table 9-1 Technology Costs and Performance Assumptions, 2007

Option	Life (years)	Sent-out capacity (MW)	Capital cost - 2010 ($/KW SO)	Efficiency improvement (% pa)	Variable non-fuel operating ($/MWH)	Fixed operating cost ($/KW)
Wind	25	99	2,134	0.2	2.0	35
Biomass - Steam	30	28	2,598	0.1	4	50
Biomass - Gasification	25	27	2,784	0.1	5	50
Concentrated Solar Thermal Plant	20	99	4,176			50
Geothermal - Hot Dry Rocks	25	45	4,400	0.1	3	70
Concentrating PV	30	97	4,640	0.1		
Hydro	35	30	2,320	0.1	3	35

Source: McLennan Magasanik Associates, 2009

In 2008, the projects listed in Table 9-2 were approved as Critical Infrastructure projects under Part 3A of the *Environmental Planning and Assessment Act 1979*. The total additional electricity generated from the projects once they are in full operation would be 560 MW per year. Development of the Coppabella Hills and Marilba Hills Precincts of the proposed Yass Valley Wind Farm is predicted to generate roughly 380 MW per year. As shown in Table 9-2, the combined total of GHG emissions from these projects is in the order of 1,558,769 tCO2e per year. In comparison this development would have a very low amount of GHG emissions associated with the construction, operation and decommissioning phases. The size of the proposed wind farm project would reduce the need for multiple smaller scale power plants.

Table 9-2:Energy Generation Projects Granted Development Approval in 2008

Project name	Project description	Projected (additional) annual energy production	Predicted (additional) annual greenhouse gas emissions
Narrabri Coal Seam Gas Utilisation Project	Expansion of the Wilga Park Power Station from 11MW to 40MW	40 MW	204,193 tCO2e
Bamarang Gas-Fired Power Station	Construction and operation of a gas fired power station (Stage 2)	400MW	1,245,576 tCO2e
North-West Parkes Gas-Fired Power Station	Construction and operation of a gas-fired power station	120 MW	109,000 tCO2e

Sources: Project EA's as found on the Department of Planning's website.

Impact on climate change

Reduction in greenhouse gas emission directly contributes to combating the adverse impacts associated with climate change including:

- The increase in extreme weather events
- Increased demand for water and associated impacts on natural systems, and
- Economic impacts associated with changing land capability.

Adverse impacts noted specifically for Australian agricultural communities include an increase in floods, droughts and forest fires. As a consequence of reduced local production capacity in conjunction with increased production in positively affected northern hemisphere countries, the economic impact of climate change is particularly relevant to agricultural economies (AGO 2003) such as the Yass region.

Major changes in vegetation composition will come through shifts in rainfall patterns and increased runoff distribution and will favour the establishment of woody vegetation and encroachment of unpalatable woody shrubs in many areas (Australian Greenhouse Office 2003). In modified landscapes, the ability of organisms to survive climate change through dispersal may be limited (Brasher & Pittock 1998, Australian Greenhouse Office 1998, cited in DECC 2007). Species at particular risk from the effects of climate change include those species with long generations, poor mobility, narrow ranges, specific host relationships, isolated and specialised species and those with large home ranges (Hughes & Westoby 1994, cited in DECC 2007). Pest species may also be advantaged by climate change.

As it represents a positive contribution to reducing the emission of GHGs, the proposal therefore is a positive contribution toward addressing the negative environmental consequences of climate change.

9.1.4 Supporting state and regional initiatives

Federal renewable targets

As mentioned in the previous Chapter, the Australian Government has committed to sourcing 20 per cent of Australia's total electricity supply from renewable energy by 2020. This Renewable Energy Target (RET) requires a total of 45,000 GWh of electricity to be generated from renewable projects. Similarly, to meet the NSW State government NRET targets an additional 1,317 GWh is needed by 2010 and 7,250 GWh by 2020.

The Coppabella and Marilba Precincts would help meet both Federal and State government renewable energy targets by providing 1200 GWh per year. This would contribute to just over 2.5% of the renewable energy needed to the Federal RET and 16.5% towards the 2020 NRET.

The RET is technology neutral, however because it is market based it feeds the electricity source with the lowest cost generation into the NEM. As shown in Table 9-3 out of all the commercially viable renewable energy technologies, wind energy currently has lower costs associated with generation.

Table 9-3: Comparison of energy technologies

	Technical Maturity	CO_2 Intensity (Kg/MWH)	Water Use (L/MWH)	Cost ($/MWH)
Coal	Mature	969	1,300,000	31 – 40
Natural Gas	Mature	500	~ 260,000 - 520,000	37 - 44
Hydro	Mature	4 - 10	Significant enviro issues	27 - 282
Wind	Mature	7	Nil	75 - 90
Solid Biomass	Mature	Possibly negative under some circumstances	~ 2000 (wet) ~ 700 (dry)	47 - 120
Solar Thermal	Demo	~ 3	~ 2000 (wet) ~ 150 (dry)	120 - 150
Solar PV	Mature	~ 3	Nil	400 - 800
Geothermal	Research	~ 3	high	Large range
Nuclear	Mature	~ 3	1,100 – 1,850	50 - 80
Ultra Clean Coal	Demo	770 - 825	Unknown	Unknown

Source: *Macquarie Generation 2007.*

Reports from three consultants, CRA International, ROAM Consulting and ACIL Tasman, have all concluded that wholesale electricity prices would be lower after the commencement of the Federal Government RET in 2010. It is forecast by CRA that by increasing low cost renewable energy to the national electricity pool, prices could fall by as much as 5% (Galacho, 2009). DECC modelling results released at the same time contradicts this by stating wholesale electricity prices would rise by an average of 0.5% from 2010 to 2020 (Galacho, 2009). Modelling undertaken by McLennan Magasanik Associates for the Federal Government found that that wholesale electricity prices will rise by less than 1% after the commencement of the RET scheme, however retail prices will rise by around 3.5% (Breusch, 2009).

The proposed Precincts would provide renewable energy eligible for Renewable Energy Certificates under the Federal Government's RET. The full costs of these schemes have already been taken into account by electricity retail companies in power prices set by them.

NSW renewable targets

The State Plan (NSW Government, 2006) is a Government planning document that provides a comprehensive overview of the strategic direction for the State. The plan outlines rigid framework which sets priorities and targets for action over the next 10 years.

In the Plan electricity has been identified as a key area of State concern, with currently only 6% of NSW's total energy consumption being provided from renewable energy sources. Priority E2 of the Plan sets a target to increase this to 10% by 2010, and to 15% by 2020. One of the initiatives established to help achieve this is the NSW Renewable Energy Target (NRET), as previously discussed.

Green house gas emissions are also identified as an area of concern and Priority E3, which directs air quality and greenhouse gas emissions across the State, sets the target of achieving a 60% cut in greenhouse emissions by 2050 and returning to the year 2000 GHG emission levels by 2025. To achieve this the NSW Government has made a commitment to support low energy emission supply projects.

The proposed Precincts of the Yass Valley Wind Farm support the strategic direction of State by providing an on-going renewable energy source with no GHG emissions. The project would assist the Government towards achieving the targets set in both Priority E2 and Priority E3 of the State Plan.

Sydney-Canberra Corridor Regional Strategy

The majority of the proposed Precincts fall within the NSW Department of Planning's Sydney-Canberra Corridor Regional Strategy (Department of Planning 2008) and would feed energy into transmission lines that service the identified Corridor area. The Strategy predicts a population increase of 46,350 people in the Region by 2031, demanding an extra 25,200 new dwellings. This expected population increase would also create the need for additional local employment opportunities. The Strategy also calculates that an additional 295 ha of land in the region would need to be rezoned for employment (Department of Planning, 2008); meaning the region would experience a growth in industrial ventures. This development would supply electricity to the regional grid, having the potential to power 150,000 homes each year or support growth in business and industry. Furthermore, the operational and maintenance phases of the wind farm would assist the Strategy by providing up to 33 on-going local jobs.

The Sydney-Canberra Corridor Strategy (2008) identifies wind farms as a "critical investment in the Region and the State's energy network" and recognises the geographical attributes of the Region as having huge potential to house wind farms. As an outcome, the Strategy advocates that planning authorities undertake actions that support renewable energy projects and provide opportunities for the development of wind powered electricity generation.

9.1.5 Economic stimulus

According to MacGill & Watt (2002) the Coppabella Hills and Marilba Hills developments have the potential to inject nearly $418 million into the Australian economy over its life time. This is based on the figure of the injection of $1.1 million per MW for wind farm installations in 2010. This economic injection would also contribute to the local economy through:

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

MacGill & Watt (2002) forecast that wind farm installations in the year 2010 would create 4.5 job-years per MW for manufacturing and installation and 0.06 on-going jobs per MW for operation and maintenance. By applying these figures, the Yass Valley Wind Farm would create 1,710 job years Australia wide and 22 on-going local jobs.

9.2 SECONDARY PROJECT BENEFITS AND OPPORTUNITIES

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

9.2.1 Infrastructure

Infrastructure required for development of the wind farm would also benefit the local community. The proponent would fund the upgrading of some local roads as outlined in the Traffic Study. The works that would mainly benefit the region include the reconstruction of segments along Whitefield's and Coppabella Roads and the paving and maintenance of sections along Berramangra and Garry Owen Roads. Other infrastructure works would include the provision of traffic signs and guide posts.

