Sonus Pty Ltd
17 Ruthven Avenue
ADELAIDE SA 5000
Phone: +61 8 8231 2100
www.sonus.com.au
ABN: 67 882 843 130
Contact: Chris Turnbull
Mobile: +61 (0) 417 845 720
ct@sonus.com.au

Stockyard Hill Wind Farm

Environmental Noise Assessment

to accompany an application to amend Planning Permit No. PL-SP/05/0548

Prepared for

Stockyard Hill Wind Farm Pty Ltd

S3425C56
May 2016

EXECUTIVE SUMMARY

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF). Planning Permit No. PL-SP/05/0548 (Pyrenees Planning Scheme) (the Permit) was issued by the Minister for Planning in October 2010 to enable the use and development of the SHWF Wind Energy Facility (WEF).

SHWFPL has prepared this application to amend the Permit to seek approval for taller turbines to achieve more efficient generation of energy. Additionally, as a result of the proposed taller turbines and to ensure the Permit reflects current standards, guidelines and departments, there are a number of other amendments proposed as part of the application. Specifically, it is recommended that Conditions 7, 23 and 26 and Permit Note 1 be amended and Conditions 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32 and 39 be replaced.

This document was prepared as an independent environmental noise assessment to accompany the application to amend the Permit. The document provides an assessment of the overall potential noise of the proposed amended WEF, whilst also describing the resulting change in potential noise from the permitted WEF.

The Permit provides noise requirements based on the *New Zealand Standard NZS6808:1998*, with additional requirements for the day and night periods and different wind conditions. The Permit requires compliance with this Standard.

The current *Policy and Planning Guidelines for Wind Energy Facilities in Victoria* (January 2016) require an assessment against *New Zealand Standard NZS6808:2010.* A complete reassessment of the environmental noise from the amended WEF has been conducted in accordance with the 2010 Standard and replacement noise conditions have been recommended based on the current *Policy and Planning Guidelines for Wind Energy Facilities in Victoria (January 2016)*.

The assessment has included:

- the measurement of background noise for a six week period at 45 locations;
- the determination of applicable noise limits based on the *Policy and Planning Guidelines for Wind Energy Facilities in Victoria* (January 2016) and *New Zealand Standard NZS6808:2010*;
- the prediction of the noise from three potential turbine models based on the amended layout;
- the confirmation that the predicted noise achieves the noise limits.

Both the permitted WEF and the amended WEF include indicative layouts and turbine models based on the understanding that the final turbine model and resulting layout will be determined by a competitive tender. Therefore, the noise experienced at dwellings is limited by reference to objective noise limits, rather than by reference to a particular layout or turbine model. In these circumstances, the most relevant comparison of the noise from the permitted WEF and the noise from the amended WEF is a comparison of the permitted and proposed noise limits. The overall noise limits established in accordance with NZS6808:1998 and NZS6808:2010 do not change significantly (i.e., no greater than 1 dB at some wind speeds) and there is a negligible change to the potential impact of environmental noise at residences resulting from the change in Standard. Therefore, it is concluded that the allowable noise from the compliant amended WEF will be no greater than the allowable noise from the compliant permitted WEF. For reference, a comparison has been made between indicative turbine selections for the permitted and amended WEFs. Depending on the turbine model used, the predicted noise at some non-participant dwellings from the amended WEF is up to 3 dB(A) higher and as much as 5 dB(A) lower than the predicted noise from the permitted WEF. That is, whilst there is an increase or decrease in noise associated with the amended WEF at some dwellings, the predicted noise at these dwellings complies with NZS6808:2010 for both the amended and permitted WEF.

The assessment indicates that the amended WEF will achieve the environmental noise related requirements of the *New Zealand Standard NZS6808:2010* and the *Policy and Planning Guidelines for the assessment of Wind Energy Facilities in Victoria (January 2016)*.

It is recommended that the application to amend the Permit seeks to amend some conditions (Conditions 7, 23 and 26 and Permit Note 1) and replace many of the existing noise related conditions of the Permit (Conditions 18, 19, 20, 21, 22, 27, 28, 29, 30, 31, 32 and 39 be removed) with conditions which reference *New Zealand Standard NZS6808:2010,* the appropriate Standard to be used in Victoria. The replacement conditions are based on the noise related Example Conditions (14, 15, 16 and 17) in the *Policy and Planning Guidelines for the assessment of Wind Energy Facilities in Victoria* (January 2016).

CONTENTS

EXECUTIVE SUMMARY **2**
1 INTRODUCTION **5**
1.1 Project Background 5
1.2 Purpose of Document 5
2 THE PROJECT **6**
2.1 WEF Site 6
2.2 Permitted WEF 7
2.3 Proposed Amendment to the Permit Conditions 8
3 NOISE LIMITS **10**
3.1 High Amenity Areas 12
4 ASSESSMENT OF AMENDED WEF **14**
5 ANTICIPATED CHANGE **18**
6 CONCLUSION **19**
GLOSSARY **20**
REFERENCES **21**
APPENDIX A – PERMITTED WEF TURBINE LAYOUT **22**
APPENDIX B – AMENDED WEF TURBINE LAYOUT **23**
APPENDIX C – PLANNING PERMIT CONDITIONS **24**
APPENDIX D – BACKGROUND NOISE MONITORING REPORT **36**
APPENDIX E – NOISE PREDICTION CONTOUR FOR NZS6808:2010 HIGH AMENITY TEST **37**
APPENDIX F – AMENDED WEF TURBINE AND DWELLING COORDINATES **38**
APPENDIX G – SOUND POWER LEVELS (SWL) **44**
APPENDIX H – TABLE OF APPLICABLE NOISE LIMITS AND PREDICTED NOISE LEVELS **48**
APPENDIX I – NOISE PREDICTION CONTOUR FOR THE HIGHEST PREDICTED NOISE LEVEL **85**
APPENDIX J – INDICATIVE PREDICTIONS FOR PERMITTED AND AMENDED WEFS **86**

1 INTRODUCTION

1.1 Project Background

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF).

The project has three components - a wind energy facility (WEF), a grid connection (approximately 75km of overhead powerlines and terminal station) and a quarry. This document relates to the WEF component of the project.

Planning Permit No. PL-SP/05/0548 (Pyrenees Planning Scheme) (the Permit) was issued by the Minister for Planning on 26 October 2010 to enable the use and development of the SHWF WEF.

SHWFPL has preparard this application to amend the Permit under Section 97I of the *Planning and Environment Act 1987*.

The primary driver for the amendment application is to seek approval for taller turbines to achieve more efficient generation of energy. However, as a result of the proposed taller turbines and to ensure the Permit reflects current standards, guidelines and departments, there are a number of other amendments proposed as part of the application. The proposed amendments to the Permit related to environmental noise are discussed in Section 2 of this document.

1.2 Purpose of Document

This document was prepared with the purpose of independently assessing the environmental noise associated with the application to amend the Permit.

Therefore, this document provides an assessment of the potential environmental noise from the proposed amended WEF, describes the resulting change in potential noise from the permitted WEF and recommends amendments to noise related conditions.

2 THE PROJECT

2.1 WEF Site

The WEF site is located in the Pyrenees Shire Council, approximately 150km west, north-west of Melbourne and approximately 35km west of Ballarat (refer Figure 1).

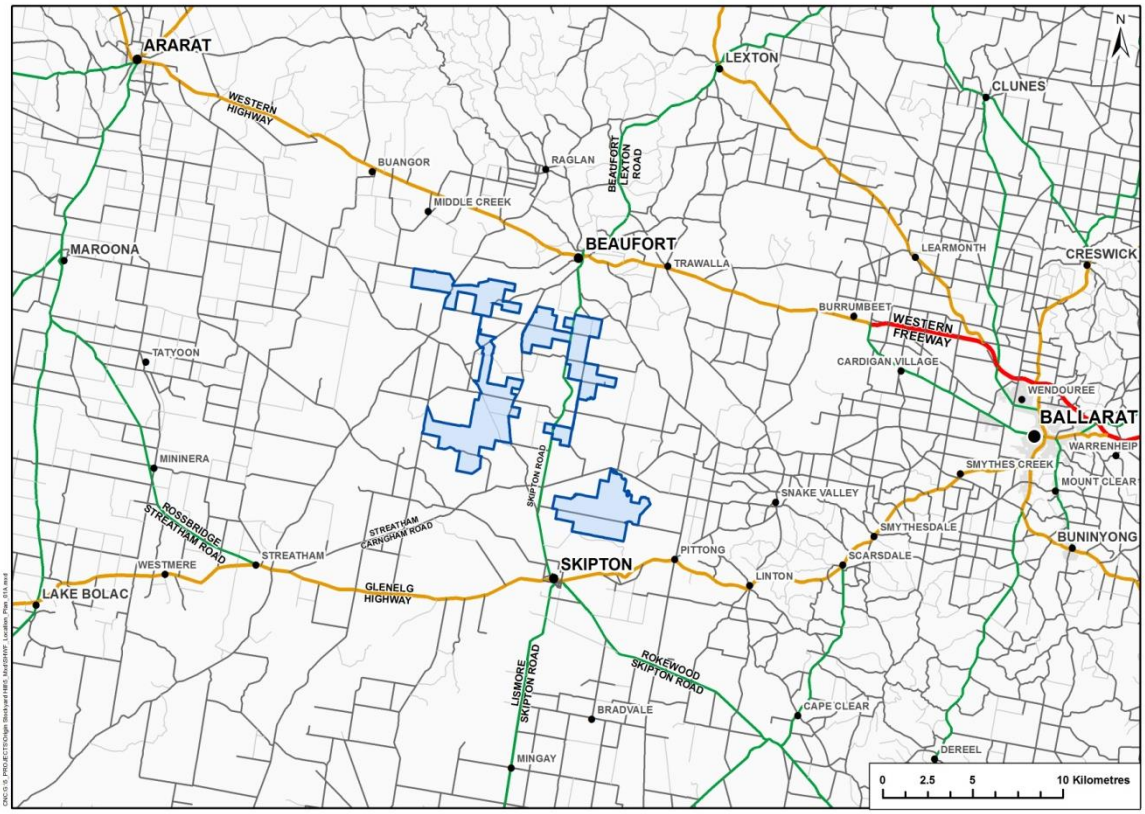


Figure 1 – WEF Site Location.

