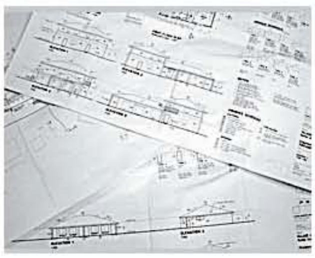
HARPER
SOMERS
O'SULLIVAN



Environmental Assessment

for

Black Springs Wind Farm

Prepared for

Wind Corporation Australia Limited
Level 42, AAP Centre
259 George Street
Sydney NSW 2000

Job Reference 23219 – November 2006

HARPER SOMERS O'SULLIVAN

PLANNING › SURVEYING › ECOLOGY

Prepared By:
Harper Somers O'Sullivan Pty Ltd
PO Box 428
Hamilton NSW 2303
Tel: (02) 4961 6500
Fax: (02) 4961 6794
Web: www.hso.com.au

PROJECT: **ENVIRONMENTAL ASSESSMENT – BLACK SPRINGS**	
CLIENT:	ENERGREEN WIND PTY LTD FOR WIND CORPORATION AUSTRALIA LTD
OUR REF	23219
DATE:	NOVEMBER 2006
APPROVED BY:	S MCCALL
SIGNATURE:	
CHECKED BY:	T LAMBERT
SIGNATURE:	

EXECUTIVE SUMMARY

Harper Somers O'Sullivan Pty Ltd has prepared this Environmental Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979* for the development of a wind farm at Black Springs NSW, acting on behalf of Wind Corporation Australia Limited.

The objective of the project is to significantly increase renewable energy production in NSW that is economically rationalised while also mitigating the production of greenhouse gas emissions. After investigating several sites in NSW, the Oberon Shire was considered suitable for the installation of an economically viable wind farm. Sufficient local energy demand, suitable wind conditions and available infrastructure are key elements of the selected site. By providing distributed electricity generation capacity close to the local demand, electricity transmission losses are reduced and supply reliability potentially is improved. Subsequently, Black Springs is considered the best location to develop the objectives of the project. The overall intention of the proposal is to design environmentally benign structures that adhere to the principles of ecological sustainable development. Wind farms provide exemplary examples of ecological sustainable development.

The proposal is known as the Black Springs Wind Farm (BSWF) and includes nine wind turbine generators (WTGs) connected via underground cables to a substation and a facilities building. Access roads to the turbines will also be constructed to allow delivery of the turbines and ongoing maintenance. The approximate construction time will take between four to eight months.

The proposal is based on the SUZLON S88/2.1 MW turbine or equivalent turbine generators with a hub height of 80m. The rotor has 3 blades on the vertical axis. The diameter of the blades is 88m and covers a swept area of 6082 m^2. The highest blade tip height would be 124m AGL.

Wind Corporation Australia has erected over 9 wind monitoring masts on a range of sites in NSW, Qld and SA. The NSW sites have been strategically selected based on information contained in the SEDA NSW Wind Atlas. Data collated from a monitoring mast located on the proposed site near the village of Black Springs has confirmed the wind resource necessary to commercially operate wind turbines. Black Springs has been identified as a preferred site for development due to the factors of:

- suitable wind speeds;
- suitable and available land;
- nearby electrical grid with available capacity; and
- local landholders are interested in wind farm opportunities on their land.

No other sites identified by the Wind Corporation Australia have demonstrated the ability to support the same number of turbines, with comparable wind speeds, proximity to the grid connection and appropriate landholder support.

The topography of the wind farm site is characterised by a series rolling hills forming a gentle ridgeline in a north west – south east direction. The knolls are separated by shallow valleys. The vegetation of the subject site is characteristic of the surrounding area. It consists of large cleared areas, open paddocks covered by grassland with sparsely scattered shade trees. Sheep and cattle grazing are the predominant land use.

The site ranges in elevation between 1100m and 1250m above mean sea level (AMSL). A trig station is located on the Daisybank property at an elevation of 1233m AMSL. The high elevation and sparse vegetation results in high average wind conditions. Large areas of land surrounding the site is used for pine timber plantations and some small remnant forest patches are scattered across the landscape.

The BSWF will generate clean, green renewable energy for consumers in the Oberon region generating sufficient electricity for up to 6000 homes. Within the 25 year design lifetime, each wind turbine will supply approximately 33 times the energy used throughout it's own life cycle. The proposal has the potential to avoid the production of up to 43,660 tonnes of greenhouse gas emissions. Energy produced by the BSWF will contribute to achieving the Commonwealth Government's Mandatory Renewable Energy Target and assist with Australia's commitment to the greenhouse response. The NSW Government has also announced a NSW Renewable Energy Target (NRET) to assist in reducing greenhouse gas emissions to 2000 levels by the year 2025, and by 60% by 2050, as NSW's input into addressing climate change. The establishment of the NRET will require electricity retailers to purchase the target proportion of their electricity supply from accredited renewable generation sources, which would include proposals such as Black Spring Wind Farm. Therefore, energy produced by the BSWF will contribute to achieving MRET and NRET and assist with Australia's and NSW's commitment to the greenhouse response.

The BSWF will also provide local participating landholders with additional income, which will add to the viability and sustainability of these traditional agricultural landholdings. The project will assist the region to meet environmental objectives and the principles of Ecologically Sustainable Development through the generation of renewable energy, and consequent greenhouse gas abatement.

The scenic quality of the area will be impacted by the turbines, though the perception of the impact will vary according to each individuals perception of wind farms and their attitude towards renewable energy production. The turbines have been located so as to provide a balance between the community needs and perceptions, the environmental issues, energy output and the need to reduce the impact on climate change.

The proposed wind farm does not involve the removal of native vegetation or trees and is compatible with the agricultural activities currently undertaken on the land. No significant flora and fauna impacts will result from the development of the wind farm. The proposed BSWF is unlikely to impact on items of Aboriginal cultural heritage as investigations have shown that the frequency of artefact occurrence is likely to be very low. A co-operative approach with the Department of Primary Industries and Straits Exploration (Australia) Pty Ltd will ensure that potentially valuable mineral resources are not sterilised and that the active exploration program within the existing Exploration Licence is not impeded. Working together, both projects can be accommodated.

The most noticeable sound produced by a wind turbine can be described as the periodic "swish swish" of the blades cutting through the air. Although the blades continuously create this noise while rotating there is a pressure change as the blade passes the tower and an intermittent "swish-swish" sound is propagated. This sound is not mechanical and does not generally have a tonal nature but is rather a "white" noise and therefore decays more rapidly with distance. Noise is described as “white” noise when it does not have a specific tonality and frequency spectrum but ranges across a large frequency band. The noise output of a turbine increases with wind speed however the background sound pressure level, which has the effect of masking the noise produced by the turbine, also increases. In the case where a significant level of annoyance or disturbance due to wind farm noise is experienced by a resident, and the limits presented by the SA EPA Guidelines are found to be exceeded during operation of the wind farm, mitigation measures will be investigated and implemented.

Construction and operation phases of the development will be in accordance with the Best Practice Guidelines for Wind Energy Projects. Prior to commencing work, the contractor will be required to prepare a Construction Environmental Management Plan (CEMP) to address Occupational Health & Safety requirements and general risk management issues. The CEMP will specify measures to be adopted by the contractor to minimise interference with and the disturbance of the environment during the construction of the wind farm and associated facilities.

The wind turbines are located well clear of any significant vegetation. The turbines will be earthed to prevent any arcing of electricity or surges resulting from lightning strikes. The bushfire management plan provides a range of measures to ensure bushfire impacts and prevention measures actively assist in the control and prevention of bushfires. Therefore, the development of the wind farm is not considered to contribute to any increased threats associated with bushfires.

There tends to be no recent sales evidence to support one view or another of a reduction of land values associated with the development of wind farms because often the rural properties involved do not change hands with a frequency that would allow a reliable assessment to be made. However, the recent sale of the ‘Winton Park’ property and subsequent subdivision provides strong evidence relative to the Black Springs area that land values adjacent to the wind farm development will not be negatively impacted. On-going monitoring of land values will be undertaken during the operation of the wind farm.

Black Springs and Oberon shire would benefit both socially and economically from the development of BSWF. As with most wind farm developments, there will be positive and negative benefits, though it is considered that the positive socio-economic impacts in this circumstance outweigh the negative impacts. The wind farm will result in a major investment in the area, which will require employing local labour and resources. The wind farm will provide tourism opportunities for Black Springs. Tourism drawn by the attraction of viewing the wind farm would also has flow on effects that extend to other ancillary service sectors such as accommodation, fuel suppliers and food outlets.

The proposal is located adjacent to existing infrastructure to allow connection to the electricity grid with minimal additional infrastructure requirements. The Electromagnetic Interference (EMI) studies indicate that minimal if any EMI will result from the proposal. The Civil Aviation Safety Authority (CASA) has assessed the proposal and will indicate in the near future if lighting is required on the turbines. Any CASA requirement will be complied with during the construction process.

No concerns exist regarding public safety and the wind farm proposal. Evidence collated over 20 years of electricity generation from more than 100,000 turbines worldwide, indicates that no member of the public has ever been injured during the operation of a wind farm.

The associated short-term cumulative impacts predominately relate to transport impacts on the surrounding road network during the delivery of turbine components. The Transport Study addresses these impacts and suggests mitigation measures to reduce them. The long-term cumulative impacts include the change to the landscape character with the introduction of the turbines. The wind farm has a small environmental footprint and a large visual impact. The wind farm impacts on the landscape in the long-term are reversible with the decommissioning of the wind farm and the removal of the structures. Therefore, considering the overall environmental benefits of wind generated electricity with respect to the reduction in greenhouse gas emissions and that the turbines visual impact is related to structures that will be removed after decommissioning, the long-term cumulative impacts are considered acceptable and nearly all impacts are reversible.

The environmental risk assessment indicates that with the implementation of appropriate mitigation measures that nearly all the impacts can be reduced to an acceptable level. The visual impact is very subjective and difficult to quantify, though the overall impact has been assessed and measures have been suggested to ameliorate the main receptor impacts. Overall, the BSWF proposal will provide ecological sustainable development that will offset the emission of a substantial amount of greenhouse gas and contribute to the Government's commitment to renewable energy production.

Glossary of Terms

AMSL. Above Mean Sea Level.

AusWEA. Australian Wind Energy Association

Biodiversity. The variety of life forms of plants, animals and micro-organisms across the genetic, species and ecosystem scales.

Blade-strike. The term used when avifauna (bats and birds) collide with the turbine blades resulting in casualty.

BSWF. Black Springs Wind Farm.

CASA. Civil Aviation Safety Authority.

CO_2. Carbon dioxide

Commissioning. The final phase of the construction period when the wind turbines and associated infrastructure a tested and fine tuned.

Construction Environmental Management Plan (CEMP). A plan of management to control and mitigate environmental impacts associated with the construction phase of the project. The plan outlines control measures, training requirements and monitoring for the construction phase.

dB(A). An A-weighted sound pressure level. An A-weighted noise level is adjusted in such a way to represent the way we hear sound.

Decommissioning. The removal of all above ground structures at the completion of the wind farm operations and the rehabilitation of the site to its original appearance.

Ecological Sustainable Development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Electricity grid. The electrical transmission and distribution network.

Electromagnetic Interference (EMI). A term used to describe the potential impact of rotating metallic, and therefore conductible surfaces and structures, on microwave, radio and television signals passing through the area in question.

Enhanced greenhouse effect. An increase in the natural process of the greenhouse effect, brought about by human activities, whereby greenhouse gases such as carbon dioxide, methane, chlorofluorocarbons and nitrous oxide are being released into the atmosphere at a far greater rate than would occur through natural processes and thus their concentrations are increasing. Also called anthropogenic greenhouse effect or climate change.

Environmental Management Plan (EMP). A plan of management to control and mitigate environmental impacts associated with the operation phase of the project. The plan outlines control measures, training requirements and monitoring required during the working life of the project.

Environmental Risk Analysis. An assessment of the risks imposed on the environment for a particular project and involves the estimation of the effects of a proposed change and the importance of those effects

Generator. A machine that converts mechanical energy into electrical energy. In a normal generator, a shaft spins a magnetic rotor. The moving magnet produces an alternating current. (It is the reverse of an electric motor.) Generators are extremely efficient in converting mechanical energy to electrical energy.

Hub height. The height of the hub above ground level.

Hub. The connection between the wind turbine blades and the driveshaft that drives the generator.

Kilowatt hour (kWh). Equivalent to the production of 1000 watts of power generated for a perion of one hour.

Life cycle analysis. An assessment that takes into consideration the impacts of procuring the basic materials, transport, manufacture, distribution and, ultimately, disposal of the used item.

Mandatory Renewable Energy Target (MRET). The *Renewable Energy (Electricity) Act 2000* requires the generation of 9,500 gigawatt hours of extra renewable electricity per year by 2010, enough power to meet the residential electricity needs of four million people.

Megawatt hour. A unit of energy that is used to measure the generation of electricity. 1 megawatt hour = 1000 kilowatts of power operating for one hour.

Megawatt (MW). The unit of energy is the joule (J) and the unit of power is the watt (W), which is the power involved in doing 1 joule of work (or using 1 joule of energy) each second. This is a very small amount of power and in most mechanical applications, we count power in kilowatts (1 kilowatt = 1000 watts). A kilowatt is about equal to the heat energy put out by a single bar radiator, and is also about equal to the power expended by a person running up stairs. When we consider power generation we use larger units. The megawatt is a 1,000,000 watts or 1000 kilowatts.

Mitigate. To make less severe.

Nacelle. The structure on top of the tower which contains the turbine and gnerator and supports the rotor.

Native vegetation. A term used in reference to flora species that naturally occur in Australia.

NSW Greenhouse Abatement Certificates. NGACs are a particular kind of carbon credit issued by the New South Wales State Government of Australia. NGAC stands for NSW (New South Wales) Greenhouse Abatement Certificate and NGACs are generated, traded and regulated under NSW law. Each NGAC abates a single tonne of carbon dioxide for 100 years.

NSW Renewable Energy Target (NRET). NSW Government has announced a Renewable Energy Target to assist in reducing greenhouse gas emissions to 2000 levels by the year 2025, and by 60% by 2050, as NSW's input into addressing climate change. Renewable energy target levels will be 10 per cent of NSW end use consumption by 2010 and 15 per cent by 2020.

Photomontage. A graphic illustration of a proposed development drawn to scale incorporating the background photograph of a location to show how a proposal will look in the landscape.

Rotor. The three airofoil blades that extend from the hub and are rotated by the wind.

Shadow Flicker Analysis. An analysis of the potential light fluctuations caused by sunlight shining through the moving rotor blades of a wind turdine.

Substation. A premises or place where high-voltage supply is converted, controlled or transformed.

Transmission losses. Electricity losses that occur in the transmission and distribution network, often as heat.

Visibility. The range to which a particular component of the development may be seen from the surrounding area.

Visual Catchment. The area surrounding the development that the wind farm will be visible.

WCA. Wind Corporation Australia Pty Ltd.

Wind turbine. A device in which a stream of air turns a series of blades, converting the kinetic energy of the air flow into mechanical energy available from the turbine shaft.

WTG. Wind Turbine Generators

Zone of viusal influence. A plan showing a representation of the area over which any part of the proposed development may be visible. The plan ignores all visual conditions, visual acuity of the observer and topographical features (trees, tall structures, etc) except for terrain. The resulting plan is representative of the worst case scenario of visibility of a proposed development.

FACT SHEET 1

Wind Farm Basics

What Is A Wind Farm?

"Wind Farm" is the name used for any group of adjacent wind turbine generators that are connected electrically. This includes vehicle access tracks, underground cabling for electrical interconnection and communications, and the switchyard at the point of connection to the grid. In Australia, wind farms have been built with between 1 and 60 wind turbines.

Each wind turbine acts independently, generating from the available wind resource. The electricity flows through common cabling out into the grid. The turbines are usually arranged to maximise use of the wind available and placed sufficiently far apart to avoid interference with one another.

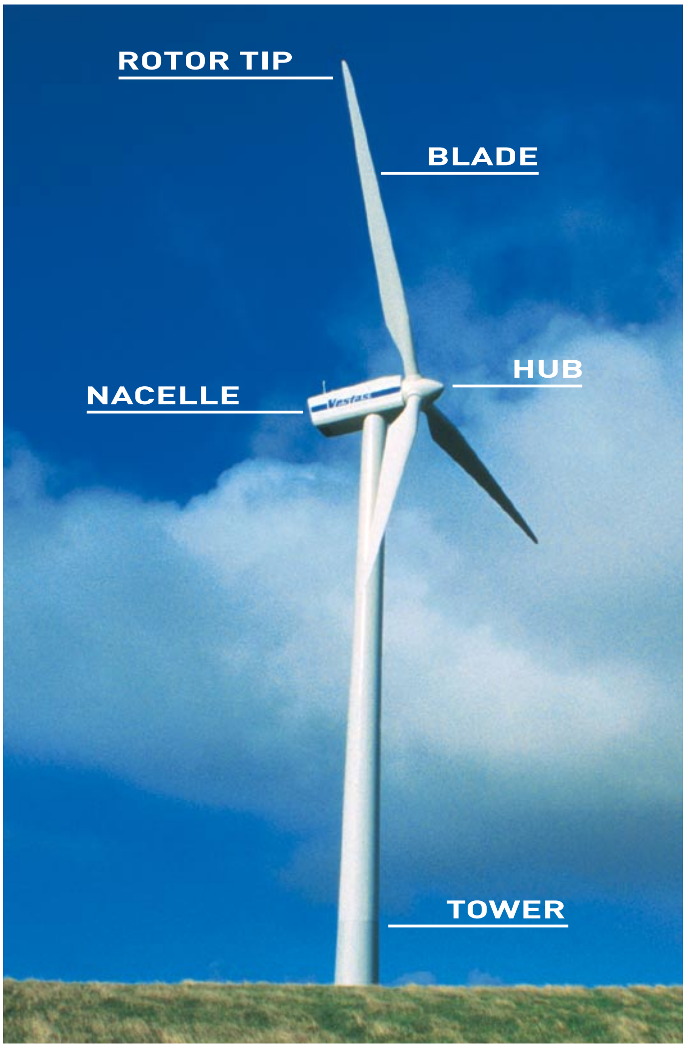
Wind farms produce electricity directly from a natural, clean and sustainable energy resource. This technology is now the world's fastest growing electrical generation source and Australia is beginning to see more wind farms proposed due to their environmental benefits.

Every development is different and site specific issues and local planning controls ultimately determine the design and layout of a wind farm. To provide a benchmark approach, AusWEA has published "Best Practice Guidelines for Grid Connected Wind Energy Projects in Australia" www.auswea.com.au.

What Is A Wind Turbine Generator?

A wind turbine generator consists of a foundation, tower, nacelle and a rotor (three blades mounted on a central hub). The foundation is typically a thick slab of reinforced concrete 12m wide and 3m deep. This is buried in the ground, allowing stock to graze right up to the tower. The nacelle rests on a large bearing which allows the whole machine to be driven by motors into the prevailing wind direction.

Whereas early wind generators overseas were built on lattice towers, in Australia only enclosed tubular steel towers are used. Towers are typically coloured white or light grey as these colours have been found to create the least visual impact. Internal ladders provide access to the nacelle which contains the drive-train, gearbox, generator and controlling equipment. Wind turbines for today's wind farms cost up to $3M each.



How Do Wind Generators Work?

The rotor turns a generator inside the nacelle, converting some of the wind's energy to electricity. As wind speed increases, more energy is delivered to the wind turbine's rotor. This energy is extremely sensitive to wind speed - doubling the wind speed gives eight times the energy.

Wind turbine generators deal with these huge variations in power using several aerodynamic strategies that regulate the power captured by the rotor.

Wind Speed (m/s)	Wind Speed (km/h)	Operating Strategy
<4	<14	machine shut down – not worth wear and tear
4– 12	14 - 45	output increases steadily with increasing wind speed
12 – 25	45 – 90	output remains steady and excess energy "spilled" from rotor
> 25	>90	machine shutdown for self protection

Blade Speed and Materials

The blades of grid connected wind generators range between 25 and 50 meters long and typically sweep to about half way down the tower. Depending on the size and design of the machine, the rotor will turn at between 10 and 25 revolutions per minute. From a distance this rotation seems quite slow and stately. Up close the strength, flexibility and speed of the rotor blades is revealed.

The blades are made from advanced composite materials that have high strength and are light weight and flexible. The maximum blade tip speed is about 215 km/h and it is quite normal to see the blades flex backward several metres under the enormous pressure of the wind.

Integrated lightning protection systems ensure the blades can withstand a direct strike without serious damage. In Australia towers are nearly always steel, whereas in Europe concrete towers are also used.

Where Are Wind Farms Sited?

Wind farms are usually sited where there is a good wind resource, access to transmission lines, local community support and plenty of open land available. Typically, the best wind resources in Australia are in coastal regions or inland at higher altitudes. Wind farms are unlikely to be built offshore in Australia in the near future because of the extraordinarily high cost of offshore construction. Nonetheless, in Europe offshore wind farms have become economically viable because of higher energy prices.

How Much Energy Does A Wind Turbine Produce?

This depends on the size of the machine and the wind resource. Typically each wind turbine can can produce enough energy to meet the needs of up to 1,000 homes, saving several thousand tonnes of CO2 emissions per year.

How Do The Costs Add Up?

Wind power and other renewables are economically viable in Australia because the Federal Government, like many governments in the world, is encouraging the uptake of renewable energy through legislated measures. The Mandatory Renewable Energy Target (MRET) requires that a certain amount of the energy sold by Australian retailers be from renewables such as wind and solar.

Currently wind energy costs around twice as much as energy from coal generation, but the cost of wind power and other renewables is falling. Importantly, the cost of fossil fuel based energy does not factor in environmental costs and should these be imposed in the future (as seems likely), the gap between wind and fossil fuel based energy will close rapidly. In more remote parts of Australia where fuel costs are higher (eg because of transport of diesel), wind energy can be cheaper than fossil fuel based generation.

Where Can I See A Wind Farm?

Wind farm locations can be found by visiting the Australian Wind Energy Association's web site www.auswea.com.au. Most wind farms have viewing areas with informative displays, some with self guided or commercial tours. Some of the larger wind farms have "virtual tours" on their web sites.

Please remember that most wind farms in Australia are located on private property. You should keep to the path and designated visitors' area and not enter private property unless invited.

Wind Farming & the Australian Electricity System

How Do I Know Wind Farms Are Reducing Greenhouse Emissions?

Whenever a wind farm is operational, its output is being fed into an electricity grid and the energy is being used somewhere in the system downstream. Although the contribution of wind energy is currently quite small relative to the total generation on Australian electricity networks, every unit generated from wind is a unit that does not need to be produced by other generation, 90% of which comes from fossil fuels. The type of generation actually displaced (and hence the emissions saved) by wind energy, will vary depending on the geographic location of the wind farm and the time of generation.

How Much Fossil Fuel Does Wind Power Offset?

Depending on where it is located in Australia, a typical new 50 megawatt (MW) wind farm displaces between 65,000 and 115,000 tonnes of carbon dioxide - equivalent to leaving tens of thousands of tonnes of coal in the ground each year. The amount varies depending on what type of fossil fuel the wind energy is displacing.

What Happens When The Wind Stops Blowing?

The output of fossil fuel fired generators can be controlled, wind power cannot. Presently, wind power variability has no impact on the operation of most large Australian electrical networks because it still makes a relatively small contribution to the total generation. Today when wind farm outputs increase, the fossil fuel generators simply back off, and vice-versa when output decreases. Networks have to be able to accommodate changes like this all the time because of fluctuations in load.

In the future, more wind farms will be built and the percentage of the electricity from wind will increase. How well the networks cope with this depends largely on the type and size of fossil fuel generation being used, network operational policy, and whether the lessons learnt from other places in the world can be applied.

In some parts of Germany, wind energy can contribute up to 70% of a region's electricity needs. This has required the use of long term wind energy forecasting and changes to the way that these networks are controlled. These changes have been driven by a desire from community and Government, to see the environmental benefits of wind energy increased.

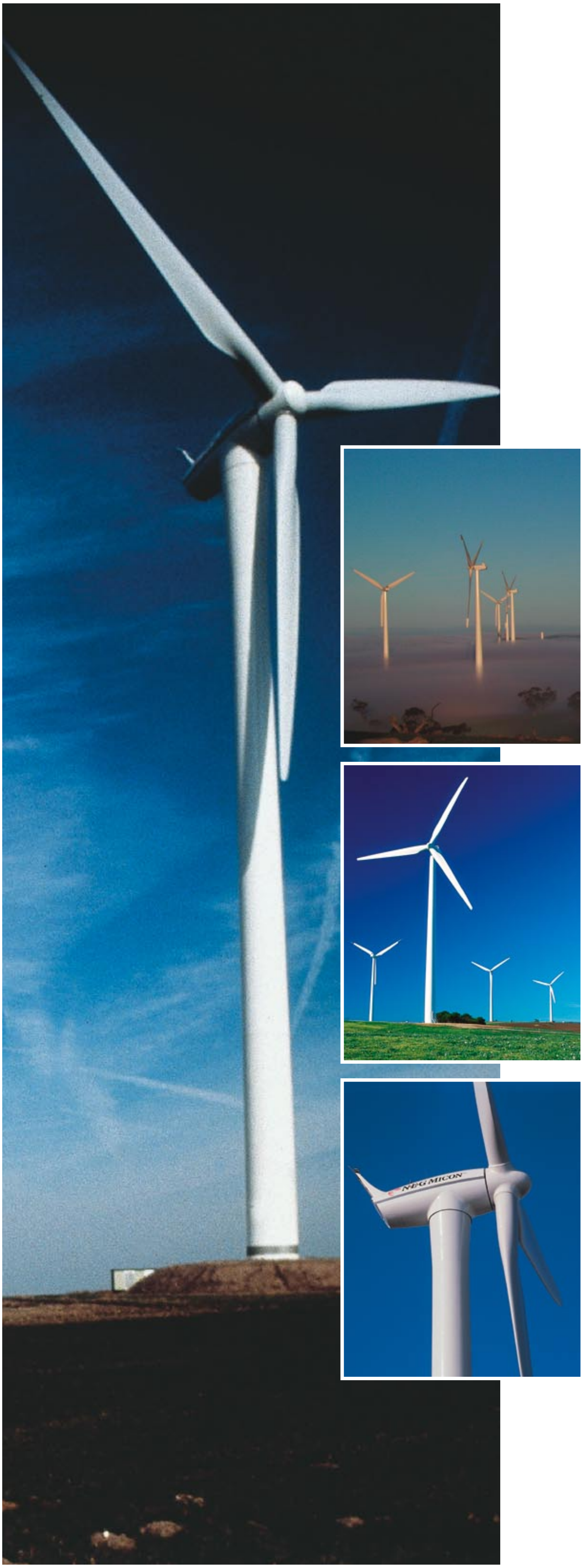
It has also been found that as more wind farms are built, their combined fluctuations and hence overall impact on electrical networks are reduced. This is because wind speed depends largely on local weather patterns and these become more diverse the further they are apart.

How Predictable Is Wind Power?

Wind power output is intermittent, but the output from wind farms can be usefully predicted as much as 24-48 hours in advance. With increasingly effective data collection across Australian wind sites, forecasts are likely to improve with significant benefit to network managers.

How Does Wind Energy Compare To Other Types Of Generation?

In terms of mechanical operation and maintenance, wind turbines are more than 99% reliable, compared to around 97% for the steam turbines used by coal plants.



Because turbines in Australia are generally located to take advantage of strong and consistent winds, their utilisation rates (the amount of time they are in use) are generally in excess of 95%, which compares favourably with conventional power plants. Wind turbines are very efficient in converting the primary fuel (wind) to energy. Today's large scale machines typically operate at efficiencies of approximately 47%. This compares with coal to energy conversion efficiencies of 30 – 40 % for coal burning plants, where the majority of energy is lost as heat in the exhaust.

How Much Wind Power Can We Have In Our Energy Mix?

Large scale wind generation needs to work hand in hand with conventional sources. AusWEA has a target of 5,000 MW of wind to be installed in Australia by 2010 - about 6% of Australia's electricity needs. Recent modelling by technical experts has revealed that at least this amount of wind power can be integrated into the national grid subject to wide distribution, strong interconnection and state of the art forecasting. However, there are plans in some overseas countries for wind power to contribute as much as 10% of energy needs by 2010.

How Can I Help Promote Wind Power?

In almost every State, householders and businesses can elect to pay a little extra on their power bills for "Green Power". Through a process audited by a third party, "Green Power" customers are assured that renewable electricity, equivalent to the normal consumption, is fed into the grid reducing the amount of fossil fuel based generation needed. The collective purchasing power of "Green Power" customers represents a significant benefit to the environment and is a way of promoting renewable energy sources such as wind power.

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Wind Farming & The Environment

Why Are Renewable Energy Sources Like Wind Power Important?

Most (90%) of the electrical energy used in Australia comes from the burning of fossil fuels such as coal and natural gas. In April 2001, the Renewable Energy [Electricy] Act was passed as one of the measures proposed by the government aimed at reducing human induced changes to our climate. This Act set targets for the increased use of renewable energy through the Mandatory Renewable Energy Target (MRET). Wind energy is clean, free and renewable. The technology is proven, fast to build and cheap in comparison to other renewable energy technologies. Wind energy is well placed to grow and deliver greenhouse pollution cuts on an increasingly cost competitive basis.

Is Climate Change Real?

The Greenhouse Effect is a natural phenomenon whereby greenhouse gases trap heat in the atmosphere, keeping earth warm enough for us to habitate. Human activity is however, releasing unprecedented quantities of these gases into the atmosphere principally through the use of fossil fuels. This is believed to be causing too much warming and may lead to accelerated climate change. While the extent and severity of the effects on the environment are uncertain, it is a serious environmental problem for humanity. To avoid dangerous climate change, well beyond what we have seen already, greenhouse emissions will need to be reduced by at least 60% below 1990 levels by 2050. While the "Kyoto Protocol" will reduce emissions by an average of 5% by 2012, it will only be the first of many initiatives required to achieve the massive reductions needed.

Where Does Australia Rate In Greenhouse Gas Production?

Australia has the highest per capita greenhouse gas emissions in the developed world. Although Australia's emissions contribute only 3.6% to the global total, they are roughly the same as the combined emissions from Austria, Denmark, Finland, Ireland, New Zealand, Norway, Portugal, Sweden and Switzerland.

Why Are Australia's Greenhouse Emissions So High?

Electricity consumption due to the burning of coal and other fossil fuels, is the most significant source of greenhouse emissions in Australia (45%). This continues to increase rapidly with economic growth. In Australia, around 10% of our electricity is renewable, most of which comes from large scale hydroelectric power stations that were built several decades ago such as the Snowy Mountains Scheme .

How Much Energy Goes Into Building Wind Turbines?

It takes only a few months for a wind turbine to pay back the energy used in its manufacture and over its 20 year lifetime, a wind turbine will produce more than 50 times the energy used in its manufacture, transportation and erection. Once dismantled at the end of its life, it will leave very little legacy of pollution for future generations.

Are There Other Benefits To Wind Generation?

Rather than generating a large amount of power in one centralised location, wind farms are often located close to where the electricity is actually used. This means that the losses usually associated with the transmission of electricity over long distances (up to 10%) can be significantly reduced. This further increases the emission reduction benefits.

How Much Energy Can A Wind Farm Produce?

Depending on siting, a typical wind turbine can produce the equivalent energy needs of up to 1,000 homes. A typical 50 megawatt (MW) wind farm in Australia displaces between 65,000 and 115,000 tonnes of carbon dioxide per annum – enabling tens of thousands of tonnes coal to be left in the ground each year.

What Is The Impact On The Local Environment?

Wind power offers an environmentally benign means of generating electricity and since the area occupied by the wind turbines themselves is so small, the impact on the natural environment is usually quite minimal. Having said this, wind turbines do need to be located in elevated and exposed places and are often visually prominent in the landscape. There is little doubt that in terms of local environmental impact, it is the visual aspects which will tend to dominate debate. This is addressed in more detail in Fact Sheet # 7. In terms of other local environmental impacts, wind developers are often able to integrate beneficial local environmental measures into their construction and operational activities. This can include the collection of indigenous plant seeds, planting of shelter belts or habitat areas, land class fencing, erosion control measures or easing fire hazard management through improved site access. Income to landowners hosting wind generators can ease pressure on agricultural land by reducing the stocking or cropping of marginal land. In addition, these landowners are often able to adopt superior pest, weed and erosion management practices as well as affording environmental plantings and other land care initiatives.

What Is The Impact On Wildlife?

Wind farms undergo stringent environmental approval processes including detailed studies of the impact on wildlife. Generally, the adverse impacts if any, will be negligible and positive outcomes can often be achieved through the integration of environmental works by the developer and host landholders.

How do Wind Turbines Impact Birds?

