
Kyoto energypark
10. Noise Impact

10.0 NOISE IMPACT

Wilkinson Murray Acoustics were engaged to undertake a Noise Impact assessment for the Kyoto Energy Park proposal The noise assessment is attached in *Appendix D Wilkinson Murray – Noise Assessment (August 2008)*. The findings of this assessment and recommendations are discussed in this Section.

10.1 Noise Assessment criteria

There are no specific guidelines relating to the noise assessment of wind farms prepared by the NSW Government. However, the guidelines for assessment of noise from industrial facilities are managed within the NSW Department of Environment & Climate Change (DECC) Industrial Noise Policy (INP).

Additionally, the DECC have adopted the South Australian guidelines "Wind Farm Environmental Noise Guidelines" (February 2003). The draft Australian Standard (EV16) has also been considered in the report by Wilkinson Murray. The report also considered the effect of temperature inversions on noise levels referred to as the 'Van den Burg Effect'.

10.2 Neighbouring residencies

Rural properties and homesteads are scattered around the Mountain and Middlebrook Station sites mainly to the east towards the Scone urban centre.

Mountain Station

Rural residencies and homesteads are scattered to the east, west, and north of the Mountain Station site, mainly along roadways. No residencies were located directly south of the Mountain Station property which is covered by the Cuan Pastoral landholdings. The closest private residence to wind turbines on Mountain Station is the *'Peakhill'* residence located at a distance of 1.2 km.

The closest residencies in relation to Mountain Station are represented in Figure 10.0 Nearest residencies

Middlebrook Station

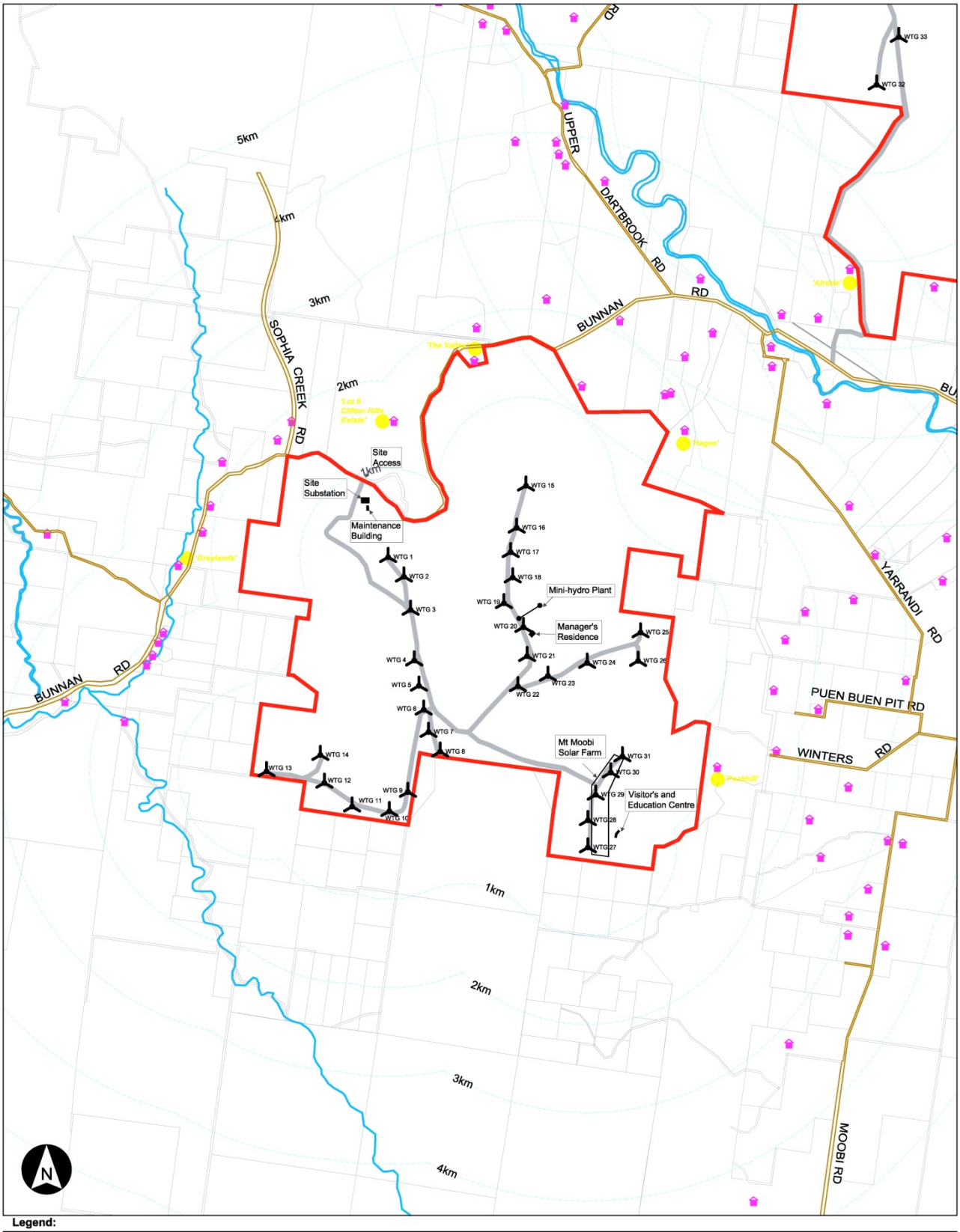
Residences surrounding Middlebrook Station are located to the east, south and west of the site. No residencies were located directly north of Middlebrook Station which area is covered by the Towarri National Park and mountainous regions.