The closest townships to the WEF site include Beaufort (approximately 4.5km north of the site) and Skipton (approximately 4km south of the site).

The site is generally bound by Eurambeen-Streatham Road and Beaufort-Carranballac Road to the west, Stockyard Hill Road and Mt Emu Settlement Road in the south, Mount Emu Creek in the east and Ballrogan Road, Long Gully Road and Dalgleishs Road in the north. Skipton Road bisects the subject site.

The existing acoustic environment in the vicinity of the site is dominated by natural sounds, such as wind in trees, birds and insects. The environment also includes intermittent noise from mechanical sources such as road traffic.

2.2 Permitted WEF

The Permit was issued by the Minister for Planning in October 2010 to enable the use and development of the SHWF WEF, subject to 48 conditions. In summary, the Permit allows for:

- Up to 157 turbines sites (with a maximum tower height of 80m, blade length of 52m and tip height of 132m);
- Underground electrical reticulation network;
- Access track network;
- Up to 5 electricity substations;
- 132 kV overhead powerlines;
- A maintenance facility;
- 3 temporary staging areas allowing for three temporary concrete batching plants;
- Up to 8 anemometers (monitoring masts);
- Removal of native vegetation; and
- Car parking and bicycle facilities.

The permitted WEF is required to demonstrate compliance with the requirements of the *New Zealand Standard NZS6808:1998 Acoustics – The assessment and measurement of sound from wind turbine generators* (NZS6808:1998) and many conditions were imposed in an attempt to interpret some of the methods and procedures of NZS6808:1998.

The permitted WEF layout is shown on the map contained in Appendix A, whilst the Permit conditions, as relevant to environmental noise are outlined in the Appendix C.

2.3 Proposed Amendment to the Permit Conditions

The 'physical' amendments proposed to the permitted project (as relevant to this assessment) are described in Table 1 and shown on the map contained in Appendix B.

Table 1 – Summary of proposed 'physical' amendments to the SHWF WEF.

Proposed Amendments		Reason for amendment
Turbine Dimensions	The turbine envelope proposed includes: • overall maximum tip height must not exceed 180m above natural ground level; • hub-height of no greater than 120m above natural ground level; and • rotor diameter no greater than 140m.	• To allow for taller turbines to achieve more efficient generation of energy.
Layout	*Turbine locations* • Ultimate design for up to 149 wind turbine locations, consisting of the following changes: – Relocation of 3 turbines onto 3 new titles within the centre of the WEF site (adjoining existing permitted address of lands). – Addition of 4 new turbine locations within the existing permit address of lands. – Deletion of 12 turbine locations. • Movement of most turbine positions, but limiting movement to 250m from the original permitted layout. *Civil and electrical infrastructure* • Optimisation and relocation of the associated civil and electrical infrastructure within the WEF area.	• In response to the spacing required for larger turbines. • To ensure compliance with shadow flicker and noise conditions of PL-SP/05/0548.
WEF boundary	Deleted and addition of land parcels in the Address of Lands.	• Re-design / optimisation process. • Relocation of 3 turbines onto land currently not included in the Address of Lands.

The noise conditions of the Permit were based on the NZS6808:1998 but included additional requirements that attempted to supplement deficiencies in NZS6808:1998. Many of these additional requirements are impractical, for example:

- Condition 18 includes:

  …..

  d) compliance must be assessed separately for 24 hour and night time and for each of those time periods for wind direction sectors of ± 45° of 0°, 90°, 180°, and 270°. For this requirement, night time is defined as 10.00 pm to 7.00 am;

  e) if the noise has a special audible characteristic the measured sound level must have a penalty up to a maximum 5dB applied.

The separation of noise monitoring into sectors and time periods, required by 18 d), will result in many data sets with limited points in each. In particular, for wind directions which do not occur very often, there will be very few data points. In contrast, the compliance testing relies on large data sets to overcome the natural variation in background noise. Without the large data sets, the variation in background noise would result in an unreliable assessment of compliance. That is, a non-complying wind farm could be shown to be compliant and non-compliance could be shown, even without the wind farm being constructed. 18e) included the requirement for a penalty to be applied for 'special audible characteristics' but these were not objectively defined, resulting in uncertainty in the application of penalties.

- Condition 19 includes:

  c) the plan, or plans, must include …..a statement of how the uncertainty of those results will be estimated;

  The definition and calculation of uncertainty for background noise is not provided by any Standard or Jurisdiction in Australia. Further, there is no indication of what is to be done with the result, once it is determined. An ambiguous condition such as this creates difficulty for the wind farm developer in determining the appropriate approach and requires the Authority assess the approach without any reference to a standard or guideline.

- Condition 20 includes:

  a) …the background noise measurement and assessment carried out by a NATA approved signatory;

  NATA is an authority which provides accredition to laboratories in a range of areas such as calibration, biological testing and medical testing. It has no role in field measurements. If the condition is interpreted to require the signatory to be approved by NATA to conduct background noise measurements, then it cannot be achieved because NATA do not provide this approval. If the condition is interpreted as requiring any NATA signatory to conduct the testing, the testing has the potential to be conducted by a testing facility working outside of its area of expertise.

Many deficiencies of the Standard have since been resolved in the *New Zealand Standard NZS6808:2010 Acoustics – Wind farm noise* (NZS6808:2010). The NZS6808:2010 is referenced in the *Policy and Planning Guidelines for Wind Energy Facilities in Victoria (*the Guidelines, January 2016).

Therefore, it is recommended that the noise related conditions in the Permit be amended or replaced with conditions based on the Example Conditions provided within the Guidelines. The proposed amended noise conditions (with minor changes to the Example Conditions explained), are outlined in Appendix C.

3 NOISE LIMITS

The Permit conditions require compliance with the NZS6808:1998. Since the Permit was issued in 2010, the Guidelines have been updated (January 2016) which provide more contemporary noise limits (NZS6808:2010) and example conditions. Therefore, the environmental noise assessment of the amended WEF has been based on the requirements of the Guidelines and NZS6808:2010.

Section 4.42 of NZS6808:1998 includes:

> *As a guide to the limits of acceptability, the sound level from the WTG (or windfarm) should not exceed, at any residential site, and at any of the nominated windspeeds, the background sound level (L_{95}) by more than 5 dBA, or a level of 40 dBA L_{95}, whichever is the greater.*

Section 5.2 of NZS6808:2010 includes:

> *As a guide to the limits of acceptability at a noise sensitive location, at any wind speed wind farm sound levels $L_{A90(10min)}$ should not exceed the background sound level by more than 5dB, or a level of 40 dB $L_{A90(10min)}$, whichever is the greater.*

There are several changes that have been introduced in NZS6808:2010, such as:

- The replacement of the L_{95} descriptor with the L_{90} descriptor to bring it in line with the descriptor used in most jurisdictions for wind farm noise;
- The introduction of High Amenity areas with more onerous noise limits in special circumstances;
- The refinement of the assessment of Special Audible Characteristics (such as tonality) during compliance monitoring;
- An improvement to the recommended methodology for noise predictions as the methodology used in NZS6808:1998, which underestimated the noise at residences has been removed; and
- The use of wind speeds referenced to hub height rather than 10m above ground to better predict noise in stable meteorological conditions.

Although some of the methodology has changed, the overall noise limits established in accordance with NZS6808:1998 and NZS6808:2010 do not change significantly and there is a negligible change to the potential impact of environmental noise at residences resulting from the change in Standard. That is, the change from the L_{95} descriptor to the L_{90} descriptor has the potential to increase the noise limit

by less than 1 dB(A) but the change also has the potential to increase the measured noise from a wind energy facility by less than 1 dB(A), resulting in a negligible overall change.

Several landowners have entered into commercial agreements with SHWFPL. For these landowners, in accordance with the current (and proposed amended) wording of conditions of the Permit, the WEF sound levels $L_{A90(10min)}$ should not exceed the background sound level by more than 5dB, or a level of 45 dB $L_{A90(10min)}$, whichever is the greater at their dwellings ("participant dwellings").

The 45 dB(A) base level for participant dwellings is in accordance with the World Health Organisation (WHO) *Guidelines for Community Noise* (WHO Guidelines) [1]. To protect against sleep disturbance, the WHO Guidelines recommend an indoor level of 30 dB(A), which equates to an outdoor noise level of 45 dB(A) with windows open.

To determine the acceptable noise limits for each dwelling, background noise levels have been monitored at 45 locations in the vicinity of the proposed SHWF WEF. The background noise monitoring and results are summarised in the Sonus report, *Stockyard Hill Wind Farm – Background Noise Monitoring,* S3425C52, which is attached in Appendix D.

Where background noise monitoring was not conducted at a particular dwelling, the measured background noise levels at the closest monitored location to that dwelling were assigned. The resultant acceptable noise limits are tabulated in Appendix H for all dwellings located within 3km of the WEF. It is noted that 3km covers a greater area than the requirement of NZS6808:2010 to include dwellings where the predicted noise level is 35 dB(A) or greater.

It is noted that there are also three dwellings within the project area that have been (or are under option to be) acquired by SHWFPL (dwellings B031, B057 and B148). For these dwellings, no noise limits are assigned in the tabulated summary as it is understood that once purchased, they will not be used as a dwelling.

[1] Berglund,B., Lindvall, T., & Schwela, D. (Eds), 1999. *Guidelines for Community Noise*. World Health Organisation.

3.1 High Amenity Areas

"Clause 52.32-4 of the Pyrenees Planning Scheme (and the Guidelines) specifically requires the design response to include "*an assessment of whether a high amenity noise limit is applicable, as assessed under Section 5.3 of the standard*" (NZS6808:2010).

