Moonies Hill Energy Pty Ltd

Moonies Hill Energy Pty Ltd.,
78 Pensioner Road, Kojonup,
Western Australia, 6395

T:+0419 864 493
F:+61 8 9831 1608
www.mhenergy.com.au

Flat Rocks Wind Farm

Environmental Impact Report

July 2011

moonies
hill energy

Environmental Impact Report

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1. INTRODUCTION

1.1 The Proposal

Moonies Hill Energy Pty Ltd (MHE) proposes to construct and operate a wind farm on cleared farm land in the Flat Rocks locality, Figure 1. The proposed wind farm will span two shire boundaries, the Shire of Kojonup and the Shire of Broomehill-Tambellup, Figure 2. The wind farm will have a nominal generating capacity in the order of 150MW, which will be connected into the South West Interconnected System (SWIS) via connection to the proposed 330kV Muja-Wellstead power line, construction of a new 132kV power line into the Kojonup substation, or via an existing 132kV power line that crosses the project area in the south.

1.2 The Proponent

The proponent of the Flat Rocks wind farm project is Moonies Hill Energy Pty Ltd, a locally owned and operated renewable energy company. The address of Moonies Hill Energy Pty Ltd is:

Moonies Hill Energy Pty Ltd
78 Pensioner Road
KOJONUP WA 6395
Ph: 0419 864 493
Fax: 0898 31 1608
Email: info@mhenergy.com.au Website: www.mhenergy.com.au

1.3 The Site

The Flat Rocks wind farm site is located on cleared farmland approximately 35km south east of Kojonup, 35km north west of Tambellup, 35km west of Broomehill and 45km south west of Katanning, The project will comprise 74 wind turbines spread over 6 farms and across two shires, Figure 3. The land is held by five landowners, all of whom are financial beneficiaries of the project.

As micrositing of the wind turbines will continue up until commencement of construction, MHE seeks approval for a project “envelope” within which the turbines will be located.

1.4 Sale of Electricity

Electricity produced by the Flat Rocks wind farm will be sold into the SWIS under a commercial agreement. The wind farm will be connected to the grid via a substation. The final location of the substation and grid connection point will be determined following the completion of an access application and system study by Western Power. MHE has several connection options as outlined in section 1.1.

1.5 Benefits of the Proposal

The Flat Rocks wind farm will contribute up to 150 MW of renewable electricity into the SWIS. This will be equivalent to the electricity required to power up to 90,000 typical households and will save up to 451,000 tonnes per annum of greenhouse gases (CO_2 equivalent) when compared with coal-fired power generation (1).

The project will inject substantial revenue into the local economy, including lease payments to participating land owners, payments to local suppliers for construction materials and labour, and employment of operating personnel. Based on a recent report by Sinclair Knight Mertz (2), "Economic Impact Assessment of the Hallett Wind Farms", MHE expects the economic flow on to be in the order of $130 million over the life of the project, with $30 million during construction and $5 million annually once the wind farm is operational.

MHE is committed to maximising local involvement in the Flat Rocks wind farm project from construction through to operation. Local employment opportunities will be created during the construction phase of the project. Workers required for the project will include plant operators, truck drivers, mechanics, welders, fencers, electricians, labourers, transport contractors, office administrators and other individuals typically used in civil construction. MHE estimates that the construction stage of the project may involve up to 200 individuals and 50 businesses. Once operational the wind farm will create up to 15 full-time jobs.

As a company committed to sustainability MHE will establish a Sustainable Communities Fund (SCF). This fund will operate for the operational life of the wind farm (typically 25 years). The fund aims to support surrounding community programs, local schools, sporting clubs and other activities that encourage a sustainable and cohesive community. The final structure of this fund is still under review. MHE has been in contact with Mr Bill Webb from Kojonup who is actively involved in the establishment of a Kojonup Community Fund. More details of the SCF will be released as the project evolves.

Wind farms like the Flat Rocks wind farm have been shown to attract tourism (2). As the second largest wind farm in the state and located just 2.5km from the Albany Highway along the Tambellup West Road, the Flat Rocks wind farm will provide a unique opportunity to visitors to the Great Southern. MHE has held preliminary discussions with a landowner about the possible collaboration of a control building, viewing platform and wool harvesting and memorabilia museum. The particular landowner already has a substantial collection of wool harvesting equipment and wool memorabilia and plans to continue to grow his collection. As there is already interest from tourists to view the collection, a combined facility would enable the collection to be better presented and persevered. Located at the northern, elevated end of the Flat Rocks wind farm, this joint facility would have views of the wind farm to the south and the Stirling Ranges to the south east.

1.6 Project Schedule

Construction of the Flat Rocks wind farm is scheduled to commence in late 2012 or early 2013 and continue for approximately 18 – 24 months.

The wind farm facility may be completed in stages. Figure 4 and 5 illustrate a possible staged development with a southern stage and northern stage respectively. This will depend upon market conditions and connection options at the time of installation.

1.7 Community and Government Consultation

MHE has consulted with a range of government and private organisations and individuals in the planning of the Flat Rocks wind farm. These include:

Shire of Kojonup

Mr Stephen Gash	Chief Executive Officer
M Phil Shephard	Town Planner
Mr Craig Baru	Natural Resource Manger
Mr Mort Wignall	Manager of Regulatory and Community Services

Shire of Broomehill Tambellup

Ms Joanne Trezona	Chief Executive Officer
Mr Barry Webster	Shire President
Ms Liz Bushby	Planning Consultant for Shire Broomehill Tambellup (Gray and Lewis Land Use Planners)

Shire of Katanning

Michelle Stewart, Manager	Planning and Environmental Services

Department of Environment & Conservation

Mr Alan Kietzman	Industrial Regulation Officer, Northam

Office of the Environmental Protection Authority

Ms Leanne Thompson	A/Senior Environmental Officer Planning and Infrastructure Assessments Branch

Department of Transport – Regional Civil Aviation Safety Authority

Mr Michael Kennedy	Principal Policy Officer

Participating Landowners

Alex and Judy Cant

Cameron and Tracey Cant

Rocky Creek Pty Ltd, AJ Bilney Family Trust, represented by Michael and Shelley Bilney.

Yantecup Trust, John Maxwell Thorn Family Trust & Hillary May Thorn Family Trust represented by;

Geoff and Wendy Thorn and Lachie and Jayne Thorn

Dovercourt Pty Ltd represented by Ben Campbell-Wilson and Sarah Rankin

Neighbouring Landowners

Helen and Paul Bignell	Craig and Melanie Dennis
Brant Dennis	Nick and Stephanie Collins
Eileen O'Neill	Ian and Sue Palmer
David and Lyn Mathwin	Michael and Karin Hilder
Gloria Hilder	Sara Robinson (Banksia Heights Pty Ltd t/as Bignell Farms)
Will and Heather Carrington-Jones	David Kinsey
Alan and Narelle Goodall	Tim and Roz Tresize
Tim Mcnamarra (Wellard Agri Ltd)	Malcolm and Fiona Anderson
Derek and Helen Walker	Graham and Virginia Bakler
Geoff Reinke	Adrian and Nadine Bilney
Roger and Maree Bilney	Graham Blacklock
Andy and Leslie Hammat	Elizabeth and Peter Atkins (Owners of "Yarranup")
Peter and Sue Sheriden	Paul and Cathy Durack (Manager of "Yarranup")
Wayne and Jean Robinson	Hamish Thorn
Garry and Kate Sheriden	Michael and Liz Reynolds
Nigel and Marie Sheriden	Ray and Chris Schlueter
Rohan Thorn	Graham and Mark Zadow
Brett and Coral Green	Betty Parnell

Civil Aircraft Safety Authority

Mr Vas Saris	Aerodrome Inspector, Airways and Aerodromes Regulatory Division
Mr Greg Doherty	Aerodrome Inspector, Airways and Aerodromes Regulatory Division

Airservices Australia

Mr Steve Tattam	Airport Relations and Development Manager

Royal Flying Doctor Service

Capt Michael Blues	Chief Pilot

Royal Australian Air Force

Sqn Ldr Murray Sullivan	Operations RAAF Base Pearce

1.8 Relevant Legislation

There is no legislation dealing specifically with wind farm construction or operation in Western Australia, although a number of legislative and policy instruments are relevant.

Planning approval for the development is being sort from the Shire of Kojonup (Town Planning Scheme No.3) and the Shire of Broomehill Town Planning Scheme No. 1) Tambellup (Town Planning Scheme No 2) in land respectively zoned "Rural" and "Farming".

The proposal was referred to the Environmental Protection Authority (EPA) in January/February 2011. The EPA decision, "*Not Assessed – no advice given"*, was received in April 2011. This decision was open to appeal for 14 days and closed on the 2 May 2011 with no objections or appeals. Clearing of native vegetation, if necessary, will be the subject of an application to the Department of Conservation and Environment (DEC) for a Clearing Permit under the clearing provisions of the *Environmental Protection Act 1986.*

This report and associated planning application has been prepared in accordance with guidelines contained in Western Australian Planning Commission (WAPC) Planning Bulletin 67: *Guidelines for Wind Farm Development* (3) and in consideration of the *Draft National Wind Farm Development Guidelines* published by the Environmental Protection and Heritage Council, July 2010 (4). To date these draft guidelines have not been accepted by the WAPC. The visual impact assessment for the Flat Rocks wind farm has been undertaken with reference to WAPC – *Visual Landscape Planning in Western Australia – 2007* (5) and the Australian Wind Energy Association and the Australian Council of National Trusts – *Wind Farms and Landscape Values* (6).

2. PROJECT DESCRIPTION

2.1 Turbine Configuration

The actual turbine model to be used for the Flat Rocks wind farm is yet to be finalised. For the purposes of this report and attaining planning approval a hybrid approach was taken to ensure compliance with WAPC planning guidelines whilst illustrating the greatest potential impact of the proposed Flat Rocks wind farm. The Vestas V112 3MW turbine was used to assess the Zone of Visual Impact, Shadow Flicker, Landscape and Visual impact, Airspace Assessment and the potential for Electromagnetic interference. A hub height of 84m and blade radius of 56m results in the V112 tip height of 140m. The noise impact assessment was performed using the Vestas V100 1.8MW turbine based on an 80m hub height and 50m blade radius which equates to a tip height of 130m. Both turbines employ a three-blade, horizontal axis design. The final turbine choice will be made on the basis of commercial factors including price, power output and availability.

Each turbine comprises of three carbon fibre composite rotor blades, a nacelle, tower and concrete footing. The tower will consist of tubular steel segments and will be approximately 4m wide at the base and 3m wide at the top. The tower colour is expected to be a non-reflective off-white or grey. Figure 6 shows a generic elevation view of the turbine and tower.

Two types of footings are typically used for wind turbines:

- Gravity Footings -Where the sediments are unconsolidated and of adequate depth, a 3m thick concrete slab 17m in diameter is installed in an excavation so that the upper surface is 1m below ground surface and then backfilled with local soil.

- Pile-anchored Footings - Where hard rock is close to the surface, eight 15m holes are drilled and become rock anchors for a 2m by 7m thick slab. The surface of this slab remains exposed to allow routine inspection.

Precise ground conditions for each turbine location will be confirmed by geotechnical assessments undertaken during the detailed design phase.

A crane hardstand area will be required at the base of each turbine with approximate dimensions of 20m by 35m. The exact dimensions will depend on the construction requirements of the chosen turbine model. Hard standing areas need to be relatively level for the assembly and erection of the turbine elements. They will be retained after construction to facilitate future maintenance, repair or replacement of the turbine parts. A transformer will be located within each turbine and will convert the electricity generated to the site reticulation voltage.