9.2.2 Tourism

Although, the operation of a tourist facility is not part of this proposal, the Yass Valley Wind Farm would provide an opportunity to increase the regional tourism industry, which currently is a main contributor to the economy. In 2001, tourism in the Sydney-Canberra Corridor Region generated $600 million (Department of Planning, 2008). The Region's heritage and its proximity to Canberra and the NSW snowfields already provide a stable base for tourism. While initial interest is likely to be higher than on-going interest, the wind farm could be utilised as an additional attraction to secure visitors to the local townships. This would lead to further contributions to the local service industry.

9.2.3 Biodiversity

During the assessment of this proposal, areas and features of high conservation significance were identified. The additional research and field work undertaken during the assessment now provides a greater understanding of the local environment. As well, specific measures accompany this proposal to ensure the key features are protected from unacceptable impacts.

In particular:

- The Coppabella Hills and Marilba Hills Precincts contain large areas of Box-gum woodland. Some of these areas are of sufficient quality to qualify as the NSW listed 'Box Yellow Box Blakely's Red Gum Woodland Endangered Ecological Community' and Commonwealth listed 'Yellow Box – White Box- Blakely's Red Gum Grassy Woodland and Derived Native Grasslands Critically Endangered Ecological Community''.
- A host of threatened flora and fauna were identified at the precincts and nearby. These include the Yass Daisy, Superb Parrot, Diamond Firetail, Speckled Warbler, Eastern Bent-wing Bat.

This information will be used in preparing a Biodiversity Management Plan and an Offset Plan to ensure the maintenance of these biodiversity attributes in the long-term.

9.3 SUITABILITY OF THE PROJECT

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

9.3.1 Strategic land use

The proposed sites and the adjacent land parcels are zoned as land use 1(a) Rural Agriculture under the Yass Valley Council LEP 1987 and the Harden Shire Interim Development Order No.1. This land has been set aside by the local councils for agricultural purposes, and the land is currently used for commercial agriculture (sheep and cattle grazing) and rural residences.

While in operation the proposed wind farm would not impact on the day-to-day farming activities currently being carried out by the existing landowners. The turbine footprint and access tracks would only

occupy approximately 1.12% of the landowner's property and through strategic planning and consultation, infrastructure would not occupy productive land. Normal farming operations may be affected during the construction phase, primarily due to increased traffic. The magnitude of these impacts are not expected to cause economic loss to the landowners.

When considering the existing and future land uses, the proposed site is suitable for a wind farm. Both local councils have strategically identified the site and its surrounds as being important agricultural land and there is no future intention to modify this zoning. The wind farm would coexist with the existing farming operations without any major disturbances to productivity. Potential impacts to land use is discussed in more detail in Section 8.4.

9.3.2 Property values

Henderson and Horning Property Consultants (2006) assessed the likely impact on local land values from the proposed Crookwell wind farm near Goulburn NSW. The context of the study was a general trend of larger properties being sold and broken up into smaller lots. Market forces appear to value the rural residential amenity above that of the agricultural productive capacity of the land. Discussions with local Crookwell agents generally indicated that although topical, the existing wind farm had little or no effect on land values in Crookwell. However, the perception of the proposed wind farm (Crookwell II) planned close to the existing farm could have an effect. The analysis of sales evidence indicated that no detectable discount exists for properties deemed directly affected by the existing wind farm. That is, the market evidence suggested that having a view of the wind turbines did not affect land value.

While there is some potential for properties in the vicinity of the proposed wind farm to be negatively affected by perceived visual or noise impacts. However, agricultural productivity would be a primary determinant in land value for the properties surrounding the wind farm. Development of the wind farm has the potential to slow down the process of rezoning agricultural land changing to rural residential uses in the short to medium term, with the shift caused by the additional income generated from the wind farm revenue making the agricultural use of (involved properties) more viable. Section 8.4 discusses the potential impacts to property values in more detail.

9.3.3 Land of significant scenic or visual value

The proposed Precinct sites are located in a man-modified environment predominantly cleared for agricultural and rural residential purposes. It is recognised that some people value the appearance of such landscapes and the undulating topography can also add to aesthetic value. The Visual Assessment report, discussed in Section 7.2, identifies three (3) of the thirty four (34) selected viewpoints as having high landscape sensitivity. Of these, the two locations that will be impacted by the wind farm are located at Burrinjuck Waters State Park and along Burrinjuck Road. These locations are associated with the Carrolls Ridge Precinct and hence do not form part of this application. The application for Carrolls Ridge Precinct will fully discuss these visual impacts and it is believed that all impacts would be able to be mitigated/remedied. Most of the visual impacts from the wind farm are classified as being minor or medium. It was also concluded that the cumulative impacts of the surrounding wind farms will not be greater than the visual impact of the Yass Valley Wind Farm on its own.

9.3.4 Land of high agricultural value, mineral reserves and conservation areas

As discussed in Section 8.9 the site and surrounding land parcels have been strategically zoned for agricultural purposes - an industry that the local economy depends on. A small percentage of agricultural land will be impacted by the wind farm infrastructure, however, this land is not considered to be of high agricultural value or expected to cause economic losses for the landowner.

There is one mining license that encompasses some of the area on the Coppabella Hills Precinct, however, consultation with the license holder has revealed that they are currently not active in this area. Refer to Section 8.3.

9.4 CONSIDERATION OF ALTERNATIVES

9.4.1 Site selection

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

- Wind speeds are not only high but consistent
- High voltage transmission lines are available on or near site
- Reasonable road access is available to site
- Relevant landowners are interested in allowing wind turbines on their land
- Native vegetation cover is sparse or would be minimally impacted
- Housing in the immediate vicinity is relatively sparse

The Proponent currently has 36 active wind monitoring masts across NSW as well as wind data from 5 decommissioned masts. By modelling information from these masts, plus over twenty third party monitoring masts, the proponent holds one of the most extensive wind data sets available in NSW. On the proposed sites the Proponent has six monitoring masts and two off-site monitoring masts within the immediate vicinity. The proponent has investigated various regions around NSW for their wind farm potential, and as such has identified the Yass area as having:

- High and consistent wind speeds
- Sparse native vegetation cover in areas that would be affected
- Low population density - one person per 29 hectares in the Yass Valley area (ABS, 2006)
- Existing electricity transmission line on site (330kV Yass - Sydney West)

After identifying this as a prospective wind farm site the area was further investigated in terms of its development potential. A major contributor in the determination of the site land parcels was the engagement of interested property owners. The final development envelope was chosen over alternatives because of its commercial viability, landowner agreements and opportunity to minimise environmental impacts.

9.4.2 Alternative turbine/infrastructure layouts

The indicative turbine layout was determined through an iterative process that aimed to minimise impacts on the existing environment (including biodiversity, noise and visual considerations), have a low infrastructure envelope, have minimal impact on land use and productivity, and produce the highest yield of wind energy. This was achieved through consultation with land owners and consultants as well as the Proponents own expert knowledge. Individual turbine locations were shifted around during the planning process to achieve a socially, environmentally and economically acceptable layout.

9.5 REVERSIBILITY OF THE PROPOSAL

During the decommissioning phase, all above ground infrastructure would be removed from the site. The concrete footings and access trails would remain, reducing the amount of further disturbance. All soil

disturbance would be rehabilitated and revegetated, as appropriate. The landforms, land use and visual character of the site would then be returned to its pre-existing state.

This Environmental Assessment outlines measures that would be implemented to facilitate protection of the existing environment and minimise both environmental and social impacts of the proposal. Nearly all of these impacts relate to the construction and operation of the project. It should be noted that with regard to environmental impacts, the proposal is entirely reversible in many areas, once decommissioned.

Visual and noise impacts relate primarily to the operational phase of the wind farm and are entirely reversible, post-decommissioning of the project.

Measures to mange biodiversity impacts are equally relevant to the construction and operational phases of the proposal. Specific measures are committed to as a part of this proposal to manage identified impacts. Adaptive management, through ongoing monitoring and analysis, is used to address uncertainty. Post-decommissioning, the Offset Plan remains to ensure that over time, the biodiversity outcomes of the site are improved, rather than reduced.

Traffic impacts are largely focussed on the construction phase. Post construction, these improvements to tracks and pavements are a medium to long-term benefit of the project.

10 ENVIRONMENTAL MANAGEMENT

The environmental impacts related to the proposal would be managed by the Proponent's commitment to the Draft *Statement of Commitments* (Section 10.2). These commitments include all mitigation measures recommended in previous sections of this EA as well as several additional measures. The framework for the implementation of these measures is discussed below (Section 10.1).

10.1 IMPLEMENTATION OF ENVIRONMENTAL MITIGATION MEASURES

The implementation of all mitigation measures would be by way of a **Project Environmental Management Plan** (PEMP), comprising a **Construction Environmental Management Plan** (CEMP) and an **Operation Environmental Management Plan** (OEMP). This process is illustrated in Figure 10-1. The PEMP would include performance indicators, timeframes, implementation and reporting responsibilities, communications protocols, a monitoring program, auditing and review arrangements, emergency responses, induction and training and complaint/dispute resolution procedures. The monitoring program would clearly identify any residual impacts after mitigation. Adaptive management would ensure that improvements were consolidated in the updated EMPs.