The Guidelines (January 2016) specifically require:

> *"An assessment of the noise impact of the proposal prepared in accordance with the New Zealand Standard NZS 6808:2010, Acoustics – Wind Farm Noise (the Standard), including an assessment of whether a high amenity noise limit is applicable, as assessed under Section 5.3 of the Standard.*
>
> *…*
>
> *Under section 5.3 of the Standard, a 'high amenity noise limit' of 35 decibels applies in special circumstances. All wind farm applications must be assessed using section 5.3 of the Standard to determine whether a high amenity noise limit is justified for specific locations, following procedures outlined in clause C5.3.1 of the Standard".*

Section 5.3 of the 2010 Standard states that:

> *"The wind farm noise limit of 40dB $L_{A90(10min)}$ in 5.2 is appropriate for protection of sleep, health and amenity of residents at most noise sensitive locations. In special circumstances at some noise sensitive locations a more stringent noise limit may be justified to afford a greater degree of protection of amenity during evening and night time. A high amenity noise limit should be considered where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area…"*

VCAT considered the translatability of 'high amenity areas' in the context of the Victorian planning framework in *Cherry Tree Wind Farm Pty Ltd v Mitchell Shire Council (2013) VCAT Reference No. P2910/2012.* The VCAT case found that "plan" referred to in section 5.3 of the 2010 Standard is a plan as defined by the *Resources Management Act 1991* of New Zealand and that Section 43AA of that Act defines 'plan' to mean 'a regional plan or a district plan'. No such plan explicitly exists under the Victorian legislation, however it could be considered to mean a planning scheme (in this instance the Pyrenees Planning Scheme) approved under the P&E Act.

Nevertheless, VCAT found in the Cherry Tree case that in the Mitchell Planning Scheme (of which the Cherry Tree was subject to) "*did not anywhere expressly or by implication 'promote a higher degree of*

protection of amenity related to the sound environment of a particular area". It is understood that this conclusion can also be made for the SHWF WEF.

Notwithstanding the above, the Standard, i.e. NZS6808:2010, includes:

> *C5.3.1 The following steps provide guidance on whether a high amenity noise limit may be justified:*
>
> *(a) There is no need to consider noise sensitive locations outside the 35 dB(A) $L_{A90(10\ min)}$ wind farm sound level contour;*
>
> and:
>
> *It is recommended that the high amenity noise limit should apply when the wind farm wind speed is 6m/s or lower.*

To determine the need to consider if a high amenity classification might be justified, a predicted noise contour at 6m/s has been prepared based on the Senvion 3.4M-140 turbine. The Senvion 3.4M-140 turbine was selected for this assessment because it results in the highest predicted noise level of the three turbines considered at 6m/s. Therefore, if the predicted noise level for the Senvion turbine at 6m/s is less than 35 dB(A), the predicted noise from the other turbines will also be less than 35 dB(A).

The noise contour is provided in Appendix E and shows that there are no non-participant dwellings within the 35 dB(A) contour. In accordance with C5.3.1(a) of NZS6808:2010, there is no need to consider the high amenity classification.

4 ASSESSMENT OF AMENDED WEF

The final turbine model and resulting layout will be determined by a competitive tender should approval be granted. As such, the application to amend the Permit is based on an amended indicative turbine layout, including a reduced maximum number of turbines and a larger maximum turbine envelope.

In these circumstances, an assessment has been made of the amended WEF by comparing predicted noise levels for three examples of turbine types against the objective noise limits of NZS6808:2010. The three representative examples of potential turbines, which meet the amended proposed Turbine Dimension limits are:

- General Electric 3.2-130 with a hub height of 110m;
- Vestas V136 3.45MW STE with a hub height of 112m; and
- Senvion 3.4M-140 with a hub height of 110m.

For the purposes of this assessment, a hub height of 110m has been used in the predictions, to allow for a direct comparison with the noise limits which are referenced to a 110m hub height wind speed.

Noise from the amended WEF has been predicted based on the use of 149 turbine locations with the coordinates listed in Appendix F. The (L_{eq}) sound power levels used in the assessment and the source of the data are detailed in Appendix G. These sound power levels are the specified levels provided by the manufacturer and therefore include a factor for uncertainty (in noise produced by different turbines of the same model) above measured sound power levels. The manufacturers often note that an additional factor can be applied for the uncertainty associated with measuring sound power levels (for variation in measurement instruments etc). This additional factor has not been specifically added to the sound power levels used in the noise modelling, although the use of the L_{eq} data in lieu of the L_{90} level (as specified by NZS6808:2010) effectively adds approximately 2 dB(A) to the predicted noise levels. It is recommended that the sound power levels and uncertainty be guaranteed by the manufacturer prior to procurement.

NZS6808:2010 states,

> "*Wind farms shall be designed so that wind farm sound does not have special audible characteristics at noise sensitive locations. However, as special audible characteristics cannot always be predicted, consideration shall be given to whether there are any special audible characteristics of the wind farm sound when comparing measured noise levels with noise limits*."

The predictions have been conducted without a penalty for the presence of tonal characteristics. Although some wind turbines can exhibit tonality without consideration being given in the design, this tonality can be mitigated if it does occur. To provide certainty with respect to tonality, it is recommended that a guarantee is sought by SHWFPL from the manufacturer that the final turbine selections do not result in a penalty when assessed in accordance with NZS6808:2010. Experience with other projects indicates that a guarantee such as this is an effective method of removing the tonal characteristic experienced at residences.

The prediction of environmental noise from the amended WEF has been made using the CONCAWE[2] noise propagation model and SoundPLAN noise modelling software. Although NZS6808:2010 indicates that ISO9613-2 is an acceptable noise model, it is designed for predicting noise for wind speeds up to 5m/s. Therefore for a wind farm, several adjustments need to be used to modify the model for wind farm noise. These adjustments include assuming the receiver height is 4m high (even though it is 1.5m high) and adding a factor of 3 dB(A) when the propagation path is considered to be concave. When these factors are applied to an ISO9613-2 model and not applied to the CONCAWE model, the predictions are comparable. The CONCAWE propagation model considers the following influences:

- sound power levels and locations of noise sources;
- separation distances between noise sources and receivers;
- topography of the area and influence of the ground;
- air absorption; and,
- meteorological conditions.

The CONCAWE system divides meteorological conditions into six separate “weather categories”, depending on wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the “lowest” propagation of noise, whilst Weather Category 6 provides “worst-case” (i.e. highest noise level) conditions. Weather Category 4 provides “neutral” weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

The assessment of the amended WEF has been based on the following input conditions:

- Weather Category 6 (night with no clouds and wind from the wind farm to the dwelling under consideration);
- atmospheric conditions at 10°C and 80% relative humidity;

[2] CONCAWE - The oil companies’ international study group for conservation of clean air and water – Europe, ‘The propagation of noise from petrochemical complexes to neighbouring communities’, May 1981.

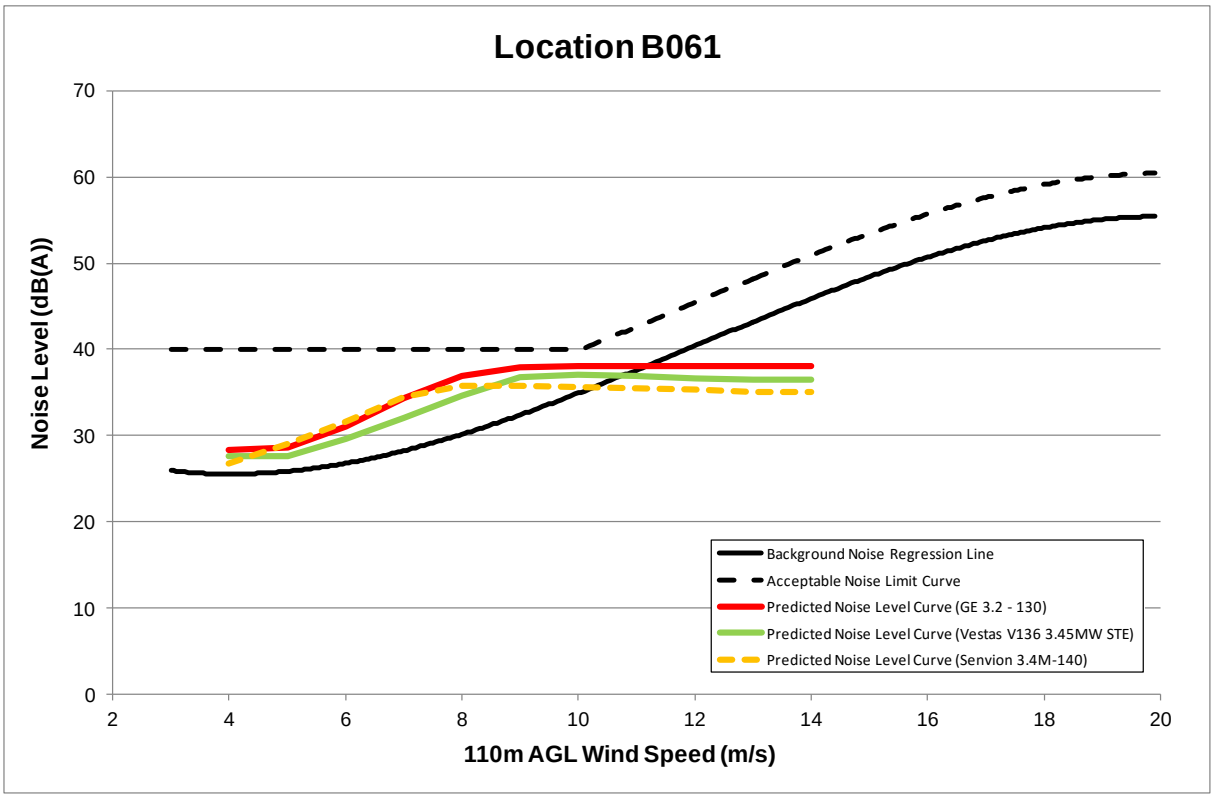
- wind direction from all WTGs to the particular dwelling under consideration, even in circumstances where WTGs are located in opposite directions from the dwelling; and,
- maximum barrier attenuation from topography of 2 dB.