2.2 Turbine Placement

Figure 3 shows the 74 wind turbine layout and the development envelope being considered for planning and development approval. This layout was based on wind data analysis and planning constraints such as noise and shadow flicker. In general, the wind turbines are placed on the highest points where winds are strongest and most reliable. Turbines are spaced to minimise airflow disruption from each other and maximize the power output from each turbine.

As the wind regime at the site is refined with additional wind data analysis and a final turbine model is selected, the locations of the wind turbines are likely to undergo minor modification or micrositing.

2.3 Access Roads

The wind farm will be accessed by the existing local road network. Where necessary, these roads will be upgraded to cope with the demands of trucks carrying the turbines and other equipment. Any such upgrading will be consistent with the Main Roads WA *Handbook of Environmental Practice for Road Construction and Maintenance*. MHE will discuss the requirements for road upgrading with the Shire of Kojonup and Shire of Broomehill Tambellup as required.

Within the wind farm, a dedicated network of gravel roads will be established to provide access to the turbines for construction, operation and maintenance. Wherever possible, the access roads will intersect the public road network via existing farm gates and access tracks, in order to minimise the need to clear roadside vegetation. The access tracks will be sited in cleared paddocks, in consultation with land owners in order to minimise interference with normal farming operations. The layout of the internal road network has not yet been determined.

Any vegetation clearing required for access road entries from public roads, will only be undertaken after a Clearing Permit has been obtained from the DEC.

2.4 Power Reticulation

The wind turbine generators will be connected by a combination of underground and overhead 33kV power lines. In general, gangs of up to 6 turbines will be joined by underground cables with overhead lines used to connect the gangs of turbines to the substation. The reticulation network will generally follow the shortest route between turbines and groups of turbines. The internal layout of the electrical network has not yet been finalised.

Both underground and overhead power lines will be routed predominantly through cleared paddocks. New poles similar to those used by Western Power in reticulating its 33kV network in the area will be used for all overhead power lines. Where it is necessary for lines to cross vegetation, farm fences or road verges, they will preferentially be installed underground by horizontal drilling so to remove the need for clearing. Where power lines must cross roads, MHE will liaise with local council regarding the timing of road closures so to minimise local traffic disruption.

An electrical substation will be constructed to house transformers required to feed the wind farm's output into the grid, as well as metering, control and circuit protection equipment. The substation will be securely fenced and monitored to prevent unauthorised access. Transformers that use oil for cooling will be bunded to capture spills and leaks. The location of the substation will be determined when the internal layout of the electrical network is finalised.

2.5 Ancillaries

A temporary construction compound, approximately 4ha, with site offices, vehicle and machinery parking, laydown area and concrete batching plant will be required during the construction of the wind farm. The location of the compound has not been finalised. The compound will be securely fenced.

Fuel and oil for cranes and earthmoving equipment may be stored on site. Any on-site storage will be in accordance with the Department of Water's *Water Quality Protection Note 58: Tanks for Temporary Elevated Fuel and Chemical Storage (2006)*.

The majority of the construction compound will be removed and rehabilitated following completion of construction, although a sub-area may be retained for future operational facilities.

An operations and maintenance building will be required to accommodate the equipment associated with the substation and wind turbine operation and for the supervision and data acquisition of the wind farm as a whole. The building will provide amenity facilities such as toilet (septic or dry composting type), kitchenette and storage for tools and spare parts. This will be suitably located in close proximity to the substation along with an employee car park. MHE will apply for all the necessary planning and building approvals once the location and design of this facility are finalised.

2.6 Project Construction

2.6.1 Construction Schedule

Construction of the wind farm is expected to start in late 2012 or early 2013, continuing for 18 to 24 months with delays. Construction will begin with the establishment of access roads. Installation of the towers and turbines will follow and is expected to continue for about twelve months.

The wind farm may be completed in stages, with a first stage of approximately 45% of turbines being commissioned by mid to late 2014 and the second stage being installed approximately 18 months later. This will depend upon market conditions at the time of installation.

2.6.2 Source of Materials

The wind turbines will be imported from overseas manufacturers. The turbine towers and ancillary materials and equipment such as power lines, buildings and control equipment will be sourced from within Australia where commercially feasible. MHE is committed to a shop local policy.

Road base (gravel) required for the access roads will be obtained either from excavations made for the turbine footings, from other sources located within the development envelope or from existing licensed pits in the Shire of Kojonup or Broomehill Tambellup. If private sources are to be used, applications for extraction licenses will be made to the Shires as required.

A mobile concrete batching plant to produce concrete for tower footings is likely to be located on the site during this process. Basic construction materials such as cement, aggregate and sand are required for the footings and will be obtained locally wherever possible, to minimise both transport costs and maximise benefits to the local community and economy.

Water will be required throughout the construction phase for concrete mixing, road construction and dust suppression. The quantities required throughout the construction phase will depend on the final number of turbines to be installed. Water quality will also vary with the purpose, ie the highest quality for concrete mixing and the lowest quality for dust suppression. Dust suppression water will be of a sufficient quality to not harm remnant or roadside vegetation.

The water requirements are expected to be met from a variety of sources, possibly including Scheme water from Carlecatup North Road (concrete mixing) and dam water or groundwater (dust suppression and road construction). The feasibility of using groundwater will depend on finding an economical source with suitable salinity. If groundwater is to be used, MHE will apply to the Department of Water for the necessary licenses.

If water from the Kojonup Katanning pipeline is used, on-site storage may be employed to provide for peak demand while regulating the draw on the pipeline.

2.6.3 Transport of Materials and Equipment

The wind turbines, towers, concrete and other materials will be transported to site by means of trucks using the existing public roads. The primary access to the site will be via Albany Highway, Tambellup West Road, Warrenup Road, Nookanellup South Road, Punchimirup South Road, O'Neill Road and Palomar Road. With the exception of the highway and Tambellup West Road, all of these roads are unsealed.

The heaviest vehicles using the roads will be the once-only delivery and later removal of a 600 tonne crawler crane and a 70 tonne crane. Other over-dimensional loads will include tower sections, turbine blades and nacelles, which will be delivered by large or extended articulated trucks, while other construction materials will be delivered by single-body trucks, truck and trailer or semi-trailers. The traffic volumes likely to be generated by a 74 turbine project over the construction phase are estimated below based on figures for the recently constructed Collgar Wind Farm. These will be finalised once the final turbine model and number is determined.

Material	*Vehicle Type*	*Round Trips*
Road base	$10m^3$ truck and trailer	4,044
Aggregate and sand	$10m^3$ truck and trailer	2,005
Cement	Semi trailer	503
Reinforcing steel	Semi trailer	75
Tower sections	Extended articulated truck	222
Turbine blades	Extended articulated truck	222
Nacelles	Heavy duty semi trailer	75
Employees and contractors	Car	27,247

Assuming a construction period of 18 months working five days per week, the average number of vehicle movements into and out of the site per day is estimated as:

Vehicle Type	*Trips Per Day*
Trucks for access road construction	25
Trucks for foundation construction	16
Trucks for turbine delivery and erection	8
Cars for employees and contractors	116

Traffic management measures will be implemented throughout construction to ensure the impact of this traffic on the public road network and local road users is minimised. Details of this management are provided in Section 5.6.4. Once operational the wind farm will have a negligible impact on local traffic and road maintenance as wind turbines are designed to operate with minimal maintenance. The only time heavy equipment would be required during the operating life of the wind farm will be for un-expected or rare events of repair or replacement of major components of the wind turbines or substation. Such events will generate increased traffic (including heavy vehicles) for short periods. Regular maintenance of the wind turbines will primarily occur inside the turbine, so access to the wind farm will by a 4WD or van similar to a typical farm vehicle. The wind farm may also encourage tourism to the area, which may cause a slight increase in local traffic. MHE will discuss this opportunity with the local council to ensure a suitable plan is established to ensure public safety and minimise the impact to local traffic.

2.7 Construction and Operation Workforce

During construction of the wind farm a work force of between 150 and 200 is estimated, depending on the staging of project. Typical project phases and their associated work groups may be:

- Final feasibility and site assessments including geotechnical, environmental, electrical and civil conducting investigative works;
- Early construction including civil works for roads and compounds involving as civil construction teams;
- Late construction including foundations, electrical cabling and turbine erection again involving teams for electrical, civil, and turbine specialists;
- Monitoring teams will have a presence throughout all construction including environmental and management teams.

The operational workforce will consist of management, support and maintenance staff, of 10 to 15 people.

The construction and operation workforce will abide by all occupational health and safety regulations, environment management plans, cultural and heritage management plan and any other laws, regulations and approvals that are applicable to this development in Western Australia.

2.8 Drainage

Drainage requirements for the wind farm will be minimal as the majority if the project area comprises of gentle sloping terrain. Access roads will be graded so that rain water runs off to the side of the track. Where access tracks cross drainage lines, culverts or floodways will be installed to maintain the existing drainage regime.

2.9 Project Lifetime

The Flat Rocks wind farm is designed for a 25 year working life, although the modern wind turbines have a nominal service life of 30 years. The overall project life may be extended by MHE with turbine refurbishment, following appropriate approvals from the local councils, as the turbines near the end of their serviceable life. The agreements held with landholders involved in the project provide for leases to be entered into for an initial 30 year term with an option to extend the lease for a further 20 years.

2.10 Refurbishment

Turbine refurbishment typically will occur after approximately 20-25 years of operation (or sooner if deemed economically viable), the nacelles and towers can be removed and replaced. Old nacelles and towers are removed from site for recycling. Nacelle replacement would potentially extend the life of the wind farm for a further 20 or so years.

Alternatively, at the end of their operational life all wind turbines will be decommissioned (see below), and new foundations, towers and nacelles installed in the same or nearby locations. Any material change to the wind farm layout, or significant changes to the turbine technology, will be discussed with the Shire of Kojonup and Broomehill Tambellup and any required permits sought. Refurbishment would also be subject to the regulations and guidelines of the day.

Refurbishment will require transportation and installation of equipment and facilities, similar to that used during the initial construction phase.

2.11 Decommissioning

At the end of the wind farms operational life, the turbines and all other above ground infrastructure on-site will be dismantled and removed. The tower bases would be cut back to below ploughing level or topsoil built up over the footing to achieve a similar result. The land will be returned to preconstruction condition (or as close as practicable) and use, in this instance broadacre farming.

Access tracks, if not required for farming purposes or fire access, would be removed and the area reinstated to preconstruction condition and use (or as close as practicable). Access gates, if not required for farming purposes, would be removed and fences re-instated.

The underground cables used to link the turbines during operation are well below ploughing depth and as they contain no harmful substances will be left in the ground. If economically attractive and environmentally acceptable these cables may be recovered. Terminal connections would be cut back to below ploughing levels.

The cost of all decommissioning work is the responsibility of the wind farm owner and subject to the relevant regulations of the day. It has been shown in Europe that the sale of scrap metal and other valuable items salvaged from the turbines and electrical components are able to meet the majority, if not all, of costs associated decommissioning.

3. EXISTING ENVIRONMENT

3.1 Climate

As the proposed wind farm is only 35km from Kojonup average climatic conditions for the development area are based on Kojonup statistics. Kojonup has a warm Mediterranean climate with, cool winters and long, dry, warm to hot summers. Average maximum temperatures range from 29.5°C in January to 14.4°C in July, while minima temperatures range from 13.7°C in February to 5.6°C in August (7).

The average annual rainfall for Kojonup is 527.9 mm, the majority of which falls between the months of May and September.

The winds in the Flat Rocks area are dominated by north-easterlies to south-easterlies in the mornings and by south-westerlies and south-easterlies in the afternoon. The prevailing winds vary somewhat throughout the year, particularly in the afternoons, with south- easterlies dominating in late summer/autumn, north-westerlies in winter and south- westerlies in spring/early summer.