Monitoring at the Codrington, Woolnorth and King Island wind farms has found bird deaths to be below levels predicted and accepted during the wind farm approvals process. The rate of bird mortality on those sites ranged from between 0.23 to 2.7 birds per turbine per year, none of which was a rare, threatened or endangered species. Putting this into perspective, millions of birds are killed by cars and other man made structures every year. Impacts on Birds are discussed in more detail in Fact Sheet #8.

What Are The Long Term Impacts Of Wind Farming?

The long term impacts of wind farming are negligible. During operation there is no depletion of the fuel source (wind). When a wind farm is removed, there is no lasting residual impact on the landscape and it can be returned to essentially the same state as it was before the wind farm was built. Most wind farm development approvals have clauses requiring developers to decommission wind turbines at the end of their design life or if they cease operation for an extended period of time.

How Much Land Do Wind Farms Take Up?

In Australia, the land occupied by wind farms may not be as much of an issue as in countries where vacant land is at a premium (eg. Europe or Japan). Yet in comparison with other energy generation technologies, wind farms still show a greater energy yield per square meter with the impact intensity of wind generation facilities being significantly lower than an equivalent sized fossil fuel based plant :

Technology	m2 land used per GWh
Coal	3,642
Solar Thermal	3,561
Photo Voltaic	3,237
Wind	1,335

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Wind Farming & Tourism

Wind farms are usually located in exposed and windy landscapes and the values placed upon these landscapes and the perceived impacts of development upon them vary considerably. Generally, responses depend on both the individual observer and the site being considered.

Wind farms tend to get more support than many other visually prominent forms of development because they produce clean energy, reduce greenhouse gas emissions and ultimately help mitigate climate change. While climate change is very important, some landscapes should be cherished and protected from all development.

Like other human-made structures such as bridges and lighthouses, well designed wind farms can give interesting perspectives and furnish the landscape with new architectural and heritage values.

In 2001, a poll[1] in Victoria showed that 94% of respondents described wind generators as "interesting" and 74% as "graceful". A subsequent survey[2] showed that 36% of respondents were more likely to visit a coastal area if it had a wind farm, while 55% said it would make no difference. Only 8% said it would deter them from visiting.

The February 2002 survey also showed that 95% of respondents supported the construction of more wind farms. This result was again backed up in a national poll[3] by AusWEA in 2003 which found that 95% support (27%) or strongly support (68%) building wind farms to meet Australia's rapidly increasing demand for electricity.

Are Wind Farms Tourist Attractions?

Yes. Hundreds of thousands of people visit Australian wind farms each year. Some of these are casual observers who stop at roadside interpretative centres or displays. Others pay to participate in organised tours. In a number of cases, tourists are able to walk right up to the base of the tower, gaining a full appreciation of their size and the power generated by these machines.

In Esperance (WA), more than 80 cars per day travel down the wind farm access roads with the majority visiting the wind farms. Although wind farms have been in operation in the region for over 20 years, visitor numbers have not declined over time.

What Is The Experien ce Overseas?

Utility scale wind energy is relatively new for most Australians but we can look to the long-term experience overseas. However we need to remain aware of differences – Australian landscapes are generally more impressive and our perceptions of environmental values may be different.

Tourism Overseas

In Denmark, there are 6,000 wind turbines in an area approximately the size of Tasmania and wind farms there are used for marketing tourism. Hotels, guest houses and camp sites may use wind turbines for "green tourism" promotion. This is particularly targeted towards the German market, where the public is known to have a high level of interest in both environmental issues and new technology.

In a Scottish study[4], 43% of responding visitors said a wind farm would have a positive effect on their inclination to visit the Argyll area, an area of high landscape value. About the same proportion said it would make no difference, whilst less than 8% felt it would have a negative effect.

Surveys in the UK show that for 94% of visitors to North Cornwall, the presence of wind farms has had no adverse impact on the likelihood of them visiting North Cornwall again. The majority of the remaining 6% say that the presence of wind farms would actually encourage them to revisit. Such public interest has led to a steady increase in the use of serviced accommodation in the area of the Delabole Wind Farm.

Public Perception Overseas

Research from a wide variety of sources consistently shows that general public support for wind power is between 70% and 80%.

In Denmark since 1991, the share of electricity consumption from wind power has grown six-fold to current levels of around 30%. However, a 2001 poll[5] indicated that 65% of Danes still believed it was a good idea to increase the share of wind energy in the Danish electricity supply. This is exactly the same share of the population as in two previous opinion polls taken five and ten years earlier. Further information on public attitudes to wind energy can be found at; http://www.bwea.org/ref/surveys.html

Visit a Working Wind Farm?

Viewing Areas

Most wind farms are located on private land so it is not always possible to walk up to the wind turbines. However in Australia every utility scale wind farm has a viewing area at which members of the public are able to safely pull

off the road and learn more about the project. Some wind farms have visitor information centres such as the Visitor Information Centre for the Toora wind farm in Victoria - www.toorawind.com.au/windfarm.

In Western Australia, a major Wind Discovery Centre for the Albany wind farm is being planned by the Albany Council to attract additional tourists to the region - www.albany.wa.gov.au/albany/windfarm/windfarm.

Self Guided Tours

Some wind farms are located on public land and allow members of the public to walk amongst the turbines at their leisure (e.g. the 9 and 10 Mile Lagoon Wind Farms - Esperance, WA and the Albany wind farm - Albany, WA).

Commercial Tours

Several wind farms in Australia attract so many visitors that commercial tour operators have been established and provide an opportunity for the public to get a close up view of the wind farm.

- Woolnorth, Tasmania: www.woolnorthtours.com.au/windfarm.html
- Challicum Hills, Victoria: www.windfarmtours.com.au
- Codrington, Victoria: www.myportfairy.com/windfarmtours

Virtual Tours on the Web

Many wind farms around the world have virtual tours on the web, in particular some of the large offshore wind farms.

1 AusPoll study - June 2001

2 AusPoll study - February 2002

3 Australian Research Group Study - September 2003

4 Tourist Attitudes Toward Wind Farms, MORI Summary Report, September 2002: http://www.bwea.com/pdf/MORI.pdf

5 http://www.windpower.org/en/faqs.htm#anchor29566

Wind Farm Siting Issues

What Do Wind Farm Developers Look For?

Wind developers favour sites with the following attributes:

- Strong and consistent winds
- Winds that blow at times of the day when the electricity is most needed
- Proximity to a suitable electrical grid
- Land where wind farm development is appropriate, away from areas of high conservation value or areas with endangered flora or fauna species [eg. National Parks and wetlands are not considered]
- Identifiable and manageable cultural heritage issues
- Open land without obstacles to the wind flow, and where such obstacles are unlikely
- Broad community support and acceptance
- Low population density
- Good access for wind farm construction and maintenance
- Suitable geology for access track base and foundations

Often a compromise needs to be found amongst these factors.

Land Use

Wind farming is compatible with many land uses ranging from cropping and grazing properties, to industrial estates, port break-waters and sometimes even forestry. In Australia, wind farms have been built on, or construction is currently proposed for most of these types of land.

Impact on local amenities such as airports, must also be considered when siting a wind farm. The long life span (20-25 years) of a wind farm means that it is also important to consider the future uses of adjacent land.

How Far Away From Houses Are They Built?

Although wind farms are not noisy in operation they still need to comply with very strict noise standards. It is therefore normally noise criteria that determines their set backs from residences. Setback distances range from about 400m to 1km or more, according to a variety of factors. These include the noise standard prescribed, local topography, prevailing wind conditions and the wind farm layout.

Why So Much Emphasis On Wind Speed?

The commercial success of a wind farm depends upon its electricity output and the selling price. Wind power in Australia has to compete with some of the cheapest electricity prices in the world, largely due to our extensive reserves of fossil fuel.

The output of a wind farm is extremely sensitive to wind speed. A 15% percent increase in wind speed adds 50% to the energy available. Only a 20% reduction in wind speed halves the wind energy produced. Wind farm developers must therefore, seek out the very best wind resources in order to develop commercial projects.

In Europe where electricity prices are much higher, wind farms can and are built in areas with considerably lower wind resources.

Where Are The Windy Sites?

Generally it gets windier away from the equator. The southern latitudes of Western Australia, South Australia, Victoria and Tasmania have excellent wind resources. However regional effects such as land/sea interactions, hills, ridges and mountains can enhance wind speeds making an otherwise uneconomic area suitable for wind farm development.

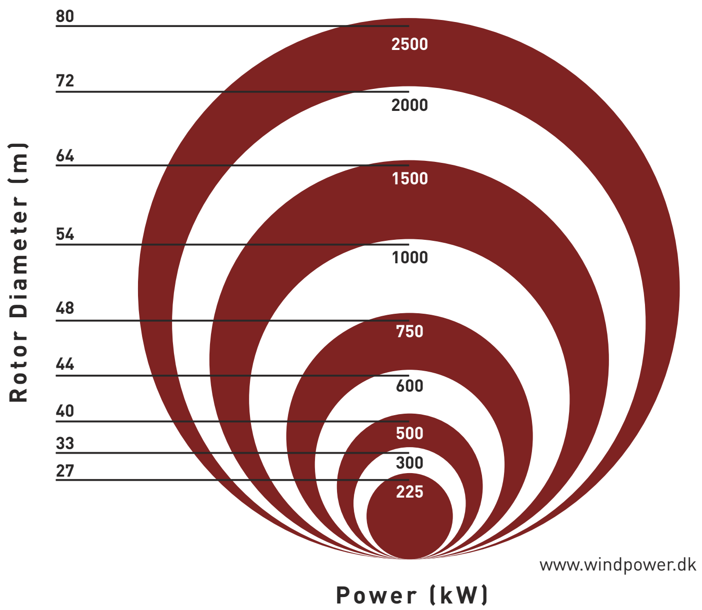
What Do Developers Avoid?

Wind developers will avoid any site with features that might slow down the wind. The impact of an obstacle will be determined by its height, its width and its porosity to the wind. Obstacles can be natural; ranging from dense forests to scattered trees, or human-made; such as wind rows or buildings. They can not only slow wind down, but induce turbulence which has a negative impact on energy yield and blade wear.

"Surface roughness" is another factor to be considered. Rougher surfaces slow the wind and introduce turbulence into the flow of air. Even a mature wheat crop will slow the wind down more than a closely grazed pasture. Scattered trees will have an even greater effect and big cities have the worst impact. The further the wind travels over rough surfaces, the more the wind slows down. This is one reason why inland sites have lower wind speeds.

Why Are Wind Turbines So Tall?

Wind speed increases with distance above ground level. In addition, towers must be tall enough to accommodate the rotor which normally sweeps past the tower at about half its height. Power output dramatically increases with rotor diameter as shown below.



Why Are Wind Farms Put On Top Of Hills?

Due to speed up effects, wind speed is significantly higher at the top of a hill or ridgeline.

Why Aren't More Wind Farms Built Inland?

Wind farms can be built inland where wind speeds are sufficient and the electricity grid is nearby. Inland sites do however, generally need to be in elevated terrain to be acceptable. Many coastal areas have stronger winds because of their exposure and proximity to the ocean where sea breeze effects are the greatest.

Why Aren't More Wind Farms Built Offshore?

In Europe there are several offshore developments underway, however they are very expensive to build and cannot be supported by Australia's low electricity prices. In Australia, there is still plenty of room for development onshore.

How Far Apart Are The Turbines

In general, wind generators will be separated by 3 to 5 rotor diameters across the prevailing wind energy direction and 5 to 7 rotor diameters with the prevailing wind energy direction.

What Other Issues Impact Wind Farm Layout?

Layout issues are very complex with several factors coming into play in varying degrees according to site conditions. Major factors include local terrain, noise constraints, aesthetic appearance, and avoidance of areas of important native vegetation and sites of cultural or archaeological significance.

Sophisticated three dimensional computer models help developers plot the many complex and often competing issues involved in designing a wind farm. The layout of most wind farms will normally need to go through many iterations before the final design is reached.

What Influences The Wind Farm Size?

Australian wind farms tend to be larger than European facilities as greater economy of scale is required to make them economically viable. In Australia, wind farms of between 10 and 50 wind turbines are usually pursued.

How Much Land Is Needed?

Although spread out, less than 1% of the land is used by the wind farm. Theoretically a 50 turbine wind farm could be squeezed into just 100 hectares, but local terrain and other factors usually means a much larger area is required and more than one landholder may be involved. For example, an attractive ridge may take in several land holdings, particularly where the ridgeline constitutes a property boundary.

FACT SHEET 6

Wind Farms & Noise

How Noisy Are Wind Turbines?

Although wind turbines do make noise, today's modern generators are generally much quieter than most people expect. It is quite possible to carry out a normal conversation at the base of a turbine running at maximum power, without raising one's voice.

The noise at locations within or around a wind farm can vary considerably depending on a number of factors including the layout of the wind farm, the topography or shape of the land and the speed and direction of the wind. It can be accurately measured using acoustic equipment.

What Do Wind Turbines Sound Like?

The main sound is the swooshing of the blades as they rotate. Sometimes when standing close to the tower, the whirr of the gearbox and generator may also be audible.

An unusual feature of wind turbine noise is that unlike most sources of industrial noise, it increases with wind speed. Around wind farms, many sources of background noise such as vegetation, are also affected by wind speed. At any given location, a wind farm's level of audibility will depend upon the relative levels of noise produced by the wind farm and the surrounding background noise.

When there is little or no wind, a wind turbine does not operate and therefore produces no noise. As the wind speed increases, the turbine commences operation and will start to produce noise which will increase as the wind speed rises. Wind related background noise at locations around the wind farm will also increase. Typically, this background noise rises more quickly and tends to mask the noise from the wind turbines.

The "noisiness" of a wind farm is therefore dependent on not only the level of noise that the wind turbines produce, but also the levels of background noise where the listener is situated. This will vary in different operational conditions.

The sound of a wind farm 100 m away would be inaudible in many urban areas of Australia as it would be drowned out by wind related and other background noises.

A listener's perception of noisiness is influenced not only by how much louder the noise is than that of the existing environment, but also by additional factors which include the acoustic characteristics of the noise itself [ie. whether it has audible tones or characteristics that may annoy the hearer]. All of these factors are considered when setting noise limits for wind farms.

Low Frequency Noise & Infrasound?

Concern is sometimes expressed about the possible effects of low frequency noise from wind turbines on nearby residents. Low frequency noise was a feature of some early wind turbine designs with the blades down-wind of the tower. This caused a low frequency 'thump' each time a blade passed the tower. Modern wind turbines have their blades upwind of the tower, thus reducing the level of this type of noise to below the threshold of human perception, eliminating any possible effect on health or wellbeing.

How Does Noise Affect Wind Farm Layout?

Noise limits are carefully determined and result in turbines being located far enough away from occupied houses to protect the amenity of the people living in them. This can have a significant impact on the number and type of turbines included in the design of a wind farm and where they are located.

In Europe, it is common to have wind turbines within 100m of houses. In Australia however, a more conservative approach has been taken and wind turbines are usually placed at least 400m from noise sensitive locations.

How Does Wind Turbine Noise Compare With Other Sounds?

Levels of sound perceived by the human ear are usually expressed in decibels, denoted dB(A). The "A" represents a weighting of the measured sound to mimic that discernable by the human ear, which does not perceive sound at low and high frequencies to be as loud as mid range frequencies.

- A change of 1dB(A) is the smallest difference one can hear within an acoustically controlled environment
- A change of 3dB(A) is a just noticeable change in level difference in an external environment
- A change of 5dB(A) is a clearly noticeable difference in level
- A change of 10dB(A) is heard as a doubling in loudness of the noise

The following table shows that at 350m, a wind farm has a noise level of between 35 and 45dB(A). In a very quiet rural setting you might therefore be able to hear a wind farm at this distance, depending on the level of wind related background noise.

Source/Activity	Indicative noise level dB (A)
Threshold of hearing	0
Rural night-time background	20-50
Quiet bedroom	35
Wind farm at 350m	35-45
Busy road at 5km	35-45
Car at 65 km/h at 100m	55
Busy general office	60
Conversation	60
Truck at 50km/h at 100m	65
City traffic	90
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Who Determines Wind Farm Noise Limits?

As wind farms have become more plentiful, they have attracted greater regulatory scrutiny. This particularly relates to noise, which is an important design criterion. A regulatory authority, often the state's Environment Protection Authority (EPA), will issue guidelines for noise limits and recommend standard methods to use in predicting and measuring noise. Standards Australia is currently developing a standard methodology for predicting and measuring noise emissions from wind farms, but the setting of noise level criteria will remain the responsibility of the relevant Regulatory Authority.

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Wind Farms & Visual Amenity

Background

At a local level, the response of the public to a wind farm proposal can vary considerably. To some, the prospect of direct views to a wind farm can be a pleasing addition to the landscape. To others, a wind farm may be seen as an unsightly blight. The response does not only depend upon the particular landscape; it is also affected by the observer and the values they ascribe it.

Wind turbines need to be placed in locations exposed to consistently strong winds. They are large machines and a wind farm will feature prominently in the landscape. In contrast, the impacts of the greenhouse gas emissions that wind power helps to reduce, are predominantly out of the public eye. Large scale coal-fired power stations – the source of 84% of Australia's electricity – are by and large "out-of-sight and out-of-mind".

Wind energy is one of the cheapest forms of renewable energy and its environmental benefits are clear. Polls show a remarkably high level of support in Australia, with one survey[1] indicating 95% support for the building of wind farms to meet our rapidly increasing demand for electricity. Opinion surveys[2] suggest most Australians use words like "interesting", "graceful" and "attractive", rather than "industrial" to describe wind turbines . Nevertheless, a wind farm's impact on visual amenity is generally the dominant issue in the reviews of wind farm proposals and it can be the cause of bitter and acrimonious debate.

The range of views, and importance of considering the context, is demonstrated by the wind farm at Esperance, a coastal town in Western Australia. Here the community actually objected to a wind farm being decommissioned, because residents had become fond of it and identified it as part of the region's cultural heritage. In other cases, wind farm approvals have been withheld because of perceived impacts on heritage landscapes.

What Is The Industry Doing?

AusWEA recognises that the long term sustainability of the wind industry depends on appropriately sited and sensitively developed projects. AusWEA strongly supports the development of guidelines to inform the assessment of all potential impacts of wind developments, including visual amenity.

Unfortunately, there is currently no universally agreed methodology for assessing landscape values across Australian states. For this reason AusWEA, in cooperation with the Australian Council of National Trusts, is undertaking a "Landscape Values Project" to jointly develop agreed landscape assessment methodologies that can be used by regulators as part of the overall project evaluation process.

The project is divided into three stages -

(i) Stage 1 will scope issues surrounding wind farms and landscape assessment, and solicit possible solutions relevant to the siting of wind farms on the landscape.

(ii) Stage 2 will establish agreed landscape assessment methodologies.

(iii) Stage 3 will trial and test the methodologies.

Stage 2 and 3 are contingent upon the successful completion of Stage1 which has been funded by the Australian Greenhouse Office and is scheduled for completion mid 2004.

Some Of The Visual Amenity Issues

Visual amenity issues can be broadly categorised into two groups; those relating to the wind turbines themselves and those that relate to their interaction with the landscape. The first category is relatively easy to deal with whilst the latter is much more complicated.

Issues relating to the general appearance of wind turbines, their colour and the impacts of shadows cast, can be reasonably easily managed in the design process. Machines in a given wind farm should be of a consistent size and visual appearance and it has been found that the best colour for wind turbines is off-white or light grey.

For visual amenity issues relating to the surrounding environment, the landscape character needs to be considered along with assessment of the primary views of that particular landscape and the values the community ascribes it. This is important because the way in which we view a landscape, the value we place on it and our perception of the impact of a wind farm on that view, are highly variable and quite subjective.

All of this is complicated by the fact that wind farm layouts are the product of a complex iterative process. The layout that provides the "best" visual outcome may have unacceptable ecological or financial outcomes and vice versa.

How Should Developers Do?

The first step is to identify the neighbours to a proposed wind farm site and the important public view points, which may vary from a scenic vantage point to simply the main roadway. Through consultation, the developer should familiarise themselves with the visual settings that members of the community and special interest groups value. This allows for a broad assessment of the visibility of the proposal.

During and sometimes prior to the planning application stages, developers are required to prepare photomontages (computer simulations) of how the wind farm will appear from these important view points. These photomontages can also play an important role in the community consultation process, allowing the developer to test different layouts as they develop the proposal in the lead up to a request for formal approval.

How Can The Visual Impact Of Wind Farms Be Minimised?

AusWEA recommends :

- Extensive community consultation on turbine placement
- If possible, important view points should be agreed with the community early in the process
- The cumulative effect of neighbouring wind farms should be considered
- Wind generators must be uniform in size and design (including direction of rotation)
- Support tower, blades and nacelles should be painted the same colour – preferably off-white or light grey – and have a matt finish. They should not be used as billboards
- All wind generators within a wind farm should be kept operating at once
- The potential for shadow and flicker at residences should be assessed and minimised

1 Australian Research Group study - September 2003
2 AusPoll study - June 2001

AusWEA
Australian Wind Energy Association
www.auswea.com.au

FACT SHEET 8

Wind Farms & Bird & Bat Impacts

Do Wind Farms Present A Collision Risk To Birds?

Wind turbines, like virtually all tall man-made structures, present a collision risk to birds and bats. The risks however are far lower than many imagine – especially when compared to risks of collision with other structures such as communication towers, tall buildings and transmission towers. The impact of wind turbines on birds and bats is insignificant compared to the impact of domestic cats and the loss of habitat through development or even more dramatically, the chronic impact of ecological change due to climate change and rises in sea level induced by increased greenhouse gas emission. In Australia, collision rates are generally around one to two birds per turbine per year.

What Are The Other Risks?

Wind farm construction and/or operation may impact the way some birds move about in a particular area. This might include direct impacts on flight, breeding and feeding behaviour as well as indirect impacts due to disturbance associated with construction activity and noise.

What Do We Know About The Impact Of Wind Farms On Birds & Bats?

Today, bird mortality from wind turbines is probably one of the best researched areas of risk to avian species. Despite some bad experiences early in the US, where wind farms were constructed with little or no understanding about the potential bird impacts, environmental scientists agree that properly sited, today's wind farms present minimal danger to bird and bat populations.

What Is The Experience In Australia?

Wind farming is relatively new to Australia, but evidence from surveys measuring the impacts of Australia's first wind farms on birds and bats, is starting to emerge. Although several years of post construction monitoring are required to fully understand the impacts, the initial results are encouraging.

- At Pacific Hydro's Codrington Wind Farm in Victoria (comprising 14 wind generators and opened in July 2001) a total of four bird deaths and one bat death were reported as a consequence of colliding with wind generators between 2001 and 2003. None of these were rare, threatened or endangered species. The measured mortality rates were used to predict a likely level of mortality from the wind farm as a whole of between 18 and 38 birds per year. Although there were some early concerns about the potential impact the wind farm might have on water birds, behavioural studies showed that this group was adept at avoiding turbines
- Stanwell's Toora wind farm in South Gippsland comprises 12 wind turbines. Between 2002 and 2003 six bat corpses were found. Common starlings, Australian magpies and ravens declined in numbers after operations started (although no fatalities were recorded), while the numbers of skylarks and gold finches increased. Wedge-tailed eagles were regularly observed before and after operations began, but these avoided the turbines by flying around or between them, not into them. The survey found no evidence that the wind farm has caused significant levels of bird mortality and stated that the impact seems to be confined to localised, indirect effects on common, farmland birds. No threatened bird species were observed on the site during a total of two years of surveys and whilst bats have been impacted, the effect is not of conservation significance.
- For Stage 1 of its Woolnorth Wind Farm, Hydro Tasmania has released results of bird studies conducted from October 2002 to October 2003,

during which wind turbines were monitored for evidence of any collisions. The wind turbines were monitored daily during peak activity periods and twice weekly throughout the remainder of the year. These studies show that mortality rates for all species are at the lower end of the levels predicted at the development assessment stage. After October 2003, Hydro Tasmania did report an additional nine birds having collided with wind turbines, one of which was a wedge-tailed eagle, which is a threatened species in Tasmania (but not on the mainland). Under the conditions of its planning permit from the Tasmanian Environmental Management and Pollution Control Board, Hydro Tasmania is required to make a contribution to the species' recovery.

What are the Regulatory Controls & Measurement Methodologies?

All Australian wind farm developers must currently comply with planning guidelines set out by Statutory Authorities. At a Federal level, all wind farm developments are accountable under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC). This powerful piece of legislation prescribes Commonwealth involvement in environmental matters where an action has or will have a significant impact on "matters of national environmental significance". There is specific reference in the Act to consideration of threatened species and listed migratory species.

In June 2003, the Australian Wind Energy Association was awarded a grant to develop bird impact assessment protocols and dataset standards to assist in data recording and analysis for evaluating the level of bird impact and mortality at Australian wind farms. The work supplements recommendations for bird assessment in AusWEA's Best Practice Guidelines and has been put together with the assistance of a broad range of stakeholders including Commonwealth and State Government agencies, bird experts and non-governmental organisations. This work will help :

- Industry in implementing effective monitoring and in addressing the bird impact issue
- Regulators in setting impact assessment and monitoring requirements as part of the development approval process
- Consultants in designing, costing and reporting impact assessment and mortality monitoring work
- Community and environment groups in understanding the significance of the bird and bat impacts of wind farms.

Importantly, the outcomes will provide a transparent and defensible basis for discussions about bird and bat mortality at wind farms in Australia.

How Does Mortality Due To Wind Farms Rate Against Other Causes & Compare With Overseas?

A US study[1] published in 2001 carried out by Western Ecosystems Technology puts wind turbine collisions into perspective with bird collisions with other structures :

- Vehicles: 60 million - 80 million
- Buildings and Windows: 98 million - 980 million
- Powerlines: tens of thousands - 174 million
- Communication Towers: 4 million - 50 million
- Wind Generation Facilities: 10,000 - 40,000

The study estimates that wind farms kill an average of 2.9 birds per turbine, per year in the US – equivalent to less than 0.02 percent of the staggering 200-500 million collision related deaths in that country. This estimate includes the fatalities at wind facilities such as those in Altamont, California which were sited in an area of high avian usage and have caused disproportionately high levels of bird mortality.

As the Australian industry enters its next stage of development, more and more information is coming to light that the mortality rates at Australian windfarms are lower than in the northern hemisphere. This appears to be due to the lack of large numbers of night-migrating songbirds in Australia. These occur in the northern hemisphere by the hundreds of millions and they make up about half of the birds that collide with wind turbines.

Further information can be found in AusWEA's Best Practice Guidelines for Implementation of Wind Energy Projects in Australia, May 2002. www.auswea.com.au.

1 National Wind Coordinating Committee (NWCC) Resource Document: Avian collisions with wind turbines: A summary of existing studies and comparisons to other sources of avian collision mortality in the United States.

Wind Farming On A Traditional Farm

Many wind farms in Australia are on freehold grazing property where the landowner enters into an agreement to host the machines in return for rental payments over the 20-25 year life of the development.

Can Wind Farming & Traditional Farming Coexist?

Yes. Most wind farm developers lease only a part of the property for the wind farm - that affected by the turbine footprint and access tracks - leaving the owner to continue their normal farming on more than 99% of the land. Broad acre agro-forestry however is sometimes prohibited because it reduces the commercial returns of the wind farm by slowing the wind. This may not be an issue if the wind resource is good enough.

In some ways, wind farms can be thought of as a vertical crop. Once construction is complete, traditional agriculture can continue underneath and around the wind farm. In most cases the land occupied by the wind farm becomes the most productive part of a holding.

How Much Land Is Required?

Theoretically, 20 machines with a rotor diameter of 40 meters can be accommodated on as little as 40 Ha. In practice however much more land is usually required after topography and other layout constraints have been taken into account.

Access tracks to each turbine need to be about 5m wide and are made from material like limestone or gravel. Interconnecting cabling between turbines is normally installed underground, alongside the access tracks. By being buried between wind turbines, ongoing cropping is not compromised.

For some developments, a single substation - about 40m by 30m - may be required to house the electrical plant, associated switchgear and metering equipment. Security fencing around the substation is also usually installed. The electrical interconnection to the existing grid is normally a common pole mounted three phase power line.

Developers are required to comply with noise regulations which impact the positioning of wind generators relative to residences. Setbacks from existing residences are usually a few hundred metres and sometimes buffer zones within which no houses can be built, need to be defined. Agriculture however, will normally be able to continue unaffected.

How Much Rent Is Paid?

Income payable to the farmer is normally agreed on a per turbine basis. Payments vary according to turbine size and wind regime, but are typically in the order of $5,000 per machine per annum.

What Agreements Are Needed?

Formal agreements range from initial option agreements, which may give the developer the right to collect wind data and other feasibility studies over a few years, to full lease agreements. These set out the responsibilities and obligations of both parties over the life of the wind farm project. Owing to the long life of a wind farm, the developer's rights will need to be transferable to any future purchaser of the host property.

What Are The Impacts During Construction?

Construction typically takes around 12 months. During this time there can be relatively high impacts compared to those experienced during ongoing operation, including frequent traffic movements that could cause disturbance.

All weather access tracks are built to link the wind turbines and can dramatically improve access across the property. Where possible, the existing farm track network is used. New fencing and gates may be required where access tracks cross pre existing fences. As part of these works, there is sometimes an opportunity to create laneway systems for stock.

Trenches and excavations are generally left open for only a few days. Appropriate fencing is used during this period. Each foundation takes approximately one week to prepare and a day to pour. The formwork is removed from the foundation a day or two later and backfilled within a week. Following approximately 4 weeks of curing, the wind generators can be erected.

Several foundations may be constructed in parallel and typically, the excavated material is stockpiled for back filling and road making. The large volumes of concrete required are mixed on site using a mobile batching plant.

Impact on livestock is minimal provided there is good communication between farm management and the construction team. Electric grids can be used to control stock as gates will generally need to be left open during construction hours to minimise delays to traffic. Stock must be kept away from excavations, usually using mobile electric fences. Alternatively, stock may need to be moved from a particular paddock for a short period of time.

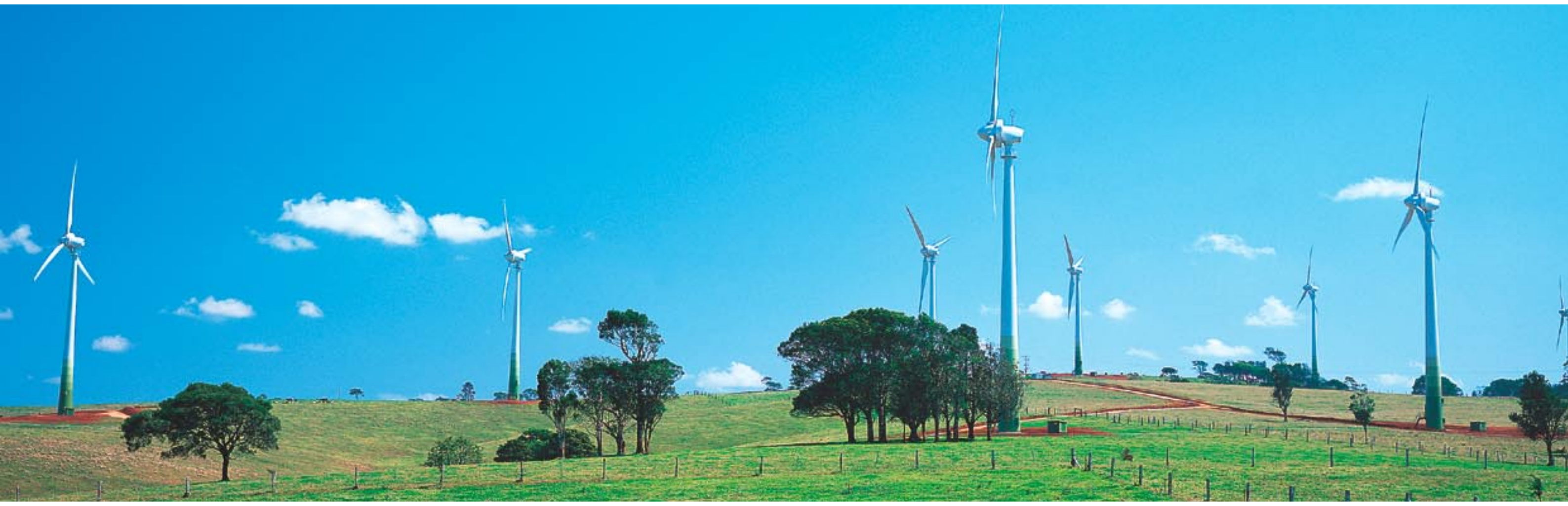
Impact on cropping is mainly due to the access tracks. Normal sowing patterns may be disrupted as it is unlikely that turbines will all end up on unproductive land or in the corners of paddocks. This said, careful planning and consultation will usually enable the landowner and developer to come to a mutually acceptable outcome.

Generally, pivot irrigators cannot be used in the vicinity of wind turbines because of the large area they occupy.