These inputs result in a higher predicted noise level than would occur for the vast majority of conditions and therefore result in an appropriately conservative assessment.

Appendix H lists the predicted noise from the turbines at each relevant wind speed for all three turbine types. The predicted noise levels are compared with the relevant noise limits for both non-participant and participant dwellings. The tables show that the relevant noise limits are achieved at all non-participant and participant dwellings. Appendix H also includes figures to show a graphical representation of the relationship between the measured background noise level, the allowable noise level and the predicted noise level for participant and non-participant dwellings where the predicted noise level is above 35 dB(A). Specifically, the graphs include:

- The background noise level taken from the closest measurement location in the background noise monitoring report (Appendix D);
- The acceptable noise level in accordance with NZS6808:2010 based on the measured background noise levels and the base limit;
- The predicted noise levels for the three turbine types.

An example of the graphs is included below for Dwelling B061.



Appendix I shows a noise prediction contour of the most conservative representative turbine (of the turbines assessed) at the most conservative (resulting in the night noise level) wind speed (10m/s). The noise contour shows that all non-participant dwellings are outside of the 40 dB(A) contour and therefore comply with the base 40dB(A) limit of NZS6808:2010, even without considering the influence of the background noise environment (in accordance with NZS6808:2010). The contour also shows that all participant dwellings are outside the 45 dB(A) contour, other than those that have been (or are under option to be) acquired by SHWFPL.

5 ANTICIPATED CHANGE

Both the permitted WEF and the amended WEF include indicative layouts and turbine models based on the understanding that the final turbine model and resulting layout will be determined by a competitive tender. Therefore, the noise experienced at dwellings is limited by reference to objective noise limits, rather than by reference to a particular layout or turbine model. In these circumstances, the most relevant comparison of the noise from the permitted WEF and the noise from the amended WEF is a comparison of the permitted and proposed noise limits. As described above, the overall noise limits established in accordance with NZS6808:1998 and NZS6808:2010 do not change significantly (i.e., no greater than 1 dB at some wind speeds) and there is a negligible change to the potential impact of environmental noise at residences resulting from the change in Standard. Therefore, it is concluded that the allowable noise from the compliant amended WEF will be no greater than the allowable noise from the compliant permitted WEF.

For reference, a comparison has been made between the predicted noise at the worst case (highest noise level) wind speed from indicative turbine selections for the permitted and amended WEFs. The permitted WEF has been based on the Senvion/REPower 3.4M-104 Turbine for a wind speed of 11m/s at the hub height of 80m. The predicted noise levels for the amended WEF is based on the General Electric GE3.2-130, the Vestas V136 3.45MW STE and the Senvion 3.4M-140 at hub height (110m) wind speeds of 11m/s, 10m/s and 9m/s respectively. The comparison of the predicted noise for the permitted WEF and the range of noise levels (for the three turbine types) of the amended WEF is shown in Appendix J. The predictions indicate that the noise from the permitted WEF is within the range of predicted noise levels for the indicative turbine selections for the amended WEF for all non-participant dwellings. Depending on the turbine model used, the predicted noise at some non-participant dwellings from the amended WEF is up to 3 dB(A) higher and as much as 5 dB(A) lower than the predicted noise from the permitted WEF. That is, while there is an increase or decrease in noise at some dwellings associated with the amended WEF, the predicted noise at these dwellings complies with NZS6808:2010 for both the amended and permitted WEF.

6 CONCLUSION

An assessment of the environmental noise of the amended WEF has been made, including:

- the monitoring of background noise at 45 locations;
- the determination of objective noise limits in accordance with NZS6808:2010;
- the prediction of noise from three representative examples of turbine models; and,
- comparison of the predictions with the objective noise limits.

The assessment indicates that the noise limits will be achieved at all participant and non-participant dwellings for all representative turbines.

Although some procedures are different between NZS6808:1998 and NZS6808:2010, the difference in applicable noise limits at dwellings is negligible. Therefore, the noise at dwellings from the compliant amended WEF will be no greater than the noise from the compliant permitted WEF. An analysis of indicative turbine selections for the permitted and amended WEFs indicates that depending on the turbine model used, the predicted noise at some non-participant dwellings from the amended WEF is up to 3 dB(A) higher and as much as 5 dB(A) lower than the predicted noise from the permitted WEF. That is, while there is an increase or decrease in noise at some dwellings associated with the amended WEF, the predicted noise at these dwellings complies with NZS6808:2010 for both the amended and permitted WEF.

GLOSSARY

	Description
A-weighting	Frequency adjustment applied to measured noise levels to replicate the frequency response of the human ear.
Amended WEF	Permitted WEF, amended as per changes described in Section 0 of this report.
Background noise level	The noise level of all existing noise sources in the environment (in the absence of the wind farm) and excludes intermittent noise sources.
CONCAWE	The oil companies' international study group for conservation of clean air and water - Europe, *The propagation of noise from petrochemical complexes to neighbouring communities* (May 1981).
dB(A)	A-weighted noise or sound power level in decibels.
High Amenity Area	Area where a plan promotes a higher degree of protection of amenity related to the sound environment of a particular area.
Hub height	The height from the base of the WTG to the centre of the wind turbine rotor.
L_{90}	The noise level that is exceeded for 90% of the measuring period.
L_{95}	The noise level that is exceeded for 95% of the measuring period.
$L_{A90(10min)}$	The A-weighted noise level that is exceeded for 90% of the 10 minute measuring period. Represents the background noise level (NZS6808:2010).
NZS6808:1998	*New Zealand Standard NZS6808:1998 Acoustics – The assessment and measurement of sound from wind turbine generators.*
NZS6808:2010	*New Zealand Standard NZS6808:2010 Acoustics – Wind farm noise.*
Permitted WEF	WEF permitted by the Permit (Planning Permit No. PL-SP/05/0548 Pyrenees Planning Scheme)).
SHWF	Stockyard Hill Wind Farm.
SHWFPL	Stockyard Hill Wind Farm Pty Ltd.
Sound power level	A measure of the sound energy emitted from a source of noise.
Special audible characteristics	Audible tonal, impulsive and/or amplitude modulating characteristics of the noise.
the Guidelines	*Policy and Planning Guidelines for Wind Energy Facilities in Victoria*, January 2016.
the Permit	Planning Permit No. PL-SP/05/0548 (Pyrenees Planning Scheme) issued by the Minister for Planning in October 2010 to enable the use and development of the SHWF.
WEF	Wind Energy Facility.
Weather Category 6	Weather category which is most conducive for noise propagation, resulting in the highest predicted noise levels when using CONCAWE. The category represents conditions of a clear night with no cloud cover and a wind breeze blowing from the wind farm to the dwellings.
WHO	World Health Organisation.
WHO Guidelines	*Guidelines for Community Noise* by Berglund,B., Lindvall, T., & Schwela, D. (Eds), 1999.
Wind speed	Wind speed at hub height.
Worst-case	Conditions resulting in the highest noise level at dwellings.
WTG	Wind turbine generator.

REFERENCES

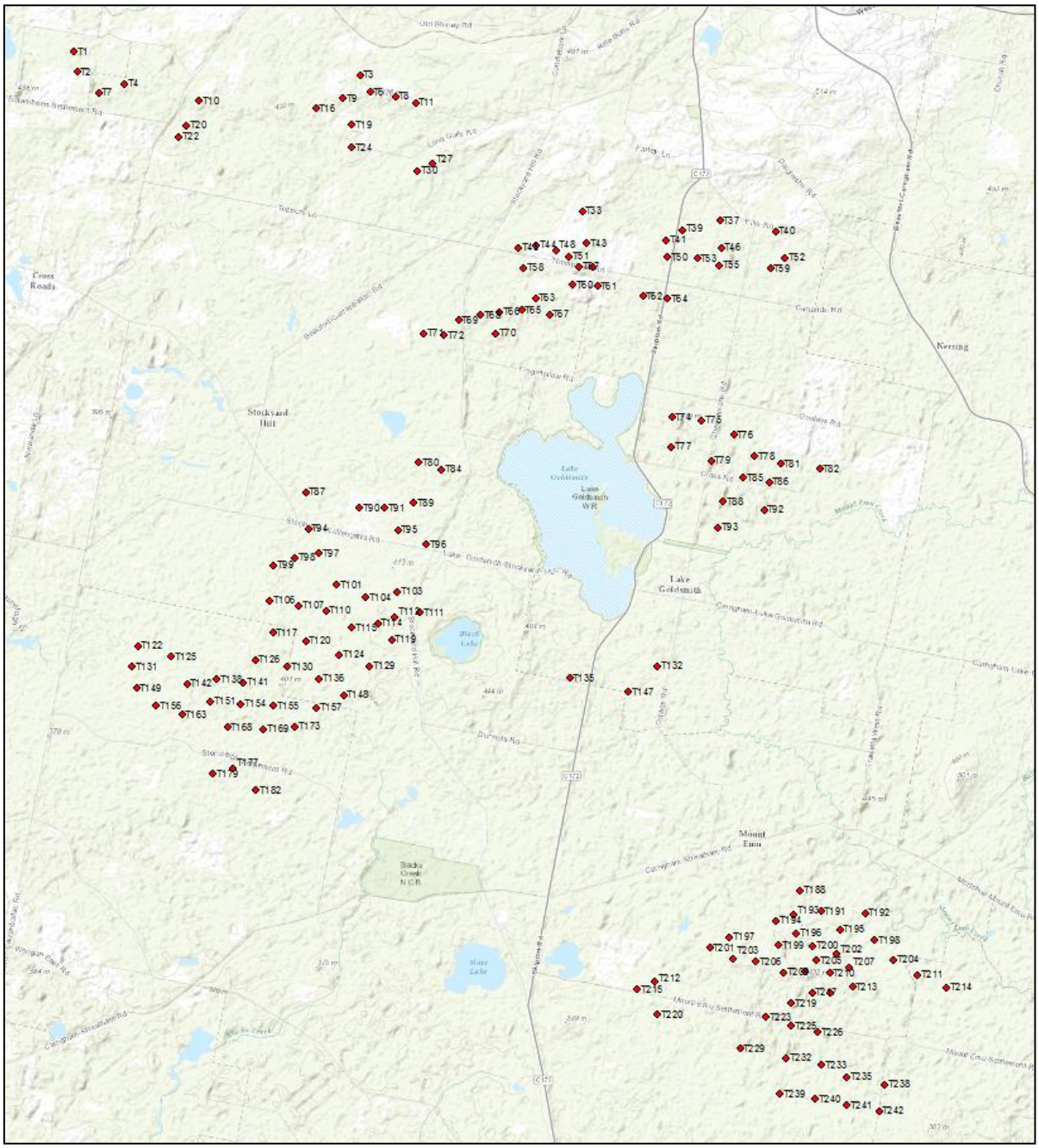
Berglund,B., Lindvall, T., & Schwela, D. (Eds), 1999. *Guidelines for Community Noise*. World Health Organisation.