MHE has carried out detailed computer-aided mapping of wind speeds in the vicinity of the project area as part of the feasibility planning of the wind farm project. This mapping has been validated by on-site data from wind measurement towers collecting detailed real-time data on wind speeds at the height of the turbines, which are generally significantly greater than the wind speed at ground- based meteorological stations. Wind monitoring to establish the viability of this resource has been undertaken at the site since May 2008.

3.2 Topography

The landscape in the vicinity of the project area is gently undulating farmland with scattered patches of native vegetation and remnant Eucalypts and Sheoaks in paddocks and roadsides. The land is 85% cleared. The land grades generally at 0-5% with occasional 5-10% slopes. Flats are virtually absent, both on hilltops and valley floors. Shallow creek-lines lie in broad shallow valleys with the land draining generally towards the south. Land elevations in the area range from 280m to 390m AHD. The general location of the wind farm is elevated above the surrounding landscape. Figure 3 – Landform, of the Flat Rocks Landscape and Visual Assessment Report (Appendix F) shows the topography of the project area.

3.3 Hydrology

There are no permanent watercourses in the project area, although there are a number of defined drainage lines and gullies. The largest of these carry surface flow for several months after winter rain and then form permanent pools over the summer and warmer months. The porous soils and low slopes of the project area mean that runoff would occur only during and shortly after intense rainfall.

The project is located within the Gordon River Catchment system. There are four creeks which flow into the Gordon River, the Wadjekanup River, Uannup Brook, Slab Hut Gully and Cowenup Brook. The Slab Hut Gully commences in the southern section of the development site.

There are some minor areas of salt scalding and saline seepage within the project area but the area is largely free of salinity, probably due in part to its elevation.

The project will not have any significant effect on drainage or groundwater recharge.

3.4 Environmentally Sensitive Areas

Two nature reserves exist close to the development area;

- Ngopitchup Nature Reserve: area 40.4685ha, located 670m north-west of nearest WTG 43.
- Ngopitchup Swamp: area 40.4686ha, located 590m west of nearest WTG 35.

Neither of these nature reserves will be affected by the construction or operation of the wind farm.

There are no other known environmentally sensitive areas in the vicinity of the proposed project area.

3.5 Vegetation and Flora

The Flat Rocks area, including the project area, is gently undulating farmland that is 85% cleared with scattered patches of native vegetation and remnant Eucalypts and Sheoaks in paddocks and roadsides.

A flora, vegetation and fauna assessment of the project area was undertaken in by Mattiske Consulting Pty Ltd, November 2010. As the proposed wind farm development occurs in primarily cleared agricultural areas, the assessment concentrated on desktop reviews and an assessment of the main remnants and road side vegetation that may be disturbed by vehicle movement and installation of the wind farm facilities. Two experienced biologists completed a site assessment on 29th September to 1st October 2010. The findings of the survey are detailed in Appendix A and summarised below.

3.5.1 Vegetation Type and Condition

Five vegetation communities were defined and mapped within the Flat Rocks Wind Farm survey area. These communities are summarised below:

- Mosaic of Open Woodland of *Eucalyptus rudis* subsp. *rudis –Acacia acuminata - Melaleuca rhaphiophylla* with patches of *Melaleuca cuticularis* over introduced grasses and Chenopod Shrubland of *Tecticornia lepidosperma* over introduced grasses on saline clays and sandy-clays in creeklines.
- Open Woodland of Eucalyptus rudis subsp. rudis – Melaleuca rhaphiophylla over Acacia saligna, Acacia acuminata, Jacksonia sternbergiana over Ficinia nodosa and introduced grasses on sandy-loams and clay-loams on fringes of creeklines.
- Woodland of Eucalyptus wandoo with patches and mixtures of Eucalyptus marginata subsp. marginata – Corymbia calophylla abuting Eucalyptus loxophleba subsp. loxophleba on sandy gravels and Allocasuarina huegeliana on granites over low shrubs of Acacia lasiocarpa var. sedifolia, Bossiaea eriocarpa, Gastrolobium praemorsum, Astrioloma compactum, Acacia pulchella, Hibbertia commutata over low sedges and annuals on sandy-loam gravels on mid and upper slopes.
- Woodland of *Eucalyptus wandoo* with patches of *Allocasuarina huegeliana* over low subshrubs and introduced grasses on sandy soils and near shallow granites on mid and upper slopes.
- Woodland of *Eucalyptus astringen*s subsp. *astringens – Eucalyptus wandoo* on sandy-loam and some *Eucalyptus marginata* subsp. *marginata* over subshrubs and introduced grasses on sandy-loams on slopes.

No threatened ecological communities as defined by the EPBC Act (1999) or the Department of Environment and Conservation (2010c) were located in this survey area.

The plant communities were very disturbed and had been largely grazed or cleared. Consequently the majority of the survey area is completely degraded or degraded.

3.5.2 Flora

A total of 77 vascular plant taxa from 59 plant genera and 22 plant families were recorded within the Flat Rocks Wind Farm survey area 2010. The majority of taxa was recorded within the Poaceae (15 taxa), Myrtaceae (13 taxa), Fabaceae (9 taxa), and Asteraceae (9 taxa) families.

A total of 23 introduced (exotic) taxa were recorded within the Flat Rocks survey area. Of these only one species is a Declared Plants species pursuant to section 37 of the *Agricultural and Related Resources Protection Act 1976* according to the Western Australian Department of Agriculture and Food (2010).

Asparagus asparagoides has a Declared Plant status of P1 for the whole state (Department of Agriculture and Food 2009). A Declared Plant status of P1 prohibits the movement within the State, specifically governing the movement of contaminated machinery and produce including livestock and fodder (Appendix A5; Department of Agriculture and Food 2010).

3.5.3 Rare and Priority Flora

There were no Declared Rare and Priority Flora species pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA] and as listed by the Department of Environment and Conservation (2010a) that were recorded within the Flat Rocks Wind Farm survey area.

No plant taxa listed as Threatened pursuant to Schedule 1 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (Department of the Sustainability, Environment, Water, Population and Communities 2010a) were recorded during the survey within the proposed Flat Rocks Wind Farm survey area.

3.6 Fauna

The general fauna of the project area is depauperate as a result of heavy clearing and fragmentation of the remaining vegetation due to the prominence of broadacre agriculture in the area. In spite of this a number of native species remain.

A fauna assessment was undertaken by two experienced Biologists from Mattiske Consulting Pty Ltd in late September 2010. The findings of this assessment are detailed in Appendix A and summarised below.

3.6.1 Overview

A NatureMap search of the Flat Rocks Wind Farm area (within a 20km radius of the survey area) revealed a total of 54 fauna taxa, including both vertebrates and invertebrates that have been recorded within the survey area (Department of Environment and Conservation 2010f). A total of 170 species have been listed as potentially occurring within a 20km radius of Flat Rocks Wind Farm (Department of Environment and Conservation 2010f).

3.6.2 Rare and Significant Fauna

A total of 15 protected fauna species were revealed from a NatureMap database search (Department of Environment and Conservation 2010f), including five birds and 10 mammals. Of these fauna species, one is extinct or likely to be extinct, nine are Threatened, three are Priority 4 and two are Priority 5 pursuant to subsection (2) of section 23F of the *Wildlife Conservation Act (1950)* [WA], the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) and the International Union for Conservation of Nature and Natural Resources' Red List.

Discussions were held with Ron Johnstone from the W.A. Museum in regard to the cockatoo species that may occur in the area and the potential for them to be impacted on by the Flat Rocks wind farm. Results of these discussions revealed that the Carnaby's Cockatoo is the most likely cockatoo to occur in the project area. In terms of risks to the Carnaby's Cockatoo and the wind farm, Ron stated that in his opinion the risk of these cockatoos flying into the wind turbine is very low (personal communication between Dr Libby Mattiske and Ron Johnstone, 15 March 2011). The wind farm occurs on the fringes of the other two Cockatoos (Red-Tailed and Baudin) and consequently the potential remains very low for these two species. On the basis of previous studies it appears that the Carnaby's Cockatoo has reasonable night vision and therefore will avoid obstacles. Current studies in areas supporting Cockatoos both north of Perth and near Albany have indicated that these species tend to avoid wind farm facilities and therefore the risk to them remains very low.

Although a range of potential fauna values were sourced from the desktop assessment of potential rare and threatened species; in view of the degree of degradation, unless remnant areas are likely to be disturbed there should not be any significant issues in relation to the native fauna species and the development of the Flat Rocks wind farm.

3.6.3 Habitat Connectivity

The area proposed for the wind farm is located within largely cleared agricultural land and as such is unlikely to provide any substantial nesting or foraging sites. The remnant vegetation that does occur is restricted to the degraded valley floors and as such is influenced by local salinity and degraded soils. Several smaller remnants occur on the edges of the proposal area, but will not be influenced by the proposed development.

In the highly modified Wheatbelt all areas of remnant native vegetation are significant from a conservation perspective. The proposed areas for the wind turbines of the Flat Rocks Wind Farm project are located almost entirely within cleared farmland and therefore will have a very low impact on native vegetation or native fauna habitats or native species. In the case that clearing of remnant vegetation is unavoidable (e.g. for access points from public roads), it is recommended that effort be made to minimise clearing by routing access points through existing gaps in vegetation such as farm gates or within remnants that do not support significant patches of native species.

To minimise impacts on the environment at all times vehicle hygiene measures should be maintained such as vehicle inspections and under vehicle clearing to minimize the spread of weeds and introduced species in the project area. This survey identified twenty three exotic species however the total number of exotic species is expected to be higher over the entire proposed wind farm area because our survey focused only on patches of remnant vegetation, not the highly disturbed cleared agricultural land.

In summary, there should be no impediments to the development of the wind farm facilities in the area surveyed providing the remnant vegetation areas (including less disturbed road verges) are not disturbed.

3.7 Social Environment

3.7.1 Existing Land Uses

The project is situated within a broadacre farming area, with individual landholdings ranging in size from a few hundred to several thousand hectares. The predominant land uses are mixed cropping and livestock production, mainly sheep. The construction and operation of the wind farm will not interfere significantly with the existing land use once the wind farm is operational. All land owners whose properties will host turbines are financial participants in the project.

3.7.2 Nearby Residences

There are a number of farm homesteads located in and around the project area, as shown in Figure 7. The location of all of these residences has been considered in all impact assessments and design of the wind farm.

3.8 Aboriginal Heritage

An ethnographic survey of the project area was undertaken in August 2010 by R. & E. O'Connor Pty Ltd. An archaeological survey was undertaken in September 2010 by John B. Cecchi on behalf of R. & E. O'Connor Pty Ltd. The surveys included searches of the Department of Indigenous Affairs' online Aboriginal Sites Database, consultation and site visits in conjunction with representatives of the local indigenous community, and detailed searches of the project area.

The findings of the ethnographic and archaeological surveys are detailed in Appendix B and C, respectively. Both reports are summarised in the next sections.

3.8.1 Ethnography

The DIA Online Aboriginal Sites Database shows no Aboriginal ethnographic sites listed in the survey area. Two registered sites were found in close proximately to the development site, but will have no effect on the proposed FRWF;

- Site Number 5354, "Tambellup Gnamma", a water source site listed on the Permanent Register under Open Access. Location 237640/6236647 and
- Site Number 5738, "Tambellup", an artifact scatter site recorded on the Permanent Register under open access. Location 541640/6236647.

The development site is covered by two applications for determination of native title, namely the Wagyl Kaip claim, Number WC98/70 (Federal Court File Number WAD6286/98) and the Southern Noogar claim WC96/109 (Federal Court File Number WAD6134/98). There is also an active Aboriginal Progress Association in Kojonup, whose members were consulted regarding the heritage of the development site. All of the consulted parties claimed to have both authority to speak for the development area and also to have traditional knowledge of the area. During visits to the proposed development site on the 4th and 5th of September 2010, the indigenous representatives were satisfied that the Flat Rocks wind farm project area contains no sacred or significant Aboriginal heritage sites. Accordingly they signed a form approving the Project.