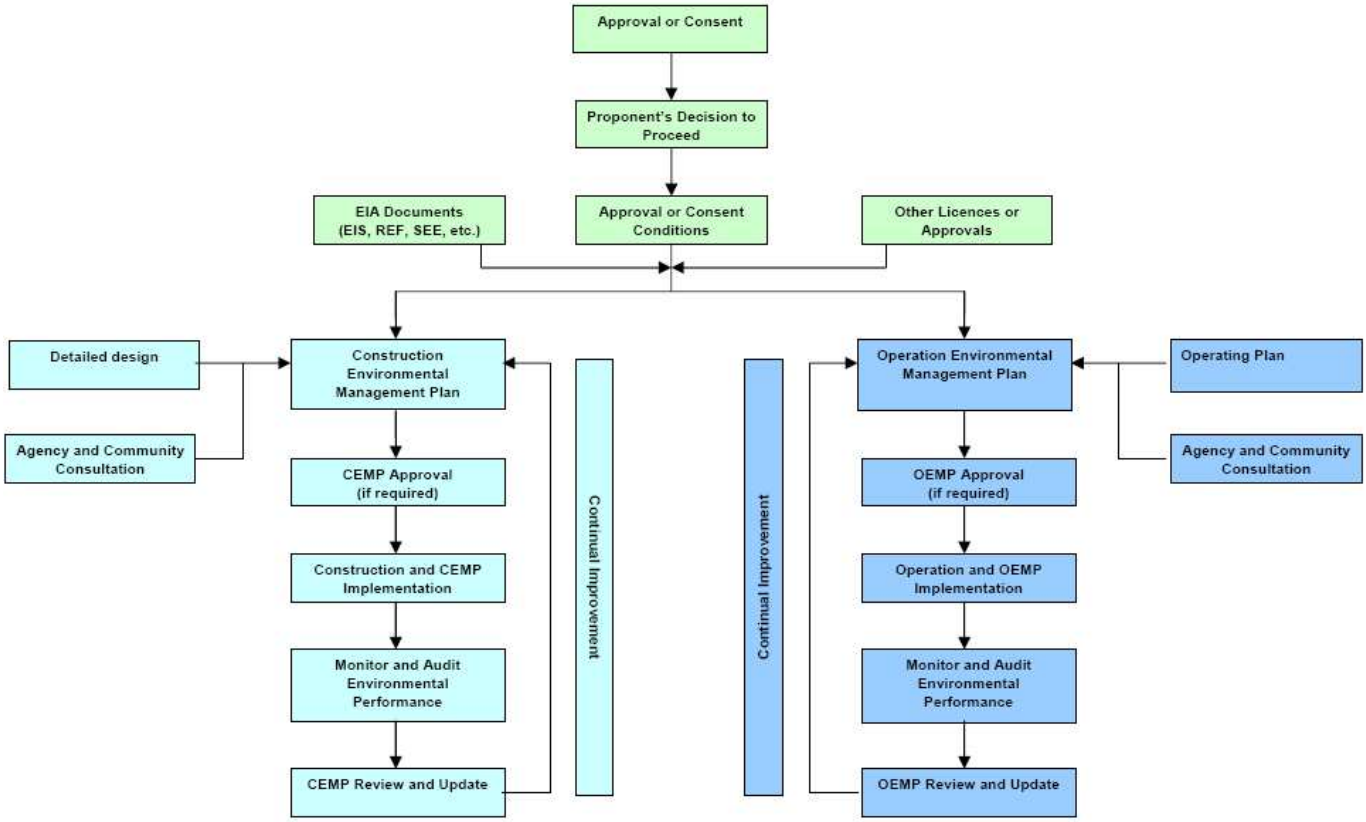


Figure 10-1: Post approval Project Environmental Management Plan (PEMP) process

10.2 DRAFT 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 where possible avoid, impacts. Avoidance and mitigation measures have been developed for the design, construction, operation and decommissioning phases of the project within this EA.

The commitments in this section have been developed into a comprehensive set of environmental impact avoidance and mitigation measures which incorporate:

- Specific recommendations contained in the specialist reports;
- Additional measures identified during the preparation of this Environmental Assessment (in consultation with the community and government agencies).

To avoid duplication in this section, mitigation measures are located under the most appropriate heading only and are not repeated in subsequent tables.

10.2.1 Visual

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
1	Deterioration of visual amenity at surrounding residences	Mitigate impacts	The proponent would offer vegetative screening of any residence within 3 km of a wind turbine. The proponent would write to the owner of each residence outlining the offer and process. A site visit would determine the extent and type of planting required Species selection would be determined in consultation with landholders using specialist advice. This offer would remain in place for a period of 1 year after project construction, to allow people time to either adjust or to decide that landscape filtering or screening is warranted. Planting would be completed within 2 years of completion of project construction.	Post Construction	OEMP	X	X
2	Deterioration of visual amenity at surrounding residences	Mitigate impacts	The Proponent would make reasonable efforts to locate powerlines, substations and control buildings in areas which minimise the visual impact where practical. Vegetative screening would be provided around substations and control buildings where they were visible from neighbouring residences.	Planning	DoP	X	X

10.2.2 Noise

Construction

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
3	Construction noise	Minimisation	The Proponent will employ appropriate noise reduction strategies to ensure the recommendations of the NSW Environmental Noise Control Manual are met. Strategies may include the re-orientation of machinery, rescheduling of noisy activities, installation of temporary noise barriers, improved vehicle noise control and the use of 'quiet work practices' (such as reducing or relocating idling machinery).	Detailed design	CEMP	x	x
4	Construction noise	Minimisation	The Proponent would only undertake construction activities associated with the project that would generate audible noise at any residence during the hours: • 7:00 am to 6:00 pm, Monday to Friday, • 8:00 am to 1:00 pm Saturday; and • At no time on Sundays or public holidays	Detailed design	CEMP	x	x
5	Construction noise	Minimisation	Meet ANZECC guidelines for control of blasting impact at residences.	Detailed design	CEMP	x	x

Operation

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
6	Operational noise	compliance	The Proponent will ensure final turbine selection and layout complies with the SA EPA Noise Guidelines of 35 dB(A) or background plus 5 dB(A) (whichever is higher) for all non-involved residential receivers. (other than those which have entered into a noise agreement with the	Detailed design	OEMP	x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
			Proponent in accordance with the SA EPA Noise Guidelines)				
7	Operational noise	Compliance	The Proponent will ensure final turbine selection and layout complies with the World Health Organisation Guidelines for Community Noise requiring 45 dB(A) or background plus 5 dB(A) (whichever is higher) for all involved residential receivers and all non-involved residential receivers which have entered into noise agreement with the Proponent in accordance with the SA EPA Noise Guidelines	Detailed design	OEMP	x	x
8	Operational noise	Compliance	Prior to construction, the Proponent will prepare and submit to the Department of Planning a noise report providing final noise predictions based on any updated background data measured, the final turbine model and turbine layout selected, to demonstrate compliance with the relevant guidelines for all residences	Detailed design	OEMP	x	x
9	Operational noise	Mitigate	If operational monitoring identifies exceedances, the Proponent would give consideration to providing mechanical ventilation (to remove the requirement for open windows), building acoustic treatments (improving glazing) or using turbine control features to manage excessive noise under particular conditions.	Detailed design	OEMP	x	x
10	Operational noise	compliance	Develop and implement an operational noise compliance testing program.	Detailed design	OEMP	x	x

10.2.3 Flora and Fauna

SoC	IMPACT	OBJECTIVE	MITIGATION TASKS	PROJECT PHASE	AUDITING[33]	Coppabella Hills	Marilba Hills
11	Loss or modification of habitat	Avoid, minimise, offset	All infrastructure would be sited entirely within the development envelope assessed in the Biodiversity Assessments. Where this is not possible, additional assessment would be undertaken and the appropriate approval would be sought (ie. variation to Conditions of Approval).	Detailed design of infrastructure layout	CEMP	x	x
12	Loss or modification of habitat	Avoid, minimise, offset	All infrastructure would be sited to avoid high constraint areas (including high constraint habitat features) and minimise impacts in moderate constraint areas. These areas are identified within Appendix 3.1 of the Coppabella Hills Precinct Biodiversity Assessment (Figure 7.1), and Appendix 3.2 of the Marilba Hills Precinct Biodiversity Assessment (Map set 4).	Detailed design of infrastructure layout	CEMP	x	x
13	Loss or modification of habitat	Avoid, minimise, offset	Where high constraint areas cannot be avoided, micrositing of infrastructure would be undertaken with input from an ecologist, to minimise impacts (includes road widening and transmission easement).	Detailed design of infrastructure layout	CEMP	x	x
14	Loss or modification of habitat	Avoid, minimise, offset	Where hollow-bearing trees cannot be avoided, nest boxes would be installed to replace this resource. This measure is considered supplementary to offsets that would also take into account the removal of hollows.	Detailed design of infrastructure layout	CEMP	x	x

[33] The Construction and Operation Environmental Management Plans (CEMP and OEMP) are documents submitted to Dept. Planning prior to construction and operation. Incorporation of these commitments within these management plans allows each commitment to be auditable.