Department of Transport, Planning and Local Infrastructure, January 2016 *Policy and Planning Guidelines for Wind Energy Facilities in Victoria.*

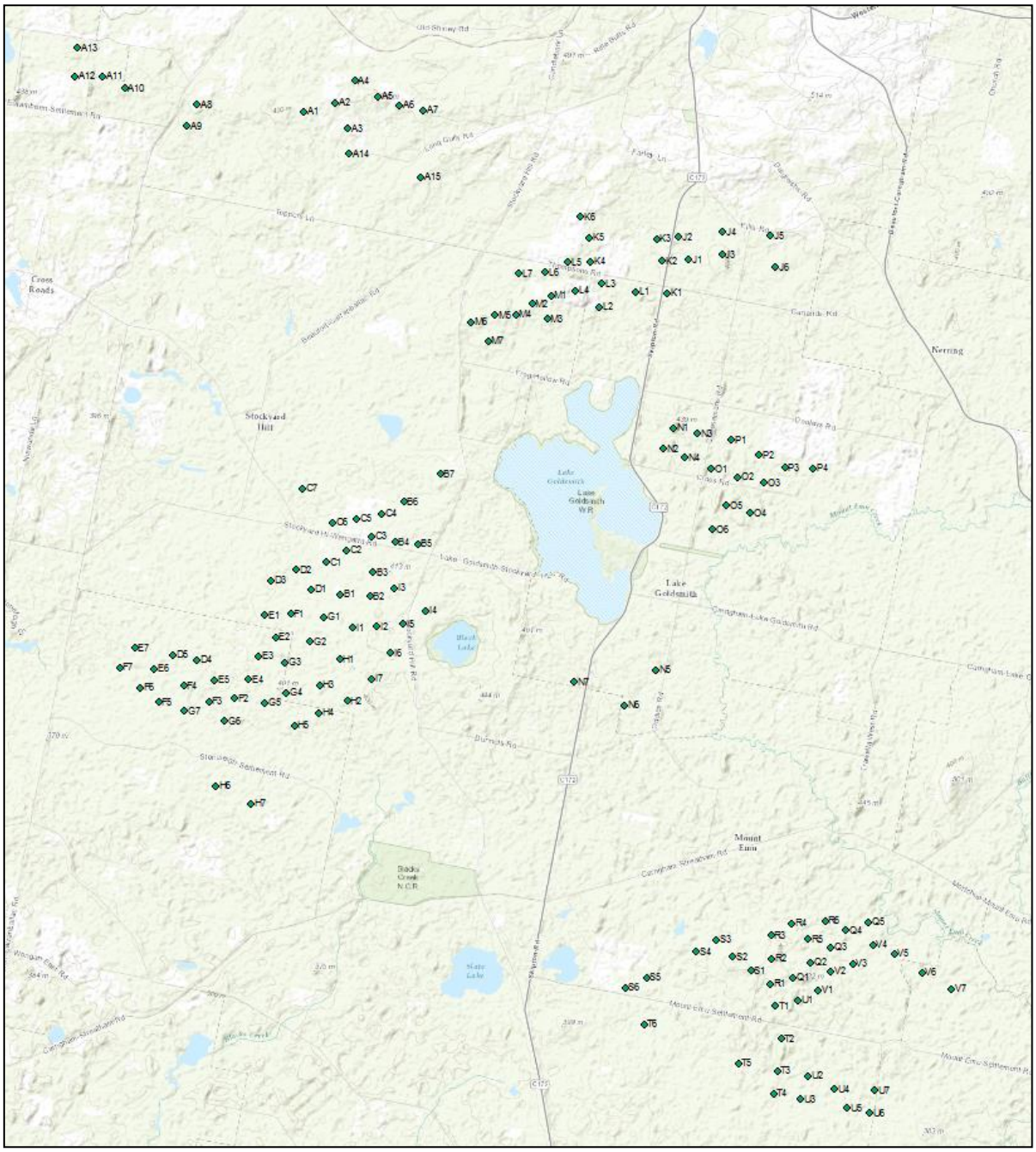
New Zealand Standard NZS6808:1998, *Acoustics - The assessment and measurement of sound from wind turbine Generators.*

New Zealand Standard NZS6808:2010, *Acoustics - Wind Farm Noise.*

APPENDIX A – PERMITTED WEF TURBINE LAYOUT



APPENDIX B – AMENDED WEF TURBINE LAYOUT



APPENDIX C – PLANNING PERMIT CONDITIONS

C.1 Existing Permit Conditions (No Amendments or Minor Amendments)

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Condition 6 Environmental Management Plan	*a) A construction and site works management plan which must include:* *...* *i) procedures for access, noise control, dust emissions, spills and leaks from the handling of fuels and other hazardous materials and pollution management. Such construction and site works procedures are to be in accordance with EPA requirements;* *....*	No amendments proposed. Reasonable from acoustic perspective.
	c) A blasting plan. This plan is only required if blasting is proposed to be undertaken on site as part of the construction of the wind energy facility. The plan must include the following: *(i) name and qualification of the person responsible for blasting;* *(ii) a description of the location of where the explosives will be used, and the location of every licensed bore on any property with an adjoining boundary within 1km of the location of the blasting;* *(iii) a requirement for the identification and assessment of any potentially sensitive site within 1 km of the location of the blasting, including the procedure for pre-blast and post-blast qualitative measurement or monitoring at such site;* *(iv) the procedure for site clearance and post blast reoccupation;* *(v) the procedure for the storage and handling of explosives;* *(vi) a requirement that blasting only occur after at least 48 hours prior notification in writing of the intention to undertake blasting has been given to the occupants of the properties which are located in whole or in part within 1km of the location of the proposed blasting; and* *(vii) a requirement that blasting only be undertaken between the hours of 8am and 4pm.*	No amendments proposed. Reasonable from acoustic perspective.
	k) A complaints management plan designed in accordance with Australian Standard Customer satisfaction – Guidelines for complaints handling in organizations (ISO 1002:2006) having regard to the guidance provided in The why and how of complaints handling HB 229-2006. *The complaints management plan must include procedures for:* *(i) readily accessible information on how complaints can be made free of cost to complainants;* *(ii) immediate acknowledgement of complaints and regular and comprehensive feedback to complainants on actions proposed, their implementation and success or otherwise;* *(iii) closure of complaints by agreement with complainants;* *(iv) establishment and maintenance of a complaint register for the recording of receipt and acknowledgement of complaints, recording the nature of the*	No amendments proposed. Reasonable from acoustic perspective.

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough =~~ proposed deletion)	Reason
	compliant as to whether it relates to noise and/or health and the associated wind direction during the period of the effect, actions taken, success or otherwise of actions and complaint closure and for the register to be available to the public during normal working hours; *(v) reporting of the contents of the complaint register to the Minister for Planning as required; and* *(vi) annual auditing of the implementation of the complaints management plan with audit results being reported to the Minister for Planning.*	
Condition 7 Environmental Management Plan	*The environmental management plan must be reviewed and if necessary amended in consultation with the Pyrenees Shire Council, Corangamite Shire, the CFA, Glenelg Hopkins CMA and DSE to the satisfaction of the Minister for Planning every 5 years to reflect operational experience and changes in environmental management ~~standards and~~ techniques and must be submitted to the Minister for Planning for re-endorsement*	Administrative Improvement - reference to department name. Remove reference to changes in environmental management standards to ensure the implementation of the EMP cannot result in changes in noise limits being implemented through the EMP.
Condition 23 Noise Modelling	Before the development starts a noise modelling ~~plan~~ **assessment** must be prepared to the satisfaction of the Minister for Planning meeting the following requirements: a) noise modelling must be undertaken by a suitably qualified and experienced acoustics expert; b) if the wind energy facility is to be constructed in stages noise modelling may ~~by~~ **be** carried out for each stage before the development of that stage commences and those results submitted successively to the Minister for Planning for approval provided that where a dwelling might be affected by noise from more than one stage that is accounted for; c) the modelling must include; i. the wind energy facility noise contours; and ii. modelling of **only the noise generated by** the wind energy facility ~~only noise~~ at those dwellings for which acceptable noise limit curves have been prepared; ~~and~~ ~~iii. an estimate of the uncertainty of the modelled results;~~	Requirement to conduct noise modelling rather than just a plan for modelling For clarity No Standard is available for determining uncertainty
Condition 24 Noise Modelling	The results of the noise modelling for each dwelling must: • be overlaid on the acceptable noise limit curve for that dwelling; • together with the comparison against the acceptable noise limit, be submitted to the Minister for Planning for approval as having demonstrated that noise compliance can be expected; and • when approved by the Minister for Planning, be made available publicly.	No amendments proposed. Reasonable from acoustic perspective.
Condition 25 Noise Modelling	Should the modelling required above not be done with the turbine finally selected for the wind energy facility that modelling must be repeated once the final turbine type is selected and resubmitted to the Minister for approval.	No amendments proposed. Reasonable from acoustic