The ethnographic report recommends that Aboriginal heritage considerations should not be deemed an impediment to the establishment of the proposed Flat Rocks wind farm.

3.8.2 Archaeology

The DIA Online Aboriginal Sites Database shows no known archaeological sites in or near the project area, other than the two listed above.

A site survey consisting of walked and vehicular traverses of the project area found no signs on any archaeological sites or material. The archaeological report recommends that there is no impediment on archaeological grounds to the Flat Rocks wind farm project proceeding.

If during project construction or operation, any archaeological material is discovered, MHE will comply with the requirements of the *Aboriginal Heritage Act 1972.*

4. ENVIRONMENTAL IMPACTS AND MANAGEMENT

4.1 Identification of Key Environmental Factors

A scoping exercise has been carried out to identify the significant environmental and social factors applying to the project. This exercise has included:

- consideration of the location, design, construction and operation of the project;
- review of policies, previous studies relevant to the Kojonup and Broomehill Tambellup area and experience of previous wind farm projects in Western Australia and elsewhere;
- consultation with relevant government agencies and local stakeholders including landowners, neighbours and the broader community in the area; and
- environmental field surveys and impact studies of the project area.

As a result of the scoping exercise, the following have been identified as the key environmental and social issues to be addressed in the design, construction and operation of the project;

- Minimising vegetation clearance and protection of rare or otherwise significant vegetation communities and species during project construction and operation.
- Protection of significant fauna and fauna habitats during project construction and operation.
- Alteration of the visual landscape of the site and surroundings.
- Potential noise impacts on neighbouring residents during construction and operation.
- Impact of construction and operation of the project on local traffic and the safety of other road users.
- Potential shadow flicker impacts on neighbouring residents during operation
- Development of a Fire Hazard and Management Plan and Emergency Response Plan

4.2 Vegetation and Flora

Impact

The project is located almost entirely within cleared farmland and as such will have an extremely low impact on native vegetation. The current turbine layout indicates that the total clearing required for the project is expected to be less than 1ha, consisting of unavoidable clearing for new access points from public roads. Considerable effort will be made in the final turbine layout to minimise clearing by routing access points through existing farm gates and gaps in vegetation.

Management

Measures will be taken in the establishment and use of the access roads to ensure that weeds and plant diseases are not introduced to or spread within the project area.

4.3 Fauna and Habitats

4.3.1 Loss of Habitat

Impact

The construction of the wind farm will have negligible impact on fauna habitats due to the extremely low level of clearing. The total loss of habitat is expected to be less than 1ha.

Management

MHE will endeavour at all times to minimise the requirement for access tracks to cross vegetated road verges. Where such crossings are unavoidable, they will be sited to avoid impacting mature trees.

4.3.2 Operational Hazards to Fauna

Impact

The following description of wind farm hazards to fauna is drawn from a number of sources including AWEA (8), Kevin Mills & Associates (9), Smales (10), Smales *et al.* (11) and Brett Lane & Associates (12).

Wind farms may affect birds and bats by:

- direct mortality due to collision with the towers or rotor blades; and
- disturbance to habitats and flight paths due to birds or bats having to make wide detours to avoid clusters of wind turbines.

Investigations in Australia and overseas have shown that the types of birds at most risk from collisions with wind turbine blades are:

- wetland birds that form large flocks;
- migratory birds that follow defined flight paths;
- night-flying birds;
- birds of prey; and
- species that flock and fly above the tree canopy (8).

The likelihood of collision mortality is highly dependent on the siting of wind farms and the characteristics of the relevant bird and bat species. The greatest impacts appear to occur near large wetlands and on important migration routes, where large flocks of birds congregate. Particular risk areas are those where flight paths are concentrated or channelled, such as coastlines or gaps in mountain ranges. Bird species that fly at the rotor height, particularly those that tend to hover or circle, are at greater risk than those that tend to fly below or above rotor height (10).

From the above it can be concluded that the lowest risk sites for wind farms in terms of bird and bat strikes are those which are located on open ground (e.g. farm paddocks) well removed from wetlands, forest and other important feeding and roosting habitats, and away from migratory routes and other flight paths. The Flat Rocks wind farm site fits this description, and consequently is expected to have a relatively low incidence of bird and bat mortality.

Relatively little research has been done on the risk of bird and bat collisions with wind turbines in Australia. What local research exists suggests that collision rates are generally between one and four birds per turbine per year (12,13) undertook a study of bird deaths at the Codrington wind farm in Victoria. The results suggested a rate of 1.2 to 2.7 bird deaths per turbine per year. All observed fatalities were of common and widespread species. Of particular concern for the Flat Rocks wind farm was the nearby presence of the Carnaby's Cockatoo. Ron Johnstone from the W.A. Museum, an expert on the local cockatoos, stated that in his opinion the risk of blade strike to these birds was very low as they have reasonable night vision and will avoid the wind turbines.

Research in Australia suggests that the mortality rates at Australian wind farms are lower than in the northern hemisphere. This may be due to the absence from Australia of large populations of night-migrating songbirds, which make up about half of the birds that collide with wind turbines in the northern hemisphere (8).

In addition to the hazard posed to birds and bats by the turbines, fauna such as kangaroos may be at risk from traffic using internal access roads. The risk in this case is similar to that posed to fauna by normal traffic on public roads in the area. Post-construction traffic movements will be very low; a maximum of up to15 people will be required as maintenance and servicing crew.

Management

MHE will take steps to reduce the potential for bird and bat deaths. These will include:

- Fully enclosing the turbine towers, ie no sites for perching or nesting.
- The turbines will be unlit (except possibly for LED safety lights for aircraft, depending upon CASA recommendations), to avoid attracting owls and bats.
- No tall buildings, poles or other structures that could provide perching sites for birds of prey will be constructed within 200m of the turbines.
- Vehicles travelling on internal access roads will be limited to a maximum speed of
- 40km/h at all times in order to minimise the risk of collisions with fauna.

4.4 Noise

Impact

Advances in the technology of wind turbine rotor blades and generators in recent years have significantly reduced noise emissions and the level of public nuisance caused by wind farms. The sound emitted by wind turbines are mainly of an aerodynamic nature due to the rotor blades moving through the air. As each blade passes the tower it generates a slight local pressure change that may cause a sound. The sound output of wind turbines is dependent on the actual wind speed; in general, the higher the wind speed the higher the sound output of the turbine. However, higher wind speeds also create higher levels of background noise (both aerodynamic and from other sources such as vegetation), so wind turbine noise tends to be less intrusive at higher speeds.

A background noise monitoring program was undertaken by Herring Storer Acoustics at in December 2010 to January 2011, in and around the project site. The findings of the February 2011 report are detailed in Appendix D and summarised below.

Background noise levels were monitored at eleven locations in and around the proposed development area in accordance with the Guidelines and AS4959-2010. A map of the logger locations is attached in the report.

Monitored noise levels were then paired with corresponding wind data, provided by the wind monitoring station located within the development by MHE (located at a height of approximately 80 metres above ground level – proposed hub height).

Rain affected data was removed from the collected data using weather information provided by the Department of Agriculture's Automatic Weather Station, located within the Kojonup district.

Background noise levels were plotted against the corresponding wind speed measurement.

The relevant regression line providing the best correlation co-efficient for each location was determined (from linear to third order). The calculated regression line equations were then used to ascertain the background noise ($L_{A90,10\ minutes}$) at each integer wind speed to determine the relevant noise criteria for the wind farm development, which should not exceed whichever is the greater of;

- 35 dB(A), or
- The background noise ($L_{A90,10\ minutes}$) by more than 5 dB(A).

Background noise monitoring regression analysis results for each of the eleven locations and time history charts are presented in the attached report.

It is noted that the noise criteria has been referenced to wind speeds at the proposed wind turbine generator hub height (80m), as stated in AS 4959-2010. This ensures a conservative result in the determination of the noise criterion, as hub height wind speeds are generally higher than those at 1.5m above ground level (microphone height), which results in measured noise levels being related to those that are higher than what is being encountered at microphone height.

A noise impact assessment of the proposed 74 turbine layout was undertaken by Herring Storer Acoustics in June 2011. The findings of this study are attached in Appendix E and summarised below.

According to the Western Australian Planning bulletin number 67 *"Guidelines for Wind Farm Development*" – (May 2004), the noise impact of proposed wind farms in Western Australia should be assessed in accordance with the criteria and approach of assessing wind farms described in the EPA of South Australia *"Wind Farms – Environmental noise guidelines (interim) – December 2007"* (Guidelines).

The Guidelines recommend the following criteria for the assessment of noise levels associated with proposed wind farms;

The predicted equivalent noise level ($L_{Aeq\ ,10\ minutes}$), adjusted for tonality in accordance with the Guidelines, should not exceed:

- 35 dB(A), or
- 40 dB(A) in a primary production / rural industry zone, or
- the "Alternative Minimum Criteria" (Varying With Wind Speed); or
- the background noise ($L_{A90,10\ minutes}$) by more than 5 dB(A).

The criteria for background noise levels will vary with wind speed, as will wind turbine generated noise.

Noise levels at 11 identified receiver points near the proposed wind farm were modeled using the computer program "SoundPlan" version 7.0. The following input data was used in the SoundPlan model:

a) Topographical Information – Ground contours of the development area
b) Residential and Wind Turbine Locations
c) Sound Power Levels, varying with wind speed, of the wind turbines intended to be utilised (Vestas V100-1.8 MW, 80m hub height)

The Guidelines indicate that noise emissions should be modelled to reflect typical, (but not extreme) "worst case" meteorological conditions for sound propagation towards the receiver.

After a review of the literature available on the subject, noise level emissions were modelled using the ISO 9613-2:1996 algorithm. These conditions, and calculating noise levels utilising a "G=0" ground absorption have been found to provide a generally realistic and conservative assessment of noise levels associated with wind turbines.

The worst-case noise contours produced by the noise study are shown in the attached report.

Noise emissions at all "non-stake holders" residences have been calculated to comply with the background noise criteria under all wind conditions.

Noise levels at "stake holders" SH27 (0.7dB) and SH28 (0.5dB) residences have been calculated to marginally exceed the background noise criteria for 8m/s at hub height (80m). Both landowners have been contacted and as noise limits are still below 40dB, neither is concerned by the results.

Management

MHE has modified the wind farm layout in light of the preliminary noise modelling results to ensure that non-stake holder residences comply with the WAPC guidelines (3). MHE deleted and relocated proposed turbines in the southern section of the project area after the Shire of Kojonup advised MHE of a planning application for a future residence.

MHE will record and respond to any public complaints received about noise throughout the lifetime of the wind farm.

4.5 Landscape and Visual Impacts

Landscape impacts relate to the effects of the proposed wind farm on the physical and environmental characteristics of the landscape and its resulting character and quality. Visual impacts refer to the effects on views experienced by visual receptors (e.g. residents, tourists or motorists) and on the visual amenity experienced by those people.

A Landscape and Visual Impact Assessment (LVIA) consisting of both desktop assessment and field surveys was undertaken by William James Landscape Architects to determine the impacts Flat Rocks wind farm on the regional landscape and on neighbours. The results of this survey are detailed in Appendix F and summarised below.

4.5.1 Visibility

The turbines will be the most visible elements of the wind farm development. The other structures and infrastructure, apart from the transmission line, will only be visible from within the development itself.

MHE commissioned GL Garrad Hassan to undertake a Zone of Visual Influence (ZVI) study of the Flat Rocks wind farm. The full report is presented in Appendix G and summarised in the LVIA report.