Depending on the site, agricultural aviation such as crop dusting or super phosphate spreading may be impacted. Agricultural pilots are highly trained and operate very manoeuvrable aircraft at very low altitudes (as low as 2m). They are very experienced in hazard management and the local operator is best placed to assess the potential impact.

Extensive tree plantings can slow the wind and cause turbulence and both of these factors reduce the commercial returns of the wind farm. Stock shelters and environmental plantings can however normally be accommodated.

Local microclimate effects are negligible. In the field measurements show little or no change in air temperature or carbon dioxide concentrations as a result of wind turbine movement and evapo-transpiration from the soil is not changed. Thus moisture content of the soil is unaffected.



Local and passing tourist interest will be stimulated by the wind farm construction. Landowners may receive phone calls from a variety of people including neighbours, the media, government departments, tourism operators, and other farmers considering wind farming, etc. Some wind developers help landowners manage enquiries of this nature.

Construction of new residences or other buildings may be restricted. This may be due to either the impacts on the wind resource, or in the case of occupied buildings, noise criteria. Detailed noise modelling during planning can provide a very good idea of "no go" zones for future residences.

How Are Farming Operations Impacted After Construction?

Impact on livestock is minimal. Sheep, cows and horses are not disturbed by wind turbines and typically graze right up to the base of the towers which they often use as rubbing posts or for shade.

Wind Farming, Electromagnetic Radiation & Interference

What Is Electromagnetic Radiation?

Electromagnetic radiation (EMR) is a wavelike pattern of electric and magnetic energy moving together. Types of EMR include X-rays, ultraviolet, visible light, infrared and radio waves. As a natural phenomenon, EMR is emitted by natural sources like the Sun, the Earth and the ionosphere.

Radio frequency (RF) EMR is commonly used for a wide variety of communications applications from the broadcast of television and radio, through to radars and mobile phones. It is important that wind farms do not impact the quality of this communication.

Is EMR Safe?

Whilst higher frequency EMR [eg X-rays] can be damaging to human health, only long-term exposure to very high levels of radio frequency (RF) EMR will heat or burn biological tissue. The levels of EMR that members of the general public are normally exposed to are far below these dangerous levels.

What About Electromagnetic Fields?

Electromagnetic Fields (EMF) emanate from any wire carrying electricity and Australians are routinely exposed to these fields in their everyday lives. The electromagnetic fields produced by the generation and export of electricity from a wind farm, do not pose a threat to public health. Typically, electrical cabling between wind turbines is buried in the ground, effectively eliminating any EMF. Grid connection is usually made at no more than 132kV, similar to the voltages used by utilities in existing distribution networks.

What Do Wind Farms Have To Do With EMR?

From a wind resource perspective, high and exposed sites are attractive. So it is not unusual for any of a range of telecommunications installations; radio and television masts, mobile phone base stations or emergency service radio masts, to be located nearby.

Care must be taken to ensure that wind turbines do not passively interfere with these facilities by directly obstructing, reflecting or refracting the RF EMR signals from these facilities. There is also potential for a wind turbine to actively interfere by producing its own low energy RF signal.

What Is EMR Interference?

Unwanted radio and background noise can impair effective telecommunications which rely on a strong signal to noise ratio. An appropriate transmitting antenna can dramatically improve this signal to noise ratio. A transmitting antenna can also increase the signal strength in a particular direction (ie toward a receiver). The directionality of a receiving antenna can also be enhanced, thus reducing the amount of unwanted noise.

How Are Wind Farm EMR Issues Managed?

The impact of wind turbine generators on electromagnetic waves is relatively minor and a means of mitigation, avoidance or remedy can be found for all potential impacts. Any interference can be minimised or eliminated through a combination of appropriate turbine siting and special technical solutions.

Point to Point Communications: Careful siting and directional antennae can eliminate any impact on point to point links.

Mobile Radio Services: Interference can be overcome by moving the mobile unit a short distance away as per normal practice for avoiding any other structure. Any interference to mobile radio services is usually negligible and limited to mobile communications within the wind farm site itself.

Television: Interference to television signals in the wind farm area can be caused by either the reflection or obstruction of the signal by the turbine blades. With glass reinforced plastic blades, modern wind turbine generators will cause minimal television interference. It cannot however, be completely discounted for houses within a few kilometres of turbines.
If interference does become apparent after construction, the possible mitigation techniques include :

- the installation of a better quality antenna or more directional antenna,
- directing the antenna toward an alternative broadcast transmitter,
- installation of an amplifier,
- relocation of the antennae to achieve better signal to noise ratio,
- installation of a terrestrial, digital set top box for digital TV,
- installation of satellite or cable TV, or
- if a wide area is affected then the construction of a new repeater station may be considered.

Active interference is minimised or completely avoided by ensuring that all equipment complies with relevant electromagnetic compatibility standards, as all wind farm equipment does.

In the unlikely event that a problem arises over time at a particular site, the wind farm operator will usually be able to rectify it using one of the aforementioned solutions.

The Australian Communications Authority web site provides details of a variety of television signal interference patterns and ways to overcome these problems - www.aca.gov.au/radcomm/publications/better_tv_radio/index.

AusWEA
Australian Wind Energy Association
www.auswea.com.au

FACT SHEET 11

Wind Farm Safety Issues

How Safe Are Wind Farms?

The wind energy industry enjoys an outstanding health and safety record. In over 20 years of electricity generation with more than 100,000 machines installed worldwide, no member of the public has ever been injured during the operation of a wind farm. The reality is that wind power, like most renewable energy technologies, poses a very low risk to human beings.

Are Wind Turbines Designed To Be Safe?

Modern wind turbines are sophisticated machines built to last for at least 20 years in all the extremes expected in their operational environment. International safety standards are used in machine design by all major wind turbine manufacturers. Compliance to these standards is audited by third party organisations.

Wind turbines have special inbuilt safety equipment to deal with emergencies. For example, they are equipped with vibration sensors to detect rotor problems and all modern turbines allow complete shut down during excessive wind speeds, virtually eliminating the risk of the turbine rotor or tower failing. In fact wind turbines are considered so safe that at wind farms on public land in Australia, the general public is allowed to walk to the base of turbines at any time.

How Is The General Public Protected?

Many of the potential risks to the public are reduced by the use of enclosed tubular steel towers (rather than open lattice towers), locking systems on doors, intruder alarms, and protective safety fencing around open switchyards.

Wind turbines do not burn anything to generate electricity and therefore, produce no harmful emissions. The only potentially toxic or hazardous materials involved in the operation of wind farms are relatively small amounts of lubricating oils, hydraulic and insulating fluids. The potential for exposure of the general public to any of these is very small.

What Are The Air Safety Implications?

Unless they are constructed on or located near airports, wind farms are unlikely to impact on the safety of commercial and domestic air transport . In relation to the impact of wind farms on aviation operations, wind developers are required to liaise with the Civil Aviation Safety Authority (CASA) and the RAAF Aeronautical Information Service, which maintains a database of structures on behalf of CASA. Each wind farm is assessed by a CASA Flying Operations Inspector for its potential aviation risk and any obstruction lighting requirements.

Do Wind Farms Impact Agricultural Aviation?

The pilots of crop dusting or super phosphate fertiliser spreading aircraft are highly skilled and are easily able to negotiate between the wind turbines which are normally positioned hundreds of meters apart. These pilots regularly navigate other less obvious hazards such as power and phone lines. During the wind farm design phase, landowners (and in some cases pilots) are consulted on the position of wind turbines, particularly any machines near the approach and takeoff paths of unregulated rural airstrips.

How Do Wind Farms Impact Recreational Aviation?

The operation of recreational aircraft is less predictable than that of commercial aircraft. The array of flight instruments is typically less extensive and sophisticated and often the pilot is less experienced than commercial pilots.

Under Visual Flight Rules, pilots must have good visibility, fly at sub-sonic speeds and must not fly lower than 500 feet above the highest point of the terrain or any object on it. This is well above the height of any part of a wind farm.

What About Impacts on Hang Gliders?

The nature of operation of hang gliders, micro-light aircraft and model aeroplanes varies considerably. Takeoff points for these activities are sometimes favoured as attractive wind generation sites and local groups need to be consulted during the planning process to assess the impacts. Whilst the modification of activities may be required, they may not need to be precluded altogether.

Are There Fire Risks?

The risk of fire at wind farms is very low; both fire damage to wind turbine generators and fire caused by the generators themselves. This is because of the following factors :

- The flammable components are located high above the ground
- There is normally no vegetation around the base of the turbine towers
- High-voltage connections are underground
- Access tracks act as firebreaks and provide fire fighting access
- Lightning protection devices are installed on every wind turbine
- Dedicated monitoring and control systems shut down the wind turbines when the threshold temperatures of critical components are reached

Does Lightning Pose A Threat?

Wind turbines are often struck by lightning, but are equipped with comprehensive lightning protection systems. These systems transfer the high voltages and currents to the ground, without affecting turbine operations. In particular, turbine blades usually have internal lightning conductor rods running all the way to the blade tips.

Blade Icing

Experience has shown that icing in severely cold weather only occurs when the rotor is stationary. Once operation recommences, blade flexing causes the ice to break off and fall vertically to the ground. Actual "sling shooting" of ice has never been reported.

What About Safety During Manufacture & Construction?

As with other similar heavy engineering there are occupational safety risks for employees during manufacturing and construction. These include :

- Working at heights (particularly in windy conditions)
- Working with cranes
- Heavy machinery
- Rotating machinery
- High voltage electricity
- Working in hazardous weather conditions
- Driving vehicles

How Many Deaths Has The Industry Seen?

Since the early 1970's the wind energy industry has experienced 14 worker fatalities worldwide, directly or indirectly during wind farm construction or related accidents. All of these deaths could have been prevented if today's safe work practices had been adopted.

Wind Farms & Land Values

In Australia, a number of wind farms have been built on or close to private land. There is often debate as to whether the value of those properties has been affected.

Factors impacting land values include :

- Changes in income earning potential of property
- Aesthetic appearance - impact on scenic views
- Changes in fencing and on site access roads
- Changes in natural vegetation and ecology
- Noise
- General trends in property prices in the area independent of wind farming.

Although no formal studies have yet been carried out in Australia, we can learn from information and studies from overseas.

What Are The Potential Effects On Land?

The most contentious and subjective issue relating to wind farms tends to be the impact on the landscape and whether the wind farm constitutes an enhancement or a negative impact on visual amenity. From a property value perspective, the greatest actual impact will be if a revenue stream is derived from the development. There is little evidence to suggest that because of landscape values, wind farms negatively impact upon the land values of neighbouring properties.

The effects are not limited to visual amenity considerations. When considering changes in land values, the impacts of ancilliary services such as grid interconnection and roadworks also need to be taken into account . Main road access is sometimes enhanced and in cases where grid upgrades are required to enable the connection of a wind farm, there can be an improvement in the quality of local supply.

Wind farms do produce some noise during operation, but provided the wind farm has been sensitively designed this should not be an issue (see Fact Sheet #6). Similarly, appropriate design is usually able to mitigate the negative impacts arising from shadow and flicker at residences near the wind farm and can ensure that such factors will not impact property values.

Wind farms also bring tourists. Although this can affect landowners by increasing traffic flows, traffic noise & human pressure on an area that may previously have experienced little such pressure, it is unlikely to impact land values.

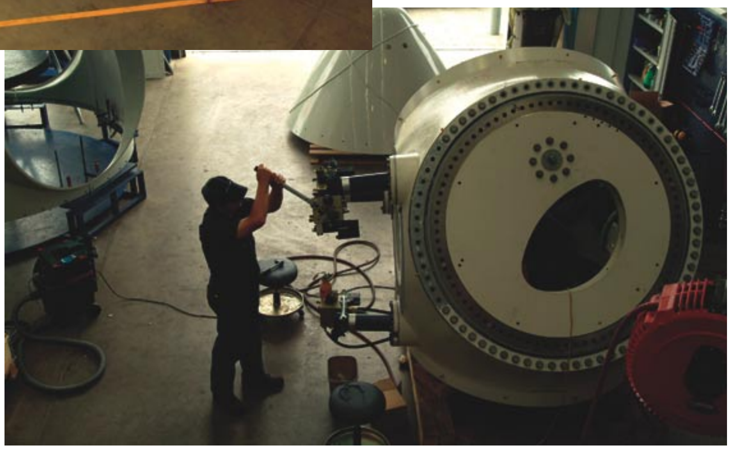
Wind farms do not have any noticeable effect on stock or cropping.

During construction there will be increased traffic movements and generally more activity than normal. This can mean some disruption to land owners caused by the increased noise during this period, but again is unlikely to impact land values.

What Is The Experience In Australia?

Owners of land where a wind farm is built receive income through land leasing and royalty agreements without impacting farming practices. This can be a very positive result for a rural property and the local rural community. However, landowners should be aware that wind farm agreements typically run for 20 years or more and therefore the impacts of this time frame need to be taken into account when considering any long term aspirations for the property. For example, a wind farm will generally limit rural subdivision potential and there may be a noise buffer of several hundred metres required around the turbines.

In Australia, there is no evidence to suggest that the value of properties with views of distant wind turbines, are adversely impacted by the wind farms In Esperance [WA], an informal investigation was made into property prices at Salmon Beach, a premier residential area 200 metres away from Australia's first wind farm. Of 15 properties investigated, only one reduced in value after the windfarm had been constructed. This was due to the property being subdivided and sold as two separate lots. Since then, Esperance has seen another two wind farms and 15 more turbines installed without a single negative comment.



Some people simply do not like the look of wind farms and this may influence their property buying decisions. In contrast, a 2001 Auspoll [VIC} survey found that the words most commonly used to describe wind farms were "interesting" (94%) and "graceful" (74%). In some situations, wind projects can provide a 20 year buffer and a net benefit to the landscape and environment by occupying an area that would otherwise have been subject to other development initatives.

What Is The Experience Overseas?

USA: Research in 2002 by ECONorthWest[1] concluded there was "no evidence supporting the claim that views of wind farms decrease property values". This was backed up by a May 2003 Analytic Report for the Renewable Energy Policy Project[2] involving the review of over 25,000 records of property sales within a distance of five miles of wind farms and interviews with property tax assessors. The report found that property values increased faster within the view shed of the wind farm than in comparable locations away from wind farms. The rate of change in average sales price within the view shed was 18% greater over the study period. Once again the report's summary concluded: "we found no evidence supporting the claim that views of wind farms decrease property values".

Denmark: A report by the Institute of Local Government Studies (AKF) found that "the economic expenses in connection with noise and visual effects from wind mills are minimal".[3]

United Kingdom: A British Wind Energy Association investigation based on a number of different studies, found no evidence that wind farms caused house prices to decrease. This is backed up by the experience of more than 70 operating wind farms in England, Wales and Scotland. In fact, when an opposition group advertised that a wind farm in Glens of Foudland, Scotland would have a detrimental effect on house prices, they were censured by the Advertising Standards Authority (ASA) when the group could not provide evidence to support its claims.[4]

An independent market research study in the UK carried out two public opinion surveys involving hundreds of face to face interviews with residents living near wind farms :

At Novar Wind Farm, Scotland: "In regards to house prices, 72 per cent say the wind farm has had no effect, with a further 26 percent saying "don't know". None of the respondents say house prices have decreased as a result of the wind farm." [5]

At Taff Ely Wind Farm, South Wales: A new housing development has been built just a few hundred metres away from Taff Ely, with views across open fields towards the wind farm. According to a study[6] 70% say they are able to see the wind farm from their home. "In regards to house prices, 78% say the wind farm has had no effect, with a further 15% saying "don't know". As many residents say house prices have increased a little because of the wind farm (3%) as say they have decreased a little. Similarly, as many say they have increased a lot (1%) as say decreased a lot."

In Nympsfield in Gloucestershire, house prices continued to gain after plans for a wind turbine were announced in 1992. They have continued to increase since the turbine began operating in 1997.[7]

1. Pheonix Economic Development Group
http://www.kvalley.com/phoenix/Kittitas%20Wind,%20final.pdf

2. Sterzinger, Beck, Kostiuk: May 2003 Analytic Report

3. Institute of Local Government Studies Denmark: Social assessment of wind power, Jorgen Jordel-Jorgensen, April 1996.

4. Renew online: Wind Works for Farmers, estracts from the Jan-Feb 2002 edition of Renew. http://technology.open.ac.uk/eeru/natta/renewonline/rol35/5

5. Novar residents survey: Robertson Bell Associates, July 1998

6. Taff Ely, Residents survey: Robertson Bell Associates, December 1997.

7. BWEA: http://www.bwea.com/ref/stroud.html

AusWEA
Australian Wind Energy Association
www.auswea.com.au

Statement of Certification

As author of the Environmental Assessment, I confirm that the information contained in this Environmental Assessment is considered to be a true and accurate reflection of the Black Springs Wind Farm development and is not considered to be either false or misleading.

…………………………………
Stephen McCall
Environmental Planner
Harper Somers O'Sullivan Pty Ltd
BEnvSc

…………………………………
Date of Certification

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Harpers Somers O'Sullivan Pty Ltd have prepared this Environmental Assessment under Part 3A of the *Environmental Planning and Assessment Act 1979* for the development of a wind farm at Black Springs NSW, acting on behalf of Wind Corporation Australia Limited.

This report provides a full description of the development proposal, a description of the environment to be affected, the likely impact of the development on that environment, and a full description of measures to mitigate any adverse effects associated with the proposed development. The report concludes with a justification for the development of the proposal.

2 THE PROPOSAL

2.1 Objectives of the proposal

The Department of the Environment and Heritage and the Australian Greenhouse Office released a *National Code for Wind Farms* discussion paper in May 2006, as part of the Australian Government response to climate change. In the renewable energy sector, wind power is a mature and relatively inexpensive form of energy production that will play an important role in securing Australia's energy needs and addressing climate change. The ability for a typical wind turbine to produce sufficient energy requirements to service 1000 homes and concurrently displace greenhouse gas emissions is becoming increasingly cost competitive in the Australian energy market. The discussion paper lists Australia's wind energy capacity at around 640MW in early 2006, with another 250MW under construction. In New South Wales (NSW), which is one of the highest electricity consumers, the current and projected share of wind, up to 2025, is less than 0.1% for the total electricity generation mix. NSW has only four operating wind farms or turbines, located at Blaney, Crookwell, Hampton and Kooragang Island, with a combined capacity of 16.62MW. It is noted that further wind farm projects are currently undergoing assessment or have been approved but not built, such as the Taurus Energy wind farm at Cullerin Range on the NSW Southern Tablelands.

The objective of the project is to significantly increase renewable energy production in NSW that is economically rationalised while also mitigating the production of greenhouse gas emissions. After investigating several sites in NSW, the Oberon Shire was considered suitable for the installation of an economically viable wind farm. Sufficient local energy demand, suitable wind conditions and available infrastructure are key elements of the selected site. By providing distributed electricity generation capacity close to the local demand, electricity transmission losses are reduced and supply reliability potentially is improved. Subsequently, Black Springs is considered the best location to develop the objectives of the project.

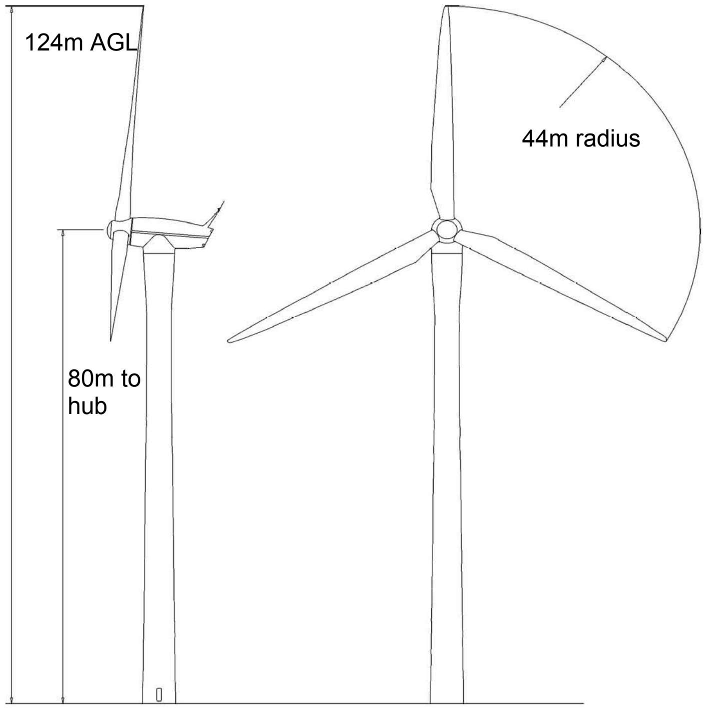
2.2 Description of the proposal

The proposal is known as the Black Springs Wind Farm (BSWF) and includes nine wind turbine generators connected via underground cables to a substation and a facilities building. Access roads to the turbines will also be constructed to allow delivery of the turbines and ongoing maintenance.

The proposal is based on the SUZLON S88/2.1 MW turbine or equivalent turbine generators with a hub height of 80m. The rotor has 3 blades on the vertical axis. The diameter of the blades is 88m and covers a swept area of 6082 m^2. The highest blade tip height would be 124m AGL. Figure 1 illustrates the SUZLON S88. Automatic controls enable the turbines to face into the wind and to vary operation speed according to wind speed. The full operating output capacity of the turbines is reached with wind speeds greater than 12-13m/s.

Each of the turbines has a generating capacity of 2.1 megawatts (MW). Therefore, the wind farm has a total generating capacity of 18.9 MW and an annual generation of approximately 47,000,000 kWh. The turbines will be connected through a 33kV underground cable network to a central substation within the wind farm area. The substation will increase the output voltage to be suitable for connection into the Country Energy 66kV transmission grid, which passes directly adjacent to the proposed substation location, crossing the centre of the wind farm. Control cables will also link the turbines to a facilities building which will house an office, electrical and computer equipment, storage, kitchen and amenities.

Figure 1: Indicative Diagram of a Suzlon S88 Wind Turbine



The 'typical' wind turbine, referred to above, should be regarded as indicative only for the purposes of the Environmental Assessment and the design could change. Final turbine design details will be determined prior to the preparation of the Construction Certificate. For the purpose of this assessment the analysis is based on an indicative turbine layout consisting of nine Suzlon S88 turbines.

2.2.1 Wind Turbine Technical Description

Suzlon Energy Pty Ltd provided the following technical information:

ROTOR BLADES

The rotor blades are aerodynamically optimized to provide high lifting forces and low air-resistance values. Manufactured using Resin Infusion Moulding (RIM) technology, they are extremely lightweight, and at the same time possess high stiffness and mechanical strength. Their low weight-to-diameter ratio results in lower stresses enhancing the life and efficiency.

Blades are the starting point of the train for power transmission. Hence, even a small increase in blade efficiency is magnified across the power train to give higher efficiencies for the entire machine.

The design also provides high reliability by eliminating alignment problems - the leading cause of unwanted loads and stresses. The integral design, tested with customized NDT and quality checks, assures highest levels of reliability. (Suzlon Energy Pty Ltd, 2006)

MICRO PITCH SYSTEM

The rotor blades are connected to the hub via pitch ball bearings and can swivel fully perpendicular to the sense of rotation. The motors of the pitching system have an in-built intelligent system, with frequency control drives controlled by their own microprocessor. These intelligent frequency drives talk with the control system in real time, with response time of just 30 ms. The control system updates the motors after gauging the available wind regime, and the motors constantly update the control system on the instant blade angle.

The precision electromechanical micro pitch mechanism achieves 0.1 deg pitching resolution, resulting in extreme fine-tuning of the aerodynamic profile. (Suzlon Energy Pty Ltd, 2006)

MACRO SLIP MECHANISM

The flexible, adjustable slip system used in the Multi Megawatt series offers a maximum slip of as high as 16%, thereby increasing the efficiency of energy conversion by ensuring extremely low loss of power from wind due to gusts and frequent changes in wind speeds.

The robust and compact mechanism ensures that the overall machine reliability is maximised. The system is simple, easy to use and cost effective to service. The main advantage of the system is that it allows the use of standard, conventional generators with proven reliability. The Macro Slip mechanism is finely synchronized with the micro pitching mechanism to give optimum performance. The entire related power electronics is static and does not rotate at high speeds, increasing their reliability and overall life. (Suzlon Energy Pty Ltd, 2006)

HEAVY DUTY CAST HUB

The hub is manufactured with high quality GGG 40.3 casting. The design has been optimized after a series of load simulation tests for fatigue and extreme load conditions. This combined with a detailed FEA analysis and the experience we have gained in running over 1000 machines worldwide, has resulted in excellent mechanical properties.

A welded squirrel cage, vibration resistant windings and a re-greasing device with grease collecting chamber, result in increased service-life and longer maintenance intervals. (Suzlon Energy Pty Ltd, 2006)

PERFORMANCE DRIVEN GEARBOX

A multi-stage planetary / spur wheel gearbox ensures highest possible mechanical efficiency and power. The first planetary gear stage takes up the slow rotor movement and distributes the high torque input to subsequent planetary gears. The highest levels of manufacturing accuracy and FEM calculation of the planet carrier ensure optimal load distribution to the planet gears. Reduced torque values and increased rotational speeds are optimally converted to the high-speed operation of the generator.

A permanent, mechanically driven oil-pump supplies the gearbox and main shaft bearings with pressure lubrication, which is in addition to the splash lubrication. The micro-filter system retains the quality of the oil and assures an extended service-interval. The oil-cooling device renders temperature optimization even under full load *operation.* (Suzlon Energy Pty Ltd, 2006). The amount of oil in each turbine is approximately 415L, all contained in the gearbox (Synthetic Mobil Gear SHC XMP 320). In addition some grease for the bearings and the yaw drives (minimal).

ASYNCHRONOUS GENERATOR

A 4-pole, single-winding, asynchronous slip ring type generator with highly adaptable and flexible "Macro Slip" mechanism translates into high efficiency values. The exceptionally high slippage is achieved by varying the resistance on the rotor windings dynamically. The resistors are connected to the rotor windings via a slip ring mechanism making them static and mountable outside the generator cage. Externally mounted resistors provide excellent heat dissipation and the resistors do not rotate at the high speed of the rotor, which results in a longer service life.

These generators are robust and have a proven track record of decades in operation. The moisture-repellant insulation in high class F configuration combined with a forced surface air-cooling system guarantees total protection from moisture and dust. (Suzlon Energy Pty Ltd, 2006)

The operating specifications and power generation rates relative to wind speed for the Suzlon S88/2.1 MW turbine are listed in Tables 1 and 2.

Table 1: Power generation relative to wind speed.

Wind Speed (m/s)	Power Output (kW)	Wind Speed (m/s)	Power Output (kW)
4	10	15	2100
5	130	16	2100
6	310	17	2100
7	525	18	2100
8	820	19	2100
9	1160	20	2100
10	1540	21	2100
11	1880	22	2100
12	2100	23	2100
13	2100	24	2100
14	2100	25	2100
Air density: 1.225 kg/m³			

(source: Suzlon Energy Pty Ltd)

Table 2: Operating data

Operating Data	
Installed elec. output	2 MW
Cut-in wind speed	4 m/s
Rated wind speed	14 m/s
Cut-out wind speed	25 m/s
Survival wind speed	60 m/s

(source: Suzlon Energy Pty Ltd)

MAINTENANCE

Maintenance is split into 6, 12 and 60 month intervals. The 6 month maintenance schedule incorporates minor maintenance, inspection of blades and electrical components, lubrication of bearings and the replacement of worn components, incorporating brake pads, oil filters, etc. The 12 month maintenance schedule incorporates the inspection of the gearboxes, generators, and blades. The 60 month maintenance schedule includes a major maintenance overhaul of the gearboxes, generators, and blades, if required. All maintenance will be condition based so that oil will only be changed if oil samples indicate a necessity.

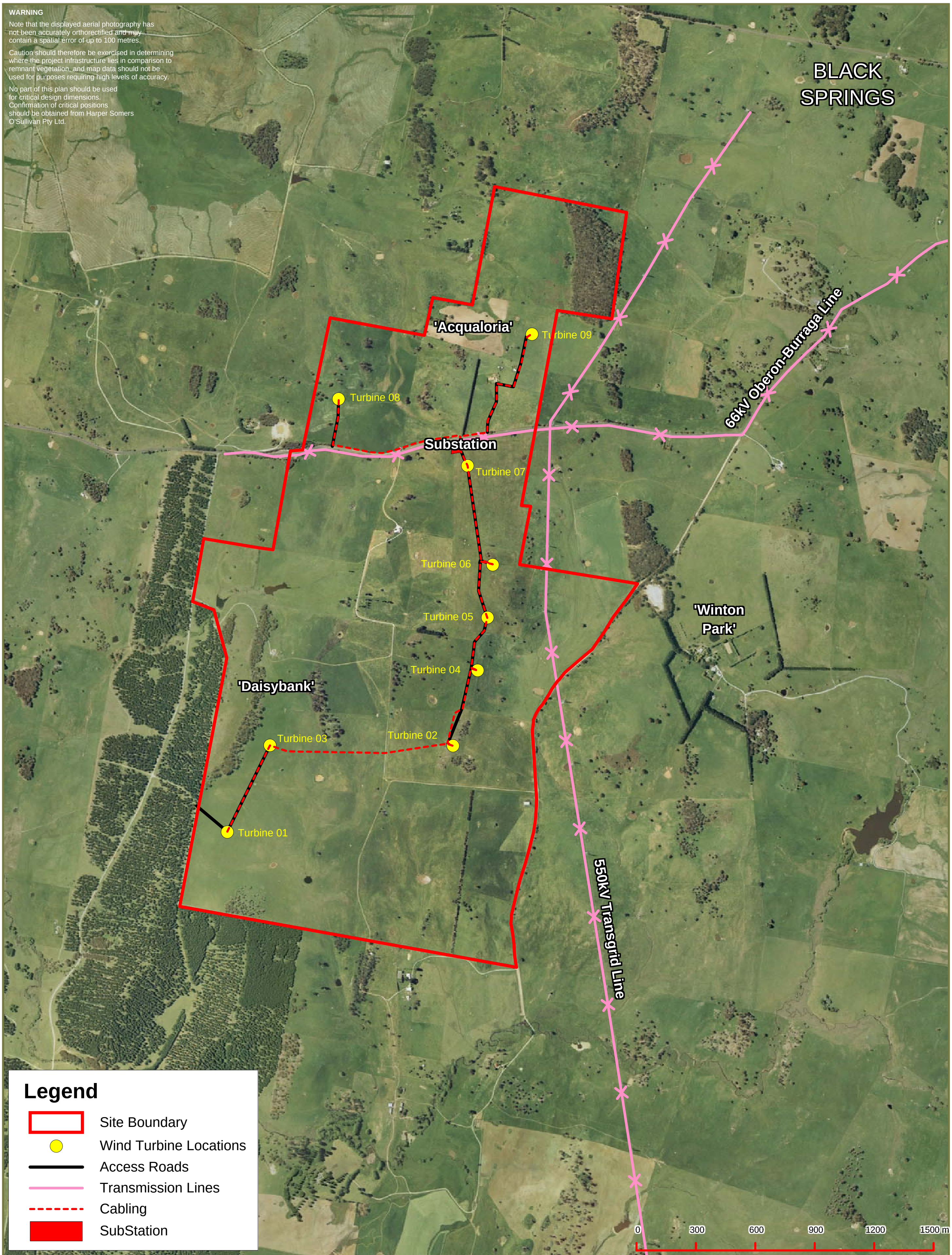
2.3 Site layout plans

Figure 2 is a Site Plan illustrating the layout of the wind farm turbines, cabling, substation, plus the location of the 500Kv Transgrid power transmission lines, transmission line tower positions and an aerial photograph of the site.

2.4 Construction detail

The approximate construction time will be four to eight months and daily construction hours of operation will be in accordance with industry standards and Council's construction hours of operation guidelines. Approximately 50 workers will be involved during the wind farm construction and 10-20 technicians will be employed during the 2-4 month commissioning phase. The construction process will be as follows:

- finalise and implement the Environmental Management Plan (EMP) and Construction Environmental Management Plan (CEMP);
- construct access tracks to turbine sites;
- excavate and construct turbine foundations and stabilised work areas for heavy machinery;
- excavate trenches for underground power connections from turbines to substation;
- erect turbines and construct substation; and
- rehabilitation of the disturbed land.