There are eight houses which are located on the Middlebrook Station property east of the proposed turbines on the Glen Range ridge. These homesteads are fully owned by the landowner, some of which are leased out to third parties. The closest residence to the Middlebrook Station turbines is Middlebrook Station Accommodation, which is owned by the landowner and is located approximately 1 km away from the nearest turbine.

The closest residencies in relation to Middlebrook Station are represented in Figure 10.1 Nearest residencies.

Background Noise Measurements

Background noise measurements were undertaken on two separate occasions in May/June 2007 and in September/October 2007 by Wilkinson Murray. Background noise loggers were located at ten (10) residential locations as shown in the Figure 10.0 and Figure 10.1. Two of these locations were repeated in the second round of measurements representing the closest residencies to Mountain and Middlebrook Station sites.



Legend:

Property Boundary
Natural Drainage
Existing Residencies (Non Landowner)
Backround Noise Logger
Radial Distance from Wind Turbine
Property Boundary

0 1.5 3.0
Kilometres

Kyoto energypark

Figure 10.0 - Nearest residencies (Mountain Station)

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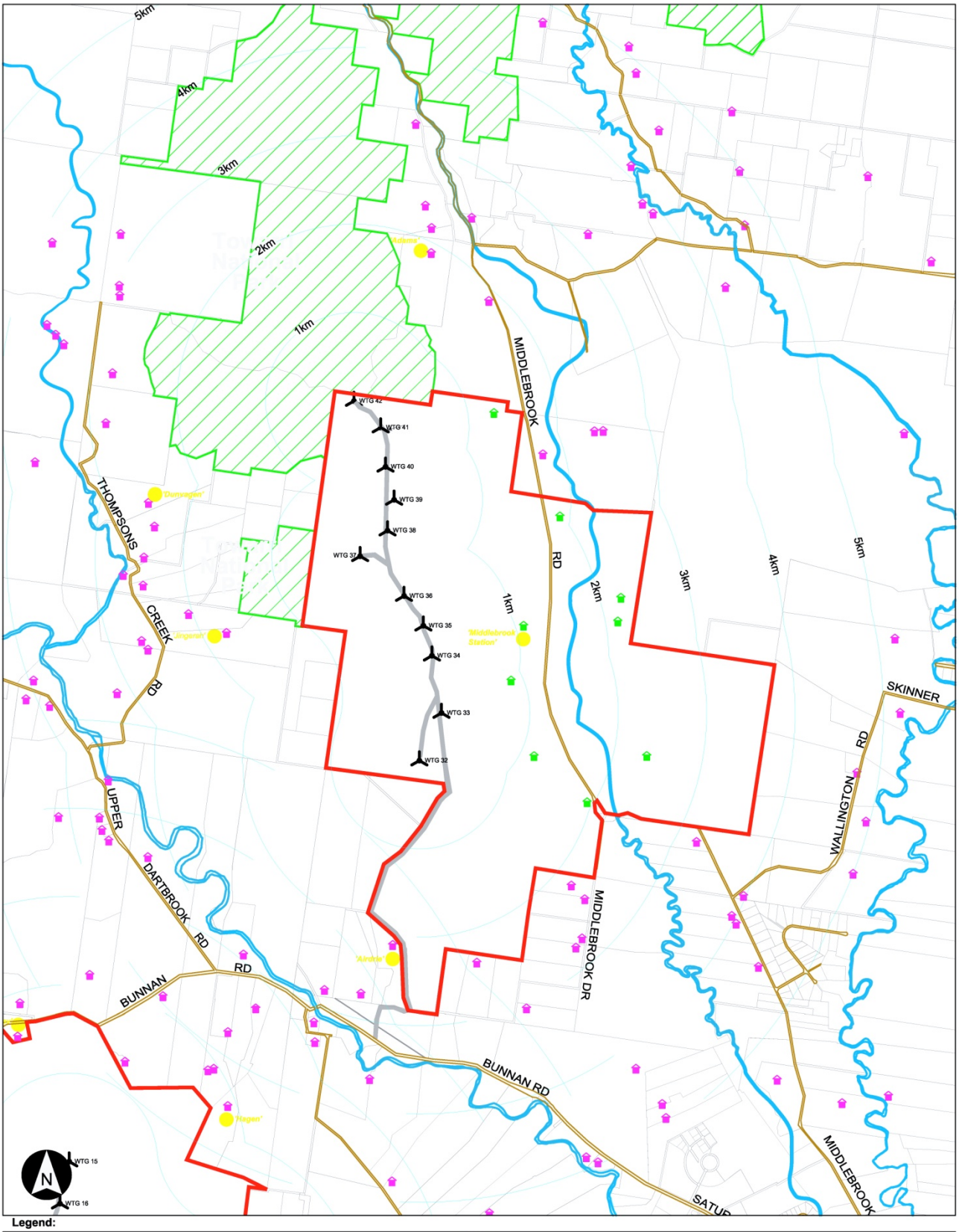
5km
4km
3km
2km
1km
MIDDLEBROOK RD
THOMPSONS CREEK RD
UPPER DARTBROOK RD
BUNNAN RD
MIDDLEBROOK DR
WALLINGTON RD
SKINNER
BUNNAN RD
MIDDLEBROOK
WTG 42
WTG 41
WTG 40
WTG 39
WTG 38
WTG 37
WTG 36
WTG 35
WTG 34
WTG 33
WTG 32
'Adams'
'Dunvegan'
'Jingarah'
'Middlebrook Station'
'Airlie'
'Hagen'
WTG 15
WTG 16
N
Legend:
Property Boundary
National Park/Nature Reserve
Natural Drainage
Existing Residencies (Non Landowner)