SoC	IMPACT	OBJECTIVE	MITIGATION TASKS	PROJECT PHASE	AUDITING[33]	Coppabella Hills	Marilba Hills
15	Loss or modification of habitat	Avoid, minimise, offset	Works should be sited outside known Yass Daisy population areas and Commonwealth-listed CEEC areas identified in Appendix 3.1 Coppabella Hills Precinct Biodiversity Assessment (Figure 5.6), and Appendix 3.2 Marilba Hills Precinct Biodiversity Assessment (Map set 2).	Detailed design of infrastructure layout	CEMP	x	x
16	Loss or modification of habitat	Avoid, minimise, offset	Where rocks and boulders cannot be avoided, they would be placed directly adjacent to the works area to preserve the availability of refuge.	Construction	CEMP	x	x
17	Loss or modification of habitat	Avoid, minimise, offset	Should dams be required to be removed during site development, alternative watering points would be established to compensate for their loss, where practical and with the agreement of the landowner.	Construction	CEMP	x	x
18	Loss or modification of habitat	Avoid, minimise, offset	Additional targeted surveys would be undertaken, if the identified areas would be impacted by the proposal. These areas include: **Coppabella Hills** • Hollow-bearing trees targeted for removal. **Marilba Hills** • Hollow-bearing trees targeted for removal. • Burrinjuck Spider Orchid, undertaken in mid-October, where the dry forest remnant in the far south of Cluster 7 would be impacted by the proposed works. • Threatened grassy woodland species, undertaken in Spring, if the secondary grassland on the south-western side of Cluster 7 would be substantially impacted.	Detailed design of infrastructure layout	CEMP	x	x

SoC	IMPACT	OBJECTIVE	MITIGATION TASKS	PROJECT PHASE	AUDITING[33]	Coppabella Hills	Marilba Hills
19	Loss or modification of habitat	Avoid, minimise, offset	Contractors and staff would be made aware of the significance and sensitivity of the constraints identified in the Biodiversity Assessment constraint map set for each precinct during the site induction process.	Construction	CEMP	x	x
20	Loss or modification of habitat	Avoid, minimise, offset	A buffer twice the distance of the tree drip-line would be established in sensitive areas identified in the Biodiversity Assessment constraint map set for each precinct to ensure indirect impacts (such as compaction, noise and dust) are minimised where practical..	Construction	CEMP	x	x
21	Loss or modification of habitat	Avoid, minimise, offset	The Proponent would commit to preparing and implementing an Offset Plan, to offset the quantum and condition of native vegetation to be removed, in order to achieve a positive net environmental outcome for the proposal. Offset areas would reflect the actual footprint of the development (ie footing areas and new tracks) not the maximum impact areas included in Table 7-7 and Table 7-9 (which include easements and existing tracks). The Offset Plan would be prepared in consultation with DECC, prior to construction.	Prior to construction	CEMP	x	x
22	Loss or modification of habitat	Avoid, minimise, offset	An adaptive Bird and Bat Monitoring Program would be developed prior to construction and would include the collection of baseline (pre-operation) as well as operational monitoring data.	Prior to construction	CEMP, OEMP	x	x
23	Loss or modification of habitat	Avoid, minimise, offset	A Biodiversity Management Plan would be prepared within the CEMP to document the implementation of biodiversity measures, sourcing the Biodiversity Assessments prepared for each precinct for area specific measures. This would include construction and operational activities.	Prior to construction	CEMP	x	x
24	Loss or modification of habitat	Avoid, minimise, offset	An EPBC referral would be submitted to determine whether the proposal constitutes a 'controlled action' under the meaning of the *Environment Protection and Biodiversity Conservation Act 1999.*	Detailed design of infrastructure layout	CEMP	x	x

SoC	IMPACT	OBJECTIVE	MITIGATION TASKS	PROJECT PHASE	AUDITING[33]	Coppabella Hills	Marilba Hills
25	Loss or modification of habitat	Avoid, minimise, offset	A flora and fauna assessment would be undertaken prior to decommissioning to identify biodiversity constraints and develop specific impact mitigation measures.	Decommissioning	OEMP	x	x

10.2.4 Aboriginal Archaeology

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
26	Unavoidable disturbance to Aboriginal objects (stone artefacts) located in generally continuous albeit low density distribution across the proposal area.	Mitigate disturbance	A salvage program of archaeological excavation and analysis would be undertaken in a sample of impact areas prior to construction. The development of an appropriate research project would be undertaken in consultation with an archaeologist, the relevant Aboriginal communities and the NSW Department of Conservation and Climate Change.	Construction and decommissioning	CEMP	x	x
27	Disturbance to an Aboriginal object of low/moderate or moderate significance	Minimise disturbance	The Proponent would minimise the extent of impacts to areas assessed to be of low/moderate or moderate archaeological significance, where possible. A program of salvage subsurface excavation would be undertaken in impact areas at these locales prior to construction as a form of Impact Mitigation. The scope of this program is provided in Tables 19, 20 and 21 of Section 12 of the Archaeological Assessment, which identify the survey units that would be targeted in the program.	Construction and decommissioning	CEMP	x	x
28	Disturbance to an unidentified Aboriginal object	Minimise risk	The Proponent would conduct additional archaeological assessment in any areas which are proposed for impacts that have not been surveyed during the current assessment.	Construction and decommissioning	CEMP	x	x
29	Inadvertent impacts to Aboriginal objects	Minimise risk	The Proponent would develop a Cultural Heritage Management Protocol which documents the procedures to be followed for minimising risk and implementing mitigation strategies. This would be	Construction and decommissioning	CEMP	x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
			undertaken in consultation with an archaeologist, the relevant Aboriginal communities and the NSW Department of Conservation and Climate Change.				

10.2.5 Aircraft Hazards

SoC	Impact	Objective	Mitigation Tasks	Project Phase	Auditing	Coppabella Hills	Marilba Hills
30	Creation of Hazard	Minimise risk	Liaise with CASA and determine the appropriate number, location and type of aircraft warning beacons to be fitted on wind turbines prior to the commencement of construction.	Pre-construction	DoP	X	X
31	Creation of Hazard	Minimise risk	The Proponent would liaise with all relevant authorities (CASA, Airservices, and Department of Defence) and supply location and height details once the final locations of the wind turbines have been determined and before construction commences.	Pre-construction	DoP	X	X

10.2.6 Communication

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
32	Deterioration of signal strength	No deterioration of signal strength	The Proponent would locate wind turbines to avoid existing microwave link paths that cross each precinct, or liaise with the owners of such links to relocate services to avoid potential impacts from turbines.	Pre construction		x	x
33	Deterioration of signal strength	No deterioration of signal strength	The Proponent would undertake a detailed investigation to develop appropriate mitigation measures associated with potential impacts to navigational aids from the Coppabella Hills and Marilba Hills Precincts. The Proponent would liaise with Airservices Australia to ensure all mitigation measures are acceptable.	Pre-construction and operation		x	x
34	Deterioration of signal strength	No deterioration of signal strength	Ensure adequate television reception is maintained for neighbouring residences as follows: • Undertake a monitoring program of houses within 5km of the wind farm site to determine any loss in television signal strength if requested by the owners. • In the event that after construction television interference (TVI) is experienced by existing receivers within 5km of the site, investigate the source and nature of the interference. • Where investigations determine that the interference is cause by the wind farm, establish appropriate mitigation measures at each of the affected receivers in consultation and agreement with the landowners. Specific mitigation measures may include: • Modification to, or replacement of receiving antenna	Operation		x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
			• Provision of a land line between the effected receiver and an antenna located in an area of favourable reception • Improvement of the existing antenna system • Installation of a digital set top box or • In the event that interference cannot be overcome by other means, negotiating an arrangement for the installation and maintenance of a satellite receiving antenna at the Proponents cost				

10.2.7 Electromagnetic Fields

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
35	Radiation exposure from EMFs	Minimise exposure	Adhere to standard industry approaches and policies with respect to EMF through maintenance of adequate easements around transmission lines.	Operation	OEMP	x	x
36	Radiation exposure from EMFs	Minimise exposure	The turbines, control building, substation and transmission lines would be located as far as practical from residences, farm sheds, and yards in order to reduce the potential for both chronic and acute exposure.	Operation	OEMP	x	x

10.2.8 Traffic and Transport

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
37	Safety and asset protection	Minimise Risk	The Proponent would develop and implement a Traffic Management Plan (TMP) in consultation with roads authorities to facilitate appropriate management of potential traffic impacts. The TMP would include provisions for: • Scheduling of deliveries and managing timing of transport • Limiting the number of trips per day • Undertaking community consultation before and during all haulage activities • Designing and implementing temporary modifications to intersections, roadside furniture, stock grids and gates • Managing the haulage process, including the erection of warning and/or advisory speed signage prior to isolated curves, crests, narrow bridges and change of road conditions • Designation of a speed limit would be placed on all of the roads that would be used primarily by construction traffic • Preparation of a Transport Code of Conduct to be made available to all contractors and staff • Identification of a procedure to monitor the traffic impacts during construction and work methods modified (where required) to reduce the impacts • Provide a contact phone number to enable any issues or concerns to be rapidly identified and addressed through appropriate procedures • Reinstatement of pre-existing conditions after temporary modifications to the roads and pavement along the route.	Construction	CEMP	x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
38	Safety and Asset protection	Minimise Risk	The Proponent would use a licensed haulage contractor with experience in transporting similar loads, responsible for obtaining all required approvals and permits from the RTA and Councils and for complying with conditions specified in those approvals.	Construction	CEMP	x	x
39	Safety and Asset protection	Minimise Risk	The Proponent would prepare road dilapidation reports covering pavement and drainage structures in consultation with roads authorities for the route prior to the commencement of construction and after construction is complete. The Proponent would repair any damage resulting from the construction traffic (except that resulting from normal wear and tear) as required during and after completion of construction at the Proponent's cost or, alternately, negotiate an alternative for road damage with the relevant roads authority.	Construction	CEMP	x	x
40	Safety and Asset protection	Minimise Risk	Route specific mitigation measures, as detailed Section 5.2 of the Traffic Impact Study, would be adopted where significant increases in use are anticipated as a consequence of the proposal.	Construction	CEMP	x	x