HARPER SOMERS O'SULLIVAN	**PLAN PRODUCED BY:** **HARPER SOMERS O'SULLIVAN** **241 DENISON STREET** **BROADMEADOW NSW 2292** **PO BOX 428** **HAMILTON NSW 2303** **T: 02 4961 6500** **F: 02 4961 6794** **E: survey@hso.com.au** **W: www.hso.com.au** **ABN: 11 093 343 858**	Copyright "This document and the information shown shall remain the property of Harper Somers O'Sullivan Pty Ltd. The document may only be used for the purpose for which it was supplied and in accordance with the terms of engagement for the commission. Unauthorised use of this document in any way is prohibited."	**SCALE:** 1: 25000 at A4 Size **DATE:** 15/08/2006 **DATUM:** AMG Zone 55 (AGD 66) **CONTOUR INTERVAL:** **DESIGNED:** T. LAMBERT **APPROVED:**	ENVIRONMENTAL ASSESSMENT BLACK SPRINGS WIND FARM, OBERON LGA FIGURE 2 SITE PLAN **LAYOUT REF:** J:\JOBS\23k\23219 - Black Springs\Drafting\Mapinfo\Planniing\23219-PLANNING FIG 2 SITE PLAN-A-A4 **JOB REF:** **23219**

AMENDMENT	DATE	TYPE
A		
B		
C		
D		

PLANNING SURVEYING ECOLOGY

E: survey@hso.com.au W: www.hso.com.au

2.4.1 Construction process

The construction process is illustrated in Figure 3 and 4 and will involve:

- A geotechnical survey of all turbine positions and sections along the access roads will be carried out prior to construction to assess the sub surface conditions.

- A construction compound will be located at the site proposed for the substation. The compound will include temporary site offices, toilet facilities, construction staff and visitor parking and material storage. Permanent chain wire fencing will be erected around the compound to ensure site security and public safety.

- Turbine location bores will be drilled to a depth required for detailed foundation design.

- Access tracks required for the construction and maintenance of the wind farm are located on private land and typically are adjacent to the underground cable network and, where possible, existing farm tracks. Tracks will be graded and road base gravel applied to facilitate the high construction loads and will be returned to 4WD access tracks post construction depending on landholder requirements. Gravel trucks will be entering and leaving the site while equipment such as graders and rollers will be operating on site. Due to the site geomorphology, no significant drainage lines or water courses will be diverted. Erosion and sediment control measures will be implemented and maintained to prevent erosion resulting from the construction of access tracks.

- Access roads will be approximately 4.5m to 5.5m wide depending on whether they are major access tracks or individual turbine access tracks.

- Depending on site geology, turbine foundations will be either anchored type foundations or standard concrete pad foundations. Construction traffic rates and access issues are detailed in the Transport Study contained in Appendix A.

- Excavators, drill rigs and dump trucks will be used on site during foundation construction. Concrete agitators will deliver concrete to the site from Readymix at Oberon.

- Underground cables will be at a depth of 0.8m to 1m and generally located alongside the access roads. The cable laying process involves a trenching machine digging a trench approximately 300mm wide followed by a cable trailer feeding out the cable into the trench. The cable will be laid on sand and the trench back filled with excavated soil.

- The turbines will be erected using an 800 – 1,000 ton crane (crawler or wheel based) and a 200-ton auxiliary crane. The two cranes will be coordinated to lift turbine sections from delivery vehicles for assembly. The larger crane will then lift turbine components into place for fixing. The cranes will be dismantled and moved to the next turbine location at the completion of each turbine. The two crane construction method takes approximately two to three days from start to completion of each turbine including assembly and disassembly of each crane. The cranes require a hard stand area of approximately 20m x 20m for each crane. The hard stand areas will be rehabilitated after construction to allow for continued agricultural use, with the hard stand sub base remaining in situ. The hard stand areas will then allow for any future maintenance works that may require cranes.

- Each turbine will occupy a site of approximately 20 m x 20m, however, the ground under each turbine will be rehabilitated following construction to allow agricultural activities to occur up to the base of the turbine tower, leaving an above ground footprint of approximately 16m^2. Rehabilitation works will incorporate grading of the finished ground level around each turbine to allow pastoral activities to be conducted up to the base of each turbine. An indicative diagrammatic footprint for each turbine is provided in figure 3.1 and 3.2 and includes the dimension of hard stand area, depth of footings and diameter of the tower.

Figure 3.1: Indicative diagrammatic footprint for each turbine.

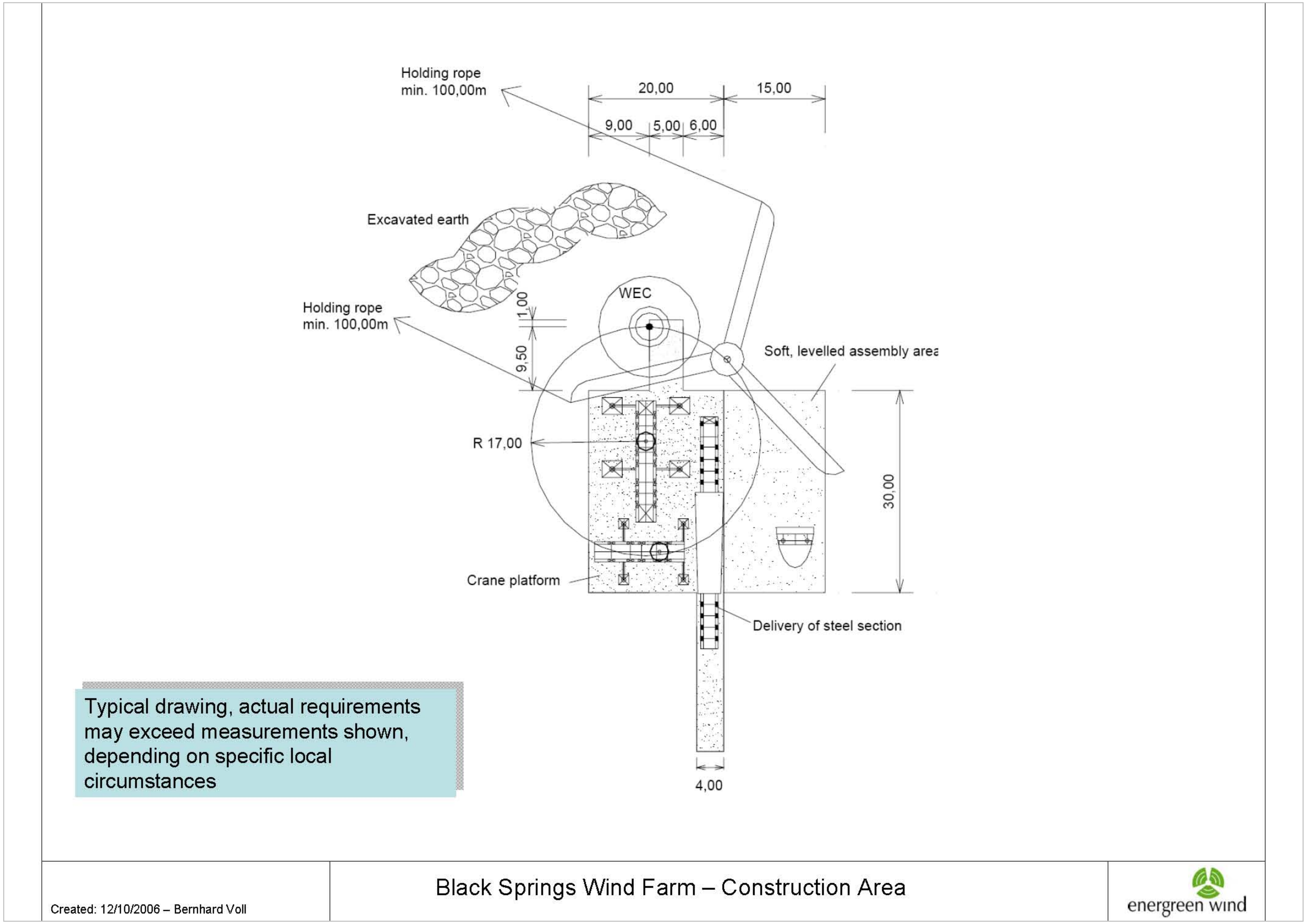


Figure 3.2: Indicative diagrammatic footprint for each turbine.

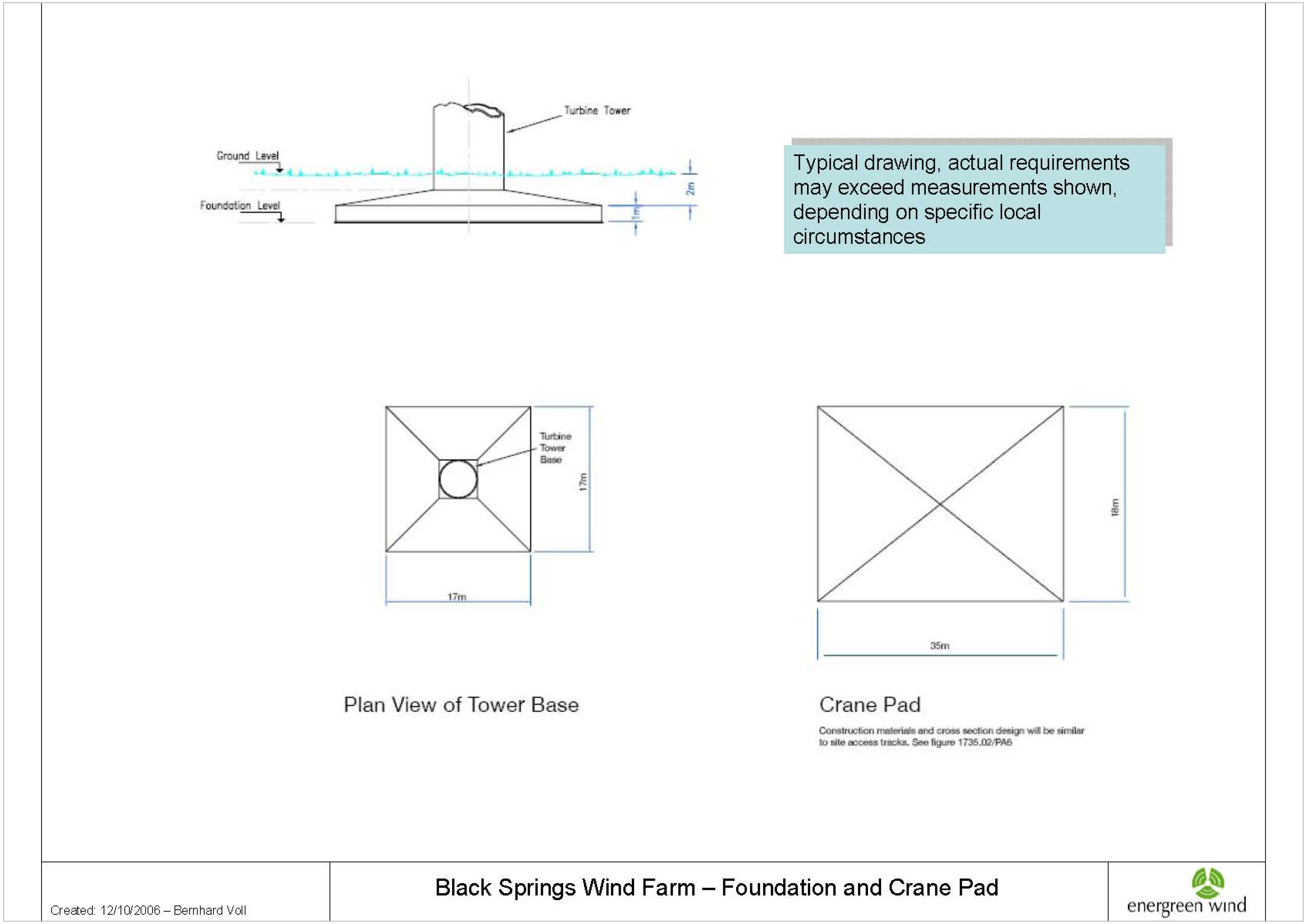


Figure 4: The following plates illustrate the construction process

Plate 4-1: Foundation pad construction components

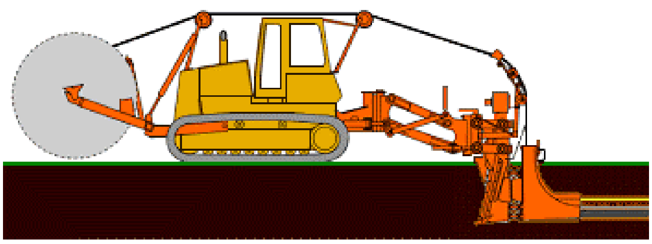
Plate 4-2: Transport of turbine

Plate 4-3: Initial turbine assembly

Plate 4-4: Rotor assembly

Plate 4-5: Final assembly

Plate 4-6: Laying underground cable



2.4.2 Construction issues

At different stages through the construction of the wind farm, oversize and over mass loads will be transported on public roads and a significant increase in local traffic may occur during the construction phase of the project. Additional internal roads will be constructed to provide access to each turbine. The period of traffic disruption will be predominately contained within the 4 – 8 month construction phase. Appropriate traffic control measures such as advisory signs and traffic controllers will be implemented to mitigate traffic disruptions.

Any fuels, chemicals or hazardous materials used during the construction process will be stored in an appropriate chemical storage container with the relevant hazardous material signage displayed. A fuel or chemical spill response program will be incorporated into the Construction Environmental Management Plan.

2.4.3 Decommissioning

The projected operational lifetime of the proposal is 25 years. Decommissioning of the wind farm will be in accordance with 'best practice' requirements in place at the time of decommissioning. Decommissioning will typically involve a similar process to the construction process. The access roads may require upgrading to accommodate heavy machinery. Large cranes and transportation of components will be required to dismantle and remove the turbines and associated infrastructure. Underground components, such as cabling and concrete foundations, will remain in situ to reduce the environmental disturbance that would result from excavating to retrieve them. All aboveground components of the wind farm will be removed and the site rehabilitated suitable for agricultural uses. Rehabilitation will incorporate the removal or control of any noxious plant species and earth works to regrade individual turbine locations and the facilities compound. Stabilisation of earthworks will be undertaken to prevent erosion and the erosion and sediment control measures will remain in place until the sites is rehabilitated suitable for the following intended land use. Stabilisation measures will include revegetation with a suitable species composition for each turbine location.

A decommissioning plan will be developed and approved by the relevant authorities before decommissioning of the wind farm commences. The economic value of recycling or reusing the wind turbine components should provide significant funding to cover the decommissioning and rehabilitation of the wind farm site.

2.4.4 Waste Management

To minimise waste products and work towards ecological sustainable development, a waste management strategy has been prepared that outlines how waste will be recycled, re-used or disposed of for the proposal. The project has been evaluated for the full life cycle of the turbines, ensuring that the costs associated with the disposal of wastes and decommissioning of the turbines and the use of natural resources is incorporated into the income generation capacity of the project. Measures incorporated include measures to prevent pollution and adherence to the polluter pays principle, where those who generate pollution and waste bear the cost of containment, avoidance or abatement. Solutions to reducing waste as listed in a waste management hierarchy include:

- prevention,
- source reduction,
- minimisation,
- treatment, and
- disposal (as a last resort).

Accordingly, the strategy specifies waste by type and volume and nominates the re-use and recycling potential. On-going waste management is also addressed. A waste management strategy is contained in section 5.8.5 Waste Management of this report.

2.5 Project Timeline

The proposal has a life cycle beyond the operation of the wind farm, including the decommissioning and rehabilitation phases evident in Table 3 provided below. Components for each turbine and associated infrastructure are sourced from a variety of resources and manufactured off-site. The wind turbines are manufactured in India and cabling is sourced from within Australia.

Table 3: Estimate Project Timeline

Wind Farm Activity	Timeframe	Cumulative Time Span
Construction Phase	4 – 8 months	0.6 years
Commissioning Phase	3 – 6 months	1.15 years
Operational Phase	25 years	26.15 years
Decommissioning Phase	4 – 8 months	26.75 years
Site Rehabilitation Phase	3 – 4 months	27 years

2.6 Construction Environmental Management Plan

Prior to commencing work, the contractor will be required to prepare a Construction Environmental Management Plan (CEMP) to address Occupational Health & Safety requirements and general risk management issues. The CEMP will specify measures to be adopted by the contractor to minimise interference with and the disturbance of the environment during the construction of the wind farm and associated facilities.

Effective and appropriate management of sediment and erosion created by the construction process is an essential component of the project. The key to effective erosion prevention and sediment control is to minimise the amount of ground disturbance at any one time and to have an effective management approach that incorporates the use of various devices in sequence to manage any runoff created during the construction process.

During construction, the site will be protected from erosion and sedimentation by the installation and maintenance of standard erosion and sediment control measures, such as sedimentation fences and swales. These control measures are to be designed and constructed in accordance with *Managing Urban Stormwater: Soils and Construction 4th Edition* – Vol 1 (the "Blue Book") Landcom, 2004. During certain stages in the construction process, controls such as silt fences or hay bales may need to be removed to allow access or work. These should be replaced as soon as possible.

The Erosion & Sediment Control Management Plan (E&SCMP) should incorporate the following principles:

- effective erosion and sediment control is essential given that the site adjoins creeks and the land has significant slope constraints;
- no disturbance within 40m of creek line, otherwise a 3A permit is required;
- site compound and temporary material storage site identified;
- existing grassed areas identified as sediment filters to remain generally undisturbed during construction;
- diversion of all clean runoff to the stable disposal areas prior to entry to disturbed areas;
- all hardstand and stockpile sites to have runoff diverted around stockpile areas;
- sediment fence to be located below all disturbed areas and stockpiles;
- all structures to be de-silted after storm events to maintain capacity and function;
- course aggregate and 'shaker ramp' at entry to site to prevent sediment being tracked onto adjoining roads;
- at end of work each day 'silt sausages' are to be placed across disturbed carriageways to minimise erosion in the event of an overnight storm;
- topsoil stockpiles should not be more than 2m high and seeded with appropriate grasses; and

- the site supervisor shall exercise discretion as to the appropriate location of erosion and sediment control measures given the stage of operations and the nature of soil disturbance.

The E&SCMP, along with other environmental management statements, will be incorporated into the CEMP prepared for the project by the contractor. Safe transport requirements and procedures for the transport of the turbines to the site, including liaison with the Police and local authorities, will also be incorporated into the CEMP.

Post construction monitoring will be in accordance with 'best practice' requirements and will be detailed in the CEMP.

The CEMP will incorporate the following:

- E&SCMP;
- rehabilitation management measures;
- waste management procedures;
- traffic and access measures;
- weed control; and
- during and post construction monitoring programs (including birds and bats).

2.7 Environmental Management Plan

A comprehensive Environmental Management Plan (EMP) will be prepared to manage and mitigate impacts associated with the on-going operation of the wind farm. The EMP will detail objectives, mitigation measures and measurable tasks to prevent or ameliorate impacts, who will be responsible for each task, how each task will be completed and the timeframe for completion. The issues and mitigation management options identified through the various specialist studies prepared for this Environmental Assessment outline the relative matters that must be addressed and are summarised in Section 8 Draft Statement of Commitments of this report.

2.8 Consideration of alternatives and justification for the preferred option

2.8.1 Alternative locations

Wind Corporation Australia has erected over 9 wind monitoring masts on a range of sites in NSW, Qld and SA. The NSW sites have been strategically selected based on information contained in the SEDA NSW Wind Atlas. Data collated from a monitoring mast located on the proposed site near the village of Black Springs has confirmed the wind resource necessary to commercially operate wind turbines. Black Springs has been identified as a preferred site for development due to the factors of:

- suitable wind speeds;

- suitable and available land;
- nearby electrical grid with available capacity; and
- local landholders are interested in wind farm opportunities on their land.

No other sites identified by the Wind Corporation Australia have demonstrated the ability to support the same number of turbines, with comparable wind speeds, proximity to the grid connection and appropriate landholder interest.

2.8.2 Alternative proposal options

An alternative proposal for the wind farm on the subject site and adjacent land has been extensively investigated by Wind Corporation Australia. Wind Corporation Australia originally proposed to construct a wind farm of 33 turbines. The turbines proposed had a generating capacity of 1.25MW and a hub height of 75m. Energreen Wind Pty Ltd have since assisted in the development of the project and remodelled the proposal because of the community concerns regarding the scale of the project.

The reduced wind farm proposal was originally designed over two properties south of Campbell's River Road incorporating the Daisybank and Winton Park properties. However, the sale of the Winton Park property during the planning stage of the project resulted in the redesign of the wind turbine layout. The new design integrates two properties separated by Campbell's River Road, now incorporating Daisybank and Acqualoria.

The economic and energy output modelling completed by the Wind Corporation Australia indicates that the proposed new design is optimised for energy output and efficiency of design, whilst still allowing adequate distances from homes and structures, and without the need to disturb existing vegetation. Subsequently, the previous proposal has been superseded by the current proposal.

2.8.3 Alternative Construction Options

The construction options selected provide for the most efficient and effective methods for transporting and erecting the turbines and associated infrastructure. The construction methods selected for the proposal are considered the most effective method to minimises the environmental impacts. The erection of the wind turbines is in accordance with construction methods that are currently utilised for land based wind farm construction.

Off-site assembley of wind turbine components is required as the turbines are manufactured overseas and transport by ship and road transport to the site for assembly. The components are delivered in large pieces that result in reduced on-site construction times.

2.8.4 Alternative for Financing

Wind Corporation Australia has elected to privately finance the project to allow more flexibility in the project design and implementation. Alternative financial arrangements have proven to be more restrictive.

2.8.5 The No- Build Option

If this project were not to go ahead it would result in the region forfeiting the following:

- local electricity supply from a local renewable source;
- the opportunity to reinforce and landmark the local region as a user of 'renewable energy";
- more than A$30 million in investment;
- local employment and training opportunities;
- local resource utilisation opportunities during the construction and maintenance processes;
- the potential to improve the local electricity supply system, as the wind farm would be generating electricity close to the point of consumption;
- local and regional economic multiplier benefits;
- potential regional tourism opportunities and ongoing regional development; and
- local community participation.

2.8.6 Preferred Option Justification

The wind farm option as detailed in this Environmental Assessment is considered the preferred option based on the following criteria:

- The nine turbines satisfy the objectives of the proposal by significantly increasing renewable energy production in NSW while mitigating the production of greenhouse gas emissions.

- The wind farm provides efficient renewable energy that meets an identified demand in the local energy network and will contribute to mitigation measures to offset future energy demands.

- The wind farm is a reliable source of energy that contributes to the Mandatory Renewable Energy Target set by the Federal Government.

- The revised proposal significantly reduces the number of proposed turbines and the associated environmental risks of the larger proposal. The environmental risk associated with the revised proposal is outlined in this Environmental Assessment and the assessment findings suggest that the risks can be mitigated to an acceptable level.

- Engineering design of the Suzlon turbines is considered more suitable for the site and any potential natural hazards, such as storms or fire.

- The revised proposal reduces the environmental footprint of the wind farm while still providing efficient use of the land. The reduced footprint decreases the demand on local resources to service the construction needs of the project. Transport interruptions and servicing requirements are also reduced with a reduced number of turbines.

- The biophysical impacts are reduced by less turbines, including construction disturbance, flora and fauna impacts and the potential for heritage impacts.

- The social impact is significantly reduced by the preferred option due to the reduction in scale of the project and therefore, the reduced visual impact of the proposal.

- The economic benefits are initially reduced due to rescaling of the project, with less demand for local resources and construction employment opportunities. However, the economic multiplier benefits from the establishment of the wind farm in Black Springs should be maintained.

- The proposal is consistent with the principles of ecological sustainable development.

- Overall, the preferred option presents a balance between environmental, social and economic benefits and constraints that will benefit Black Springs and the wider region while assisting in reducing greenhouse gas emissions.

2.9 Ecological Sustainable Development

The principles of Ecological Sustainable Development (ESD) are particularly relevant when considering new development proposals to prevent environmental degradation from in appropriate practices. The ESD principles as listed in the *Protection of the Environment Administration Act 1991* were amended in 1997. The ESD principles include:

- the precautionary principle;

- inter-generational equity;

- conservation of biological diversity and ecological integrity; and

- improved valuation, pricing incentive mechanisms to include environmental factors in the valuation of assets and services.

The ESD principles were incorporated into key decision making phases of the project. This was achieved by apply the following guidelines throughout the study:

- The precautionary principle – decisions were guided by careful evaluation to avoid, where ever practicable, serious or irreversible damage to the environment, for example, locating access tracks over cabling trenches to reduce the amount of landscape disturbance and minimise impacts on potentially sensitive lands in reference to Aboriginal heritage.

- Inter-generational equity – decisions were guided to ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. Sustainable energy production through the use of wind turbines assist in reducing the reliance on coal based energy production. This intern results in reduced greenhouse gas emissions and helps alleviate adverse contributions to climate change.

- Conservation of biological diversity and ecological integrity – conservation of biological diversity and ecological integrity was fundamental in project outcome considerations. Conservation of existing the vegetation and no requirement to remove vegetation will assist in maintaining biological diversity and ecological integrity while still allowing development across the site.

- Improved valuation and pricing incentive mechanisms that include environmental factors in the valuation of assets and services – environmental goals were established in the most cost effective way, to maximise benefits and minimise cost in developing solutions and responses to environmental problems. Consideration was given to full life cycle costs in the use of natural resources and disposal of waste. The wind turbines themselves generate income through the sale of the electricity via renewable energy production that does not rely on burning fossil fuels.

The overall intention of the proposal is to design environmentally benign structures that adhere to the principles of ecological sustainable development. Wind farms provide exemplary examples of ecological sustainable development.

3 THE LOCATION

3.1 Planning context

3.1.1 Introduction

The proposed wind farm requires development consent under the Part 3A of the *Environmental Planning and Assessment Act 1979* (*EP&A Act*). Under State Environmental Planning Policy (Major Projects) 2005, development that, in the opinion of the Minister, is development of a kind that is described in Schedule 1 is declared to be a project to which Part 3A of the Act applies.

3.1.2 State Environmental Planning Policy (Major Projects) 2005

In November 2004 the Minister for Infrastructure and Development declared proposals involving electricity generation facilities using wind energy to be state significant development under the *EP&A Act 1979* subject to specific characteristics. In December 2005 the criteria for State significant development were revised. Under State Environmental Planning Policy (Major Projects) 2005, state significant development now includes development for the purpose of an electricity generation facility that:

a) Has a capital investment value of more than $30 million for gas or coal-fired generation, or co-generation, or bioenergy, bio-fuels, waste gas, bio-digestion or waste to energy generation, or hydro or wave power generation, or solar power generation, **or wind generation**, or

b) (Repealed)

c) Is located in an environmentally sensitive area of State significance.

Clause 24 (b) has been repealed though previously referred to wind energy developments that triggered state significance based on the amount of towers, the generating capacity and whether the proposals were in more than one council area.

The project capital value is approximately $32,600,000. The capital value by virtue meets the criteria listed in Schedule 1 Part 3A projects-classes of development, Group 8 Transport, Energy and Water Infrastructure. Clause 24 – Electricity generation incorporates development for the purpose of an electricity generation facility that has a capital investment value of more than $30 million for wind generation. The Minister for the Department of Planning is the approval authority.

Under State Environmental Planning Policy (Major Projects) 2005, environmentally sensitive areas of state significance are defined as:

a) coastal waters of the State, or

b) land to which *State Environmental Planning Policy No 14—Coastal Wetlands* or *State Environmental Planning Policy No 26—Littoral Rainforests* applies, or

c) land reserved as an aquatic reserve under the *Fisheries Management Act 1994* or as a marine park under the *Marine Parks Act 1997*, or

d) land within a wetland of international significance declared under the Ramsar Convention on Wetlands or within a World heritage area declared under the World Heritage Convention, or

e) land identified in an environmental planning instrument as being of high Aboriginal cultural significance or high biodiversity significance, or

f) land reserved as a State conservation area under the *National Parks and Wildlife Act 1974*, or

g) land, places, buildings or structures listed on the State Heritage Register, or

h) land reserved or dedicated under the *Crown Lands Act 1989* for the preservation of flora, fauna, geological formations or for other environmental protection purposes, or

i) land identified as being critical habitat under the *Threatened Species Conservation Act 1995* or Part 7A of the *Fisheries Management Act 1994*.

The development does not meet any of the above criteria to qualify as development within an environmentally sensitive area.

3.1.3 Threatened Species Conservation Act 1995 & Environment Protection and Biodiversity Conservation Act 1999

Pursuant to the *Environmental Planning Assessment Act 1979* (*EPA Act*), developments requiring approval from a Council or a NSW statutory authority are required to be assessed in accordance with the *Threatened Species Conservation Act 1995* (*TSC Act*). The Flora and Fauna Assessment prepared for the proposal has investigated and assessed the potential impacts the proposal and addresses the requirements under the *TSC Act* and *Fisheries Management Act 1994*.

No threatened flora species have been previously recorded within 10km of the site, although seven species have been recorded on the Atlas of Wildlife Oberon 1:100,000 Map Sheet and / or are listed on the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999)* Protected Matters Report. Field surveys revealed five (5) threatened fauna species present within the vicinity of the proposed wind farm. No Endangered Ecological Communities were observed on the site.

Given that a number of the factors regarding the ecological impacts of wind turbines are poorly understood, a precautionary approach was taken for the threatened species assessment. Accordingly, even those species considered to have a low / moderate level of potential impact have been subject to a Seven Part Test under the provisions of Section 5A of the *EPA Act*. The assessment concluded that no significant impact on threatened species will occur.

No species of flora and fauna or threatened communities listed under the *EPBC Act 1999* were recorded during field investigations. The Flora and Fauna Assessment recommends that the proposal should therefore be considered unlikely to comprise a controlled action.

3.1.4 Oberon Local Environmental Plan 1998

Under the provisions of the Oberon Local Environmental Plan 1998 (LEP) the subject land is zoned 1(a) – General Rural Zone.

The objectives of this zone are to promote the proper management and utilisation of resources by:

(a) protecting, enhancing and conserving:

(i) agricultural land in a manner which sustains its efficient and effective agricultural production potential, and

(ii) soil stability, by controlling and locating development in accordance with land capability, and

(iii) forests of existing and potential commercial value for timber production, and

(iv) valuable deposits of minerals, coal, petroleum and extractive materials, by controlling the location of development in order to ensure the efficient extraction of those deposits, and

(v) trees and other vegetation in environmentally sensitive areas where the conservation of the vegetation is likely to control land degradation or is significant to scenic amenity or the natural wildlife habitat, and

(vi) water resources, including groundwater, for use in the public interest, preventing the pollution of water supply catchments and water storage, and

(vii) areas of significance for nature conservation, including areas with rare plants, wetlands and significant habitats, and

(viii) items of archaeological or heritage significance, including Aboriginal relics and places, and

(b) preventing the unjustified development of prime crop and pasture land otherwise than for the purpose of agriculture, and

c) facilitating farm adjustments, and

(d) minimising the cost to the community of:

(i) fragmented and isolated development of rural land, and

(ii) providing, extending and maintaining public amenities and services, and

(e) providing land for rural small holdings development and for other non-agricultural uses in accordance with demand for that development and in a manner which has the least adverse impact on prime crop and pasture land, and

(f) controlling and locating dwelling-house development to provide buffers from adjoining agricultural land in order to provide adequate environmental safeguards to the inhabitants and not prejudice future agricultural activity in the near vicinity.

Limited agriculture and forestry are permissible without consent. Wind farms are not specifically defined in the LEP therefore they are considered permissible with consent.

Agricultural activities require and use electricity for a variety of purposes including machinery, shearing, pumps and electric fences. Wind power generators are historically compatible with agricultural activities and should be considered as a related land use. In the past, before the advent of an extensive reticulated power supply, isolated rural properties used their own wind power generators.

Under Clause 10, a relevant clause relating to this proposal concludes that:

The Council must not consent to development on land within Zone No 1 (a) or 1 (c) unless it has taken into consideration, if relevant, the effect of the carrying out of the proposed development on:

> *(c) the future recovery from known or prospective areas of valuable deposits of minerals, coal, petroleum, sand, gravel or other extractive minerals, and*

This Clause is addressed in Section 6 of this Environmental Assessment.

3.1.5 Oberon Development Control Plan Part O Wind Power Generation 2005

Oberon Council adopted the Oberon Development Control Plan O (DCPO) – Wind Power Generation 2005 on 13 September 2005. The Council has prepared DCPO in order to manage wind power developments with a power rated output of greater than 10kW and encourage economic development within the Shire. The Oberon Council vision for wind generation is:

To promote well planned and considered development of wind energy development in Oberon that recognises, promotes and enhances the Oberon Shire as a desirable place to live in, invest in and visit.

DCPO was taken into consideration during the project re-evaluation phase for the BSWF with the recommendations and objectives incorporated into the proposed design. Most of the requirements listed in DCPO are covered throughout this Environmental Assessment.

3.1.6 State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 – Koala Habitat Protection encourages the conservation and management of natural vegetation areas that provide habitat for koalas to ensure permanent free-living populations will be maintained over their present range. Oberon Local Government Area (LGA) is listed under Schedule 1 of SEPP 44, therefore the policy is applicable to the site. The project area is predominately cleared of native vegetation, though one species of tree, *Eucalyptus viminalis* (Manna Gum), listed as a 'Koala Feed Tree Species' in Schedule 2 of the SEPP occurs on the subject site. The site qualifies as 'Potential Koala Habitat' but does not qualify as 'Core Koala Habitat'. The Flora and Fauna Assessment has addressed the requirements under SEPP 44.