The ZVI maps show locations from which varying numbers of turbines would be visible if there was an unobstructed line of sight from each turbine to the viewer, except for blockages caused by terrain, including due to the curvature of the earth. It does not take into consideration other obstacles such as intervening vegetation, buildings or other structures, weather induced visibility reducers such as fog or haze, physical limitations of the human eye or visual cognition response of the observer. There are two ZVI maps in the report, one showing visible tips of blades at the top of the rotation, and the other showing the hubs. As you would expect with the greater height, the map showing blade tips has an increased visibility, than that of hub height. The ZVIs are predicted using digital landform information only (2m and 10m resolution height contours) and the turbine specifications of the Vestas V112, 3 MW turbines.

The ZVI is a useful tool for identifying the places from which the turbines may be visible. It does not show how much of the turbines will be seen apart from whether only the blades are seen or blades and towers.

The ZVI should not be interpreted as a map of the visibility of the turbines or, more importantly, as an indicator of the visual impact of the turbines. It is an indication of possible visibility.

The impact of the wind farm on views is represented in the renderings and photo-simulations included in the full Landscape and Visual Assessment report. The renderings and photo simulations represent the appearance of the wind farm from selected locations in the middle of a clear day in summer. In real life the appearance will constantly change with atmospheric conditions, the time of day, the weather and the seasons. Changes of longer duration will result from the growth, decay and death of intervening vegetation.

The locations chosen were to illustrate the key views and a representative sample of typical viewing locations where there were likely to be views of the wind farm. Key viewpoints were identified based on the extent of potential visibility of the wind farm and using the results from consultation and natural and cultural values. Several of the locations – 1, 4 and 8 were nominated by the Shires of Kojonup and Broomehill Tambellup.

The renderings and photo simulations demonstrate that wind turbines will be highly visible from certain locations, barely visible from others and not visible from others. They also demonstrate that from no single location will all of the turbines be visible at once.

Impact

The degree of change to landscape values is low when viewed from the Albany Highway, the only Sensitivity Level One travel route that provides views of the wind farm. They are visible only in the Background.

From the Level 2 roads the wind farm will result in a moderate level of change to landscape values. This results from the proximity of turbines to the roads – turbines are visible within the Foreground and Close Middleground.

Turbines are visible in the Foreground and Close Middleground from Level 3 and 4 roads. The local government Planning Schemes provide little guidance in managing landscape values. The state government has provided guidance for minimising the visual impact of wind farms through Planning Bulleting 76 “Guidelines for Wind Farm Development” and the WAPC “Visual Landscape Planning Manual”.

The Flat Rocks wind farm will have moderate impact on landscape character and low impact on significance.

Management

The application of the following general planning and design principles helps to minimise the impacts of the wind farm (Planning Bulleting 76 “Guidelines for Wind Farm Development”- (3).

- Ensure all turbines look alike, have a clean, sleek appearance and that the blades rotate in the same direction.
- Minimise the number of turbines, as appropriate, by using the largest possible model rather than numerous small ones.
- Site the turbines, ancillary buildings, access roads and transmission infrastructure to complement natural landform contours.
- Ensure the choice of materials and colour (e.g. off white and grey for turbines, low contrast for roads) for the development complements the skyline and the backdrop of the view sheds.

- Minimise removal of vegetation and use advanced planting and vegetation screens as visual buffers where appropriate.
- Ensure good quality vegetation and landform rehabilitation, on-site and off-site, where appropriate.
- Locate turbines to reflect landscape and topographical features (in this case a random pattern will suit a rolling, varied landform).
- Avoid clutter, such as advertisements and apparatus.

The neighbour level assessment indicates that some neighbouring residences will experience no visual impacts while others will experience low and moderate impacts. Some neighbouring residences may require planting. This would be done by the proponents in consultation with the affected neighbours.

The turbines will have a low to moderate impact on values experienced from local roads. Where the turbines are within the foreground of the view from local roads and there is no roadside vegetation between the road and the turbine it is recommended to either relocate the turbines or plant screening vegetation adjacent to the road reserve.

4.5.2 Shadow Flicker

A shadow flicker assessment of the Flat Rocks wind farm was undertaken by GL Garrad Hassan in May 2011. The findings of this assessment are detailed in Appendix H and summarised below. The report assessed the shadow flicker of the proposed 74 turbine layout using the dimensions of the Vestas V112, 3MW turbine.

Impact

Shadow flicker involves the modulation of light levels resulting from the periodic passage of a rotating wind turbine blade between the sun and an observer. The duration of shadow flicker experienced at a specific location can be determined using geometric analysis which considers the relative positions of the sun throughout the year, the wind turbines at the site and the viewer. It should be noted that this method tends to be conservative and over estimates the number of hours of shadow flicker experienced (14). As such, the report attempts to quantify the likely reduction in shadow flicker duration due to turbine orientation and cloud cover, and produce an actual shadow flicker duration prediction likely to be experienced at each dwelling.

The impact of shadow flicker is typically only significant up to a distance of around 10 rotor diameters or 1120m, beyond this distance the shadow is diffused to point where the variation in light levels is not likely to cause annoyance. Shadow flicker is most noticeable when it occurs inside buildings. The likelihood and duration of shadow flicker depends upon a number of factors, including:

- Direction of the property relative to the turbine
- Distance from the turbine (the further away from the turbine the less pronounced the effect)
- Wind direction (the shape of the shadow will be determined by the position of the sun relative to the blades which will be orientated to face the wind)
- Turbine height and rotor diameter
- Time of year and day (ie the position of the sun in the sky)
- Weather conditions (cloud cover reduces the occurrence of shadow flicker)

Western Australia has no specific guidelines on the assessment of shadow flicker, a number of assessments throughout Australia have applied the Victorian Planning Guidelines (15) recommending a shadow flicker limit of 30 hours per year in the area immediately surrounding a dwelling. In addition, the EPHC Draft National Wind Farm Development Guidelines (DNWFG) (4) recommend a limit on the theoretical shadow flicker duration of 30 hours per year, and an actual limit on the actual shadow flicker duration of 10 hours per year.

The assessment of theoretical shadow flicker duration shows that all dwellings identified in close proximity to the proposed wind farm experienced theoretical shadow flicker duration below the recommended limit of 30 hours per year as per DNWFG (4) and Victorian Guidelines (15).

Approximation of the degree of conservatism associated with the worst case results was conducted by calculating the possible reduction in shadow flicker duration due to turbine orientation and cloud cover. This analysis shows that all dwellings identified by MHE are predicted to experience actual shadow flicker duration below the limit of 10 hours as per DNWFG (4).

This calculation does not take into account any reduction due to low wind speed, vegetation or other shielding effects around each residence. Therefore values may still be regarded as conservative.

Management

MHE has modified the wind farm layout to ensure that residences owned by non-stake holders in the project are not affected by shadow flicker as per the DNWFG (4) and in accordance with the W A P C guidelines (3).

MHE will record and respond to any public complaints received about shadow flicker throughout the lifetime of the wind farm.

4.5.3 Blade Glint

Impact

Blade glint is caused by sunlight reflecting off the turbine blades towards an observer. Blade glint may occur at any sun angle or time of day, although its occurrence is sporadic and generally short-lived due to changes in sun angle and wind direction. The majority of blade glint occurs where the viewer is located above the altitude of the turbine hub.

Blade glint occurs most often in wind farms with large numbers of turbines. It can be perceived over considerable distances. Blade glint is dependent on the reflectivity of the blades, which is influenced by the colour, finish and age of the blade. It is most notable with new turbines, and typically diminishes after a few months when the blades have become dulled by weathering.

Blade glint can be distracting to drivers if roads are aligned towards turbines, particularly where the road is at a higher altitude than the turbine hub.

Management

The turbines installed at the Flat Rocks wind farm will have blades of a low gloss (~30%) off-white or pale grey colour that will reduce the potential for glint to occur. This, and the absence of viewpoints higher than the turbine hubs, will minimise the potential for blade glint to occur.

4.6 Construction Impacts

4.6.1 Construction Noise and Dust

Impact

The wind farm is sufficiently remote from houses and other sensitive receptors that noise and dust impacts during construction will not be significant. Broadacre livestock and cropping areas are normally subject to periodic high noise levels due to operation of farm machinery, trucks and aircraft. The noise levels generated by the construction activities will be comparable to those generated by normal farming activities.

The most significant source of construction phase noise will be the movement of heavy trucks transporting the turbine components. This noise will be short-term and intermittent.

Dust could be generated by the movement of traffic along the unsealed public roads and internal access roads.

Management

Construction activities will generally be confined to daylight hours on weekdays, although some weekend work might occur during critical periods. MHE will comply with the *Environmental Protection (Noise) Regulations 1997* at all times.

Dust suppression watering will be carried out on the internal access roads and possibly unsealed public roads during construction in dry conditions to control the generation of dust. MHE will consult with the Shire on management of the impacts of dust during construction.

4.6.2 Erosion

Impact

Water or wind erosion could occur on access tracks, construction sites and other disturbed areas. Given the generally low gradients and soils of the project area, the potential for water erosion is low.

Management

All access roads within the project area will be appropriately constructed, graded and drained to minimise erosion. Access roads will be designed so that runoff is shed to the sides of the road, where it will infiltrate or dissipate. Where necessary, roadside bunds and swales will be provided to intercept and infiltrate runoff.

MHE will carry out a pre-construction survey of the public roads within the project area and will maintain and, if necessary, repair or upgrade the roads throughout the construction program to ensure that they remain at least in the condition they were prior to construction. MHE will discuss requirements for road upgrading and repair with the Shire of Kojonup and Broomehill Tambellup.

4.6.3 Weeds

Impact

Weeds, plant material or seeds could be introduced to or spread within the project area through the importation of fill (e.g. road base) or the movement of vehicles.

Management

MHE will ensure, through appropriate supply contract conditions, that all fill imported into the project area is obtained from weed-free sources.

MHE will consult with landowners before the commencement of site works on the location of known weed infestations and will implement measures, including inspection and/or under-vehicle cleaning by water or compressed air, of vehicles leaving infested areas, to ensure that weeds are not spread within the project area. All procedures will be detailed in a Biosecurity Plan.

If new weed infestations are discovered in the project that are attributable to construction activities, MHE will arrange treatment using accepted methods.

4.6.4 Traffic

Impact

The construction program will generate significant traffic by light and heavy vehicles on public roads within and around the project area for a period of approximately 18 to 24 months. This traffic will range from light utility and passenger vehicles up to multiple- axle extended articulated vehicles carrying turbine components.

As the construction program is expected to continue through all seasons, this traffic has potential to interfere with the movement of grain trucks and farm machinery during the harvest and seeding seasons.

Management

The most suitable access routes will be selected in order to reduce the effect of the construction and operational traffic upon the locality. Access requirements for oversize loads will be discussed with the relevant authorities in order that all requirements can be put into place prior to construction.

MHE will consult with the Shires of Kojonup and Broomehill Tambellup, local farmers and local police to agree ways to minimise conflict between construction, public and local traffic, in particular School Bus services. Measures might include:

- Scheduling of heavy deliveries for early and late in the day, when harvesting is generally not occurring (due to moisture levels and grain receival point operating hours).

- Liaison with local School Bus contractors to ensure all routes and times are known and avoided.

- Provision of police or other escorts for oversize loads.

- Establishment of a designated mobile telephone number that farmers can call to check on heavy vehicle movements on particular roads.

MHE will prepare and implement a Traffic Management Plan for the construction phase in consultation with the local landowners, Shire Council, Main Roads, School Bus operators and Police. The Traffic Management Plan will address haulage routes to the wind farm, scheduling of heavy vehicle movements, speed limits, provision of escorts and other relevant matters.

4.7 Aircraft Safety

MHE undertook and Airspace Assessment in May 2011. Findings of the assessment are detailed in Appendix I and summarised below.