10.2.9 Fire and Bushfire

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
41	Bushfire risk	Minimise risks	The Proponent would prepare a Bushfire Management Plan as part of the Construction Environmental Management Plan. The Rural Fire Service and NSW Fire Brigade would be consulted in regard to its adequacy to manage bushfire risks during construction, operation and decommissioning. The plan would as a minimum include: • Hot-work procedures, asset protection zones, safety, communication, site access and response protocols in the event of a fire originating in the wind farm infrastructure, or in the event of an external wildfire threatening the wind farm or nearby persons or property • Flammable materials and ignition sources brought onto the site, such as hydrocarbons, would be handled and stored as per manufacturer's instructions. • During the construction phase, appropriate fire fighting equipment would be held onsite when the fire danger is very high to extreme, and a minimum of one person on site would be trained in its use. The equipment and level of training would be determined in consultation with the local RFS • Substations would be bunded with a capacity exceeding the volume of the transformer oil to contain the oil in the event of a major leak or fire. The facilities would be regularly inspected and maintained to ensure leaks do not present a fire hazard, and to ensure the bunded area is clear (including removing any rainwater) • Substations would be surrounded by a gravel and concrete area free of vegetation to prevent the spread of fire from the substation and reduce the impact of bushfire on the structure. The substation area would also be surrounded by a security fence as a safety precaution to prevent trespassers and stock ingress • Asset protection zones (APZs), based on the RFS Planning for Bushfire	Construction Operation Decommissioning	CEMP and OEMP	x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
			Protection, would be maintained around the control room, sub-station and in electricity transmission easements. 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 • Fire extinguishers would be stored onsite in the control building and within the substation building • Shut down of turbines would commence if components reach critical temperatures or if directed by the RFS in the case of a nearby wildfire being declared (an all hours contact point would be available to the RFS during the bushfire period). Remote alarming and maintenance procedures would also be used to minimise risks • Overhead transmission easements would be periodically inspected to monitor regrowth of encroaching vegetation				

10.2.10 Hydrology

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
42	Deterioration of water quality (Surface Water)	Minimise risk	Infrastructure placement, including turbines, tracks, substations, control buildings, stockpiles, and site compounds and turnaround areas, would not be sited within 40 metres of a major drainage line or water course	Detailed design	CEMP	x	x
43	Deterioration of water quality (Surface Water)	Achieve neutral or beneficial water quality impact	The Proponent would prepare a Sediment / Erosion Control Plan (SECP) as a sub plan of the Construction Environmental Management Plan. This plan would include the following provisions: • Sediment traps would be installed wherever there is potential for sediment to collect and enter waterways • Stockpiles generated as a result of construction activities would be bunded with silt fencing, (mulch bunds or similar) to reduce the potential for runoff from these areas • On the steeper slopes check banks would be installed across the trenchline, as appropriate, following closure of the trench. These would discharge runoff to areas of stable vegetation • Stabilisation and site remediation would be undertaken as soon as practicable throughout and post construction. • Soil and water management practices would be developed as set out in Soils and Construction Vol. 1 (Landcom 2004)	Construction	CEMP	x	x
44	Deterioration of water quality (Surface Water)	Minimise risk	Design water crossings to minimise impact on existing banks, water flow and animal passage.	Construction	CEMP	x	x

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
45	Water supply	Minimise risk	Undertake liaison with representatives of Golden Fields County Council regarding the potential supply of construction water	Construction	CEMP	X	X
46	Deterioration of water quality (Surface Water)	Minimise risk	All vehicles onsite would follow established trails and minimise onsite movements	Construction Operation	CEMP OEMP	X	X
47	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Machinery would be operated and maintained in a manner that minimises risk of hydrocarbon spills	Construction Operation	CEMP OEMP	X	X
48	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintenance or re-fuelling of machinery would be carried out on hard-stand in accordance with industry standards for fuel transfer	Construction	CEMP	X	X
49	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Design of concrete batch plants would ensure concrete wash would not be subjected to uncontrolled release. Areas of the batching would be bunded to contain peak rainfall events and remediated after the completion of the construction phase. Waste sludge would be recovered from the settling pond and used in the production of road base manufactured onsite. The waste material would be taken from the batching plant to be blended in the road base elsewhere onsite.	Construction	CEMP	X	X
50	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Carry out dust suppression as required through either watering or chemical means (environmentally friendly polymer based additives to water).	Construction Decommissioning	CEMP	X	X
51	Deterioration of water quality	Achieve neutral or	A Site Restoration Plan (SRP) would be prepared as part of the Construction Environmental Management Plan. This would set out	Construction	CEMP	X	X

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
	(Surface Water)	beneficial water quality impact	protocols for restoration works including: • Site preparation • Stabilisation • Revegetation • Monitoring	Decommissioning			
52	Deterioration of water quality (Surface and Ground Water)	Minimise risk	A Spill Response Plan would be prepared as part of the CEMP and OEMP including: • Identify persons responsible for implementing the plan if a spill of a dangerous or hazardous chemical/waste would occur • Identify all chemicals required for the Proposal, including physio-chemical properties, risks posed to water quality objectives and appropriate methods of storage of these chemicals. • Locate Material Safety Data Sheets (MSDS) for all chemical inventories at on site and readily available • Comply with manufacturers recommendations in relation to application and disposal where chemicals are used • Report any spill that occurs to the Construction Manager regardless of the size of the spill • Establish clearly defined works and refuelling areas • Spill protocols in this plan would dictate when the EPA would be notified • Chemical / fuel storage areas would be identified, and be bunded to prevent loss of any pollutants • Hydrocarbon spill kits would be stored at the site. A	Construction Operation Decommissioning	CEMP OEMP	X	X

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
			number of site staff are to be trained in the use of the spill kits				
53	Deterioration of water quality (Surface and Ground Water)	Minimise Risk	The Proponent would notify the NSW DECC EPA in the event of any spill that had the potential to pollute waters.	Construction Operation	CEMP OEMP	X	X
54	Protection of ground water	Minimise risk	Undertake investigations, as part of the geotechnical investigation, to ensure that the project would have no material adverse effect on groundwater/aquifers as a result of blasting activities.	Pre-construction	CEMP	X	X
55	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Monitor bunded infrastructure to ensure that volume of oil could be fully contained in the event of leak	Operation	OEMP	X	X
56	Deterioration of water quality (Surface and Ground Water)	Minimise risk	Maintain septic systems, if installed, to meet appropriate Australian standards	Construction Operation Decommissioning	CEMP OEMP	X	X

10.2.11 Soils and Landforms

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
57	Landform stability	Minimise risk	The Proponent would undertake geotechnical investigations in the area of the proposed turbines to determine ground stability.	Pre - construction	DoP	X	X
58	Contamination	Minimise risks	Consult with involved property owners in relation to areas of land potentially contaminated by past land use and manage impacts in these areas to avoid affecting the any areas of contamination.	Pre - construction	CEMP	X	X
59	Soil quality	Minimise risks	Subsoil would be separated from topsoil for rehabilitation purposes. Topsoil from the excavation sites would be stockpiled and replaced. On steep slopes, topsoil would be stabilised. Any excess subsoil would be removed from the site and disposed of at an appropriate fill storage site.	Construction	CEMP	X	X
60	Soil quality	Minimise impact	Avoid compaction of soil resulting from vehicle access and laying of materials particularly during saturated soil conditions, and remediate as necessary	Construction	CEMP	X	X
61	Soil quality	Minimise impact	The Proponent would prepare a protocol in the instance that suspected contamination is unexpectedly found. Should contamination or potential contamination be disturbed during excavation works, the area would be assessed by appropriately qualified consultants. The DECC would be notified if warranted.	Construction	CEMP	X	X
62	Soil loss or stability of landform loss	Minimise risks	Concrete wash would be deposited in an excavated area, below the level of the topsoil, or in an approved landfill site. Where possible, waste water and solids would be reused onsite.	Construction	CEMP	X	X
63	Soil loss or stability of landform loss	Minimise risks	Access routes and tracks would be confined to already disturbed areas, where possible. All contractors would be advised to keep to established tracks.	Construction	CEMP	X	X

10.2.12 Mineral Exploration

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
64	Conflict with mineral exploration	Minimise conflict	The Proponent would liaise with the current mineral lease holder providing a final turbine and infrastructure layout, prior to the construction phase	Pre-construction	CEMP	X	X
65	Conflict with mineral exploration	Minimise conflict	The Proponent would liaise with continue to liaise with Taronga Mines. This consultation would be ongoing between the Proponent and Taronga Mines.	Pre-construction / Construction	CEMP	X	X
66	Conflict with mineral exploration	Minimise conflict	The Proponent would provide a point of contact to the current mineral lease holder	Pre-construction	CEMP	X	X
67	Conflict with mineral exploration	Minimise conflict	The Proponent would liaise with the involved land owners and current mineral lease holders prior to rehabilitation, to ensure that any project access roads that they may wish to retain are retained. Several of these access roads are likely to be of benefit both to routine agricultural activities as well as to exploration activities onsite	Construction	CEMP	X	X

10.2.13 Economic

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
68	Affect on local community	Maximise positive impact of Proposal	Liaise with local industry representatives to maximise the use of local contractors and manufacturing facilities in the construction and decommissioning phases of the project.	Construction	CEMP	X	X
69	Affect on local community	Maximise positive impact of Proposal	Liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works and to the extent practical coordinated with local events	Construction	CEMP	X	X
70	Affect on local community	Maximise positive impact of Proposal	Liaise with Yass Valley and Harden Shire Councils and the Department of State and Regional Development to provide information to assist in attracting people to the local area to facilitate meeting the expected demand for human resources for both construction and operation of the Proposal	Construction Operation	CEMP	X	X
71	Affect on local community	Maximise positive impact of Proposal	Make available employment opportunities and training for the ongoing operation of the wind farm to local residents where reasonable	Operation	OEMP	X	X