Existing Residencies (Landowner)
Backround Noise Logger
Radial Distance from Wind Turbine
Property Boundary
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0
1.0
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Figure 10.1 - Nearest residencies (Middlebrook Station)
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10.3 Noise emissions

10.3.1 Wind Turbine Generators

Four different wind turbine models are under consideration and were considered in the noise assessment undertaken by Wilkinson Murray Acoustics. These turbine configurations are presented in Table 2.1 of this report. The assessment modelled the 'worst case' choice of turbine at the time of the assessment being the Suzlon Energy A/S S88-2.1 MW, V3 turbines which have a maximum sound power level (SPL) of 104.3dBA. If an alternate turbine is chosen noise levels will not be higher than an SPL of 104.3 dBA.

Three (3) non-landowner residences were identified at locations where the noise criteria was potentially exceeded. Of these 3, exceedances at one (1) non-landowner residence were considered to be negligible as they would occur less than 1% of the time throughout the year.

The Clifton Hills Estate is a 15 lot rural subdivision located immediately to the north east of the Mountain Station site. There is currently one household residence constructed on Lot 6 of the estate. The exceedances at the Clifton Hills Estate are predicted at night time only and up to 13% of the night time during summer periods. These levels were considered by Wilkinson Murray as marginal and no amelioration measures recommended. Subject to approval, operational noise levels would be modelled at this location for compliance with noise criteria.