3.2 Site description and locality information

The BSWF is to be located within the Shire of Oberon, in the Blue Mountains on the Great Dividing Range west of Sydney. The site is approximately 3km south west of the village of Black Springs and 25km southwest of Oberon. Figure 5 illustrates the Site Location in relation to the surrounding region.

The proposed wind farm covers a total area of approximately 527ha of which the turbines and ancillary structures will cover approximately 0.61ha. The proposal will be situated on two privately owned rural landholdings as listed in Table 4.

Table 4: Land tenure and title details.

Landholder	Property	Lot No.	DP
Lorena Turner (Mazzotti Residence)	Acqualoria	31	757072
		48	757072
		32	757072
Gavin Douglas	Daisybank	1	115062
		144	757072
		171	757072
		110	757072
		172	757072
		182	42908
		19	757072
		36	757072
		81	757072
		84	757072

The topography of the wind farm site is characterised by a series rolling hills forming a gentle ridgeline in a north west – south east direction. The knolls are separated by shallow valleys. The vegetation of the subject site is characteristic of the surrounding area. It consists of large cleared areas for open paddocks covered by grassland with sparsely scattered shade trees. Sheep and cattle grazing are the predominant land use.

The site ranges in elevation between 1100m and 1250m above mean sea level (AMSL). A trig station is located on the Daisybank property at an elevation of 1233m AMSL. The high elevation and sparse vegetation results in high average wind conditions.

Large areas of land surrounding the site is used for pine timber plantations and some small remnant forest patches are scattered across the landscape.

Due to the high elevation, climatic conditions in Black Springs and the wider Oberon Shire are seasonally distinct. Summer temperature average 21°C in the daytime to 12°C at night. Winter averages 8°C in the daytime and 1°C at night. Weather conditions can change quickly at any time of the year and snow usually falls each winter. The site is a designated high wind area according to the NSW Wind Atlas produced by Sustainable Energy Development Authority. The site is located in an area that has average wind speeds of approximately 18 – 19 km/hr.

4 IDENTIFICATION AND PRIORITISATION OF ISSUES

The *Draft NSW Wind Energy Environmental Impact Assessment Guidelines* (Department of Planning, 2002) provided the base environmental assessment structure for this report. The Guidelines provided an outline of specific requirements to be included in a wind farm Environmental Impact Assessment. Those same requirements are relevant for this Environmental Assessment and therefore the subsequent report structure has been prepared in a similar format as suggested in the Guidelines. The Guidelines detail typical environmental issues relating to wind farm developments and appropriate management and mediation measures that should be investigated as part of any project development assessment. The information provided in the Guidelines and reviews of similar assessments for other wind farms, including the Environmental Assessment for the Cullerin Range Wind Farm and Capital Wind Farm, plus issues raised during the consultation process are all factors that have been considered in identifying and prioritising issues associated with the BSWF.

The issues have been prioritised into ‘moderate’ to ‘high’ key issues that require more in depth analysis and associated ‘low’ impact issues that do not require such in depth analysis, though they are addressed through relevant mitigation measures. Table 5 lists the issues identified and their order of prioritisation.

Table 5: Black Springs Wind Farm prioritisation of environmental issues.

Environmental Issues	Prioritisation	Refer to Section
Greenhouse / Energy	Low	5.1
Landscape and visual	High	5.2
Noise	High	5.3
Air quality	Low	5.4
Soil, drainage and geology	Moderate	5.5
Flora and Fauna	High	5.6
Heritage	High	5.7
Infrastructure and utilities	Moderate	5.8
Bushfire	Low	5.9
Social	High	5.10
Economic	Moderate	5.10
Cumulative	Moderate	5.11

PLAN PRODUCED BY:
HARPER SOMERS O'SULLIVAN
241 DENISON STREET
BROADMEADOW NSW 2292
PO BOX 428
HAMILTON NSW 2303
T: 02 4961 6500
F: 02 4961 6794
E: survey@hso.com.au
W: www.hso.com.au
ABN: 11 093 343 858

AMENDMENT	DATE	TYPE
A		
B		
C		
D		

SCALE: 1: 150000 at A4 Size
DATE: 01/03/2006
DATUM: Longitude / Latitude (AGD 84)
CONTOUR INTERVAL:
DESIGNED: S. WATSON
APPROVED: T. LAMBERT

ENVIRONMENTAL ASSESSMENT
BLACK SPRINGS WIND FARM, OBERON LGA

FIGURE 4

SITE LOCATION

LAYOUT REF:
J:\JOBS\23k\23219 - Black Springs\Drafting\Mapinfo\23219-F&F FIG 1-1 SITE LOCATION-B-A4.wor

JOB REF: 23219

PLANNING SURVEYING ECOLOGY E: survey@hso.com.au W: www.hso.com.au

5 THE ENVIRONMENTAL ISSUES

The environmental issues associated with the BSWF have been addressed in this section. At the end of each sub-section is an environmental impact summary table providing a checklist of environmental impacts and a scaling of the overall impacts based on the severity and mitigation options applicable to each environmental issue. A checklist has been used to provide a systematic approach to ensure the key environmental issues are listed and evaluated to determine the merit of the project across the range of sometimes-complex entities. Each section checklist has been collated in Section 7 - Environmental Risk Assessment to assess the risk value of each component of the project and determine the overall environmental risk associated with the development of wind farm. The method used to achieve the environmental impact summary involved the examination of:

- the potential issues as identified through the Director-General Requirements and the environmental investigations and assessments;
- the potential consequences (impacts) associated with each issue; and
- the mitigation options available to ameliorate the impacts.

Using this method a qualitative assessment of the issues and impacts identified in each environmental investigation was evaluated for the resulting environmental impacts. A qualitative assessment was used because the environmental issues associated with the proposal in some aspects are subjective and not easily quantified. The qualitative assessment provides an assessment methodology that can then be used to determine the environmental risk associated with each action. Each environmental issue in Section 5 has been classified into the following impacts;

- positive/negative;
- beneficial/adverse;
- short term/long term; and
- reversible/irreversible.

A scaling checklist has also provided to establish a qualitative rating of the severity of the impact of the wind farm for each environmental issue. The scaling checklist is a qualitative measure of the impact of the wind farm during the construction, operation and decommissioning phase of the project. The methodology for the scaling checklist is based on the potential for environmental impacts and the predominate outcome of each environmental issue to result in a positive or negative impact and whether each impact would be major, minor or negligible in nature. The scaling checklist for each environmental issue has been collated in Section 7 - Environmental Risk Analysis to provide a subjective assessment of the severity of the impacts resulting from the proposal. The severity of the impacts is required to determine the risk associated with each environmental issue and is further explained in Section 7 - Environmental Risk Analysis. A summary table is also provided outlining the relevant impacts and mitigation measures for each environmental issue.

5.1 Greenhouse and energy issues

Modern wind turbines will recover the energy used in their life cycle within their first year of operation. A recent life cycle assessment study by Elsam Engineering (2004) incorporating the energy balance of a similar wind turbine, the Vesta V80 2.0MW turbine revealed that the energy balance payback period under normal operational conditions is approximately 7.7 – 9 months. Energy balance is the ratio between the amount of energy used in the manufacture, operation, maintenance, repairs and decommissioning of a wind turbine compared to the energy the turbine will produce in its life time. Therefore, within a 25 year design lifetime, each of the proposed wind turbines will supply approximately 33 times the energy used throughout it's own life cycle.

Australia's electricity generation sector is dominated by fossil fuel based generators. Approximately 84% of Australia's electricity generation is currently provided by coal-fired power stations, releasing 170 million tonnes of carbon dioxide (CO_2) into the atmosphere (Diesendorf, 2003), with less than 10% of electricity generated from clean renewable sources. Energy demands in Australia are growing, with the Newcastle - Sydney – Wollongong area growing at around 300MW per year (Transgrid, 2006). Most of the electricity to meet this demand is expected to be derived from gas, wind or coal generators located outside of the area. The energy harvested by a wind turbine is proportional to the cube of the wind speed. Therefore, if the wind speed increases only marginally, the harvestable energy in that wind increases dramatically and provides energy generation with no greenhouse gas emissions.

The Australian energy sector plays a key role in the country's economy. The Australian Government's Energy White Paper sets out a comprehensive approach to ensure Australians have access to low cost reliable energy resources. As part of the Governments plan to achieve this commitment and Australia's long-term greenhouse response, a Mandatory Renewable Energy Target (MRET) has been adopted. The MRET is the generation of an additional 9,500 GWh of renewable energy per year by 2010.

The NSW Government has announced a NSW Renewable Energy Target (NRET) to assist in reducing greenhouse gas emissions to 2000 levels by the year 2025, and by 60% by 2050, as NSW's input into addressing climate change. A summary of the NRET is listed in the following points:

- NRET will require a proportion of electricity consumed by NSW consumers to be sourced from renewable electricity generation anywhere in the National Electricity Market (NEM). It is important to note that the target refers to electricity consumed in NSW, not electricity generated in NSW.

- The renewable energy target levels will be 10 per cent of NSW end use consumption by 2010 and 15 per cent by 2020.

- Of the total electricity from the NEM consumed in NSW, 6.1 per cent is from renewable generation.

- The amount of renewable energy required less the amount from existing measures means that the additional renewable energy required to meet the target is 1,317 GWh by 2010 and 7,250 GWh by 2020.

- Over the life of the scheme (to 2030) the amount of renewable energy generated will accumulate to 120,929 GWh. Displacing fossil fuel generation with a carbon intensity of 0.95 tonnes/MWh (pool coefficient) will result in greenhouse gas emission savings of about 115 million tones, which is equivalent to taking over 25 millions cars off the road for a period of twelve months.

- An enforceable penalty for non-compliance will be established under the NRET scheme legislation.

- It is proposed to have legislation in place and commence the NRET scheme in 2007. The first target level to be met is in 2008.

- At a maximum, the NRET scheme is expected to increase the annual electricity bill for the average NSW household customer by about a dollar a week in 2020 and much lower before and after 2020.

- The efficient average cost for average households is estimated to be approximately 30 cents each week, or $16 each year, over the full modeling period to 2030.

The benefits of the establishment of the NRET will include:

- zero or low greenhouse gas emissions from generation activities, reducing dependence on fossil fuel electricity generation;

- minimise particulate and other emissions including NO_x and SO_x;

- embedded electricity generation within loxcal networks which will reduce electricity network losses as generation sites are located closer to customer demand centers;

- potential savings in network enhancements due to the distributed location of embedded renewable electricity generation easing network loads; and

- local economy benefits from installation of renewable energy including increased employment, use of local material and lease payments for land use.

The establishment of the NRET will require electricity retailers to purchase the target proportion of their electricity supply from accredited renewable generation sources, which would include proposals such as Black Spring Wind Farm. Therefore, energy produced by the BSWF will contribute to achieving MRET and NRET and assist with Australia's and NSW's commitment to the greenhouse response.

In addition to the Government's response, increasing numbers of consumers are seeking electricity generated from renewable energy sources rather than fossil fuels that contribute to the greenhouse effect. Consumers are voluntarily choosing to purchase "green" electricity even though the purchase price is higher than conventionally produced electricity. Wind energy provides a renewable resource that does not release carbon dioxide in the production of electricity. Each kWh of electricity generated by wind power displaces the equivalent amount of electricity that must be produce by a traditional fossil fuel burning generator to maintain sufficient power to the electricity grid. Therefore, the BSWF will contribute to production of clean renewable energy and has the potential to avoid up to 43,660 tonnes of greenhouse gas emissions when compared to traditional energy production sources. Figures are based on the NSW greenhouse pool coefficient of 0.929kg of CO_2 produced per 1kWh of electricity produced, multiplied by the average rate of consumption and the number of dwellings (Australian Greenhouse Office). Other emissions from coal burning that also decrease as a result of renewable energy production include sulphur dioxide, nitrogen dioxide, fluoride, hydrochloric acid, boron, sulphuric acid, mercury and particulate matter. Gipe (1999) states that wind generation offsets up to 7kg per Megawatt-hour of sulphur dioxide, nitrogen dioxide and particulates, 0.1 kg per Megawatt-hour of trace metals and more than 200 kg per Megawatt-hour of solid wastes from coal tailings and ash. The BSWF will have a total generating capacity of 18.9 MW and an annual generation of approximately 47,000 MWh. Therefore, this equates to the displacement of approximately 329,000 kg per annum of sulfur dioxide, nitrogen dioxide and particulates, 4700kg per annum of trace metals and 9,400,000kg per annum of solid waste into the environment through the development of the BSWF and accentuates the associated environmental benefits of wind power electricity generation. BSWF annual generation of electricity will have the ability to power around 6,000 dwellings, satisfying the power requirements of Oberon, Black Springs, Burraga and the timber mill in Oberon based on an average rate of consumption of 7,900 kWh per household.

The BLWF will assist electricity retailers to meet:

(i) Demand for renewable energy to meet demand for green power;

(ii) MRET and NRET; and

(iii) Emission benchmarks for the NSW Greenhouse Benchmarking Program and the production of NSW Greenhouse Abatement Certificates under the NSW legislation.

Construction activities associated with the development of the wind farm will result in very small levels of greenhouse gas emissions. These can be reduced through effective construction activity management. For example, the Construction Management Plan should outline measures to control construction machinery exhaust or turn off engines rather than idling unused for long periods of time.

The BSWF will also provide local participating landholders with additional income, which will add to the viability and sustainability of these traditional agricultural landholdings, which is particularly important as an alternative income during the current drought. The project will assist the region to meet environmental objectives and the principles of Ecologically Sustainable Development through the generation of renewable energy and consequent greenhouse gas abatement.

5.1.1 Environmental Impact Summary: Greenhouse & Energy Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Greenhouse & Energy	X		X			X		

Environmental Issue	Construction	Operation	Decommissioning
Greenhouse / Energy	0	+2	0

Key

Major positive impact	+2	Minor positive impact	+1	No appreciable impact	0
Minor negative impact	-1	Major negative impact	-2		

Impact	Mitigation measures	Management option	Monitoring required
Greenhouse emissions from construction and maintenance machinery	• Ensure machinery is adequately serviced to ensure efficient operation; • Turn off engines rather than idle for long periods	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities

5.2 Landscape and visual issues

This Visual Impact Assessment has been prepared with regard to the Australian Wind Energy Association and Australian Council of National Trust's *Wind Farms and Landscape Values: Stage 1 Final Report – Identifying Issues, March 2005*, with particular emphasis on Appendix B: *Wind Farms and Landscape Values: Final Issues Paper*, the *Draft NSW Wind Energy Environmental Impact Assessment Guidelines* (Department of Planning, 2002) and a review of the visual impact assessments from similar wind farm projects, including the Cullerin Range Wind Farm and Capital Wind Farm.

The assessment methodology of the visual impact of the wind farm involves consideration of the visual or scenic quality of the area, the landscape values, the visual sensitivity and the visual effect. Visual assessment relates to the aesthetics of an area and in most circumstances is largely a qualitative assessment. There are generally accepted landscapes and visual aspects that are continually preferred by the general community over other landscapes. Scientific research has resulted in the development of more quantitative methodology that is based on these generally accepted landscape values. The visual quality assessment of the BSWF also incorporates a Visual Quality Reference Table (Clouston and Brouwer, 1995) to provide a quantitative assessment of the existing landscape quality. A copy of the Visual Impact Assessment is contained in Appendix B

5.2.1 Scenic quality

The existing character of the area between Black Springs and Burraga and the wider region may be described as undulating, moderately sloped rolling hills with shallow valleys in between, typical of the Oberon district. No significant ridgelines dominate the landscape. Cleared grass covered undulating terrain characterises the hills. Only very small patches of remnant vegetation remain across the precinct. No dominant permanent water sources are visible from public viewing areas within the visual catchment. A moderately sized dam exists in a natural depression adjacent to the eastern boundary of 'Winton Park', though this is not visible from any public viewing area.

The hills and the valley floors have been predominately cleared for agricultural purposes since European settlement. The site and the surrounding visual catchment has been moderately modified reflecting long-term agricultural use. The pine plantations reflect highly modified landscapes, particularly where clear felling has occurred. The existing pine plantations bound the north, east and western boundaries of the visual catchment.

The visual catchment has a number of distinctive existing anthropogenic structures located within the landscape. These include 500kV and 66kV transmission line towers, wind monitoring tower, pine plantations and the existing road network. The 500kv towers running adjacent to the site are prominent visual structures that exist within and beyond the visual catchment of the wind farm. The visual catchment beyond the site consists of undulating hills and valleys. Farm residences plus farm associated sheds and structures are scattered through the landscape.

While the addition of nine wind turbines would attract visual attention within the landscape, other engineered structures currently exist that are equally visually significant, though probably more acceptable due to their common and accepted utilitarian contribution to modern society. This point accentuates the fact that the impact of the wind farm upon the scenic quality of the area is qualitative and subjective. Some members of the community see the wind farm as positive, promoting green energy and providing an opportunity for Oberon and Black Springs to be associated with alternative energy production and utilise this concept for tourism (personal communications with residents). Other members of the community may not dispute the benefits of green energy, but do not want the wind farm in their locality. It is well recognised that the community generally accept powerlines, masts, phone towers and similar structures in prominent locations, as acceptable and even necessary, despite the perceived visual impact, but object to wind turbines even though they provide an equally vital service to our community.

The community consultation indicated that several groups and individuals within the area are opposed to the proposal. It is understandable that those members of the community most affected by the location of the turbines may be perturbed by their presence and mitigation measures should be implemented to ameliorate the impacts.

5.2.2 Distance to adjacent residences

The wind farm has been strategically located to avoid visual impacts upon any existing towns or villages within the Oberon Shire. The turbines will not be prominently visible from most of Black Springs Village. Only a few residences, located on the southwest outskirts of the village, are elevated and positioned sufficiently to overlook the proposal, though at a distance greater than 2700m from the nearest tower.

The turbines will not overshadow any occupied dwellings. The 'Daisybank' residence is located at a distance of approximately 1000m to the closest turbine and is host to the development. The second host property, 'Acqualoria' has its residence located at a distance of approximately 275m to the closest turbine. The turbines will be visible from both the 'Daisybank' and 'Acqualoria' residences.

5.2.3 Visual Sensitivity

Visual sensitivity is an estimate of the significance that a change within the landscape will have upon the visual receptor. The general principles of visual sensitivity include a decrease in visual sensitivity as viewer distance increases, a decrease in visual sensitivity as the viewing time decreases and a relationship between the view activity and sensitivity.

Visual prominence of the wind farm to the surrounding area will be influenced by the topography and vegetation between the viewer and the turbines. The foreground and middleground vegetation elements will in some receptor locations partially or completely obscure the view of the turbines.

The sensitivity of viewers of a wind farm is based on perception and is highly subjective. Studies of the wind farms in Searsburg, Vermont and Hull, Massachusetts showed that the support for the wind farm proposals increases after the completion of construction of the turbines. In Searsburg, Vermont, support grew from 66% support/neutral pre construction to 83% post construction. Similar results have been recorded in Europe. The proposed wind farm is expected to increase tourism within the area. Fact Sheets published by AusWEA indicate that hundreds of thousands of people visit Australian wind farms each year. The location of the proposed wind farm adjacent to Campbell's River Road should result in additional "green tourism" opportunities for Black springs and the Oberon Shire. The wind farm also has the potential to reduce power disruptions to the local area. Therefore, the sensitivity of the viewer is dependent upon more factors than just the visual prominence of the turbines. The broader community and environmental benefits are critical factors that will influence the sensitivity of the viewer.

5.2.4 Scale, dominance and size of objects

The scale of the turbines in relation to the surrounding landscape is graphically illustrated in the photomontages. The wind farm will be a prominent feature of the landscape south west of Black Springs. The scale and dominance of the turbines within the landscape will vary with the location from where the turbines are viewed. The wind farm location will act as the background from Abercrombie Road. The foreground and middle ground elements within the view corridor, such as trees and buildings and other structures, will influence the perception of scale and dominance of the turbines within the landscape. The turbines will be prominent in the foreground when viewed from Campbell's River Road.

The final size of the turbines are still to be determined depending upon the type of turbine to be used for the project. The proposed turbine hub height will be around 80m with a typical blade length of 44m. The height of the turbines is a design constraint that balances the length of the rotor blades and the efficiency of the turbine. Turbines are constructed at typical heights of 60m or more to reduce the interference of friction and turbulence resulting from the interaction between the wind and the land surface. The heights of the proposed turbines are based on current available turbine models. Reducing the height, in general reduces the blade length and therefore efficiency and would result in the need for additional turbines to maintain the viability of the wind farm. Additional turbines result in other unwarranted effects such as increased land area and visual clutter. The original BSWF was for 33 smaller turbines, though community concerns about the scale of the project led to a significant modification of the proposal. The revised wind farm has nine larger turbines than the original 33. The larger turbines, but reduced turbine number is considered a better outcome for the landscape and alleviates some community concerns.

5.2.5 Compatibility with the landscape

Wind farms are considered compatible with agricultural landscapes due to their small environmental footprint and ability for agricultural activities to continue un-interrupted to the base of the turbines. Indeed farm windmills have become an iconic part of the typical rural landscape. The amount of area and environmental impact resulting from wind turbines and access tracks and other associated infrastructure are significantly smaller per megawatt of power produced compared to the traditional coal fired power station. The existing landscape has been modified during European occupation, predominately for agricultural purposes. Engineered or built structures such as transmission line towers, phone towers, roads, pine plantations, clear felling operations and monitoring masts currently exist within the landscape. The introduction of nine turbines is considered consistent with the existing infrastructure and compatible with the agricultural use of the landscape.

5.2.6 Photomontages

A set of photomontages has been produced and provided in Visual Impact Assessment to illustrate the turbines within the landscape. The photomontages illustrate the visual prominence of the wind turbines particularly from Campbell's River Road. A plan relating to the location where each photomontage picture was taken has also been incorporated. The photomontages illustrate the visual impact the turbines will have on the landscape.

5.2.7 Shadow Flicker

A Shadow Flicker Study has been undertaken by Energreen Wind to assess the potential impact shadow flicker may have upon adjacent receptors (homes). Shadow flicker is a term used to describe the change in light intensity observed when a turbine blade casts an intermittent shadow upon a receptor.

With regard to wind farms, the effect is caused by the rotating blades casting a moving shadow over a residence. Shadow flicker can cause disturbance to residents if the orientation of the turbines and a home are such that the residence experiences significant periods of flicker impact. For example if a person is within a building, shadow flicker from a turbine will result in an intermittent variation in the natural light intensity. If the regular changes in light intensity levels are high or experienced for significant periods of time, then the shadow flicker may cause a nuisance.

It has been scientifically established that frequencies of light flicker above 2.5 hertz may cause disturbance and nuisance to people. This was established for both the general population and the 2% who suffer from epilepsy. Of those that suffer epilepsy, 5% have exhibited an adverse reaction to flicker effects above 2.5 to 3 hertz.

The rotational speed of the SUZLON S88 turbine is 15.79 rpm at rated power resulting in a flicker frequency of approximately 0.6-1.0 Hertz which is significantly lower than that considered to be the cause of nuisance or disturbance as described above. Although an impact cannot be neglected it is considered to be less severe than that for higher flicker frequencies and more generally related to receptor's comfort. To minimize the potential impact from Shadow Flicker, sufficient distance between houses (having large windows and sides facing the turbines without screening through vegetation) and wind turbines has been considered in the design.

There is only one residence not participating in the project and potentially experiencing flickering shadows for a maximum of 21 hours per year. This property is surrounded by trees masking any shadow generated by turbines and therefore no impact from shadow flicker is expected. No consideration of screening due to vegetation or structures is considered in the calculation model and such features are in reality, likely to further reduce any shadow flicker impact. The affected residence is the residence proposed to be leased for the life of the project. Therefore, the potential for shadow flicker associated with the proposal is considered negligible. A copy of the Shadow Flicker Study is contained in Appendix C.

5.2.8 Conclusion

The Visual Impact Assessment concludes that the turbines will impact the scenic quality of the area, though the perception of the impact will vary according to each individual's perception of wind farms and their attitude towards renewable energy production. The landscape cultural values, including the social, indigenous, artistic and environmental values have been reviewed as part of the Visual Impact Assessment to provide a more balanced appraisal of the existing landscape value. The existing landscape character incorporates built elements into the landscape including infrastructure such as the Transgrid 500Kv powerline and other electrical powerlines which combined with the landscape modification, as a result of agricultural activities, lessens the impact of the wind farm.

It should be noted that a high visual impact does not necessarily equate with a reduction in scenic quality. The turbines have been located so as to provide a balance between the community needs and perceptions, the environmental issues and energy output. The wind farm location is not within the main visual catchment of Black Springs or any other residential area. The site has a relatively small immediate visual catchment, though some residences within this catchment will be impacted visually by the proposal. Mitigation measures such as plant screening are possible for those residences most impacted by the proposal.

When assessing the visual impact of a wind farm the preponderance of the environmental benefits must also be included in the assessment. The visual and environmental impact of a wind farm is considerably lower than impacts associated with other traditional energy production facilities, such as coal-fired power stations. Therefore, even though the wind farm will impact the visual catchment the environmental benefits associated with renewable energy also provide significant remuneration and the impacts in this circumstance can be mitigated to a level where the environmental benefit outweighs the potential visual impact.

5.2.9 Environmental Impact Summary: Landscape and Visual Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Landscape & visual		X		X	X	X	X	

Environmental Issue				Construction	Operation	Decommissioning
Landscape and visual				-1	-2	+1
Key						
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0
Minor negative impact	-1	Major negative impact	-2			

Impact	Mitigation measures	Management option	Monitoring required
Visual impact from construction and on-going operation of turbines on adjacent residents	• plant screening for those residences most impacted by the proposal; • reducing turbine numbers from 33 to 9; • increasing turbine size to further reduce turbine numbers while balancing energy generation and associated benefits; • locating powerlines and cabling underground to remove visual clutter and allow uninterrupted farm activities across the remaining areas of the subject properties; • use of muted colours for turbines to reduce the visual contrast against the background.	Address via Environmental Management Plan	Actions implemented via project officer during construction activities
Visual impact from construction and on-going operation of turbines on driver distraction	• warning signs to forewarn approaching motorists of visual distraction; • development of a viewing area and educational signage to create a safe viewing location.	Address via Environmental Management Plan	Actions implemented via project officer during construction activities

5.3 Noise issues

5.3.1 Turbine noise issues

The most noticeable sound produced by a wind turbine can be described as the periodic “swish swish” of the blades cutting through the air. Although the blades continuously create this noise while rotating there is a pressure change as the blade passes the tower and an intermittent “swish-swish” sound is propagated. This sound is not mechanical and does not generally have a tonal nature but is rather a “white” noise and therefore decays more rapidly with distance. Noise is described as “white” noise when it does not have a specific tonality and frequency spectrum but ranges across a large frequency band.

The noise output of a turbine increases with wind speed however the background sound pressure level, which has the effect of masking the noise produced by the turbine, also increases. The assessment of noise from wind farms considers the variation of noise output with change in wind. As a reference the sound power level of a wind turbine at a wind speed of 8 m/s is often used in the industry as this is about the level at which the sound of a wind turbine is most noticeable.

The guidelines used for the assessment are the South Australian Environmental Protection Agency (SA EPA) Environmental Noise Guideline: Wind Farms (SA EPA Guidelines). This standard provides guidance in monitoring, predicting, and assessing noise from wind farm developments. It sets a noise limit for residences and sensitive locations that are not financially involved in the project at greater than 35 dB(A) or 5 dB(A) above background noise. Note that the Director General’s Requirements for the EIS also request this study to be performed in accordance with the NSW Industrial Noise Policy, however this Policy states that it is not applicable to wind farms, hence it was not considered relevant to this study. The SA EPA Guidelines have been adopted by the NSW Government as assessment guidelines for wind farm noise.

The “Daisybank” and the “Acqualoria” Residence are involved in the proposed development and are hence considered as “non-relevant residences” since there is scope in the SA EPA Guidelines for agreements regarding the noise level at such residences to be made between the developer and the landowner as long as the maximum noise levels in such agreements are still considered reasonable. The “Miller” residence (owned by Forestry Commission) is also considered as non-relevant as the Forestry Commission has indicated that higher noise limits will be accepted. A noise agreement has been made between the owners of these residences and the proponent. A copy of the noise agreements is contained in Appendix D - Noise Assessment.

For the assessment, conservative estimates of the variation in background noise level with change in wind speed, based on local measurement, have been used to determine the appropriate adjusted noise limit at residences. The results of the predictive calculations indicate that all the relevant residents in the immediate vicinity of the Black Springs Wind Farm generally comply with the base 35 dB(A) or background adjusted limits of the SA EPA Guidelines, with a couple of small exceedances. The small exceedance of maximum 2.3 dB(A) in one residence (Kringas Kalgoorrlie Hall) and 1.6 dB(A) in another residence (Winton Park) is minimal considering the model accuracy of 2 dB(A), the accuracy of the equipment used for background noise measurements and the fact that 2 dB(A) difference is hardly recognisable. House 31 (Winton Park) is surrounded by trees and shelter belts to the west of the house and therefore some masking is expected which would reduce the noise level generated by the wind farm to acceptable noise limits at this residence. It should be noted that guaranteed sound emission levels are usually well above the actual sound emissions of such turbines and therefore adding conservativeness to the model. As a result it is expected that actual sound pressure levels during the operation of the wind farm will lower than the calculated levels.

In the case where a significant level of annoyance or disturbance due to wind farm noise is experienced by a resident, and the limits presented by the SA EPA Guidelines are found to be exceeded during operation of the wind farm, mitigation measures should be investigated. Appropriate mitigation measure would be:

- Installation of double-glazing for windows facing the wind farm
- Change of blade pitch to reduce noise-emissions for specific directional sectors (wind sector management). This should only be used in exceptional circumstances when other measures to not bring the desired effect.

A copy of the Noise Assessment is contained in Appendix D.

5.3.2 Construction noise issues

Construction work noise is to be carried out so that no intrusive or offensive impacts from the noise are caused to the surrounding area. The operating noise level of machinery, plant and equipment should comply with the NSW EPA Noise Control Manual or equivalent. The hours of operation for construction will be in accordance with the Oberon Council and Department of Planning guidelines and industry standards. Additional noise 'best management practices' for construction activities listed in the NSW EPA *Noise Guide for Local Councils* that can be implemented during the construction of the development include:

- schedule noisy activities to a suitable time to avoid sensitive times of the day for adjoining development;
- relocate the noise source away from receivers or behind existing structures that can serve as a barrier;
- conduct regular maintenance of equipment to ensure they work efficiently and minimise noise;
- change the orientation of equipment away from receivers;
- adopt 'quiet' work practices, such as turning off truck engines rather than idling for long periods;
- informing neighbouring properties of the proposed noise activities and duration;
- educating staff and contractors about noise and quiet work practices.

5.3.3 Environmental Impact Summary: Noise Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Noise		X		X	X	X	X	

Environmental Issue				Construction	Operation	Decommissioning
Noise				-1	-1	-1
Key						
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0
Minor negative impact	-1	Major negative impact	-2			

Impact	Mitigation measures	Management option	Monitoring required
Noise emissions from construction machinery	• Ensure machinery is adequately serviced to ensure noise efficient operation; • Minimise use of engine braking • Schedule noisy activities to a suitable time to avoid sensitive times of the day for adjoining development; • Relocate the noise source away from receivers or behind existing structures that can serve as a barrier; • Change the orientation of equipment away from receivers; • Adopt 'quiet' work practices, such as turning off truck engines rather than idling for long periods; • Informing neighbouring properties of the proposed noise activities and duration; • Educating staff and contractors about noise and quiet work practices.	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities
Noise emissions from turbines	• Lease affected property for the life of the project • Installation of double glazed windows or change in blade pitch		Investigate any noise complaints should they arise and develop appropriate mitigation measures

5.4 Air quality issues

Once constructed the wind farm will not cause or be affected by any air emissions. Air pollution control measures will need to be implemented to control typical pollutants emitted during the construction phase. The potential air quality issues associated with construction activities include dust related to earthworks, exhaust emissions from diesel powered excavation equipment, emissions from pavement laying operations and vehicle exhaust from construction vehicles. The site specific Construction Environmental Management Plan prepared by the contractor before the commencement of construction works should include a section addressing mitigation measure to minimise construction air pollution.