10.2.14 Community Wellbeing

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
72	Community wellbeing	Provide accurate information	Dissemination of accessible and independent information on wind farm impacts	Pre-construction	CEMP	X	X
73	Community wellbeing	Provide accurate information	Biodiversity monitoring information collected during the operation of the wind farm would be made publicly available	Operation	OEMP	X	X

10.2.15 Tourism

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
74	Affect on local activities	Minimise disruption	Co-ordinate construction activities with local tourist operators. The Proponent would liaise with the local visitor information centres to ensure that construction and decommissioning timing and haulage routes are known well in advance of works	Pre-construction	CEMP	x	x
75	Affect on local activities	Maximise benefits	The Proponent would work with the involved landowners, the community and both Yass Valley and Harden Shire Councils to allow for the development of the wind farm as a tourist attraction, if this option becomes desirable to these three parties.	Operation	OEMP	x	x

10.2.16 Agricultural

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
76	Impact on current land use	Minimise disruption	Stock would be restricted from works areas where there is a risk stock injury or where disturbed areas are being stabilised.	Construction	CEMP	x	x
77	Impact on current land use	Minimise impact	Develop, implement and monitor the effects of a **Site Restoration Plan.** The plan would aim to stabilise disturbed areas as rapidly as possibly. The Plan would consider: • Appropriate stabilisation techniques across the precincts • Suitable species for re-seeding (native species would be given preference due to their superior persistence and for conservation purposes) • Monitoring for weed and erosion issues	Construction and Decommissioning	CEMP	x	x
78	Impact on current land use	Minimise disruption	Liaison would be undertaken with neighbouring landowners and landowners adjoining access roads, to provide information about the timing and routes to be used during construction and decommissioning. This could be in the form of advertising and provision of a contact point for further inquiries. The aim would be to reduce the risk of interference with agricultural activities on affected roads and road verges.	Construction	CEMP	x	x
79	Impact on current land use	Minimise impacts	Ensure that the switchyard and substation is appropriately fenced to eliminate stock ingress.	Operation	OEMP	x	x

10.2.17 Health and Safety

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
80	Safety of persons or stock	Minimise risks	A detailed **Health and Safety Plan (H&SP)** would be prepared, as a sub plan of **the Construction Environmental Management Plan**, identifying hazards associated with construction works, the risks of the identified hazards occurring and appropriate safeguards would be prepared prior to the commencement of construction works. The Plan would include, but not be limited to: • Inductions for all contractors requiring site access. • Ensure all staff are appropriately qualified and trained for the roles they are undertaking	Construction	CEMP	x	x
81	Safety of persons or stock	Minimise risks	Site fencing would be installed where there is a risk to the safety of the general public (i.e. when the trench is left open for extended periods)	Construction and Decommissioning	CEMP	x	x
82	Safety and Asset protection	Minimise Risk	Establish procedures to ensure that soil is not carried onto the Hume Highway on the wheels of construction traffic	Construction	CEMP	x	x
83	Safety / nuisance to persons or stock	Minimise risks	If shadow flicker is found to be a nuisance to residents, conditions would be pre-programmed into the control system and individual wind turbines automatically shut down whenever these conditions are present	Operation	OEMP	x	x
84	Safety of persons or stock	Minimise risks	Shadow flicker effects on motorists would be monitored following commissioning and any remedial measures to address concerns would be developed in consultation with the RTA and the Department of Planning	Operation	OEMP	x	x
85	Safety of persons	Minimise risk	Establish a turbine maintenance program in accordance with industry standards.	Operation	OEMP	x	x

10.2.18 Historic Heritage

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
86	Disturbance to a non-Indigenous potential heritage item	Minimise disturbance	The Proponent would limit the extent of impacts to the three identified heritage items.	Construction and decommissioning	CEMP	x	x

10.2.19 Climate and air quality

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
87	Air quality	Minimise risks	A cost benefit analysis would be completed on differing potential mitigation options for dust suppression, for inclusion in the CEMP.	Construction	CEMP	x	x
88	Air quality	Minimise risks	Dust levels at stockpile sites would be visually monitored. Dust suppression would be implemented if required. Stockpiles would be protected from prevailing weather conditions	Construction	CEMP	x	x
89	Air quality	Minimise risks	Undertake ongoing visual dust monitoring and suppression (if required) during the construction phase. Monitoring would regularly assess the effectiveness of dust suppression activities. Monitoring would regularly assess the effectiveness of dust suppression activities.	Construction	CEMP	x	x
90	Air Quality	Minimise risks	Should a complaint relating to dust by a resident be received, monitoring at the boundary of the construction site would be undertaken using dust gauges. The Proponent would assess the dust gauges and identify additional mitigation measures, where required.	Construction	CEMP	x	x
91	Air quality	Minimise risks	Should blasting be required, it would be carried out in accordance with all relevant statutory requirements and residences within 1km of blasting activities would be informed prior to blasting	Construction	CEMP	x	x
92	Air quality	Minimise risks	Dust filters would be installed on silos, where required	Construction	CEMP	x	x

10.2.20 Resource impacts

SoC	Impact	Objective	Mitigation tasks	Project phase	Auditing	Coppabella Hills	Marilba Hills
93	Waste generation	Minimise waste and maximise recycling of materials	The Proponent would prepare a **Waste Management Plan** to be included within the **Construction Environmental Management Plan**. It would include but not be limited to the following: • The scope for reuse and recycling would be evaluated • Provision for recycling would be made onsite • Wastes would be disposed of at appropriate facilities • Toilet facilities would be provided for onsite workers and sullage from contractor's pump out toilet facilities would be disposed at the local sewage treatment plants or other suitable facility agreed to by Council • Excavated material would be used in road base construction and as aggregate for footings where possible. Surplus material would be disposed of in appropriate locations on site (on agreement with the landowner), finished with topsoil, and revegetated	Construction Operation	CEMP OEMP	x	x

11 CONCLUSION

This Environmental Assessment (EA) has assessed the likely environmental impacts that may result from the proposed Yass wind farm; a proposal that would be capable of generating up to 380 [34] MW of greenhouse gas emission free electricity.

The proposal has incorporated the environmental constraints identified in an iterative manner throughout the project design to arrive at the most appropriate site layout. It has also incorporated measures to proactively address identified environmental risks throughout the construction, operation and decommissioning of the project. All measures to which the Proponent would commit are detailed in the draft Statement of commitments, Section 10.2.

This EA considers the key issues of the proposal relating to visual, operational noise, biodiversity, communications, traffic and transport impacts and a range of issues relating to the benefits and impacts to local community, including wellbeing, lifestyle values and tourism. These impacts must be considered in balance with the public benefits of the proposal.

Benefits of the proposal have been identified at the global, regional and local scale. These include:

- In full operation, it would generate 1200 GWh of electricity per year -sufficient for the average consumption of 150,000 homes
- It would improve the security of electricity supply through diversification
- It would reduce greenhouse gas emissions by approximately 1,160,000 tonnes of carbon dioxide (equivalent) per annum
- It supports the strategic direction of the region, as outlined in the Sydney-Canberra Corridor Regional Strategy
- It would contribute to the NSW Government's target of providing 15% of consumed energy from renewable sources by 2020
- It would contribute to the NSW Government's target of reducing green house gas emissions by 60% by the year 2050
- It would create local employment opportunities and inject funds of up to $334 million into the Australian economy

The success of the proposal in mitigating environmental impacts hinges on the development and implementation of the Project Environmental Management Plan and its associated Construction and Operation Environmental Management Plans. The Proponent is committed to ensuring the measures developed in these plans are best practice and is committed to working to ensure the best possible result is achieved for the proposed Yass Valley Wind Farm. This not only has immediate benefits for the site and locality which would house the project, it would also set a high standard for the development of wind energy resources in the region.

[34] Based on the development of the Coppabella Hills and Marilba Hills Precincts, a maximum of 152 turbines.

12 GLOSSARY AND ACRONYMS

ABARE	Australia Bureau of Resource Economics
AHD	Australian Heritage Database
AHIMS	Aboriginal Heritage Information Management System
AIS	Aeronautical Information Service
APANSA	Australian Radiation Protection and Nuclear Safety Agency
APZ	Asset Protection Zone (for bushfire compliance)
ARL	Acoustic Research Laboratories
AusWEA	Australian Wind Energy Association
CANRI	Community Access to Natural Resource Information
CASA	Civil Aviation Safety Authority
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
DCP	Development Control Plan
DEC	NSW Department of Environment and Conservation, now the Department of Environment and Climate Change
DECC	NSW Department of Environment and Climate Change, formerly the Department of Environment and Conservation
DEH	Commonwealth Department of Environment and Heritage, now the Department for Environment and Water Resources
DEWR	Commonwealth Department for Environment and Water Resources, formerly the Department of Environment and Heritage
DGRs	NSW Department of Planning's Director Generals Requirements. The Environmental Assessment report must address issues as directed in the DGRs
DoP	NSW Department of Planning
DPI	Department of Primary Industries
EA	Environmental Assessment report, format dictated by the NSW Department of Planning's Director Generals Requirements
EEC	Endangered Ecological Community
EMF	Electromagnetic fields
EPA	Environmental Protection Agency
ER	Environmental Representative, appointed during the environmental management of the construction and operational phases, appointment must be approved by the Department of Planning
ERM	Environment Resources Management (visual impact consultants for this project)
ESC	Effective Survey Coverage (referred to in Aboriginal Archaeology survey

	methods and results)
ESD	Ecologically Sustainable Development
GWh	gigawatt-hour
HN	Hawkesbury Nepean
IBRA bioregions	Interim Biogeographic Regionalisation for Australia
kV	kilovolt
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
mG	milligaus
MW	megawatt
MWh	megawatt-hour
Mitchell landscape	Landscapes classified for IBRA bioregions
MOS	Manual of Standards
NES	National Environmental Significance
NPI	National Pollutant Inventory
OEMP	Operational Environmental Management Plan
PEMP	Project Environmental Management Plan
PFM	Planning Focus Meeting
Proponent	Epuron Pty. Ltd.
REP	Regional Environmental Plan
RFS	Rural Fire Service
RNE	Register of the National Estate
SC	Shire Council
SEPP	State Environmental Planning Policy
SHI	State Heritage Inventory
TMP	Traffic Management Plan
TVI	Television Interference
V	volt
W	watt

13 ASSESSMENT PERSONNEL

This report was prepared by **ngh**environmental. Specific sections were drawn from consultants' reports or from the Proponent, as detailed in Table 13-1.