Noise levels at the *'Peakhill'* residence (the closest non-landowner residence at 1.2km from the closest turbine) located directly east of Mountain Station were considered more significant and sector management of the closest turbines required. Sector management would be considered for Wind turbines numbers 27,28,29,30,31 (the subject turbines) to be addressed in the Operational Environmental Management Plan (OEMP) for the Kyoto Energy Park.

Noise level exceedances at the Peakhill residence were predicted to occur for short periods in Winter during the nighttime, at the exterior of the residence (i.e. outside as opposed to inside the residence). It would therefore be expected that during winter exterior windows would be closed and noise levels experienced inside the residence would be acceptable. Further conditional noise monitoring would be undertaken during the operational phase of the Kyoto Energy Park at the Peakhill residence to confirm predictions.

There are eight (8) landowner residencies located on Middlebrook Station which are owned by the landowner. Noise exceedances at two of these residencies were predicted to occur during winter nights, however it would be expected that closing windows during this time would reduce impact. An informed agreement with Pamada and the landowner has been signed with respect to noise exceedances at these properties on Middlebrook Station.

10.3.2 Ancillary Components

The noise assessment concluded that the contribution of the other components (mini hydro plant, Solar PV plant (all options) and site substation) under adverse conditions and full operation generate minor and insignificant noise in accordance with the Industrial Noise Policy (INP). The assessment modelled the 'worst case scenario' choice of turbine, the Suzlon Energy A/S S88-2.1 MW, V3 turbines which have a maximum sound power level of 104.3dBA.

Noise modelling of the solar PV plant has considered noise from tracking motors for all options base on manufacturers specifications for motor sizes. Up to 1000AC motors at 3m above ground have been used as a worst case scenario. Cumulative noise impacts are expected to be inaudible at nearest receivers. Topographic shielding of arrays from nearest receivers would also increase shielding effects.

The site substation is located at a distance of more than 1 km from Lot 6 Clifton Hills Estate. Noise emitted from the substation is a function of total electrical power output which has been estimated in accordance with *AS 2374-6 Power transformer Noise Levels*. The cumulative noise contribution from the substation modelled under worst case conditions was found not to contribute to a measurable

increase in noise levels at nearest receivers. Additional shielding towards Clifton Hills Estate would be provided by a 4m high bund wall placed around the north-eastern edge of the substation as shown in Figure 2.15.

A Land Owners Agreement has been obtained for residencies located on the Middlebrook and Mountain Station properties (landowner). Noise levels at the proposed Managers Residence have not been considered in the noise assessment as the building. Noise exceedances at the residence shall be subject to testing during operations and managed in accordance with the site OH&S Plan.

10.3.3 Construction Noise Levels

The assessment of construction is dependent on the duration of construction in the vicinity of the potentially affected residential receiver in accordance with the *Environmental Noise Control Manual* (ENCM) by the DECC.

Construction activities have been split into three main construction phases which are representative of the noisiest activities:

- Earthworks (Site Establishment, construction of access tracks, hardstand areas)
- Foundation works (Concrete footings and foundations)
- Superstructure (Turbines/Substation/transmission lines/Mini-Hydro/Solar-PV/Buildings erection)

Allowing for worst case cumulative impacts associated with internal construction activities during the construction phase, overall noise level criteria would not be exceeded.

10.3.4 Traffic Noise Levels

Traffic volumes during the construction period would average 9 heavy vehicle movements per day (18movements). On peak days during deliveries prior to concrete pours this could increase to 20 heavy vehicles per day (i.e. 40 movements) for a short period. During site preparation trucks will assumed to be coming from the existing quarry on the Middlebrook Station site, which would occur for an estimated period of 2 months duration. Traffic noise levels have been estimated at critical locations along the direct route during peak periods and are considered within criteria.

Site access for both sites during operation is via Liverpool St, Satur and Bunnan Road. Traffic noise impacts were assessed along this route based on ‘worst case’ combination of employee traffic, additional tourism associated with the Visitors and Education Centre and Kyoto Energy Park scheduled maintenance activities. Traffic noise levels during operation would therefore be intermittent and would be negligible based on peak traffic regimes.

10.3.5 Transmission Line Construction

The construction of the overhead transmission line connection to the local electricity grid would require line construction works along proposed routes. The preferred option has not been determined at this stage. From a construction noise perspective there is a requirement to provide power poles along the alignment, requiring works in the same location for only a few days to provide foundations and erect the power pole and hang the transmission lines. These mostly follow existing road alignments.