5.4.1 Environmental Impact Summary: Air Quality Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Air quality	X		X			X	X	

Environmental Issue				Construction	Operation	Decommissioning
Air quality				0	+2	0
Key						
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0
Minor negative impact	-1	Major negative impact	-2			

Impact	Mitigation measures	Management option	Monitoring required
Exhaust emissions from machinery	• Ensure machinery is adequately serviced to ensure efficient operation; • Turn off engines rather than idle for long periods.	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities
Dust from construction activities	• Minimising the surface area disturbed by excavation, stockpiling and/or filling locations where practical; • Confining vehicle movements to paved roads or available hard stand areas, where practical; • The use of a water cart, as appropriate, to eliminate wind blown dust; • Use of sprays or sprinklers on stockpiles or loads to lightly condition the material; • Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; • Covering stockpiles or loads with polythene or geotextile membranes; • Restriction of stockpile heights to 2 m above surrounding site level; • Ceasing works during periods of inclement weather such as high winds or heavy rain.	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities

5.5 Soil, drainage and geological issues

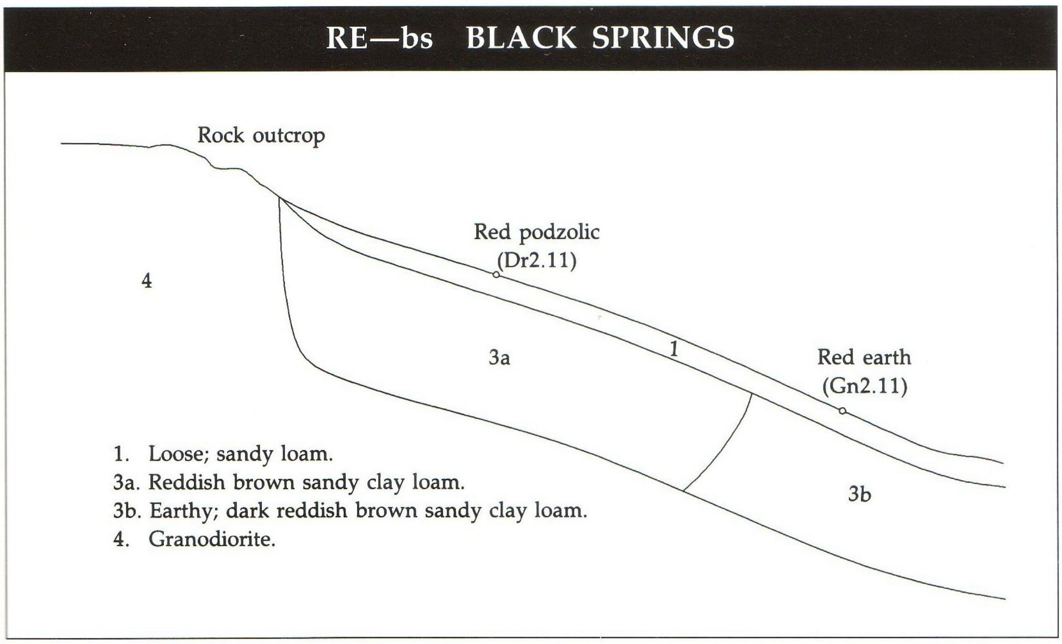
The Black Springs Soil Landscape is described in the *Soil Landscapes of Bathurst 1:250 000 Sheet* (Kovac *et al* 1990) as undulating hills, ranging in elevation from 960 – 1223m with slopes from 5-10% and from 1300 – 2500m in length with dominate soils comprising red earths with red podsolic soils on the lower slopes. Figure 6 illustrates a typical cross section of the Black Springs landform. The local relief ranges between 120 – 150m. Kovac *et al* (1990) shows two main soil landscapes as occurring within the study area. These are Oberon Soil Landscape and Porters Retreat Soil Landscape (from the Daisybank trig hill to the northern boundary). Figure 7 shows the soil landscape classification of the Black Springs area and the subject site.

The site soil classifications include:

- Porter's Retreat Krasnozems: Porters Retreat Landscape consists of krazonems on mid-upper slopes and chocolate soils on midslopes grading into red podzolics and yellow solodic soils on lower slopes.

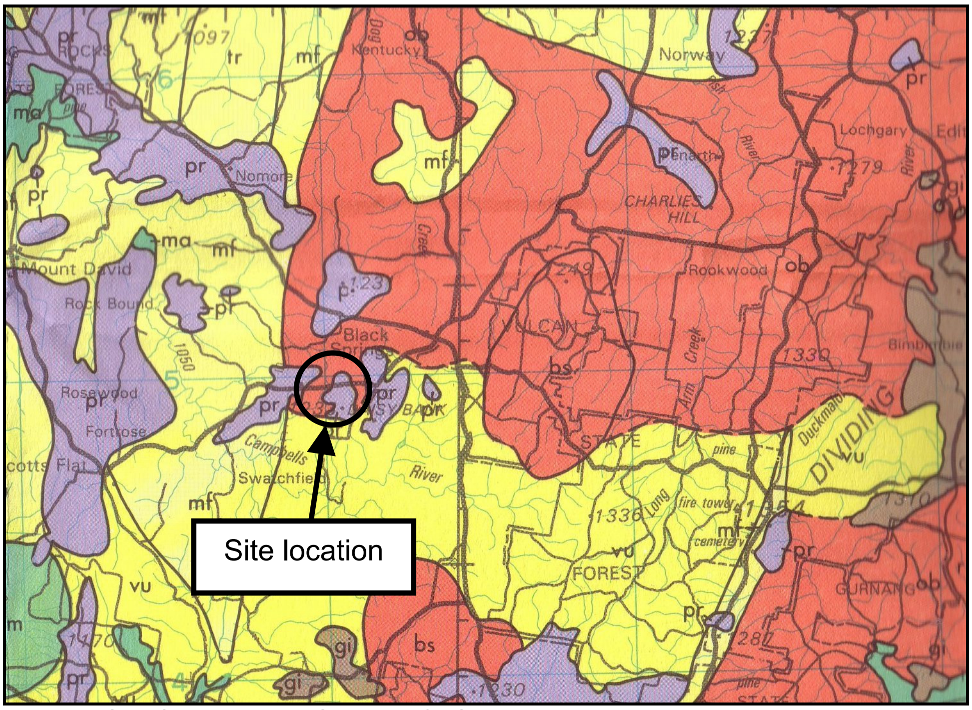
- Oberon Red Earths: The Oberon Soil Landscape consists predominantly of Red earths on mid-upper slopes and Yellow podzolics / Yellow earths on mid-lower slopes.

Figure 6: Black Springs landform cross section.



(source: Kovac *et al* 1990)

Figure 7: Extract from the Bathurst Soil Landscape Series Sheet SI 55-8 showing the soil classifications for Black Springs and the surrounding area.



(source: Soil Conservation Service of NSW)

A third soil landscape group, the Vulcan Soil Landscape is located immediately to the south of the site. The Vulcan Soil Landscape is located to the south of Daisybank and is dominated by yellow earths on mid-upper slopes and yellow soloths in drainage depressions.

The soil characteristics associated with the Black Springs Soil Landscape are detailed in Table 6.

Table 6: Black Springs Soil Landscape characteristics.

Black Springs Soil Landscape		
	Red earths	**Red podsolic soils**
Dominance	Common	Common
Landform element	Lower slope	Upper slope
Surface condition	Loose	Loose
Drainage	Well drained	Well drained
Soil permeability	Moderately permeable	Moderately permeable
Water Depth	+ 150cm	+ 80cm
Available water-holding depth	Moderate	Moderate

Black Springs Soil Landscape		
Depth to bedrock	+ 150cm	+ 80cm
Flood hazard	Nil	Nil
pH (topsoil)	5.5	6.0
Fertility (chemical)	Low	Low
Known nutrient deficiencies	N, P	N, P
Soil salinity	Low	Low
Erodibility (topsoil)	Low	Low
Erodibility (subsoil)	Low	Low
Structural degradation hazard	High	High
Shrink-swell potential	Low	Low to moderate
Mass movement hazard	Nil	Nil
Soil erosion	Gullying <1.5m when disturbed	Gullying <1.5m when disturbed

(source: Kovac *et al* 1990)

Geological investigations by ERM indicated that the geological structure of the region is part of the Lachlan Fold Belt, with the sites underlying geology consisting of two sandstone, siltstone and volcanic variants of the Rockley Formation (part of the Cabonne group) and a basaltic unit (Cainozoic Unit). The Geological unit is the Black Springs and Isabella Granodiorite, with the parent rock being granodiorite.

ERM investigations stated that each of the soils are considered stable from erosion and none are characterised as having a mass movement hazard.

Drainage lines range between 300 – 1000m apart. As shown in Table 7, the site soils are well drained and moderately permeable. The scale of soil disturbance is restricted to access tracks, turbine construction areas and the facilities compound. Drainage impacts from works in these areas will be mitigated through the implementation of the erosion and sediment control measures that will be incorporated into the CEMP. Incorporating standard erosion and sediment control practices during construction and until the sites are rehabilitated should ensure that drainage and erosion impacts on the surrounding environment from the wind farm are mitigated to a suitable standard.

5.5.1 Environmental Impact Summary: Soils, Drainage and Geological Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Soil, drainage & geology		X			X		X	

Environmental Issue				Construction	Operation	Decommissioning
Soil, drainage and geology				-1	0	-1
Key						
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0
Minor negative impact	-1	Major negative impact	-2			

Impact	Mitigation measures	Management option	Monitoring required
On-site erosion from construction operations	• Prepare an Erosion & Sediment Control Plan for all activities; • Exposing the smallest possible area of land for the shortest possible time; • Saving topsoil for reuse; • Controlling runoff onto, through and from the site; • Using erosion measures to prevent on-site damage; • Using sediment control measures to prevent off-site damage; • Rehabilitating disturbed areas quickly; and • Maintaining erosion and sediment control measures.	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities

5.6 *Flora and Fauna Issues*

Harper Somers O'Sullivan undertook a Flora and Fauna Assessment for the BSWF. The report has been structured and conducted to fulfil the requirements of the *Environmental Planning and Assessment Act 1979*, *Threatened Species Conservation Act 1995* (TSC Act) and the *Fisheries Management Act 1994*. Assessment of the site under the requirements of State Environmental Planning Policy No. 44 (SEPP 44) – 'Koala Habitat Protection' is also included. Additionally, consideration of the proposal has been undertaken in relation to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Given the size and scale of the project, the ecological impacts of the proposal are expected to be comparatively minimal. This is due to the following factors:

- Wind turbines are a non-polluting renewable energy source and reduce greenhouse gas emissions from other sources of power generation by significantly displacing generation from coal and gas fired power plants (thereby addressing the problem of climate change).

- The area is predominantly cleared of native vegetation with the majority of properties used for cattle, sheep and horse grazing.

- Design phase siting of turbines and associated infrastructure away from vegetated areas.

- There will be minimal removal of trees (if any) and few or no impacts to remnant native vegetation.

- The area does not occur as part of any significant habitat resource for threatened flora and fauna species.

- No significant bird / bat migration corridors were identified or considered likely to occur within the site or within the immediate locality.

- Implementation of a number of the report recommendations.

Application of Section 5A of the EPA Act indicated that no significant impacts to threatened species or endangered ecological communities are likely as a consequence of the proposal. Likewise, no significant impacts are expected to threatened flora and fauna species listed under the *Fisheries Management Act 1997* (FM Act).

No significant impacts are expected to any matters of National Environmental Significance (NES), as listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is considered that no further assessment / approval is required under the EPBC Act.

As a positive environmental consequence, the project addresses (in-part) the key threatening processes of “human-caused climate change” (as listed under the TSC Act), and “loss of climatic habitat caused by anthropogenic emissions of greenhouse gases” (as listed under the EPBC Act).

Some minor impacts to birds and bats may be expected due to turbine collisions. These are likely to be in line with stated AusWEA (2004) collision rates of several individuals per turbine per year. Some minor changes to the local distribution and abundance of locally occurring common species may also be expected as a consequence of the ongoing operation of the turbines. However, these impacts are not expected to be significant with few or no impacts on population(s) sizes or surrounding habitats. Sufficient baseline data has been collected and presented herein from which a post-construction monitoring program can be developed.

Whilst some minor impacts to individual birds and bats may be expected as a consequence of the project, these impacts should be viewed in light of the growing body of scientific evidence which highlights the potentially drastic environmental consequences (including loss of species and ecosystems) from a continued dependence on traditional energy sources that produce greenhouse gas emissions, such as coal-fired power stations (eg. AGO 2003). Wind energy’s ability to generate electricity without many of the environmental impacts associated with other energy sources (eg. air and water pollution and greenhouse gas emissions) can significantly benefit birds, bats, and many other flora and fauna species (NWCC 2004), including those species / communities on the South Eastern Highlands bioregion that are currently threatened by climate change.

From the data presented in the report, there appears to be no significant ecological constraints to the development of wind farms within this locality of the South Eastern Highlands. This is based on the premise that appropriate baseline studies are undertaken, potential ecological impacts are minimised through appropriate siting of turbines and associated infrastructure, and further mitigation measures are dealt within the Environmental / Construction Management Plans, as demonstrated herein.

The following recommendations should be adhered to / implemented to minimise and monitor any likely and potential ecological impacts of the proposal:

- All vegetation removal should be restricted to the actual development footprint. Careful micro-siting of roads and cabling should be undertaken to minimise potential impacts.
- Access roads and cabling should be aligned along existing tracks wherever possible to minimise vegetation removal, number of easements, and the spread of weeds.
- Powerlines between turbines should be constructed underground and along road infrastructure to minimise number of easements through the property and further incidents of potential avian collisions (including the creation of perching locations in the vicinity of turbines).
- A post-construction bird and bat monitoring program, such as that described by NWCC (1999) should be established to determine the impacts of the project on bird / bat populations. Such data may prove invaluable for assessing the impacts of future wind farms within the South Eastern Highlands and elsewhere within Australia.
- Constructional and operational phases of the development should be inline with the Best Practice Guidelines for Wind Energy Projects (AusWEA 2002), including the implementation of an Environmental Management Plan (EMP) and a Construction Environmental Management Plan (CEMP).

A copy of the Flora and Fauna Assessment is contained in Appendix E.

5.6.1 Environmental Impact Summary: Flora and Fauna Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Flora and Fauna		X	X	X	X		X	

Environmental Issue	Construction	Operation	Decommissioning
Flora and Fauna	-1	-1	+1
Key			

Major positive impact	+2	Minor positive impact	+1	No appreciable impact	0

Minor negative impact	-1	Major negative impact	-2		

Impact	Mitigation measures	Management option	Monitoring required
Potential for bird and bat impacts from blades during turbine operation		Address via Environmental Management Plan	On-going monitoring for bird and bat impacts during the operation of the wind farm
Vegetation removal & spread of weeds	• Restrict clearing to only areas required for turbine and facility structures. • Access roads and cabling should be aligned along existing tracks wherever possible to minimise vegetation removal • Sharing of easements in common trench for power and turbine control cabling	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities

5.7 Heritage issues

Environmental Resource Management Australia (ERM) has prepared a Draft Heritage Assessment for the BSWF proposal based on the projects original larger proposal. The assessment area incorporates the original proposal area that consisted of 33 wind turbines and associated infrastructure. This assessment has been used as it adequately covers the turbine locations. A copy of the Draft ERM Heritage Assessment is contained in Appendix F.

5.7.1 Aboriginal

5.7.1.1 Background

As part of the heritage investigations for the wider BSWF project consultation was held with the Pejar Local Aboriginal Land Council (LALC). Members of the Pejar LALC were also present during field investigations.

Background research did not reveal any previously recorded Aboriginal sites within the study area. A search of the NPWS Aboriginal Heritage Information Management System (AHIMS) within 5km of the site has shown that 5 Aboriginal artefact scatters are recorded near the proposed wind farm, though none are located within the site itself. Six Aboriginal sites were identified during fieldwork.

The project layout changed in June 2006, due to the sale of Winton Park. This resulted in only one of the turbines being located in an area away from the transects undertaken during the heritage field investigations. The revised turbine site not covered by the heritage transects is located slightly down hill from the main ridgeline on the 'Acqualoria' property, on land that has been highly modified over many decades for agricultural purposes. Consequently, implementation of the recommendations of the heritage assessment will ensure that should any artefacts be found on site during the construction, appropriate measures will be employed to ensure they are protected.

5.7.1.2 Summary & Recommendations

A summary of the recommendations includes:

- The proposed BSWF is unlikely to impact on items of Aboriginal cultural heritage as investigations have shown that the frequency of artefact occurrence is likely to be very low.

- The turbines will be located on ridge crests that are exposed to the elements and will not affect sensitive landforms.

- It is recommended that access tracks be constructed following the same path as the cable trenching to avoid unnecessary impacts on any sensitive landforms.

- A qualified archaeologist be on-site for clearing of vegetation for the construction of access tracks. All monitoring activities will be undertaken under a section 87 permit.

- In the event that a site is identified during construction, work will cease immediately, the Pejar Local Aboriginal Land Council will be notified and an application made under section 90 of the National Parks & Wildlife Act will be made to remove or destroy as appropriate.

5.7.2 Non-Aboriginal

A desk top assessment identified one historical heritage item that may be located within the study area, the “explored railway line”. The route was one of several explored during the construction of the Tarana – Oberon branch line. Field investigations by ERM failed to find any evidence of this line ever being constructed.

Two other heritage items were identified as listed in the Oberon LEP, National Trust of Australia Jubilee Register and the Register of the National Estate. These consisted of the Catholic Cemetery at Black Springs and a lone grave on Springvale, Black Springs, Rockley Road.

The impact of the turbines on the cultural landscape of the district has been considered, by placing the turbines in locations that maximise use of the wind energy, though still at a significant distance from any major residential/cultural area. Careful siting of the wind farm assists in limiting the impact on the cultural landscape.

The predominantly rural character of the area generally consists of cleared, undulating countryside and grazing land, fenced into paddocks for stock management, with limited numbers of built structures but includes large power transmission lines. The addition of the wind turbines will impact the small immediate visual catchment, but the wider Oberon shire will be largely unaffected.

5.7.3 Environmental Impact Summary: Heritage Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Heritage								X

Environmental Issue				Construction	Operation	Decommissioning
Heritage				0	0	0
Key						
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0
Minor negative impact	-1	Major negative impact	-2			

Impact	Mitigation measures	Management option	Monitoring required
Potential for impact on unidentified items of Aboriginal cultural heritage	• Locate turbines on ridge crests that are exposed to the elements and will not affect sensitive landforms. • Access tracks should be constructed following the same path as the cable trenching to avoid unnecessary impacts on any sensitive landforms. • A qualified archaeologist should be on-site for clearing of vegetation for the construction of access tracks. All monitoring activities will be undertaken under a section 87 permit. • In the event that a site is identified during construction, work will cease immediately, the Pejar Local Aboriginal Land Council will be notified and an application made under section 90 of the National Parks & Wildlife Act submitted to salvage or destroy artefacts as appropriate.	Address via Construction Environmental Management Plan	Actions controlled via environmental officer during construction activities to ensure archaeologist is on site during clearing

5.8 Infrastructure and Utilities issues

5.8.1 Transmission network and grid connection

The wind farm will be located adjacent to Transgrid's 500kV transmission network and Country Energy's 66kV transmission line. The wind farm will connect into the grid via a substation transformer constructed by the Wind Corporation Australia and located in the wind farm facilities compound. The transformer will allow the electricity generated by the turbines to be stepped up in voltage to be suitable for connection to the 66kV transmission line. The only augmentation required is the connection between the transformer and the 66kV transmission line, which will be undertaken at the expense of the Wind Corporation Australia. A Grid Connection Agreement with Country Energy and the Wind Corporation Australia will detail the technical requirements for the connection of the BSWF to Country Energy's transmission network.

The turbines will be connected to the transformer and control station via 33kV underground cabling located underneath the access tracks where possible. The underground electrical cabling will share a common trench with the turbine control cabling, therefore reducing the number of easements and reducing vegetation and soil disturbance.

5.8.2 Electromagnetic interference issues

Electromagnetic Interference (EMI) is a term used to describe the potential impact of rotating metallic, and therefore conductible surfaces and structures, on microwave, radio and television signals passing through the area in question. Direct point to point links between transmitters sending on a high frequency (Microwave) may also be affected by the rotating blades and metallic surfaces of the wind turbines. In a number of existing wind farm projects it has been proven that the effect, if any, is minimal unless a turbine stands directly in the path of a Microwave link. VHF/UHF Signals are normally not disturbed by wind turbines as the metallic surfaces are very small compared to the size of the signal beam.

A detailed analysis of the transmitter/receiver towers in the area around the Black Springs Wind Farm Project has been undertaken and there is only one signal from Black Springs to the Burraga Fire Tower which passes through the site. This signal is a VHF Signal with between 450 MHz and 460 MHz and although two turbines are very near to the path of the signal, the effect is assumed to be minimal as this frequency band is not very susceptible to the rotating frequencies of the rotor blades (15 rpm = 0.8 Hz). In addition the rotor blades are made out of glass fibre and only contain a low diameter lightning rod. Therefore the effect on any signals passing the site is assumed to be negligible. In case that the operating wind farm actually causes an unacceptable effect, mitigating measures should be undertaken such as installing repeaters at the turbines in question. The addition of repeater antennas will not add additional height to the turbine as the repeaters would be attached to the tower and not the nacelle. The turbine towers are well outside the signal path impact zone therefore the towers to not represent an obstacle.

A copy of the Electromagnetic Interference Study is contained in Appendix G.

5.8.3 Aviation issues

Under Civil Aviation Safety Regulations Civil Aviation Authority (CASA) Part 139, the Civil Aviation Authority must be notified:

- *By a person who proposes to construct a building or structure the top of which will be 100 metres or more above ground level.*

Additionally, CASA must be notified if the wind farm is within the vicinity of an aerodrome (within 15km). No aerodrome has been identified within 15km of the wind farm, however two private landing strips are located in the area. Bathurst Airport is located 70km to the northwest of the site.

CASA has released a draft Advisory Circular (AC 139-18(0)) – Obstacle Marking and Lighting of Wind Farms (Dec 05). The draft circular outlines when CASA must be notified in regard to a wind farm proposal and defines the height of a wind turbine as the maximum height reached by the tip of the blade. The turbine blade height for this proposal is 124m above ground level. Notification to CASA is required in this circumstance and the wind farm should also be registered on the national database of tall structures, maintained by the Royal Australian Air Force.

CASA has been notified of the proposal through the CASA NSW Country Field Office at Canberra. CASA are currently determining whether the turbines will be a hazardous object to aircraft safety and whether obstacle lighting is necessary. Should obstacle lighting be required, it will be designed and constructed in accordance with the provisions listed in the draft circular or by CASA.

5.8.4 Transport and Roads

The Transport Study has been undertaken to investigate the impact of the transport and traffic related activities associated with the development. The study includes the transport of people, equipment, and materials to site during the construction period as well as the development of roads on the wind farm site.

Turbine components will be transported from either Melbourne, or Port Botany or Port Kembla by road in a westerly direction across the Blue Mountains to the site at Black Springs. The Study illustrates the alternate routes to the site. At different stages through the construction of the wind farm there will be oversize and over-mass loads transported on public roads. There will be an increase in traffic on public roads in the local area and immediate vicinity of the site associated with the wind farm construction. During construction there will be additional gravel access roads constructed on the wind farm site allowing all weather access for road vehicles to each of the turbine locations and the proposed substation. The issues associated with these different activities include:

1. Suitability of existing roads and structures

2. Disturbance to community, other road users and traffic safety

3. Impact of new road construction on site.

For access and delivery to and from the site it is proposed that road access will be created via Campbells River Rd. It is anticipates that all turbine components arrive within a 1-3 week period thus creating disturbance only for a very short time.

The impacts of wind farm construction traffic are going to be greatest in the immediate vicinity of the site. Notification of the local community, appropriate warning signs and traffic control measures will minimize any safety risk. Any daytime noise disturbance or delays in traffic are considered to be a relatively small impact considering the local population and the temporary nature of the traffic. Close consultation with local councils and the implementation of mitigation measures will ensure a minimal impact to both the local community and those traveling through the area.

Transport of turbine components to site will require over size and over mass haulage and it is predicted this will occur at an average of one additional road movement per day. The alternate routes have been identified and are considered feasible however consideration of timing to avoid peak traffic times as well as an awareness of safety issues will be important. It is recommended a Traffic Management Plan be prepared by experienced contractors, liaison with the permitting sections of both state road departments and notification of local shire councils on route will ensure that the overall impact and disturbance to infrastructure and other road users is minimal.

The impact of traffic on the wind farm site is largely associated with the construction of gravel roads and hardstands. Independent flora, fauna and archaeological studies have been completed and have concluded that the impacts are minimal and adequately mitigated. Through the implementation of an on site construction environmental management plan and consultation with landowners other potential impacts such as erosion, disturbance of waterways, weed propagation and stock control can be minimized.

Considering the current road usage near the Black Springs site and the expected increase in traffic, particularly during the construction phase, the Study concludes that the impacts from traffic and traffic related activities due to the BSWF are not significant and where there are impacts identified these can be mitigated with good management and the implementation of a Traffic Management Plan by an experienced contractor during construction.

A copy of the Transport Study is contained in Appendix A.

5.8.5 Waste Management

5.8.5.1 Construction Waste Management

During the construction phase a supervisor (Waste Management Officer) should be appointed to oversee the waste management of materials. The waste minimization strategy should follow the waste minimization hierarchy of Avoid (waste at source), Reuse (materials and components), Recycle (materials into new products) and Dispose (in a responsible manner).

Table 7 lists the Waste Minimization Plan for the construction phase of the development. As listed in the *Waste Planning Guide for Development Application* published NSW Waste Boards, the Waste Management Officer should:

- identify waste material before work commences;
- consider site offices, sheds and day to day waste produced by staff and sub-contractors;

- involve waste contractors to ensure records are kept and waste targets are met;
- develop a disposal procedure:
- specify the number and type of waste containers, allowing for different stages in the project;
- organize signage and location of bins, skips and stockpiles;
- designate areas for reusables, returnables and recyclables;
- keep separated waste material clean; and
- provide training and education to ensure waste management objectives are met.
- arrange for waste pickups as needed; and
- maintain a clean waste stream and ensure new sub-contractors are aware of waste minimization strategy.

Table 7: Construction Phase Waste Minimisation Strategy

Construction Stage				
Materials on site		**Destination**		
		Reuse & Recycle		**Disposal**
Type of Material	**Estimated Volume**	**On-site**	**Off-site**	
Excavation Material	N/A	Excavation material will be re-used onsite to obtain level areas around each turbine	Nil	If found to be contaminated, details will be provided on remediation action
Concrete	5 m^3	Crush and use to stabilise access tracks or site compound	Nil	Nil
Timber -	5 m^3	Nil	Re-use for form work for concrete pours	Nil
Metals -	3 m^3	Nil	Recycled at Metal Recyclers such as Bathurst Waste Management Centre	Nil
Reo				
Structural Steel				
Other -				

Construction Stage				
Miscellaneous	5 m^3	Nil	Recycled at Metal Recyclers such as Bathurst Waste Management Centre if applicable	Dispose at Oberon or Black Springs Waste Depot
Liquid Waste – Turbine transmission and hydraulic oil	20 Lt per turbine			Dispose at Oberon or Black Springs Waste Depot

5.8.5.2 Waste Transfer Locations

The Oberon Waste Depot is located 5km from Oberon on the Lowes Mount Road. The Oberon Waste Depot is open from 8am to 10am and 3pm to 5pm weekdays, and 1pm to 5pm on weekends. The Black Springs Waste Depot is located on Dog Rocks Road, west of the Black Springs township. The Black Springs Waste Depot is open on Thursdays and Saturdays from 3pm until 5pm. Closed all Public Holidays. The Bathurst Waste Management Centre is located at College Road, Bathurst and is open 7 days from 7:30am to 5pm.

A plan has been made for the use of premises for waste and recycling generation as evident in Table 8 provided below.

Table 8: Use of premises - waste and recycling generation and destination.

Use Of Premises			
Type of Waste Generated	**Expected Maximum Volume per Week**	**Proposed on-site storage and Treatment Facilities**	**Destination**
Glass, aluminium & plastic (bottles)	10 Lt*	Recycling bin located in Facilities Building to be emptied daily into 240Lt MGB recycling bins located in the waste storage area.	Recycled by a private recycling agent
Paper/Cardboard	50 Lt *	Recycling bin located in Facilities Building to be emptied daily into 240Lt MGB recycling bins located in the waste storage area.	Recycled by a private recycling agent
Garbage - food wastes, plastic wrapping, unrecyclable retail waste etc.	50 Lt *	General waste bin, located in Facilities Building to be emptied daily into 240Lt MGB general waste bin located in the waste storage area.	To landfill by a private contractor to be determined by Management.
Liquid Waste – Turbine transmission and hydraulic oil	415 Lt** per turbine	Collect in oil receptacle and transfer off site	Dispose at Oberon or Black Springs Waste Depot

Note: *Recycling and Garbage rates used for calculations are based on 2 staff at a generation rate calculated over five days using a daily generation rate of:

- Glass, aluminium & plastic (bottles) 1 Lt/day/per person
- Paper/Cardboard 5 Lt/day/per person
- Garbage 5 Lt/day/per person

Please note that the Facilities Building is only expected to have personnel operate from the building one to two days per week on average.

Note: ** Turbine transmission oil waste is only relevant during scheduled maintenance operations. The amount of transmission oil for each turbine is approximately 415Lt. All maintenance will be condition based so oil will only be changed if oil samples indicate necessity, with major overhauls of the gearbox approximately every 60 months.

On-site Building Waste Management

STORAGE – SPACE AND LOCATION

- **Inside the Facilities Buildings**
  - Waste cupboards will be located in the space below the kitchen sink in kitchen area. This will hold one day's waste and enable the separation of garbage and recyclables into their respective receptacles.
  - Waste Bins will be used to collect general waste.
  - Recycling Bins will service the recycling needs of the building.
  - The standard operating procedures should include emptying of garbage bins at the end of each working day into Mobile Garbage Bins (MGB).
- **General Waste & Recycling Bins**
  - Two MGBs will be used to store general waste and recycling for collection. The MGBs will be located in a separate waste storage area and secured to prevent opening of bins by animals. The MGBs will be emptied by a private contractor at a schedule suitable for the amount of waste and recycling generated by the Facilities Building. The contract for collection is to be organised and managed by the Black Springs Wind Farm Management.

NOISE

The main source of noise associated with depositing of garbage and or recycling into bins would be the emptying of glass into bins. The noise generated from depositing waste and or recycling should be inconsequential due the amount of waste generated and the hours during which waste and recycling will be deposited. Reversing of collection vehicles may provide additional noise but is limited to the short period required to service the bins. No residential dwellings are located within 350m of the Facilities Building, therefore noise generated by waste management procedures should not result in any significant impact on the acoustic amenity of the area.

ODOUR/HYGIENE/VERMIN

Odour will be minimised through adequate ventilation of the waste storage area and regular washing of bins.

To maintain hygienic conditions, the waste storage area and bins should be washed and disinfected regularly.

Vermin should be prevented from accessing the waste storage bins. MGB should have a vermin proof locking mechanism. No bins should be left open and any spilled garbage should be cleaned up as soon as possible.

SECURITY AND SAFETY

Access to the MGB bins should be restricted for use of the Wind Farm personnel only via a locking mechanism on the bin lid. This design would ensure other parties do not fill the bins. The waste storage area should be well lit if necessary to allow use at night.

SIGNAGE AND EDUCATION

All garbage and recycling bins will be clearly labelled. Posters providing instructions on separating waste and how to use the waste facilities will be located prominently within the Facilities Building. Staff will be educated on the importance of separation of waste and recyclables and how these actions aid our environment.

5.8.5.3 On-going Management

It is possible that some future maintenance activities may result in waste generation. During activities where waste may be generated, the Project Control Officer or another nominated officer is to address objectives to minimise waste, increase and separate recycling plus establish and allocate responsibility for waste management issues.

5.8.6 Safety issues

Wind farm safety issues are predominantly related to turbine construction and maintenance. The AusWEA *Fact Sheet 11* states that over 20 years of electricity generation from more than 100,000 turbines worldwide, no member of the public has ever been injured during the operation of a wind farm.

Air safety is an important factor associated with wind farms. CASA has been notified regarding the BSWF and an assessment of air safety requirements has been undertaken. Land owners with airstrips within the vicinity of the BSWF should be notified regarding the development of the wind farm prior to construction.

Under icing conditions all exposed surfaces of the wind turbine can be liable to ice accretion. The exposed moving parts of the turbine rotor experience significantly heavier build-up of icing due to rime icing. Rime icing occurs when the turbine structure is at a sub-zero temperature and is subject to incident airflow with significant velocity and liquid water content (Morgan *et al*, 1998). Rotor blade ice then has to potential to dislodge and be cast some distance from the turbine as atmospheric conditions change. The heaviest ice build-up tends to occur at the tip of the blade due to the increased velocity of rotation. Rime build is quite hard and tends to remain attached to the rotor under significant flexure of the blades (Morgan *et al*, 1998). Morgan *et al* (1998) indicate that a typical scenario is that ice builds up on the rotor as well as the wind speed and direction sensors which are mounted on the nacelle. The ice results in a sensor malfunction which causes an automatic turbine shutdown. In most instances the turbine will only restart after the ice has thawed and the operator has reset the turbine sensors, however, it is also considered common practice to accelerate the thawing process by thawing the sensors and restarting the turbines with some ice still attached. This situation can lead to heavy ice shedding and the potential for ice fragments to travel some distance. Morgan *et al*, (1998) indicate that ice predominantly falls downward from the rotor plane, though the risk of ice landing at a specific location is found to reduce quite quickly when more than a few metres distance of the location from the turbine. Fragments of ice have been observed to have a mass in the range of less than 1kg (Morgan *et al*, 1998). To mitigate the risk of falling ice striking the public or operational staff the following measures will be implemented:

- The probability of a person being hit by falling ice can be reduced by preventing public access to close proximity to the turbines and restricting operational staff access during high risk periods.