Table 13-1: Preparation of the Environmental Assessment

Section		Author
1	Executive summary	**ngh**environmental
2	Introduction	**ngh**environmental
3	Description of the Proposal	Epuron
4	The Energy Context of the Proposal	Epuron
5	Planning context	**ngh**environmental
6	Consultation	Epuron and **ngh**environmental
7	Assessment of key issues	
7.1	Scoping and prioritisation of issues	**ngh**environmental
7.2	Visual impact	Environmental Resources Management
7.3	Operational and construction noise	Heggies Pty Ltd and Marshall Day Pty Ltd
7.4	Flora and Fauna	**ngh**environmental
7.5	Mitchell Landscapes	**ngh**environmental
7.6	Aboriginal Archaeology	NSW Archaeology
7.7	Aircraft hazard impacts	Epuron
7.8	Communication impacts	Epuron
7.9	Electromagnetic fields (EMFs)	Epuron
7.10	Traffic and transport	Bega Duo Designs
7.11	Fire and bushfire impacts	**ngh**environmental
8	Assessment of additional issues	
8.1	Hydrology (Water, Water Quality and Water Table impacts)	**ngh**environmental
8.2	Soils and landforms	**ngh**environmental
8.3	Mineral Exploration Impacts	**ngh**environmental
8.4	Land Value Impacts	**ngh**environmental
8.5	Economic impacts	**ngh**environmental

8.6	Community wellbeing	**ngh**environmental
8.7	Lifestyle impacts	**ngh**environmental
8.8	Tourism impacts	**ngh**environmental
8.9	Agricultural impacts	**ngh**environmental
8.10	Health and safety	**ngh**environmental
8.11	Historic Heritage	NSW Archaeology and **ngh**environmental
8.12	Climate and Air Quality	**ngh**environmental
8.13	Resource Impacts	**ngh**environmental
8.14	Cumulative impacts	**ngh**environmental
9	Strategic Justification	Epuron
10	Environmental management	**ngh**environmental
11	Conclusion	**ngh**environmental

Nick Graham-Higgs, Tim Browne and Brooke Marshall of **ngh**environmental constitute the document's primary authors. The information contained in this document is neither false nor misleading. All information is considered by the authors to be correct at the time of writing.

Nicholas Graham-Higgs

nghenvironmental (Director)

……

Tim Browne

nghenvironmental (Project Officer)

……

Brooke Marshall

nghenvironmental (Senior Project Officer)

……

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 development of sustainable power generation facilities, including hydro and wind generated electricity. 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, the development of mini-hydro plants at Jounama, Khancoban and Geehi and environmental assessment for a wind farm on the Snowy Plains, near Kosciuszko National Park.
Tim Browne *Bachelor of Science* *Masters Environmental Management*	Tim completed a Bachelor of Science (in earth and environmental studies) at the University of Technology, Sydney and a Masters of Environmental Management at the University of NEW England. Tim has consulting experience in environmental impact assessment, contaminated land investigation and remediation, as well as experience within the mining industry of Western Australia. Tim was one of the primary authors of another Part 3A assessment for the proposed Silverton Wind Farm. Tim has recently prepared and assisted in the preparation of environmental impact assessments and biodiversity and management documents for clients such as Country Energy, RTA and Epuron Pty Ltd. These projects have given Tim a detailed understanding of the local and regional environments of south-eastern NSW, complimenting his knowledge of greater metropolitan Sydney and northern NSW. Tim has had field experience in environmental impact assessments, biodiversity assessments including terrestrial fauna and flora and fauna surveys and contaminated site investigations. Tim is also an active member of the Environment Institute of Australia and New Zealand and The Geological Society of Australia.
Brooke Marshall *Bachelor of Natural Resources (Hons)*	Since joining nghenvironmental in 2004, Brooke has prepared impact assessment reports relating to residential developments, road construction, water supply infrastructure, telecommunications infrastructure, river modification, wind farms and prescribed burning activities. These reports have included threatened flora and fauna species assessments requiring research, fieldwork and GIS components. Brooke has prepared DAs under Parts 3A, 4 and 5 of the EP&A Act, as well as Environmental Management Plans, Rehabilitation Plans and Community Consultation Plans associated with these proposals. Brooke has prepared strategic reports considering natural values for local government (Snowy River Shire and Bega Valley Shire) and has worked on Species Impact Statements and EPBC Referrals. Brooke's work has been focussed on the South Coast, Southern Tablelands and Snowy Mountains regions of NSW, including sensitive sub-alpine areas. Brooke is currently focusing on environmental impact assessment, biodiversity assessments and wildlife management issues.

14 REFERENCES

ABC (2007) http://www.abc.net.au/news/stories/2007/10/16/2060466.htm accessed December 2008

Australian Greenhouse Office (2003). *Climate change: An Australian Guide to the Science and Potential Impacts*. Australian Greenhouse Office, edited by B Pittock, 2003.

Australian Radiation Protection and Nuclear Safety Agency (2007). *Electricity and Health*. Retrieved Oct 2007 from: http://www.arpansa.gov.au/radiationprotection/Factsheets/is_electricity.cfm.

Australian Wind Energy Association (2001). *Wind farm safety in Australia*. Retrieved Feb 2008 from http://www.wind-power.com.au/Downloads/BP11_Safety.pdf

Australian Wind Energy Association (2004). *Wind Farms and Landscape Values Report*. Retrieved from http://www.auswea.com.au/auswea/

Auswind (2006). *Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia*.

Baidya, R.S., Pacala, S.W. & Walko, R. L., 2004, 'Can large wind farms affect local meteorology?' *Journal of Geophysical Research*, vol. 109, D19101.

Breusch, J., 2009 'Renewable energy not overly costly' *Australian Financial Review*, 12 February, p.5

British Wind Energy Association 2007. Reference Wind energy frequently asked questions.' Retrieved May 2008 from http://www.bwea.com/ref/faq.html#safe

Danish Wind Industry Association website. http://www.windpower.org/en/tour.htm

Davey, R. and Coppin, P. (2003) South East Australia Wind Power Study *Wind Energy Research Unit CSIRO Atmospheric Research*

Dent, P. and Sims, S. (2007). *What is the impact of wind farms on house prices?*. Oxford Brooks University, March 2007.

Department of Climate Change (DCC), 2009a *Australia's Renewable Energy Target*, February 2009, www.climatechange.gov.au/renewabletarget/index.html

Department of Climate Change (DCC), 2009b *Climate Change Impacts*, February 2009, www.climatechange.gov.au/impacts/overview.html

Department of Climate Change (DCC), 2008a *National Greenhouse Gas Inventory 2006: Accounting for the Kyoto Target*

Department of Climate Change (DCC), 2008b *State and Territory Greenhouse Gas Inventories 2006*

Department of Climate Change (DCC), 2008c *Stationary Energy Sector Greenhouse Gas Emissions Projections 2007*

Department of Environment and Climate Change (2009) accessed 2009: http://www.environment.nsw.gov.au/ieo/Murrumbidgee/index.htm

Department of Environment and Climate Change (2009a) Accessed 2009: http://www.environment.nsw.gov.au/clmapp/searchregister.aspx

Department of Environment and Climate Change (DECC), 2006 *NSW Greenhouse Office data 2006 www.environment.nsw.gov.au/soe/soe2006/download/chapter3/fig_3-4.xls*

Department of Environment and Conservation (2006) *Using the ANZECC Guidelines and Water Quality Objectives in NSW*

Department of Energy, Utilities and Sustainability (DEUS), 2006 *NSW Renewable Energy Target: Explanatory Paper*, November 2006 www.deus.nsw.gov.au/Publications/NRET%20Explanatory%20Paper%20FINAL.pdf

Department of Energy, Utilities and Sustainability (2000). *Energy at a Glance 2000*, Department of Energy, Utilities and Sustainability. Retrieved from: http://www.deus.nsw.gov.au/publications/esp/enswc/index.htm

Department of Lands (2008) *Hume and Hovell Walking Track, Spirit of Discovery* accessed December 2008, available from *www.lands.nsw.gov.au/_media/lands/pdf/recreation/**Hume**__and__**hovell**_DL.pdf -*

Department of Planning (2002), *Draft NSW Wind Energy Environmental Impact Assessment Guidelines.*

Department of Planning, 2008 *Sydney–Canberra Corridor Regional Strategy 2006-2031*

Diesendorf, M., 2003 *Why Australia needs wind power,* Dissent, no. 13, pp.43-48

Elsam Engineering A/S, 2004 *Life Cycle Assessment of offshore and onshore sited wind farms*, March 2004 from Elsam Engineering A/S and Vestas Wind Systems A/S, 2004 *Life cycle assessment (LCA) of turbines – Analysis of possibilities of product directed environmental optimisation*

Eltham, D.C. Harrison, G.P. and Allen, S.J (2008) Change in public attitudes towards a Cornish wind farm: Implications for planning, *Energy Policy,* 36 pp 23-33

Fallding, M. (2002). *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands,* prepared by the Land and Environment Planning, NSW National Parks and Wildlife Service, Hurstville.