In preparing the report MHE liaised with Air services Australia, the Civil Aviation Safety Authority, Aerial Agricultural Association of Australia, operating aerial agricultural contractors, local aerodrome operators, private plane and airstrip owners, the Royal Flying Doctor Service and the Regional Passenger Transport and Aviation Policy , Department of Transport, Western Australian Government and local landowners.

The closest aerodromes to the proposed development area are the Kojonup Aerodrome, 23.5km to the north west of the site, and the Katanning Aerodrome approximately 33km north east of the site. Both aerodromes are owned and maintained by the respective local shires.

In addition to the aerodrome, six privately operated airstrips have been identified in the area:

- Yantecup airstrip - located within the wind farm development;
- The Meadows airstrip - located within the wind farm development
- Sherwood airstrip - located 9.5 km west of the boundary of the wind farm
- Kitto airstrip - located 10.2 km west of the boundary of the wind farm
- Condeena airstrip - located 18.1 km north east of the boundary of the wind farm
- Eticup airstrip - located 18.3 km east of the boundary of the wind farm

The report demonstrates that the Flat Rocks wind farm development will present little additional risk to civil aircraft operations within the vicinity of the proposed site and that such risk is within the level generally acceptable in the industry.

Operations at Kojonup Aerodrome will not be affected by the proposed wind farm. Air Services Australia has indicated that a minor adjustment to the approach procedures at Katanning Aerodrome maybe required. The adjustment to procedures entails raising the MSA by 100 ft, which is operationally insignificant. MHE is committed to fund these changes prior to the commencement of construction as required. Private airstrip operations will not be affected by the wind farm however pilots operating out of these strips or any paddocks in the vicinity of the wind farm, need to be aware of the conditions on and surrounding the landing sites. No concerns were raised regarding current aviation operations by private airstrips owners. Aerial agricultural operations will be largely unaffected on non-stakeholder properties, whilst some areas in close proximity to the wind turbines on stakeholder properties may be inaccessible.

Currently there are no enforceable obstacle lighting requirements for wind farms. MHE will notify CASA and RAAF of the location and height of the wind turbines prior to commencement of construction for inclusion of the structures on aeronautical charts, ensuring the appropriate notification of pilots by way of NOTAM. An assessment for obstacle lighting will be undertaken at this time and consider input from local planning authorities, aerodrome operators, insurers and financiers.

The wind turbine generators installed at the Flat Rocks wind farm will be light grey in colour to ensure they are conspicuous against the surrounding background in terms of ground cover and vegetation, to ensure that pilots can see and avoid the towers during daylight operations.

Consultation with Airservices Australia confirmed that the wind farm will not impact on the technical performance of Precision/Non-Precision Nav Aids, HF/VHF Comms, A-SMGCA, Radar or Satellite/Links.

4.8 Electromagnetic Interference

An electromagnetic interference (EMI) assessment for the proposed Flat Rocks wind farm was undertaken by MHE in April 2011, current radiocommunications sites and licenses in the vicinity of the proposed wind farm were identified from the Australian Communication and Media Authority database (ACMA).

This assessment investigated the impact of the proposed wind farm on:

- Fixed point-to-point links
- Fixed point-to-multipoint links
- Radiocommunications assets belonging to emergency services
- Meteorological radar
- GPS systems
- Wireless internet
- Broadcast radio
- Satellite television and internet
- Broadcast television

The report of the study is attached in Appendix J and summarised below.

The ACMA database was accessed by MHE to identify all broadcast towers and transmission vectors in the vicinity of the proposed development. MHE also contacted all relevant stakeholders requesting comment on the potential for interference to services as a direct result of the proposed wind farm. At the time of writing this report, no operator had identified any problems or potential for interference.

Wind turbines can degrade the performance of fixed point to point links through three principal mechanisms of EMI – near field effects, diffraction and reflection/scattering. Two point to point type microwave link vectors pass through the wind farm site in close proximity to WTG 40 and WTG 67. Appropriate exclusion zones for these links have been calculated and compared to the current buffer zones. MHE has contacted the operator of the links for feedback on service effects and to date has had no reply. It is recommended that prior to finalisation of the turbine layout MHE liaise with the license operator or consider relocating WTG 67 and WTG 40 by 50m and 60m respectively.

Radio signals, GPS and digital technologies will be unaffected by the Flat Rocks wind farm development. This includes services like land mobile repeaters, radio, the audio component of analogue television and mobile phones. Currently analogue broadcast signals, which are susceptible to interference from wind turbines, are used to transmit domestic television in Western Australia. In mid-2013, coinciding with commencement of construction, digital television will be the main form of TV broadcast signal in the Flat Rocks region as analogue signals are scheduled to be switched off. Interference to TV signals and reception in the vicinity of the wind farm is therefore not expected as digital signals are less likely to be affected by EMI from wind turbines (16).

As some nearby residents already experience poor TV reception, MHE will offer a pre-wind farm and post-wind farm assessment of television reception, and will remedy any reception problems attributable to the presence of the wind farm. In the event that TV interference is encountered and attributable to the wind farm, the following mitigation options are available to rectify the situation:

- Realigning the resident's TV antenna more directly towards their existing transmitter;
- Tuning the resident's antenna into alternative sources of the same or suitable TV signal;
- Installation of more directional and/or higher gain antenna at the affected residence;
- Relocating the antenna to a less affected position;
- Installation of satellite TV at the affected residence; and
- Installation of a TV relay station.

4.9 Rehabilitation

All areas disturbed during construction that are not required for ongoing operations will be rehabilitated following construction. These will include construction stockpile and laydown areas, temporary access tracks and underground cable trenches.

Because the wind farm is predominantly located in cleared farmland, the rehabilitation will mostly consist of reestablishment of topsoil and returning disturbed land to agricultural use. Because native vegetation will only be cleared in very limited areas where essential for access roads, little if any rehabilitation of native vegetation is expected to be necessary.

4.10 Fire Risk and Management

Fire prevention and control will be of paramount importance during the construction, operation and decommissioning or refurbishment of the Flat Rocks wind farm site. All aspects of the project will adhere to the *Fire and Emergency Services of Western Australia Act 1998*, and will be in consideration of the *Australian Wind Energy Association's Best Practice Guidelines: Fire Management* (2006).

Wind farms present a low risk of fire. Wind turbines themselves have complex monitoring systems (SCADA) that can detect temperature increases in a wind turbine and shut them down when the threshold temperature is reached, thus reducing fire risk. The electrical control systems of wind turbines are enclosed in the nacelle housing and steel tower, reducing the risk of a fire spreading due to an electrical fault. Modern turbines are fitted with fire extinguishers and lightning protection devices. All related high voltage electrical works will be installed and operated to relevant national and international standards and regulations.

Despite the low risk of fire imposed by the proposed Flat Rocks wind farm it is important to have an effective fire management plan in place. Not only does an effective fire management plan provide wind farm proponents with assurance that minimum damage would result from a fire incident, it also reassures the local community and enables the local volunteer bush fire brigade to confidently plan and execute an effective response if required.

Appropriate fire management plans will be implemented for all stages of the wind farm development. These plans will include:

- Adherence to all regulations under the Fire and Emergency Services of Western Australia Act 1998
- Installation of access tracks at least 5 m wide (7 m for corners) and with appropriate vertical clearance and suitability for all weather conditions
- Provision of basic fire-fighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions
- Identification of water resources in the immediate area, (including fast fill points from local private dams)
- Maintaining provision for mobile telephone and UHF radiocommunications
- Provision of on-site identification of individual turbine locations and access gates for firefighting services, and an undertaking to provide local volunteer bush fire brigades with access to any gates
- Consideration of total fire ban days in regard to hours within which certain activities can occur

Pre-Construction Activities

Prior to commencement of construction MHE will provide the Fire and Emergency Services Authority (FESA), local volunteer Bush Fire Brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West) and the Shires of Kojonup and Broomehill Tambellup with:

- A construction works schedule
- Maps of final turbine layout and identification information for individual turbine sites
- Access road plans and locations of access gates
- Security information such as location of locked gates and restricted access areas
- Location of any additional water supplies installed for construction activities
- Location of potential landing pads for fire-fighting aircraft or helicopters

MHE will consult with relevant regional and local volunteer bush fire brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West) to develop a Fire Hazard Management Plan (FHMP) including agreed fire response actions and communication protocols.

Construction and Decommissioning Activities

During the construction and decommissioning phases of the Flat Rocks wind farm, MHE will:

- provide the local volunteer bush fire brigades with access keys or cards to locked gates and restricted areas (where appropriate);
- incorporate fire prevention and response actions (as per FHMP) and contractor's Emergency Response Plan (ERP) in staff inductions;
- ensure the FHMP and ERP is accessible to all staff and local volunteer bush fire brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West);

- incorporate fire response planning into any Occupational Health & Safety (OH&S) audits conducted onsite, and;
- keep local volunteer bush fire brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West) updated about any changes to works schedules or access arrangements.

Operational Activities

Once commissioned and operation, regular maintenance vans or 4WD vehicles will visit the Flat Rocks wind farm site to undertake routine turbine maintenance. MHE will ensure the following fire management actions are outlined in the operational section of the Fire Management Plan:

- Ensure operations staff are inducted in fire response and have access to the FHMP and ERP.
- Ensure the regional and local volunteer bush fire brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West) have up-to-date maps, access gate keys/cards and turbine numbering information.
- Inform the local volunteer bush fire brigades of the wind farm maintenance schedule (if available) and any planned activities which pose an additional fire risk or hazard
- Liaise with the local volunteer bush fire brigades on high-fire risk days.

In addition to the specific plans for the various stages of the wind farms development outlined above, the following standard rules will apply to the Flat Rocks wind farm site:

- Smoking will not be permitted on site during days of total fire ban, except during breaks in designated areas
- Smoking on site will only be permitted on formed surfaces or at the Site Compound and all butts will be removed from site.
- Burning of waste materials on site will be forbidden.
- All welding and burning operations must be authorised by the Site Manager prior to commencement. During the fire danger season, the Site Manager will lodge a request for permits, as issued by the local volunteer Bush Fire Brigade representative. Upon commencement, all necessary precautions must be taken to comply with the permit.
- No Hot Work will be undertaken on days of Total Fire Ban unless a permit has been issued.
- Emergency services (including the FESA) representatives will be consulted prior to construction commencing in order to gain their input into the construction management plan.
- Prior to the construction of access tracks, only diesel vehicles will be permitted on site.
- Once access tracks have been constructed, petrol vehicles will also be permitted on site,

On the granting of developmental approval MHE will notify FESA of the proposed Flat Rocks wind farm project and commence consultation regarding construction and operations impacts and the FHMP. Specific fire prevention and response measures for the Flat Rocks wind farm will be developed in consultation with the Shires of Kojonup and Broomehill Tambellup and the local volunteer bush fire brigades.

5. SUMMARY OF MANAGEMENT MEASURES

The following summarises the management measures to be implemented to minimise the risk of adverse environmental or social impacts from the construction and operation of the Flat Rocks wind farm.

1. MHE will avoid, as much as practically possible, the clearing of native vegetation in the construction of the wind farm and ancillary facilities.

2. Where vegetation clearance is unavoidable, MHE will minimise the area affected and will position the clearing based on detailed on-site surveys so as to avoid disturbance where possible to mature trees and significant flora.

3. The turbine towers will be fully enclosed, with no sites for perching or nesting.

4. Clearing Permits from the DEC will be obtained prior to commencing any on- site or roadside clearance works.

5. Turbines will be unlit (except for nacelle-mounted safety lights for aircraft, depending on the recommendations of CASA and negotiations with interested parties), to avoid attracting owls and bats.

6. Vehicles travelling on internal access roads will be limited to a maximum speed of 40km/h at all times in order to minimise the risk of collisions with fauna.

7. MHE will liaise with Ron Johnstone from W.A. Museum to monitor and report any instances of bird strike once the wind farm is operational.