This will require use of small excavation plant such as a mini excavator and bobcat, a small concrete pour for foundations and a crane and cherry picker to mount the pole and undertake the electrical fixing.

Noise levels are predicted to exceed criteria for a few days at residences within 200m of the alignment.

10.3.6 Van Den Burg Effect

The Van Den Burg effect is concerned about the possibility that there is sufficient wind energy at hub height to drive wind turbine generators, whilst wind speeds at the residences in the lower lying areas

surrounding the ridge are much lower. Due to atmospheric instability at night this potentially results in background noise levels being much lower than the best fit regression of the all the background noise data at night time.

Previously this aspect was considered an issue where all wind data was referenced to a 10m height (i.e. 10m agl). Background noise levels were required to be plotted against wind speed at 10mAGL. In addition, historically the manufacturer's turbine SWL data was based on an assumed wind shear between 10m and hub height at the turbine test site, whilst measurements were undertaken.

If wind shear differences both between day and night and the wind farm site and turbine test site were not properly understood, noise levels could be under predicted under certain conditions because it is possible that higher wind speeds (therefore greater turbine SWL) exist at actual hub height in relation to the hub height wind speed estimated from 10m AGL using a wind shear coefficient. More recent turbine SWL data is now provided based on hub height wind speeds, eliminating this uncertainty.

On site wind speed and direction has been measured at Wind Mast 2 since January 2007 with data collected at three heights (30m, 45m and 65m). Sufficient data was collected from these heights to determine the wind shear coefficients (speedups) with height and to look at this data for the different months and daytime and night time periods.

The data concludes that the wind shear at night time is steeper than during the daytime and some months it is steeper than others. However in all cases the speedups result in a relatively small change in noise emissions (Sound Power Levels) from the generator with change in wind speed. Therefore potential for aspects of the Van den Burg effect at the site are considered low.

Blade Modulation and Temperature Inversions

Van den Berg is also concerned about the potential for modulation in turbulent noise levels from the blades which can occur if the wind speed across the blades at the top of the swept path is sufficiently different to the wind speed at the bottom. This is more likely to occur also at night where the atmosphere can be more stable with a steeper wind speed gradient above the ground. Modulation can be exacerbated if two turbines experience this modulation and are in phase when perceived from a particular residence.

The table below shows modulation factors in relation to atmospheric stability classes as determined by Van den Burg (Van den Burg 2003) In relation to modulation, if the wind shear (m) is less than 0.2, then Van den Berg considers the atmosphere would be unstable enough that modulation is unlikely to be considered a significant enough feature of the proposed windfarm to warrant consideration.

Table 10.0 – Modulation Classes for determination of Atmospheric Stability (Van Den Burg)

Pasquill Class	Name	m
A	Unstable	0.09
B	Moderately unstable	0.20
C	Neutral	0.22
D	Slightly stable	0.28
E	Moderately stable	0.37
F	(Very) Stable	0.41

Table 2 Atmospheric Stability Classes

Wind shear data taken for the Kyoto Energy Park at Mast 2 (Mountain Station) indicates that 'm' varies between nighttime and daytime but is generally higher during the first half of the day where it falls between 0.15 and 0.24 between hub height speeds of approximately 4-10m/s (see Figure 10.2). This falls into the neutral to slightly stable range, such that some degree of modulation may occur at times.