Galacho, O, 2009 'Power prices tipped to fall' *Herald Sun,* 13 February, p.86

Gipe, P. 2008 Deaths in Wind Energy Database available from: http://www.wind-works.org/articles/BreathLife.html

Greenhouse Gas Reduction Scheme (GGAS), 2008 *FS-Comp-PoolCoeff*, November 2008 www.greenhousegas.nsw.gov.au/documents/FS-Comp-PoolCoeff-Nov08.pdf

Gross, C. 2007 Community perspectives of wind energy in Australia: The application of a justice and community fairness framework to increase Social acceptance *Energy Policy* Vol 35 pp 2727-2736

Gurran, N., Squires, C. and Blakely, E. (2005). *Meeting the Sea Change Challenge: Sea change communities in coastal Australia*, prepared by the University of Sydney, Faculty of Architecture, Planning Research Centre. Report for the National Sea Change Taskforce, 31 March 2005.

Harden Shire Council (2004) *State of the Environment Report*

Harden Shire Council (2006) *Harden Shire Council Social Plan* available at: http://www.harden.nsw.gov.au

Harden Shire Council (2008) *Harden Shire Council Management Plan 2008-2011* available at: http://www.harden.nsw.gov.au

Hird, C. (1991) *Soil Landscapes of the Goulburn 1:250 000 Sheet.* Soil Conservation Service of NSW, Sydney

Health Protection Agency United Kingdom (2004). *Substations and Electromagnetic Fields*, Retrieved Oct 2007 from: http://www.hpa.org.uk/radiation/understand/information_sheets/substations_and_emfs.htm

Henderson and Horning Pty Ltd, 2006 *Land Value Impact of Wind Farm Development, Crookwell New South Wales* February 2006

Interim Biogeographic Regionalisation of Australia 5.1 Available from http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html

Intergovernmental Panel on Climate Change (IPCC), 2008 *Climate Change 2007: Synthesis Report*

Iravani, R., Graovac, M. and Dewan, S. (2004). *The Health Effects of Magnetic Fields Generated by Wind Turbine*, summary of report, Ontario Canada October 2004

Landcom 2004. Soils and Construction Vol. 1. Prepared by Landcom March 2004.

Local Government Elections (LG Elections) http://www.lg.elections.nsw.gov.au/LGE2008/result.Upper_Lachlan.poll.html accessed 2009

MacGill, I.F. and Watt, M. E. (2002). *Jobs and Investment Potential of Renewable Energy: Australian wind industry scenarios.* Retrieved from: http://www.acre.ee.unsw.edu.au/anzses2002/ANZSES_WindScenario_UNSW.pdf

Macquarie Generation Annual Report (2007). Retrieved Feb 2008 from: http://www.macgen.com.au/News/MG990web.pdf

Martinez, E., Sanz, F., Pellegrini, S. and Blanco, J. (2009) Life cycle assessment of a multi-megawatt wind turbine *Renewable Energy* 34 pp. 667-673

National Parks and Wildlife Service (NPWS) 2006 Black Andrew Nature Reserve Plan of Management available at: *www.environment.nsw.gov.au/resources/parks/blackAndrewMgmtplan.pdf*

National Parks and Wildlife Service (NPWS) 2008 *Burrinjuck Nature Reserve Draft Plan of Management* available at: http://www.environment.nsw.gov.au/parkmanagement/BurrinjuckDraftPOM.htm

Needham, S., 2008 *The potential for renewable energy to provide baseload power in Australia*, Research Paper no. 9 2008–09, 23 September 2008 www.aph.gov.au/library/pubs/rp/2008-09/09rp09.htm, accessed 11 March 2009

National Electricity Market Management Company Limited (NEMMCO), 2008 *An Introduction to Australia's National Electricity Market*, June 2008

New South Wales Department of Environment and Conservation (2006) *Using the ANZECC Guidelines and Water Quality Objectives in NSW*

New South Wales Department of Environment and Conservation (2004). *Interim Guidelines for Aboriginal Community Consultation: Requirements for Applicants*.

New South Wales Department of Environment and Climate Change (2009) *NSW Water Quality and River Flow Objectives* available at: http://www.environment.nsw.gov.au/ieo/

New South Wales Department of Environment and Climate Change (2009a) *Contaminated land record* http://www.environment.nsw.gov.au/clmapp/searchregister.aspx

New South Wales Environment Protection Authority (2000). NSW Industrial Noise Policy, EPA, Sydney.

New South Wales Greenhouse Office (2005). GGAS Fact Sheet: 'The NSW Pool Coefficient', NSW Greenhouse Office, November 2005. Retrieved Feb 2006 from: http://www.greenhousegas.nsw.gov.au/documents/FS-Comp-PoolCoeff-05.pdf

NSW Government, 2006 *State Plan: A Direction for NSW*, November 2006

Pedersen, E. (2003). *Noise annoyance from wind turbines: A review*. Retrieved Feb 2008 from http://www.nowap.co.uk/docs/620-5308-6.pdf

Pittock, B. (ed.) (2003). *Climate Change: An Australian Guide to the Science and Potential Impacts.* Australian Green House Office. Retrieved from: http://www.greenhouse.gov.au/science/guide/pubs/science-guide.pdf

NSW Rural Fire Service (2006) ***Planning for Bushfire Protection.*** RFS publication.

REARK Pty Ltd 2007. 'Wind farm impact study – Southern Tablelands'. Report prepared for Epuron, August 2007.

Road Traffic Authority 2002, Guide to Traffic Generating Developments.

Impact of wind farms on the value of residential property and agricultural land, An RICS survey, 2004.

Sammut, J. (2000) An introduction to acid sulphate soils Environment Australia and Agriculture, Fisheries and Forestry - Australia

Schleisner L. 2000, 'Life cycle assessment of a wind farm and related externalities', *Renewable Energy*, vol. 20, pp. 279-288.

Sheppard, H (2006) Environmental Planning Officer, Yass Valley Council, personal communication.

Smith, R., Banon, C. and Finn, P (2004) Bald Hills Wind Farm Project EES, EES supplement and called-in planning permits

Snowy River Shire Council (SRSC) 2005, 'Snowy River Shire Wind Farm Development: Issues paper'. Snowy River Shire Council 4 August 2005.

South Australia Environmental Protection Agency (2003). *Wind Farm Environmental Noise Guidelines*.

State Water (2008) State Water website *http://statewater.com.au* accessed 2008

Sterzinger, G. Beck, F. and Kostiuk, D. (2003). *The Effect of Wind Development on Local Property Values*. Renewable Energy Policy Project, Washington, D.C., May 2003.

Sustainable Energy Development Authority 2004, 'Wind farm safety in Australia'. available at: http://www.auswea.com.au/WIDP/assets/BP11_Safety.pdf

Sustainable Energy Development Authority (2002). *Wind Energy Handbook*. SEDA, Sydney.

Tourism NSW (2008) http://www.visitnsw.com/town/Yass.aspx accessed December 2008

TransGrid, 2008 *NSW Annual Planning Report 2008*

Twyford Consulting 2007, 'Interview with Local Stakeholders', a Research Report for Epuron Pty. Ltd, May 4 2007.

Union of Concerned Scientists 2005, 'Farming the Wind: Wind Power and Agriculture fact sheet' available at: http://www.ucsusa.org/assets/documents/clean_energy/agfs_wind_2003.pdf

Vestas Wind Systems A/S, 2006 *Life cycle assessment of offshore and onshore sited wind power plants based on Vestas V90-3.0 MW turbines* www.vestas.com/Admin/Public/Download.aspx?file=Files/Filer/EN/Sustainability/LCA/LCAV90_juni_2006.pdf

Warren, C.R., Lumsden, C., O'Dowd, S. and Birnie, R.V. 2005, 'Green on Green: Public Perceptions of Wind Power in Scotland and Ireland', *Journal of Environmental Planning and Management*, vol 48, No. 6, 873-875.

Wasson, R.J., Mazari, R.K., Starr, B and Clifton, G. (1998) The recent history of erosion and sediment on the Southern tablelands of southeastern Australia: sediment flux dominated by channel incision *Geomorphology,* vol.24, 291-308

World Health Organisation Guidelines for Community Noise (1999) Accessed from http://www.who.int/docstore/peh/noise/guidelines2.html

Yass Tribune (2006) http://yass.yourguide.com.au/news/local/news/general/council-responding-to-wind-farm-presure/240702.aspx

Yass Valley Shire Council (2004) *State of the Environment Report* accessed 2008 available from http://www.environmentcommissioner.act.gov.au/soe/soe2004/YassValley/index.htm

Yass Valley Council (2006) *2006-2011 Yass Valley Council Social Plan* accessed 2008 available from: http://www.yassvalley.nsw.gov.au

Yass Valley Council (2006a) *Historic Yass Valley* accessed 2008. available from http://www.yass.nsw.gov.au

Yass Valley Council (2007) *2006-2007 Supplementary State of the Environment Report*: available from: http://www.yassvalley.nsw.gov.au

Yass Valley Council (2007a) *2006-2007 Annual Report* available from: http://www.yassvalley.nsw.gov.au

Yass Valley Council (2008) *Yass Valley Visitors Guide,* accessed December 2008 available from: http://www.yassvalley.nsw.gov.au

Zilkha Renewable Energy 2002. Web site, retrieved from: www.zilkha.com/whatweredoing.asp?id=