8. This development application contemplates a development envelope within which the final detailed design and turbine siting will be undertaken. The final siting will only allow turbines to be sited such that relevant noise criteria will be complied with.

9. MHE will carry out a pre-construction survey of the public roads to be used by construction traffic and will maintain and, if necessary, repair or upgrade the roads throughout the construction program to ensure that they are left in at least the same condition as they were prior to construction. All surveys and works will be undertaken in consultation with the local Shire.

10. MHE will ensure, through supply contract conditions, that all fill imported into the project area is obtained from weed-free sources. MHE will source fill from local supplies where possible.

11. MHE will consult with landowners before the commencement of site works on the location of known weed infestations and will implement measures, including inspection and/or cleaning by water or compressed air, of vehicles leaving infested areas, to ensure that weeds are not spread within the project area.

12. If new weed infestations are discovered in the project that are attributable to construction activities, MHE will arrange treatment using accepted methods.

13. MHE will prepare and implement a Traffic Management Plan for the construction phase in consultation with the local landowners, Shire Council, School Bus contractors and Police. The Traffic Management Plan will address haulage routes to the wind farm, scheduling of heavy vehicle movements, speed limits, provision of escorts and other relevant matters.

14. MHE will offer nearby residents a pre-wind farm and post-wind farm assessment of television reception, especially those with pre-existing reception issues, and will remedy any reception problems attributable to the presence of the wind farm.

15. MHE will develop and implement a Fire Hazard Management Plan in consultation with the local shires of Kojonup and Broomehill Tambellup and local volunteer bush fire brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West)

16. MHE will provide local volunteer bush fire brigades (Lumeah, Ryans Brook, Jingalup, Broomehill West and Tambellup West) with project details including turbine location, access points and location of water points

17. MHE will provide the local volunteer bush fire brigades with access keys or cards to locked gates and restricted areas (where appropriate)

18. MHE will ensure the provision of basic fire-fighting equipment at each active site, including fire extinguishers, knapsacks and other equipment suitable for initial response actions

6. REFERENCES

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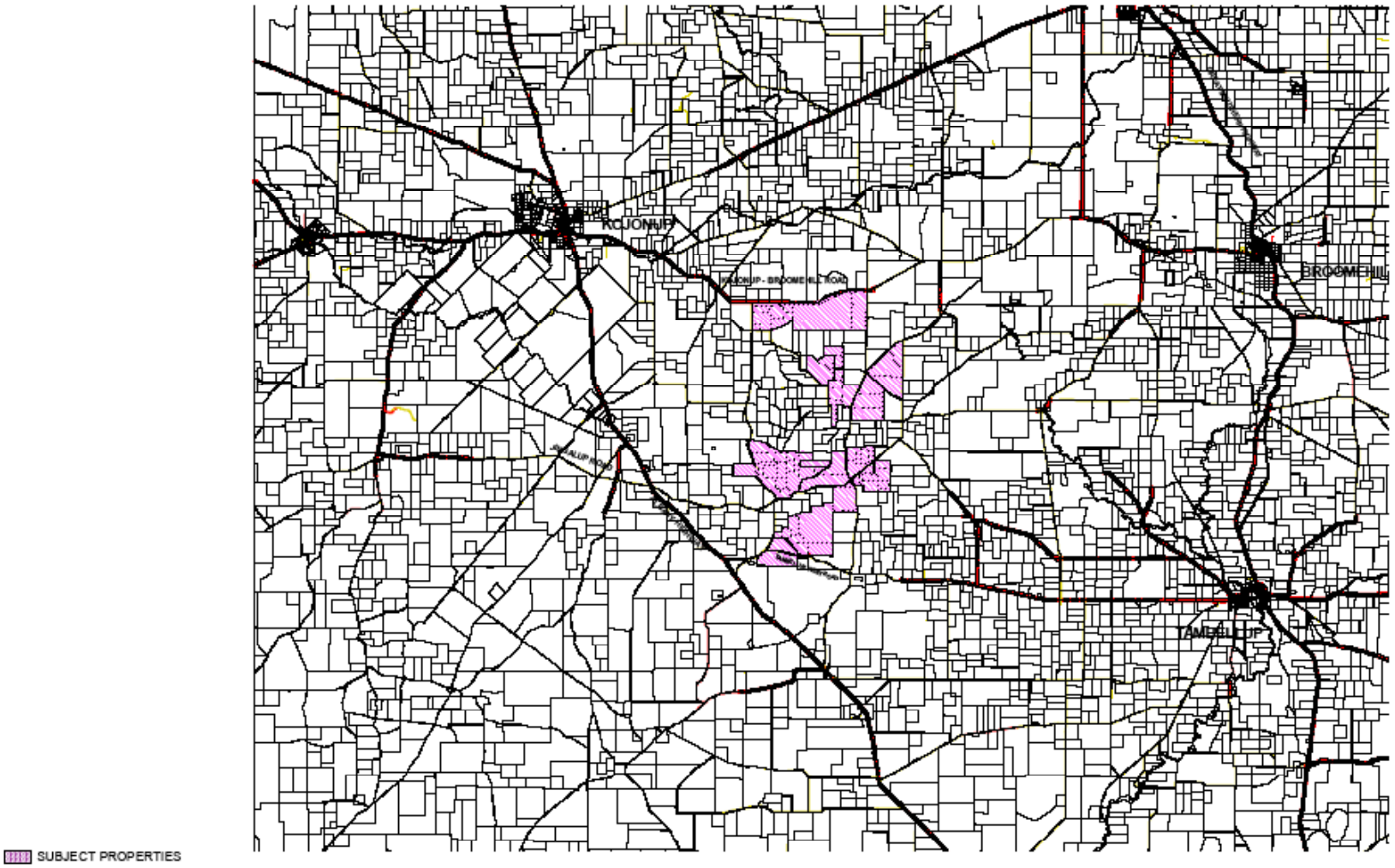
FIGURES

Figure 1: Proposed Flat Rocks Wind Farm Development Site



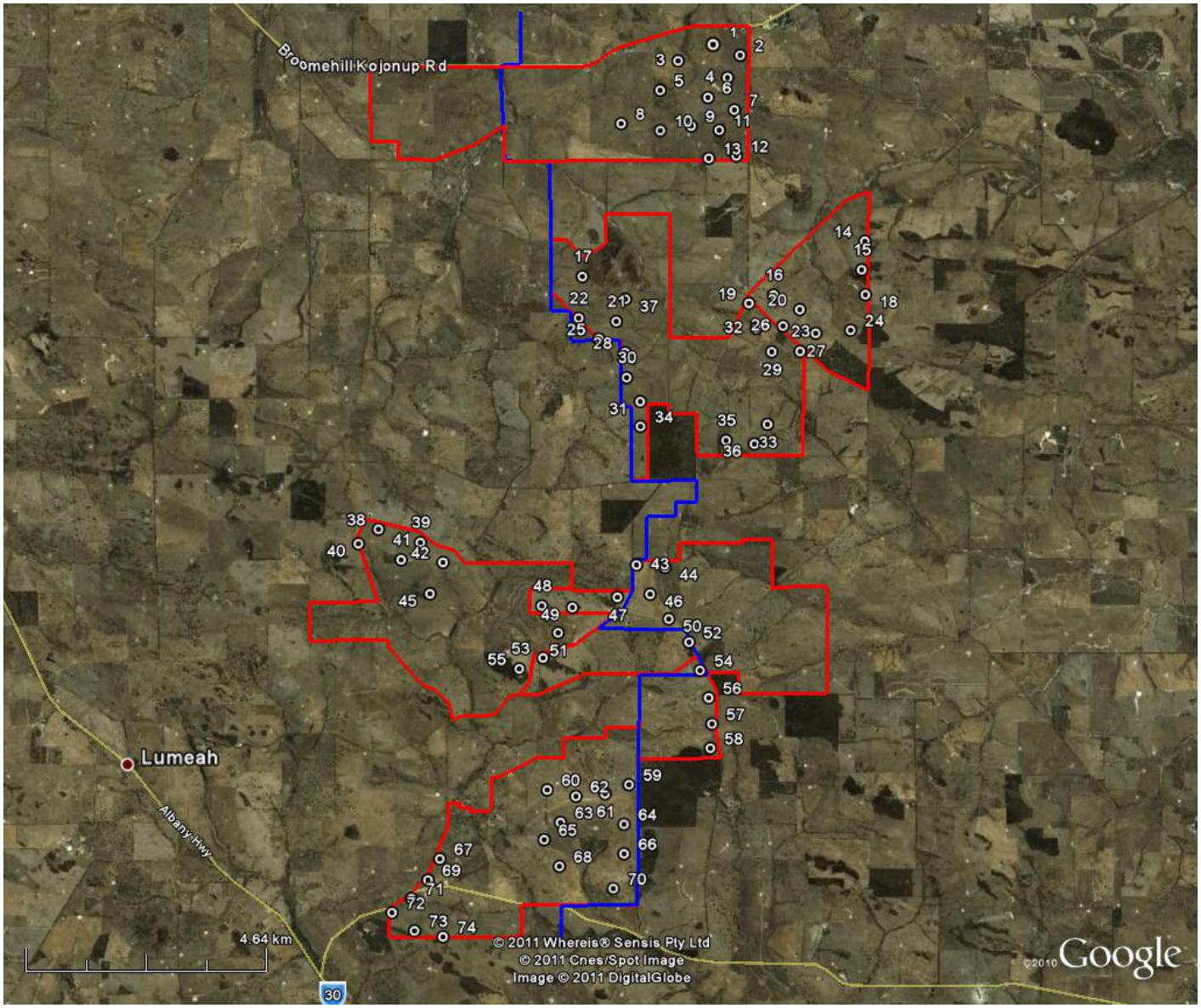


Figure 2: 74 Turbine Configuration with Shire Boundary – Kojonup and Broomehill Tambellup