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough =~~ proposed deletion)	Reason
		perspective.
Condition 26 Noise Compliance Testing	*Before the wind energy facility is commissioned, a noise compliance testing plan must be prepared to the satisfaction of the Minister for Planning meeting the following requirements:* *a) the noise compliance testing plan must be prepared by a suitably qualified and experienced acoustics expert;* *b) the noise compliance testing plan must include a plan for noise monitoring to assess noise levels after construction of the wind energy facility and a plan for concurrent assessment of the presence or otherwise of special audible characteristics;* *c) the noise compliance testing plan must include advice on timing of the assessment including defining when commissioning of the wind energy facility, or an identified stage of it, will occur, and when the compliance noise monitoring results will be provided to the Minister for Planning~~. That time must not be more than 60 days after commissioning unless with the further consent of the Minister for Planning~~;* *d) if the Wind Energy Facility is to be constructed in stages a noise compliance testing plan may be prepared for each stage before the development of that stage commences and those plans submitted to the Minister for Planning for approval provided that where a dwelling might be affected by noise from more than one stage that is accounted for;* *e) the noise compliance testing must be carried out at* ***locations defined in Accordance with the Standard, including the consideration of alternative locations for assessment (if locations become inaccessible in the future).*** *~~those dwellings at which background noise curves were determined as identified in Conditions 19 d) – e).~~* ***When approved, the plan will be endorsed by the Ministyer for Planning and then form part of this permit.***	While it is important that compliance testing commence after commissioning, setting a limit of 60 days for the completion of the report is counterproductive as it will limit the proper assessment and analysis of noise. Defines measurement requirements locations in accordance with NZS6808:2010 and allows flexibility in the event that not all locations remain accessible.
Permit Note 1	*For the purpose of these conditions, a ~~non-stakeholder or non~~ participating landholder means a landowner whose land is listed in the Address of the Land in this permit or has written agreement relating to their land dealing with noise or shadow flicker from the permitted wind turbines. ~~the land holder of an abutting property without a contract for the installation of the permitted wind turbines on that person's property.~~ A non-participating landowner means any landowner who is not a participating landowner.*	Provide clarity on the definition of a participating and non-participating landowner.

C. 2 Existing Permit Conditions (Proposed to be Deleted / Replaced by conditions in Table C.3)

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Condition 18 Noise Limits	~~*Except as provided below in this condition, the operation of the wind energy facility must comply with the noise criteria recommended in NZS 6808:1998 Acoustics – 'The assessment and measurement of sound from wind turbine generators' at any dwelling existing on land on or in the vicinity of the proposed wind energy facility as at the date of issue of this permit. In determining compliance the following requirements apply:*~~ ~~*a) noise from construction of the wind energy facility must comply with the requirements of the Interim Guidelines for Control of Noise from Industry in Country Victoria, N3/89 (EPA Vic, 1989);*~~ ~~*b) the noise of the wind energy facility only at any non-stakeholder dwelling after the wind energy facility has commenced operation must not exceed the background noise level by more than 5dBA, or a level of 40dBA L95, whichever is the greater;*~~ ~~*c) the noise of the wind energy facility only at any participating landowner's dwelling after the wind energy facility has commenced operation must not exceed the background noise level by more than 5dBA, or a level of 45dBA L95, whichever is the greater. This condition does not apply to any dwellings under option to the permit holder;*~~ ~~*d) compliance must be assessed separately for 24 hour and night time and for each of those time periods for wind direction sectors of ± 45° of 0°, 90°, 180°, and 270°. For this requirement, night time is defined as 10.00 pm to 7.00 am; and*~~ ~~*e) if the noise has a special audible characteristic the measured sound level must have a penalty up to a maximum 5dB applied.*~~	Condition replaced by more contemporary Condition in Table C.3. Superseded Standards and Guidelines replaced in proposed condition.

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Condition 19 Background and Acceptable Noise Levels	~~*Before the development starts, background noise monitoring must be undertaken to the satisfaction of the Minister for Planning complying with the following requirements:*~~ ~~*a) a background noise monitoring plan, or plans, must be prepared by a suitably qualified and experienced acoustics expert;*~~ ~~*b) if the wind energy facility is to be constructed in stages, the background noise monitoring plan may be prepared for each stage before the development of that stage begins and those plans may be submitted successively to the Minister for Planning for approval, provided that where a dwelling might be affected by noise from more than one stage that is accounted for;*~~ ~~*c) the plan, or plans, must include the number and location of background noise monitoring sites and the justification for the selection of those sites, the methodology to be used for the noise monitoring and the development of the background noise curves, and a statement of how the uncertainty of those results will be estimated;*~~ ~~*d) the plan must include background noise monitoring at a minimum of 20 representative non-stakeholder dwellings for the whole wind energy facility, subject to access being granted, or a lesser number per stage if the wind energy facility is to be so constructed, as approved by the Minister for Planning. These monitoring sites must be within the modelled 35dBA L95 noise contour for noise from the wind energy facility only, as determined in Condition 19 c);*~~ ~~*e) the plan must include background noise monitoring at a minimum of 10 representative stakeholder dwellings, other than dwellings under option to the permit holder, for the whole wind energy facility, or a lesser number per stage if the wind energy facility is to be so constructed, as approved by the Minister for Planning. These monitoring sites shall be within the modelled 40dBA L95 noise contour for noise from the wind energy facility only as determined in Condition 19 c); and*~~ ~~*f) when approved by the Minister for Planning the noise monitoring plan, or each plan (if the wind energy facility is to be developed in stage), must be made publicly available.*~~	This Condition related to a requirement to measure background noise after the previous approval. These measurements have now been conducted and are summarised in Appendix D. Therefore, condition is no longer required.
Condition 20 Background and Acceptable Noise Levels	~~*After the noise monitoring plan is approved, the background noise testing at each dwelling must be carried out in accordance with that plan and in accordance with NZS 6808:1998 Acoustics – 'The assessment and measurement of sound from wind turbine generators' subject to the following:*~~ ~~*a) unless with the consent of the Minister for Planning, the equipment used for measuring noise, wind speed and wind direction must be calibrated by a NATA accredited testing organisation and the background noise measurement and assessment carried out by a NATA approved signatory;*~~ ~~*b) unless with the consent of the Minister for Planning, the noise monitor used at each site must be a Type 1 noise logger calibrated with a Type 1 calibrator;*~~ ~~*c) the anemometer used for the correlation of background noise against wind speed must:*~~	This Condition related to a requirement to measure background noise after the previous approval. These measurements have now been conducted and are summarised in Appendix D. Therefore, condition is no longer required.

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
	~~*be situated at hub height on the nearest meteorological mast to the noise monitoring site;*~~ ~~*• remain in place after commissioning of the wind energy facility or that stage of it, and*~~ ~~*• be unaffected by wind turbine turbulence.*~~ ~~*d) a minimum of 4000 ten minute data pairs are to be collected for each site;*~~ ~~*e) the data pairs must be correlated by 24 hour and night (10 pm to 7 am) time periods and for each time sector for wind directions of ± 45° of 0°, 90°, 180°, and 270° using the regression technique of NZS 6808:1998 or 'bin analysis', as appropriate*~~ ~~*f) for each noise monitoring site, the same correlation technique must be used for this pre construction background noise monitoring as this will be used for the post construction compliance monitoring, including the same order regression equation; and*~~ ~~*g) an estimate must be made of the uncertainty of the background noise curves.*~~	
Condition 21 Background and Acceptable Noise Levels	~~*For each of the above background noise curves the derived acceptable noise limit curves for the wind energy facility at each dwelling for the specified time periods and wind direction sectors must then be prepared as described in NZS 6808:1998 Acoustics – 'The assessment and measurement of sound from wind turbine generators'.*~~	This Condition related to a requirement to measure background noise after the previous approval. These measurements have now been conducted in accordance with the most contemporary Standard. Condition is therefore no longer required.
Condition 22 Background and Acceptable Noise Levels	~~*The background noise curves and the derived acceptable noise limit curves for each background noise monitoring site for the specified time periods and wind direction sectors must be provided to the Minister for Planning for approval as having been carried out in accordance with these conditions; and when approved by the Minister for Planning the background noise curves and the acceptable noise limit curves must be made publicly available.*~~	This Condition related to a requirement to measure background noise after the previous approval. These measurements have now been conducted in accordance with the most contemporary Standard. Condition is therefore no longer required.

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Condition 27 Noise Compliance Testing	~~*After approval of the testing plan by the Minister for Planning the noise compliance testing shall be carried out by a suitably qualified and experienced acoustics expert:*~~ ~~*• generally in accordance with NZS 6808:1998 Acoustics – 'The assessment and measurement of sound from wind turbine generators' with the variations described in this permit; or*~~ ~~*• subject to approval by the Minister for Planning by an 'on/off' or 'shutdown' method as referred to in sections 7.1.2 and 7.7.1 of NZS 6808:2010 – Acoustics – Wind farm noise. If this method is used, it must have been earlier approved by the Minister for Planning as a part of the noise compliance testing plan*~~ ~~*and must be designed by a suitably qualified and experienced acoustics expert; The presence or otherwise of special audible characteristics must be assessed concurrently at all the subject dwellings over a range of operational and meteorological conditions.*~~	Condition replaced by more contemporary conditions in Table C.3, which require demonstration of achievement of NZS6808:2010.
Condition 28 Noise Compliance Testing	~~*The results of the noise compliance testing for each dwelling, adjusted for any penalty for special acoustic characteristics, must:*~~ ~~*• be compared with the acceptable noise limit curve for that dwelling to identify whether or not compliance has been achieved;*~~ ~~*• whether with an accompanying statement of compliance or otherwise, be submitted within the time specified in Condition 26 c) to the Minister for Planning; and*~~ ~~*• be made available publicly and provided to the owner or occupier of the*~~	Condition replaced by more contemporary conditions in Table C.3, which require demonstration of achievement of NZS6808:2010.