- Restricting operation of turbines during periods of ice accretion.

- Erection of warning signs alerting anyone in the area of the risk.

- Educating the operational staff about the conditions likely to lead to ice accretion, the risk of ice falling from the rotor and the location of areas of risk.

During the construction of the turbines and associated infrastructure, normal construction safety issues will be applicable. A Construction Safety Management Plan should be prepared by the contractor prior to construction and outline safe work practices to mitigate construction safety issues. The Construction Safety Management Plan shall be incorporated into the Construction Environmental Management Plan.

Wind turbine occupational safety is incorporated into the design. The conical steel tower provides a safe and comfortable access to the nacelle for maintenance and repairs. Fall protection devices are fitted as standard safety measures for personnel climbing the internal ladder system to the nacelle, and the internal access provides protection for the worker from outside weather elements. Braking of the turbine is controlled by both an aerodynamic and mechanical braking system. Aerodynamic braking is the primary braking system, where the blades are rotated 90° along their longitudinal axis. Mechanical braking is used as a back up system and as a park brake during maintenance. The rotor can be locked in place with a pin once stopped to prevent any movement of the mechanical parts. As a safety precaution the turbines automatically shutdown at a threshold temperature of 155°C.

Fire extinguishers will be placed in the base of each tower and the nacelle as well as the sub-station, for use in fire suppression should the unlikely event of a fire occur within the turbine. In the event of a fire within the turbine, the local Fire Brigade Unit based at Oberon would respond with support from the Rural Fire Service if needed. Liaison with the Oberon Fire Station personnel will be undertaken prior to construction to educate local fire fighters about wind turbines and prepare a fire action plan.

5.8.7 Environmental Impact Summary: Infrastructure and Utilities Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Infrastructure and Utilities Issues	X	X	X		X	X	X	

Environmental Issue		Construction		Operation		Decommissioning	
Infrastructure and utilities		+2		+2		0	
Key							
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0	
Minor negative impact	-1	Major negative impact	-2				

Impact	Mitigation measures	Management option	Monitoring required
Potential interruption of the Black Springs to the Burraga Fire Tower VHF signal	• Place a collector / repeater station on the towers that impact the signal	Address via Environmental Management Plan	Check interruption during post construction monitoring of turbine operation
Potential for the turbines to be a hazardous object to aircraft safety	• Erect aircraft obstacle lighting in accordance with CASA's directions	Address following direction from CASA	
Blade ice injuring a person	• Restrict access to the turbines, • Erect warning signs, • Educate staff	Address via Environmental Management Plan	Operational staff to monitor during operations
Traffic delays during delivery and construction operations	• Notification of the local community, appropriate warning signs and traffic control will minimize any safety risk.	Address via Traffic Management Plan	Actions controlled via traffic officer during delivery and construction activities
Driver distraction during operation of wind farm	• Erection of warning signs and development of viewing area to allow interested drivers to safely stop and observe the turbines	Address via Environmental Management Plan	Liaise with Oberon Council through out operation of the wind farm for changes in traffic impacts
Generation of waste products	• prevention, • source reduction, • minimisation, • treatment, and • disposal (as a last resort).	Address via Waste Management Plan in Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities and on-going operations
Fire within the turbine	• Install fire extinguishers; • Liaise with local fire brigade	Address via Environmental Management Plan	Liaison with local fire brigade

5.9 Bushfire Issues

As part of the Director General Requirements the potential for the wind farm to start or influence the patterns of bushfires has been addressed. A Bushfire Risk Management Plan (BRMP) has been prepared in consultation with Terry O'Toole (NSW, RFS) and Ralph Tambasco (Oberon Council). Bushfire Risk Management involves identifying the risk posed by fire to assets and life and establishing management strategies to reduce the level of risk and offer an increased level of protection. The development of risk management strategies, in accordance with the appropriate legislation, policies and statutory documents, is a tool widely recognised as instrumental in the protection of life and property from the threats posed by bushfire.

The wind turbines are located well clear of any significant vegetation. The turbines will be earthed to prevent any arcing of electricity or surges resulting from lightning strikes. The risk of fire at wind farms, or the risk of fire damage to wind turbine generators, is very low, as a result of:

- the height of the wind turbine towers above the ground;
- the lack of vegetation around the base of turbine towers;
- the fact that high-voltage connections are underground;
- access tracks act as firebreaks and provide good fire fighting access
- lighting protection devices are installed on every wind turbine; and
- dedicated monitoring systems that detect temperature increases in the turbines and shut them down when the threshold temperatures are reached.

Strategies identified in the BRMP include management of the vegetation onsite, provision of adequate services such as access and water supply for use during a bushfire emergency. With the implementation of measures suggested in the BRMP the potential for the wind farm to start or influence the pattern of bushfires should be ameliorated.

A copy of the Bushfire Assessment is contained in Appendix H.

5.9.1 Environmental Impact Summary: Bushfire Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Bushfire		X		X	X		X	

Environmental Issue				Construction	Operation	Decommissioning	
Bushfire				0	0	0	
Key							
Major positive impact	+2	Minor positive impact	+1	No appreciable impact			0
Minor negative impact	-1	Major negative impact	-2				

Impact	Mitigation measures	Management option	Monitoring required
Start a bushfire or contribute to bushfire threats	• Avoid contact of hot exhaust systems with dry and flammable vegetation • No smoking during construction activities • Bushfire mitigation measured planned to respond to bushfire threats • All vehicles to carry emergency communication equipment. • All vehicles to carry fire extinguisher or fire fighting equipment. • A 20m Asset Protection Zone should be established around each turbine.	Address via Construction Environmental Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and on-going operations

5.10 Socio-Economic issues

A Socio-economic Impact Report for the original proposal of 33 turbines was prepared by ERM and details the consultation process during the period November 2004 – March 2005 and is contained in Appendix I. The report addresses the potential social and economic impacts of the proposed wind farm. Many of the issues examined were raised by the local community during consultation undertaken throughout the original Environmental Impact Assessment (EIA) process for the 33 turbine Black Springs Wind Farm. Other socio-economic issues have been identified by government agencies for consideration. The main issues identified related to property devaluation, visual impact and community identity and cohesion.

The project will have significant social and economic benefits for the local area and the wider community plus some associated negative impacts. The Oberon Council – Local Environmental Study contains a vision statement for Black Springs, developed through community consultation describing the future direction and opportunities for growth:

"To invigorate both the village of Black Springs and its surrounding areas, through the provision of additional employment opportunities, including tourism, housing options and support services, while still maintaining a rural village atmosphere".

The wind farm will result in a major investment in the area, which will require employing local labour and resources. During the construction period opportunities will exist for employment of local labour, though most of the technical roles will be filled by experienced personal from outside of the region. These personal will require accommodation and meals, supporting local businesses during the eight month construction period. Local sourcing of resources will be required for road and footing construction, therefore providing opportunities for plant operators, material suppliers and truck operators. On-going maintenance requirements would most likely need locally sourced resources in order to reduce transport costs. The indirect benefits from input into the local economy would extend beyond those listed here.

The wind farm will provide tourism opportunities as outlined in the vision statement for Black Springs. Tourism drawn by the attraction of viewing the wind farm also has flow on effects that extend to other ancillary service sectors such as accommodation, fuel suppliers and food outlets. The Australian Wind Energy Association (AusWEA) has produced series of fact sheets and publications about wind farms and their impacts and opportunities. *Fact Sheet 4 - Wind Farming and Tourism* states that hundreds of thousands of people visit wind farms within Australia each year. Tourists range from casual observers stopping at interpretative viewing locations to organised participants in organised tours. The 'green tourism' sector is a growing market in Australia as more people become aware of greenhouse gas issues and climate change concerns. These same issues and the development of the wind farm could provide educational opportunities for local schools, where students could visit the wind farm and see renewable energy production in action.

Wind farms provide interesting architectural elements within the landscape that are still fairly unique in most areas of Australia. Individual perception of the turbine architecture and its impact within the landscape often polarises a community's view of a wind farm, particularly during the pre-development phase. The community consultation undertaken for the initial larger wind farm proposal indicates that there is a potential for this to occur in Black Springs. During the construction period, there is the potential for some minor traffic delays because of oversized transport truck movements. Mitigation measures to ameliorate any traffic related impacts are detailed in the Traffic Assessment in Appendix A.

Consultation for this development was conducted by ERM in late 2004 during the preparation of an Environmental Impact Assessment for the earlier stage of the proposal, which incorporated the erection of 33 wind turbines over a larger site. The results of this consultation have been incorporated into this Environmental Assessment and a copy of the ERM Stakeholder and Community Consultation Report detailing the consultation process during the period November 2004 – March 2005 is contained in Appendix L. As part of the consultation process since March 2005, Black Springs Wind Farm Action Group were contacted to discuss the project and inform them of the changes to the project design. The group's representative declined the offer to discuss the proposal or review any documentation offered by HSO. The decision severely impeded the community consultation process. The group was advised that should they decide to review the proposal, Oberon Council would have a copy of the Preliminary Environmental Assessment and a copy is also available on the Department of Planning's website.

To assist in mitigating community polarisation WCA will actively pursue community investment opportunities, with the local school, tennis club and progress association, once the wind farm has been established. This would assist in demonstrating to the local community that WCA is genuinely interested in the ongoing wellbeing of their area and community while also providing an opportunity for WCA to contribute to the development of the local community.

5.10.1 Land values

Roger Lee Land Valuers were engaged to assess the potential impact the BSWF may have on surrounding property values. The accepted valuation method for the assessment of the impact of any particular activity on value of adjacent properties is the so called "Before and After" method in which an assessment of value is made by normal valuation processes of the market value of a subject site, i.e. the hypothetical price that a willing but not anxious purchaser and seller will agree upon when they are acting freely, carefully, and with complete knowledge of the situation – firstly before the event and secondly after the event. Because of the unique nature of wind farm developments the before and after method of valuation becomes less relevant in that:

- Wind farm developments are unique in nature and few are truly comparable in a valuation sense one with another; and

- There tends to be no recent sales evidence to support one view or another because often the rural properties involved do not change hands with a frequency, which would allow a reliable assessment to be made.

It therefore becomes an exercise in empirical and anecdotal evidence on what the impact on value to adjacent premises is likely to be of the development in a particular area.

The assessment reviewed empirical and anecdotal evidence and concludes that it is unlikely that in long-term there will be a negative impact on the market value of rural landholdings in the neighbourhood of the proposed BSWF development by virtue solely of the wind farm. A copy of the Property Values Assessment is contained in Appendix J. This is further supported by the recent sale of the 'Winton Park' property, which was an active landholder for the BSWF development. The property sold above market value, with the knowledge that the BSWF would be operating on land adjacent. Subsequently, 'Winton Park' is now no longer an active landholder in the BSWF, with the new owners deciding not to participate. Therefore, this sale provides strong evidence for the Black Springs area that land values adjacent to the wind farm development will not be negatively impacted. The Socio-economic Impact Report prepared by ERM also examines property devaluation concerns and outlines antic dotal evidence of property values surrounding the existing wind farms in NSW. The ERM findings support the Property Values Assessment findings that further monitoring is required due to the lack of sales evidence to support property devaluation. A copy of the Socio-economic Impact Report is contained in Appendix I

It is evident that Black Springs and Oberon shire would benefit both socially and economically from the development of BSWF. As with most wind farm developments, there will be positive and negative benefits, though it is considered that the positive socio-economic impacts in this circumstance out weigh the negative impacts.

5.10.2 Environmental Impact Summary: Social Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Social	X	X	X	X	X	X	X	

<table>
<tr><th colspan="3">Environmental Issue</th><th colspan="2">Construction</th><th>Operation</th><th colspan="2">Decommissioning</th></tr>
<tr><td colspan="3">Social</td><td colspan="2">-1</td><td>-1</td><td colspan="2">+2</td></tr>
<tr><th colspan="8">Key</th></tr>
<tr><td>Major positive impact</td><td>+2</td><td colspan="2">Minor positive impact</td><td>+1</td><td colspan="2">No appreciable impact</td><td>0</td></tr>
<tr><td>Minor negative impact</td><td>-1</td><td colspan="2">Major negative impact</td><td>-2</td><td colspan="2"></td><td></td></tr>
</table>

Impact	Mitigation measures	Management option	Monitoring required
Polarisation of community views regarding the wind farm	• Provide information to the community about the wind farm in the form of brochures/hand outs for schools, tourists and interested community groups, newspaper advertisements informing the local community about the proposal, and signage at a viewing location to inform the viewer about the wind farm and benefits of alternative energy. • WCA will actively pursue community investment opportunities, with the local school, tennis club and progress association, once the wind farm has been established.	Address via Environmental Management Plan	Actions controlled via environmental officer during operation of the wind farm

5.10.3 Environmental Impact Summary: Economic Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Economic	X		X		X	X		

Environmental Issue				Construction	Operation	Decommissioning
Economic				+2	+2	+2
Key						
Major positive impact	+2	Minor positive impact	+1	No appreciable impact		0
Minor negative impact	-1	Major negative impact	-2			

Impact	Mitigation measures	Management option	Monitoring required
Potential for land values to be impacted by the development of the wind farm.	• WCA should continue active involvement with AusWEA, who are undertaking ongoing investigations into the impacts of wind farms into property values.	Monitor local land values and sales	Actions controlled by WCA

5.11 Cumulative issues

In assessing the cumulative impact of the proposed wind farm it is necessary to balance the various impacts including visual, noise, flora and fauna against the benefits of generating renewable, non polluting electricity to the local population and the wider community. The placement of a wind farm in any environment will result in a variety of impacts. The most suitable areas are usually agricultural landscapes, with few large structures. Locating the wind farm next to the transmission lines reduces construction costs and material consumption. By locating the wind farm next to a suitable grid access point, the environmental footprint associated with the proposal is also reduced.

The cumulative effect of the wind farm with regard to similar development within the surrounding area will result in a concentration of large anthropogenic structures across the site. The construction of the wind turbines will provide additional infrastructure in addition to the existing 500Kv transmission towers that transect the site. It is well recognised that the community generally accept quarries, roads, railways, highways, powerlines, masts, phone towers and similar structures in prominent locations, as acceptable and even necessary, despite the perceived visual impact. However, some people in the community object to wind turbines even though they provide an equally vital service to our community.

The cumulative impact of existing and planned wind farms within the wider region should also be considered. Wind farms that currently exist within the region include Hampton Wind Farm, Blayney Wind Farm and the Crookwell Wind Farm. Hampton Wind Farm consists of two Vestas 660kw turbines, Blayney consists of 15 Vesta 660kw turbines and Crookwell has eight Vestas 600kW turbines. Hampton is the closest wind farm to the proposed BSWF, at a distance of around 40km and Blayney Wind Farm is located approximately 65km to the north-west. The relative distance between the wind farms is considered large enough to not result in any increased significant impacts. A number of wind farms are proposed around Taralga and Goulburn to the south of Oberon Shire, though again no negative cumulative visual impact would result due to considerable separation of the sites. The proposed Paling Yard Wind Farm (north of Taralga) will be located approximately 30-40km south of BSWF and consist of 30-50 turbines at a generating capacity of 60-100MW. The proposed Taralga Wind Farm will be located approximately 70km south of BSWF and consist of 69 turbines at a generating capacity of 103 - 109MW.

A positive cumulative impact of the wind farm proposals and existing farms is that the central and southern tablelands of NSW could generate additional tourist visits. Visitors could be drawn to the area to visit the various wind farms, with economic multipliers that extend to other ancillary service sectors such as accommodation, fuel suppliers and food outlets.

Short-term cumulative impacts are predominately associated with transport impacts on the surrounding road network during the delivery of turbine components. The Transport Study has investigated these impacts and suggests mitigation measures to reduce them. The long-term cumulative impacts include the change to the landscape character with the introduction of the turbines. The wind farm has a small environmental footprint and a large visual impact. The wind farm impacts on the landscape in the long term are reversible with the decommissioning of the wind farm and removal of the structures. Therefore, considering the overall environmental benefits of wind generated electricity with respect to the reduction in greenhouse gas emissions and that the turbines visual impact is related to structures that will be removed after decommissioning, the long-term cumulative impacts are considered acceptable and nearly all impacts are reversible.

5.11.1 Environmental Impact Summary: Cumulative Issues

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Cumulative	X	X	X		X	X	X	

Environmental Issue	Construction	Operation	Decommissioning
Cumulative	-1	+1	+1

Key					
Major positive impact	+2	Minor positive impact	+1	No appreciable impact	0
Minor negative impact	-1	Major negative impact	-2		

Impact	Mitigation measures	Management option	Monitoring required
Cumulative impacts	• Ensure all mitigation options where necessary are implemented to reduce each individual impact	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and operation of the wind farm

6 CONSULTATION

Consultation regarding this proposal was commenced with the Department of Planning in February 2006. The Director-General's Requirements (DGRs) were issued on the 4th May 2006. A copy of the DGRs is provided below in Figure 8.

Figure 8: Director-General Requirements

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Application number	06_0062
Project	Black Springs Wind Farm
Location	"Winton Park" and "Daisy Bank", Black Springs, Oberon Local Government Area
Proponent	Wind Corporation Australia Limited
Date issued	4 May 2006
Expiry date	4 May 2008
General requirements	The Environmental Assessment (EA) must include • an executive summary; • a detailed description of the project including the: - need for the project; - alternatives considered; - various components and stages of the project, including a timeline which clearly identifies the proposed commencement of construction and operation of the farm, its envisaged life span and arrangements for decommissioning; and - details on grid connection. • consideration of any relevant statutory provisions and guidelines, including the Department's draft *NSW Wind Energy Environmental Impact Assessment Guidelines, 2002*; • an environmental risk analysis of the project which takes into consideration the issues raised during consultation; • a detailed assessment of the key issues specified below, which includes: - description of the existing environment; - an assessment of the potential impacts of the project; - a description of the measures that would be implemented to avoid, minimise, mitigate, offset, manage, and/or monitor the impacts of the project; • a draft Statement of Commitments, outlining environmental management, mitigation and monitoring measures • a conclusion justifying the project, taking into consideration the environmental impacts of the proposal, the suitability of the site, and whether or not the project is in the public interest; and • a signed statement from the author of the Environmental Assessment certifying that the information contained in the report is neither false nor misleading.
Key issues	• **Project Justification** – the Environmental Assessment must include a clear demonstration of quantified and substantiated greenhouse benefits, taking into consideration sources of electricity that could realistically be replaced and the extent of their replacement. The Environmental Assessment must also identify the socio-economic benefits of the proposal, particularly any direct benefits for the local community arising from the proposal. • **Visual Impacts** – the Environmental Assessment must: • provide a comprehensive assessment of the landscape

	character/ values of the areas potentially affected by the project; • assess the visual impact of the proposal on this landscape (including existing and approved dwellings) for a distance of at least 2 kilometres from the turbines, taking into consideration the impact of blade "flicker" and blade "glint"; and • include photomontages of the proposal taken from strategic vantage points, including potentially affected residences. The visual impact assessment should be prepared with regard to the Australian Wind Energy Association and Australian Council of National Trust's *Wind farms and Landscape Values: Stage 1 Final Report - Identifying Issues, March 2005,* particularly Appendix B: *Wind Farms and Landscape Values: Final Issues Paper.* • **Noise Impacts** – the Environmental Assessment must include a comprehensive assessment of the predicted noise impacts resulting from the operation of the proposal, including measures to manage and/ or mitigate any noise impacts. The noise assessment must be undertaken in accordance with the Department of Environment and Conservation's *Industrial Noise Policy* and with regard to the South Australian Environment Protection Authority's *Wind Farms – Environmental Noise Guidelines, 2003.* Consideration should also be given to the effect of temperature inversions and seasonal variations in background noise levels on the noise predictions. If any noise agreements with residents are proposed for areas where noise criteria cannot be met, sufficient information must be provided to enable a clear understanding of what has been agreed and what criteria have been used to frame any such agreements. • **Flora and Fauna** – the Environmental Assessment must address: • the impact of the proposal on critical habitats; threatened species, populations or ecological communities, or their habitats in accordance with section 5A of the *Environmental Planning and Assessment Act 1979*; • the impact of the proposal on birds and bats from strikes and alteration to movement patterns resulting from the turbines and transmission lines. An outline of an adaptive management program must be included. Consideration should be given to the Australian Wind Energy Association's *Assessing the Impacts on Birds – Protocols and Data Set Standards*; and • vegetation clearing during construction and maintenance, including details on its location, composition and quantity. The flora and fauna assessment must be prepared in accordance with the Departments of Environment and Conservation and Primary Industries' draft *Guidelines for Threatened Species Assessment* and have regard to the Commonwealth Department of the Environment and Heritage's *Cumulative Risk for Threatened and Migratory Species, March 2006.* • **Traffic and Transport** – the Environmental Assessment must assess the impact of traffic generated as a result of the proposal during construction and operation and must include: details on the nature/ mode of traffic generated; transport routes; traffic volumes and the potential impact of this on local and regional roads, bridges and intersections, including any proposed road upgrades. Details regarding site access, access tracks and parking must also be provided.

	• **Indigenous Heritage** – the Environmental Assessment must include an assessment of the potential impact on Aboriginal heritage values and items, in accordance with the Department of Environment and Conservation's draft *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation*; • **Services** – the Environmental Assessment must assess the potential impact of the proposal on telecommunications and aircraft. In reference to aircraft, the assessment must consider the Civil Aviation Safety Authority's draft advisory circular AC 139-18(0) *Obstacle Marking and Lighting of Wind Farms*, December 2005. • **Land Values/ Development Potential** – the Environmental Assessment must assess the potential impact of the proposal on surrounding land values, including a prediction of the land value changes as a result of the proposal in both the short and long term. • **Bushfire Risk** – the Environmental Assessment must address the potential for wind farms to start/ influence the pattern of bushfires, and must include bushfire management strategies and measures, in consultation with the NSW Rural Fire Service and Oberon Council.
Consultation	During the preparation of the Environmental Assessment, you must consult with the relevant local, State or Commonwealth government authorities, service providers, community groups or affected landowners. In particular you must consult with; • Department of Environment and Conservation; • Roads and Traffic Authority; • Department of Primary Industries; • Department of Natural Resources; • Oberon Shire Council; • Country Energy; • NSW Rural Fire Service; • Civil Aviation Safety Authority (CASA); and • Pejar Local Aboriginal Land Council. The consultation process and the issues raised should be described in the Environmental Assessment.
Deemed refusal period	• 120 days

In accordance with the Director-General Requirements consultation was undertaken with the following Authorities, service providers and relevant community group:

- Department of Environment and Conservation;
- Roads and Traffic Authority;
- Department of Primary Industries;
- Department of Natural Resources;
- Oberon Shire Council;
- Country Energy;
- NSW Rural Fire Service;
- Civil Aviation Safety Authority;
- Pejar Local Aboriginal Land Council; and
- Black Springs Farm Action Group.

A copy of the Preliminary Environmental Assessment was forward with the correspondence and an updated turbine layout forwarded during the consultation period. A copy of the correspondence received from each Authority is contained in Appendix K. The response from each Authority or group is listed below:

Department of Environment and Conservation

The Department of Environment and Conservation were contacted as part of the consultation process and indicated that they reserved their right to comment when the Environmental Assessment is placed on public exhibition and did not wish to pursue further consultation at this time.

Roads and Traffic Authority

The Roads and Traffic Authority reviewed the Preliminary Environmental Assessment and a draft copy of the Transport Study. At this stage the RTA have indicated that the information provided to date is adequate for them to complete an assessment of the proposal. The RTA will provide further comment upon referral of the development from the Department of Planning.

Department of Primary Industries

The Department of Primary Industries responded that there are no Agricultural Issues relating to the project. The Fisheries Division outlined that no net impacts on the receiving waterways was to result from the proposal. Consideration has been given to the aquatic environment and the potential threats associated with the proposal relate to soil erosion and surface water quality control. These impacts will be mitigated through the implementation of a CEMP and EMP. Additional potential impacts could result from chemical or fuel spills. These issues will also be addressed via the CEMP and EMP.

The Minerals Division objects to the proposal because the BSWF is located on an active Exploration Licence (EL 5574) held by Straits Exploration (Australia) Pty Ltd (Straits). The Mineral Division feels that the proposed wind farm has the potential to sterilise valuable mineral resources and impede an active exploration program within an active Exploration Licence area. The Mineral Division advised that the Black Springs area is subject to a Section 117(2) Direction notification under the *Environmental Planning and Assessment Act 1979*. Generally Section 117 Directions relate to rezoning of land, though discussion with the Department of Planning revealed that the relevant Direction is expressed through the Oberon Local Environmental Plan (LEP) 1998 – Clause 10: General considerations for development within rural zones. Under Clause 10, the relevant clause concludes:

(1)The Council must not consent to development on land within Zone No 1 (a) or 1 (c) unless it has taken into consideration, if relevant, the effect of the carrying out of the proposed development on:

> *(c) the future recovery from known or prospective areas of valuable deposits of minerals, coal, petroleum, sand, gravel or other extractive minerals*

Straits contacted HSO and submitted a preliminary submission in response to the proposal after being advised of the development by the Department of Primary Industries. Due to the limited time available for Straits to comment on the proposal, a more comprehensive comment may follow in due course. Straits has indicated that the BSWF proposal is located centrally between two identified primary areas of mineralisation and the wind farm location is yet to be explored. Straits expressed concern in its ability to conduct its exploration activities in the area around the wind farm and that the proposal would also significantly impact on the potential to develop and mine any resource that may be identified there in the future.

Considering the potential of the site to contain primary areas of mineralisation, the impact that the BSWF may have on mineral exploration and recovery has been considered. The wind turbines cover approximately $16m^2$ of area at their base. The tracks connecting the turbines will have the electric cable connections located beneath them. The actual area of the wind farm site used for facilities, connections and turbines is extremely small. Exploration activities could be undertaken up to the base of each turbine, thereby providing apple opportunity to conduct exploration across the proposed wind farm site. It is considered that development of the wind farm would not impede exploration. If the exploration activity identifies the area as suitable for mineral extraction, Straits must apply for a Mining Lease and undertake the relevant environmental studies and approvals to allow mining operations. The time periods associated with these activities before mining operations can commence is typically many years. The exploration area extends along approximately 10km and the mineral opportunities are not confirmed upon the BSWF site. Therefore, it is considered unreasonable that a development that is permissible with consent under the Oberon LEP 1989 should be prohibited on the basis that the site has a potential for mineralisation opportunities. The wind farm has an operational life of 25 years, and consequently is not sterilising a valuable resource, because the time period between the current exploration activities and commencement of mining operations is expected to be extensive. It is possible for the mining operations, should they prove feasible, to commence on areas either side of the wind farm and by the time the operations reach the wind farm site, the remaining life expectancy of the wind farm would be considerably reduced. Therefore, the wind farm could operate successfully, generating clean renewable energy and upon decommissioning, the site could then be mined should it prove feasible. Preventing the development of an environmentally beneficial development on speculation of potential mineral resources, when scope is available for mining works upon the decommissioning of the wind farm is considered unreasonable in this circumstance. It is reasonable for both developments to proceed and work together to accommodate each other needs, thereby allowing exploration to continue and ensuring that any potentially valuable mineral resources are not sterilised. This would also comply with the intentions of Clause 10 of the Oberon LEP 1989 by providing consideration to the *future recovery from known or prospective areas of valuable deposits of minerals, coal, petroleum, sand, gravel or other extractive minerals*.

Department of Natural Resources

The Department of Natural Resources responded with an outline of basic requirements it suggested should be considered within the Environmental Assessment. Each of the assessment guidelines was reviewed carefully, with most adequately addressed in this Environmental Assessment. Some issues were not considered relevant due to the nature of the development and the limited impact that would result. Issues not considered relevant in this circumstance include a detailed groundwater investigation and management plan.

Oberon Shire Council

Consultation regarding the BSWF was undertaken with Ralph Tambasco, Director of Development for Oberon Shire Council at a meeting at Oberon Council on 22 February 2006 and through various phone consultations since that time. Mr Tambasco outlined Council's Development Control Plan O for Wind Farms and indicated Council would provide additional support where possible on the understanding that the project was to be assessed under Part 3A of the *EP&A Act 1979*. Mr Tambasco also assisted in the development of the Bushfire Risk management Plan.

Country Energy

Country Energy were contacted as part of the consultation process and indicated they would provide a comment for the consideration regarding the wind farm and connection to the electricity grid. Country Energy had not responded at the time of lodgement of this Environmental Assessment.

NSW Rural Fire Service

Terry O'Toole from NSW Rural Fire Service was consulted as part of the development phase of the Bushfire Risk Management Plan. Mr O'Toole provide bushfire mitigation advice regarding the management of bushfire related risks and outlined the bushfire concerns for the site of the NSW Rural Fire Service.

Civil Aviation Safety Authority

A copy of the Preliminary Environmental Assessment was forwarded to the Civil Aviation Safety Authority (CASA) to allow CASA to assess the proposal and any potential safety concerns related to air safety. CASA had not responded with their final determination of the proposal at the time of lodgement of this Environmental Assessment. Based on the Guidelines issued CASA's draft advisory circular AC 139-18(0) *Obstacle Marking and Lighting for Wind Farms* (December 2005), it is anticipated that obstacle lighting will be necessary for each turbine. Compliance with any recommendation from CASA for obstacle lighting will be incorporated during the turbine construction phase.

Pejar Local Aboriginal Land Council

Representatives of the Pejar Local Aboriginal Land Council (PLALC) were consulted and participated in the Aboriginal Heritage Assessment for the original larger wind farm proposal. Field investigations with ERM and PLALC representatives were undertaken over four days in November 2004 and one day in April 2005. The Assessment concluded that the proposed 33 turbine wind farm will not impact on the Aboriginal cultural significance of the site. To ensure the integrity of Aboriginal sites are maintained, the Assessment recommends that access tracks and construction activity in areas considered to have potential for Aboriginal sites should be constructed in consultation with representatives of the PLALC and in the presence of a qualified archaeologist.

Black Springs Farm Action Group

The Black Springs Farm Action Group was recommended by Oberon Council as the relevant community group to consult regarding the revised wind farm proposal. The Group was opposed to the original 33 turbine wind farm proposal. The group's representative was contacted in May 2006 by telephone to obtain a contact address where information regarding the proposal could be forwarded. The groups contact representative indicated that the group was opposed to the wind farm in all manner and elected not to receive a copy of the Preliminary Environmental Assessment or consult further with Harper Somers O'Sullivan about the revised proposal. The group representative expressed concern that any response they made would be used against them at a later stage. The group were advised that should they wish to view the revised proposal that a copy is available on the Department of Planning's website or that Oberon Shire Council has a copy for them to view.

Community Consultation

ERM undertook a comprehensive community consultation process as part of the original larger wind farm project. ERM developed a Community Engagement Strategy to guide the community consultation process in accordance with the statutory requirements for the preparation of an Environmental impact Assessment. The ERM consultation period had a duration of five months between November 2004 – March 2005.

The consultation program included the following activities:

- Provision of general information via 2 newsletters;
- A public information session at Black Springs Community Hall;
- Feedback forms provided at the public information session;
- Advertisement in the local newspaper regarding the public information session;
- Meetings with landholders located adjacent to the larger original wind farm proposal;
- Community inquiry phone line, fax number, postal address and email address.
- Consultation with the Pejar tribal representatives from the local Aboriginal Community.

ERM state that there was very little feedback from the local community regarding the wind farm proposal. The feedback that was received related primarily to concerns regarding property devaluation, visual impact and noise impacts. These issues have been addressed in this Environmental Assessment. A copy of the Draft ERM Stakeholder and Community Consultation Report is contained in Appendix L.

Harper Somers O'Sullivan contacted the Black Springs Farm Action Group in May 2006 via telephone to provide the community with an update on the wind farm project and advise them of the reduction in turbine numbers as part of the mitigation measures to respond to the community concerns raised in earlier stages of the community consultation. As indicated above, the Group's representative declined the offer of further information.

A second newsletter outlining the revised proposal is proposed to communicate about the wind farm with the local and wider community, passing on factual information about the farm, its electricity generation and the environmental benefits it creates. This would help to engender not only a more positive image of wind farms within the community, but also allow in time the local community to take ownership of the wind farm as part of it's community identity.