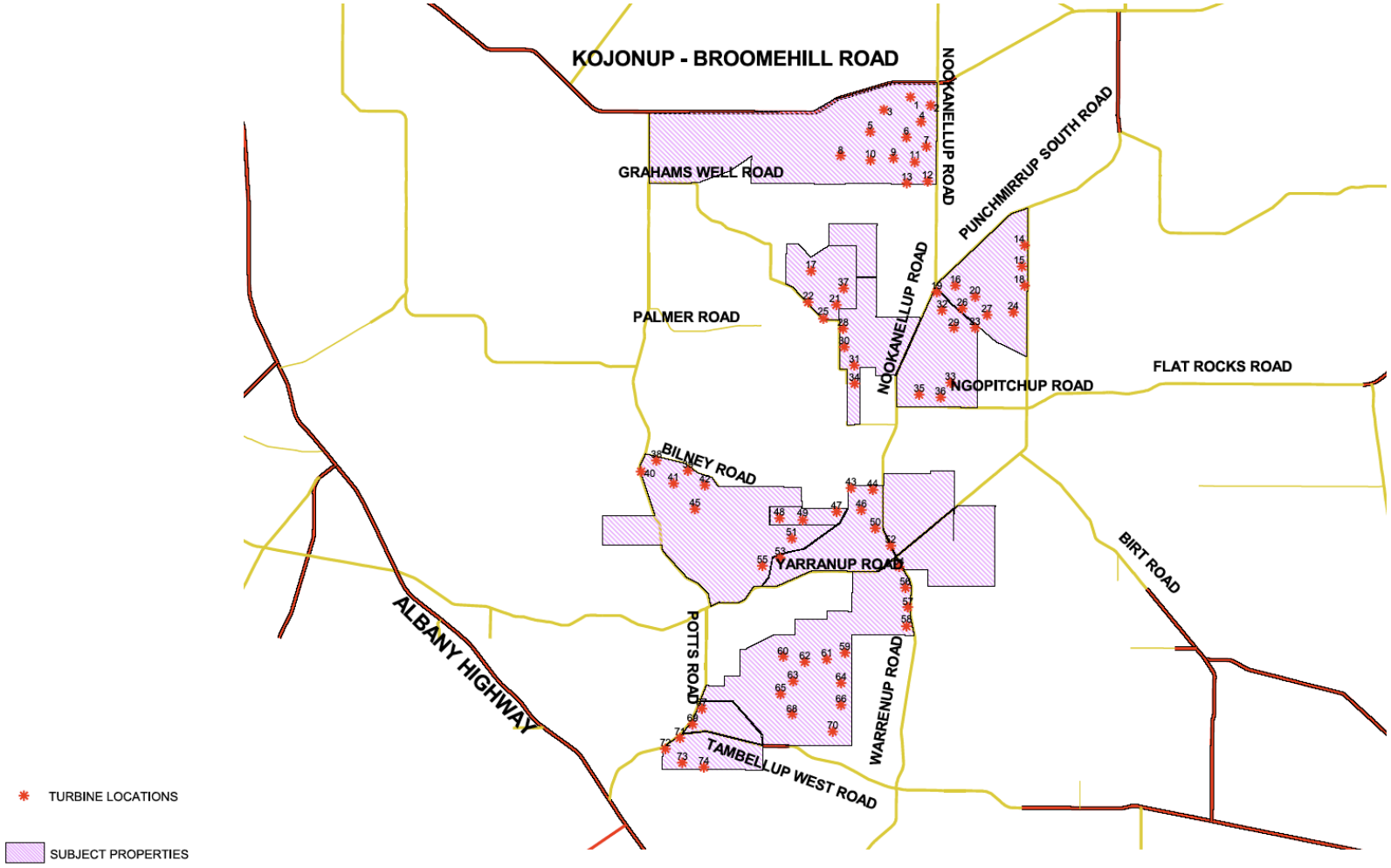


Figure 3: 74 Turbine Configuration with Road Names

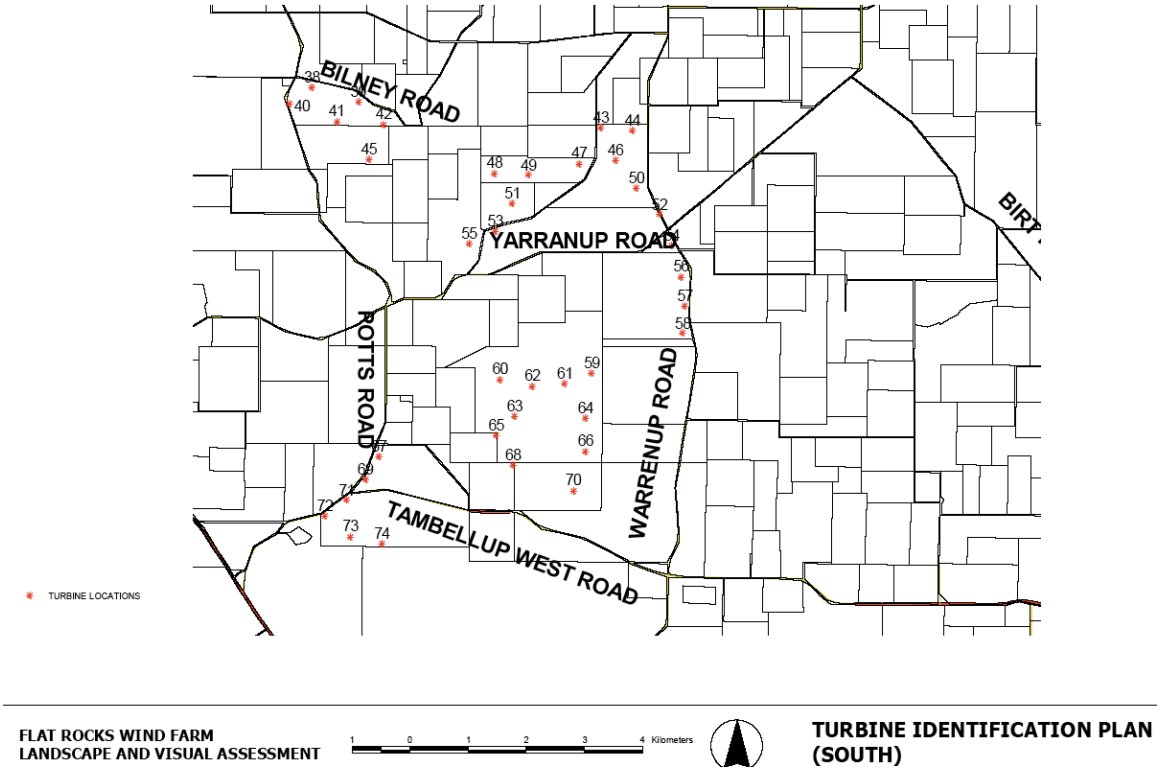


Figure 4: Southern stage of Flat Rocks Wind Farm

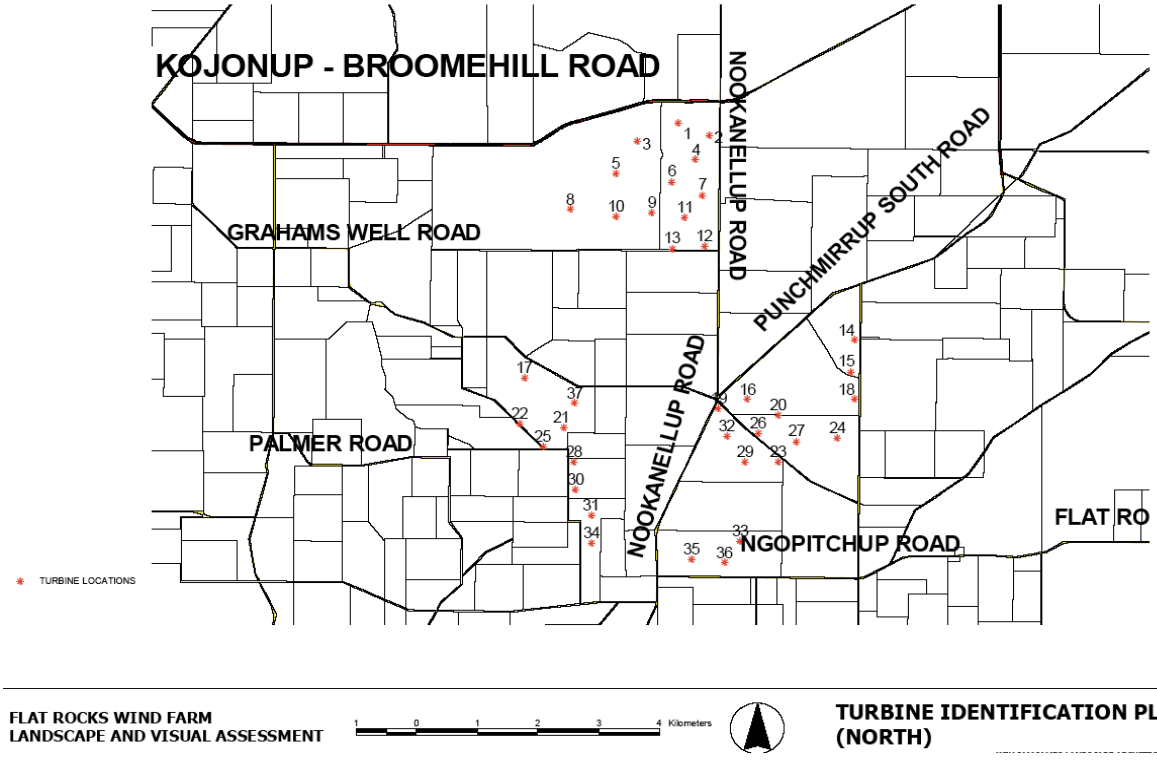


Figure 5: Northern stage of Flat Rocks Wind Farm

Figure 6: Anatomy of a Wind Turbine Generator

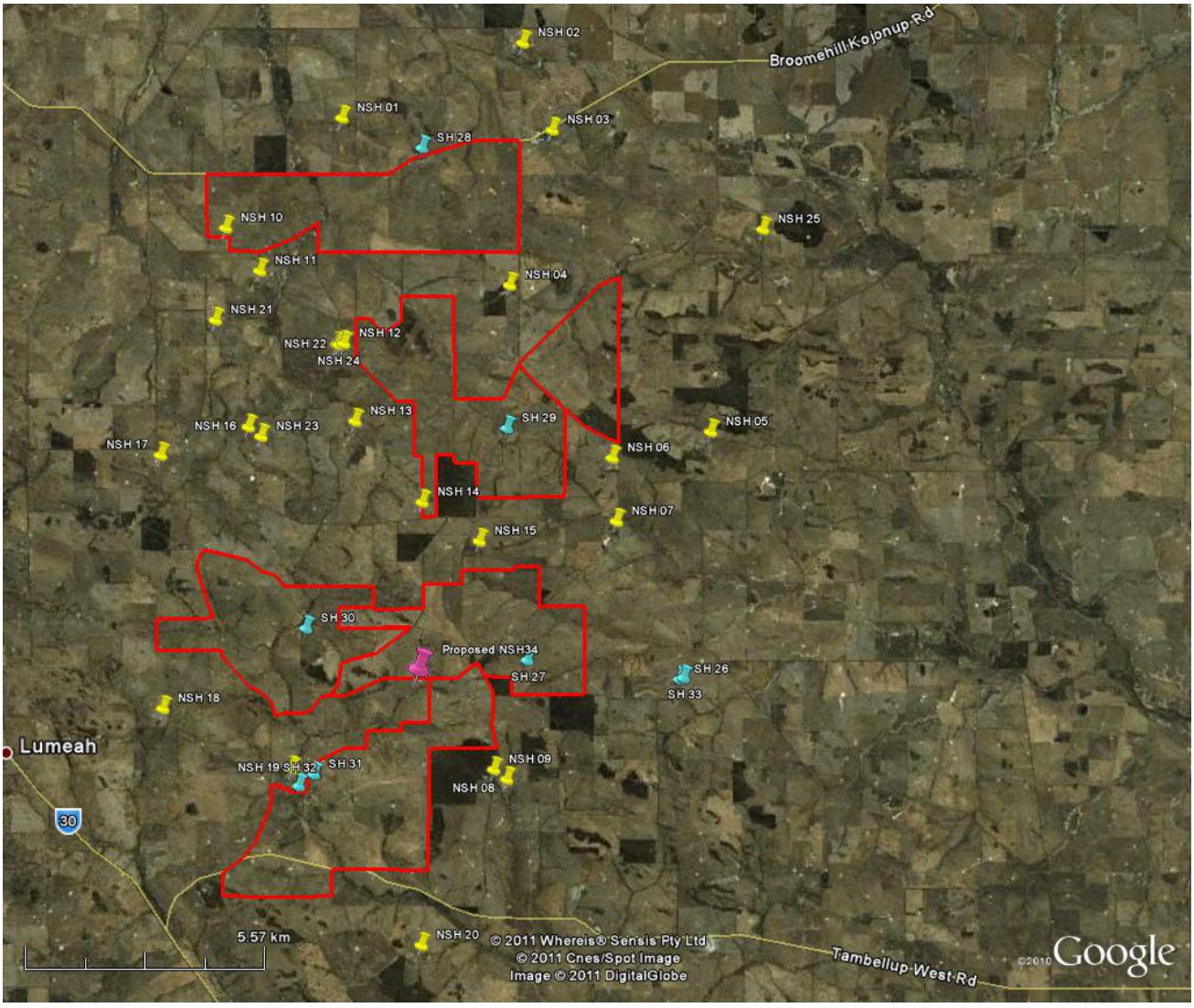


Figure 7: Residences in the vicinity of Flat Rocks Wind Farm