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
	~~*dwelling(s) involved*~~	
Condition 29 Noise Compliance Enforcement	~~*If a breach of the noise limits prescribed in Condition 18 is detected by the procedure in Condition 27:*~~ ~~*a) the permit holder must take immediate action to vary the operation of the Wind Energy Facility such that, based on professional advice, it can be expected to be brought into compliance;*~~ ~~*b) when the breach of noise limits is notified to the Minister for Planning as required by Condition 28 the permit holder must advise of the immediate response in Condition 29 a) and the actions to be taken to bring the wind energy facility into compliance and to demonstrate that compliance;*~~ ~~*c) within 180 days of the commissioning of the wind energy facility it must be brought into compliance to the satisfaction of the responsible authority. That compliance must be demonstrated by testing as described in Condition 26 having been completed;*~~ ~~*d) the wind energy facility must continue to be operated in that noise compliant mode unless a plan for varied operation is submitted to and approved by the Minister for Planning;*~~ ~~*e) should such a variation as foreshadowed by Condition 29b) be sought and approved that must be made available publicly.*~~ ~~*f) between 10 and 14 months after commissioning of the wind energy facility noise compliance testing as required by Condition 28 must be repeated to demonstrate continuing compliance of the facility and submitted to the Minister for Planning; and*~~ ~~*g) when approved by the Minister for Planning the noise compliance testing results required by Condition 28 must be made available publicly.*~~	Condition replaced by more contemporary conditions in Table C.3, which require demonstration of achievement of NZS6808:2010.
Condition 30 Noise Complaints	~~*Any complaint about noise from the construction or operation of the wind energy facility must be dealt with in accordance with the complaints management section of the Environmental Management Plan in Condition 6 above, or in accordance with Condition 29 above, as appropriate to the receipt of the complaint.*~~	Condition covered by Condition 6(k) of the Permit (see Table C.1).

Condition	Proposed Amendments to the Permit conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Condition 31 Active Noise Management System	~~*Before the development starts, an active noise management system plan must be prepared and submitted to the Minister for Planning for approval. It must meet the following requirements:*~~ ~~*a) the plan must indicate that an active noise management system for the wind energy facility has to be prepared by a suitably qualified and experienced acoustics expert;*~~ ~~*b) the plan must indicate that the active noise management system will be supplementary to the design of the proposed wind energy facility to meet the noise standards required by these conditions and hence will be designed to respond to any non-compliance with noise standards and to assist with the resolution of any justified noise complaints whilst having regard to operational efficiency; and*~~ ~~*c) the active noise management system plan must describe the methodology and timing for the design of the system, its testing, refinement and implementation.*~~	Condition replaced by more contemporary conditions in Table C.3, which require demonstration of achievement of NZS6808:2010.
Condition 32 Active Noise Management System	~~*When approved by the Minister for Planning, the active noise management system plan will form part of this permit and must be made available publicly. Thereafter, the operation of the wind energy facility must comply with the active noise management system.*~~	Condition replaced by more contemporary conditions in Table C.3, which require demonstration of achievement of NZS6808:2010.
Condition 39 Complaints Made To The Responsible Authority	~~*If a complaint is received by the responsible authority about the wind energy facility the responsible authority will after consideration of the views of the complainant and the wind energy facility operator, determine if a dispute exists. For the purposes of this condition a dispute is a matter remaining unresolved after application of the complaints management plan.*~~ ~~*If the responsible authority determines and advises that a dispute does not exist, the complainant and the wind energy facility operator should use the provisions of the complaint management plan to resolve the complaint. If the responsible authority determines that a dispute does exist and that there is a breach of the permit, action must be taken to bring the operation of the wind farm into compliance with the permit. In determining whether a breach exists the responsible authority may require the wind energy facility operator to:*~~ ~~*• Commission a suitably qualified expert to provide an opinion as to whether a breach exists, and/or*~~ ~~*• Conduct compliance testing.*~~	Condition replaced by more contemporary conditions in Table C.3, which require demonstration of achievement of NZS6808:2010.

C.3 Proposed Permit Conditions (Based on Example Permit Conditions)

Proposed Amendments to Example Permit Conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
Performance requirement *The operation of the wind energy facility must comply with New Zealand Standard 6808:2010, Acoustics – Wind Farm Noise (the Standard) as modified by this condition to the satisfaction of the responsible authority. The following requirements apply:* *a. The operator must ensure that at any **hub height integer** wind speed, wind farm sound levels **at non-participant dwellings** do not exceed a noise limit of 40dB $L_{A90(10\ min)}$, provided that where the circumstances specified in condition [Performance Requirement](b) apply, the noise limit of 40dB $L_{A90(10\ min)}$ will be modified as specified in condition [Performance Requirement] (b).* *b. At the specified non-participant dwelling assessment positions referred to in condition [Noise Compliance Assessment](b), the noise limit of 40dB $L_{A90(10min)}$ referred to in condition [Performance Requirement](a) will be modified in the following way when the following circumstances exist:* *i. where the background sound level is greater than 35 dB $L_{A90(10\ min)}$, the noise limit will be the background sound level $L_{A90(10\ min)}$ plus 5 dB;* ~~ii. where special audible characteristics, including tonality, impulsive sound or amplitude modulation occur, the noise limit will be modified by applying a penalty of up to + 6 dB L90 in accordance with section 5.4 of the Standard;~~ ~~*iii. where a high amenity noise limit has been found to be justified, as defined by section 5.3 of the Standard, for specific locations determined to be high amenity areas following procedures outlined in clause C5.3.1 of the Standard.*~~ *c. At the specified non-participant assessment positions referred to in condition [Noise Compliance Assessment](b), the wind farm sound level at the noise sensitive locations will be modified in the following way when the following circumstances exist:* *i. **where special audible characteristics, including tonality, impulsive sound or amplitude modulation occur, the sound level will be modified by applying a penalty of up to + 6 dB L_{90} in accordance with section 5.4 of the Standard;*** *d. **The operator must ensure that at any hub height integer wind speed, wind farm sound levels at participant dwellings do not exceed a noise limit of 45dB $L_{A90(10\ min)}$, provided that where the circumstances specified in condition [Performance Requirement](e) apply, the noise limit of 45dB $L_{A90(10\ min)}$ will be modified as specified in [Performance Requirement](e).*** ***e. At the specified participant dwelling assessment positions referred to in condition [Noise Compliance Assessment](b), the noise limit of 45dB $L_{A90(10min)}$ referred to in condition [Performance Requirement](c) will be modified where the background sound level is greater than 40 dB $L_{A90(10\ min)}$, the noise limit will be the background sound level $L_{A90(10\ min)}$ plus 5 dB.*** ***For the purpose of this condition, a participant dwelling means a dwelling on land listed in the Address of the Land in this permit or where the landowner has a written agreement relating to their land and dealing with noise from the permitted wind turbines. A non-participant dwelling means any dwelling that is not a participant dwelling***	The words "hub height integer" have been added to "wind speed" to confirm the methodology of NZS 2010. Non-participant dwellings added in to reflect the dwellings with commercial agreements, consistent with the intent of the existing conditions of the Permit. (b)ii of this example condition has been modified and changed to (c)i as penalties are added to measured (or predicted) levels for the periods in which they apply, rather than being subtracted from the noise limit. This is important as NZS2010 specifically requires penalties to be added only in the periods in which the character applies. This is not possible if the penalty is subtracted from the noise limit. Section relating to high amenity noise limit is removes as the assessment has found that it does not apply. Noise limits for participant dwellings are added to example conditions to reflect agreements and existing conditions of the Permit The final paragraph of this condition has been included to reflect the intent of the existing conditions of the Permit.
Noise compliance assessment *For the purposes of determining compliance, the following requirements apply:*	Clarity is added around participant and non-participant noise assessment positions.

Proposed Amendments to Example Permit Conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
a. Acoustic compliance reports shall be prepared by a suitably qualified and experienced independent acoustic engineer to demonstrate compliance with the noise limits specified in the Standard. *b. Noise assessment positions must be located according to the Standard, and shown on a map.* ***The map shall clearly identify each noise assessment position as either a participant or non-participant dwellings****.* *c. An initial acoustic compliance report must be submitted within six months of the commissioning of the first turbine, and at six monthly intervals thereafter until full operation (following completion of construction and commissioning).* *d. A final compliance report must be submitted to the responsible authority after a 12 month period following full operation of the facility.* *e. Compliance reports should be publically available.* *f. Following facility commissioning, all complaints shall be managed following procedures set out in the noise complaints management plan.*	
Noise complaints evaluation *For the purposes of complaints evaluation, the following requirements apply:* *a. Post installation sound levels shall, where practical, be* ***measured at a selection of*** *locations where the background sound levels were determined (GPS coordinates and a map showing these locations is to be provided).* *b. If a non-compliance ~~with condition 14~~ is detected, or an acoustic investigation is required under the noise complaints plan ~~endorsed under condition 17~~, an independent assessment report must be prepared by a suitably qualified and experienced independent acoustic engineer to:* • *identify the weather or operational conditions associated with the complaint / breach* • *analyse the uncertainty and confidence levels in the monitoring, and the steps taken to reduce uncertainty* • *target assessment to identify the cause and remediation actions* • *submit a remediation plan to the satisfaction of the responsible authority outlining, the investigation process, complainant communications, actions and timelines to resolve the complaint/breach* *If the complaint is not resolved through the processes outlined above, the responsible authority may request an independent peer review at the cost of the permit holder and on/off shut down testing to resolve uncertainty.* *c. Following the initial post-construction reporting process, additional independent assessment may be requested by the responsible authority at any time, where complaints are received and are considered to reasonably warrant investigation.* *d. If investigations indicate special audible characteristics are potentially occurring, procedures outlined in Appendix B of the Standard should be applied.*	The words "be selected from" have been added to "locations where the background sound levels were determined". This is because the background sound levels were measured at 45 locations including many participant dwellings. Measuring at this large number of dwellings does not assist in the understanding of compliance and is not required by the methodology of NZS2010. Reference to condition numbers has been removed to allow different condition numbers to those designated in the example conditions without changing the intent.
Noise complaint response plan *Before the first turbine is commissioned, the permit holder must prepare a noise complaint investigation and response plan to the satisfaction of the responsible authority.* *The plan shall include:* • *a process of investigation to resolve a complaint* • *a requirement that all complaints will be recorded in an incidents register* • *how contact details will be communicated to the public* • *a toll free telephone number and email contact for complaints and queries* • *details of the appropriate council contact telephone number and email address*	No changes are proposed to this example condition.