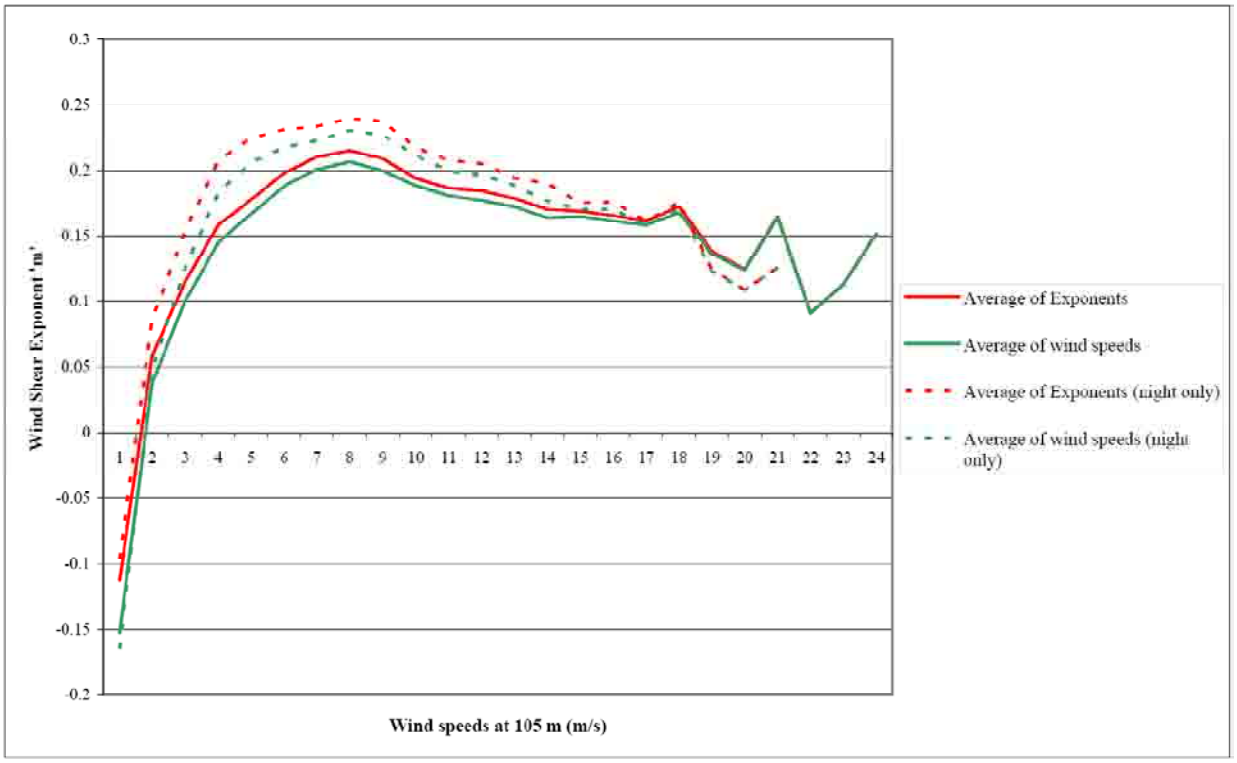

Figure 10.2 Variation of Average Wind Shear Exponent vs hub height wind speed

It will be necessary to review the likelihood of modulation during operations to understand whether controlling of wind turbines is required to eliminate high degrees of modulation under certain stable atmospheric conditions.

The site data also indicates that at ridge heights and above, temperature inversions are unlikely to occur at the hub height wind speeds capable of operating the turbines. Temperature inversions can cause an increase in noise level from ground-level sources because sound energy that would otherwise be directed upward is "bent" back down to earth. However, this effect is much less prominent if the source is located above the inversion layer, due to the effect of "bending" both above and below the layer. In this case it is likely that if turbines are rotating, they would be above the inversion layer, as within an inversion layer wind speeds are typically restricted to "drainage flow" of a few metres per second. Hence, it is not considered necessary to include the effect of temperature inversions in calculating noise levels from wind turbines.

10.4 Conclusion

With the exception of some minor exceedances that can be addressed with appropriate mitigation measures:

- The noise generated from on-site activities is predicted to meet NSW Department of Environment & Climate Change (DECC) criteria and Draft Australian Standard EV16 during operation of the Kyoto Energy Park;
- Noise levels at nearest receivers during construction periods is expected to be within DECC criteria;
- Traffic noise during construction and operation of the Kyoto Energy Park is expected to be negligible based on worst case scenarios achievable along the access route. The Visitor's and Education Centre is not to be opened full time to the public, and traffic flow would be intermittent. The specifications within the Environmental Criteria for Road Traffic Noise (ECRTN) will be complied with.
- An agreement in relation to noise levels at the Middlebrook Station residencies (landowner properties) between Pamada and the landowner has been made.

Kyoto Energy Park Scone is wholly an Australian Enterprise. The Management is 100% Australian.
The funding of this proposal and report is 100% Australian.
An Australian Project

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