7 ENVIRONMENTAL RISK ANALYSIS

An environmental risk analysis is an assessment of the risks imposed on the environment for a particular project and involves the estimation of the effects of a proposed change and the importance of those effects (Thomas 2001). The environmental risk analysis is expressed in a table format and takes into consideration the issues raised during the consultation period. The risk assessment is presented in a series of tables evaluating the impacts associated with the wind farm and environmental issues. Table 9 is a checklist that illustrates the overall qualitative rating for each environmental issue based on the associated impact and mitigation measures discussed in Section 5 of this Assessment. Where no impact is indicated in the table, the impact on the environmental issue is considered negligible or not relevant. The BSWF will result in a number of positive and negative impacts though all are reversible except for the potential to disturb undiscovered Aboriginal heritage items. The likelihood of disturbing heritage items is considered low and clearing activities will be under the supervision of the Pejar Local Aboriginal Land Council representatives and a qualified archaeologist.

Table 9: Checklist of Environmental Issues and Impacts.
(Key: X = impact)

Environmental Issues	Positive	Negative	Beneficial	Adverse	Short Term	Long Term	Reversible	Irreversible
Greenhouse & Energy	X		X			X		
Landscape & visual		X		X	X	X	X	
Noise		X		X	X	X	X	
Air quality	X		X			X	X	
Soil, drainage & geology		X			X		X	
Flora and Fauna		X		X	X		X	
Heritage								X
Transport		X		X	X		X	
Infrastructure & utilities	X	X	X	X	X	X	X	
Bushfire		X		X	X		X	
Social	X	X	X		X	X	X	
Economic	X		X		X	X		
Cumulative	X	X	X		X	X	X	

Table 10 is a scaling checklist of the environmental issues providing a qualitative rating of the severity of the impact. The severity of the impact is based on the associated impact and mitigation measures discussed in Section 5 of this Environmental Assessment. The scaling provides a subjective assessment of the impacts severity. In some instances it is difficult to quantify the impact because the impact will vary from receiver to receiver. For example, the visual impact of the wind farm is extremely subjective, with many communities polarised about the impacts associated with the development of wind turbines in the landscape. The project is divided into three separate phases: construction, operation and decommissioning, to allow the associated impacts of each activity to be addressed separately. Table 6 shows that the overall impact of the proposal has a positive value (sum of scores = +7) indicating that the overall benefits of the wind farm proposal will outweigh the negative impacts.

Table 10: Scaling checklist of the environmental issues providing a qualitative rating of the severity of the impact of the wind farm.

Environmental Issues	Construction	Operation	Decommissioning
Greenhouse / Energy	0	+2	0
Landscape and visual	-1	-2	+1
Noise	-1	-1	-1
Air quality	0	+2	0
Soil, drainage and geology	-1	0	-1
Flora and Fauna	-1	-1	+1
Heritage	0	0	0
Infrastructure and utilities	+2	+2	0
Bushfire	0	0	0
Social	-1	-1	+2
Economic	+2	+2	+2
Cumulative	-1	+1	+1
Score	**-2**	**+4**	**+5**

Key	Value
Major positive impact	+2
Minor positive impact	+1
No appreciable impact	0
Minor negative impact	-1
Major negative impact	-2

To determine the environmental risk relevant for the environmental issues, each environmental impact is rated via a risk assessment calculator. Table 11 contains the risk assessment calculator and Table 12 details the Risk Assessment Score and Action relating to the figures in Table 12. The calculator compares the severity of the impacts as rated in Table 10 against the likelihood of occurrence and provides a score related to the risk associated with the environmental issue. Table 13 provides the risk assessment for each impact without the implementation of mitigation measures and with the implementation of mitigation measures.

Table 11: Risk Assessment Calculator

SEVERITY			LIKELIHOOD			
Level	Descriptive Word	Outcomes	A Imminent	B Very Likely	C Likely	D Unlikely
-2	Catastrophic	Large permanent environmental impact	1	1	2	3
-2	Critical	Large non-permanent environmental impact	1	2	3	4
-1	Marginal	Moderate environmental impact	2	3	4	5
-1	Nuisance	Minor environmental impact	3	4	5	6

Table 12: Environmental Risk Score and Assessment Table used in conjunction with Table 12.

Score	Risk assessment and action
1	Very high risk, consider discontinuing activity until hazard eliminated or appropriate controls are implemented
2	High risk, corrective action required to reduce risk
3	Substantial risk, some mitigation required to moderate risk
4	Moderate risk, need for attention indicated
5	Low priority risk, do something when possible
6	Low risk, risk perhaps acceptable, monitor as appropriate

Table 13: Environmental Risk Assessment for BSWF using the Risk Assessment Calculator in Table 11.

Impact	Environmental Risk Score without implementation of mitigation measures			Environmental Risk Score with implementation of mitigation measures		
	Severity	Likelihood	Score	Severity	Likelihood	Score
Greenhouse emissions from construction machinery	-1, Nuisance	B, Very Likely	4	-1, Nuisance	C, Likely	5
Visual impact from construction and on-going operation of turbines on adjacent residents	-2, Critical	B, Very Likely	2	-1, Marginal	C, Likely	4
Visual impact from construction and on-going operation of turbines on driver distraction	-1, Marginal	B, Very Likely	3	-1, Nuisance	C, Likely	5
Noise emissions from construction machinery	-1, Nuisance	C, Likely	5	-1, Nuisance	D, Unlikely	6
Noise emissions from turbines	-1, Nuisance	B, Very Likely	4	-1, Nuisance	C, Likely	5
Exhaust emissions from machinery	-1, Nuisance	B, Very Likely	4	-1, Nuisance	C, Likely	5
Dust from construction activities	-1, Nuisance	B, Very Likely	4	-1, Nuisance	C, Likely	5
On-site erosion from construction operations	-1, Marginal	B, Very Likely	3	-1, Nuisance	D, Unlikely	6
Potential for bird and bat impacts from blades during turbine operation	-1, Nuisance	D, Unlikely	6	-1, Nuisance	D, Unlikely	6
Vegetation removal & spread of weeds	-1, Nuisance	C, Likely	5	-1, Nuisance	D, Unlikely	6
Potential for impact on unidentified items of Aboriginal cultural heritage	-1, Marginal	D, Unlikely	5	-1, Nuisance	D, Unlikely	6
Generation of waste products	-1, Nuisance	C, Likely	5	-1, Nuisance	D, Unlikely	6
Potential interruption of the Black Springs to the Burraga Fire Tower VHF signal	-1, Nuisance	D, Unlikely	6	-1, Nuisance	D, Unlikely	6
Blade ice injuring a person	-2, Critical	D, Unlikely	4	-1, Marginal	D, Unlikely	5
Potential for the turbines to be a hazardous object to aircraft safety	-1, Marginal	D, Unlikely	5	-1, Nuisance	D, Unlikely	6
Traffic delays during delivery and construction operations	-1, Nuisance	B, Very Likely	4	-1, Nuisance	C, Likely	5
Start a bushfire or contribute to bushfire threats	-1, Nuisance	D, Unlikely	6	-1, Nuisance	D, Unlikely	6
Polarisation of community views regarding the wind farm	-1, Marginal	C, Likely	4	-1, Nuisance	C, Likely	5
Potential for land values to be impacted by the development of the wind farm.	-1, Nuisance	D, Unlikely	6	-1, Nuisance	D, Unlikely	6
Cumulative impacts	-1, Marginal	B, Very Likely	3	-1, Nuisance	C, Likely	5

The environmental risk assessment presented in Table 13 shows that with the implementation of mitigation measures to ameliorate the impacts, nearly all of the impacts can be reduced to a suitable risk level, with the exception of the visual impact on adjacent residents. The visual impact as described in the visual assessment is a subjective impact dependant on the viewer's attitude to the development and use of alternative energy. The proponent will assist in providing vegetation screening measures to those residence within a 2km radius that request such measures.

8 DRAFT STATEMENT OF COMMITMENTS

A Draft Statement of Commitments has been prepared to outline the environmental management, mitigation and monitoring measures that will be implemented with the development of the BSWF. A number of ameliorative measures have been designed into the project to minimise the environmental impact of the overall development. Consideration has been given to the industry 'best practice' mitigation measures listed in the *NSW Wind Energy Handbook* (SEDA 2002) and these measures have been implemented where practical. Table 14 provides a compilation of the main environmental impacts and associated mitigation measures proposed to ameliorate the impacts as part of the Draft Statement of Commitments for the Black Springs Wind Farm. Wind Corporation Australia is committed to implementing the environmental safeguards and measures as listed in Table 14.

Table 14: Draft Statement of Commitments

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
1	Greenhouse emissions from construction machinery	• ensure machinery is adequately serviced to ensure efficient operation; • turn off engines rather than idle for long periods	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	ECMP prepared by HSO Planning Consultant	Prepare ECMP prior to the construction phase	Actions recorded as part of ECMP	Comply with ECMP mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
2	Visual impact from construction and on-going operation of turbines on adjacent residents	• plant screening for those residences most impacted by the proposal; • reducing turbine numbers from 33 to 9; • increasing turbine size to further reduce turbine numbers while balancing energy generation and associated benefits; • locating powerlines and cabling underground to remove visual clutter and allow uninterrupted farm activities across the remaining areas of the subject properties; • use of muted colours with a matt finish for turbines to reduce the visual contrast against the background; • all turbines to be the same colour and size; • turbine blades to rotate in the same direction and all turbines to operate at the same time, except when undergoing maintenance work; • the turbine layout will be clustered as close as possible and where possible in a linear layout to minimise cumulative visual effect of the farm when viewed from a distance.	Address via Environmental Management Plan	Actions implemented via project officer during construction activities	EMP prepared by HSO Planning Consultant	Prepare EMP prior to the construction phase	Actions recorded as part of EMP	Comply with EMP mitigation measures
3	Visual impact from construction and on-going operation of turbines on driver distraction	• warning signs to forewarn approaching motorists of visual distraction; • development of a viewing area and educational signage to create a safe viewing location.	Address via Environmental Management Plan	Actions implemented via project officer during construction activities	EMP prepared by HSO Planning Consultant AWC to arrange signs and viewing area	Prepare EMP prior to the construction phase	Actions recorded as part of EMP Signs erected and viewing area established	Comply with EMP mitigation measures

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
4	Noise emissions from construction and maintenance machinery	• Ensure machinery is adequately serviced to ensure noise efficient operation; • Minimise use of engine braking • Schedule noisy activities to a suitable time to avoid sensitive times of the day for adjoining development; • Relocate the noise source away from receivers or behind existing structures that can serve as a barrier; • Change the orientation of equipment away from receivers; • Adopt 'quiet' work practices, such as turning off truck engines rather than idling for long periods; • Informing neighbouring properties of the proposed noise activities and duration; Educating staff and contractors about noise and quiet work practices.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	ECMP prepared by HSO Planning Consultant	Prepare ECMP prior to the construction phase	Actions recorded as part of ECMP	Comply with ECMP mitigation measures
5	Noise emissions from turbines	• Lease affected property for the life of the project • Installation of double glazed windows or change in blade pitch		Investigate any noise complaints should they arise and develop appropriate mitigation measures	AWC to address noise complaints	As required	Complaints and remedial actions recorded in EMP	Comply with SA EPA guidelines for noise
6	Exhaust emissions from machinery	• Ensure machinery is adequately serviced to ensure efficient operation; • Turn off engines rather than idle for long periods.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Construction contractor	During construction and maintenance works	Construction contractors signing they have read the ECMP	

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
7	On-site erosion from construction operations	• Prepare an Erosion & Sediment Control Plan for all activities; • Exposing the smallest possible area of land for the shortest possible time; • Saving topsoil for reuse; • Controlling runoff onto, through and from the site; • Using erosion measures to prevent on-site damage; • Using sediment control measures to prevent off-site damage; • Rehabilitating disturbed areas quickly; and Maintaining erosion and sediment control measures.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Engineering consultant	Prior to construction period	Maintenance actions recorded in a register as part of ECMP and EMP	Landcom's Soil & Construction – Managing Urban Stormwater "Blue Book"

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
8	Dust from construction activities	• Minimising the surface area disturbed by excavation, stockpiling and/or filling locations where practical; • Confining vehicle movements to paved roads or available hard stand areas, where practical; • The use of a water cart, as appropriate, to eliminate wind blown dust; • Use of sprays or sprinklers on stockpiles or loads to lightly condition the material; • Use of tarpaulin or tack-coat emulsion or sprays to prevent dust blow from stockpiles or from vehicle loads; • Covering stockpiles or loads with polythene or geotextile membranes; • Restriction of stockpile heights to 2 m above surrounding site level; • Ceasing works during periods of inclement weather such as high winds or heavy rain.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Construction contractor	Prepare ECMP prior to the construction phase	Actions recorded as part of ECMP	Comply with ECMP mitigation measures
9	Potential for bird and bat impacts from blades during turbine operation		Address via Environmental Management Plan	On-going monitoring for bird and bat impacts during the operation of the wind farm	HSO Ecological consultant	Post construction period	Monitoring as per the Flora and Fauna Assessment recommendations	Contribute to the scientific research of bird and bat strikes – compare results against current identified potential for impact

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
10	Vegetation removal & spread of weeds	• Restrict clearing to only areas required for turbine and facility structures. • Access roads and cabling should be aligned along existing tracks wherever possible to minimise vegetation removal • Sharing of easements in common trench for power and turbine control cabling	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities	Construction contractor and AWC	During and post construction works	Maintenance register recorded as per EMP	Actions as per "best practice" for weed control
11	Potential for impact on unidentified items of Aboriginal cultural heritage	• Locate turbines on ridge crests that are exposed to the elements and will not affect sensitive landforms. • Access tracks should be constructed following the same path as the cable trenching to avoid unnecessary impacts on any sensitive landforms. • A qualified archaeologist should be on-site for clearing of vegetation for the construction of access tracks. All monitoring activities will be undertaken under a section 87 permit. In the event that a site is identified during construction, work will cease immediately, the Pejar Local Aboriginal Land Council will be notified and an application made under section 90 of the National Parks & Wildlife Act will be made to remove or destroy as appropriate.	Address via Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities to ensure archaeologist is on site during clearing	AWC in consultation with Aboriginal heritage consultant and local Aboriginal land councils.	During the construction period	Actions recorded in ECMP and EMP	Actions in accordance with Department of Environment and conservation guidelines

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
13	Potential interruption of the Black Springs to the Burraga Fire Tower VHF signal	• Place a collector / repeater station on the towers that impact the signal	Address via Environmental Management Plan	Check interruption during post construction monitoring of turbine operation	WCA	Immediately post construction	Actions recorded in EMP	Actions to comply with the Australian Broadcasting Association regulations
14	Potential for the turbines to be a hazardous object to aircraft safety	• Erect aircraft obstacle lighting and all other measures in accordance with CASA's directions	Address following direction from CASA		WCA	During construction	Compliance with CASA direction	CASA regulations and recommendations
15	Blade ice injuring a person	• Restrict access to the turbines, • Erect warning signs, • Educate staff	Address via Environmental Management Plan	Operational staff to monitor during operations	WCA	During and post construction	Mitigation measures implemented	Maximise safety with respect to falling ice
16	Traffic delays during delivery and construction operations	• Notification of the local community, appropriate warning signs and traffic control will minimize any safety risk.	Address via Traffic Management Plan	Actions controlled via traffic officer during delivery and construction activities	Traffic consultant and construction contractor	Prior to construction period	Traffic Management Plan forwarded to RTA and Council for approval	Approval from RTA and Council that Plan is adequate
17	Driver distraction during operation of wind farm	• Erection of warning signs and development of viewing area to allow interested drivers to safely stop and observe the turbines	Address via Environmental Management Plan	Liaise with Oberon Council through out operation of the wind farm for changes in traffic impacts	WCA	Prior to construction period	Signs erected	Warn drivers of potential driver distraction
18	Generation of waste products	• prevention, • source reduction, • minimisation, • treatment, and • disposal (as a last resort).	Address via Waste Management Plan in Environmental Construction Management Plan	Actions controlled via environmental officer during construction activities and on-going operations	WCA and construction contractor	Prior to construction	Measures implemented as listed in ECMP and EMP	Maximise recycling and reuse and minimise waste
19	Fire within the turbine	• Install fire extinguishers; • Liaise with local fire brigade	Address via Environmental Management Plan	Liaison with local fire brigade	WCA and construction contractor	Prior to construction	Measures implemented as listed in ECMP and EMP	Liaison with local fire brigade

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
20	Start a bushfire or contribute to bushfire threats	• Avoid contact of hot exhaust systems with dry and flammable vegetation • No smoking during construction activities • Bushfire mitigation measured planned to respond to bushfire threats • All vehicles to carry emergency communication equipment. • All vehicles to carry fire extinguisher or fire fighting equipment. • A 20m Asset Protection Zone should be established around each turbine. • Liaison with local RFS station	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and on-going operations	WCA and construction contractor	Prior to construction	Measures implemented as per ECMP and EMP	Protocols in accordance with RFS guidelines
21	Polarisation of community views regarding the wind farm	• Provide information via a mail out to the Black Springs community about the wind farm in the form of brochures/hand outs for schools, tourists and interested community groups, newspaper advertisements informing the local community about the proposal, and signage at a viewing location to inform the viewer about the wind farm and benefits of alternative energy. • WCA will actively pursue community investment opportunities, with the local school, tennis club and progress association, once the wind farm has been established.	Address via Environmental Management Plan	Actions controlled via environmental officer and WCA during operation of the wind farm	WCA	Prior to construction	Measures implemented as per EMP Record mail out in EMP	Ameliorate Community concerns

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
22	Potential for land values to be impacted by the development of the wind farm.	• WCA should continue active involvement with AusWEA, who are undertaking ongoing investigations into the impacts of wind farms into property values.	Monitor local land values and sales	Monitor land values during operation of the wind farm	WCA and property valuation consultant	Pre and post construction		Comply with mitigation measure
23	Cumulative impacts	• Ensure all mitigation options where necessary are implemented to reduce each individual impact	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and operation of the wind farm	WCA	Prior to construction period	Actions implemented as per EMP	Comply with mitigation measures
24	Construction works	• All construction works will be in compliance with the Department of Planning approval and undertaken in accordance with the ECMP	Address via Environmental Construction Management Plan and Environmental Management Plan	Actions controlled via environmental officer during construction activities and operation of the wind farm	WCA	Prior to construction period	Actions implemented as per EMP	Comply with Department of Planning approval and mitigation measures
25	Future site land use	• The wind farm will be constructed to allow for ongoing grazing and agricultural activities currently practiced on site to continue up the base of each turbine; • Landowners educated about operational dangers associated with the turbines (ie blade ice)	Address via Environmental Management Plan	Actions controlled via environmental officer during operation of the wind farm	WCA and land owners	Prior to construction	Actions implemented as per EMP	Safety measures implemented as per ECMP and EMP

Item	Impact	Mitigation measures	Management option	Monitoring required	Responsibility	Timing	Auditing	Criteria
26	Decommissioning	• Decommissioning of the wind farm will be in accordance with "best practice" requirements in place at the time of decommissioning; • All wind turbines and associated above ground infrastructure is to be removed and the site restored within 12 months of decommissioning; • Decommissioning and Site Restoration Plan to be submitted and approved by Department of Planning and Council prior to decommissioning	Address via Decommissioning and Site Restoration Plan	Actions controlled via environmental officer during decommissioning of the wind farm	WCA	Prior to decommissioning	Actions implemented as per Decommissioning and Site Restoration Plan	Decommissioning and Site Restoration Plan approved by Department of Planning and Council

A Construction Environmental Management Plan and Environmental Management Plan for the operation of the wind farm will be prepared as part of the Draft Statement of Commitments.

8.1 Construction Environmental Management Plan

A comprehensive Construction Environmental Management Plan (CEMP) will be prepared to manage and mitigate impacts associated with the construction of the wind farm. The CEMP will detail objectives, mitigation measures and measurable tasks to prevent or ameliorate impacts, who will be responsible for each task, how each task will be completed and the timeframe for completion. The CEMP will include:

- Site Location Plan;
- Site Management Strategy;
    - Environmental Health and Safety;
    - EMP Action Plan Responsibilities;
    - Site Security;
    - Safety Management Strategy;
- Traffic Management Strategy:
    - Designated Material Delivery Road Routes;
    - Site Access Stabilisation;
    - Entry/Egress Measures and Controls;
    - Traffic Control Measures;
    - Community Traffic Impact Advice;
- Soil and Water Management Strategy:
    - Surface Runoff and Drainage Line Plans;
    - Control and Management of Surface Water including measures to control the quality and quantity of surface water;
    - Erosion and Sediment Control;
    - Material Stockpiles;
    - Maintenance and Control Measures;
    - Weed Control Measures:
- Waste Minimisation Strategy:
    - Construction Waste Minimisation;
    - Operational Waste Minimisation;
- Dust Management Strategy;
    - Traffic Dust Control Measures;
    - Site Dust Control Measures;
- Noise and Air Management Strategy:
    - Acoustic Issues;
    - Construction Noise Control Measures;

    - Air Emission and Control Measures;

- Community Relations Strategy:
    - Community Information Dissemination;
    - Community Concerns Contact Information;

- Site Rehabilitation

8.2 Environmental Management Plan

A comprehensive Environmental Management Plan (EMP) will be prepared to manage and mitigate impacts associated with the on-going operation of the wind farm. The EMP will detail objectives, mitigation measures and measurable tasks to prevent or ameliorate impacts, who will be responsible for each task, how each task will be completed and the timeframe for completion. The EMP will include:

- Environmental Management System:
    - Policies and Objectives;
    - Responsibilities;
    - Procedures;
    - Training and Environmental Awareness;
    - Documentation and Reporting;
    - Review and Improvement;

- Environmental Issues Management:
    - Site Management:
    - Landscape Management;
    - Heritage;
    - Flora and Fauna;
    - Visual Impacts;
    - Noise Emissions;
    - Soil and Water Management;
    - Weed Control;
    - Disease Control;
    - Bushfire Protection;
    - Waste Management;
    - Fuel and Chemical Storage;

- Maintenance Activities:
    - Maintenance Schedule and Procedures;
    - Waste Generation and Disposal;
    - Safety of Operations;
    - Traffic Management;
    - Facilities Management;

9 PROJECT JUSTIFICATION

Wind Corporation Australia looks forward to establishing an environmentally friendly, viable and sustainable wind energy project in the Black Springs area whilst providing significant environmental and economic benefits to the local population, the region and the state of NSW. Through consultation with all relevant stakeholders, constant communication with the involved landholders and a design encompassing all aspects of sustainable power generation, Wind Corporation Australia believes a positive example of a renewable energy project can be created.

The BSWF will generate clean, green renewable energy for consumers in the Oberon region generating sufficient electricity for up to 6000 homes. Within the 25 year design lifetime, each wind turbine will supply approximately 33 times the energy used throughout it's own life cycle. The proposal has the potential to avoid the production of up to 43,660 tonnes of greenhouse gas emissions. Energy produced by the BSWF will contribute to achieving the Commonwealth Government's Mandatory Renewable Energy Target and assist with Australia's commitment to the greenhouse response. The NSW Government has also announced a NSW Renewable Energy Target (NRET) to assist in reducing greenhouse gas emissions to 2000 levels by the year 2025, and by 60% by 2050, as NSW's input into addressing climate change. The establishment of the NRET will require electricity retailers to purchase the target proportion of their electricity supply from accredited renewable generation sources, which would include proposals such as Black Spring Wind Farm. Therefore, energy produced by the BSWF will contribute to achieving MRET and NRET and assist with Australia's and NSW's commitment to the greenhouse response.

The BSWF will also provide local participating landholders with additional income, which will add to the viability and sustainability of these traditional agricultural landholdings. The project will assist the region to meet environmental objectives and the principles of Ecologically Sustainable Development through the generation of renewable energy and consequent greenhouse gas abatement.

The scenic quality of the area has the potential to be impacted by the turbines, though the perception of the impact will vary according to each individuals perception of wind farms and their attitude towards renewable energy production. The turbines have been located so as to provide a balance between the community needs and perceptions, the environmental issues, energy output and the impact on climate change.

The proposed wind farm does not involve the removal of native vegetation or trees and is compatible with the agricultural activities currently undertaken on the land. No significant flora and fauna will result from the development of the wind farm. The proposed BSWF is unlikely to impact on items of Aboriginal cultural heritage as investigations have shown that the frequency of artefact occurrence is likely to be very low. A co-operative approach with the Department of Primary Industries and Straits Exploration (Australia) Pty Ltd will ensure that potentially valuable mineral resources are not sterilised and that the active exploration program within the existing Exploration Licence is not impeded. Working together, both projects can be accommodated.

The most noticeable sound produced by a wind turbine can be described as the periodic "swish swish" of the blades cutting through the air. Although the blades continuously create this noise while rotating there is a pressure change as the blade passes the tower and an intermittent "swish-swish" sound is propagated. This sound is not mechanical and does not generally have a tonal nature but is rather a "white" noise and therefore decays more rapidly with distance. Noise is described as "white" noise when it does not have a specific tonality and frequency spectrum but ranges across a large frequency band. The noise output of a turbine increases with wind speed however the background sound pressure level, which has the effect of masking the noise produced by the turbine, also increases. In the case where a significant level of annoyance or disturbance due to wind farm noise is experienced by a resident, and the limits presented by the SA EPA Guidelines are found to be exceeded during operation of the wind farm, mitigation measures will be investigated and implemented.

Construction and operation phases of the development will be in accordance with the Best Practice Guidelines for Wind Energy Projects. Prior to commencing work, the contractor will be required to prepare a Construction Environmental Management Plan (CEMP) to address Occupational Health & Safety requirements and general risk management issues. The CEMP will specify measures to be adopted by the contractor to minimise interference with and the disturbance of the environment during the construction of the wind farm and associated facilities.

A comprehensive Environmental Management Plan (EMP) will be prepared to manage and mitigate impacts associated with the on-going operation of the wind farm. The EMP will detail objectives, mitigation measures and measurable tasks to prevent or ameliorate impacts, who will be responsible for each task, how each task will be completed and the timeframe for completion.

The wind turbines are located well clear of any significant vegetation. The turbines will be earthed to prevent any arcing of electricity or surges resulting from lightning strikes. The bushfire management plan provides a range of measures to ensure bushfire impacts and prevention measures actively assist in the control and prevention of bushfires. Therefore, the development of the wind farm is not considered to contribute to any increased threats associated with bushfires.

In general, across NSW and Australia, there tends to be no recent sales evidence to support one view or another of a reduction land values associated with the development of wind farms because often the rural properties involved do not change hands with a frequency which would allow a reliable assessment to be made. However, the recent sale of the 'Winton Park' property and subsequent subdivision provides strong evidence relative to the Black Springs area that land values adjacent to the wind farm development will not be negatively impacted.

Black Springs and Oberon Shire would benefit both socially and economically from the development of BSWF. As with most wind farm developments, there will be positive and negative benefits, though it is considered that the positive socio-economic impacts in this circumstance out weigh the negative impacts. The wind farm will result in a major investment in the area, which will require employing local labour and resources. The wind farm will provide tourism opportunities for Black Springs. Tourism drawn by the attraction of viewing the wind farm also has economic multiplier effects that extend to other ancillary service sectors such as accommodation, fuel suppliers and food outlets.

The proposal is located adjacent to existing infrastructure to allow connection to the electricity grid with minimal additional infrastructure requirements. The EMI studies indicate that minimal if any EMI will result from the proposal. CASA has assessed the proposal and will indicate in the near future if lighting is required on the turbines. Any CASA requirement will be complied with during the construction process.

No concerns exist regarding public safety. Evidence collated over 20 years of electricity generation from more than 100,000 turbines worldwide, indicates that no member of the public has ever been injured during the operation of a wind farm.

The associated short-term cumulative impacts predominately relate to transport impacts on the surrounding road network during the delivery of turbine components. The Transport Study addresses these impacts and suggests mitigation measures to reduce them. The long-term cumulative impacts include the change to the landscape character with the introduction of the turbines. The wind farm has a small environmental footprint and a large visual impact. The wind farm impacts on the landscape in the long-term are reversible with the decommissioning of the wind farm and removal of the structures. Therefore, considering the overall environmental benefits of wind generated electricity with respect to the reduction in greenhouse gas emissions and that the turbines visual impact is related to structures that will be removed after decommissioning, the long-term cumulative impacts are considered acceptable and nearly all impacts are reversible.

The environmental risk assessment indicates that with the implementation of appropriate mitigation measures that nearly all the impacts can be reduced to an acceptable level. The visual impact is very subjective and difficult to quantify, though the overall impact has been assessed and measures have been suggested to ameliorate the main receptor impacts.

The proposal is consistent with principles of ecological sustainable development. Following the precautionary principle, no threats of serious or irreversible environmental damage will result, as demonstrated by the environmental risk assessment. Inter-generational equity is ensured with regards to greenhouse gas emissions, with the present generation ensuring that the development contributes towards maintaining the health, diversity and productivity of the environment for the benefit of future generations. The proposal does not impact on the conservation of biological diversity and ecological integrity, and through mitigating the release of greenhouse gas emissions from traditional power generation sources, the project will assist in ensuring the conservation of biological diversity and ecological integrity. The proposal also incorporates improved valuation, pricing and incentive mechanisms through the inclusion of environmental factors in the valuation of assets and services. This is achieved by the incorporation of measures to prevent pollution and adherence to the polluter pays principle, where those who generate pollution and waste bear the cost of containment, avoidance or abatement. The project has been evaluated for the full life cycle of the turbines, ensuring that the costs associated with the disposal of wastes and decommissioning of the turbines and the use of natural resources is also incorporated into the income generation capacity of the project. The wind farm has been designed to minimise environmental impacts and achieve environmental protection to maximise environmental benefits and minimise development costs. The overall BSWF proposal will provide ecological sustainable development that will offset the emission of a substantial amount of greenhouse gas and contribute to the Government's commitment to renewable energy production.

10 REFERENCES

AGO (2003) *Climate Change - An Australian Guide to the Science and Potential Impacts* Australian Greenhouse Office. Edited by Barrie Pittock.

Australian Greenhouse Office, available online at: http://www.greenhousegas.nsw.gov.au/overview/other_schemes/national.asp

AusWEA Fact Sheets, available online at: http://www.auswea.com.au/WIDP/factsheets.htm

AusWEA (2002) *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*. Australian Wind Energy Association. March 2002.

Countryside Council for Wales (2003) *Visual Perception versus Photomontage – Non-Technical Study*. Available online at: http://www.ccw.gov.uk

Clouster and Brouwer, (1995) in Verge Landscapes (2005) Visual Impact Assessment of Cessnock Airport Hotel.

Diesendorf (2003) "Why Australia needs wind power" published in *Dissent* (13, Summer 2003/20040)

Elsam Engineering (2004) *Life cycle Assessment of offshore and onshore sited wind farms*, Elsam Engineering.

Federal Government (2004) *Securing Australia's Energy Future* – White Paper.

Federal Government (2006) *National Code for Wind Farms – A Discussion Paper*.

Gipe (1999) *Overview of worldwide wind generation*, Paul Gipe & Associates.
Available online at: http://www.ilr.tu-berlin.de/WKA/overview.html

Kovac, M., Murphy, B.W. and Lawrie, J.W. (1990) *Soil Landscapes of the Bathurst 1:250000 Sheet - Report*. Soil Conservation Service of NSW, Sydney

Kovac, M., Murphy, B.W. and Lawrie, J.W. (1989) *Soil Landscapes of the Bathurst 1:250000 Sheet – Map.* Soil Conservation Service of NSW, Sydney

Morgan, C., Bossanyi, E. and Seifert, H. (1998) *Assessment of Safety Risks arising from Wind Turbine Icing*, Boreas IV, Hetta Finland.

Ngh Environmental (2005) *Proposed Development of a 30MW Wind Farm at Cullerin, NSW, Project Application*.

Plan i sphere (2005) *Wind Farms and Landscape Values, Stage One Final Report, Identifying Issues*, Australian Wind Energy Association and Australian Council of National Trusts.

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

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

Suzlon Energy (2006) available online at: www.**suzlon**.com

TransGrid (2006) *NSW 500 Grid, Energising the future*, TransGrid.
Thomas, I (2001) *Environmental Impact Assessment in Australia, Theory and Practice, Third Edition,* Federation Press.

van de Wardt and Staats, (1988) in Plan i sphere (2005) *Wind Farms and Landscape Values, Stage One Final Report, Identifying Issues*, Australian Wind Energy Association and Australian Council of National Trusts.

APPENDIX A Transport Study

APPENDIX B Visual Impact Assessment

APPENDIX C Shadow Flicker Study

APPENDIX D Noise Assessment

APPENDIX E Flora and Fauna Assessment

APPENDIX F Heritage Assessment

APPENDIX G Electromagnetic Interference Study

APPENDIX H Bushfire Risk Management Plan

APPENDIX I Socio-Economic Impact Assessment

APPENDIX J Property Values Assessment

APPENDIX K Correspondence With Authorities & Key Stakeholders

APPENDIX L Stakeholder and Community Consultation