Proposed Amendments to Example Permit Conditions (Bold = insertions, ~~Strikethrough~~ = proposed deletion)	Reason
(where available) • *a table outlining complaint information for each complaint received, including:* • *the complainant's name* • *any applicable property reference number if connected to a background testing location* • *the complainant's address* • *a receipt number for each complaint which is to be communicated to the complainant* • *the time, prevailing conditions and description of the complainant's concerns including the potential incidence of special audible characteristics* • *the processes of investigation to resolve the complaint.* *A report including a reference map of complaint locations, and outlining complaints, investigation and remediation actions is to be provided on an annual basis to the satisfaction of the responsible authority.* *The register and complaints response process shall continue for the duration of the operation of the wind energy facility and must be made available to the responsible authority on request.* *The owner of the wind energy facility must implement and comply with the Approved Noise Complaint, Investigation and Response Plan for the duration of the operation of the wind energy facility.*	

APPENDIX D – BACKGROUND NOISE MONITORING REPORT

Sonus Pty Ltd
17 Ruthven Avenue
ADELAIDE SA 5000
Phone: 08 8231 2100
Facsimile: 08 8231 2122
www.sonus.com.au
ABN: 67 882 843 130

Stockyard Hill Wind Farm

Background Noise Monitoring

Prepared for

Stockyard Hill Wind Farm Pty Ltd

S3425C54
April 2016

TABLE OF CONTENTS

1 INTRODUCTION 3
2 BACKGROUND NOISE MONITORING LOCATIONS 4
3 DATA COLLECTED 6
3.1 Background Noise Data 6
3.2 Reference Wind Speed and Wind Direction Data 6
3.3 Pre-processing of Noise Data 7
4 DATA ANALYSIS AND RESULTS 10
APPENDIX A: BACKGROUND NOISE MONITORING LOCATIONS 12
APPENDIX B: BACKGROUND NOISE LEVEL DATA AND REGRESSION CURVES 13
APPENDIX C: MEASUREMENT LOCATION PHOTOGRAPHS 36

1 INTRODUCTION

Stockyard Hill Wind Farm Pty Ltd (SHWFPL) (a subsidiary of Origin Energy) is developing a wind farm project in south-west Victoria, known as the Stockyard Hill Wind Farm (SHWF).

As part of the development stage works, background noise monitoring has been conducted at 45 locations within the wind energy facility (WEF) site and its surrounding area. The background noise levels are used to establish environmental noise criteria for the wind energy facility (WEF).

Sonus conducted the background noise monitoring between 22 May 2012 and 9 November 2012, and the subsequent data analysis, in accordance with New Zealand Standard NZS6808:2010 *Acoustics - Wind Farm Noise* (NZS6808:2010). This document provides details of the background noise monitoring and summarises the analysis results.

2 BACKGROUND NOISE MONITORING LOCATIONS

Table 1 provides coordinates of the 45 background noise monitoring locations and the monitoring period at each location. Appendix A includes a map of the monitoring locations. Of the 45 monitored locations, 23 locations are “participant dwellings” (dwellings of landowners who have a commercial agreement with SHWFPL).

In addition to the background noise logging, local weather logging was conducted at 6 noise monitoring locations. The weather logger measured the rainfall and wind speed at microphone height for the purposes of identifying data that might have been adversely affected by weather. The weather loggers were “Hobo HL-002” data loggers and associated sensors. For locations where a weather logger was not deployed, data from the closest weather logger (deployed at the time of the noise logging) was considered. Table 1 indicates the locations where local weather logging was conducted and the closest logged location to the others.

Table 1: Background noise monitoring locations.

No	Monitoring Location	Coordinates (WGS 84 Zone 54)		Monitoring Period	Weather Logger	Participant Dwelling
		Easting	Northing			
1	B006	706598	5851419	4/7 – 15/8	B113	No
2	B029	712691	5850227	4/7 – 14/8	B113	No
3	B033	712130	5850615	22/5 – 3/7	B118	No
4	B053	711654	5847694	4/7 – 14/8	B113	Yes
5	B058	709602	5846934	16/8 – 27/9	B059	Yes
6	B059	711489	5845301	16/8 – 5/9 27/9 – 18/10	YES B059/B144	No
7	B060	711346	5846675	5/7 – 14/8	B113	No
8	B061	711425	5846998	24/5 – 3/7	B083	No
9	B064	710122	5842214	4/7 – 15/8	B080	Yes
10	B065	710659	5841003	5/7 – 15/8	B080	No
11	B079	716254	5834790	4/7 – 14/8	B080	No
12	B080	714284	5834840	4/7 – 15/8	Yes	Yes
13	B081	714337	5836172	4/7 – 15/8	B080	No
14	B083	712071	5835637	23/5 – 4/7	Yes	No
15	B085	709512	5834975	24/5 – 4/7	B083	Yes
16	B097	708413	5839709	24/5 – 3/7	B083	Yes
17	B099	707770	5841024	5/7 – 15/8	B113	No
18	B102	715208	5831351	23/5 – 3/7	B083	Yes
19	B103	714086	5831530	15/8 – 27/9	B203	Yes

No	Monitoring Location	Coordinates (WGS 84 Zone 54)		Monitoring Period	Weather Logger	Participant Dwelling
		Easting	Northing			
20	B104	710964	5832177	23/5 – 3/7	B083	Yes
21	B105	708392	5832654	15/8 – 27/9	B203	No
22	B111	706549	5850422	23/5 – 3/7	B118	No
23	B113	704777	5848872	3/7 – 15/8	Yes	No
24	B114	703278	5849504	23/5 – 3/7	B118	No
25	B118	698297	5850437	23/5 – 2/7	Yes	No
26	B120	699091	5852288	16/8 – 26/9	B059	Yes
27	B121	699065	5853496	5/7 – 16/8	B113	No
28	B124	695993	5853205	5/7 – 23/7 16/8 – 5/9	B113/B203	Yes
29	B127	697000	5851971	23/5 – 2/7	B118	Yes
30	B140	706693	5846351	24/5 – 2/7	B118	Yes
31	B142	706379	5844805	23/5 – 2/7	B118	Yes
32	B143	703650	5844425	6/9 – 18/10	B059/B144	Yes
33	B144	703708	5844723	27/9 – 9/11	Yes	No
34	B145	705069	5843041	5/7 – 15/8	B113	Yes
35	B146	705366	5841862	4/7 – 15/8	B113	Yes
36	B149	701381	5842779	24/5 – 3/7	B118	Yes
37	B151	696961	5840834	16/8 – 26/9	B203	Yes
38	B167	702533	5836503	24/5 – 3/7	B083	No
39	B170	699005	5837908	5/7 – 15/8	B113	Yes
40	B171	697412	5837902	24/5 – 3/7	B118	No
41	B172	696617	5838628	5/7 – 15/8	B113	No
42	B203	701662	5836676	16/8 – 26/9	Yes	Yes
43	B245	701773	5837169	24/5 – 3/7	B083	Yes
44	B318	710643	5849866	24/5 – 2/7	B118	Yes
45	B328	712411	5850530	16/8 – 27/9	B059	No

3 DATA COLLECTED

3.1 Background Noise Data

Background noise levels (L_{A90}) were measured continuously in 10 minute intervals during the monitoring period using NATA calibrated, Type 1 Rion NL 52 sound level meters with noise floors less 20 dB(A), typically between 15 and 18 dB(A). The sound level meters were field calibrated before and after the background noise monitoring regime with a Type 1 NC-74 calibrator. Each of the microphones was fitted with a double windshield for weatherproofing and to reduce the effect of wind on the microphone. The double windshields were either Rion WS-15 or windshields with a diameter of approximately 90mm.

At each dwelling location, the noise logger (comprising a sound level meter and batteries within a weatherproof container connected to a pole mounted microphone) was placed:

- on the WEF side of the dwelling to enable future compliance checking measurements to be taken at the same point;
- at least 5m from the building facade to remove the effects of large reflecting surfaces on any future compliance checking measurements to be taken at the same point; and,
- at an equivalent distance to large trees as those trees are to the facade of the dwelling, to ensure the position was representative of the background noise levels experienced at the dwelling.

Photographs of the noise loggers are shown in Appendix C.

3.2 Reference Wind Speed and Wind Direction Data

During the background noise monitoring regime, wind speed was monitored by SHWFPL at meteorological masts (met masts) located across the wind farm site. All instrumentation at the met masts has been calibrated by a MEASNET facility. The locations of the met masts are provided in Table 2 and are shown on the map in Appendix A.

Table 2: Met mast locations.

Met Mast	Coordinates (WGS84 Zone 54)		Anemometer Height (m)
	Easting	Northing	
WF1	701372	5839185	82, 80, 65, 50 35
WF2	711444	5848364	80, 78, 50, 10
WF3	712257	5833098	80, 78, 50, 10
EXT1	711003	5846520	80, 78, 50, 10